# New York State Climate Action Council

# Draft Scoping Plan

December 30, 2021

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# Acronyms and Abbreviations

| | |
|---|---|
| AEM | Agricultural Environmental Management |
| AGM | New York State Department of Agriculture and Markets |
| AgNPS | Agricultural Nonpoint Source Abatement and Control |
| ASHP | Air-source heat pump |
| AR5 | IPCC Fifth Assessment Report |
| AR6 | IPCC Sixth Assessment Report |
| AV | Automated vehicles |
| BIPOC | Black, Indigenous, and People of Color |
| BMP | Best management practices |
| BOA | Brownfield Opportunity Area |
| BSM | Buyer-side mitigation |
| CALS | College of Agriculture and Life Sciences |
| CCA | Community Choice Aggregation |
| CCE | Cornell Cooperative Extension |
| CDR | carbon dioxide removal |
| CFCs | chlorofluorocarbons |
| CJWG | Climate Justice Working Group |
| Climate Act | Climate Leadership and Community Protection Act |
| $CO_2$ | carbon dioxide |
| $CO_2e$ | carbon dioxide equivalent |
| COBRA | EPA's CO Benefits Risk Assessment Health Impacts screening and mapping tool |
| COP26 | 26th Conference of Parties |
| CPP | Conservation Partnership Program |
| CRF | Climate Resilient Farming |
| CRRA | Community Risk and Resiliency Act |
| CSRO | Chief State Resilience Officer |
| DASNY | Dormitory Authority of the State of New York |
| DEC | New York State Department of Environmental Conservation |
| DER | Distributed energy resource |
| DFS | New York State Department of Financial Services |
| DG | Distributed generation |
| DHSES | New York State Division of Homeland Security and Emergency Services |
| DOH | New York State Department of Health |
| DOL | New York State Department of Labor |
| DOS | New York State Department of State |
| DOT | New York State Department of Transportation |
| DPS | New York State Department of Public Service |
| DRI | Downtown Revitalization Initiative |

| | |
|---|---|
| ECL | Environmental Conservation Law |
| EFC | Environmental Facilities Corporation |
| EITE | Energy-intensive and trade-exposed |
| EPA | U.S. Environmental Protection Agency |
| EPF | Environmental Protection Fund |
| EPR | Extended Producer Responsibility |
| EQIP | Environmental Quality Incentives program |
| ESD | Empire State Development |
| ESF | College of Environmental Science and Forestry |
| E-TOD | Equitable transit-oriented development |
| EV | Electric vehicle |
| FERC | Federal Energy Regulatory Commission |
| GEIS | Generic Environmental Impact Statement |
| GHG | greenhouse gas |
| GSHP | Ground-source heat pump |
| GSP | Gross state product |
| GW | gigawatt |
| GWP | global warming potential |
| HCFC | hydrochlorofluorocarbon |
| HCR | New York State Homes and Community Renewal |
| HFC | hydrofluorocarbon |
| HVAC | heating, ventilation, and air conditioning |
| IPCC | Intergovernmental Panel on Climate Change |
| ISCMP | New York State Invasive Species Comprehensive Management Plan |
| ITS | New York State Office of Information Technology Services |
| JTWG | Just Transition Working Group |
| LDV | Light-duty vehicle |
| LGBTQIA+ | Lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual, and other |
| LIPA | Long Island Power Authority |
| LMI | Low- and moderate-income |
| mgd | million gallons per day |
| MHD | medium- and heavy-duty |
| MMT | million metric tons |
| MOD | Mobility-oriented development |
| MPO | Metropolitan Planning Organization |
| MSW | Municipal solid waste |
| MTA | Metropolitan Transportation Authority |
| MW | megawatt |
| MWBE | Minority- and women-owned businesses |
| NGO | Non-governmental organization |

| | |
|---|---|
| $NO_2$ | nitrogen dioxide |
| $NO_X$ | nitrogen oxides |
| NPV | net present value |
| NRCS | Natural Resources Conservation Service |
| NYCRR | Compilation of the Rules and Regulations of the State of New York |
| NYISO | New York Independent System Operator |
| NYPA | New York Power Authority |
| NYSERDA | New York State Energy Research and Development Authority |
| OGS | New York State Office of General Services |
| OPRHP | New York State Office of Parks, Recreation, and Historic Preservation |
| ORES | Office of Renewable Energy Siting |
| OTDA | New York State Office of Temporary and Disability Assistance |
| PANYNJ | Port Authority of New York and New Jersey |
| PES | Payment for ecosystem services |
| PM | particulate matter |
| $PM_{2.5}$ | fine particulate matter |
| PSC | Public Service Commission |
| PV | Photovoltaics |
| RD&D | Research, development, and demonstration |
| REDC | Regional Economic Development Council |
| RGGI | Regional Greenhouse Gas Initiative |
| RNG | renewable natural gas |
| SAPA | State Administrative Procedures Act |
| SDVOB | Service-disabled veteran-owned business |
| SEQRA | New York's State Environmental Quality Review Act |
| $SF_6$ | sulfur hexafluoride |
| $SO_2$ | sulfur dioxide |
| SUNY | State University of New York |
| SWCC | Soil and Water Conservation Committee |
| SWCD | Soil and Water Conservation District |
| TCI | Transportation and Climate Initiative |
| The Council | Climate Action Council |
| TOD | Transit-oriented development |
| USCA | United States Climate Alliance |
| USDA | U.S. Department of Agriculture |
| VMT | vehicle miles traveled |
| VOC | volatile organic compound |
| WPDC | Wood Products Development Council |
| WRRF | Water resource recovery facility |
| ZEV | zero emission vehicle |

# Overview

## Chapter 1. PLACEHOLDER

# Chapter 2. The Time is Now to Decarbonize Our Economy

## 2.1 Scientific Evidence of Our Changing Climate

The consequences of a changing climate are not just a future concern, they are here. New Yorkers have felt the devastation from several extreme weather events in recent years:

- Historic flooding from Hurricane Ida in 2021 not only left lasting damage to the Gulf Coast but also devastated the Northeast. The National Weather Service issued its first flash flood emergency warning for parts of northeastern New Jersey and its second ever flash flood emergency for New York City.[1]
- Tropical Storm Isaias left over 800,000 New Yorkers without power in 2020, with high winds causing damage to critical infrastructure.[2]
- In 2012, Superstorm Sandy killed dozens and left hundreds of thousands of New Yorkers without power. It brought storm surges over 13 feet high and devastated many parts of New York City.[3] The Federal Emergency Management Agency spent over $25 billion on recovery efforts in New York and New Jersey in the five years after Sandy.[4]
- In 2011, Tropical Storm Irene caused damage across many regions of the State, flooding main streets, washing out roads, overwhelming wastewater treatment plants, and leaving hundreds of thousands without power. Not two weeks later, Tropical Storm Lee came through New York and overwhelmed communities still dealing with the aftermath of Irene.

The World Meteorological Organization found that in the 50-year period from 1970 to 2019, the number of disasters worldwide increased by a factor of five, and economic losses due to weather, climate, and water extremes have increased sevenfold.[5] Scientific consensus is represented by the works of notable international, national, and local scientific institutions. Through their assessments, they determine the

[1] Chelsea Harvey, "Ida smashes rain records in glimpse of future warming," E&E News, September 2, 2021, https://www.eenews.net/articles/ida-smashes-rain-records-in-glimpse-of-future-warming/.

[2] Mihir Zaveri and Ed Shanahan, "2.5 Million Lose Power and One Is Killed as Isaias Batters N.Y. Area," The New York Times, August 4, 2020, https://www.nytimes.com/2020/08/04/nyregion/isaias-ny.html.

[3] Weissman Center for International Business, Baruch College/CUNY 2021, "Disasters: New York City Hurricane Sandy – 2012," NYCdata. Accessed on November 30, 2021 at https://www.baruch.cuny.edu/nycdata/disasters/hurricanes-sandy.html.

[4] Federal Emergency Management Agency, "Remembering Sandy Five Years Later," FEMA, October 28, 2017, https://www.fema.gov/press-release/20210318/remembering-sandy-five-years-later.

[5] World Meteorological Organization. 2021. *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2019)*. Geneva. Accessed at https://library.wmo.int/index.php?lvl=notice_display&id=21930#.YaY979DMJ9N.

current state of knowledge on climate change, identify consensus, and outline knowledge gaps where further research is necessary to understand the full ramifications of impacts.

New York's geographic and socioeconomic diversity will lead to a wide range of experienced climate-driven impacts. Warming trends and incidences of intense heat waves will contribute to greater localized heat stresses; heavy rainfall events that exacerbate localized flooding will continue to impact food production, natural ecosystems, and water resources; and sea-level rise threatens sensitive coastal communities and ecosystems. Climate-driven impacts are magnified when accounting for New York's most vulnerable populations, who are often disproportionately affected and on the front lines of climate change. Women, femmes, youth, and children in poverty commonly face higher risks and greater burdens from the impacts of climate change.

New York is feeling the impacts of a global issue. The Intergovernmental Panel on Climate Change (IPCC) is a body established by the World Meteorological Organization and the United Nations to assess scientific, technical, and socioeconomic information relevant for understanding climate change, its potential impacts, and options for adaptation and mitigation. The IPCC is undergoing its Sixth Assessment cycle, with the recent release of the Working Group 1 report *Climate Change 2021: The Physical Science Basis.* The entirety of the Sixth Assessment Report (AR6) will be released in 2022. Since the IPCC's Fifth Assessment Report (AR5), released in 2014, the scientific community has made significant strides in simulation modeling, analyses, and understanding.

The U.S. Global Change Research Program is currently developing its fifth National Climate Assessment, with an anticipated delivery in 2023. The fourth assessment, released in 2017, states, "thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor."

According to both the U.S. Global Change Research Program and the IPCC, substantial reductions in greenhouse gas (GHG) emissions will be required by mid-century in order to limit the global average increase in temperature to no more than 2°C (and ideally 1.5°C), thus minimizing the risk of severe impacts from climate change.

## 2.2 Climate Projections

### *New York Climate Projections*

New York has undertaken research to better understand what a changing climate means for the State. A New York State Energy Research and Development Authority (NYSERDA) technical report, *The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State* (ClimAID), discusses the New York–specific climate risks and projections. The ClimAID report, originally released in 2011, was subsequently updated in 2014 based on newer datasets and AR5, improved baseline scenarios, and the latest generation of climate models and emissions projections. Both the original 2011 ClimAID report and the 2014 update provide projections of mean annual changes in precipitation, temperature, and sea-level rise through the year 2100, as well as the frequency and duration of extreme temperature and precipitation events through the 2080s for each of the seven regions of the State. The ClimAID projections for sea-level rise served as the basis for the Department of Environmental Conservation's (DEC) adoption of sea-level rise projection regulations pursuant to the Community Risk and Resiliency Act (CRRA), 6 Compilation of the Rules and Regulations of the State of New York (NYCRR) Part 490.

An analysis released by the U.S. Environmental Protection Agency (EPA) in September 2021 shows that the most severe harms from climate change fall disproportionately upon underserved communities that are least able to prepare for, and recover from, heat waves, poor air quality, flooding, and other impacts. EPA's analysis indicates that racial and ethnic minority communities are particularly vulnerable to the greatest impacts of climate change.[6] The particular focus on prioritizing action in Disadvantaged Communities in this draft Plan coupled with the Climate Act requirements around investments will serve to improve outcomes for Disadvantaged Communities.

Climate change is here, and the related impacts in New York are projected to grow. NYSERDA's ClimAID report discusses these impacts in detail and articulates, by sector, the likely effects of these changes across the State. NYSERDA has also launched a climate assessment, *New York State Climate Impacts Assessment: Understanding and Preparing for Our Changing Climate*, which will provide:

- Updated projections and methodologies;
- In-depth economic analysis;

[6] EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency, EPA 430-R-21-003.

- New regions;
- More diverse perspectives and stakeholder engagement;
- Adaptable formats to drive wider usage;
- Technical workgroups that cover eight sectors, including agriculture, buildings, ecosystems, energy, human health and safety, society and economy (including finance and insurance), transportation, and water resources; and
- Cross-cutting topics such as the impact on Disadvantaged Communities, municipal perspectives, and the effect on marine and Great Lakes coastal zones.

### Use of the Term "Disadvantaged Communities"

This Plan uses the term "Disadvantaged Communities" in order to be consistent with the language in the Climate Leadership and Community Protection Act (Climate Act). The Climate Act defines Disadvantaged Communities as "communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate-income households."

The Climate Act requires that Disadvantaged Communities be identified by the Climate Justice Working Group based on geographic, public health, environmental hazard, and socioeconomic criteria, which shall include but are not limited to:

- Areas burdened by cumulative environmental pollution and other hazards that can lead to negative public health effects;
- Areas with concentrations of people that are of low income, high unemployment, high rent burden, low levels of home ownership, low level of educational attainment, or members of groups that have historically experienced discrimination on the basis of race or ethnicity; and
- Areas vulnerable to the impacts of climate change such as flooding, storm surges, and urban heat island effect.

The Council recognizes, however, that this growing body of literature often uses other terms that more appropriately describe these populations, such as "frontline communities," "overburdened communities," and "environmental justice communities," among others. This draft Scoping Plan often uses these terms to describe communities that have been disproportionately impacted by historical environmental policy and the effects of climate change, and uses Disadvantaged Communities when referring directly to actions or requirements that are contained in the Climate Act. Furthermore, at the time of writing, the Climate Justice Working Group is in the process of establishing criteria to identify "Disadvantaged Communities."

For more information on Disadvantaged Communities, see *Chapter 6. Achieving Climate Justice*.

Draft core projections for the updated climate assessment have been completed, including for average and extreme temperatures and precipitation. These resources will be made publicly available once the assessment is completed, which is expected in early 2023.

### *Global Climate Projections*

The IPCC's AR6 is applying new methods that greatly reduce uncertainty and can clearly attribute ongoing climate change and its effects to continuing man-made emissions of climate pollutants. It considers five scenarios to illustrate the range of possible futures based on trends in anthropogenic drivers of climate change. In summary, the report states several factors:

- The global mean surface temperature will continue to increase until at least the mid-century under all GHG emission scenarios considered by the IPCC.
- Between 1.5°C and 2°C warming will be exceeded this century unless deep reductions in carbon dioxide ($CO_2$) and other GHG emissions occur in the coming decades.
- Changes in precipitation show:
    - Strengthened evidence since AR5 that the global water cycle will continue to intensify, leading to more variability in precipitation and surface water flows over most land regions (both seasonally and year over year);
    - The portion of global land experiencing detectable increases or decreases in seasonal mean precipitation is projected to increase;
    - There will continue to be earlier onset of spring snowmelt; and
    - It is likely that heavy precipitation events will intensify and become more frequent in most regions with additional global warming.
- Many changes due to past and future GHG emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets, and global sea level.
- Over the longer term, there is high confidence that the sea level will continue to rise for centuries to millennia due to ongoing deep ocean warming and ice sheet melt and will remain elevated for thousands of years.
- It is virtually certain that the global mean sea level will continue to rise over the 21st century. Even under the very low GHG emissions scenario (Shared Socioeconomic Pathways), it is likely that the global mean sea-level rise by 2100 will be 0.28 to 0.55 meters (0.9 to 1.8 feet).

Although no single entity can solve this global problem on its own, the Climate Act established New York as a leader in the critical effort to maintain a livable planet. AR6 makes the critical nature of this

work clearer. The report notes that, while many of the changes observed in the climate are unprecedented, strong and sustained reductions in GHG emissions would limit climate change. It is imperative that we take immediate action to aggressively reduce GHG emissions, as well as invest in resiliency measures.

## 2.3 Benefits of Climate Action

Climate change is adversely affecting economic well-being, public health, natural resources, and the environment of New York. The severity of current climate change and the threat of additional and more severe change will be affected by the actions undertaken in New York and other jurisdictions to reduce GHG emissions: such actions will have an impact on global GHG emissions and will encourage other jurisdictions to implement complementary GHG reduction strategies by providing an example of how such strategies can be implemented. Climate change especially heightens the vulnerability of Disadvantaged Communities, which often bear disproportionately greater environmental and socioeconomic burdens as well as legacies of racial and ethnic discrimination. Although substantial GHG emissions reductions are necessary to avoid the most severe impacts of climate change, complementary adaptation measures will also be needed to address those risks that cannot be avoided.

### What the Climate Act means for New York State

**Clean Electric Grid of Tomorrow** | Solar, wind, and other renewables, combined with energy storage, will deliver affordable and reliable electricity over the next decade and beyond.

**Comfortable, Affordable, and Safe, Energy-Efficient Homes and Businesses** | New clean heating and cooling technologies, such as electric heat pumps and smart thermostats, combined with energy efficiency, will save New Yorkers energy and money.

**Clean, Reliable Transportation** | Zero emission transportation options for families and neighborhoods will enable New York to trade gridlock and diesel fumes for fresh air and cleaner communities.

**A Clean Energy Economy for Everyone** | Every community, every trade, and every region will have access to clean energy solutions and the economic opportunities that the transition to a just and equitable energy system provides.

Recognizing the scale of change necessary to avoid the most severe impacts of climate change, New Yorkers will realize the extraordinary benefits of climate action extending across all sectors of society. The investments made today will continue to drive value creation into the future, spurring a cleaner, more competitive economy. The Climate Act means that the electric grid of tomorrow will be cleaner, more affordable, and more reliable. New York homes and businesses will be more energy-efficient, leveraging the latest clean heating and cooling and distributed energy resource technologies. Transportation will be clean and reliable, with zero emissions, and New York will be transformed into a

clean energy economy that benefits everyone. These investments will support new jobs, new businesses, and new opportunities for all New Yorkers. From clean, renewable energy generation to advanced recycling and reuse programs, New York will witness a scale of change that has not been seen before.

The Climate Act recognizes communities that have historically witnessed and continue to bear the disproportionate health and socioeconomic burdens of environmental pollution and climate change. These frontline communities, by law, will benefit from the transition New York is undertaking. Foundational to the Climate Act and to this draft Scoping Plan is marrying climate action with equity.

As sectoral progress rapidly increases, additional co-benefits and compounding benefits[7] will be realized.

### *Benefits of GHG Emission Mitigation*

Mitigating GHG emissions and adapting to a changing climate will provide many direct and indirect benefits, including improved public health. Direct benefits will result from reducing the many public health impacts associated with climate change, such as heat-related morbidity and mortality; food-, water-, and vector-borne diseases; and injury and death following flooding. Indirect health benefits will occur when initiatives to mitigate GHG emissions also result in other beneficial outcomes such as reducing air pollutants produced by GHG emissions sources ("co-pollutants"), encouraging active transport (such as walking and cycling), and reducing home health risks through building energy efficiency retrofit interventions. In addition to these public health benefits, GHG emissions mitigation will result in improvements to the overall economy through economic stimulus, social community and labor, social inclusion and social justice, housing security, accessibility and quality of mobility services, avoided costs, and resources efficiency.

### *Benefits of Adaptation and Resilience*

Adaptation and resilience planning is about protecting people and ecosystems from the changes caused by a changing climate. Individuals, communities, and regions have come to recognize the need to prepare for the risks posed to their quality of life, infrastructure, and physical safety by climate change. These risks are disproportionately high for Disadvantaged Communities. Investment in adaptation and resilience can improve quality of life, stimulate local economies, and protect the environment. The benefits of adaptation and resilience actions include improved economic opportunities, infrastructure, and equity in

[7] Bachura, Simeran, Lovell Arminel, McLachlan Carly, and Minas Mae Angela. 2020. The Co-Benefits of Climate Action, Accelerating City-level Ambition. London: CDP. Accessed at https://www.cdp.net/en/reports/downloads/5329.

our rural and urban communities. New York will promote the integration of climate change adaptation and resilience planning into all relevant policies and programs using the best available science.

## 2.4 Technology Advancement and Trends

Technology advancement will continue to be vital in determining the trajectory of climate change mitigation and adaptation success. Current projections rely on certain assumptions of technology adoption, prioritization, and acceptance. Technology advancements include several components:

- Better science, data collection technologies, modeling, and understanding the complex relationship of natural systems;
- Advancement in mitigation, such as the continued development of renewable energy technologies, energy efficiency improvements, and new and emerging technologies (like energy storage, carbon capture and removal, and potential geoengineering);
- Advancement in adaptation and resilience, such as technologies that can mitigate impacts resulting from wave action, and improved flood and thermal resilience in buildings, and improved understanding of nature-based solutions to address the urban heat island effect, stormwater runoff and drought; and
- Accessibility, supply chains, funding, and prioritization needs to realize potential.

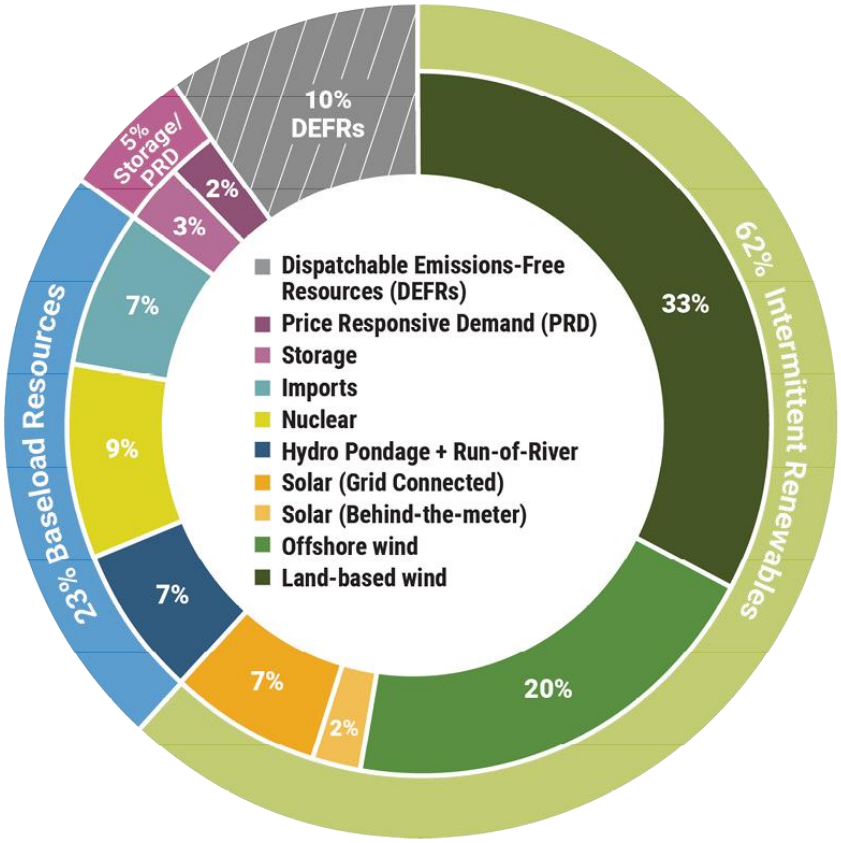
As science and technology continue to advance, the understanding of complex climate and environmental forces evolves, and new progress is incorporated into existing knowledge. Methodological advances and new datasets have contributed approximately 0.1°C to the updated estimate of warming per AR6, which states in the Summary for Policymakers, "Since AR5, methodological advances and new datasets have provided a more complete spatial representation of changes in surface temperature, including in the Arctic. These and other improvements have additionally increased the estimate of global surface temperature change by approximately 0.1ºC, but this increase does not represent additional physical warming since the AR5."[8]

To achieve a more resilient, efficient, and balanced grid, new technologies will be required to replace the phase down of fossil fuel resources that are currently relied upon. The New York Independent System

[8] IPCC, 2021. Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press. Accessed at: https://www.ipcc.ch/report/ar6/wg1/#SPM.

Operator (NYISO) has been evaluating potential impacts to system reliability and resource availability associated with climate change and extreme weather events. Through its *Climate Change Impact and Resilience Study*, which analyzes the Climate Act's 2040 zero-emissions electricity target, NYISO has made it clear that innovation is critical to accelerating the development of new flexible and dispatchable resources to replace the existing reliability service capabilities of fossil fuel resources (see Figure 1).

**Figure 1. NYISO Climate Study: 2040 Projected Climate Act Winter Energy Production by Resource Type**




*Source:* NYISO Power Trends 2021.

## 2.5 The Global and National Context for Climate Action

The United Nations Framework Convention on Climate Change was founded in 1992 to serve as the international forum for multilateral climate action. The original convention was supported by the Kyoto Protocol of 1997 and the 2015 Paris Climate Agreement. Under the Paris Agreement, signatories agreed to nationally determined contributions for GHG reductions within a specified timeframe. The goal of the Agreement was to keep global warming below 2°C compared to preindustrial levels, with the recognition of scientific consensus that warming at or below 1.5°C is preferable to mitigate the worst effects of

climate change.[9] The IPCC's AR6 has highlighted an even more dire need for aggressive climate action, as discussed in *Scientific Evidence of Our Changing Climate* and *Global Climate Projections*.

Mostly recently, the global climate community convened in Glasgow, Scotland, for the 26th Conference of Parties (COP26), the 2021 United Nations climate change conference. Each conference more urgent than the last, this year's COP ended with notable progress toward addressing the climate crisis—including via commitments secured toward the reduction of methane, to end deforestation, and to advance a U.S.-China climate agreement—but also fell short on critical overarching issues, such as the phaseout of fossil fuels, establishment of concrete targets to limit temperature rise to 1.5 degrees Celsius, and ensuring financial support for the hardest-hit developing nations. New York was well represented in Glasgow by state government officials, appointed members of the Council, and other partners and stakeholders. While New York did not have a direct seat at the negotiating table itself, together with other sub-national states and provinces around the world, we wield considerable influence and are the durable backbone upon which global action can be built. With the world's sights already set on Egypt for next year's convening of nations on climate, we can take some encouragement by the fact COP26 helped focus the world's attention on national governments that have the ability to reverse course on climate, leveraging their technological and financial resources and learning from the sub-national governments like New York that are showing how it can be done.

At the federal level, the Trump administration signaled its intention in 2017 to withdraw the United States from the Paris Agreement in 2020. Responding to this federal abdication, New York and other states took up the mantle of climate action. The governors of New York, California, and Washington formed the United States Climate Alliance (USCA) with the aim of advancing policies that would help each state meet the Paris Agreement goals. There are currently 25 states that have joined the USCA. Each Member State commits to:

- Implement policies that advance the goals of the Paris Agreement, aiming to reduce GHG emissions by at least 26% to 28% below 2005 levels by 2025;
- Track and report progress to the global community in appropriate settings, including when the world convenes to take stock of the Paris Agreement; and

[9] IPCC, 2018. Summary for Policymakers. In: Global Warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global GHG emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Accessed at: https://www.ipcc.ch/sr15/download/.

- Accelerate new and existing policies to reduce carbon pollution and promote clean energy deployment at the state and federal levels.[10]

The United States has since rejoined the Paris Agreement, just three months after the formal withdrawal. In consultation with Special Presidential Envoy for Climate John Kerry, United States National Climate Advisor Gina McCarthy developed and committed to an economy-wide target of a 50% to 52% net reduction in GHG emissions by 2030 compared to 2005 levels, and President Biden has informally committed to reaching economy-wide "carbon neutrality" by 2050. In addition, via Executive Order on December 8, 2021, President Biden ordered that the U.S. government would lead by example to leverage its immense scale and procurement power to drive clean, healthy, and resilient operations of federal buildings, vehicles, construction, and other activity—designed to achieve net-zero emissions from overall federal operations by 2050, including a 65% emissions reduction by 2030, among other important interim milestones and sector-specific goals.

[10] USCA. 2019. Frequently Asked Questions.

# Chapter 3. New York's Climate Leadership

## 3.1 High-Level Overview of Past and Current Policies

New York continues to set an international precedent for addressing climate change. This is only possible because so many diverse minds and tireless leaders are united in a common cause. Climate change is a "wicked problem" that requires a holistic approach and collaborative reasoning.[11] Recognizing the complexity of the energy transition and the imperatives to mitigate the worst scenario projections of a warming global climate, New York stands ready to continue its legacy of climate leadership. This draft Scoping Plan incorporates new, innovative strategies and expands upon existing efforts to combat the systemic risks associated with the impacts of a changing climate while addressing the disproportionate impacts on frontline communities.

### *Climate Action*

The development and purpose of this draft Scoping Plan builds upon decades of New York's climate leadership at all levels, including executive, regulatory, legislative, and programmatic. The implementation of strategies in this Plan will be guided by our past successes and informed by lessons learned here in New York and in other jurisdictions. The following sections provide an overview of this leadership.

#### Executive Leadership

DEC Commissioner's Policy 49 (revised December 1, 2021) provides guidance to agency divisions, offices, and regions regarding the incorporation of climate change considerations into agency activities. CP-49 was revised to reflect the requirements of Sections 7 and 9 of the Climate Act.

New York signed a medium- and heavy-duty (MHD) zero-emission vehicles (ZEVs) Memorandum of Understanding (MOU) on July 14, 2020, along with 14 other states and Washington D.C., committing to work collaboratively to advance and accelerate the market for electric MHD vehicles. The mutual goal is to ensure that 100% of all new MHD vehicle sales will be zero emission by 2050, with an interim target of 30% MHD ZEV sales by 2030. This MOU builds off the success of the 2013 light-duty ZEV Memorandum of Understanding and the Multi-State ZEV Taskforce and Action Plans.

[11] Stony Brook University, "What's a Wicked Problem?" Stony Brook University | Wicked Problem, Stony Brook University, accessed on November 22, 2021, https://www.stonybrook.edu/commcms/wicked-problem/about/What-is-a-wicked-problem.

The Health Across All Policies Initiative (Executive Order 190, 2018) developed the necessary network and communications between agencies to address and improve public and individual health through collaborative efforts to address social determinants of health, like air quality, housing, and access to affordable energy.

Redoubling New York's Fight Against the Economic and Environmental Threats Posed by Climate Change and Affirming the Goals of the Paris Climate Agreement (Executive Order 166, 2017) calls on all affected State entities to take action to reduce emissions from all operations, buildings, and vehicle fleets.

Build Smart NY (Executive Order 88, 2012) was issued to improve energy efficiency in State buildings by 20% by 2020, accomplished by measuring building energy performance in all State buildings larger than 20,000 square feet and targeting the largest and poorest performing buildings for energy audits, efficiency upgrades, and best operations and maintenance practices.

The State Green Procurement and Agency Sustainability Program (Executive Order 4, 2008) promotes the State purchase of environmentally friendly commodities, services, and technologies, as well as agency sustainability and stewardship programs.

### Regulatory Action

Advanced Clean Trucks (DEC Proposed Part 218 Regulation), proposed in 2021, takes the first step toward a zero emissions medium- and heavy-duty sector, proposing requirements for zero-emission sales from 2025 to 2035.

Oil and Natural Gas Sector regulations (DEC Proposed Part 203 Regulations), proposed in 2021, would lower methane and volatile organic compound (VOC) emissions for sources in New York's oil and natural gas sector.

Hydrofluorocarbon Standards and Reporting (DEC Part 494 Regulations) prohibits specific hydrofluorocarbons (HFCs), potent GHGs in certain refrigerants, aerosol propellants, and foam-blowing agent end uses that represent avoidable HFC emissions where safer alternatives are available.

Projected Sea-Level Rise (DEC Part 490 Regulations), finalized in early 2017, establishes statewide sea-level rise projections for use in the consideration of permits and other decision-making processes specified under CRRA. Under CRRA, DEC is required to update these sea-level rise projection regulations at least every five years.

Regional Greenhouse Gas Initiative (RGGI; DEC Part 242 Regulations) is the first mandatory market-based emissions trading program in the United States to reduce $CO_2$ emissions, and the first anywhere to use the cap-and-invest model for reducing pollution. New York and 10 other RGGI participating states set a cap for total emissions of $CO_2$ from electric generation facilities in the region. Each state implements the program through its own regulations, which include emissions budgets in individual RGGI participating states that are equal to shares of the regionwide cap. The RGGI cap declines over time, gradually lowering $CO_2$ emission limits.

### Legislation

Chapter 423 of the Laws of 2021 related to ZEV sales outlines that new non-road vehicles and equipment sold in New York are targeted to be zero-emissions by 2035, and new MHD vehicles sold in New York are targeted to be zero-emissions by 2045.

Chapter 58 of the Laws of 2020 established the Accelerated Renewable Energy Growth and Community Benefit Act as part the State Fiscal Year 2020-2021 budget to dramatically speed up the siting and construction of clean energy projects to combat climate change and help jump-start the State's economic recovery from the COVID-19 health crisis. This law created a first in the nation Office of Renewable Energy Siting (ORES) to improve and streamline the process for environmentally responsible and cost-effective siting of large-scale renewable energy projects across New York, while delivering significant benefits to local communities. This law, which is being implemented by the New York State Department of State (DOS), NYSERDA, New York State Department of Public Service (DPS), DEC, the New York Power Authority (NYPA), and Empire State Development (ESD), will accelerate progress toward New York's nation-leading clean energy and climate mitigation requirements, including the mandate to obtain 70% of the State's electricity from renewable sources, as identified under the Climate Act.

Chapter 59 of the Laws of 2019 established the Metropolitan Transportation Authority (MTA) Reform & Traffic Mobility Act (Congestion Pricing) that directs MTA to design, develop, build, and run a toll program that applies to vehicles that enter or remain in Manhattan's Central Business District. The purpose of the program is to reduce congestion and enhance mobility in Manhattan's Central Business District. By reducing traffic and helping improve mass transit, the program would improve air quality and enhance equity by providing expanded access. MTA held public hearings on the proposal in fall 2021 and is undergoing an environmental assessment pursuant to the National Environmental Policy Act.

Chapter 355 of the Laws of 2014 established New York CRRA to build New York's resilience to rising sea levels and extreme flooding. The Climate Act made modifications to CRRA, expanding the scope of climate hazards and projects for consideration, which became effective January 1, 2020. As part of the implementation of CRRA, DEC, in consultation with DOS and other stakeholders, developed the *New York State Flood Risk Management Guidance 1* to help ensure the health, safety, and well-being of New Yorkers now and in the future.[12]

Chapter 388 of the Laws of 2011 established the Power NY Act, which directed DEC to promulgate rules and regulations limiting emissions of $CO_2$ by newly constructed major generating facilities. DEC adopted 6 NYCRR Part 251 in 2012, setting $CO_2$ emission limits that effectively prohibited new coal-fired power plants. In 2018, DEC adopted further revisions to this regulation applicable to existing facilities, effectively phasing out all remaining coal-fired power plants in the State. The last coal-fired power plant in the State was closed in 2020.

Chapter 433 of the Laws of 2010 established the State Smart Growth Public Infrastructure Policy Act, Article 6 of the Environmental Conservation Law (ECL), prohibiting a state infrastructure agency from approving, undertaking, supporting, or financing a "public infrastructure project" unless, to the extent practicable, the project is consistent with 11 smart growth criteria.

Chapter 433 of the Laws of 2009 related to the State Energy Planning Board reauthorizes Article Six of the Energy Law, regarding energy planning requiring comprehensive studies of the State's energy needs.

### Programmatic Action

Several agencies have existing programs related to renewable energy, climate resilience and adaptation, and overall climate change mitigation. New York's Reforming the Energy Vision, including the NY-Sun program, the Clean Energy Standard, Evolve NY, Drive Clean Rebates, Clean Energy Communities, and the Clean Energy Fund are all examples of existing climate leadership. In addition, Climate Smart Communities is a multi-agency program that helps local governments take action to reduce GHG emissions and adapt to a changing climate, including grants for climate mitigation and adaptation projects, ZEV vehicles, and ZEV infrastructure. Charge NY is a multi-agency initiative aiming to create a statewide network of up to 3,000 public and workplace charging stations and to put up to 40,000 plug-in

[12] New York State Department of Environmental Conservation. 2020. New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act, Estimating Guideline Elevations. Albany. Accessed at https://www.dec.ny.gov/docs/administration_pdf/crraestelevguidelines.pdf.

vehicles on the road. And, in an example of multi-state cooperation, the Engineering Department of the Port Authority of New York and New Jersey (PANYNJ) *Climate Resilience Design Guidelines*, produced in 2015, ensure that new port authority infrastructure and buildings are designed to account for projected changes in temperature, precipitation, and sea level. The guidelines provide PANYNJ architects and engineers with a framework for evaluating the vulnerability of projects to future climate impacts and addressing those impacts in the design of port authority infrastructure and buildings.[13]

New York stands ready to deliver the results necessary to avoid the most catastrophic impacts of climate change while providing the necessary resources for New York to be more resilient and adaptable to the irreversible changes already embedded.

## 3.2 Landmark Accomplishment of the Climate Act and Key Components of the Legislation

On July 18, 2019, the Climate Act was signed into law.[14] This historic legislation cements the State's position as a leader in combating climate change. This Act, which became effective on January 1, 2020,[15] builds upon the State's clean energy and GHG emission reduction policies described above, codifying critical goals as statutory requirements. The Climate Act will have far-reaching effects across all areas of the environment and economy.

**New York's Nation-Leading Climate Directives**

- 85% Reduction in GHG Emissions by 2050
- 100% Zero-Emission Electricity by 2040
- 70% Renewable Energy by 2030
- 9,000 MW of Offshore Wind by 2035
- 3,000 MW of Energy Storage by 2030
- 6,000 MW of Solar by 2025
- 185 trillion Btu of end-use energy savings

The implementation of the Climate Act requires a significant regulatory undertaking by DEC as well as substantial action by NYSERDA, the Public Service Commission (PSC), and other State agencies and authorities. These efforts will be informed by the Climate Action Council (the Council), the final Scoping Plan, and, recognizing the importance of ensuring a just transition, essential groups that are focused on environmental justice issues.

[13] New York City Mayor's Office of Resiliency. 2020. Climate Resiliency Design Guidelines. New York City. Accessed at https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf.

[14] Chapter 106 of the Laws of 2019.

[15] Climate Act § 14; Chapter 735 of the Laws of 2019.

For the next several years and beyond, the implementation of the Climate Act necessitates an all-hands-on-deck approach across state government, with input from a broad array of stakeholders, technical advisors, and experts. This section provides a summary of key provisions of the Climate Act as well as an outline of the key milestones and implementation steps thus far.

## *Summary of Key Provisions*

### GHG Emission Reduction Requirements

The heart of the Climate Act is the addition of Article 75 to the ECL, which, among other things, directs DEC to establish statewide GHG emission limits, requiring a 40% reduction in statewide GHG emissions from 1990 levels by 2030 and an 85% reduction by 2050.[16] The Climate Act also establishes a goal of net zero emissions across all sectors of the economy by 2050.[17] Within four years of the effective date, the Climate Act requires DEC to promulgate regulations to ensure compliance with such statewide GHG emission limits.[18]

### Clean Energy Generation Requirements

In addition to ECL Article 75 and its essential GHG emission reduction requirements, the Climate Act adds a new Section 66-p to the Public Service Law, which requires the PSC to establish a program to decarbonize the electric sector. Specifically, the program must have two targets: 70% of the State's electricity deriving from renewable energy by 2030 (70x30) and 100% carbon-free energy by 2040 (100x40).[19] The Public Service Law provisions also codify previously existing ambitious clean energy goals, including a requirement for the procurement of at least 9,000 megawatts (MW) of offshore wind by 2035, 6,000 MW of distributed solar generation by 2025, and 3,000 MW of energy storage by 2030.[20]

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[16] ECL § 75-0107(1). As set forth in the Climate Act, statewide GHG emissions include all emissions of GHGs from sources within the state, as well as GHGs produced outside the State but associated with either the generation of electricity imported into the State or the extraction and transmission of fossil fuels imported into the state. ECL § 75-0101(13).

[17] ECL § 75-0103(11).

[18] ECL § 75-0109.

[19] PSL § 66-p(2).

[20] PSL § 66-p(5).

## Council and Advisory Panels

Critical to the implementation of the Climate Act is the 22 member Council,[21] made up of the heads of various State agencies, as well as other members appointed by the governor and Legislature.[22] The co-chairs of the Council are the DEC commissioner and NYSERDA president.[23] The Council includes Advisory Panels for particular subject areas including waste, transportation, energy-intensive and trade-exposed (EITE) industries, land use and local government, energy efficiency and housing, power generation, and agriculture and forestry.[24]

The Council is charged with developing a Scoping Plan, which provides recommendations for achieving the statewide GHG emission limits, including regulatory measures.[25] The Council consulted with the Advisory Panels for subject-matter expertise when developing recommendations in this draft Scoping Plan.[26] A final Scoping Plan will be released in 2023 and reviewed and updated at least every five years.[27]

## Environmental and Climate Justice Provisions

Notably, the Climate Act recognizes historically Disadvantaged Communities and the fact that these communities suffer disproportionate and inequitable impacts from climate change and therefore establishes mechanisms to ensure that these communities benefit from the Climate Act. This includes a goal that Disadvantaged Communities receive 40% of the overall benefits of spending on clean energy and energy efficiency programs and a requirement that such communities receive at least 35% of the benefits of such State investments.[28]

The Climate Act also creates the Climate Justice Working Group (CJWG) within DEC, which is comprised of representatives from environmental justice communities and State agencies.[29] The CJWG is currently establishing criteria to define Disadvantaged Communities. During the development of this draft Scoping Plan, the CJWG has also advised the Council to ensure that Disadvantaged Communities are

[21] ECL § 75-0103.

[22] ECL § 75-0103(1).

[23] ECL § 75-0103(4).

[24] ECL § 75-0103(7).

[25] ECL §§ 75-0103(11)-(14).

[26] ECL § 75-0103(7).

[27] ECL § 75-0103(15).

[28] ECL § 75-0117.

[29] ECL § 75-0111.

considered in the implementation of the Climate Act.[30] This is in addition to input from the Just Transition Working Group (JTWG) within the Council.[31]

The Climate Act establishes a community air monitoring program to identify locations to deploy community air monitoring systems, to develop a strategy to reduce toxic and criteria air pollutant emissions in Disadvantaged Communities, and to select communities around the State to implement emissions reduction programs.[32] The Climate Act also requires State agencies to ensure that permitting, licensing, contracting, and other approvals and decisions will not disproportionately burden Disadvantaged Communities and to prioritize reductions of GHG emissions and co-pollutants in Disadvantaged Communities.[33]

### *Other Provisions*

As previously noted, the Climate Act requires an all-hands-on-deck approach across state government, and various provisions affect all State agencies and their decision-making. Further, the Climate Act directs all State agencies to reduce their GHG emissions and provides State agencies with the authority to promulgate GHG emissions regulations to help achieve the statewide GHG emission limits.[34] The Climate Act also requires state agencies to consider GHG emissions and limits in permitting, licensing, contracting, and other approvals and decisions, and that wherever such decisions are deemed inconsistent or would interfere with the statewide GHG emission limits, State agencies must provide a detailed statement of justification for the action notwithstanding the inconsistency and identify alternatives or GHG mitigation measures.[35] The Climate Act also expands the scope of the existing CRRA,[36] including by covering additional DEC permitting programs such as State Pollutant Discharge Elimination System permitting and Air Pollution Control permitting, and by allowing State agencies to require mitigation of climate risks, including adverse impacts on Disadvantaged Communities.[37]

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[30] ECL § 75-0111; ECL §§ 75-0103(10), (12).

[31] ECL §§ 75-0103(8), (12).

[32] ECL § 75-0115.

[33] Climate Act § 7(3).

[34] Climate Act §§ 7(1) and 8.

[35] Climate Act § 7(2).

[36] Chapter 355 of the Laws of 2014.

[37] Climate Act § 9.

### *Key Milestones and Implementation Steps To-Date*

This draft Scoping Plan and recommendations outline measures and other State actions to ensure attainment of the statewide GHG emission limits and net zero emission goal. The statewide GHG emission limit rulemaking is the first regulatory action to implement the Climate Act, the foundation for multiple components of the Climate Act, and critically important for successful implementation of the Climate Act. DEC promulgated 6 NYCRR Part 496 that established the two statewide GHG emission limits called for in the Climate Act: a limit for 2030 that is equal to 60% of 1990 GHG emission levels and a limit for 2050 that is equal to 15% of 1990 emission levels. Specifically, using a 20-year global warming potential (GWP) and including upstream emissions from fossil fuels imported into New York as required by the Climate Act, the statewide GHG emission limit for 2030 is 245.87 million metric tons (MMT) of carbon dioxide equivalent ($CO_2e$), and the statewide GHG emission limits for 2050 is 61.47 MMT $CO_2e$.[38] DEC, in consultation with NYSERDA, continues to update the inventory of GHGs and will publish the annual statewide GHG emissions report that reflects these updates.

Further, DEC, in consultation with NYSERDA, established the Value of Carbon guidance to help State agency decision-making by placing a monetary value for the avoided emissions of GHGs.[39] The Value of Carbon guidance provides metrics that may be broadly applicable to all State agencies' and authorities' actions—such as benefit-cost analyses, rulemaking processes, environmental assessments, and demonstrations of the benefits of climate change policies—to demonstrate the global societal value of actions to reduce GHG emissions. The guidance provides a recommended procedure for using a damages-based value of carbon along with a general review of the marginal abatement cost approach and recommends the use of a central discount rate of 2%, which should be reported alongside a 1% and 3% discount rate for informational purposes. For example, use of the 2% central discount rate translates into a 2020 central value of $CO_2$ of $121 per ton, methane of $2,700 per ton, and nitrous oxide of $42,000 per ton.

The Climate Act solidifies New York's status as a climate leader. It establishes the country's—and perhaps even the planet's—strongest GHG emission reduction and clean energy requirements. While the scale of the effort to implement the Climate Act is enormous, so is the challenge it is meant to address. Successful implementation of the Climate Act will not only provide direct environmental and economic benefits for the State, it will also serve as a model for other jurisdictions in combatting climate change.

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[38] 6 NYCRR § 496.4.

[39] ECL § 75-0113; New York State Department of Environmental Conservation. 2021. Establishing a Value of Carbon: Guidelines for Use by State Agencies. Albany. Accessed at https://www.dec.ny.gov/docs/administration_pdf/vocguidrev.pdf.

# Chapter 4. Current Emissions

DEC is required to release an annual report on GHG emissions as a measure of progress toward reaching the Climate Act's emission limits and net-zero goal. The first annual report will be released in 2021 and cover the years 1990 through 2019. Additional details on data, methods, and historical trends will be provided in that report. In addition, some of the co-pollutants discussed in this draft Scoping Plan affect both human health and climate change, even if they are not included in the suite of GHGs listed in the Climate Act. For example, actions to address particulate matter (PM), including black carbon, also contribute to the State's broader climate strategy.

The Climate Act requirements for GHG emissions accounting deviate from the standard protocols[40] used by other governments in a few key ways. First, GHG emissions must be measured in terms of $CO_2e$ using a 20-year rather than a 100-year time interval. This results in an apparently higher numeric value for some gases, such as methane, even if the emission rate was the same. Secondly, "statewide" GHG emissions under the Climate Act include out-of-State GHG emissions associated with imported electricity and the extraction and transmission of imported fossil fuels. This greatly expands the scope of GHG emission sources typically included in governmental GHG reduction goals and inventories. Addressing some of these GHG emission sources may require action at the federal level. Finally, the emission values provided here include $CO_2$ associated with the combustion of biogenic fuels, although this comprises a very small portion of statewide emissions (less than 4%). Therefore, the emission values provided here are not comparable to those reported by other governments, nor are they comparable to values reported by New York State in the past. The economic sectors described here may not represent the same emission sources as presented in other GHG reports.

Based on this assessment, emission reductions are needed from all sectors of the economy to achieve the goals and requirements of the Climate Act. For the purposes of this draft Scoping Plan, emissions are broken down according to the economic sectors covered in *Sector Strategies* (Chapters 11 through 16), *Chapter 18. Gas System Transition*, and *Chapter 19. Land Use.* The transportation, buildings, and electricity chapters include not only GHG emissions from fuel use, but also GHG emissions associated with imported fuels. In summary, *Chapter 11. Transportation* includes GHG emissions associated with on-road transportation; non-road transportation such as aviation, rail, and marine; and other mobile equipment, as well as HFCs used for mobile heating, ventilation, and air conditioning (HVAC) and

[40] Per the IPCC Taskforce on National GHG Inventories.

refrigeration. *Chapter 12. Buildings* includes fuels used in residential and commercial buildings and HFCs used in HVAC and refrigeration. *Chapter 13. Electricity* includes fuels used for generating electricity within the State, imported electricity, and the transmission and distribution of electricity. The remaining economic sectors include industry, agriculture and forestry, and waste. Industrial emission sources include fuels used in industrial buildings and for industrial processes as well as emissions from the oil and gas industry in the State. The waste sector includes emissions associated with solid waste management, wastewater management, and waste combustion. GHG emissions from the agriculture and forestry sector are from livestock and soil management practices. These practices, as well as land use in general, also contribute to carbon removals.

Figure 2 provides an estimate of statewide GHG emissions across these major economic sectors. Gross total emissions for 2019 were 379.4 MMT $CO_2e$ (GWP-20). Figure 3 is an estimate of annual emission removals, or carbon sequestration. Net total emissions, or gross emissions minus emission removals and biogenic $CO_2$, were 338.5 MMT $CO_2e$ (GWP-20) in 2019.[41]

Importantly, emission removals were equivalent to less than 8% of gross emissions in 2019, suggesting that all emission sources from every segment of the economy must be addressed to achieve net zero emissions. More than half of current emissions are related to emission sources covered in *Chapter 11. Transportation* and *Chapter 12. Buildings* (approximately 60%). These sources include the direct use of fossil fuels, "upstream" emissions from the fuel system, and HFCs.

[41] If measured using the standard protocols, gross emissions were 194.6 MMT $CO_2e$ (GWP-100) and net emissions were 165.5 MMT $CO_2e$ (GWP-100) in 2019.

**Figure 2. 2019 New York State GHG Emissions by Scoping Plan Sector**

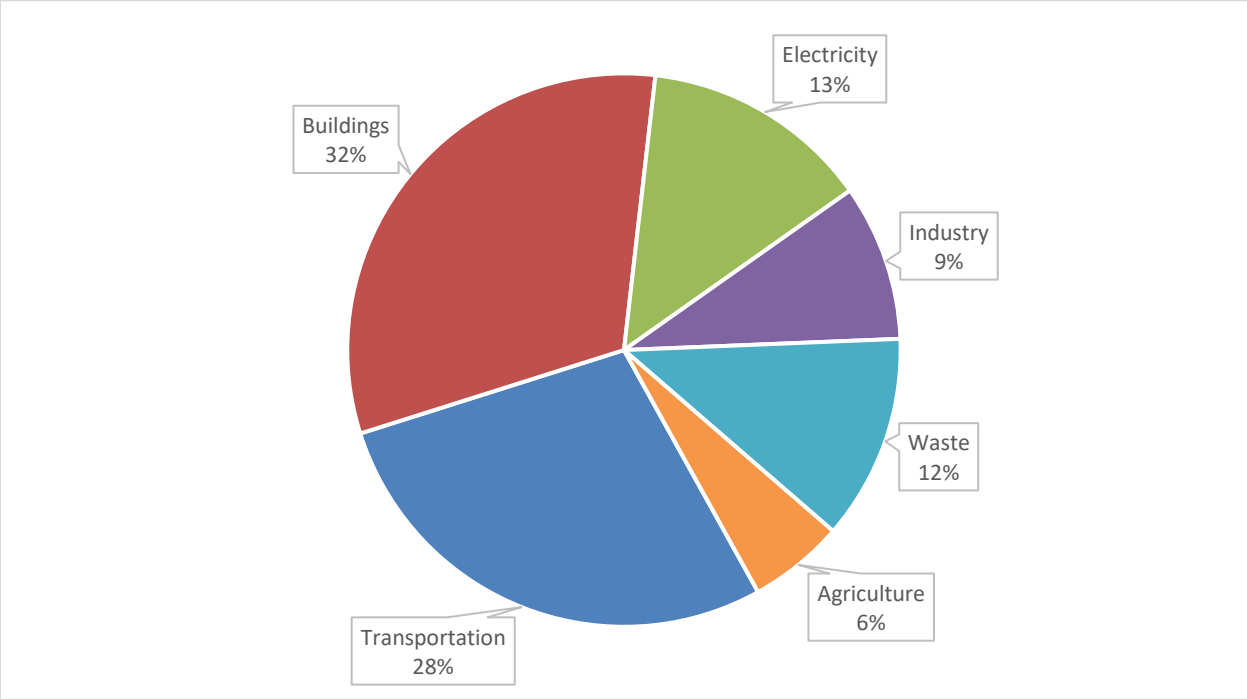
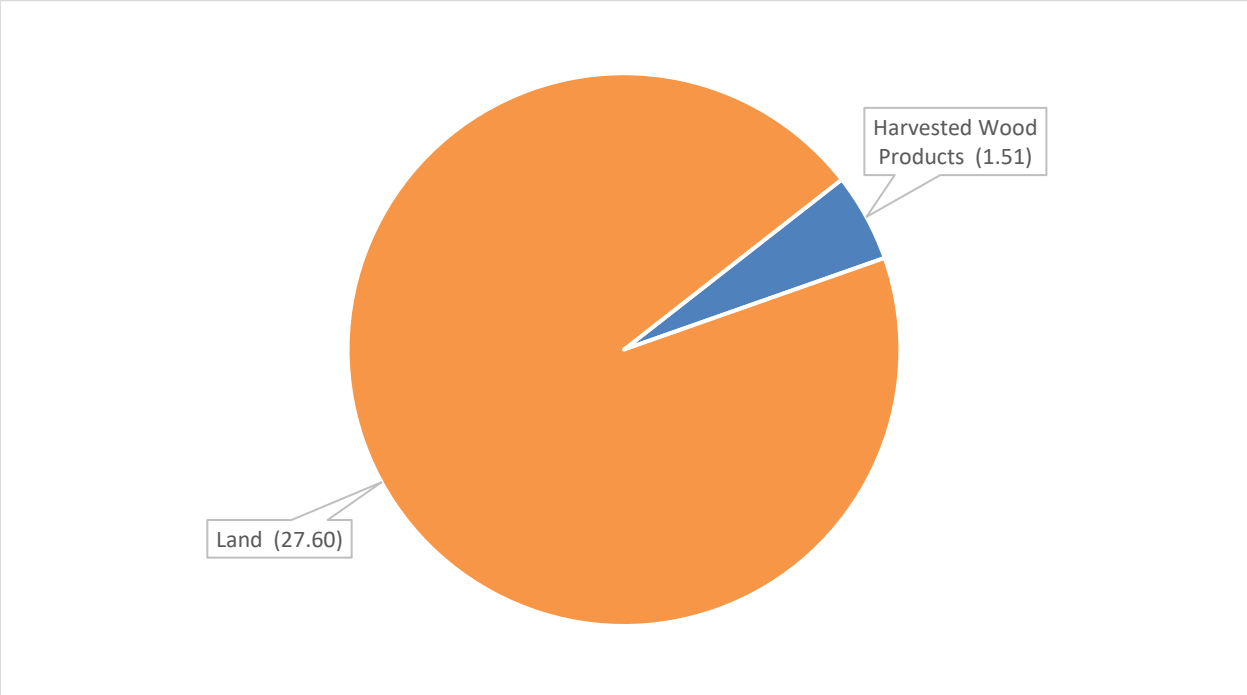



**Figure 3. 2019 New York State GHG Emissions Removals by Sector (in MMT $CO_2$)**



## 4.1 Summary of Sectoral Emissions

### *Transportation*

The transportation sector was responsible for approximately 28% of the State's emissions in 2019, which includes on-road transportation (59%), non-road such as aviation (12%), emissions from imported fuels (26%), and HFCs used in vehicle air-conditioning and refrigeration (3%). Transportation sector emissions are about 16% higher today than they were in 1990. The transportation sector today is largely dependent on petroleum-based fuels such as gasoline, diesel, and jet fuel, but the State has made strong progress in transitioning from petroleum-based fuels to zero-emission technologies.

### *Buildings*

The buildings sector was the largest source of emissions in 2019 and responsible for 32% of emissions, which includes the combustion of fossil fuels in residential (34%) and commercial buildings (19%), emissions from imported fuels (33%), and HFCs released from building equipment and foam insulation (14%). The fuels used in buildings today include natural gas, distillate fuel (heating fuel oil #2), wood, propane, kerosene, and residual fuel oil.

### *Electricity*

The electricity sector comprised 13% of emissions in 2019, including electricity generation within the State (44%), imported electricity (15%), emissions from imported fuels (41%), and the sulfur hexafluoride ($SF_6$) used in electricity distribution and transmission (<1%).

### *Industry*

Industrial emissions made up 9% of emissions in 2019, including emissions from methane leaks and combustion from the oil and gas system in New York (45%), the direct combustion of on-site fuel (27%), emissions from imported fuels (20%), and non-combustion industrial processes (6%).

### *Agriculture and Forestry*

Agricultural emissions represented approximately 6% of the statewide emissions in 2019 from livestock (92%) and soil management practices (8%). However, agriculture and forestry also provide carbon sequestration benefits and can provide significant contribution toward achieving net zero total emissions from all sectors in the State. For example, the long-term storage of carbon in harvested wood products alone provided 5% of the State's GHG emissions removals in 2019. These benefits are also discussed in *Chapter 19. Land Use*.

### *Waste*

GHG emissions from the waste sector represent about 12% of statewide emissions, including landfills (78%), waste combustion (7%), and wastewater treatment (15%). Most of these emissions represent the long-term decay of organic materials buried in a landfill, which will continue to emit methane at a significant rate for more than 30 years. It also represents both the landfilling of waste in New York and the exporting of waste to landfills in other states.

### *Emissions Removals*

The only current method for removing emissions from the atmosphere is through the process of natural carbon sequestration, which is a service provided by our forests, croplands, and wetlands. In 2019, these lands removed an amount of $CO_2$ equal to 8% of the State's GHG emissions.

# Pillars of New York's Planned Climate Action to Realize Net Zero Emissions

## Chapter 5. Overarching Purpose and Objectives of the Scoping Plan

The Scoping Plan, prepared and approved by the Council, is designed to be a pathway, or pathways, the State should take to meet the requirements of the statewide GHG emission limits and achieve statewide net zero emissions in accordance with the schedule established by the Climate Act. It discusses economy-wide strategies and strategies by economic sector. The Plan shall also inform the State energy planning board's adoption of an updated State Energy Plan in accordance with section 6-104 of the energy law.[42] The State Energy Plan is a comprehensive roadmap to build a clean, resilient, and affordable energy system for all New Yorkers. The State Energy Plan establishes how the State can ensure adequate supplies of power, reduce demand through new technologies and energy efficiency, preserve the environment, reduce dependence on imported gas and oil, stimulate economic growth, and preserve the individual welfare of New York citizens and energy users. The most recent plan was adopted in 2015 and amended in 2020. The first State Energy Plan issued after the completion of the final Scoping Plan shall incorporate the recommendations of the Council and the strategies presented will guide the implementation of policies statewide.[43]

### 5.1 New York's Climate Vision

New York will undertake a sweeping set of measures to reduce the State's carbon footprint, transform electricity generation in the State, and drive innovative solutions through technology advancement. This draft Scoping Plan establishes the path forward for New York to achieve 70% renewable energy by 2030, 100% zero-emission electricity by 2040, a 40% reduction in statewide GHG emissions by 2030, an 85% reduction in statewide GHG emissions by 2050, and net zero emissions statewide by 2050. The paths to 2030 and 2050 require a comprehensive vision and integrated approach to build new programs while significantly expanding existing efforts. Each economic sector discussed in this Plan establishes a vision for 2030 and 2050 in an effort to paint the picture of the future and show the direction the State must head.

[42] ECL § 75-0103(11).

[43] *Id.*

Successful implementation of this Plan requires one cohesive voice across all State agencies and authorities, but State government action alone will not be enough. The State can set the stage for action, but engagement from all New Yorkers in the decisions they make each and every day will impact the ability of New York to make progress toward its goals. This draft Scoping Plan is the foundation of extensive collaboration. Not only is it a synthesis of sector-specific strategies, but it is also designed as overarching strategic initiatives intended to work in parallel to achieve the requirements of the Climate Act. Successful implementation will also require rapid integration and assimilation of strategies designed to achieve real results across the State.

### *Inform Agency Actions*

As discussed, this draft Scoping Plan is intended to act as a strategic plan for State agencies, authorities, and other entities that are responsible for implementing new policies and programs. Many of the sector-specific chapters are organized by policy themes, and each of those themes include several strategies that are intended to mitigate GHG emissions or enable the mitigation of GHG emissions. Each of these chapters acknowledge the existing work that the key stakeholders, including State agencies, in those economic sectors have done or are currently doing to address climate change, and when appropriate builds on those policies and programs. Beyond that, the sector-specific chapters include new strategies to guide New York in meeting the requirements of the Climate Act. It continues to be important that New York operate unilaterally, leveraging action with coordination within and between agencies and authorities. Linkages between programmatic actions across agencies should be highlighted.

## 5.2 Process for Development

Shortly after the Governor and the Legislature completed their appointments, the Council convened its first meeting in March of 2020. Since that time, and all throughout the COVID-19 pandemic, the Council continued its important work of developing a draft Scoping Plan of strategies to reduce New York's GHG emissions to meet the GHG emission limits and social justice requirements set forth in the Climate Act. The Council has held eighteen meetings in which they, among other work, appointed the Advisory Panels, approved their work plans, received progress reports, received their final recommendations, received feedback from CJWG on the benefits and impacts to Disadvantaged Communities of the Advisory Panels' recommendations and received data on costs and benefits of the mitigation strategies.

The Council convened seven Advisory Panels: Agriculture and Forestry, Energy Efficiency and Housing, EITE Industries, Land Use and Local Government, Power Generation, Transportation, and Waste and the JTWG. These groups are comprised of professionals from all across the State who are providing their

expertise in developing strategies that reduce GHG emissions in New York while benefiting New York's workers and Disadvantaged Communities. The Advisory Panels and JTWG held over 90 public meetings throughout the course of their recommendation development process. At the direction of the Council, the panels sought the perspective of other panels, additional experts, and other stakeholders in the development of the recommendations. The Advisory Panels also engaged with the CJWG for feedback on the recommendations under development. The Advisory Panels delivered their GHG mitigation recommendations for Council consideration at the April and May 2021 Council meetings. The full slate of recommendations can be found in Appendix A. The Council also received adaptation and resilience recommendations from the Land Use and Local Government Advisory Panel and recommendations on workforce opportunities and busines impacts from the JTWG. The delivery of the Panels' recommendations was a major milestone in the development of this draft Scoping Plan and all consensus recommendations from the Panels have been incorporated in this draft Scoping Plan. Feedback the Council received from the CJWG is noted within the discussion of strategies; some of this requires additional Council discussion to determine a consensus Council position as to how to address the feedback.

In Summer and Fall of 2021 the Council was presented with results from an integration analysis on a suite of mitigation strategy scenarios, which were built off the recommendations provided by the Advisory Panels. This analysis provided data on the emission reductions and societal costs and benefits that can be expected from differing options of strategy sets that could be included in this draft Scoping Plan. Additional information on the integration analysis is provided in *Chapter 9. Analysis of the Plan* and *Chapter 10. Benefits of the Plan.* The culmination of this work is this draft Scoping Plan.

The Council will consider the Advisory Panels' recommendations along with information from the integration analysis, the CJWG, public feedback on this draft Scoping Plan, and further deliberations in developing the final Scoping Plan for achieving the requirements of the Climate Act. The final Scoping Plan will identify and make recommendations on regulatory measures and other state actions that will ensure the attainment of the Climate Act requirements.

### *Stakeholder Engagement*

This draft Scoping Plan considers inputs from many stakeholders, as well as critical feedback during consultation with the CJWG established pursuant to Section 75-0111 of the ECL. The Council's Advisory Panels were committed to a public process in the development of their recommendations, holding public engagement sessions, conducting public surveys, and accepting and incorporating public comment

throughout. This stakeholder input is reflected in the recommendations that were delivered to the Council. Additionally, the Council has accepted written feedback throughout the development of this draft Scoping Plan. Agencies and other stakeholders representing many different perspectives were critical in developing this Plan and feedback was gathered at several different public webinars and workshops, including outreach on the upcoming annual GHG emissions report, a technical conference on oil and gas emissions accounting, and outreach on net emissions accounting. Additionally, NYSERDA held a Reliability Speaker Session to engage experts, including the NYISO and the Utility Intervention Unit of DOS, on electric system reliability planning for the purposes of informing the development of this draft Scoping Plan. The Council welcomes feedback from the public on its work at any time during the process. After this draft Scoping Plan is issued, the Council will hold at least six public hearings and accept written comments on the draft for at least 120 days. Feedback received during the public comment period will be accounted for in the final Scoping Plan. The public comment process will be designed to ensure that all New Yorkers have opportunities to provide input on this draft Scoping Plan.

Continued engagement on anything that has been previously discussed is encouraged as this Plan and other reports required by the Climate Act are updated over the years. Additional opportunity for stakeholder outreach and engagement will be required to continue moving New York forward on climate action.

### *Integration Analysis*

The Climate Act requires that the Council, in developing this draft Plan, evaluate the total potential costs and potential economic and non-economic benefits, considering the Value of Carbon established by DEC under the Climate Act, of this draft Scoping Plan for reducing GHGs. An integration analysis was developed to estimate the economy-wide benefits, costs, and GHG emissions reductions associated with pathways that achieve the Climate Act GHG emission limits and carbon neutrality goal. This integration analysis incorporates and builds from Advisory Panel and Working Group recommendations, as well as inputs and insights from complementary analyses, to model and assess multiple mitigation scenarios. Key assumptions, drivers, and results of the analysis have been made publicly available throughout the analytic process, and feedback from Advisory Panels, State agency staff, CJWG, and the Council has been incorporated as part of the analytic process. In addition, a Technical Advisory Group of experts from academia and national labs were also consulted throughout the analytic process. The results from the integration analysis were presented to the Council in Summer and Fall of 2021 and are available to the public on the Climate Act website.

## 5.3 Summary of Strategies

Through the process of the developing this draft Scoping Plan to this stage, the Council recognized several key strategies that are fundamental to achieving the GHG emission limits and net zero GHG emissions:

- Energy efficiency measures that achieve the Climate Act energy efficiency goal
- Transition from fossil gas to electrification in buildings
- Zero emissions electricity
- Transportation electrification
- Enhancement of transit, smart growth, and reduced vehicle miles traveled (VMT)
- A transition to low-GWP refrigerants and enhanced refrigerant management
- Maximizing carbon sequestration in New York's lands and forests
- Fugitive methane emissions mitigation across the waste, agriculture, and energy sectors
- A diverse portfolio of solutions in industry, including efficiency, electrification, and limited and strategic use of low-carbon fuels and carbon capture technologies for certain industrial applications.

The development of this Plan, which includes these fundamental strategies, is one of the pillars of New York's planned climate action. Climate justice, a just transition, and the benefits to public health are the remaining pillars and are discussed in the following chapters.

Reliability and resiliency of energy systems is critical to providing robust systems that respond to changing demand in real-time and withstand unexpected events. The strategies to implement and achieve the goals of the Climate Act must support the high reliability standards in place in the State by implementing improvements and enhancements where needed and sustaining the practices that provide high quality electric service. If reliability is properly integrated, the additional clean distributed generation (DG), storage and large-scale renewables developed under the Climate Act will provide a more flexible and resilient grid to address and mitigate the impacts of climate change.

# Chapter 6. Achieving Climate Justice

## 6.1 Climate Justice and the Climate Act

A fundamental objective of the Climate Act is to ensure that New York's transition to a low-carbon economy results in beneficial outcomes for traditionally underserved communities. In New York, as in the rest of the nation, frontline communities such as Black, Indigenous, and People of Color (BIPOC), as well as low-income communities, bear the largest burden of climate change impacts and associated pollution. Additionally, these frontline communities have historically been excluded from the environmental decision-making process and had limited opportunities for participation.

The Climate Act recognizes that climate change especially heightens the vulnerability of Disadvantaged Communities, which bear environmental and socioeconomic burdens as well as legacies of racial and ethnic discrimination. The Climate Act requires all State agencies and authorities to prioritize reductions of GHGs and co-pollutants in Disadvantaged Communities and recognizes that actions undertaken by the State to mitigate GHG emissions should prioritize the safety and health of Disadvantaged Communities, control potential regressive impacts of future climate change mitigation and adaptation policies on these communities, and prioritize the allocation of public investments in these areas. Additionally, this draft Scoping Plan recognizes that women, femmes, youth, and children are more vulnerable to the climate crisis and acknowledges the need to specifically provide support and opportunities to these populations who are disproportionately impacted by the climate crisis.

The Climate Act seeks to address the disproportionate burden that some communities have borne from past and current emissions in many ways. The Climate Act ensures that Disadvantaged Communities will reap the benefits of New York's transition to a low-carbon economy, including by requiring that certain State investments deliver benefits to these communities.[44] Through the work of the CJWG, the Climate Act ensures that these communities are consulted and will benefit from New York's climate action. Input from the CJWG will support the development of climate policies and investment programs designed to deliver meaningful and equitable benefits to Disadvantaged Communities. The Climate Act also contains important provisions that ensure agency decision making does not disproportionately burden Disadvantaged Communities and prioritizes reductions of GHG emissions and co-pollutants in these

[44] ECL § 75-0117.

communities.[45] These are priorities that encompass all State agencies and authorities and a coordinated approach to implementation is needed to ensure these provisions of law are integrated into agency actions.

### *The Climate Justice Working Group*

As required by the Climate Act, DEC created the CJWG, which is comprised of representatives from environmental justice communities statewide, including three members from New York City communities, three members from rural communities, and three members from urban communities in upstate New York, as well as representatives from the State Departments of Environmental Conservation, Health, Labor, and from NYSERDA. Among other responsibilities, the CJWG is tasked with developing the definition of Disadvantaged Communities and has an important advisory role, providing strategic advice to the Council for incorporating the needs of Disadvantaged Communities in this draft Scoping Plan. The CJWG was formed in June 2020 and held 23 public meetings through 2021.

### *Identifying New York's Disadvantaged Communities*

A primary task of the CJWG is to develop the criteria by which a community in New York can be designated as a Disadvantaged Community under the Climate Act. The Climate Act defines Disadvantaged Communities as "communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate- income households . . ."[46] The establishment of the Disadvantaged Communities criteria is fundamental to many provisions of the Climate Act and key to successful implementation of this draft Scoping Plan in prioritizing reductions of GHG emissions and co-pollutants in these communities and ensuring no disproportionate burdens on such communities. Disadvantaged Communities are being identified by the CJWG based on geographic, public health, environmental hazard, and socioeconomic criteria that include, but are not limited to:

- Areas burdened by cumulative environmental pollution and other hazards that can lead to negative public health effects;
- Areas with concentrations of people that are of low income, high unemployment, high rent burden, low levels of homeownership, low levels of educational attainment, and/or members of groups that have historically experienced discrimination based on race or ethnicity; and

[45] Climate Act § 7(3).

[46] ECL § 75-0101(5).

- Areas vulnerable to the impacts of climate change such as flooding, storm surges, and the urban heat island effects.[47]

The CJWG has approved a draft definition for determining Disadvantaged Communities in New York. The criteria in the draft definition expands beyond pollution burden, which is central to many existing environmental justice definitions and frameworks, to include broader considerations of burdens, risks, and vulnerabilities within communities. The draft definition developed by the CJWG is subject to public comment and refinement prior to finalization. The Climate Act requires the CJWG to meet annually at a minimum to review the criteria and methods used to identify Disadvantaged Communities for the purpose of modifying methods or incorporating new data and scientific findings.[48]

The Council directed the Advisory Panels to include benefits and impacts to Disadvantaged Communities in the development of their recommended strategies for reducing GHG emissions and co-pollutants. These considerations are woven throughout the *Sector Strategies* chapters of this draft Plan. As the policies and programs outlined in this draft Plan move into the implementation phase, agencies will need to incorporate the CJWG definition of Disadvantaged Communities into those processes to ensure that the requirements of the Climate Act, including the direction of benefits to these communities as described below, are being satisfied.

### *Directing Benefits to Disadvantaged Communities*

In transforming New York's energy economy and mitigating climate change, the Climate Act mandates an investment of certain benefits of State agencies, authorities, and entities to Disadvantaged Communities. Disadvantaged Communities must receive a minimum of 35%, with a goal of 40%, of benefits of spending on clean energy and energy efficiency programs, projects, or investments in the areas of housing, workforce development, pollution reduction, low-income energy assistance, energy, transportation, and economic development.[49]

State agencies, in consultation with the CJWG and other relevant stakeholders, are developing a methodology for defining these benefits. The definition of Disadvantaged Communities and the

[47] ECL § 75-0111(1)(c).

[48] ECL § 75-0111(3).

[49] ECL § 75-0117.

methodology for defining benefits will be provided to all State agencies to ensure a coordinated approach to ensuring benefits are being directed to Disadvantaged Communities as required by the Climate Act.

In demonstrating a commitment to meeting or exceeding the benefits requirements of the Climate Act, the State has already begun adapting clean energy and energy efficiency investments to include prioritization of Disadvantaged Communities based on the interim definition described above. Examples of these actions are:

- **Clean Green Schools:** $59 million was made available by NYSERDA to serve more than 500 P-12 schools in underserved/ Disadvantaged Communities with clean energy and energy efficiency solutions, creating a healthier learning environment in schools across New York State. In addition, a minimum of $3 million will be provided to schools in Disadvantaged Communities participating in the Clean Green Schools program to support education, career awareness and training related to clean energy and energy efficiency retrofit projects, careers, and jobs.
- **NY Sun Solar Equity Framework:** $200 million was directed to increase access to solar energy for low- to moderate-income (LMI) households, affordable housing, and environmental justice communities.
- **EmPower New York:** EmPower New York incorporated a geo-eligibility component, streamlining eligibility determinations for households located in communities with more than 50% of residents at or below 150% of the federal poverty level.
- **Regional Clean Energy Hubs:** $36 million was made available to establish clean energy hubs in each of the 10 economic development regions of the State and to build capacity at the local level to position Disadvantaged Communities to benefit from the emerging clean energy economy. Initiatives will include outreach and education, increasing access to clean energy programs and resources, conducting equitable stakeholder engagement, and connecting residents and small businesses with workforce or business development opportunities.
- **Climate Justice Fellowships:** $6 million was made available to support individuals residing in Disadvantaged Communities or from priority populations to gain experience working in clean energy or climate justice through organizations such as community-based organizations, universities, municipalities, climate tech innovators/start-ups and clean energy businesses to advance climate justice and clean energy priorities for Disadvantaged Communities, including assisting with community engagement activities (e.g., plan, policy, or project) or clean energy project development and implementation.

- **New York Clean Transportation Prizes:** $85 million was made available to fund innovative electric transportation approaches that improve air quality and expand access to mobility in Disadvantaged Communities.
- **Large Scale Renewables and Clean Energy Standard:** In an October 15, 2020 Order, the PSC directed NYSERDA to take measures to ensure that interests of Disadvantaged Communities are valued in all future CES procurements.

### *Community Air Monitoring in Disadvantaged Communities*

The Climate Act created a program to measure and record air pollutant concentrations in the ambient air at or near places like hospitals, schools, and day care centers in Disadvantaged Communities and to use this information to create a strategy to reduce emissions of toxic air contaminants and criteria air pollutants in Disadvantaged Communities with high exposure burdens. DEC plans to implement the community air monitoring program and in 10 communities with a population of around five million to derive a broad picture of air quality in disadvantaged communities across the State. DEC will further define the areas for monitoring and other details of the program in in consultation with the CJWG and community members. The strategy will include methods for assessing and identifying the emissions sources, estimating their relative contribution to elevated exposure to air pollution, and assessing measures to reduce emissions from these sources. DEC will use the strategy to design community emissions reduction programs in Disadvantaged Communities.

## 6.2 Engagement in the Draft Scoping Plan

The consideration of benefits and impacts that GHG emissions mitigation strategies may have on Disadvantaged Communities was integral to the development of this draft Scoping Plan. The Council sought robust engagement with environmental justice organizations throughout the process to ensure these perspectives were prioritized in this draft Scoping Plan. Members of environmental justice organizations were represented on all the Council's Advisory Panels and the JTWG, which was vital to ensuring that the perspective of Disadvantaged Communities was included in the development of their respective recommendations. Additionally, the Advisory Panels and JTWG consulted with the CJWG as they were developing their recommendations. These bodies delivered their recommendations to the Council in the spring of 2021. The Council consulted with the CJWG on the Advisory Panel and JTWG recommendations. The CJWG provided feedback on all Advisory Panel and JTWG recommendations at Council meetings in the summer of 2021, with slides and recorded presentations available on the Climate Act website. The sectoral strategies in this draft Plan incorporate CJWG feedback and note where the group provided feedback on specific strategies. Table 1 represents a high-level overview of general

feedback, organized by Advisory Panel. A compilation of the feedback provided by the CJWG is provided in Appendix B. Consideration of Disadvantaged Communities is woven throughout this draft Scoping Plan.

**Table 1. Climate Justice Working Group Feedback by Advisory Panel**

| Advisory Panel | Feedback |
|---|---|
| Transportation | • Ensure that VMT reduction strategies are equitable<br>• Oppose Transportation and Climate Initiative (TCI) cap-and-invest program<br>• Support electrification; avoid reliance on biofuels<br>• Prioritize communities facing barriers<br>• Expand public transportation including high-speed rail and long-range bus service |
| Energy Efficiency and Housing | • Supportive of the Panel's recommendations<br>• Ensure that strategies enhance consumer protection and place emphasis on a just transition |
| Power Generation | • Support strategies to retire fossil fuel infrastructure and a moratorium on new fossil fuel infrastructure<br>• Develop behind-the-meter microgrids in Disadvantaged Communities<br>• Limit the use of hydrogen, nuclear, and biofuels to strategic applications<br>• Place greater focus on public power |
| Energy-Intensive and Trade-Exposed Industries | • Support the emphasis on green job creation for members of DACs, data collection and reporting requirements on industrial facilities' impact on DACs, and State procurement of low-carbon materials<br>• Ensure that climate and environmental justice objectives are equal to the business development objectives |
| Agriculture and Forestry | • Adopt the climate goals in the Federal Agriculture Resiliency Act, which requires cutting agricultural GHG emissions in half from 2010 levels by 2030 and to net zero by 2040<br>• Ensure that strategies address equity in the agricultural sector<br>• Prioritize the use of on-site biogas over strategies that use Anaerobic Digesters for biogas or biomass for energy to mitigate GHG emissions on farms<br>• Eliminate synthetic fertilizers and encourage organic farming<br>• Ensure that strategies include regulatory or mandatory actions and rely less on voluntary programs |
| Land Use and Local Government | • Incorporate stakeholders from Disadvantaged Communities in adaptation and resilience planning and fund nature-based infrastructure<br>• Engage communities in smart growth and consider a grant program to fund capacity building in Disadvantaged Communities<br>• Avoid gentrification through transit-oriented development (TOD) and adopt explicit land use strategies in Disadvantaged Communities<br>• Remove barriers to community choice aggregation (CCA) in Disadvantaged Communities<br>• Prioritize benefits and investments in conservation in Disadvantaged Communities |
| Waste | • Support strategies focused on waste reduction, materials reuse, and composting<br>• Support zero-emissions waste trucking |

| Advisory Panel | Feedback |
|---|---|
| | • Reduce food waste through programs that transfer excess edible foods to feed the hungry<br>• Ensure that biogas from the waste sector does not result in new gas transmission infrastructure; prioritize the on-site use of biogas |
| Just Transition Working Group | • Ensure that impacted workers can contribute to workforce assessment planning and include retirement planning that facilitates a dignified retirement<br>• Ensure that community benefit agreements between manufacturers, union groups, and impacted communities are legally binding<br>• Reuse shuttered power plants for clean energy and sustainable manufacturing<br>• Eliminate implicit bias in searching for and hiring workers |

## 6.3 Prioritizing Measures to Reduce Greenhouse Gas Emissions and Co-Pollutants in Disadvantaged Communities

The Climate Act requires that the State prioritize measures to maximize reductions of GHGs and co-pollutants in Disadvantaged Communities. Strategies that reduce New York's reliance on fossil fuels not only reduce GHG emissions, but also reduce co-pollutants, leading to corresponding benefits to Disadvantaged Communities. As New York approaches full decarbonization by 2050, emissions of unhealthy pollutants like fine particulate matter ($PM_{2.5}$), nitrogen oxides ($NO_X$) (which contribute to PM and ozone formation), and various toxic pollutants will see commensurate declines statewide, including in Disadvantaged Communities.

This draft Plan includes many strategies to target GHG emission reductions in Disadvantaged Communities, as described in more detail in *Sector Strategies*. There are several examples:

- Incentives for electrification of trucks and buses will be targeted in the first instance to vehicles operating in areas overburdened by air pollution, and fleet electrification requirements will drive the electrification of fleets operating in and through these Disadvantaged Communities, including drayage fleets serving port areas. In addition, until the trucking sector is fully electrified by midcentury, the replacement of diesel with renewable diesel and green hydrogen, which is hydrogen generated entirely by renewable energy, will reduce harmful $PM_{2.5}$ emissions in Disadvantaged Communities.
- In the power sector, incentives for distributed energy resources (DERs) and energy storage will be targeted to Disadvantaged Communities, reducing GHG emissions from peaking power plants in those locations.

- Incentives for energy efficiency, including heat pumps, will be targeted to LMI and Disadvantaged Communities, reducing both costs and emissions in those communities. Reducing fossil gas combustion in buildings results in improved indoor air quality and healthier living spaces.
- Diverting organics and capturing methane from landfill facilities in Disadvantaged Communities reduces landfill odors that significantly impact the quality of life and pose potential health impacts for those communities. Waste reduction and increased recycling will reduce waste hauling and related emissions.
- Alternative manure management strategies in the agricultural sector can help prevent excessive ammonia, hydrogen sulfide, methane, and nitrous oxide emissions in rural Disadvantaged Communities.

Collectively, implementation of these and other recommendations will ensure substantial reductions of GHGs and harmful co-pollutants in communities overburdened with harmful pollution. In addition, State agencies will vigorously apply Section 7(3) of the Climate Act to prioritize reductions of GHG emissions and co-pollutants in Disadvantaged Communities in their programs and policies. Coordinated guidance for agencies is necessary to ensure Section 7(3) is applied effectively and consistently in agency decision making. State agencies will also prioritize compliance with the Climate Act's investment provision, which establishes a requirement to invest 35%, with a goal of 40%, of clean energy and energy efficiency investments for the benefit of Disadvantaged Communities.[50]

## 6.4 Barriers and Opportunities Report

Pursuant to Section 6 of the Climate Act, to ensure that the material benefits of mitigating and adapting to climate change are realized in Disadvantaged Communities, DEC is working with NYSERDA, NYPA, other State agencies, the Council, and the CJWG to prepare a report on barriers to and opportunities for access to and/or community ownership of several services and commodities in Disadvantaged Communities:

- Distributed renewable energy generation
- Energy efficiency and weatherization investments
- Zero-emission and low-emission transportation options

[50] ECL § 75-0117.

- Other services and infrastructure that can reduce risks associated with climate-related hazards including but not limited to shelters and cool rooms during extreme heat events, shelters during flooding events, and medical treatment for asthma and other conditions that could be exacerbated by climate-related events

The report framework was developed through agency input and secondary research on barriers and opportunities related to these services and commodities. The report team is using the knowledge, experience, and networks of the interagency team to refine examples of services, commodities, and models to explore within the research. Robust public input is essential to ensure that the report is responsive and reflects the needs all New Yorkers, particularity those who live or work in historically overburdened and under-resourced communities. Public input has been gathered through eight small group discussions focused on specific topic areas covered by the report. Public input on the development of the report was gathered at two public hearings in November 2021. The report is expected to be released by January 1, 2022. After consultation with the Council, the final Scoping Plan will include recommendations from the report. Climate Act implementation reporting will include an assessment of Disadvantaged Communities' access to the services and commodities covered by this report.

# Chapter 7. Just Transition

As the State continues the implementation of the Climate Act, which demands a transition away from traditional energy sources and industries, New York will ensure this is a just transition. A just transition is one that builds connections, creates opportunity, and ensures a good quality of life for New Yorkers from all different walks of life. The JTWG was convened by the Council, as required by Section 75-0103(8) of the ECL. The Climate Act specifically requires the JTWG to advise the Council on various issues related to workforce development and opportunities, advise on potential impacts of carbon leakage risk to New York industries and communities, identify sector specific impacts, and identify electric generating sites that may be closed as a result of a transition to a clean energy sector, including the issues and opportunities that are presented by reuse of those sites.[51] The JTWG presented this information to the Council on April 12, 2021, and it is published on the State's Climate Act website. Additional materials are included in Appendices C, D, and E. The Climate Act requires this Plan to include recommendations to aid in the transition of the State workforce and rapidly emerging clean energy industry, which is discussed below.

## 7.1 Just Transition Principles

The JTWG's just transition principles, shown in Table 2, were developed to serve as a guide for Advisory Panel recommendations with the acknowledgement that each may have different applicability depending on economic sector. The principles have been developed to support a fair and equitable movement from fossil fuel-based economies toward the achievement of the carbon neutral future envisioned by the Climate Act. The Climate Act presents economic development opportunity for the State and its communities. Accordingly, the principles were also defined with local, regional, and statewide job creation and workforce development in mind.

[51] ECL § 75-0103(8)(a)-(f).

**Table 2. Just Transition Principles**

| Category | Principle Language |
|---|---|
| Stakeholder-Engaged Transition Planning | Engage a diverse range of stakeholders via early, inclusive engagement in communities' transitions to local low-carbon economies, including New York's workforce and the State's Disadvantaged Communities. |
| Collaborative Planning for a Measured Transition Toward Long-Term Goals | Encourage collaborative State and community-based long-term planning, capacity building, and robust social dialogue in order to ensure a gradual and supported transition. |
| Preservation of Culture and Tradition | Ensure that transition plans, policies, and programs reflect and respect local wisdoms, cultures, and traditions, including recognition of indigenous sovereignty. |
| Realize Vibrant, Healthy Communities Through Repair of Structural Inequalities | Seek to lift up New Yorkers in the transition to a low-carbon economy by implementing transition policies and programs that promote cross-generational prosperity and gender and racial equity, in recognition of the disproportionate burden of environmental pollution and climate change on Disadvantaged Communities. |
| Equitable Access to High Quality, Family-Sustaining Jobs | Promote the creation of high-quality, family-sustaining jobs, including union jobs, and ensure that new jobs are created in transitioning and Disadvantaged Communities, connecting workers to employment opportunities through career services, skills training, and infrastructure investments. |
| Redevelopment of Industrial Communities | Promote diversified, strengthened economies in the transition to a low-carbon economy, examine opportunities for community-centered ownership structures, and promote industry recovery, retention, and growth for regions and sectors in transition. |
| Development of Robust In-State Low-Carbon Energy and Manufacturing Supply Chain | Develop a robust in-State low-carbon supply chain, spanning full product lifecycles, to increase focus on exporting low- and no-carbon products and to ensure that jobs in these emerging sectors become more accessible to the local workforce and to Disadvantaged Communities. |
| Climate Adaptation Planning and Investment for a Resilient Future | Integrate climate adaptation into transition planning, including through promotion of community resilience and investment in sustainable infrastructure. |
| Protection and Restoration of Natural and Working Lands Systems & Resources | Promote the restoration, conservation, and resiliency of the State's agricultural and natural systems, improving local food security and supply and fostering healthy ecosystems, particularly in Disadvantaged Communities through sustainable land and natural resource use. |
| Mutually-Affirming Targets for State Industrialization & Decarbonization | Implement decarbonization policies that simultaneously bolster industry retention and sustainable economic development and growth and ensure that economy-wide programs and policies address the social, environmental, and economic challenges of workers and communities in transition. |

## 7.2 Workforce Impacts and Opportunities

Achieving a just and equitable transition will generate numerous opportunities for New York's existing and emerging workforce. Since the Council's JTWG and seven multi-sector Advisory Panels were launched, representatives from public, private, academic, environmental, and community groups; labor unions; environmental justice communities; impacted industries; and renewable energy developers have met on several occasions to debate and analyze the impacts of transitioning to clean energy on the labor

market. Together, the JTWG and the Council's Advisory Panels have identified the following recommendations to help ensure that New York's workforce is prepared for and stands to benefit from the State's transition to a clean economy.

### *Direct Displaced Worker Support*

New York's transition toward a cleaner, greener power grid will create new opportunities for economic success in communities that have historically relied on fossil fuel power plants. As New York leaves fossil fuels behind, some power plants will inevitably be forced to close. To mitigate any economic impact and ensure that current and formerly employed power plant workers benefit from the transition to clean energy, it is imperative to support displaced workers as much as possible and early on. This means establishing continuing education, Registered Apprenticeships, certifications, and licensing in trades and professions for current workers and supporting companies in transitioning their workforce to building operations and maintenance, design, construction, and other clean energy jobs. Consideration should be given to businesses and jobs not only in installation, but also in manufacturing and the entire supply chain. Engagement with clean energy providers will be important to evaluating current and future workforce needs, aligning training with business demand, including by geographical area and, ultimately, developing a successful talent pipeline.

In cases when continued operation of a power plant is needed, even as it winds down, efforts should focus on retaining workers while retraining them for new, clean energy jobs. In other cases, when facility closures are known ahead of time, training and supportive services should be implemented while individuals are still working to prepare workers for the transition to clean energy. Areas identified to support fossil fuel workers include securing wage support and setting aside a fund for on-the-job training, providing resume writing support and career coaching, and hosting job fairs with relevant clean energy employers, while also leveraging opportunities at dual-commodity utilities. Where business interests align, decarbonization-related roles should be leveraged. Surveys may also be a useful tool to identify power plant workers' career status, future interests, timing needs, and other considerations.

Distinct strategies and responses must be developed for key existing traditional energy sectors, namely electric power generation, transmission, distribution, storage fuels, and motor vehicles. In electric power generation, displaced power plant workers should be supported through retraining, retention, early retirement/pension support, and mutual aid/work agreements. One option might be to require a cost share by plant owners while distinguishing between workers and executives. In the transmission, distribution, and storage sector, natural gas utility workers are supported by PSC rules to retrain for roles on the

electric side of dual utilities (supported by cost recovery), with specific wage floors and protections. In the fuels industry, it will be important to address changes to businesses. Finally, greater attention must be paid to addressing the shift in work for other sectors that are central to the transition to a low-carbon economy, for example automotive workers and service technicians as internal combustion engines are replaced with electric vehicles (EVs).

### *Evaluation of Labor Standards*

As New York continues to work toward the Climate Act mandates and the overall energy landscape changes, labor standards should be further evaluated and enhanced to promote family sustaining wages and comprehensive benefits, as well as employer-led pre-apprenticeship and Registered Apprenticeship training, thereby supporting the development of pathways into good-paying jobs. Where appropriate, feasible, and permitted by law, project labor and community workforce agreements, as well as local and targeted hiring provisions, should be explored, particularly to incentivize the hiring of workers from Disadvantaged Communities, including environmental justice and New York opportunity zones. Enacting fair pay provisions will be particularly important in ensuring that new, clean energy jobs pay as well as former or existing jobs. Prevailing wage and project labor agreements, as well as the use of Registered Apprenticeship programs, can help ensure that jobs turn into long-term careers for New York residents that live in the local communities hosting renewable industries.

### *Targeted Financial Support for Businesses*

To build a diverse, equitable, and inclusive clean energy economy, businesses must be supported with targeted financial support to ensure access to contracting and procurement opportunities in the transition away from fossil fuels. Funding must provide for supported on-the-job, recruitment, training, hiring, and job retention for Disadvantaged Communities, minority- and women-owned businesses (MWBEs), service-disabled veteran-owned businesses (SDVOBs), employee-owned businesses, cooperatives, design and installation firms, community-based organizations, and start-ups. Concurrently, manufacturing of clean energy components and equipment must be promoted locally to stimulate the economy and increase job growth. Government support must target efforts both specific to clean energy technologies and to affected regions. The focus must be on creating stable, well-paid jobs as opposed to takeover by out-of-State workers in the “gig” economy. Entrepreneurship training and small business startup support could further increase small business creation and ownership in climate adaptation and resilience products and services, particularly by MWBEs and SDVOBs.

### *Training Curriculum and Programs*

New training curricula and programs will be critical to this economy-wide transition. These programs must be developed with a focus on Disadvantaged Communities. NYSERDA's Climate Justice Fellowship is one example of a program that will fund fellows from Disadvantaged Communities to advance climate justice and clean energy in their respective communities. Additional efforts should target education outreach and clean energy training at traditional education channels such as K-12 schools, Pathways in Technology Early College High Schools, Boards of Cooperative Education Services, local labor unions, community colleges, and 4-year colleges and universities. Some of the most successful education outreach programs feature ambassador programs, mentoring, job shadowing, science fairs, career days, guest speakers, and work site visits to generate excitement around clean energy and expose students to different career pathways early on. General science, technology, engineering, and mathematics programming should be expanded to include clean energy content leading to industry-recognized certificates, advanced training, internships, Registered Apprenticeship, and job placement. Within community and 4-year colleges and universities, the State should support the development of decarbonization curricula by qualified subject matter experts and training entities for the fields of engineering, architecture, construction, and related programs. Collaborations with professional organizations and for-profit training groups can further be beneficial in developing training programs and scaling them statewide.

### *Comprehensive Career Pathway Programs*

The State must develop comprehensive programs to develop career pathways into clean energy for both existing and future workers. Existing workers include workers from transitioning fossil fuel, clean energy industries, manufacturers, community-based organizations, MWBEs, SDVOBs, as well as State/public workers. Existing workers must be given access to technical skill development (upskilling) based on the most current, nationally recognized curricula and state-of-the-art labs and training equipment. This includes training on energy efficiency, building electrification, healthy homes/buildings in coordination with adjacent industries that work in homes. Working with unions will be crucial to incorporating renewable energy and decarbonization training into existing and new Registered Apprenticeship programs. Additionally, workers must be provided with opportunities for career advancement, including management and leadership training. Future workers are new entrants (primarily entry-level) to clean energy, often young adults (16-to-24-years of age) with high school degrees whose success depends on workforce development programs such as Youth Build and Job Corps, pre-apprenticeships, internships, and jobs with clean energy employers. Career awareness and supportive services are key to ensuring job placement and retention, particularly for members of Disadvantaged Communities and other segments of

the population who may be underrepresented (such as women, single parents, and formerly incarcerated individuals). Technical skills should further be complemented by professional skills, such as communication, leadership development, and workplace etiquette to ensure long-term success. Climate Justice Job Corps Fellowships for both entry-level and transitioning workers, as well as employer-sponsored on-the-job and Registered Apprenticeship programs, can serve as meaningful pipeline to good-paying clean energy careers.

### *Community Engagement, Stakeholder Input, Market Assessments*

Finally, it is imperative to continue stakeholder engagement to identify and assess industry skills gaps, employee demand, as well as curriculum and training needs. Open dialogue among relevant stakeholders will be key to sharing needs and best practices, support industry opportunity awareness, and enhance recruitment efforts for new, transitioning, and existing workers. Particular attention must be placed on fossil fuel workers to understand and leverage transferrable skills with complementary training in both energy and non-energy roles. Additionally, the needs of people in frontline communities, indigenous community members, formerly incarcerated New Yorkers, women in non-traditional trades, immigrants, and people transitioning from unemployment must be prioritized. Strategies must be in place to reach underrepresented communities and to include them in the development of clean energy policies, strategies, and solutions; ensuring their voices are not only heard but also drive the successful achievement of New York's clean energy future. These strategies include campaigns to build public awareness of climate change effects and solutions, including co-benefits of actions to mitigate and adapt to climate change through public calls for ideas and projects to advance Climate Act requirements in Disadvantaged Communities.

### *General Considerations*

As the State of New York and the world at large adapts to a new reality in the wake of COVID-19, workforce development and training initiatives will also be required to adjust. Flexibility and resilience are two important characteristics of successful workforce training models, enabling online and in-person training with courses offered in multiple languages and at different times to accommodate various health, safety, and learning needs. The most effective workforce development efforts further combine robust diversity, equity, and inclusion initiatives; generous wraparound services; and relevant safety training (such as the Occupational Safety and Health Administration and EPA) as applicable. To the extent possible, training entities should leverage State, federal, or other funding to cover training and education costs and, thereby, eliminate barriers for both employers and individuals. Collaboration among relevant State entities, such as NYSERDA, City University of New York, State University of New York (SUNY),

NYPA, ESD, and New York State Department of Labor (DOL) will be critical in ensuring an "all government approach" to designing, implementing, and resourcing the above-referenced workforce development and training efforts.

## 7.3 Measures to Minimize the Carbon Leakage Risk and Minimize Anti-Competitiveness Impacts

In its transition to a net zero emission economy, the State must also consider the issue of GHG emissions "leakage." Under the Climate Act, leakage is defined as, "a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside of the state."[52] The concept of leakage is important given the fact that climate change is a global problem, whereas the State's policy authority is confined to activities within its borders. New policies that increase the cost of energy, reduce the reliability of energy, or increase the cost of emitting GHGs could cause businesses to shift their production outside of New York State, or avoid the State altogether, and instead invest in out-of-State locations with lower energy cost and/or less stringent environmental and GHG emission reduction policies. Mitigating leakage risk is of interest to the State for both climate and economic reasons, which is further demonstrated by the Climate Act requirements related to mitigating anti-competitive impacts and for the emission reduction regulations ultimately adopted by DEC to incorporate measures to minimize emissions leakage.

As the State implements this draft Scoping Plan, it will need to carefully monitor the potential for unintended emission and economic leakage. The following are potential measures to mitigate the risk of leakage. A more detailed analysis related to the risk of leakage and the mitigation measures can be found in Appendix C.

- **Recognize Early Action:** The State should credit emitters for early investments to reduce their GHG emissions. The absence of early action credit could discourage short-term emission reductions by firms as they await the onset of a new system and the establishment of their baseline.
- **Set Industry-Specific Benchmarks:** If assigning emission reduction targets to individual emitters, the State should apply benchmarks for the emissions intensity of their production, taking into account current technology and types of emissions and adjusting them over time to reduce the risk of leakage caused by the imposition of infeasible reduction requirements.

[52] ECL § 75-0101(12).

- **Utilize Market Forces:** The State should consider measures to financially incentivize emission reductions while also providing emitters with compliance methods intended to mitigate leakage, increasing the cost-effectiveness of reducing emissions, such as through a cap-and-trade program.

## 7.4 Principles

Climate change will have vast and varied impacts on public health and is already affecting the people of New York and its resources. New York continues to make progress on its goal to becoming the healthiest State through continued implementation of the New York State Prevention Agenda[53] and recent adoption of the Health Across All Policies approach.[54] The Prevention Agenda is the State health improvement plan, the blueprint for State and local action to improve the health and well-being of all New Yorkers and promote health equity, based on several cross-cutting principles.

**Cross-Cutting Principles of the Prevention Agenda**

To improve health outcomes, enable well-being, and promote equity across the lifespan, the Prevention Agenda has several cross-cutting principles:

- Focuses on addressing social determinants of health and reducing health disparities
- Incorporates a Health Across All Policies approach
- Emphasizes healthy aging across the lifespan
- Promotes community engagement and collaboration across sectors in the development and implementation of local plans
- Maximizes impact with evidence-based interventions for State and local action
- Advocates for increased investments in prevention from all sources
- Concentrates on primary and secondary prevention, rather than on health care design or reimbursement

Embodiment of these principles is critical for developing a successful climate policy. The Climate Act provides a foundation that incorporates these principles in that it requires consideration of impacts to public health and Disadvantaged Communities, as well as mitigation actions that will address health impacts. This draft Scoping Plan goes further, identifying specific opportunities to reduce emissions, support communities, reduce existing health risks, and avoid introducing new risks. This chapter seeks to

[53] New York State Department of Health. 2019. Prevention Agenda 2019-2024 New York State's Health Improvement Plan. Albany. Accessed at https://www.health.ny.gov/prevention/prevention_agenda/2019-2024/.

[54] New York State Department of Health, "Health-Across-All-Policies Initiative Launched to Support the Prevention Agenda Goal of Becoming the Healthiest State," Accessed on November 23, 2021, https://www.health.ny.gov/prevention/prevention_agenda/health_across_all_policies/.

describe both the direct and indirect human health impacts of climate change and the health co-benefits of climate change mitigation and adaptation strategies and policies.

## 7.5 Power Plant Retirement and Site Reuse

On the road to achieving the power sector goals within the Climate Act—namely, to achieve 70% renewable electricity by 2030, and 100% zero-emission electricity by 2040—the existing power sector will undergo significant evolutions and transformations, leading to uncertain outcomes for conventional power plants (primarily fossil fuel) and their workers and host communities. These impacts were contemplated by the Climate Act as something New York would have to proactively plan around: specifically, the Climate Act tasked the JTWG with two discrete deliverables, which the Group considered with the leadership of a Subgroup formed specifically to tackle these power plant topics. The two power plant tasks contained in the Climate Act include identifying generation facilities that "may be closed as a result of a transition to a clean energy sector" and identifying issues and opportunities presented by the reuse of those sites.

The JTWG, with the help of a Power Plants Subgroup, set about to tackle these two tasks with a robust, data-driven approach rooted in real-world case-studies and the "facts on the ground" as much as possible, while acknowledging that future scenarios would not be known and fixed. These full work-products are made available in Appendix D, with results making clear that power plant reuse is an area where there are both challenges as well as promises of opportunity moving forward.

## 7.6 Jobs Study

In accordance with the Climate Act, the JTWG also provided oversight to a Jobs Study, serving to forecast clean energy job growth tied to the State's decarbonization goals, with the following specific objectives:[55]

- The number of jobs created to counter climate change, which shall include but not be limited to the energy sector, building sector, transportation sector, and working lands sector;
- The projection of the inventory of jobs needed and the skills and training required to meet the demand of jobs to counter climate change; and
- Workforce disruption due to community transitions from a low-carbon economy.

[55] ECL § 75-0103(8)(g).

The Jobs Study team leveraged its modeling framework and analysis to better understand and characterize job requirements and how those requirements can be constructed into workforce training and development pathways, including for priority populations and Disadvantaged Communities.

### *Summary of Jobs Study Findings*

As stated above, the Climate Act tasked the JTWG with conducting a study of the jobs needed to counter climate change, with explicit direction to focus on the buildings, fuels, electricity, transportation, and natural working lands sectors. A competitive process was established to select a team of leading consultants in the field of clean energy workforce to undertake this new analysis to accompany and complement the integration analysis work.

The Jobs Study team—BW Research, NYSERDA, DOL, and members of other State agencies including DEC, ESD, DOS, NYPA, and Long Island Power Authority (LIPA)—conducted and supported a rigorous literature review to derive the analytical framework and methodology deployed to this analysis. Further, the Jobs Study team qualified and calibrated its analytical model by benchmarking its outputs against other modeling frameworks that have been previously validated. The Jobs Study focuses its analysis on a baseline year of 2019 and provides data outputs in five-year increments through 2050 (i.e., 2019, 2025, 2030, 2035, 2040, 2045, and 2050).

Grounded by projected investments in the State's clean energy economy, the Jobs Study focuses on the opportunity to create jobs associated with New York's decarbonization pathways. Currently, the Jobs Study does not provide additional sensitivity analysis nor does it articulate the potential for low-carbon, export-oriented economic development; nonetheless, that opportunity represents a potentially significant additional upside in an emerging global marketplace much greater in size than New York. The Jobs Study modeling framework comprised energy supply and energy demand represented by four primary sectors (electricity and fuels, for energy supply) and (buildings and transportation, for energy demand). Further, a total of 28 subsectors were included in the modeling framework and analyses.

The following key highlights from the Jobs Study are presented as evidence of the significant growth anticipated over the next 30 years:

- Across 21 subsectors, total employment increases by over 60% from 2019 to 2030, adding at least 211,000 new jobs in the state of New York. Just seven subsectors experienced displacement of 22,000 jobs, or 14%, in this time period. Overall employment in the four primary sectors increases by at least 189,000 jobs from 2019 to 2030, or a 38% increase in the workforce. The

number of jobs added from growing subsectors outnumbered jobs lost in displaced subsectors by a ratio of approximately 10 to one.

- Overall employment in the four primary sectors from 2019 through 2050 increased by at least 268,000 jobs, or a 54% increase in the workforce.
- The buildings sector accounted for well over half of all jobs added in growing subsectors from 2019 to 2030, with the most sizeable increases in added jobs found in the residential HVAC and residential shell subsectors. This finding indicates the need to expand the residential and commercial building workforce training considerably before 2030 to meet the expected need.
- Conventional fueling stations (gas stations) account for over one-third to almost one-half of all displaced jobs in the primary sectors from 2019 to 2030, as more drivers shift to lower-cost charging of electric vehicles. This finding indicates that traditional fueling stations will likely need to adapt beyond providing gasoline for cars to avoid diminishing opportunities for revenue and employment.
- In the electricity sector, more mature subsectors like transmission, distribution, and solar will see strong growth between 2019 and 2040, while more nascent subsectors like offshore wind, storage, and hydrogen are expected to experience exponential growth. This finding indicates that parts of the growing electricity sector will be able to build upon their current established workforce, while other parts of this sector will almost need to start from the beginning because they have little if any existing workforce foundations.

The Jobs Study also provides an estimate of how jobs will change from 2019 to 2030, by industry, occupation, wages, and geography across the state of New York, under both modeled scenarios, in the four primary sectors. All the major industry categories for the Jobs Study, which include construction, professional services, manufacturing, and other supply chain, saw a net increase of employment in the four primary sectors.

The largest net employment increases were found in the construction and manufacturing industries. In the growth subsectors, over three-quarters of total added jobs will be found in the construction industry. In the displaced subsectors, over four out of five industry jobs lost will be found in the other supply chain industries, which include transportation and warehousing, utilities, wholesale, and retail industries.

Additional key findings include the following:

- Geographically, the net job increases from 2019 to 2030 are found in every corner of the state, with each of New York's five regions seeing an increase of between 10,000 and 48,000 net new

jobs. This finding indicates that each of the regions should prioritize workforce development efforts and training to supply a well-prepared labor force for these growing positions.

- Occupationally, the largest job increases from 2019 to 2030 will be found in installation and repair occupations. They are expected to account for almost two-thirds of added jobs in the growth subsectors. This finding indicates that additional research should probably be done to understand the education and training resources that lead into these positions and the different career paths that can be found in this category of occupations.
- Though there is clear growth in job opportunities at all parts of the income spectrum, the wage profile of jobs in the four sectors—energy, building, transportation, and working lands—shows the largest increase from 2019 to 2030 in middle wage positions ($28 to $37 an hour),[56] while high wage (>$37 an hour) and low wage positions (<$28 an hour) grow at slower rates. This finding goes against national and statewide trends that have seen middle wage positions decline over the last 50 years.

The full findings of the JTWG Jobs Study can be found at .

[56] Boehm, Michael. February 8, 2014. "Job polarization and the decline of middle-class workers' wages." *Vox EU.* https://voxeu.org/article/job-polarisation-and-decline-middle-class-workers-wages
and
Chicago Metropolitan Agency for Planning. May 25, 2018. *Technology, Tastes, and Demographic Shifts Contribute to Job Polarization in the U.S.* Accessed at https://www.cmap.illinois.gov/updates/all/-/asset_publisher/UIMfSLnFfMB6/content/technology-tastes-and-demographic-shifts-contribute-to-job-polarization-in-the-u-s-.

# Chapter 8. Public Health

## 8.1 Climate Change Impacts on Public Health

Climate change directly and indirectly impacts physical, social, and mental health and will intensify some health stressors and cause other new health threats to emerge. Possible health impacts are far-reaching, even if not all are equally likely to occur among New Yorkers in the immediate future.

This year, COP26 emphasized public health more than ever before and referred to Climate Change as a "public health emergency."[57] Recently, the editors of over 200 medical journals united to issue a call for urgent government action to address global warming and protect public health and nature.[58] NYSERDA's ClimAID report describes the impacts and adaptation strategies for New York's water resources, coastal zones, ecosystems, agriculture, energy, transportation, and telecommunications sectors, as well as vulnerabilities and adaptation strategies related to climate change and public health. According to the New York State Department of Health (DOH) Climate and Health Profile[59] there are several potential climate-related health impacts in the State:

- Increased heat stress (such as heat edema, heat stroke, heat cramps, heat stress, and dehydration) and other heat-related morbidity and mortality
- Exacerbation of respiratory conditions (including pneumonia, asthma, and chronic obstructive pulmonary disease) and cardiovascular disease
- Increased risk for food- and water-borne diseases due to increasing temperatures and flooding
- Increased duration and severity of allergy symptoms due to increased duration and intensity of pollen season
- Increased risk for vector-borne diseases (such as Lyme disease, West Nile virus, and other pathogens)
- Increased risk of injury and death following extreme precipitation events and flooding

Other significant impacts associated with public health that are not listed above include droughts, rising sea levels that threatening infrastructure, saltwater intrusion of our groundwater resources (which may

[57] Romanello, M. et al. 2021. The 2021 report of the *Lancet* Countdown on health and climate change: code red for a healthy future. The Lancet. 398(10311): 1619-1662.

[58] "Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health" see for example the *New England Journal of Medicine* September 5, 2021.

[59] DOH. 2015. Building Resilience Against Climate Effects (BRACE) – Climate and Health Profile. Accessed at climatehealthprofile6-2015.pdf (ny.gov).

impact drinking water supplies), poor indoor air quality (such as mold and moisture), and deteriorating outdoor air quality, particularly ground-level ozone that increases with rising temperature.[60] Climate change will add uncertainty to the continuity of the food system, which may have impacts on food security, particularly in low-income communities.[61] Heatwaves and extreme heat events result in greater risk of heat stress.[62] Heavy rainfall associated with the remnants of Hurricane Ida resulted in flooded subways and drowning deaths in basement apartments and cars. Superstorm Sandy resulted in the deaths of 44 New York City residents and caused $19 billion in damages (see *Chapter 2. The Time is Now to Decarbonize Our Economy*).[63] These kinds of extreme weather events have been associated with anxiety and post-traumatic stress disorder. Some populations are more vulnerable to certain climate and health impacts than others, whether due to demographic factors, socioeconomic status, physiological condition, place, or occupation. Many impacts of climate change disproportionally affect Disadvantaged Communities.

In New York, as well as other parts of the U.S., significant disparities in health outcomes exist for certain groups by age, race, ethnicity, and socioeconomic status. Disparities are observed in life expectancy and rates of diabetes, cancer, heart disease, asthma, infant mortality, and low birth weight.[64,65,66] Cardiovascular disease is the leading cause of death nationally and in New York.[67] Research studies have shown an association between exposure to air pollutants, which are released through combustion of fossil

[60] Stowell, Jennifer D., et al. "The impact of climate change and emissions control on future ozone levels: Implications for human health." Environment International 108 (2017): 41-50.

[61] USDA. 2015. Climate Change, Global Food Security, and the U.S. Food System. Accessed at https://www.usda.gov/sites/default/files/documents/FullAssessment.pdf.

[62] DOH, "About Heat Stress," DOH, Accessed at https://www.health.ny.gov/statistics/environmental/public_health_tracking/about_pages/heat_stress/about_hs.

[63] Centers for Disease Control and Prevention. Health concerns associated with mold in water-damaged homes after Hurricanes Katrina and Rita--New Orleans area, Louisiana, October 2005. MMWR Morb Mortal Wkly Rep. 2006 Jan 20;55(2):41-4. PMID: 16424858.

[64] CDC. Health Disparities and Inequities Report, United States. Morbidity and Mortality Weekly Reports. January 14, 2011.

[65] Insaf TZ, Talbot T. Use of Spatial Epidemiology in Identifying Areas at Risk of Low Birth Weight: Small Area Surveillance Study. Preventive Medicine 2016, 88:108–114; doi: https://doi.org/10.1016/j.ypmed.2016.03.019.

[66] DOH. New York State Minority Health Surveillance Report: Public Health Information Group. 2007. Accessed at http://www.health.state.ny.us/statistics/community/minority/docs/surveillance_report_2007.pdf.

[67] DOH. Vital Statistics of New York State: 2018 Tables. Accessed at https://apps.health.ny.gov/public/tabvis/PHIG_Public/lcd/reports/#state.

fuels, and increased hospitalization rates and mortality from cardiovascular disease.[68,69,70,71] Nationally and in New York, there are disparities in heart disease mortality and stroke mortality by race. Rates are highest in Black non-Hispanics among all race and ethnic groups.[72,73] Hospitalization rates for heart disease are also highest in Black non-Hispanics.[74] In addition to cardiovascular disease, asthma is a major health problem nationally and in New York. Asthma is a multifactorial disease that has many contributing causes. This includes four components of air pollution, ozone, sulfur dioxide ($SO_2$), $NO_X$, and PM that are known to exacerbate asthma and to cause eye and respiratory tract irritation, cough, shortness of breath, and reduced lung function.[75,76,77,78,79,80] Asthma hospitalization rates in New York are higher in low-income areas than in higher income areas.[81,82] Asthma surveillance in New York has shown that the age-adjusted asthma emergency department visit, hospital discharge and mortality rates were higher among

[68] He, M.Z., Do, V., Liu, S. et al. Short-term PM2.5 and cardiovascular admissions in NY State: assessing sensitivity to exposure model choice. Environ Health 20, 93 (2021). https://doi.org/10.1186/s12940-021-00782-3.

[69] Brook, Robert. Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science for the American Health Association. Circulation: Journal of the American Health Association. 109:2655-2671. 2004.

[70] Al-Kindi, S.G., Brook, R.D., Biswal, S. et al. Environmental determinants of cardiovascular disease: lessons learned from air pollution. Nat. Rev Cardiol 17, 656–672 (2020). https://doi.org/10.1038/s41569-020-0371-2.

[71] World Health Organization. Regional Office for Europe. (2018). Environmental noise guidelines for the European Region. World Health Organization. Regional Office for Europe. Accessed at https://apps.who.int/iris/handle/10665/279952.

[72] DOH. New York State Minority Health Surveillance Report. 2012. Accessed at https://www.health.ny.gov/statistics/community/minority/docs/surveillance_report_2012.pdf.

[73] CDC. CDC Health Disparities and Inequalities Report. 2011. Accessed at https://www.cdc.gov/minorityhealth/chdir/2011/chdir2011.html.

[74] CDC. CDC Health Disparities and Inequalities Report. 2011. Accessed at https://www.cdc.gov/minorityhealth/chdir/2011/chdir2011.html.

[75] US. EPA. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2019). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-19/188, 2019.

[76] Guarnieri M, Balmes JR. Outdoor air pollution and asthma. Lancet. 2014;383(9928):1581-1592. doi:10.1016/S0140-6736(14)60617-6.

[77] EPA. 2004. Air Quality Criteria Document for Particulate Matter.

[78] Burnett, Richard, et al. "Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter." Proceedings of the National Academy of Sciences 115.38 (2018): 9592-9597.

[79] Samet, M., Jonathan. The National Morbidity, Mortality, and Air Pollution Study. Part II: Morbidity and Mortality from Air Pollution in the United States. Research Report Health Effects Institute. 2000. 94(pt 2):5-70, 71-79.

[80] Gauderman, W. James. Association between Air Pollution and Lung Function Growth in Southern California. American Journal of Respiratory Critical Care Medicine. 2000. 162(4Pt1):1383-1390.

[81] Lin, Shao, Fitzgerald, Edward, Hwang, Syni-An. Asthma Hospitalization Rates and Socioeconomic Status in New York State 1987-1993. Journal of Asthma. 2002. 36:239-251.

[82] DOH. New York State Asthma Surveillance Summary Report. 2013. Accessed at https://www.health.ny.gov/statistics/ny_asthma/pdf/2013_asthma_surveillance_summary_report.pdf.

non-Hispanic Black and Hispanic New Yorkers than non-Hispanic White.[83] For more detail, see the Appendix F.

Climate change mitigation and adaptation policies are crucial in reducing the public health impacts described above, particularly for vulnerable communities and Disadvantaged Communities, such as those that can be identified by the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry Social Vulnerability Index. DOH has worked to support public health adaptation efforts. For example, DOH's scientific research on the health effects associated with heat contributed to the National Weather Service lowering its Heat Advisory Threshold and led to the development of County Heat and Health Profiles, where users can view county temperature trends and projections, along with heat-related health effects and vulnerabilities.[84] DOH staff have worked with local partners to enhance awareness and accessibility to cooling centers during heat advisories.[85] DOH also identified populations that are vulnerable to extreme heat by developing a Heat Vulnerability Index. Studies have sought to increase awareness about climate impacts on health in New York,[86] and have explored associations between temperature and respiratory outcomes, cardiovascular outcomes, renal diseases, and birth defects. Additional studies have explored climate change trends in New York, impacts of air pollutants on health (which could assist in understanding co-benefits to improved air quality through climate policy), and impacts of specific events that could stem from extreme weather. The State could conduct additional studies to continue to increase its understanding of the health impacts of climate change and the health benefits of climate policy.

## 8.2 Considering Health in Climate Policy

The development of sound policy to mitigate GHG emissions and adapt to the changing climate will provide direct and indirect public health benefits. Direct benefits will result from mitigating GHG emissions and adapting to global climate change by reducing the many public health impacts associated

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[83] Lin, Shao, Fitzgerald, Edward, Hwang, Syni-An. Asthma Hospitalization Rates and Socioeconomic Status in New York State 1987-1993. Journal of Asthma. 2002. 36:239-251.

[84] Chow NA, Toda M, Pennington AF, et al. Hurricane-Associated Mold Exposures Among Patients at Risk for Invasive Mold Infections After Hurricane Harvey - Houston, Texas, 2017. MMWR Morb Mortal Wkly Rep. 2019;68(21):469-473. Published 2019 May 31. doi:10.15585/mmwr.mm6821a1.

Nayak SG, Shrestha S, Kinney PL, Ross Z, Sheridan SC, Pantea CI, Hsu WH, Muscatiello N, Hwang SA. Development of a heat vulnerability index for New York State. Public Health. 161:127-137. 2018.

[85] Nayak, Seema G., Srishti Shrestha, Scott C. Sheridan, Wan-Hsiang Hsu, Neil A. Muscatiello, Cristian I. Pantea, Zev Ross et al. "Accessibility of cooling centers to heat-vulnerable populations in New York State." Journal of Transport & Health 14 (2019): 100563.

[86] Insaf, T.Z., Lin, S., S.C. Sheridan. Climate trends in indices for temperature and precipitation across New York State, 1948-2008. Air Quality, Atmosphere & Health. 2013. 6(1): 247-257.

with climate change. Indirect health benefits will occur when initiatives to mitigate GHG emissions also result in other beneficial outcomes such as reducing air pollutant emissions (co-pollutants), encouraging active transport (such as walking and cycling), and reducing home health risks through building energy efficiency retrofit interventions. Improved air quality will reduce incidences of asthma and cardiovascular disease, and increased physical activity will reduce obesity and negative cardiovascular outcomes. Cardiovascular disease is the leading cause of death nationally and in New York, with almost 44,000 New Yorkers dying of cardiovascular disease every year. Asthma is a major health problem nationally, and in New York 1.4 million adults and 315,000 children suffer from this disease.[87]

State and federal government programs to control air pollutant emissions through regulations and permitting have contributed to greatly improved air quality in New York over the last 40 years (see Appendix F). Although the State currently complies with the requirements of, or is "designated attainment for," the National Ambient Air Quality Standards for the criteria pollutants carbon monoxide, lead, nitrogen dioxide ($NO_2$), and PM, substantial additional health benefits will be achieved through continued emission reductions. For $SO_2$, a small portion of St. Lawrence County has been designated as nonattainment. Nine counties, in which 65% of the State's population reside, are currently not in attainment for the 2015 ozone standard. Concentrations of non-criteria pollutants attributed to fuel combustion have also decreased significantly over the last decade, due in part to programs and regulations directed at reducing transportation source pollution, including the adoption of reformulated gasoline programs and improvements in vehicle emissions technology, the statewide adoption of the California Low Emission Vehicle program, and emission reductions from oil refineries and other stationary sources under federal and State air pollution control programs. Recent studies of long-term air quality trends in NYC demonstrate that enactment of local and regional clean air regulations, as well as changes in fuel usage (e.g., natural gas out-competing coal), significantly reduced ambient levels of PM. During this time, the sources of PM and the PM composition changed (i.e., reduction in sulfate but increased organic matter).[88,89]

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[87] Centers for Disease Control and Prevention, "Most Recent Asthma State or Territory Data," CDC, Accessed on November 23, 2021, https://www.cdc.gov/asthma/most_recent_data_states.htm.

[88] Blanchard *et al*. 2020. Accessed at https://www.tandfonline.com/doi/full/10.1080/10962247.2021.1914773?scroll=top&needAccess=true&.

[89] Pitiranggon *et al*. 2021. Accessed at https://www.sciencedirect.com/science/article/pii/S135223102100056X.

COVID-19 is one of the most significant emerging diseases of the 21st century. Air pollution, in particular $PM_{2.5}$, which is released during combustion, can exacerbate symptoms of respiratory illness.[90] Long-term exposure to $PM_{2.5}$ from the 2020 wildfires in Western United States, which are increasing in frequency due to climate change, has also been shown to increase the risk of death from COVID-19. Disadvantaged Communities, as defined in the Climate Act, are likely to have greater health disparities (or inequities) and shoulder more significant environmental burdens than other communities. Elevated levels of $NO_2$,[91] which can be a product of vehicle combustion emissions, among other sources, and are air pollutants associated with Disadvantaged Communities, are associated with higher rates of COVID-19 infection and higher rates of death.[92,93] By addressing climate change, we can decrease air pollution and reduce the effects pollutants have on respiratory illnesses, including COVID-19 infection, protect and improve health, and address underlying economic and social inequities using asset-based approaches.

## 8.3 Sector-Specific Health Co-Benefits of Climate Policies

In addition to the health impacts associated with climate change, the production, distribution, and use of carbon-based fuels can have many other health impacts. These impacts can arise from routine operations, accidents, and catastrophic events. Health impacts resulting from routine carbon-based fuel use and production can range from local to global in scale and examples include degradation of air quality due to the combustion of fossil fuels and accidents such as fires, fuel oil spills, natural gas pipeline explosions, and other occupational and nonoccupational accidents. Reduction of these impacts through GHG emissions reductions strategies results in health co-benefits. Some of these impacts are discussed in the sections below. Table 3 summarizes the human health effects that are associated with GHG emissions (climate change) and exposure to some air pollutants commonly associated with carbon-based fuel combustion.

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[90] Croft DP, Zhang W, Lin S, et al. The Association between Respiratory Infection and Air Pollution in the Setting of Air Quality Policy and Economic Change. Ann Am2 Thorac Soc. 2019;16(3):321-330. doi:10.1513/AnnalsATS.201810-691OC.

[91] Liu T, Mickley LJ, Cooper M, Dominici F. Excess of COVID-19 cases and deaths due to fine particulate matter exposure during the 2020 wildfires in the United States. Sci Adv. 2021 Aug 13;7(33):eabi8789. doi: 10.1126/sciadv.abi8789.

[92] Liang, D. Shi L., Zhao J., Liu P., Sarnat, J.A., Gao S., Schwartz J., Liu Y., Ebel S.T., Scovronick N., Chang, Urban H.H. 2020. Air Pollution May Enhance COVID-19 Case-Fatality and Mortality Rates in the United States, The Innovation, 1(3), https://doi.org/10.1016/j.xinn.2020.100047.

[93] Lipsitt J, Chan-Golston AM, Liu J, Su J, Zhu Y, Jerrett M. Spatial analysis of COVID-19 and traffic-related air pollution in Los Angeles. Environ Int. 2021 Aug;153:106531. doi: 10.1016/j.envint.2021.106531. Epub 2021 Mar 22. PMID: 33812043; PMCID: PMC7983457.

**Table 3. Health Effects Associated with Carbon-Based Fuel Combustion Pollutants**

| Air Pollutant | Human Health Effects |
|---|---|
| GHGs | Climate-related effects on morbidity and mortality (such as increased mold and pollen allergy incidence and severity, heat stress, heat-related mortality, vector-borne disease, injury, and death due to flooding) |
| Carbon monoxide[94] | Likely effects on existing cardiovascular disease |
| $NO_2$[95] | Respiratory effects |
| Ozone[96] | Respiratory effects |
| $PM_{2.5}$[97] | Cardiovascular effects and pre-mature mortality (cardio-pulmonary) |
| $SO_2$[98] | Respiratory effects |
| Metals[99] | Effects vary depending on specific metal |
| Polycyclic aromatic hydrocarbons[100] | Cancer (not all polycyclic aromatic hydrocarbons) |
| VOCs[101] | Effects vary depending on the specific chemical (some examples are central nervous system effects; liver or kidney toxicity; eye, skin, and respiratory tract irritation; and cancer) |

Many VOCs, such as toluene, can cause central nervous system effects, and some, like benzene, are carcinogens. In addition to VOCs and GHGs (discussed earlier), non-criteria pollutants that can be emitted from fuel combustion include chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans, polycyclic aromatic hydrocarbons, and various metals, particularly mercury from coal combustion. Exposure to high levels of chlorinated dioxins and furans is associated with cancer and effects on the liver and skin. Health effects associated with exposure to metals vary by the metal. For example, mercury, after being transformed to methylmercury in the environment and entering the food chain, can cause effects on the nervous system, especially for children and fetuses. Exposure to high levels of some polycyclic aromatic hydrocarbons is associated with lung cancer. Modeling changes in health outcomes associated

[94] EPA. EPA/600/R-019F/January 2010: Integrated Science Assessment for Carbon Monoxide, 2010.

[95] EPA. EPA/600/R-15-068/January 2016: Integrated Science Assessment for Oxides of Nitrogen – Health criteria, 2016.

[96] EPA/600/R-20/012, April 2020 U.S. EPA. Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants, 2020

[97] EPA. EPA/600/R-19/188, December 2019: Integrated Science Assessment (ISA) for Particulate Matter, 2019.

[98] EPA. EPA/600/R-17/451/December 2017.: Integrated Science Assessment for Sulfur Oxides- Health Criteria.

[99] Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services. Toxicological Profiles for Specific Metals. http://www.atsdr.cdc.gov/toxprofiles/index.asp.

[100] ATSDR. Toxicological Profiles for specific PAHs: http://www.atsdr.cdc.gov/toxprofiles/index.asp.

[101] ATSDR. Toxicological Profiles for specific VOCs: http://www.atsdr.cdc.gov/toxprofiles/index.asp.

with exposure to air pollutants can be helpful to inform policy, but modeling those for non-criteria pollutants is more challenging and uncertain.

### *Power Generation*

The transition in the power generation sector away from carbon-based fuel combustion to meet the requirements of the Climate Act will result in the same kinds of health co-benefits achieved through this transition across all sectors. However, there are health concerns specific to this sector, and they have been considered in the development of this Plan. The health risks associated with combustion emissions and combustion waste products are not associated with renewable power generation and will substantially decrease with large-scale reduction in combustion for power generation. Coal—a fuel with significant emissions and associated health impacts—has already been phased out in New York power generation following DEC's adoption of $CO_2$ emission limits for power plants, as part of 6 NYCRR Part 251. Although emissions from power plant stacks can travel great distances, power generation facilities also contribute to air quality impacts in nearby communities, including Disadvantaged Communities.

Health concerns associated with onshore generation of wind energy are limited. Physical safety concerns can be mitigated through the choice of appropriate minimum setbacks (the minimum allowable distances between turbines and roads, property lines, or structures). Annoyance,[102] associated with wind turbines producing characteristic sounds or noise as wind passes over the rotating blades, is a health effect according to the *Environmental Noise Guidelines for the European Region*, published by the World Health Organization in 2018.[103] Data indicates that noise from wind turbines may be more noticeable, annoying, and disturbing than other community or industrial sounds of the same level. Reviewing acceptable noise thresholds for wind turbine siting as scientific understanding evolves will be important as onshore wind energy is increasingly adopted.

Finally, there are emerging energy technologies that may pose new opportunities as well as new risks that have yet to be fully understood. Hydrogen combustion does not directly generate most combustion byproducts such as PM, thus conveying a potentially large health benefit, but does emit $NO_x$ (which are precursors to ozone, PM, and $NO_2$ formation) at levels that may be higher than those from natural gas combustion because of hydrogen's high combustion temperature. Opportunities to further reduce $NO_x$

[102] Noise annoyance is defined by the World Health Organization as a (long term) feeling of displeasure, nuisance, disturbance, or irritation caused by a specific sound.

[103] World Health Organization Regional Office for Europe. 2018. Environmental Noise Guidelines for the European Region. Copenhagen. Accessed at https://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf.

emissions from hydrogen combustion exist and need to be further studied. The combustion of renewable natural gas (RNG) is likely to result in pollutant emissions similar to fossil gas combustion.

While transitioning away from carbon-based energy sources, maintaining reliability of the energy system is crucial. Reliable electricity production is critical to maintain good public health in our energy-dependent society. Increasing the reliability of the electric grid can reduce health effects during high temperatures, when air conditioning is the principal means to prevent heat-related morbidity and mortality. During summer, power outages pose specific health-related impacts such as: (1) spoiled food and digestive tract illness; (2) spoiled vaccines; and (3) increased rodent populations as a result of discarded perishables.[104,105,106] Winter outages also pose specific risks to public health such as carbon monoxide.[107,108] Following a 2006 winter storm in Western New York, 264 people were diagnosed with carbon monoxide poisoning.[109] After Hurricane Sandy, 80 carbon monoxide poisoning cases were reported.[110,111] At least 57 deaths were attributed to this weather event, and there was over $195 million in property damage. By improving the reliability of the grid, the State can prevent millions of dollars in damages and prevent premature mortality.

### *Transportation*

Opportunities for health co-benefits associated with transportation sector climate policies include reductions in traffic noise and accidents and reductions in morbidity and mortality associated with improved air quality and increased availability and use of active transportation options. Transportation sector emissions are usually concentrated at the ground level, often in densely populated areas, resulting in a tendency toward higher levels of exposure for more people than emissions associated with other

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[104] Bell, K.N. Risk Factors for Improper Vaccine Storage and Handling in Private Provider Offices. Pediatrics. 2001. 107(6): art-e100.

[105] Marx, A. Melissa. Diarrheal Illness Detected Through Syndromic Surveillance after a Massive Power Outage: New York City, August 2003. American Journal of Public Health. 2006. 96:547-553.

[106] Beatty, Mark. Blackout of 2003: Public Health Effects and Emergency Response. Public Health Reports. 2006.

[107] Daley, W. Randolf. An Outbreak of Carbon Monoxide Poisoning after a Major Ice Storm in Maine. The Journal of Emergency Medicine. 2000. Vol. 18, No. 1, pp. 87–93.

[108] Muscatiello, Neil, Babcock, G., Jones. R., Horn, E., and Hwang, S.A. Hospital Emergency Department Visits for Carbon Monoxide Poisoning Following an October 2006 Snowstorm in Western New York. Journal of Environmental Health. 2010. Volume 72, Number 6, pages 43-48.

[109] Graber, Judith M. Results from a State-Based Surveillance System for Carbon Monoxide Poisoning. Public Health Reports. 2007. 122:145-154.

[110] Center for Disease Control and Prevention. Notes from the Field: Carbon Monoxide Exposures Reported to Poison Centers and Related to Hurricane Sandy - Northeastern United States. 2012 Morbidity and Mortality Weekly Report. 66(44);905-905.

[111] The University of Texas at Austin Energy Institute. 2021. The Timeline and Events of the February 2021 Texas Electric Grid Blackouts. Accessed at https://energy.utexas.edu/ercot-blackout-2021.

energy use sectors. Some of the co-pollutants emitted are associated with an increased risk of respiratory and cardiovascular effects, among others. Numerous studies have investigated the increased risk of these effects by looking at the relationship between traffic patterns and the distance from roadways and the associated pollutant concentrations and health endpoints. Studies have found associations between asthma exacerbation or emergency room visits for respiratory illness and transportation-related factors such as traffic proximity or traffic density[112] and diesel traffic density in particular.[113]

The recommendations for reducing single-occupancy vehicle travel and reducing gasoline and diesel use, discussed further in this Plan, could improve health outcomes. Transportation emissions have been concentrated in Disadvantaged Communities for generations and decarbonizing the transportation sector provides an opportunity to focus emission reductions in the communities that have historically been overburdened by pollution.[114] Additionally, transportation planning that uses Complete Streets policies ensures that considerations are made for the safety of all roadway users (pedestrians, bicyclists, public transportation users, and motorists). Not getting enough physical activity is a risk factor for diabetes and obesity (which are also risk factors for those with high blood pressure and a family history of these health risks). Almost 1.7 million New Yorkers (10.5%) had diabetes in 2016, and obesity has reached epidemic proportions with more than half (60.8%) of New York adults reported to be overweight or obese in 2016. Being obese or overweight is currently the second leading preventable cause of death in the United States and may soon overtake cardiovascular disease as the leading cause of death. Additionally, one-third of New York's children are obese or overweight. A reduction in the reliance on personal automobiles by incorporating smart growth and Complete Streets policies into transportation planning has the benefit of increasing opportunities for physical activity. In recent years, studies have begun to examine the relationship between neighborhood walkability and physical activity levels, body mass index, waist circumference, obesity, and hypertension. These studies have generally shown that neighborhood walkability is associated with increased physical activity and decreased body mass index, waist circumference, obesity, and hypertension.

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[112] Lin, S., Munsie, J.P., Hwang, S.A., Fitzgerald, E., Cayo, M.R.. Childhood Asthma Hospitalization and Residential Exposure to State Route Traffic. Environmental Research. 2002. Section A (88): 73-81.
Lwebuga-Mukasa, James S. Traffic Volumes and Respiratory Health Care Utilization among Residents in Close Proximity to the Peace Bridge Before and After September 11, 2001. Journal of Asthma. 2003. 40(8): 855-864.
Kim, Janice. Residential Traffic and Children's Respiratory Health. Environmental Health Perspectives. 2008. 16(9):1274-9.

[113] McCreanor, James. Respiratory Effects of Exposure to Diesel Traffic in Persons with Asthma. New England Journal of Medicine. 2007. 357(23):2348-58.

[114] New York State Department of Transportation, "Complete Streets," Department of Transportation, Accessed on November 23, 2021, https://www.dot.ny.gov/programs/completestreets.

Health risks associated with transportation emissions can be reduced with a shift toward technologies that do not rely on carbon-based fuels and the enhancement of public transportation systems and other low-carbon mobility options. Currently, most mobile source emissions result from the combustion of gasoline and traditional petroleum-based diesel fuel. When compared with petroleum-based fuels, biodiesel and alcohol-based fuels have higher levels of combustion emissions of respiratory irritants and some ozone-precursors such as acrolein, carcinogens, formaldehyde, and acetaldehyde.[115] Work conducted as part of the New York "Renewable Fuels Roadmap" discusses research suggesting that replacing gasoline with ethanol reduces emissions of carcinogenic benzene and butadiene but increases emissions of formaldehyde and acetaldehyde, which have other health impacts.[116]

Widely used public transportation results in considerably less fuel use and air contaminant emissions per person-mile traveled than other modes of transportation such as personal cars. Therefore, targeted geographic and temporal expansion of public transportation availability could reduce health risks associated with transportation emissions. Electrifying transit buses can ensure that emissions are reduced even further. Investments in transit bus electrification will benefit overburdened communities, both because many bus depots are located in these areas and because buses provide essential transportation services in these areas. Regulations limit school bus and heavy-duty vehicle idling, which produces harmful emissions, to protect the health of school children and others exposed to this type of air pollution and electrification of vehicles will reduce these harmful pollutants even further.[117] Electrification of school buses would also prevent exposure of school children to diesel exhaust which often leaks into the cabin of buses posing a larger health threat than outdoor idling emissions. Electrification of heavy-duty farm equipment and construction vehicles, that are typically diesel-powered, will protect the health of farm and construction workers and reduce emissions (and noise) in rural and urban areas where that are often in close proximity to residents and pedestrians. Emissions associated with transportation can also be reduced through carpools and investments in infrastructure that supports safe walking and bicycling.

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[115] Corrêa, Sergio M. and Arbilla, G. Formaldehyde and Acetaldehyde Associated with the Use of Natural Gas as a Fuel for Light Vehicles. Atmospheric Environment 39. 2005. 4513-4518.
Tang, Shida. Unregulated Emissions from a Heavy-Duty Diesel Engine with Various Fuels and Emission Control Systems. Environmental Science and Technology. 2007. 41:5037-5043.

[116] NYSERDA, "Renewable Fuels Roadmap and Sustainable Biomass Feedstock Supply for New York," Accessed on November 23, 2021, https://www.nyserda.ny.gov/About/Publications/Research-and-Development-Technical-Reports/Biomass-Reports/Renewable-Fuels-Roadmap; Vieira da Silva, M.A., B.L.G. Ferreira, L.G. da Costa Marques, A.L.S. Murta, and M.A.V. de Freitas. 2017. Comparative study of $NO_X$ emissions of biodiesel-diesel blends from soybean, palm and waste frying oils using methyl and ethyl transesterification routes. Fuel, 194: 144-156.

[117] DEC, "Heavy Duty Vehicles," DEC. Accessed at https://www.dec.ny.gov/chemical/8585.html.

These mechanisms can be supported through integrated local and regional transportation planning using Complete Streets principles.

Reductions in fuel use and emissions can also be achieved through congestion mitigation and smart growth planning that facilitates the establishment of more walkable communities, with sidewalks, bike lanes, and bike paths. Policies and technologies to reduce congestion, such as congestion pricing and traffic signal synchronization, can alleviate major bottlenecks and improve local air pollution, especially in communities located near busy roads. Bike sharing programs have become a popular feature in cities across the nation, providing additional opportunities for physical activity. Active transport for shorter journeys has both the benefits of reduced emissions and of exercise, leading to reduced risk for obesity, cardiovascular disease, and other health impacts. Nevertheless, in spite of the emission reductions associated with bicycling and walking for transportation and the health benefits, exercising in polluted air can also have health impacts, especially for vulnerable populations.[118] However, among healthy adults, moderate to high-intensity exercise may neutralize any short-term negative effects of air pollution. While the benefits of increased physical activity have been found to outweigh the risks of exercise in polluted air,[119] air quality in areas of heavy traffic should still be considered in the choices made for siting of bicycle lanes and paths.[120] Further, traffic accidents have been found to increase in number and severity with increased active transport. Therefore, as active transport options continue to be made available, efforts to minimize accident potential become increasingly important.

Vehicle electrification can also contribute to reduced traffic noise, especially at slower and medium speeds where tire and wind noises are low. Particularly in cities, with high volumes of traffic, noise reduction is important health co-benefit for the deployment of EVs.

### *Buildings and the Built Environment*

The building industry presents a unique and largely untapped resource for integrating climate action and public health. Workforce education, training, job placement, and job development equips New York's current and future workforce to design, install, inspect, maintain, and operate healthy, comfortable, low-

[118] Mittleman, Murray A. Air Pollution, Exercise and Cardiovascular Risk. New England Journal of Medicine. Sept 13. 2007. 357(11):1147- 9.

[119] Tainio, M., de Nazelle, A., Götschi, T., Kahlmeier, S., Rojas-Rueda, D., Nieuwenhuijsen, M., Hérick de Sá, T., Kelly, P., Woodcock, J. 2016. Can air pollution negate the health benefits of cycling and walking? Preventive Medicine; 87:233-236.

[120] Hertel, Ole. A Proper Choice of Route Significantly Reduces Air Pollution Exposure – A Study on Bicycle and Bus Trips in Urban Streets. Science of the Total Environment. 2008. 389(1):58-70.

carbon buildings while increasing clean energy job placement for Disadvantaged Communities and advancing industry diversity. This could be accomplished by promoting broad public awareness and education to create strategic partnerships with trusted community leaders, and by scaling-up targeted outreach and decision-making to increase market demand and accelerate the transition to low-carbon, energy-efficient, all-electric buildings.

### Outdoor Built Environment

The built environment is the primary environment people are exposed to because people spend approximately 90% of their time indoors.[121] However, outdoor green space is also part of the built environment, and it can have health benefits (mental health, exercise, etc.) for those who have access. Consequently, there are significant opportunities for improving public health while reducing GHG emissions by introducing green space, such as parks, especially in urban environments and Disadvantaged Communities. Green spaces, such as parks, urban greenery, and street trees, as well as blue space, comprised of water elements, can have beneficial health effects, particularly in urban environments. Effects include decreasing risk of cardiovascular disease and type 2 diabetes mellitus while improving mental health and quality of sleep and increasing birth weight.[122,123,124,125,126,127,128,129] Urban environments, which experience the "heat island effect," trees and other green spaces can cool their

[121] U.S. Environmental Protection Agency. 1989. Report to Congress on indoor air quality: Volume 2. EPA/400/1-89/001C. Washington, DC.

[122] Hartig, T. 2007. Three Steps To Understanding Restorative Environments As Health Resources. In: Thompson, C. W. & Travlou, P. (Eds.) Open Space: People Space. Abingdon: Taylor & Francis.

[123] Hartig, T., Mang, M. & Evans, G. W. 1991. Restorative Effects Of Natural Environment Experiences. Environment And Behavior, 23, 3-26.

[124] Beyer, K. M., Kaltenbach, A., Szabo, A., Bogar, S., Nieto, F. J. & Malecki, K. M. 2014. Exposure to neighborhood green space and mental health: Evidence from the survey of the health of Wisconsin. International Journal Of Environmental Research & Public Health, 11, 3453-72.

[125] Völker, S. & Kistemann, T. 2015. Developing The Urban Blue: Comparative Health Responses To Blue And Green Urban Open Spaces In Germany. Health & Place, 35, 196–205.

[126] Astell-Burt, T., Feng, X. & Kolt, G. S. 2014a. Is Neighborhood Green Space Associated With A Lower Risk Of Type 2 Diabetes? Evidence From 267,072 Australians. Diabetes Care, 37, 197-201.

[127] Maas, J., Verheij, R. A., De Vries, S., Spreeuwenberg, P., Schellevis, F. G. & Groenewegen, P. P. 2009b. Morbidity Is Related To A Green Living Environment. Journal Of Epidemiology And Community Health, 63, 967-973.

[128] Bodicoat, D.H., O'donovan, G., Dalton, A.M., Gray, L.J., Yates, T., Edwardson, C., Hill, S., Webb, D.R., Khunti, K., Davies, M.J. & Jones, A.P. 2014. The Association Between Neighbourhood Greenspace And Type 2 Diabetes In A Large Cross-Sectional Study. British Medical Journal Open, 4, E006076.

[129] Dzhambov A.M., Dimitrova, D.D. & Dimitrakova, E.D. 2014. Association Between Residential Greenness And Birth Weight: Systematic Review And Meta-Analysis. Urban Forestry & Urban Greening 13, 621-629.

surrounding areas by up to 1°C.[130,131] Disadvantaged Communities can have less access to green space, and poverty is associated with greater distances to parks.[132] To reduce inequality, the New York State Department of Agriculture and Markets (AGM) and DEC have provided grants to support community gardens in urban areas, and more can be done to bring accessible green space to Disadvantaged Communities.[133,134]

### Housing/Residential Built Environment

Building energy efficiency measures provide significant energy savings and health benefits. These include the basic benefits of affordably maintaining a comfortable living and working environment, preventing hypo- and hyperthermia, and combatting fuel poverty (facing the choice between heating the home or feeding the family).

Tight insulation in residential buildings without ensuring appropriate ventilation, filtration, and/or inadequate weatherproofing can negatively impact indoor air quality. Disadvantaged Communities, in particular, experience these issues, which can worsen health disparities. The New York Building Code and Property Maintenance Code designates minimum air ventilation rates for new and existing buildings. Inadequate ventilation increases exposure to air contaminants such as VOCs (including those from consumer care products and off-gassing from building materials), radon gas, dust, allergens, mold, carbon monoxide, and $CO_2$.

NYSERDA has programs to use industry-accrediting organizations to set standards and best practices for conducting energy efficiency upgrades. Program requirements concerning source removal, ventilation systems, minimum ventilation rates, and proper sizing and installing of HVAC systems help avoid and alleviate indoor air quality problems in existing buildings and the associated health effects. NYSERDA also strives to support advanced sustainability standards and tools by partnering with organizations like

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[130] Bowler, D. E., Buyung-Ali, L., Knight, T. M. & Pullin, A. S. 2010a. Urban Greening To Cool Towns And Cities: A Systematic Review Of The Empirical Evidence. Landscape And Urban Planning, 97, 147-155.

[131] Lafortezza, R., Carrus, G., Sanesi, G. & Davies, C. 2009. Benefits and well-being perceived by people visiting green spaces in periods of heat stress. Urban Forestry & Urban Greening, 8, 97-108.

[132] Wen M, Zhang X, Harris CD, Holt JB, Croft JB. Spatial disparities in the distribution of parks and green spaces in the USA. Ann Behav Med. 2013 Feb;45 Suppl 1(Suppl 1):S18-27. doi: 10.1007/s12160-012-9426-x. PMID: 23334758; PMCID: PMC3590901.

[133] AGM, "Community Gardens and Urban Agriculture," Accessed at https://agriculture.ny.gov/community-gardens-and-urban-agriculture.

[134] DEC, "Environmental Justice Grant Programs," Accessed at https://www.dec.ny.gov/public/31226.html.

the Collaborative for High Performance Schools, the U.S. Department of Energy, the EPA, and the U.S. Green Building Council.

When effectively combined with other home intervention programs (such as the New York State Healthy Neighborhoods Program), energy efficiency upgrades can have direct and indirect health benefits for residents.[135] For example, these combined measures can reduce hot and cold thermal stress, arthritis symptoms, asthma hospitalization or emergency department visits, missed days of work, carbon monoxide poisonings, home fires, and trip and fall injuries for residents.[136] These programs could also consider identifying code violations which increase risks associated with flooding, and thus contribute toward increased community resiliency.

Electrification of the building sector will also reduce the health risks associated with combustion-based appliances for heating, cooking, and other uses. Leaking home heating systems were the primary cause listed among the 15,000 carbon monoxide poisonings resulting in emergency department visits in the United States annually.[137] In New York alone, there are approximately 1,500 emergency department visits and 160 hospitalizations for carbon monoxide poisoning annually.[138] Electrification of home heating systems could prevent many of these poisonings going forward. Cooking with gas stoves can increase indoor air concentrations of $NO_2$, carbon monoxide, and formaldehyde, and children living in homes with gas stoves can have an increased risk of being diagnosed with asthma.[139] Disadvantaged Communities are disproportionately affected by asthma and may be more likely to have unvented and/or piloted gas stoves. Thus, electrification of gas cooking appliances can reduce the risk of asthma in Disadvantaged Communities and improve the health of all New Yorkers.

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[135] Gomez, Marta MS; Reddy, Amanda L. MS; Dixon, Sherry L. PhD; Wilson, Jonathan MPH; Jacobs, David E. PhD, CIH A Cost-Benefit Analysis of a State-Funded Healthy Homes Program for Residents with Asthma: Findings from the New York State Healthy Neighborhoods Program, Journal of Public Health Management and Practice: March/April 2017 - Volume 23 - Issue 2 - p 229-238.

[136] Bureau of Environmental and Occupational Epidemiology, Center for Environmental Health, DOH. Based on Analysis of Statewide Planning and Research Cooperative System Hospital Outpatient Emergency Department data. Statewide Planning and Research Cooperative System (ny.gov).

[137] Centers for Disease Control and Prevention. Nonfatal, Unintentional, Non-Fire Related, Carbon-Monoxide Exposures-U.S. 2008.

[138] Bureau of Environmental and Occupational Epidemiology, Center for Environmental Health, DOH. Based on Analysis of Statewide Planning and Research Cooperative System Hospital Outpatient Emergency Department data. Statewide Planning and Research Cooperative System (ny.gov).

[139] Bhangar S, Mullen NA, Hering SV, Kreisberg NM, Nazaroff WW. Ultrafine particle concentrations and exposures in seven residences in northern California. Indoor Air. 2011 Apr;21(2):132-44. doi: 10.1111/j.1600-0668.2010.00689.x. Epub 2010 Oct 28. PMID: 21029183.

Biomass and biofuels are burned in New York for heat and combined heat and power for the residential, commercial, and industrial sectors. Of these energy use sectors, the residential sector has the greatest use as residents increasingly turn to biomass to heat their homes. EPA estimates the $PM_{2.5}$ emissions from residential wood heating in New York State, representing 2% of homes, is greater than that from the power generation sector and the entire and transportation sectors combined. Adverse health effects associated with exposure to wood smoke are consistent with those identified for $PM_{2.5}$ (a major component of wood smoke) including exacerbation of cardiovascular symptoms (e.g., chest pain, heart rhythm changes, heart attack, stroke), and respiratory symptoms (e.g., asthma). The elderly, people with heart and lung diseases, people of low economic status, and children are particularly vulnerable to the effects of fine particle exposures in wood smoke. Wood smoke is found in particularly rural areas of the State, and some wintertime smoke impacts are significant.[140]

### Commercial/Industrial Built Environment

In the industrial sector, in addition to the potential use of green hydrogen as described above for the power generation sector, carbon capture and sequestration could reduce GHG emissions. Depending on the specific technology, carbon capture and sequestration may also reduce emissions of some other pollutants, but in many cases does not. While carbon capture technology requires energy, which can lead to additional power sector emissions,[141] potential increases in emissions for powering carbon capture and sequestration would depend on the energy generation source.

[140] Allen, George and Lisa Rector. "Characterization of Residential Woodsmoke PM2.5 in the Adirondacks of New York." Aerosol and Air Quality Research 20 (2020): 2419-2432.

[141] Jacobson, M.Z. Energy Environ. Sci., 2019,12, 3567-3574.

# Evaluation of the Plan

# Chapter 9. Analysis of the Plan

## 9.1 Integration Analysis Approach

The objective of the integration analysis is to develop GHG mitigation scenarios for this draft Scoping Plan that incorporate the information used by the Council in developing this draft plan, including Advisory Panel and Working Group recommendations and CJWG input, capture and account for how strategies interact across sectors, and that evaluates the benefits and costs of a suite of strategies. The integration analysis is built within the New York Pathways model, which is a multi-model framework that includes a representation of all categories of GHG emissions in New York and takes as inputs relevant complementary analyses, including the Power Grid Study, building and transportation roadmaps, oil and gas system analysis, and refrigerant management analysis.

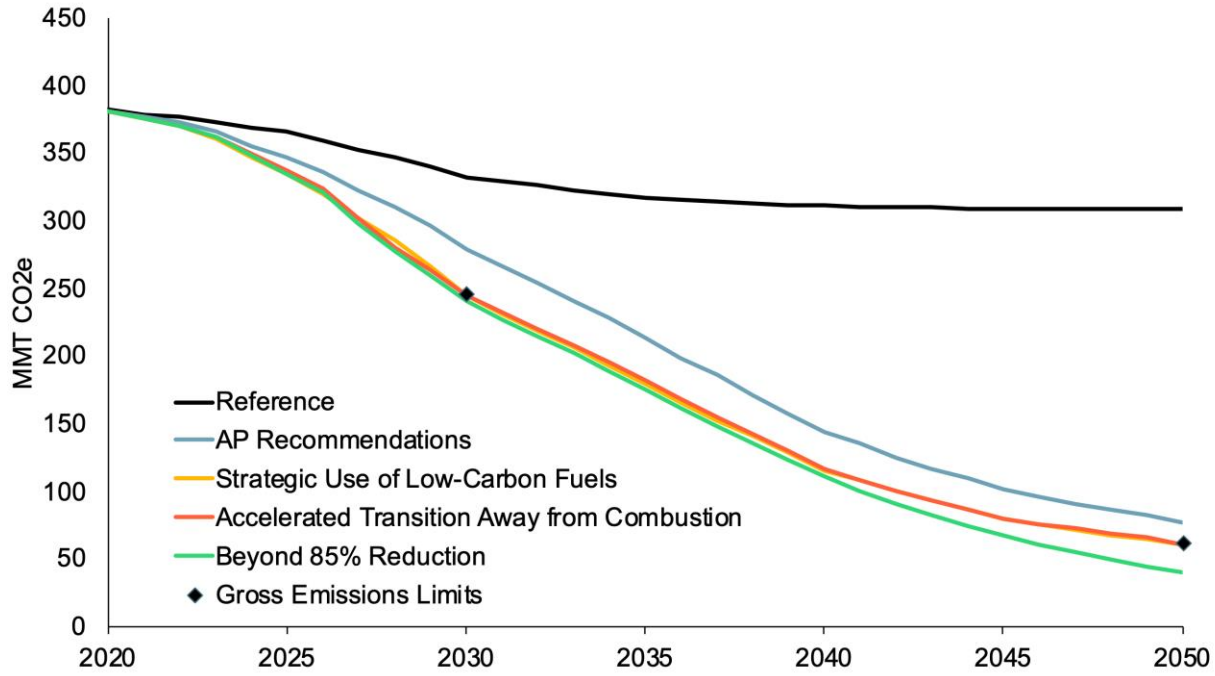
This chapter contains a high-level summary of the integration analysis results. Detailed technical information on the mitigation scenarios presented in this chapter can be found in the Integration Analysis Technical Supplement (Appendix G). For this draft Plan, the Council is including multiple modeled scenarios and seeks public feedback on the mix of strategies and level of ambition of these strategies in order to achieve the emission limits. Detailed information on the proposed strategies to realize the levels of transformation included in the integration analysis scenarios can be found in the Sector Strategies chapters of this draft Plan.

## 9.2 Scenario Design

The initial runs of the integration analysis evaluated a business-as-usual future (Reference Case) and a representation of a future based on an ambitious interpretation of the recommendations from the Council's Advisory Panels (Scenario 1). Analytical results indicated that the Advisory Panel recommendations alone were not sufficient to achieve the Climate Act emission limits (Figure 4). These results were presented to the Council in July 2021 and initiated a scenario design planning exercise by the Council, facilitated by the analytical team and informed by feedback from the CJWG on the Advisory Panel recommendations, to develop scenarios with additional emissions reductions. This exercise resulted in three additional scenarios designed to meet or exceed GHG limits and achieve carbon neutrality. Scenarios 2, 3, and 4 all include foundational themes based on findings from Advisory Panels and supporting analysis but represent different approaches based on Council feedback and CJWG input. The

Council will continue deliberations on these scenarios, informed by public comment on this draft Plan, as they work to develop the final Scoping Plan.

**Figure 4. Greenhouse Gas Emissions by Mitigation Scenario**



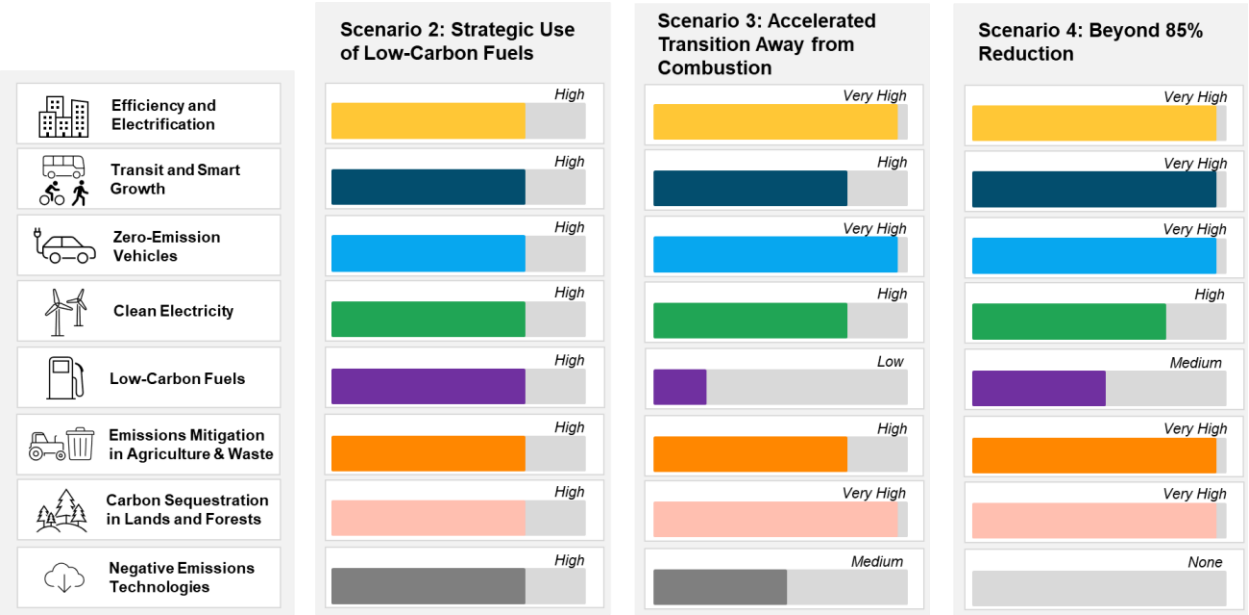

- **Reference Case:** Business as usual plus implemented policies.[142]
- **Scenario 1: Advisory Panel Recommendations:** Representation of the Advisory Panel recommendations, which provide a foundation for all scenarios; however, scenario modeling shows that further effort is needed to meet Climate Act emission limits.
- **Scenario 2: Strategic Use of Low-Carbon Fuels:** Advisory Panel recommendations adjusted for strategic use of bioenergy derived from biogenic waste, agriculture and forest residues, and limited purpose grown biomass, as well as a critical role for green hydrogen for difficult-to-electrify applications. This scenario includes a role for negative emissions technologies to reach carbon neutrality.
- **Scenario 3: Accelerated Transition Away from Combustion:** Advisory Panel recommendations adjusted to include a very limited role for bioenergy and hydrogen combustion and accelerated electrification of buildings and transportation. This scenario includes a role for negative emissions technologies to reach carbon neutrality.

[142] The Reference Case is used for evaluating incremental societal costs and benefits of GHG emissions mitigation.

- **Scenario 4: Beyond 85% Reduction:** Advisory Panel recommendations adjusted to reflect accelerated electrification and targeted use of low-carbon fuels. This scenario includes additional reductions in VMT and innovation in methane abatement. This scenario reduces gross GHG emissions beyond the 2050 limit and avoids the need for negative emission technologies.

Figure 5 highlights the key differences in assumptions across the three scenarios that meet or achieve New York's GHG emission limits and achieve carbon neutrality by 2050. All scenarios share common foundational themes of decarbonization, including a zero-emission power sector by 2040, enhancement and expansion of transit, rapid and widespread efficiency and electrification, electric end-use load flexibility, and methane mitigation in agriculture and waste.

**Figure 5. Level of Transformation by Mitigation Scenario**




More detailed scenario assumptions are available in the Integration Analysis Technical Supplement (Appendix G) and on https://climate.ny.gov/Climate-Resources.

Transformative levels of effort are required across all sectors, and all three scenarios include high levels of electrification, including Scenario 2, which also incorporates the strategic use of low-carbon fuels. Scenario 3 pushes harder on accelerated electrification to meet the emission limits using a very low-bioenergy and low-combustion mix of strategies. Scenario 4 pushes beyond 85% direct reductions in 2050 by layering some low-carbon fuels back in, examining very high VMT reduction, and assuming high (but also highly uncertain) levels of innovation in the waste and agriculture sectors. Scenario 4 is the only evaluated scenario that achieves carbon neutrality without the use of negative emissions technologies like direct air capture of $CO_2$, which is also subject to high uncertainty, but is required in Scenarios 2 and

3 to address the gap between remaining gross emissions in 2050 and the ambitious assumed projections of natural sequestration. Figure 6 shows the emissions reductions under Scenario 1. Key assumptions for scenarios 2, 3, and 4 are shown in Figure 7, Figure 8, and Figure 9. Additional documentation of scenario assumptions can be found in the Integration Analysis Technical Supplement (Appendix G). The Council expressly seeks feedback on the components of these scenarios (with detailed information found in *Sector Strategies*).

**Figure 6. Advisory Panel Recommendations**

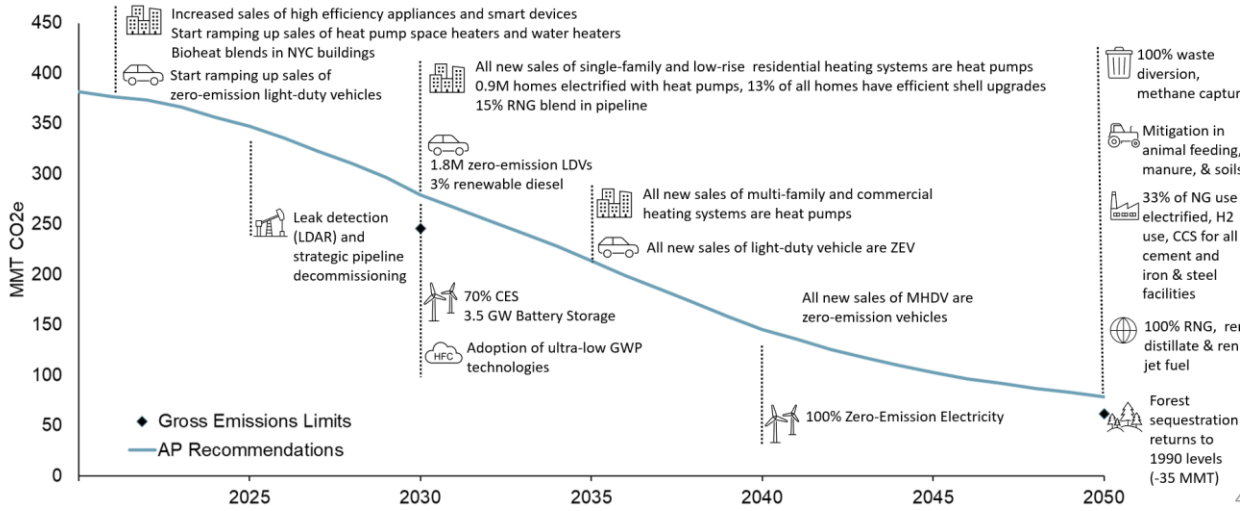



**Figure 7. Key Assumptions in Scenario 2: Strategic Use of Low-Carbon Fuels**

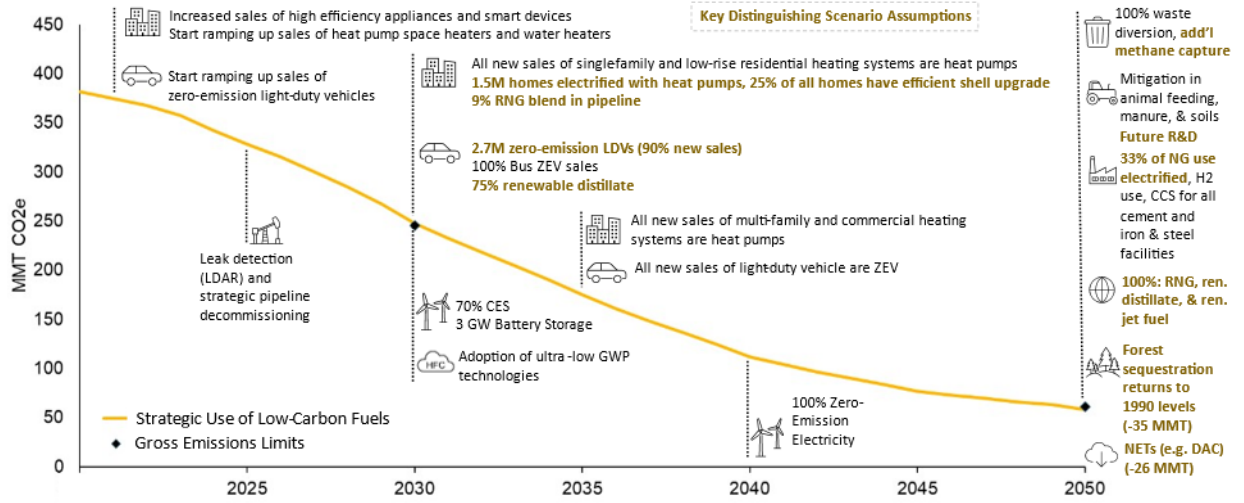


**Figure 8. Key Assumptions in Scenario 3: Accelerated Transition Away from Combustion**

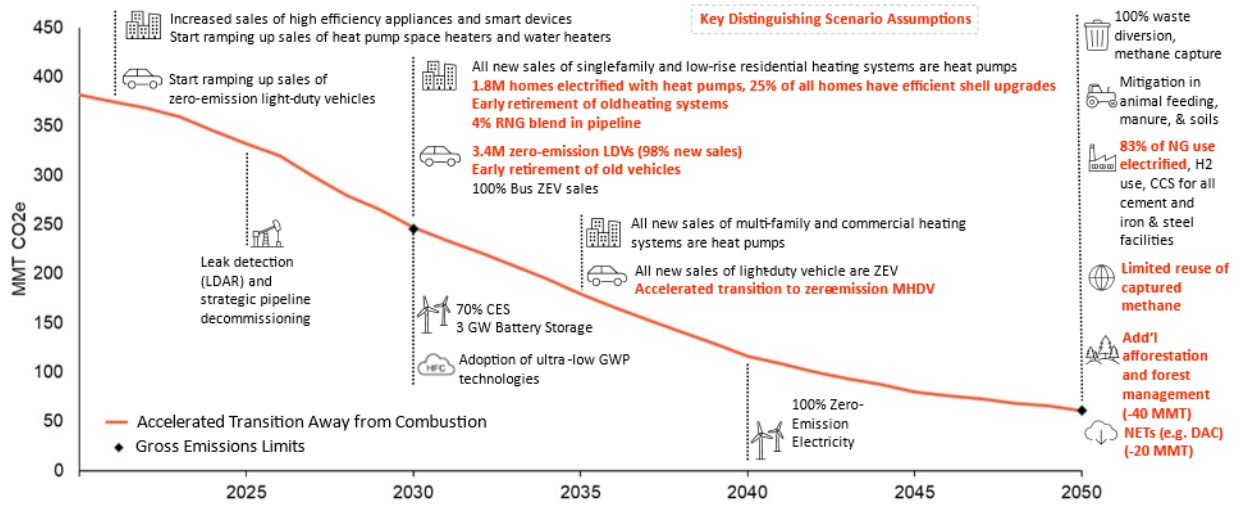
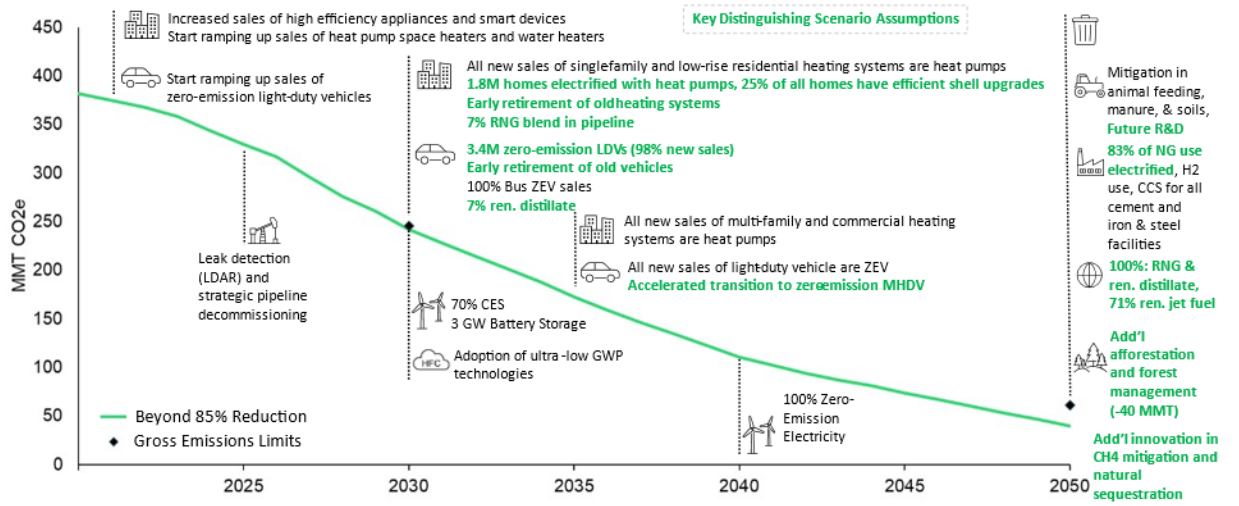



**Figure 9. Key Assumptions in Scenario 4: Beyond 85% Reduction**




## 9.3 Key Findings

The integration analysis presented multiple pathways to achieving the GHG emission limits and let to several key findings:

- **Achieving deep decarbonization is feasible by mid-century.** Achieving the emission limits **requires action in all sectors**, especially considering the Climate Act's emissions accounting, as described in *Chapter 4. Current Emissions*. Every sector will see high levels of transformation over the next decade and beyond, requiring critical investments in New York's economy.
- **Energy efficiency and end-use electrification are essential parts of any pathway that achieves New York State emission limits.** Approximately 1 to 2 million efficient homes will

need to be electrified with heat pumps by 2030. Approximately 3 million zero-emission vehicles (predominantly battery electric) will need to be sold by 2030.

- **A transition to low-GWP refrigerants and enhanced refrigerant management will be required** to electrify while reducing and ultimately eliminating GHG emissions from HFC-based refrigerants used in today's heat pumps.
- **Consumer and community decision-making is key, and especially important for the purchase of new passenger vehicles and heating systems for homes and businesses through the next decade.** In all modeled scenarios, zero-emission vehicles and heat pumps will need to become the majority of new purchases by the late 2020s, and fossil fuel-emitting cars and appliances will no longer be sold after 2035.
- **New York will need to substantially reduce VMT while increasing access to public transportation.** This should include expanding transit services structured around community needs, smart growth inclusive of equitable TOD (E-TOD), and transportation demand management.
- **Wind, water, and sunlight will power most of New York's economy in 2050 in all pathways.** Even with aggressively managed load, electric consumption doubles and peak load nearly doubles by 2050, and New York becomes a winter peaking system by 2035, with offshore wind of around 20 gigawatts (GW), solar of around 60 GW, and 4- and 8-hour battery storage of around 20 GW by 2050. Firm, zero-emission resources, such as green hydrogen or long-duration storage, will be important to ensuring a reliable electricity system beyond 2040.
- **Low-carbon fuels such as bioenergy or hydrogen may help to decarbonize sectors that are challenging to electrify.** By 2030, scenarios include initial market adoption of green hydrogen in several applications (including MHD vehicles and high-temperature industrial). Additional promising end-use applications include district heating and non-road transportation such as aviation and rail.
- **Large-scale carbon sequestration opportunities include lands and forests and negative emissions technologies.** Protecting and growing New York's forests is required for carbon neutrality. Negative emissions technologies (such as the direct air capture of $CO_2$) may be required if the state cannot exceed 85% direct emissions reductions by 2050. Strategic land-use planning will be essential to balance natural carbon sequestration, agriculture activities, new renewables development, and smart urban planning (smart growth).
- **Necessary methane emissions mitigation in waste and agriculture will require transformative solutions.** Diversion of organic waste and the capture of fugitive methane

emissions are key in the waste sector. Alternative manure management and animal feeding practices will be critical in reducing methane emissions in agriculture.

- **Continued research, development, and demonstration (RD&D) is key to advancing a full portfolio of options and mitigating risk.** Additional innovation will be required in areas such as carbon sequestration solutions, long-duration storage, flexible electric loads, low-GWP refrigerants, and animal feeding, in concert with federal action (such as Earthshots).
- **The largest three remaining sources** of emissions in 2050 across scenarios are landfills, aviation, and animal feeding.

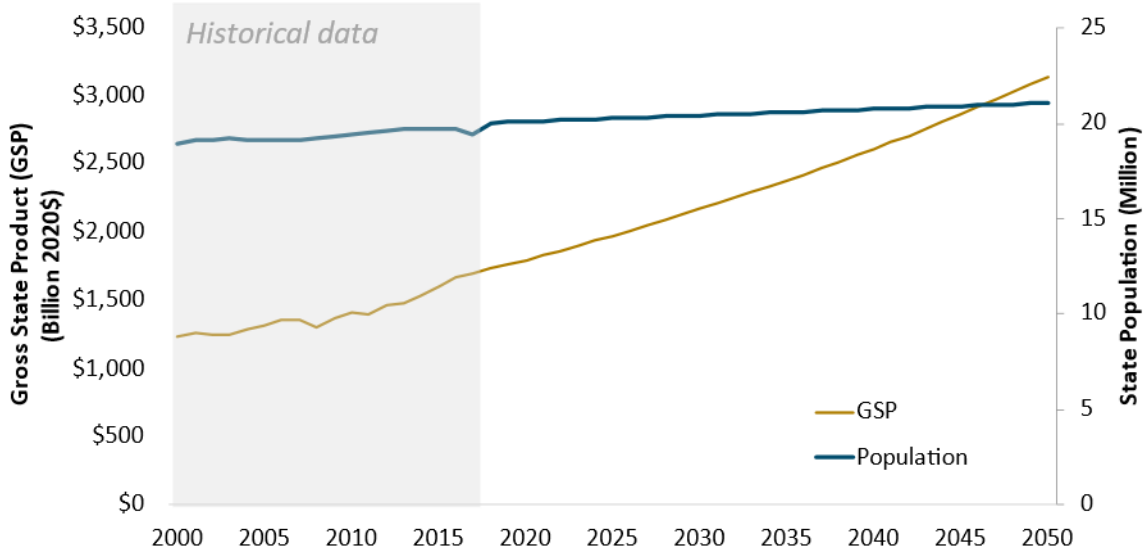
More detailed economy-wide and sectoral results are presented in the Integration Analysis Technical Supplement (Appendix G).

# Chapter 10. Benefits of the Plan

## 10.1 Background

New York's economy has been steadily growing for the last two decades and state economic output per capita has been growing even more quickly. These trends are projected to continue over time (Figure 10).

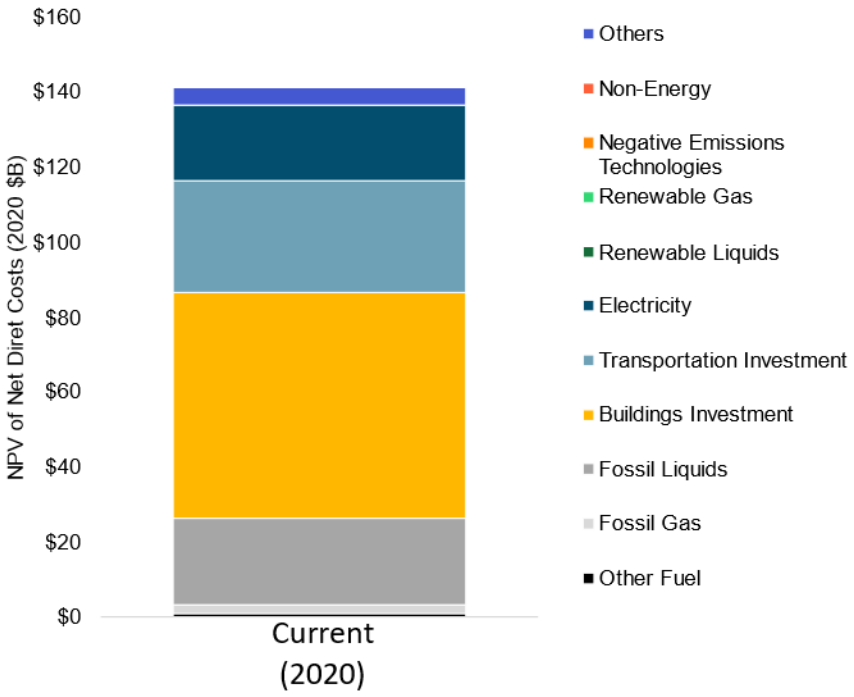
**Figure 10. Historical and Projected Population and Gross State Product**




*Source:* NYSERDA Patterns and Trends, Federal Reserve Economic Data, Cornell Program on Applied Demographics.

Current annual system expenditure—the costs related to energy consumption in the state—to support New York's population and economy is estimated to be over $140 billion. This estimate includes capital investments for energy consuming devices, liquid and gas fuel costs, and costs for in-state and imported electricity generation. While system expenditures are significant at over $140 billion, these make up a small share of gross state product (GSP; 8.9% in 2020, see Figure 11).

**Figure 11. Estimated Current System Expenditure by Category**




Estimated system expenditures do not reflect direct costs in some sectors that are represented with incremental costs only. These include investments in industry, agriculture, waste, forestry, and non-road transportation.

Of these total system expenditures, annual energy expenditures are approximately $50 billion, with over half of that amount (almost $30 billion) estimated to leave New York State.[143] Petroleum fuel expenditures are the largest single category at approximately $24 billion. Current energy expenditures outline the opportunity for import substitution through electrification, where a greater share of energy services is provided by in-state resources, driving economic activity and job creation.

## 10.2 Integration Analysis Benefit-Cost Approach

In addition to analyzing GHG reductions, the integration analysis sought to quantify the costs and benefits of the mitigation scenarios described in *Chapter 9. Analysis of the Plan*. The quantified benefits include the value of avoided GHG emissions and avoided health impacts; Cost categories include annualized capital, operations, and maintenance cost for infrastructure (such as devices, equipment, generation assets,

[143] NYSERDA Patterns and Trends, accessed at https://www.nyserda.ny.gov/about/publications/ea-reports-and-studies/patterns-and-trends.

and transmission and distribution) and annual fuel expenses by sector and fuel (conventional or low-carbon fuels, depending on scenario definitions).[144]

### *Value of Avoided GHG Emissions*

All scenarios model significant GHG emissions reductions, which avoid the economic impacts of damages caused by climate change. The value of avoided GHG emissions calculations are based on DEC Value of Carbon guidance, developed under the Climate Act.[145] The value of these avoided GHG emissions is measured in each scenario relative to the Reference Case. GHG emissions were measured using value of avoided $CO_2$, avoided methane, avoided nitrous oxide, and avoided HFCs. For other GHG, avoided emissions were converted to $CO_2e$ using the IPCC's AR5 20-year GWP values. The avoided GHG emissions time series in each year was multiplied by the annual social cost of GHG based on the DEC Value of Carbon guidance appendix, using the central case estimate for each GHG (2% discount rate for GHG emissions). More information on the approach to estimating the value of avoided GHG emissions can be found in the Integration Analysis Technical Supplement (Appendix G).

### *Value of Health Co-Benefits*

The integration analysis also evaluated health benefits of mitigation scenarios relative to the Reference Case. For more information on these analyses, see *10.4 Health Effects* below. Three categories of potential health benefits were analyzed:

- Improvements in health outcomes due to improved air quality, including reduced incidence of premature mortality, heart attacks, hospitalizations, asthma exacerbation and emergency room visits, and lost workdays;[146]
- Public health benefits from increased physical activity due to increased use of active transportation modes (such as walking and cycling) while accounting for changes in traffic collisions; and

[144] This analysis does not natively produce detailed locational or customer class analysis, but those may be developed through subsequent implementation processes. More specificity is needed around individual proposals in order to determine the impact on specific customers. The Council recommends that as proposals are advanced with additional implementation details, a complete consumer benefit-cost impact be performed to show the impact and inform program design prior to full implementation.

[145] The value of avoided GHG emissions calculations are based on DEC guidance, which can be accessed at https://www.dec.ny.gov/energy/99223.html.

[146] Health benefits are calculated as High" and "Low." The economy-wide benefits applied the High case and the Low case are included in the uncertainty analysis. For more information, see Appendix G.

- Estimated benefits of energy efficiency interventions in LMI homes.

### *Integration Analysis Costs*

The pathways framework produces economy-wide resource costs for the various mitigation scenarios relative to a reference case. The framework is focused on annual societal costs and benefits and does not track internal transfers (such as incentives). Outputs are produced on an annual time scale for the state of New York, with granularity by sector.

The integration analysis included calculations for three cost metrics: net present value (NPV) of net direct costs, annual net direct costs, and system expenditure.

- **NPV of Net Direct Costs:** This is the NPV of levelized costs in a given scenario incremental to the Reference Case from 2020 through 2050.[147] This metric includes incremental direct capital investment, operating expenses, and fuel expenditures.
- **Annual Net Direct Costs:** Net direct costs are levelized costs in a given scenario incremental to the Reference Case for a single year snapshot. This metric includes incremental direct capital investment, operating expenses, and fuel expenditures.
- **System Expenditure:** System expenditure is an estimate of absolute direct costs (not relative to the Reference Case). Estimates of system expenditure do not reflect direct costs in some sectors that are represented with incremental costs only. These include investments in industry, agriculture, waste, forestry, and non-road transportation.

Cost categories included in the metrics listed above are shown in Table 4.

**Table 4. Integration Analysis Cost Categories**

| Cost Category | Description |
|---|---|
| Electricity System | Includes incremental capital and operating costs for electricity generation, transmission (including embedded system costs), distribution systems, and in-state hydrogen production costs. |
| Transportation Investment | Includes incremental capital and operating expenses in transportation (e.g., BEVs and EV chargers) |

[147] All NPV calculations assume a discount rate of 3.6%. This discount rate was applied to all annual cost and benefit streams, including the value of avoided GHG emissions, which has an embedded, separate, and distinct perspective on discounting described in the DEC guidance, which can be accessed at https://www.dec.ny.gov/energy/99223.html.

| Cost Category | Description |
|---|---|
| Building Investment | Includes incremental capital and operating expenses in buildings (e.g., HPs and building upgrades) |
| Non-Energy | Includes incremental mitigation costs for all non-energy categories, including agriculture, waste, and forestry |
| Renewable Gas | Includes incremental fuel costs for renewable natural gas and imported green hydrogen |
| Renewable Liquids | Includes incremental fuel costs for renewable diesel and renewable jet kerosene |
| Negative Emission Technologies (NETs) | Includes incremental costs for direct air capture of $CO_2$ as a proxy for NETs |
| Other | Includes other incremental direct costs including industry sector costs, oil & gas system costs, HFC alternatives, and hydrogen storage |
| Fossil Gas | Includes incremental costs spent on fossil natural gas (shown as a negative for cases when Gas expenditures are avoided compared with the Reference Case) |
| Fossil Liquids | Includes incremental costs spent on liquid petroleum products (shown as a negative for cases when liquids expenditures are avoided compared with the Reference Case) |
| Other Fuel | Includes incremental costs spent on all other fossil fuels |

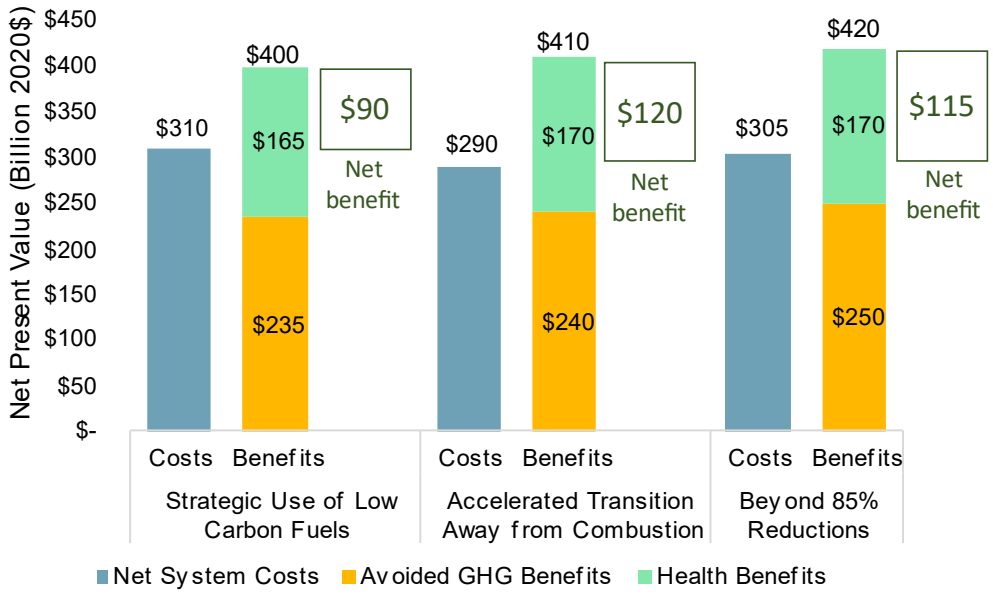
Cost outputs from integration analysis are key inputs to the Jobs Study described in *Chapter 7. Just Transition*.

## 10.3 Key Benefit-Cost Assessment Findings

The integration analysis assessed the benefits of avoided GHG emissions, health co-benefits, and resource costs for Scenario 2: Strategic Use of Low-Carbon Fuels, Scenario 3: Accelerated Transition Away from Combustion, and Scenario 4: Beyond 85% Reduction (Figure 12). There are three key findings from this assessment:

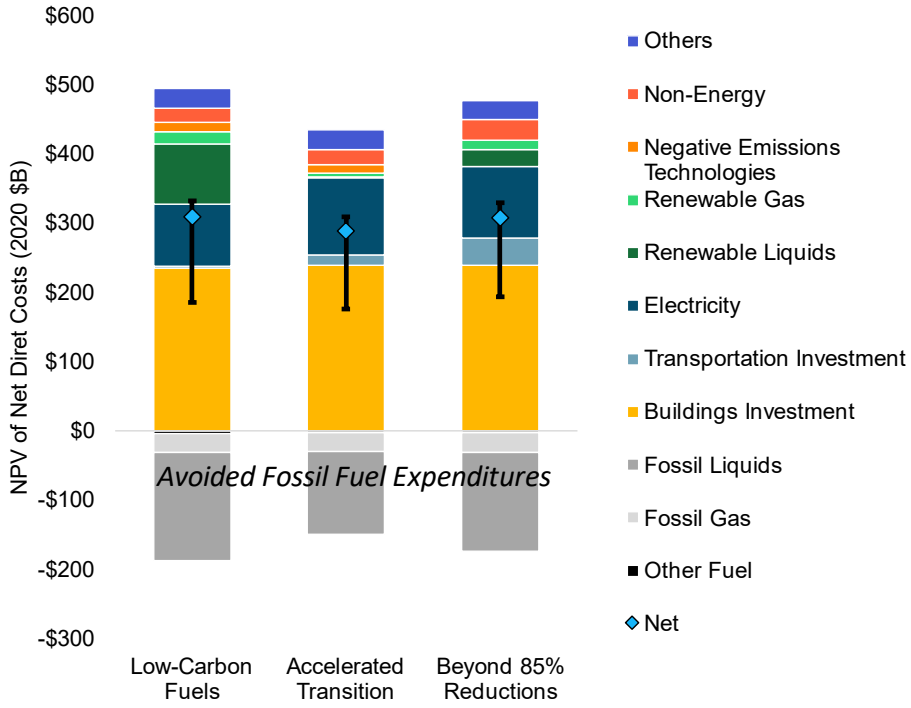
- **The cost of inaction exceeds the cost of action by more than $90 billion.** There are significant investments required to achieve Climate Act GHG emission limits, accompanied by even greater external benefits and the opportunity to create hundreds of thousands of jobs.
- **Net benefits range from $90 billion to $120 billion.** Improvements in air quality, increased active transportation, and energy efficiency interventions in LMI homes generates health benefits ranging from approximately $165 billion to $170 billion. Reduced GHG emissions avoids the economic impacts of damages caused by climate change equaling approximately $235 to $250 billion. The combined benefits range from approximately $400 billion to $420 billion.
- **Net direct costs are small relative to the size of New York's economy.** Net direct costs are estimated to be 0.6% to 0.7% of GSP in 2030, and 1.4% of GSP in 2050.

**Figure 12. Summary of Benefits and Costs (Net Present Value Relative to Reference Case)**




The NPV of net direct costs in Scenario 2, Scenario 3, and Scenario 4 are in the same range (due to uncertainty) and are primarily driven by investments in buildings and the electricity system (Figure 13). All scenarios show avoided fossil fuel expenditures due to efficiency and fuel-switching relative to the Reference Case (shown in the chart as negative costs). Scenario 2: Strategic Use of Low-Carbon Fuels includes significant investment in renewable diesel, renewable jet kerosene, and RNG. Scenario 3: Accelerated Transition Away from Combustion meets emission limits with greater levels of electrification, which results in greater investments in building retrofits, zero-emission vehicles, and the electricity system. Scenario 4: Beyond 85% Reduction builds on the electrification levels in Scenario 3, includes greater investments in transportation, waste, and agriculture sector mitigation, and layers back in a limited use of low-carbon fuels to reduce gross GHG emissions beyond the 2050 limit. Scenario costs are sensitive to the price of fossil fuels and technology cost projections, as reflected in error bars. More detail on uncertainty and sensitivity analysis can be found in the Integration Analysis Technical Supplement (Appendix G).

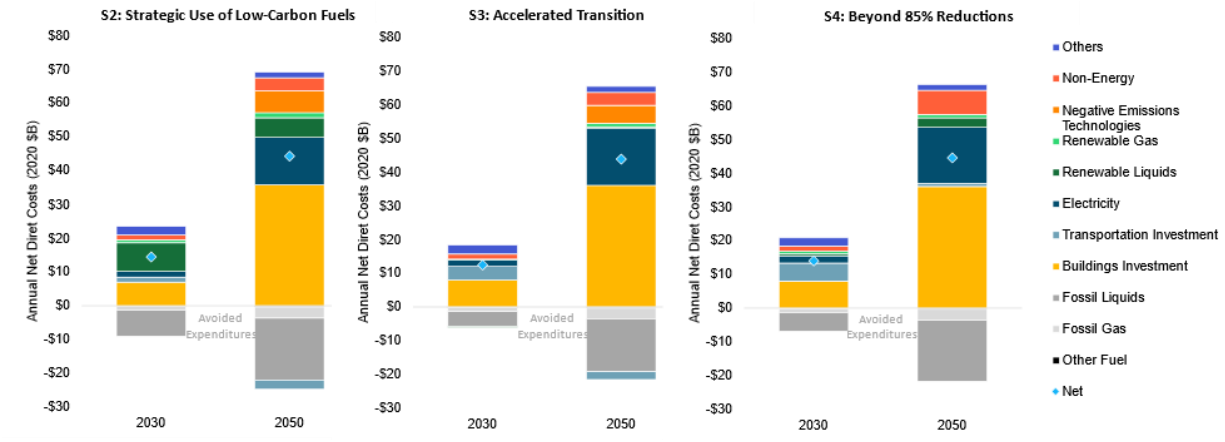
**Figure 13. Net Present Value of Net Direct Costs Relative to Reference Case (2020–2050)**




Uncertainty error bars include low and high fuel price sensitivities from AEO 2021, and low technology costs for heat pumps, EVs, wind, solar, storage, and direct air capture of $CO_2$.

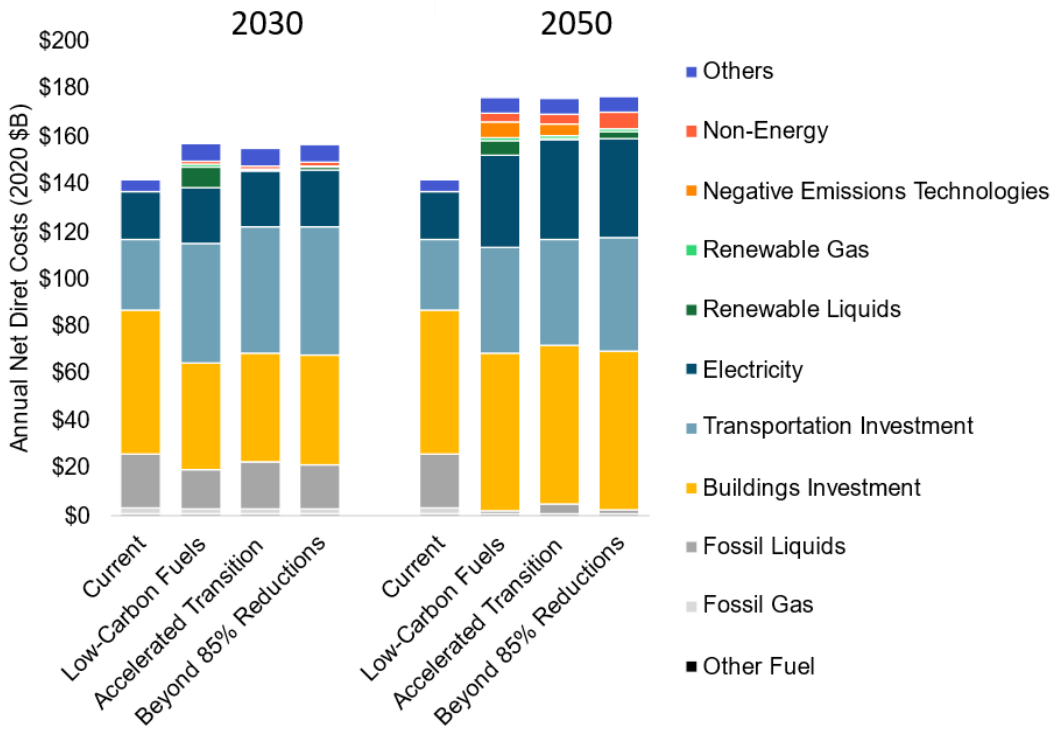
Annual net direct costs show the timing of key investments required to meet the Climate Act GHG emission limits. Scenario 2 includes significant investment in renewable diesel, renewable jet kerosene, and RNG starting in the mid-2020s. Scenario 3 includes greater levels of electrification compared to Scenario 2, which results in greater investments in building retrofits, zero-emission vehicles, and the electricity system. Scenario 4 layers on additional investments in transportation, agriculture, and waste mitigation relative to Scenario 3. Both scenarios 2 and 3 include investment in negative emissions technologies to achieve net zero emissions by 2050, whereas scenario 4 does not require any negative emissions technologies due to the incremental investments in transportation, smart growth, agriculture, waste reductions. In 2030, annual net direct costs relative to the Reference Case are around $15 billion per year, approximately 0.7% of GSP; in 2050, costs increase to $45 billion per year, or 1.4% of GSP (Figure 14).

**Figure 14. Annual Net Direct Costs Relative to Reference Case in Scenarios 2-4**




Net direct costs were measured relative to the Reference Case, but system expenditures were evaluated on an absolute basis. System expenditures increase over time as New York invests in infrastructure and clean fuels to meet the Climate Act's emission limits. As a share of overall system expenditures, costs are moderate: 9% to 11% in 2030 and 25% to 26% in 2050 relative to current estimated expenditure levels (Figure 15).

**Figure 15. Annual System Expenditures in Scenarios 2-4**



More detail on the benefit-cost assessment approach, input assumptions, results, uncertainty analysis, and sensitivity analysis is included in the Integration Analysis Technical Supplement (Appendix G).

## 10.4 Health Effects

### *Health Analyses Approach Overview*

The analysis of potential public health benefits associated with the decarbonization policy scenarios evaluated the potential for the scenarios to affect changes in public health outcomes relative to the Reference Case. Three analyses were undertaken, evaluating the potential to:

- Improve air quality and ensuing health outcomes through reduced combustion and associated pollutant emissions;
- Improve public health through increased activity associated with active transportation modes such as walking and cycling; and
- Improve health outcomes in homes, especially LMI homes, through energy efficiency interventions.

The air quality analysis applied EPA's CO Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool, customized with detailed inputs specific to New York State and the scenarios analyzed, to evaluate air quality and ensuing public health outcomes at the county level. COBRA evaluates ambient air quality based on emissions of direct $PM_{2.5}$ and its precursors ($SO_2$, VOC, and $NO_X$) and the ensuing changes in annual average total $PM_{2.5}$ concentrations. The results include 12 different health outcomes, such as premature mortality, heart attacks, hospitalizations, asthma exacerbation and emergency room visits, and lost workdays. Results are calculated as "High" and "Low," reflecting two alternative methods adopted by EPA for evaluating premature mortality and non-fatal heart attacks based on two epidemiological studies of the impacts of air quality on public health. The economy-wide benefit results described in the sections above applied the High case, and the Low case is included in the uncertainty analysis described in Appendix G. Note that COBRA does not include additional potential benefits from reduced ozone concentrations; the value of those benefits is estimated to be a few percent of the benefits associated with $PM_{2.5}$. Additional benefits not included are potential benefits associated with reduced $NO_2$ concentrations and reduced toxics, which were not evaluated given the high uncertainty and lack of sufficient data to provide reasonable estimates.

COBRA was applied to the Reference Case and the policy scenarios described above for 2020 through 2050 in 5-year increments, and the value of the improved health outcomes was interpolated to estimate

benefits for the entire period. The analysis includes emissions in all sectors and all states, and the effect of the scenarios on emissions in New York as well as any potential effect of changes in New York's electricity consumption on electricity generation in other states.

Potential public health benefits from increased physical activity due to increased use of active transportation modes, while accounting for potential increases in traffic collisions, were estimated using the Integrated Transport Health Impacts Model, customized to represent New York State.

Values from published literature on the health and safety benefits of energy system changes and weatherization programs in homes were used to estimate the potential benefits of energy efficiency interventions. These applied only to LMI homes expected to have upgraded systems and weatherization. While additional benefits may result from building changes in higher-income homes, those benefits would likely be less, and no data is available to estimate those details.

For a detailed description of the health analyses methods, see Appendix G.

### *Key Health Findings*

Decarbonizing New York can result in a substantial health benefits from improved air quality, on the order of $50 billion to $120 billion from 2020 through 2050 (based on reduced mortality and other health outcomes) relative to the Reference Case.

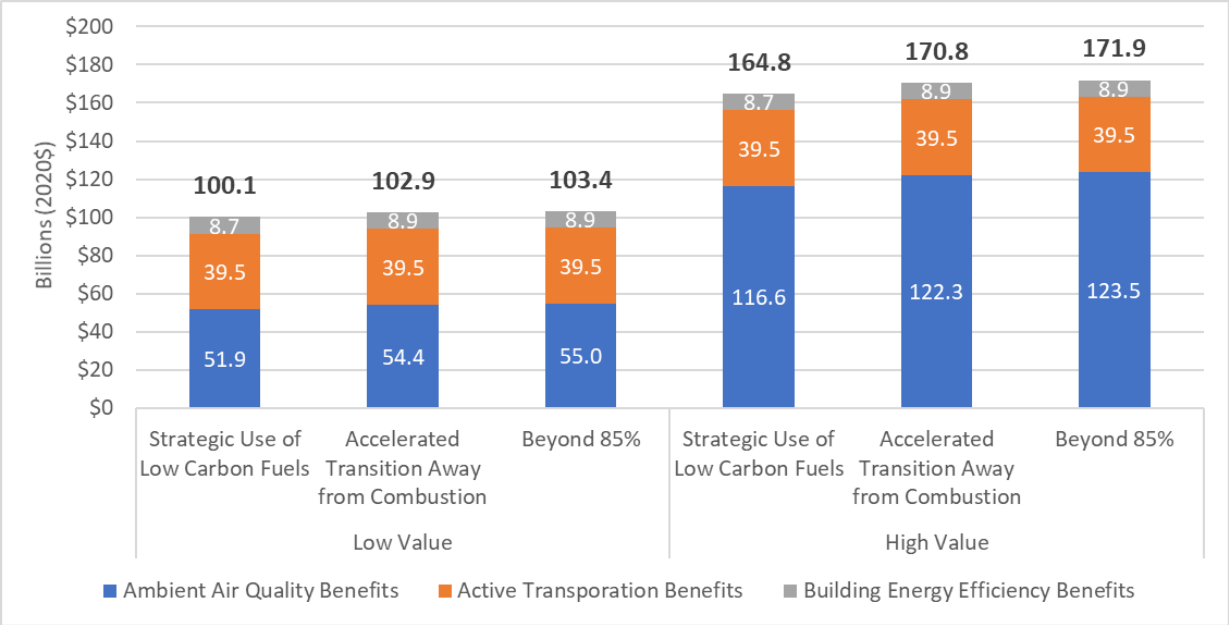
- Benefits would be experienced throughout the State and downwind in neighboring states.
- Benefits of reduced fossil fuel combustion are higher in urban areas due to both higher emissions and larger impacted populations.
- Benefits of reduced wood combustion are higher in upstate areas.
- Annual benefits would grow over time as pollution rates decrease.

Two additional potential health benefit categories were estimated:

- $40 billion associated with the health benefits of increased active transportation (such as walking and cycling); and
- $9 billion associated with energy efficiency interventions in LMI homes (additional benefits, not quantified, may occur in other buildings as well).

The total projected potential health benefits associated with the scenarios analyzed are presented in Figure 16. Results are presented for the High Value and Low Value cases.

**Figure 16. Total Projected Health Benefits (Net Present Value, 2020–2050)**

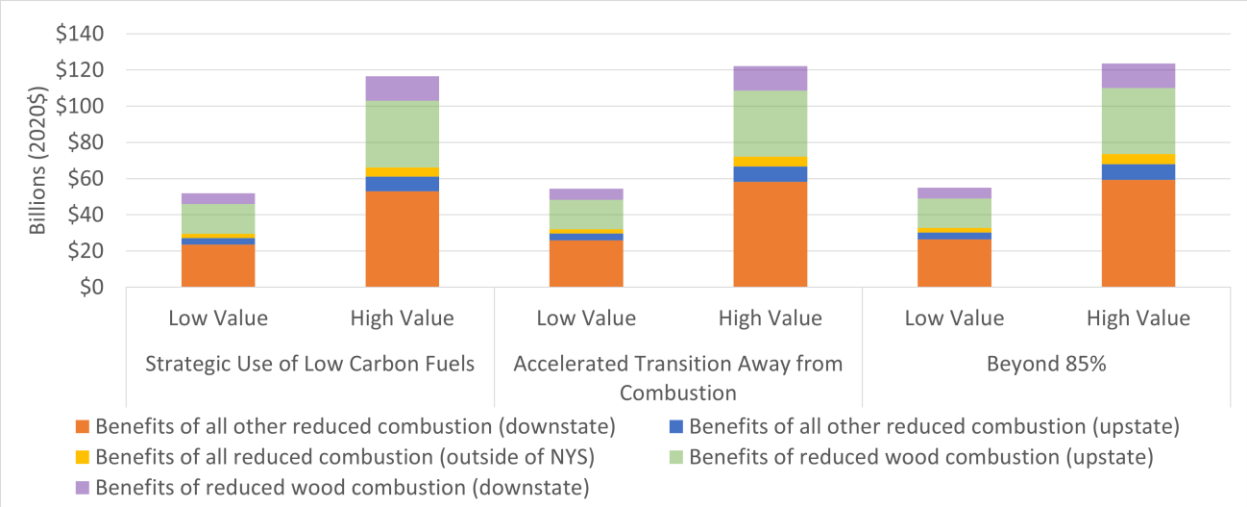



### *Ambient Air Quality Benefits*

In all scenarios, air quality improvements can avoid tens of thousands of premature deaths, thousands of non-fatal heart attacks, thousands of other hospitalizations, thousands of asthma-related emergency room visits, and hundreds of thousands of lost workdays.

The value of the benefits by scenario are presented in Figure 17. While a small amount of benefits would occur downwind of New York in neighboring states, the vast majority of benefits would occur within New York. A large portion of the projected benefits would result from reduced wood combustion. Benefits from reduced fuel combustion (excluding wood) would be larger Downstate, and benefits from reduced wood combustion would be larger Upstate. While the reduced wood combustion represents a small amount of the total reduced fuel combustion, it has an outsized impact on PM emissions, resulting in substantially high health benefits.

**Figure 17. Total Projected Ambient Air Quality Health Benefits (Net Present Value, 2020–2050)**




Benefits would increase over time as policies affecting emission reductions take effect, gradually increasing up to approximately $7 billion in the Low case and under $16 billion in the High case by 2050.

As presented in Figure 18, approximately 40% of the projected benefits are associated with reduced wood combustion in industrial, commercial, and residential uses. The remaining benefits are associated with relatively equal amounts from transportation (on-road and non-road) and building fuel combustion, and additional small fractions of the benefits are associated with reduced combustion in the electricity generation sector. While buildings and electricity generation have substantial emissions and ensuing health impacts locally, much of the building energy and power in New York is based on natural gas, which burns much cleaner and therefore has a substantially lower impact on PM emissions and public health than oil. Oil combustion can have a much larger health impact locally, but the quantities of oil used statewide are much smaller. However, despite having lower PM emissions than wood combustion overall, those oil and natural gas emissions from buildings do have a large impact on public health because they are in more populated urban areas, while wood combustion is more heavily weighted to rural areas with less dense population, resulting in similar health benefits from reducing wood and oil/gas (this is true also for renewable oil and gas). The benefits from substantially reducing or eliminating combustion in the electricity sector are on the order of 4%, and do not change materially in cases where limited hydrogen is combusted relative to non-combustion scenarios. For a sensitivity analysis of fuel options see Appendix G.

**Figure 18. Health Benefits by Sector (2020–2050)**

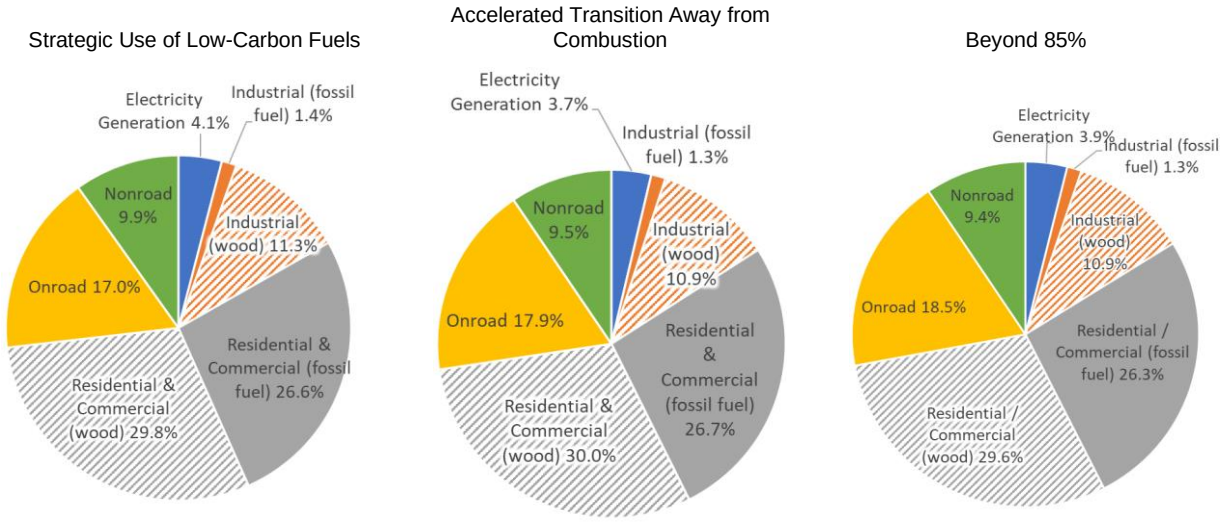
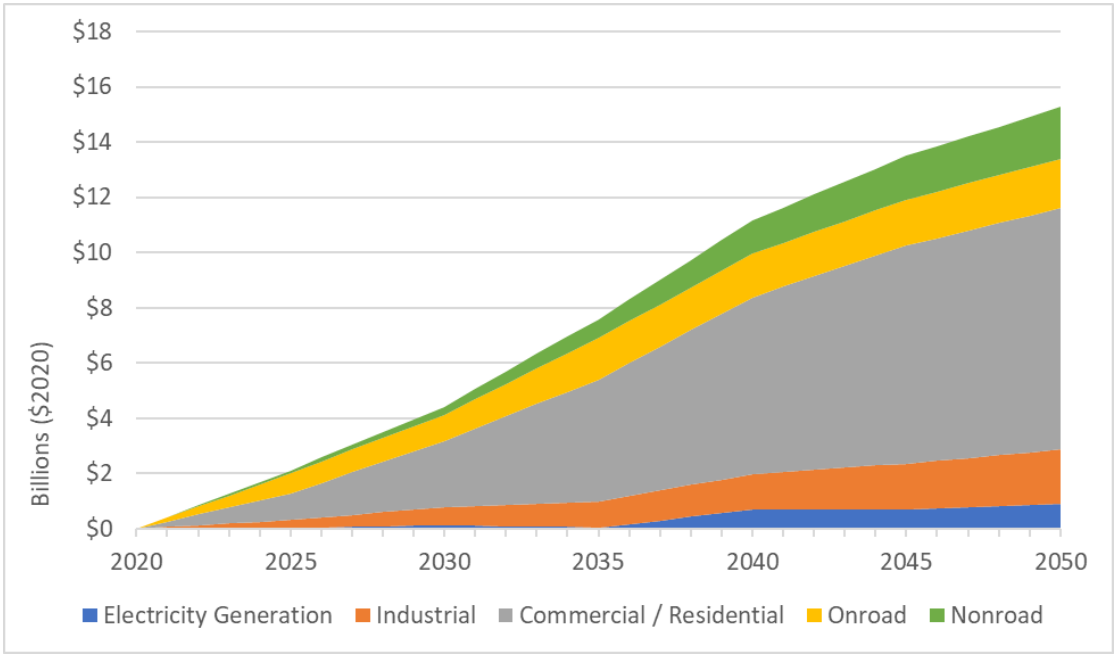



Figure 19 presents the annual health benefits (high value) by sector from the Strategic Use of Low-Carbon Fuels scenario, demonstrating the increasing benefits over time in all sectors. These sectoral results show that the majority of the benefits over time are due to emission reductions in the commercial and residential sector. In addition, these results show that the benefits from emission reductions in the electricity generation sector largely begin in 2040.

**Figure 19. Annual Health Benefits by Sector (high value) for the Strategic Use of Low-Carbon Fuels Scenario.**



The maximum annual average $PM_{2.5}$ concentration reductions by county projected to be achieved by 2050 are presented in Figure 20. Note that the concentration reductions in all three scenarios are very similar. The distribution of benefits per capita are presented in Figure 21, both with and without the benefits of wood combustion. While much higher benefits overall would accrue in urban areas due to the higher population, per-capita benefits are also higher in urban areas due to higher baseline health incidence and larger reductions in emissions (due to larger sources available to be reduced). The distribution of benefits is very similar in all three scenarios.

**Figure 20. Reduction in $PM_{2.5}$ Annual Average Concentrations, Strategic Use of Low-Carbon Fuels (2030 and 2050)**

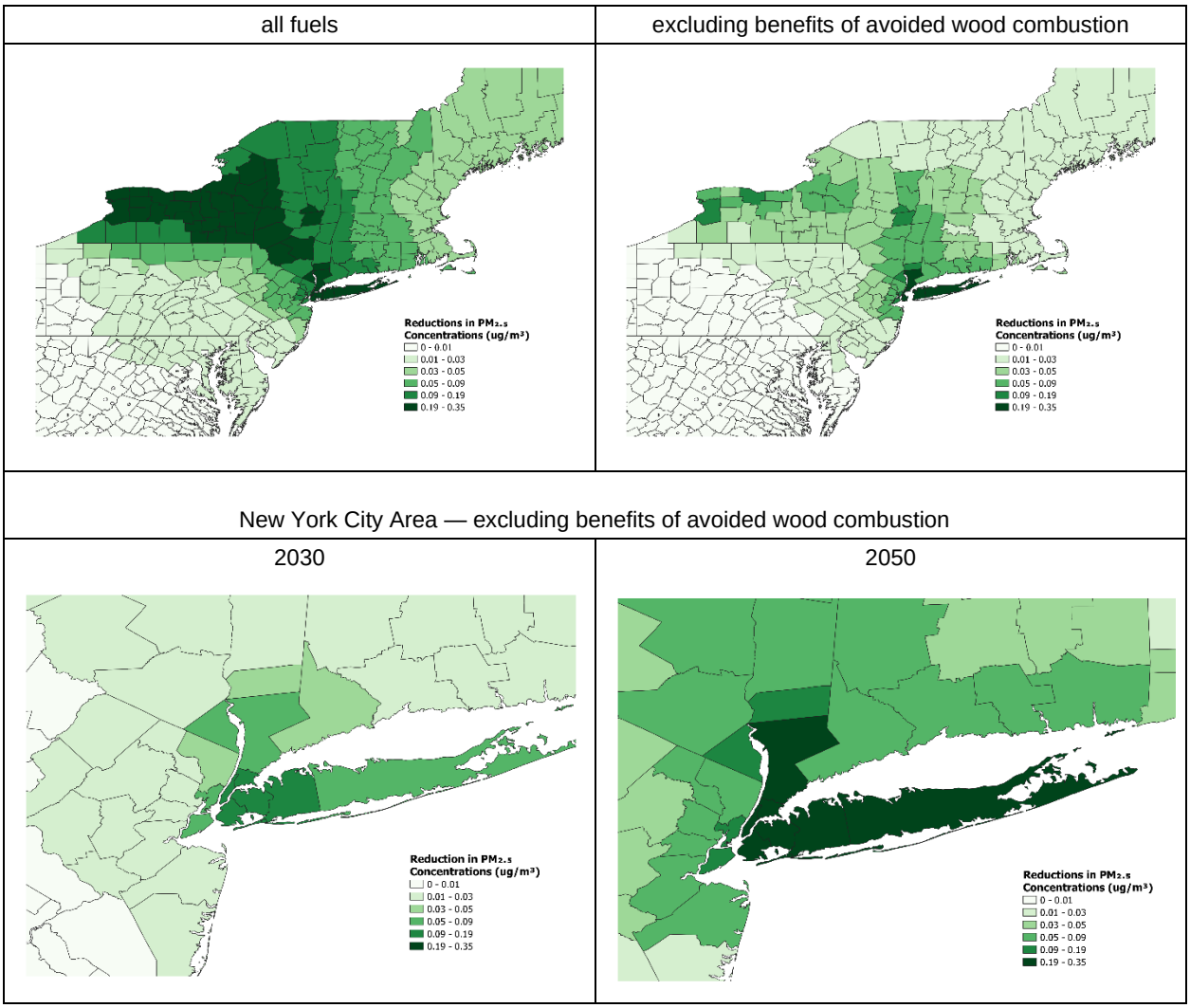
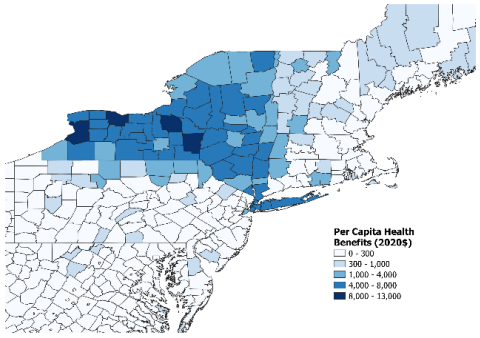
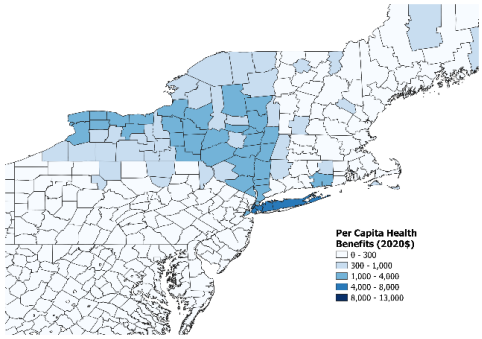
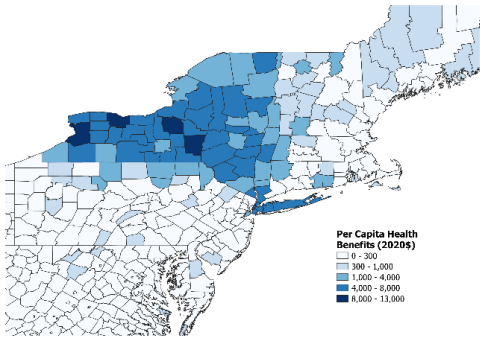
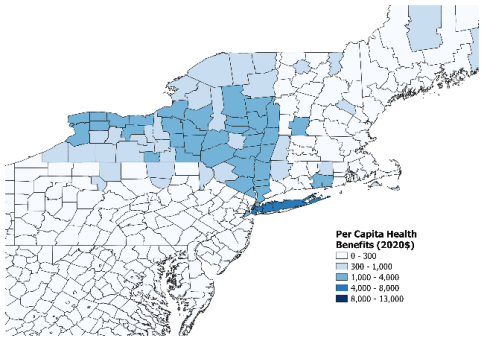
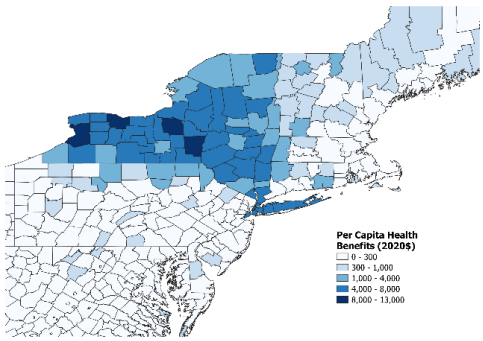
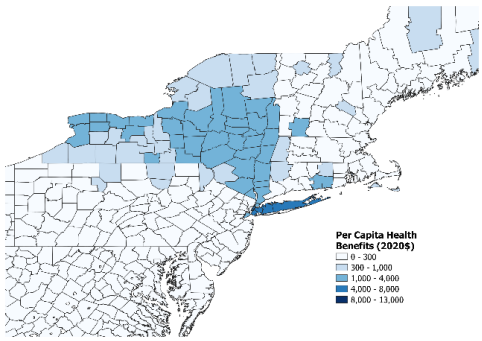
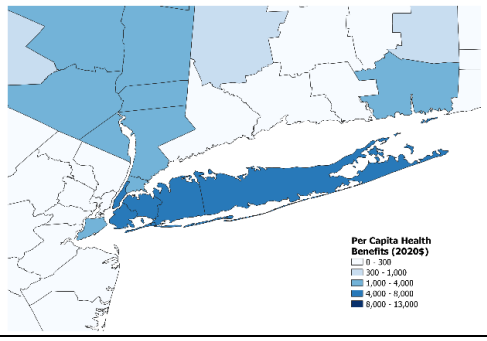


**Figure 21. Per Capita Health Benefits (2020–2050)**

| Scenario | all fuels | excluding benefits of avoided wood combustion |
|---|---|---|
| Strategic Use of Low-Carbon Fuel |   |   |
| Accelerated Transition Away from Combustion |   |   |
| Beyond 85% |   |   |

New York City area – excluding benefits of avoided wood combustion

| | Low-Carbon Fuels | Accelerated Transition | Beyond 85% |
|---|---|---|---|
| Bronx | $3,539 | $3,907 | $3,941 |
| Brooklyn | $4,532 | $4,894 | $4,944 |
| Manhattan | $5,263 | $5,648 | $5,685 |
| Queens | $5,907 | $6,347 | $6,440 |
| Staten Island | $3,092 | $3,317 | $3,359 |



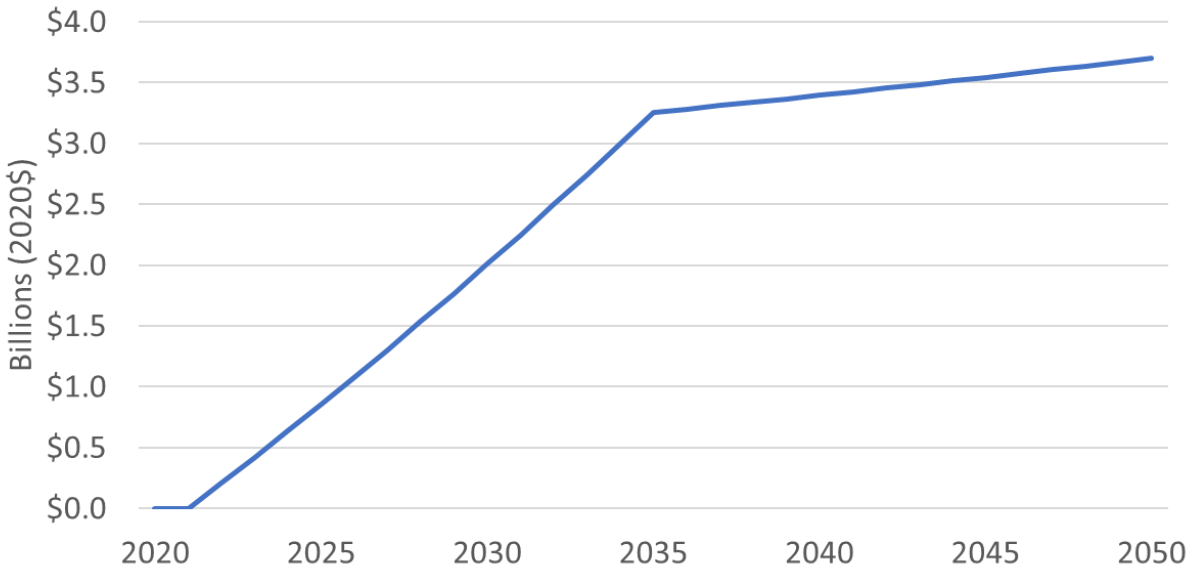

## *Health Benefits of Increased Active Transportation*

The potential value of the net reduction in the number of deaths, including the decrease in deaths from increased physical activity and the increase in deaths from traffic collisions, is estimated to be a NPV of

$39.5 billion (2020 to 2050). As presented in Figure 22, the values increase over the years as walking and cycling increases with the introduction of infrastructure and other measures to encourage the use of these modes. Note that the projected decrease in premature deaths from physical activity far outweighs the potential increase in deaths from traffic collisions.

Active transportation benefits are the same for the Low-Carbon Fuels and Accelerated Transition scenarios.

**Figure 22. Potential Annual Value of Public Health Benefits from Increased Active Transportation**




### *Health Benefits of Residential Energy Efficiency Interventions*

Health benefits in residential energy efficiency interventions are expected to result from several factors listed in Table 5. These do not include all the potential benefits, but rather only those for which sufficient study of benefits per intervention was available to apply to the New York scenarios. Not included, for example, are the benefits of indoor air quality associated with reduced indoor combustion of gas for cooking. Indoor air quality improvements can be achieved by ensuring appropriate ventilation (often in cases where ventilation and existing conditions were not appropriate prior to the intervention) combined with heat recovery where needed. Crucial to this benefit is ensuring appropriate ventilation when tightening building envelopes.

**Table 5. Health Benefits Included in the Analysis of Residential Energy Efficiency Interventions**

| Health-Related Measure | Causes for Each Benefit | Low-Income Single Family | Low-Income Multifamily |
|---|---|---|---|
| Reduced thermal stress – heat and cold | Building envelope tightening, appliance replacements | ☑ | ☑ |
| Reduced asthma-related incidents or reduced asthma symptoms | Improved ventilation | ☑ | * |
| Reduced trip or fall injuries | Removal of trip hazards, roofing improvements, lighting improvements | ☑ | ☑ |
| Reduced carbon monoxide poisonings | Appliance replacements, carbon monoxide monitors | ☑ | Not available |

* This was studied but no significant difference was detected.

In many cases, benefits occur due to programs ensuring that associated measures are taken at the same time, such as ensuring that carbon monoxide monitors are available where needed and that weatherization does not happen prior to fixing existing conditions such as mold.

The analysis was undertaken at high-level, applying the number of homes to average benefits from the existing studies. Benefits were estimated only for LMI homes. There are likely also benefits for higher income homes, but data to estimate those benefits is not available.

Benefits would be highly dependent on the structure of the interventions. Energy efficiency programs differ based on whether they include appliance replacement, building shell retrofits, or other non-energy interventions (such as installing carbon monoxide detectors).

Following the current practice in NYSERDA's energy efficiency programs, the analysis assumes that a range of non-energy measures would be included as appropriate in each case.

The projected benefits by health measure and building type are detailed in Table 6 and Table 7 for the Strategic Use of Low-Carbon Fuels and the Accelerated Transition Away from Combustion, respectively.

**Table 6. Potential Public Health Benefits of Energy Efficiency Intervention (2020–2050) — Strategic Use of Low-Carbon Fuels**

| Health-Related Measure | LMI Single-Family (billion $) | LMI Multifamily (billion $) | Total (billion $) |
|---|---|---|---|
| Reduced asthma-related incidents or reduced asthma symptoms | $3.0 | Not available | $3.0 |
| Reduced trip or fall injuries | $1.4 | $0.5 | $1.9 |
| Reduced thermal stress - cold | $0.4 | $0.9 | $1.2 |
| Reduced thermal stress - heat | $0.6 | $1.5 | $2.2 |
| Reduced carbon monoxide poisonings | $0.5 | Not available | $0.5 |
| **Total** | **$5.8** | **$2.9** | **$8.7** |

**Table 7. Potential Public Health Benefits of Energy Efficiency Intervention (2020–2050) — Accelerated Transition Away from Combustion**

| Health-Related Measure | LMI Single Family (billion $) | LMI Multifamily (billion $) | Total (billion $) |
|---|---|---|---|
| Reduced asthma-related incidents or reduced asthma symptoms | $3.0 | Not available | $3.1 |
| Reduced trip or fall injuries | $1.4 | $0.5 | $1.9 |
| Reduced thermal stress - cold | $0.4 | $0.9 | $1.3 |
| Reduced thermal stress - heat | $0.6 | $1.6 | $2.2 |
| Reduced carbon monoxide poisonings | $0.5 | Not available | $0.5 |
| **Total** | **$5.9** | **$3.0** | **$8.9** |

# Sector Strategies

# Chapter 11. Transportation

## 11.1 State of the Sector

### *Overview*

Historically, the evolution of transportation systems has served as a catalyst for economic growth, productivity, and land use and development patterns. Transportation investments significantly influence where economic growth ensues, at what rate that growth occurs, and the design and density of the built environment. The challenge is how to balance growth, facilitated by transportation, while mitigating harmful GHG emissions. Compounding this challenge are historically low motor fuel prices and individual consumers' preference for larger, less fuel-efficient vehicles. Short trips are often accomplished by single occupancy vehicles. Innovations in commerce—such as just-in-time delivery and dispersion of production facilities—have made delivery of goods more inefficient. Local residential land use and commercial development policies have driven unconstrained sprawl and thereby increasing VMT and congestion. These challenges present an opportunity for adopting mobility-oriented development (MOD) strategies through targeted transportation investments.

The challenge of achieving the Climate Act requirements should be approached strategically and with an eye toward recognizing the opportunity and delicate balance of facilitating transportation's role in economic growth with the need to address adverse community, environmental, and human health impacts. To fully implement the requirements of the Climate Act while maintaining economic competitiveness, the State needs the full support of complementary national, regional, and local strategies.

When considering how to reduce transportation GHG emissions, it is important to note that measures for reducing emissions from transportation are interconnected. Actions to achieve the Climate Act goals and requirements transcend the transition to ZEVs and include diversified mobility alternatives; promotion of denser, more diverse, better designed, and more transit-oriented land use and development policies; and implementation of market-based policies to influence travel decisions.

As of November 2021, one half of one percent of the over 9 million registered LDVs in New York were ZEVs.[148] To facilitate the level of transformation required by the Climate Act and accounting for growth

[148] Atlas Public Policy, "EValuateNY Vehicle Deep Dive" Accessed November 2021, https://atlaspolicy.com/evaluateny/.

in vehicle registrations, there will need to be approximately 3 million zero emission LDVs in use by 2030 and approximately 10 million zero emission LDVs in use by 2050. In addition, enhancing the availability, accessibility, reliability, and affordability of public transportation services, with an emphasis on unserved and underserved communities, as well as reimagining residential and commercial development utilizing MOD principles, will be integral to mitigating single-occupant discretionary vehicle trips, and associated vehicle congestion and harmful GHG emissions.

### *Vision for 2030*

**Emissions Overview**

The transportation sector was responsible for approximately 28% of the New York's GHG emissions in 2019, which includes road transportation (59%), non-road such as aviation (12%), emissions from imported fuels (26%), and HFCs used in vehicle air-conditioning and refrigeration (3%). Transportation sector emissions are about 16% higher today than they were in 1990. The transportation sector today is largely dependent on petroleum-based fuels such as gasoline, diesel, and jet fuel, but the State has made strong progress in transitioning from petroleum-based fuels to zero-emission technologies.

An aggressive and implementable mix of policies will be required to accelerate GHG emission reductions to the level needed by 2030. By 2030 nearly 100% of LDV sales and 40% or more of MHD vehicle sales must be ZEVs and a substantial portion of personal transportation in urbanized areas would be required to shift to public transportation and other low-carbon modes.[149] New York can achieve these goals through ZEV sales requirements and accompanying incentives and investments to help achieve these mandates, historic investments in expanded public transportation and micro-mobility, enhanced bicycle and pedestrian infrastructure, smart growth development, market-based policies that support lower-carbon transportation choices, and potentially a clean fuel standard that reduces the average carbon intensity of fuels as the transition to zero emissions vehicles proceeds.

The recommended policies are expected to result in as many as three million ZEVs (about 30% of LDVs and 10% of MHD vehicles) on the road by 2030.[150] Electric non-road equipment, such as those used in lawncare, construction, and farming, are expected to gain market share, especially in subsectors that are

[149] E3 Integration Analysis, as presented by Carl Mas to CAC on October 14, 2021, slides 18-22, Accessed at https://climate.ny.gov/-/media/CLCPA/Files/2021-10-14-CAC-Meeting-presentation.pdf.

[150] E3 Integration Analysis, as presented by Carl Mas to Climate Action Council on October 14, 2021, slides 18-22, Accessed at https://climate.ny.gov/-/media/CLCPA/Files/2021-10-14-CAC-Meeting-presentation.pdf.

most conducive to electrification. Hydrogen fuel cell vehicles are expected to begin to emerge into the market by 2030, primarily for some trucking and non-road applications less suited to electrification, and the State should begin investing prudently in the required supporting infrastructure to enable these vehicles to play a larger role in transportation emission reductions beyond 2030. Regional collaboration among states and coordination with the federal government will be needed to ensure that ZEV technologies can achieve the hoped-for growth trajectory. Supporting the development of companies in the ZEV supply chain can help create additional economic benefits and ensure a sufficient supply of these vehicles for New York State purchasers.

Because a large portion of vehicles on the road are expected to still use internal combustion engines in 2030, particularly in the MHD vehicle classes, one path to achieving 2030 emissions reduction targets would include strategies to make limited use of renewable diesel and other lower-carbon fuels to replace diesel in existing internal combustion engine vehicles until the transition to zero emission vehicles is complete. Policies like a clean fuel standard would be designed to displace fossil fuels with fuels and other energy carriers with lower emissions of GHGs and some co-pollutants, including green hydrogen and advanced biofuels, while also supporting electrification. Development of these policies would need to be mindful of the CJWG's admonition to avoid fuel policies that extend reliance on fossil fuel infrastructure or allow emissions from fuel combustion to continue to disproportionately impact Disadvantaged Communities. Another path to achieving 2030 emissions reduction targets requires accelerated ZEV adoption and early retirement of internal combustion vehicles. Additional incentives would be required to achieve these outcomes.

Significant increases in the availability of public transportation services and other zero-emission mobility alternatives in the State's urbanized areas should help reduce VMT by 2030. While mobility-on-demand strategies are expected to be adopted between now and 2030, this is primarily a longer-term emission reduction strategy. System efficiency improvements, such as traffic management systems and other congestion mitigation activities, can curb emissions through reduced idling and can be deployed immediately. Land use policies that shift travel to cleaner shared mobility alternatives or reduce discretionary single occupant VMT provide significant community benefits such as air quality improvements and reduce the number of ZEVs needed to meet GHG emission reduction requirements.

### *Vision for 2050*

By 2050, the transportation sector will need to shift nearly completely to ZEVs while substantially increasing the use of low-carbon transportation modes like public transportation, walking, and biking that

reduce the number of personal vehicle trips. LDVs and a large majority of MHD vehicles will be ZEVs. Marine operations and port facilities are envisioned to be 100% electric by 2050. Some segments of hard-to-electrify subsectors, such as aviation, freight rail, and potentially some MHD vehicles are expected to rely on green hydrogen and renewable biofuels (e.g., renewable jet fuel) to fully replace fossil fuel combustion if zero emission applications are not feasible. A large-scale investment in expanded public transportation and complementary modes of transportation like shared mobility, biking and walking infrastructure, and smart growth (higher density, mixed use development centered around low-carbon transportation options) will help make it easier for New Yorkers to travel without using a personal car. Trips are expected to be shorter, on average, because people will have easier access to jobs, schools, and services. Transportation system investments will reflect community needs and be appropriate for the people they serve.

Achieving this 2050 vision will require a mix of regulatory action and investment to achieve widespread ZEV adoption and additional incentives may be required to retire older internal combustion vehicles. The expansion of transportation options and smart growth development practices will rely on extensive investments at the State and local level alongside collaborations between State and local authorities to revise land use rules and coordinate on plans that create an integrated system for travelers choosing low-carbon transportation modes. Public-private collaboration and broad industry action are critical to bring the level of investment needed and to ensure New Yorkers have climate friendly transportation options available. Market-based policies will help fund the transition and send appropriate price signals.

Importantly, to achieve the 2050 vision, early action and investment will be needed in the early 2020s to ensure the availability and affordability of the future fuels and technologies, including but not limited to green hydrogen production, delivery, and applications; renewable jet fuel or other zero-emission aviation solutions; MHD ZEV engines; and infrastructure to support large-scale electrification including heavy freight solutions.

### *Existing Sectoral Mitigation Strategies*

New York uses less energy per capita for transportation purposes than any state in the nation due in large part to the extensive investment and utilization of public transportation services and compact land use patterns in the State's larger urbanized areas.[151] While these services help the State avoid more than

[151] U.S. Energy Information Administration, "More energy is used per person for transportation in states with low population density," Today in Energy, Accessed November 2021, https://www.eia.gov/todayinenergy/detail.php?id=44956.

17 million metric tons of GHG emissions each year, much more needs to be done to meet the Climate Act GHG emission reduction requirements. There are currently over 80,000 EVs on the road in the State and the number is rapidly growing, with sales in the first half of 2021 (approximately 18,000 EVs) exceeding the full-year sales in any previous year.[152]

New York's ongoing strategies to promote the transportation emissions reductions include:

- In 1990, DEC adopted California's Low Emission Vehicle program, requiring all new vehicles sold in the State to meet California emissions standards, which are more stringent than federal standards. The goal of the Low Emission Vehicle program is to reduce emissions of air pollutants including PM, $NO_X$, carbon monoxide, and VOCs. Reducing engine pollution protects the environment and the health of the State's residents.
- In 2013, the State initiated two major actions in transportation decarbonization programs. First, the State signed the light-duty ZEV memorandum of understanding, which formed the Multi-State ZEV Taskforce, a coalition of states working together to advance the deployment of ZEVs through policy research and marketing campaigns. Second, the State launched Charge NY, a series of initiatives that, over time, grew to include the Drive Clean Rebate program, offering up to $2,000 for EV purchases or leases; the New York State Truck Voucher Incentive program, offering incentives of up to $385,000 for the purchase or lease of electric trucks and buses; the Charge Ready NY program, offering $4,000 per Level 2 charging port; and awareness and educational campaigns.[153]
- In addition to State-level initiatives, many local-level jurisdictions and organizations, including counties, cities, utilities, and ports, are aggressively pursuing climate action and transportation GHG emissions reduction. For example, New York City is a member of the C40 Cities Climate Leadership Group that implemented a 2050 carbon neutrality goal (One NYC 2050 2020) and has already purchased more than 2,000 EVs for its fleet (NYC Sustainability Office 2020).
- To advance light-duty EV adoption, the State launched the Clean Fleets NY program in 2015, which supports deployments of EVs in State government fleets. In 2018, NYPA launched EVolve NY program, which complements Charge NY 2.0 with an additional $250 million investment in EV charging infrastructure, services, and consumer awareness efforts. In 2019, began a $31

[152] Atlas Public Policy, "EValuateNY," Accessed October 2021, https://atlaspolicy.com/evaluateny/.

[153] The PSC made a declaratory Ruling that it did not have jurisdiction over (1) Charging Stations; (2) the owners or operators of Charging Stations, so long as the owners or operators do not otherwise fall within the Public Service Law's definition of "electric corporation;" or (3) the transaction between such owners or operators of Charging Stations and members of the public.

million program to address demand charges for DC fast charging devices, investor-owned utilities began offering a per plug incentive that tapers down over seven years.

- Through the New York Truck Voucher Incentive Program, the State aims to accelerate the deployment of all-electric and alternative fuel trucks and buses in MHD vehicle classes throughout the State. NYSERDA administers the program, which currently offers $53.9 million in funding and uses funds from the Volkswagen settlement overseen by DEC and the Congestion Mitigation and Air Quality Improvement program overseen by the New York State Department of Transportation (DOT). New York also directed Volkswagen settlement funds ($9.9 million) to the New York City Clean Trucks Program, which replaced diesel trucks in New York City industrial business zones that are within defined environmental justice areas.
- In July 2020, New York announced two new sweeping programs. First, New York was one of 15 states to sign a MHD ZEV memorandum of understanding, with the goal of having 30% of MHD vehicle sales be ZEVs by 2030 and 100% by 2050. Second, New York announced a $701 million Make-Ready program, through which investor-owned utilities pay up to 100% of the costs of electric facilities necessary to make sites ready for EV charging of 850,000 LDVs by 2025.
- NYSERDA and the electric utilities are required by the electric vehicle supply equipment Make-Ready order of 2020 to undertake feasibility studies for MHD fleets, including for school districts & transit agencies, to identify benefits, costs, logistical challenges, financing options, other barriers to electrification. By bearing these soft costs, the State is providing fleet managers with the financial information necessary to make the case for investment in zero emission fleets.
- Clean Air NY is a marketing and outreach program in the New York City metro area sponsored by DOT to educate travelers about the small changes they can make every day in their transportation choices. The goal is to reduce the number of VMT and improve air quality. The year-round program, formerly called Ozone NY, includes Air Quality Action Day notifications, indicating unhealthy levels of PM and/or ozone as forecast by DEC.
- The 2011 New York State Complete Streets Act requires agencies to consider the convenience and mobility of all users, including pedestrians and bicyclists, when developing transportation projects that receive State and federal funding. This initiative presents an opportunity to expand upon existing programs and collaborate with bicyclists, pedestrians, people with disabilities, and others to identify best practices and designs for transportation facilities.
- The State uses federal funding through the Transportation Alternatives Program and the Congestion Mitigation and Air Quality Improvement Program, which is available to State and local governments for zero emission transportation-related projects/programs (active transportation), and projects/programs to help address the requirements of the Clean Air Act.

- Active transportation safety is promoted through projects developed under the State's Pedestrian Safety Action Plan. This five-year, multi-agency initiative provides $110 million to improve safety for pedestrians through infrastructure improvements, public education efforts, and enforcement across upstate and Long Island. This draft Scoping Plan calls for a systemic approach to proactively address widespread safety issues and minimize the potential for crashes by implementing low-cost improvements throughout the roadway network.
- The State provides nearly $6 billion in direct and State authorized support for public transportation services, more than 46 other states combined. This support is intended to maintain and enhance service levels; ensure passengers fares are reasonable and equitable; and support environmental/climate and economic goals. Due in large part to downstate transit use, the State's per capita motor fuel consumption is the lowest in the nation.
- New York is also supporting municipally sponsored public transportation services transition to ZEVs through a multi-year funding commitment to provide the incremental cost of procuring all-electric buses.

These ongoing GHG emission mitigation and air quality improvement strategies contributed to New York's transportation sector progress over the last decade. The variety of these current strategies underscores the need to consider a wide range of new and enhanced strategies to further improve air quality and reduce GHG emissions. It will take a variety of strategies working in concert to limit the negative effects of climate change and create a sustainable transportation system in New York that serves all its users.

### *Key Stakeholders*

Key stakeholders responsible for the successful implementation of proposed transportation sector strategies include:

- **Transitioning to ZEVs and equipment:** DEC, NYSERDA, DOT, DPS, New York City Department of Buildings, New York State Department of Motor Vehicles, New York State Office of General Services (OGS), DOS, New York State Education Department, NYPA, Dormitory Authority of the State of New York (DASNY), NY Green Bank, PANYNJ, MTA, New York City, utility companies, automotive original equipment manufacturers, EV charging station providers, car and truck dealers, port operators, transit agencies/authorities/municipal sponsors, and the New York Legislature
- **Enhancing public transportation and mobility alternatives:** NYSERDA, DOT, DPS, OGS, DOS, NYPA, MTA, utility companies, bus manufacturers, and transit agencies/authorities/municipal sponsors

- **Reduce VMT:** DEC, NYSERDA, DOT, DPS, DOS, NYSTA, NYPA, ESD, MTA, New York City, New York State Council on the Arts, transit agencies/authorities/municipal sponsors, local governments, companies providing mobility services, major New York employers, and the New York Legislature
- **Market-Based Solutions and Financing:** DEC, NYSERDA, DOT, DPS, New York State Department of Motor Vehicles, New York State Education Department, New York State Department of Taxation and Finance, NY Green Bank, and local governments

## 11.2 Key Sector Strategies

The key strategies within this sector are organized into four themes, as shown in Table 8.

**Table 8. Transportation Sector Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Transitioning to ZEVs and Equipment | T1. Light-Duty ZEV Adoption<br>T2. Adoption of Zero-Emission Trucks, Buses, and Non-Road Equipment |
| Enhancing Public Transportation and Mobility Alternatives | T3. Community-Based Service Enhancements<br>T4. Customer Convenience and Service Connectivity<br>T5. Fleet Modernization and Electrification |
| Smart Growth and Mobility-Oriented Development | T6. Mobility-Oriented Development<br>T7. Smart Growth Public Education and Awareness<br>T8. Expanding the Availability of Low-Carbon Active Transportation Alternatives<br>T9. New Technology Integration |
| Market-Based Solutions and Financing | T10. Transportation Sector Market-Based Policies<br>T11. Unlock Private Financing<br>T12. Lower Carbon Renewable Fuels |

Recognizing that there is no one-size-fits-all statewide strategy for effectively reducing emissions from the transportation sector and transitioning to zero-emission technologies, the Council expects many of the strategies necessary to achieve the Climate Act's ambitious requirements and goals will be informed through extensive engagement and outreach with affected communities, with an emphasis on overburdened and LMI areas.

### *Transitioning to Zero-Emission Vehicles and Equipment*

Transitioning the transportation sector to zero-emission technologies is central to achieving the State's GHG emission reduction requirements. In most cases this means replacing existing vehicles that run on gasoline or diesel fuel with either battery electric, hydrogen fuel cell or future zero-emission propulsion

technologies. Zero-emission vehicles and their related infrastructure present an economic development opportunity as well, offering a chance to build on New York's robust historical involvement in manufacturing and supplying vehicles and vehicle components. Other advanced clean fuels will play a role in decarbonizing hard-to-electrify segments of the transportation sector.

On September 8, 2021 Governor Kathy Hochul signed legislation establishing a goal for all new LDVs and non-road vehicles sold in the State to be zero-emission by 2035 and all new MHD vehicles to be zero-emissions by 2045.[154] To help meet the State's Climate Act requirements and goals, New York should take regulatory and programmatic actions to achieve these goals. The strategies proposed aim for an even more rapid transition to ZEVs, achieving close to 100% ZEV sales for LDVs by 2030, 50% ZEV sales of medium-duty vehicles by 2030, and 80% ZEV sales of heavy-duty vehicles by 2035, which the integration analysis indicates will position the State to meeting the Climate Act requirements.

The strategies to achieve these goals involve expanding light-duty ZEV adoption and converting trucks, buses and other MHD vehicles to ZEVs.

### *T1. Light-Duty Zero Emission Vehicle Adoption*

There are approximately 9 million LDVs in New York, which make the emissions from LDVs the largest component of transportation emissions.[155] Since 2010, sales of light-duty ZEVs have increased and in 2021 account for more than 3% of all LDV sales and about 1% of all LDVs on the road. Light-duty ZEVs have come down in price compared to their petroleum-fueled counterparts but are still comparatively more expensive; they are expected to reach price parity from a total cost of ownership perspective in the next two to four years and from a purchase price perspective later in the 2020s. Most light-duty ZEVs are expected to be battery electric, but hydrogen fuel cell vehicles are emerging into this market, primarily in California. A key challenge is that most of these vehicles are owned by individuals, who will each have to make their own purchase decisions if the State is to meet its Climate Act requirements and goals. Achieving the aggressive transition in this market will require a mix of regulations, incentives (which will require identifying new sources of funding), and removal of market barriers and depends on industry greatly accelerating the expansion of production capacity for these vehicles. Incentives for EVs and charging stations are expected to be needed primarily over the next five to 10 years, as the market for ZEVs reaches maturity. Enhanced incentives for LMI consumers will help achieve the air quality benefits

[154] Chapter 423 of the Laws of 2021.

[155] Atlas Public Policy, "EValuateNY," Accessed October 2021, https://atlaspolicy.com/evaluateny/.

of these vehicles in Disadvantaged Communities. Incentives for hydrogen fuel cell vehicles may be needed for longer, as they are expected to take longer to enter the market in significant quantities.

The CJWG enthusiastically encourages a rapid transition to ZEVs, although it cautioned that focusing on providing access to transit and lower-cost options for transportation, rather than just personal vehicles, is critical for LMI New Yorkers. The CJWG also expressed concern about investment in EVs leaving the State. Of course, most of the billions of dollars that New Yorkers spend on petroleum-based fuels each year leaves New York; accordingly, the State should continue supporting the development of businesses in the ZEV supply chain to ensure that the ZEV transition is economic benefits the State's residents economically.

### Components of the Strategy

- **Adopt California's Advanced Clean Cars 2 Regulations:** California is currently developing the Advanced Clean Cars 2 regulations that are expected to require 100% light-duty ZEV sales by 2035. DEC should adopt these regulations once they are finalized in California. California is also pushing to electrify for-hire vehicles through a clean-miles standard, which the State could also adopt or take other approaches to electrifying these vehicles, such as providing targeted incentives for fleet ZEV purchases and charging/fueling stations.
- **Provide enhanced ZEV purchase incentives:** ZEVs are approaching price parity with petroleum-fueled vehicles and the price of battery EVs is expected to eventually fall below that of their petroleum equivalents. Offering strategic incentives will accelerate ZEV production, price parity, and purchases. New York should enact legislation to establish a "feebate" program that would offer direct rebates for ZEV purchases supported by imposing a fee on purchases of fossil fuel vehicles. The fee and rebate levels should be dynamic in response to market conditions and ambition levels. Such a program can be designed to be revenue-neutral and can incorporate other policy goals, such as higher rebates for LMI customers and exemptions from the fee for lower-priced vehicles purchased largely by LMI consumers. Feebates should be applied to new car sales, but there should be an additional rebate for used ZEVs targeted toward LMI customers, which could be paired with affordable financing options. Although each scenario under consideration relies heavily on LDV electrification, the scenario that relies more heavily on expedited electrification will require the establishment of additional incentives to retire internal combustion vehicles early.
- **Enhance ZEV awareness and reduce sales barriers:** New York should enact legislation to expand direct-to-consumer sales of ZEVs by manufacturers, which can serve to increase the

availability and sales of ZEVs in the State; the State should provide dealer incentives for franchise car dealers to sell ZEVs; and NYSERDA should partner with industry participants and stakeholders to fund consumer engagement activities to increase consumer interest in ZEVs.

- **Invest in and remove barriers for ZEV charging and fueling infrastructure:** To support the level of ZEV adoption anticipated by 2030, New York must quickly increase the number of EV charging stations and hydrogen filling stations in the State. New York should fund rebates or investment in EV charging stations and hydrogen filling stations, either directly through programs run by NYSERDA and/or NYPA or through market-based mechanisms like a clean fuel standard that would generate resources for ZEV infrastructure. All financing and ownership models should be considered. As part of the State's focus on investments in Disadvantaged Communities, programs in this area should focus on charging at multi-unit dwellings and convenient urban fast charging, especially in areas with less access to home charging, Strategies should also prioritize fast charging along travel corridors and support, and market segments that have been slow to attract private investment, including hydrogen fueling stations for appropriate applications. DOS should incorporate EV charging into building codes to ensure new construction is EV-ready.
- **Enact utility rate design changes:** The PSC should direct utilities, as appropriate, to implement programs that offer lower rates for or otherwise encourage off-peak charging and/or controlled, managed charging. The PSC should further examine the effectiveness of its per plug incentive program to determine if it offers sufficient opportunities to reduce operating costs that support the near-term build-out of public and fleet charging infrastructure to make this type of charging more cost effective when utilization is low or whether a change should be considered in the structure of demand chargers that is cost-based and nondiscriminatory. The PSC and NYSERDA should also consider how to maximize the value of ZEVs as grid-interactive assets and storage devices, which could potentially lower electric grid upgrade costs and generate revenue for ZEV owners, and whether any policy changes are required to enable these use cases. These changes will be relevant to both LDVs and MHD vehicles.
- **State fleet:** Procurement targets, with appropriate funding allocated, should be established to operationalize the State's announced November 2021 commitment to a fully zero emission State fleet of passenger vehicles by 2035. DEC should continue supporting municipal ZEV acquisition by providing rebates under the Climate Smart Communities program.

### *T2. Adoption of Zero-Emission Trucks, Buses, and Non-road Equipment*

Converting New York's trucks, buses, and non-road equipment (including construction and farm equipment) to zero-emissions technologies plays a dual role of both reducing GHG emissions from a

major source and reducing local air pollution from one of the most significant sources of poor air quality and adverse health impacts. Trucks and buses and non-road equipment are just starting to transition from diesel fuel to electricity as more options become available, but electric trucks, buses, and equipment are still much more expensive than their diesel counterparts. The transition to ZEVs for this subsector will entail a mix of battery electric and hydrogen fuel cell vehicles, which are just beginning to emerge into the market. Achieving the aggressive transition in this market will require a mix of regulations, incentives (which will require identifying new sources of funding), and removal of market barriers and depends on industry greatly accelerating the expansion of production capacity for these vehicles. Incentives for EVs and charging stations are expected to be needed primarily over the next 10 to 15 years, as the market for ZEVs reaches maturity. Incentives for hydrogen fuel cell vehicles may be needed for longer, as they are expected to take longer to enter the market in significant quantities.

Diesel trucks and port equipment are one of the largest sources of local air pollution in Disadvantaged Communities. Although they comprise only a small portion of total vehicles in the State, diesel trucks and buses are responsible for 30% of total PM and $NO_X$ emissions from mobile sources. Replacing diesel trucks and port equipment with ZEV trucks and equipment would have a substantial impact on improving air quality statewide, especially in Disadvantaged Communities.

The CJWG enthusiastically encourages a rapid transition to ZEVs, especially for MHD vehicles. Consistent with CJWG input, this Plan prioritizes MHD ZEV incentives in air pollution-overburdened communities for vehicles such as port equipment, refuse trucks, local delivery vehicles, construction equipment, and both transit and school buses and an accelerated transition of the State's fleet vehicles to ZEVs.

### Components of the Strategy

- **Adopt California's Advanced Clean Trucks regulations:** In 2020 California promulgated the Advanced Clean Trucks regulations that require an increasing percentage of new zero-emission MHD truck sales annually through 2035. In September 2021, DEC proposed to adopt the Advanced Clean Trucks regulation under 6 NYCRR Parts 200 and 218.[156] In accordance with the legislation signed by Governor Hochul, DEC should finalize the adoption of these regulations. DEC should also consider adopting additional regulations, such as California's proposed Advanced Clean Fleets regulation currently under development, that would provide a regulatory

[156] XLIII N.Y. Reg. 11-15 (Sept. 8, 2021).

framework for 100% MHD ZEV sales by 2045 or earlier (e.g., Advanced Clean Fleets would require 100% MHD ZEV sales by 2040). These regulations could be targeted to the type of fleets operating in overburdened communities and, like California, exclude smaller fleets largely operated by small businesses. In accordance with the legislation signed by Governor Hochul cited above, DEC should consider regulatory options, consistent with federal law, for requiring 100% ZEV sales for non-road vehicles by 2035.

- **Provide enhanced ZEV purchase incentives:** ZEV trucks, buses, and non-road vehicles are significantly more expensive than diesel equivalents today. While the cost of ownership is becoming more cost-competitive, targeted incentives will be needed to facilitate the transition to emerging ZEV technologies. The State should fund direct incentives supporting the purchase of ZEV trucks and buses, with a focus on fleets operating in LMI and overburdened communities, small fleets, and school buses, as well as non-road vehicles and equipment such as airport ground support equipment, port cargo handling equipment, construction, and farm equipment. The State should also provide incentives or offer buybacks for small engines, including electric yard and garden equipment and small marine vessels, and encourage local electrification requirements.
- **State fleet:** Procurement targets, with appropriate funding allocated, should be established to operationalize the State's November 2021 commitment to a zero-emission State fleet of medium- and heavy-duty vehicles, where technically feasible, by 2040.
- **Require ZEV equipment use for State contractors and at targeted facilities:** To further encourage ZEV adoption, New York should enact legislation that establishes procurement and contracting rules to increase the percentage of zero-emission equipment and vehicles used for State-funded projects to be ZEVs (including contractors and subcontractors), based on production and availability, to align with New York's November 2021 commitment to converting 100% of public medium- and heavy-duty fleet (where technically feasible) to ZEVs by 2040. DEC should also adopt regulations similar to California's Advanced Clean Fleets proposal that require MHD trucks in use at, or accessing, certain types of facilities such as ports or intermodal railyards to be ZEVs by a set date. The date should be determined based on truck vocation, product, and related infrastructure availability.
- **Invest in ZEV charging or fueling infrastructure:** Similar to LDV infrastructure, the State should provide rebates or direct investment in EV charging stations and hydrogen filling stations, where market support is needed. Preference for investments would be provided to fleets adversely impacting LMI communities that have been disproportionately burdened by the impacts of air pollution. DPS should continue to work with the utilities to plan for expected service levels

needed to support the electrification of MHD fleets, especially in Disadvantaged Communities where such depots tend to cluster.

### *Enhancing Public Transportation and Mobility Alternatives*

One of the more impactful supporting strategies for achieving the Climate Act's energy efficiency, housing, and land use GHG emission reduction requirements is through enhancing the availability, accessibility, reliability, and affordability of public transportation services with an emphasis on unserved and underserved communities. The strategies to achieve these goals involve service enhancements, MOD, convenience and connectivity, and fleet modernization. For the purposes of the scoping discussion, public transportation includes but is not limited to transit, micro-transit, shared mobility, and longer distance passenger rail services.

### *T3. Community-Based Service Enhancements*

MTA enhancements will focus on policies and programs that support system reliability, resilience, and network expansion projects identified in their current five-year capital plan/twenty-year needs study. Recognizing that the service needs of communities will vary throughout the state, enhancements are intended to be locally derived and tailored to achieve the maximum utilization and GHG emission reductions. This may include but not be limited to increasing the number of routes, increasing service frequency, increasing the number of scheduled stops to facilitate last mile connectivity, introducing demand response services, partnering with mobility providers, providing direct connectivity to longer-distance bus and passenger rail services, or a combination of these and other service modifications. Providing and expanding access to public transportation in the context of business location and economic development will help provide access to jobs and reduce the time and expense to commute to places of employment.

Feedback from the CJWG included the need to provide more detail on what specific public transportation enhancement were proposed and how enhancements would be identified and accomplished. As detailed below, these issues are intended to be addressed through context appropriate community-based discussions. The CJWG emphasized the need to think beyond traditional urban public transit and enhance inter-regional rail transportation.

Downstate services provided by municipalities other than the MTA is defined as services provided, directly or under contract by municipalities in the Metropolitan Commuter Transportation District as designated in Section 1262 of Public Authorities Law.

### Components of the Strategy

- **Identify, Plan, and Implement Service Enhancements:** The State should work with communities and service providers to design strategies that increase utilization of public transportation alternatives. Public transportation service enhancements are intended to be further informed through community-based discussions. For example, availability/accessibility may refer to an increase of service hours/frequency; an increase in routes; and/or an increase in the number of stops along a route. It is anticipated that a combination of approaches will be required in most communities.

In addition to State agencies identified as key stakeholders for the transportation sector, others responsible for the implementation of these strategies include the federal departments of Transportation, Housing and Urban Development, Energy, and the EPA.

## *T4. Customer Convenience and Service Connectivity*

In addition to providing high-quality amenities at public transportation facilities/stops, including sidewalks, seating, lighting, electronic customer information (next-bus); the State should assess ways to implement strategies for making public transportation easier to use and more competitive on a travel time basis, including simplified and integrated fare media; dedicated bus lanes and intelligent transportation/bus signal prioritization; and deploying new phone-based applications technologies that makes public transportation more logical/easier to understand. These enhancements will facilitate increased use of public transportation in support of the goal of reducing VMT. Current efforts underway in the State to enhance convenience and connectivity include the implementation of micro-mobility services in the Capital Region; the realignment of services to support jobs and job training in the Finger Lakes Region; and the deployment of new integrated service, trip planning, and fare payment apps in the Southern Tier Region.

The CJWG supported increased investments in enhanced public transportation alternatives and noted that doing so creates jobs in local communities offering employment opportunity for disadvantaged workers. In addition, the CJWG suggested to incentivize hiring of disadvantaged workers in transit manufacturing by enabling companies to get a credit for setting aside a certain proportion of their workforce for hiring them.

### Components of the Strategy

- **Improve Public Transportation Ease of Use:** The State should facilitate the development and implementation of strategies for making public transportation easier to use. This includes working with the public and private sector on a simplified and integrated statewide fare media and deploying new phone-based applications technologies that makes public transportation more logical and easier to navigate.

## *T5. Fleet Modernization and Electrification*

Recognizing that bus maintenance/service facilities are historically more likely to have been located near or within LMI communities, the State is committed to accelerating the deployment of zero-emission buses, which will mitigate GHG emissions and noise pollution. As part of this transition, the State will support electrification of buses and other service vehicles appropriate for the communities being served.

The CJWG requested more detail to confirm what "make ready costs" include. As described below, the term "make ready costs" in this context is intended to describe the utility infrastructure costs associated with bringing the power needed/building modifications to bus support facilities to facilitate electric bus charging.

### Components of the Strategy

- **Transition to Zero Emission Public Transportation Fleets:** The State should work with municipally-sponsored public transportation systems on a plan to transition to all-electric/zero-emission public transportation vehicles at defined replacement schedules appropriate for the transit provider. The State has already taken action to implement this strategy by:
    - Committing more than $100 million toward the electrification of 25% of the five largest fleets, outside the MTA, by 2025 and 100% by 2035. MTA has committed to purchase only electric buses after 2029 and to fully electrify its fleet by 2040.
    - Directing a significant portion of $45 million in funding available through the Volkswagen Settlement Funds to assist public transportation providers with the replacement of existing diesel buses with more than 100 all-electric transit buses.
    - Expanding Charge Ready NY incentives for Disadvantaged Communities and enhancing options for electric transit bus procurements.
    - Supporting the deployment of all electric transit buses through the New York Truck Voucher Incentive Program.

- Improving electric fleet economics for developers by supporting the Make-Ready program, which promotes EV charging station deployment.

Barriers to implementation include funding as well as federal "payback" if vehicles financed with federal funds are replaced prior to the end of the Federal Transit Administration–rated service life.

In addition to State agencies identified as Key Stakeholders in *11.1. State of the Sector*, others involved in the implementation of these strategies include the U.S. Department of Transportation and the municipal owners of the vehicles and infrastructure.

### *Smart Growth and Mobility-Oriented Development*

Smart growth land use patterns facilitate reductions in GHG emissions in the transportation sector by reducing VMT, increasing the viability and practicality of low-carbon transportation modes, and decreasing the travel distance between locations through a denser concentration and mix of residential and commercial development. Personal travel is often enhanced by the increased availability of mobility alternatives, including walking, biking, and public transportation. Taking a holistic approach to community development and MOD can help expand transportation options and economic opportunity. Strategies like MOD and expanded mobility options reduce the environmental footprint of transportation on communities and provide increased access to existing services such as healthcare, retail, hospitality, and entertainment while attracting new services, and can be designed to encourage mobility-rich affordable neighborhoods.

Smart growth strategies to reduce transportation GHG emissions fall within four categories: MOD, public education and awareness, expanding the availability of low-carbon transportation alternatives, and new technology integration. A broader set of smart growth strategies and recommendations are contained within *Chapter 19. Land Use*. Expanding site or facility re-use planning assessments and studies should include assessments of utility infrastructure and capacity to support electric vehicle supply equipment.

### *T6. Mobility-Oriented Development*

To reach GHG emissions reduction requirements, the State should place greater emphasis on programs and projects that that enable greater use of public transportation and other low-carbon mobility alternatives and investments that are informed by criteria that maximize sustainable land use/development patterns and climate outcomes. Because smart growth and new development happens over decades, starting as early as possible is important. Strong collaboration between the State and local governments is critical for these strategies to be effective, as most land use decisions fall under the purview of local

governments. These strategies may not be applicable in every community, but many different variations on MOD are possible in communities of different sizes. The CJWG has been supportive of the expansion of low-cost transportation options accessible to underserved communities, a key element of MOD.

While the State currently incorporates public transportation needs into efforts to attract and retain businesses, New York should implement incentives and policies for businesses and localities for development located adjacent to and integrated into public transportation services, including tax credits for businesses that accommodate non-vehicular commuting, such as Employee-Based Trip Reduction programs; low-/no-cost transit passes for employees; micro-transit options for employees; ride-sharing programs; bike-sharing; and cycling accommodations.

Examples of integrated supportive policies and incentives to facilitate MOD include:

- **Capital District Transportation Authority:** Recognizing that there is no one size fits all mobility solution, working with the communities that make up the multi-county transportation district, Capital District Transportation Authority has implemented an innovative and diversified range of mobility alternatives, including several high frequency/high quality bus rapid transit lines; regional ride-matching; bicycle and electric scooter sharing; and micro-transit services. The goal is to support rezoning and development that is occurring within the central business districts of Albany and Troy and to promote sustainability and environmental stewardship.
- **MTA/Developer Collaboration on One Vanderbilt Development Project (adjacent to Penn Station):** MTA worked with City Zoning and the developer early to secure transit access improvements (such as easements, stairways, and elevators) at the developer's expense in exchange for added density.
- **Niagara Frontier Transportation Authority Metro Amherst Extension:** The Niagara Frontier Transportation Authority and Town of Amherst planners are developing proposed plans and zoning to promote both TOD and MOD along the proposed extension of the City's Metro light rail system into the town.

### Components of the Strategy

- **Coordinate investments in MOD:** New York should establish an inter-agency, multi-stakeholder, multi-disciplinary strategy to coordinate investments in and around mobility centers, which should include DOS, DOT, ESD, DASNY, DEC, NYSERDA, and other relevant agencies.
- **Tie incentives for business development to mobility access:** ESD should expand and institutionalize its initiatives to incorporate public transportation needs into efforts to attract and retain businesses. This includes implementing incentives and policies for developments that are

located adjacent to and integrated into public transportation services, including incentives for businesses to accommodate non-vehicular commuting, such as employee-based trip reduction programs; low-/no-cost transit passes for employees; micro-transit options for employees; ride-sharing programs; bike-sharing and scooter-sharing; and cycling accommodations.

- **Revise design manuals:** To further guide MOD, DOS should facilitate, in cooperation with municipalities, the reimagining of the design manual used by local governments and developers for the construction of buildings, roadways, parking, and bicycle and pedestrian amenities. This updated manual should address both public infrastructure and buildings and how they can be designed to support clean transportation options. DOS should support municipalities in eliminating or reducing parking minimums and maximizing access to other mobility alternatives.

Examples of such incentives currently in place include:

- **Onondaga Industrial Development Authority:** Developers seeking tax credits receive preference for proposals that incorporate transit-accessibility into their proposals. If a development requires transit service, they must address the issue in their proposal before submitting a request for a tax incentive.
- **Buffalo Green Code's Transit-Supportive Development Incentives:** The City's form-based code will grant a "zero-parking" waiver to projects that meet the criteria for being "transit-supportive," developers must also submit transportation demand management plans to qualify.

- **Designate priority development areas:** DOS and ESD should designate priority development areas to concentrate development and make it easier to build in areas that facilitate low-carbon transportation modes. Development incentives should focus on building transportation-related infrastructure in these areas. Such an initiative would provide the greatest climate and public health benefits when combined with other Climate Act strategies, including housing and power generation. Additionally, such an effort should consider and not conflict with New York State Homes and Community Renewal (HCR) Well-Resourced areas.

### *T7. Smart Growth Public Education and Awareness*

Public perception is critical to understanding and expanding smart growth. There are common misperceptions about its principles and their effects on municipalities, particularly density, mixed-uses, mixed income/affordable housing, and sometimes transit itself. Helping the public understand the benefits of smart growth and public transportation to the climate, energy, socioeconomic equity, fiscal, economic, and public health removes some of the many barriers to successfully completing these projects.

Emphasizing the links between transportation investments (particularly public transportation) and land use and development outcomes, particularly as it relates to socioeconomic equity, will help generate support for these measures.

The CJWG has been supportive of smart growth and the many benefits that flow from this strategy. The CJWG, along with the Council, recognizes that these types of projects require community buy-in, which only comes through greater public education and awareness.

### Components of the Strategy

- **Define benefits of smart growth:** DOS and DOT should produce research and materials that demonstrate the links between planning and transportation in New York, including impacts on local finances and equity. This will include developing fiscal impact analyses of smart growth compared with sprawl, regarding both public infrastructure investments for each and tax revenues generated. The agencies should also conduct additional analysis on the equity impacts of Smart Growth and ways to increase affordability of smart growth developments.
- **Conduct public education campaign:** Led by DOS, the State should develop and launch an expansive, multi-dimensional, grass-roots public education campaign on the links between smart growth, transportation, transit, and housing; their roles in reversing climate change; best practices for sustainable smart growth actions at the local level; and the many benefits of smart growth. These materials will be developed in concert an on-line, iterative, interactive Sustainable Development Handbook.

## *T8. Expanding the Availability of Low-Carbon Transportation Alternatives*

MOD and priority development areas are highly dependent upon the availability of low- and zero-emission transportation alternatives to complete the first mile/last mile of trips. This includes prioritizing the availability of safe and accessible pedestrian and bicycle amenities, high quality and frequent transit, and mobility-on-demand services. As part of future investments, agencies and authorities should be required to prioritize low- and zero-emission transportation infrastructure in all activities, where feasible.

The technology surrounding low- and zero-emission first-mile/last-mile mobility will help guide individual choice. As such, the State should facilitate the development and deployment of apps to make mobility alternatives and multi-modal trips more attractive, accessible, and user-friendly.

The CJWG has been supportive of the expansion of low-cost transportation options accessible to underserved communities, a key element of this strategy.

### Components of the Strategy

- **Update the Smart Growth Public Infrastructure Policy Act:** The State should enact legislation to amend and strengthen the State's Smart Growth Public Infrastructure Policy Act (ECL, Article 6) to more effectively avoid new State infrastructure spending that would promote sprawl and define and prioritize priority development areas, such as TOD. This is discussed further in *Chapter 19. Land Use*.
- **Fund low-emission zones and car-free streets:** The State should prioritize investments in local projects that establish low-emission transportation zones, car-free streets, and similar concepts that encourage travelers to take alternative transportation modes and support the infrastructure required to shift freight to lower-emission modes, like rail, cargo bikes, and electric trucks.
- **Fund mobility options:** The State and metropolitan planning organizations (MPOs) should prioritize, incentivize, and expand access to funding for bike, pedestrian, transit, and complete streets projects that serve employment and population centers.
- **Expand partnerships with businesses:** ESD should encourage businesses seeking economic development incentives (local or State) to consult transit agencies early when seeking to locate or expand in areas with existing multi-modal options and to provide services for employees (employee-based trip reduction programs, transit/micro-transit services, ridesharing, bike-sharing, cycling accommodations, free/reduced transit passes). DOS and DOT should provide technical assistance to these businesses and New York should offer local and State tax credits for businesses that accommodate employee public transportation and transportation demand management alternatives and for employees who use alternative mobility options.

## *T9. New Technology Integration*

New mobility solutions also require a rethinking of the technology people use to travel and access transportation services. Emerging technologies like automated vehicles (AVs), shared mobility services, and Internet-of-Things (IoT)–enabled infrastructure could be used to reduce energy use and emissions from transportation if used in a coordinated and constructive manner. Setting the right rules for technology and data use and investing in demonstrating technologies that enable low-carbon modes of transportation can help enable equitable, clean transportation solutions.

### Components of the Strategy

- **Support intelligent transportation systems and AVs that save energy:** NYSERDA should invest in RD&D and demonstrations of emerging intelligent transportation systems, connected vehicles and AVs, and fund the broader adoption of technologies that prove effective in improving transportation system efficiency, such as smart parking systems, adaptive traffic lights, IoT-enabled streetlights. New York should enact policies discouraging "empty" AV miles traveled and requiring AVs used as for-hire vehicles to be ZEVs.
- **Make data accessible and secure:** DOT, New York State Thruway, and the New York State Office of Technology Services (ITS) should support the adoption of open-source technologies and standard data collection protocols for transportation data and connected infrastructure. ITS should convene an interagency group to develop strategies to combat cybersecurity risks associated with new transportation technologies, such as AVs and EV charging.
- **Enable user-friendly apps through data sharing with transit operators:** MTA and other transit operators should facilitate the development of electronic mobility platforms offering seamless multi-modal trip planning and payment options to make public transportation more attractive, accessible, and user-friendly.

## *Market-Based Solutions and Financing*

The strategies and policies referenced in this chapter for decarbonizing the transportation sector will require substantial private and public investment. These investments should be facilitated, in part, through market-based and other supportive policies that generate resources necessary to implement investments required to achieve the Climate Act requirements and goals. Some of the recommended policies animate the flow of private capital while others provide a source of public funding. These policies can also provide a market-signal encouraging private action that reduces emissions, from increased use of public transportation to purchase of lower-emitting vehicles. The strategies to achieve these goals include transportation sector market-based policies, unlocking private financing, and developing a clean fuel standard.

## *T10. Transportation Sector Market-Based Policies*

Market-based policies focused solely on the transportation sector can provide the dual benefits of discouraging more costly carbon-intensive behavior and providing a revenue source for investment in other strategies. One such policy in the development process is the implementation of congestion pricing in the Manhattan Central Business District. Congestion pricing, which reduces emissions by pricing driving and, through a system of variable tolling, provides a funding source for enhancements in the

region's low-carbon public transportation system. Other market-based policies recommended for adoption are described below.

Two policy mechanisms, cap-and-invest and carbon pricing, can be adopted by sectoral or economy-wide policies. Numerous stakeholders throughout this draft Scoping Plan development process have recommended participation in the multi-jurisdiction policy for low-carbon transportation by adopting the TCI cap-and-invest program.

Other stakeholders, including members of the CJWG, oppose participation in the TCI program. Some of those stakeholders recommend instead proposed legislation that would adopt an economy-wide carbon price. Given the multi-sector implications, these potential policies are addressed along with other economy-wide market-based approaches in *Chapter 17. Economy-Wide Strategies*.

### Components of the Strategy

- **Variable Pricing/Parking Policies:** Similar to congestion pricing, these policies discourage driving into and parking in central cities through a system of fees, the collection of which can be used to support alternatives to driving such as public transportation and cycling infrastructure. Pricing policies could include variable fees that discourage parking at peak times or demand parking policies, which limit parking to certain users or vehicles, including ZEVs. Generally, these policies would be adopted by municipalities, but the State can play a supportive role through, for example, development of model code language.
- **Vehicle Registration Fees:** The State should enact legislation establishing a system of registration fees that would discourage the purchase and continued use of more-carbon intensive vehicles. These fees would vary based on emissions or attributes related to emissions such as a vehicle's weight and/or drive train. If accompanied by incentives for lower-emitting vehicles, this approach would resemble the feebate program discussed above under the ZEV strategies.
- **Mileage-Based User Fees:** The State should enact legislation to establish a per mile fee system to fund investment in transportation infrastructure. This system would reduce emissions by discouraging driving, although consumers are generally quite price insensitive to such systems. Thus, although mileage-based users fees could effectively replace declining gas tax revenues, they may not have a significant impact on incentivizing ZEVs or lowering emissions.
- **Tax Increment Financing/Special Assessment Districts:** Municipally adopted special assessment districts provide a mechanism to finance public transportation investments. For

example, New York City funded investment in the extension of the 7-Line with assessments on properties in the Hudson Yards redevelopment project.

### *T11. Unlock Private Financing*

The use of EVs yields substantial savings in fuel consumption and reduced maintenance over the life of the vehicles. Analyses indicate that the total cost of ownership of ZEVs, both LDVs and MHD vehicles, is nearing parity, which will be achieved across all vehicle classifications by the end of this decade. But the higher initial cost of ZEVs presents an obstacle to purchasers unable or unwilling to bear the higher initial cost to reap savings in the longer term.

The CJWG is supportive of measures to accelerate truck and bus electrification and provide financing opportunities to those who generally lack access to affordable capital, which is the focus of this strategy.

#### Components of the Strategy

Several financial strategies can be utilized to reduce the obstacles posed by the higher initial cost:

- **Establish a First Loss Protection product based on existing financial market instruments and practice:** The purchase of ZEVs can be facilitated by increasing the availability of low-cost capital/bank loans to fund the higher upfront costs of commercial ZEVs. One area of uncertainty that inhibits banks and other financial institutions from financing the purchase of ZEVs, however, is uncertainty about the residual value of the vehicles being purchased. New York should identify a State agency or authority to guarantee at least a portion of the residual value of the ZEVs being financed at the end of the loan term (such as First Loss Protection). Providing that certainty will help unlock the lowest cost private financing needed, further reducing upfront costs to enable the purchase of ZEVs in place of fossil fuel-powered vehicles.
- **Offer fleet feasibility studies**: NYSERDA and the electric utilities should undertake feasibility studies for MHD fleets, including school districts & transit agencies, to identify benefits, costs, logistical challenges, financing options, other barriers to electrification. By bearing these soft costs, the State should provide fleet managers with the financial information necessary to make the case for investment in zero emission fleets.
- **Expand NY Green Bank's mission:** The State should enable the NY Green Bank to take on different types of investment opportunities in defined categories of electrification financing, potentially including EV charging infrastructure as well as fleets.

### *T12. Lower Carbon Renewable Fuels*

The strategies described above will reduce the State's reliance on fossil fuels for transportation as expeditiously as possible. For harder to electrify vehicles and equipment, the scenarios identified for meeting the Climate Act GHG emission reduction requirements rely, in part, on the increased use of lower carbon renewable fuels, including renewable diesel, renewable jet fuel, and/or green hydrogen. Given the service life of current vehicles and equipment under the most aggressive scenarios identified for transitioning to zero-emission technologies, fossil fuels are expected to constitute most of the fuel mix until the mid- or late-2030s. Substituting sustainable renewable fuels for a portion of this remaining fossil fuel combustion will reduce GHGs and other emissions.

The CJWG opposed policies supporting renewable fuels on the grounds that they still release harmful air pollutants, particularly in areas overburdened with diesel emissions, and that the State should focus instead on expeditiously electrifying vehicles and the use of hydrogen fuel cells. Because this Plan expedites electrification as much as reasonably feasible, any GHG emission reductions from the use of renewable fuels are in addition to the emission reductions from accelerated electrification. Although the CJWG is correct that renewable fuels still emit air pollutants, some renewable fuels have lower emissions of PM.

#### Components of the Strategy

- **Clean Fuel Standard:** A clean fuel standard could facilitate decarbonization of transportation fuels by requiring the providers of fossil fuels to reduce the carbon content of the fuels they provide by either blending lower carbon fuels or by acquiring credits from providers of lower-carbon fuels into the stream of commerce. Since electricity in the State is an increasingly low-carbon fuel, a clean fuel standard will support decarbonization as petroleum fuel providers finance the use of electricity for transportation use. DEC could structure the clean fuel standard to reward public transportation providers statewide for emission reductions from electrified transit, providing them with resources to accelerate zero-emission rollingstock and infrastructure enhancements. Legislation could be structured to allow aviation fuels to voluntarily opt into the program, reducing emissions in this difficult-to-electrify subsector. Decisions regarding the carbon intensity of alternative fuels will provide market signals that promote the use of those fuels that have a lower fuel cycle carbon intensity.
- **Clean Fuel Infrastructure**: The State should fund incentives for infrastructure for cleaner fuels, such as green hydrogen, where market support is needed.

# Chapter 12. Buildings

## 12.1 State of the Sector

### *Overview*

New York's residential and commercial buildings sector encompasses over 6 million buildings, which are home to 7.4 million households and encompass over 5 billion square feet of commercial and institutional space where New Yorker's work, learn, gather, and access essential services. The State's large geography, varied climate, and vibrant economy drives a diverse buildings mix. New York City and the downstate region are characterized by a mixed-humid climate zone (Climate Zone 4), higher cost of real estate, a high proportion of multifamily housing and leased space, and predominantly urban areas with taller buildings. The upstate region is characterized by colder climates (Climate Zones 5 and 6) which are both cool and humid, lower cost of real estate, smaller cities and towns with more suburban and rural areas, and predominantly low-rise buildings. Statewide, New York's residential and commercial buildings are older than the national average, pointing to opportunities for upgrading buildings in ways that improve both quality of life and energy performance. Additionally, nearly half (48%) of households statewide are LMI households, underscoring the importance of careful attention to housing and energy affordability.

Residential and commercial buildings use energy for HVAC, water heating, lighting, refrigeration, cooking, computer and office equipment, and other small appliances. Direct GHG emissions from the buildings sector come from burning fossil fuels onsite in residential and commercial buildings—primarily for space and water heating–and associated upstream emissions.

Decarbonizing building operations describes the elimination of GHG emissions from building end uses through improving the building envelope and switching from equipment and systems powered by burning gas, oil, or other fossil fuels to highly efficient equipment and systems powered by

**Emissions Overview**

The buildings sector was the largest source of emissions in 2019, responsible for 32% of emissions statewide, which includes the combustion of fossil fuels in residential (34%) and commercial buildings (19%), emissions from imported fuels (33%), and HFCs released from building equipment and foam insulation (14%). The fuels used in buildings today include natural gas, distillate fuel (heating fuel #2), wood, propane, kerosene, and residual fuel.[157]

[157] For additional detail including emissions by fuel type, see the *Annual Greenhouse Gas Emissions Report* issued by DEC.

emissions-free energy sources. In addition, embodied carbon associated with building construction can be reduced through building reuse and through using lower carbon materials or carbon-sequestering products.

Specifically, electrification of space and water heating with high efficiency heat pumps is a viable, cost-effective approach to decarbonizing operations for nearly all buildings in New York. Modern heat pumps that work in very cold weather are commercially available and able to keep homes and businesses comfortable year-round, as long as they are properly chosen, sized, and paired with an energy-efficient building envelope. Electrically-powered heat pumps circulate refrigerant to move heat from one place to another—typically between indoors and the air, ground, or water outside. Compared to fossil fuel or electric resistance heating systems, air-source heat pumps (ASHPs) are two to three times more efficient and ground-source heat pumps (GSHPs) are three to five times more efficient. Heat pumps eliminate onsite emissions of GHGs and air pollutants from the combustion of fossil fuels in buildings.

GSHPs perform well in extreme temperatures without the need for electric resistance or fuel back-up since heat is exchanged between the building and fairly stable ground temperatures via an underground piping system. Cold climate ASHPs also work efficiently in New York's climate, but in very cold outdoor conditions both their heating capacity (output) and efficiency (coefficient of performance) are reduced. In the State's coldest regions, where heating systems are designed for temperatures of zero (0F) or lower, some homes that install cold climate ASHPs may therefore use supplemental heat (wood, home heating oil, propane, or gas) for peak cold conditions to avoid unnecessary oversizing of heat pumps and to mitigate electric grid impacts. Larger multifamily, mixed-use, or complex commercial buildings that are concentrated downstate also may use supplemental heat (likely gas) for peak cold conditions, with a plan to phase it out over time as technology develops. At a district or community-scale, underground pipes can be installed alongside other infrastructure to distribute thermal energy among multiple buildings; these community thermal systems can recycle waste heat among diverse building types, provide load smoothing, and drive economies of scale.

The Integration Analysis indicates that by 2050, the large majority of buildings statewide will need to use electric heat pumps for heating and cooling to meet the Climate Act requirements. This approach depends upon 100% zero-emissions electricity by 2040 and making energy efficiency improvements in all buildings, with the emphasis on improvements to building envelopes (air sealing, insulation, and replacing poorly performing windows) to reduce energy demand by 30% to 50%. The Integration Analysis finds that widespread building electrification is needed even with the strategic utilization of low-

carbon fuels that are projected to be available, notably the use of RNG to meet back-up heating demands in a small proportion (less than 10%) of electrified buildings and the utilization of green hydrogen to power a smaller Con Ed district system by 2050.[158] To manage the impacts of widespread electrification on the State's electric grid, it will be important for buildings to adopt smart controls, energy storage, and other load flexibility measures. Policymakers also should assess the differential grid impact, costs, and benefits of cold climate air source, ground source, and community thermal heat pump systems; at this writing, related analysis in underway.

### *Vision for 2030*

By 2030, one to two million energy-efficient homes should be electrified with heat pumps; and heat pumps should provide space heating and cooling for 10% to 20% of commercial space statewide. Heat pumps should become the majority of new purchases for space and water heating by the late 2020s. From 2030 onward, more than 250,000 New York homes and thousands more commercial buildings each year are expected to be retrofitted or constructed to be energy-efficient and to install heat pumps for primary heating, cooling, and hot water, which is more than a tenfold increase from annual adoption today. This rapid market growth is projected to generate 100,000 new jobs in energy-efficient construction and clean heating and cooling. Public support for job growth and training in electrification and energy efficiency services will provide both new and incumbent workers with opportunities in the clean energy economy, while in-State engineering companies and manufacturers expand innovation and capacity to serve the growing New York and regional markets.

To achieve this dramatic growth, New York State should invest in a significant scale-up of financial support for energy-efficient building envelope upgrades and electric heat pump systems, with priorities afforded to Disadvantaged Communities. State codes should require new construction to be highly efficient, all-electric, and resilient to the effects of climate change. State regulations should be in place to phase out fossil fuel use in existing buildings by requiring zero emissions equipment and appliances at the time of replacement and by setting energy efficiency performance standards for large existing buildings.

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[158] The "Strategic Use of Low-Carbon Fuels" scenario modeled in the Integration Analysis projects that 20% of installed heat pumps are GSHP and 80% are cold climate ASHP, of which one in ten ASHP are modeled to use fuel back-up to meet heating demands during the coldest 5% of hours. In this scenario, nearly all RNG is used in the buildings sector, assuming a 9% RNG blend in gas pipelines by 2030 and 100% RNG to meet dramatically reduced gas demand in buildings by 2050. The scope of RNG use is limited by available feedstocks and by the need to mitigate statewide emissions from all sectors (since under the Climate Act requirements for emissions accounting, RNG is a low-carbon fuel but it is not zero-emissions). green hydrogen use is limited mostly to transportation, industrial purposes, and electricity reliability, though a small amount of hydrogen is used to power the Con Ed district system by 2050, with steam demand reduced by about 66% as many existing customers electrify in whole or in part.

These regulations will send a clear policy signal, with compliance dates that allow regulated entities to plan and build capacity while regulators protect low-income households from cost burdens. Utility price signals and technological innovation also should support expansion of grid-interactive buildings, energy storage, and other demand-side solutions for load shifting, reducing the need to operate peaker power plants and to build additional grid capacity. Throughout this transformation and through the strategies in this Plan, LMI households and frontline communities will need to be protected from displacement and threats to affordability.

### *Vision for 2050*

By 2050, 85% of homes and commercial building space statewide should be electrified with energy-efficient heat pumps. New York should have advanced a managed, phased, and just transition from reliance on fossil gas and the gas distribution system in buildings to a clean energy system (see *Chapter 18. Gas System Transition*). Embedded subsidies for fossil fuels will have been eliminated, and energy-efficient, zero-emissions buildings will have become the most cost-effective option in a clean energy economy that supports secure jobs and demonstrates leadership in innovation. Investments in research and development will have brought affordable batteries and thermal storage, grid-interactivity, ultra-low GWP refrigerants, and advanced technical solutions for the hardest-to-electrify building types to market. All New Yorkers will benefit from a just transition that supports vibrant, healthy communities and repairs structural inequalities in access to housing, credit, economic opportunities, environmental resources, and a clean and healthy environment.

### *Existing Sectoral Mitigation Strategies*

Catalyzing energy efficiency and electrification of space and water heating in buildings is a pillar of New York's climate and equity agenda. The New Efficiency: New York strategy demonstrates the State's commitment to reducing energy waste, fossil fuel use, and GHG emissions in the buildings sector—and to doing so in a manner that advances equity, creates clean energy jobs in communities statewide, supports energy affordability, prioritizes benefits to Disadvantaged Communities, and expands access to comfortable, healthy, and energy-efficient homes and businesses. New York invests over $1 billion in public funds annually for State and utility-administered grant and market development programs focused on energy-efficient buildings. This includes a coordinated, statewide framework to benefit LMI New Yorkers and the launch of the New York State Clean Heat initiative. The State's clean energy workforce training initiative helps to equip the current and future workforce while increasing industry diversity and job opportunities in line with a just transition. Another long-standing priority is catalyzing innovation and

bringing leading technologies and companies to New York, for example, through public-private partnerships that spur scalable demonstration projects for visionary, low-carbon buildings.

DEC has adopted regulations that prohibit certain HFCs in specified uses (such as commercial refrigeration and large air-conditioning equipment) (6 NYCRR Part 494). Additionally, there have been legislative proposals to strengthen State building codes and energy efficiency standards. Such legislation should be enacted as soon as possible to enable regulatory action.

Yet the speed and scale of action to decarbonize buildings must accelerate dramatically. Meeting New York's ambitious climate requirements and goals in the residential and commercial buildings sector requires multi-pronged policy action, including new regulations and a major scale-up of public investments, to break through thorny market barriers and to manage significant risks to achieving the necessary equity and emissions reduction outcomes. The strategies recommended for the buildings sector work to achieve the Climate Act's energy efficiency goal for 2025, and critically, to spur more rapid and widespread end-use efficiency and electrification in buildings.

### *Key Stakeholders*

Collaboration is critical among multiple State agencies, local governments, consumers, non-governmental organizations (NGOs), New York's electric and gas utilities, affected workers and unions, and industry actors including the construction and building improvement industry, real estate actors, and clean energy businesses. Stakeholder engagement must include meaningful involvement of households, businesses, and community-based organizations from frontline communities, LMI households, public housing authorities and residents, environmental justice organizations, and affordable housing groups.

## 12.2 Key Sector Strategies

The key strategies within this sector are organized into four themes, as shown in Table 9.

**Table 9. Buildings Sector Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Adopt Zero Emissions Codes and Standards and Require Energy Benchmarking for Buildings | B1. Adopt Advanced Codes for Highly Efficient, All-Electric, and Resilient New Construction<br>B2. Adopt Standards for Zero Emissions Equipment and the Energy Performance of Existing Buildings<br>B3. Require Energy Benchmarking and Disclosure |
| Scale Up Public Financial Incentives and Expand Access to Public and Private Low- | B4. Scale Up Public Financial Incentives<br>B5. Expand Access to Public and Private Low-Cost Financing |

| Theme | Strategies |
|---|---|
| Cost Financing for Building Decarbonization | B6. Align Energy Price Signals with Policy Goals |
| Expand New York's Commitment to Market Development, Innovation, and Leading-by-Example in State Projects | B7. Invest in Workforce Development<br>B8. Scale Up Public Awareness and Consumer Education<br>B9. Support Innovation<br>B10. Reduce Embodied Carbon from Building Construction |
| Transition from HFCs | B11. Advance a Managed and Just Transition from Reliance on HFC Use |

As a cross-cutting strategy, New York State should additionally establish a 2030 target for the buildings sector that is commensurate with the level of electrification and efficiency needed to achieve the State's climate goals and then should monitor progress to ensure that policies and programs are in place to achieve this target.

### *Adopt Zero Emissions Codes and Standards and Require Energy Benchmarking for Buildings*

When new buildings are constructed, clear and cost-effective opportunities exist for decarbonizing building operations and reducing embodied carbon emissions, which will have long-term impacts throughout the construction market. Advanced codes will minimize the near-term installation of additional fossil fuel equipment and ensure that new buildings going forward are resilient to the impacts of climate change.

In existing buildings, the best opportunity for energy improvements is during routine home and capital improvements and when HVAC equipment retire out of service. Since HVAC service lives range from 15 to 30 years, seizing the opportunities to electrify New York's over 6 million buildings by 2050 requires near-term action.

Electrification and efficiency improvements in existing buildings present a larger challenge of sheer scale. NYSERDA, DEC and DOS will collaborate to adopt regulatory requirements that will bring about the end of fossil fuel combustion in buildings by prohibiting replacement of fossil fuel equipment at end of useful life. Building performance standards also will compel efficient operation of buildings and capital investments in high-performance building envelopes and efficient HVAC systems.

These regulations and complementary market support must be thoughtfully designed to drive adoption of highly efficient heat pump systems that are coupled with measures that reduce thermal energy demand, rather than uptake of inefficient alternatives such as electric furnaces or boilers. If not managed, there is a

risk that consumers could install inefficient electric equipment in inefficient buildings to minimize upfront costs; but this would result in unaffordable electric bills for building occupants and, if widespread, excessive system peak electricity demands that would be extremely costly to meet. Put simply, policy action to decarbonize buildings must address both energy efficiency and electrification.

Advancing equitable outcomes for lower-income households and Disadvantaged Communities also demands careful design of regulatory actions and complementary strategies. The CJWG expressed support for regulatory sunset dates for combustion equipment in buildings provided that these regulatory actions are coupled with additional goals and public investments to benefit Disadvantaged Communities. This draft Scoping Plan endorses this condition for regulatory action and proposes complementary strategies to minimize the risk of negative impacts on lower-income and vulnerable households while prioritizing investments that benefit affordable housing and Disadvantaged Communities.

For buildings, resilience is the ability of the building systems to be prepared for, withstand, adapt, and quickly recover from disruptions such as severe weather and power outages. Given the increased frequency of extreme weather events, which also increase the probability and scale of electric grid outages, it is critical to consider and manage risks to resilience when electrifying the heating systems of buildings. Flexible technologies and grid-interactive appliances that actively manage building energy consumption can contribute to improved grid reliability and resilience. At the building level, high-performance building envelope features prolong passive survivability. Additional resilience strategies include onsite renewable energy that is able to disconnect from the grid, energy storage, and EV battery-interactive capabilities. The resilience of building and energy systems is a priority area for public investment in research, solution development, and demonstration projects.

### *B1. Adopt Advanced Codes for Highly Efficient, All-Electric, and Resilient New Construction*

This draft Scoping Plan recommends adopting all-electric State codes on an accelerated timeframe (and somewhat sooner than was recommended by the Energy Efficiency and Housing Advisory Panel), as an important policy lever that can contribute to the rapid transformation presented in the Integration Analysis. Meeting the proposed 2024 date for low-rise construction code is predicated on New York State passing legislation by early 2022, which would direct and enable the subsequent regulatory action.

## Components of the Strategy

DOS and the New York State Fire Prevention and Building Code Council (Code Council), in collaboration with DEC, NYSERDA, local governments, and interested stakeholders, should adopt codes and standards for new construction (and additions and alterations as applicable) of residential and commercial buildings to be built to a highly efficient, zero emission standard, and incorporate requirements for building resilience. The State should enact legislation to enable this regulatory action. In coordination, the PSC and DPS should work with New York's electric and gas utilities to account for updates to building codes and standards in their distribution system planning and infrastructure investments, while continuing to enhance the associated tools and data available to customers and stakeholders.

- **Update regulations to improve energy efficiency and building resilience:** As soon as possible, the State should enact legislation to revise the Energy Law relating to the State Energy Code 10-year cost effectiveness criterion to require an assessment over a longer time horizon with consideration for equipment lifecycle or societal effects. DOS and the Code Council should then amend codes that are presently in effect.
    - 2023: Adopt highly efficient State Energy Code for new construction (and additions and alterations as applicable) of residential and commercial buildings, to require highly insulated thermal performance and air tightness; electric readiness for space conditioning, hot water, cooking, and dryers; EV readiness where parking is provided; and solar wherever the opportunity exists and is feasible (with allowances for green roofs and other uses of rooftop space).
    - 2023: Adopt additional building resilience features into State codes to require energy storage or onsite renewable generation that is able to disconnect from the grid, with specifications for sizing to meet resilience demands.[159] Also require grid-interactive electrical appliances as feasible (such as batteries and hot water heaters) to support grid reliability.
- **Adopt regulations to end on-site emissions:** As soon as possible, the State should enact legislation that aligns State Energy Code and Uniform Code with Climate Act requirements, including by adding consideration of GHG emissions to Energy Code. DOS, NYSERDA, and the Code Council should then advance all-electric code provisions that prohibit gas/oil equipment for space conditioning, hot water, cooking, and appliances. Until all-electric codes are adopted

[159] NYSERDA is conducting research to understand building load profiles for thermal comfort/safety in order to recommend standards for battery or thermal storage in instances of power outages.

statewide, NYSERDA should encourage local governments to adopt NYStretch Energy Code. The State also should provide additional funding for local code enforcement (staff, training, materials) and a credentialing program for Energy Code inspectors.

- 2024: Adopt all-electric State codes that prohibit gas/oil equipment for space conditioning, hot water, cooking, and appliances for new construction of single family and low-rise residential buildings (and additions and alterations as applicable).
- 2027: Adopt all-electric State codes that prohibit gas/oil equipment for space conditioning, hot water, cooking, and appliances for new construction of multifamily buildings over 4 stories and commercial buildings (and additions and alterations as applicable).

### *B2. Adopt Standards for Zero Emissions Equipment and the Energy Performance of Existing Buildings*

Among the 6.1 million existing buildings in New York, single-family homes and other low-rise residential buildings (up to three stories) are relatively straightforward to upgrade and convert to zero emissions heating and hot water systems using residential-sized GSHPs or ASHPs that are suited to heat efficiently in cold climates. Larger, complex building typologies may necessitate more flexibility in both timing and technological solutions, and affordable housing will need compliance paths that protect tenants.

Technical solutions to retrofit high-rise multifamily and commercial buildings are advancing rapidly. New York State is supporting RD&D activity that ranges from demonstrating heat pump solutions to maintain centralized heating and hot water systems in large buildings (transferring technology now in use in Northern Europe and Canada) to fostering the development of small, cold climate packaged/window heat pumps that will be affordable for high-rise multifamily buildings. In large and complex commercial and institutional buildings, phased electrification retrofits also offer a feasible, resource-efficient path. Steps include integrating electrification with near- and long-term capital planning (including tenant lease turnover); reducing space conditioning loads and recovering waste heat; and converting steam to hydronic distribution to accommodate the lower temperature hot water produced by heat pumps. For central plant equipment, feasible heat pump installations may meet the large majority of the building's heating load while maintaining a supplemental fuel heat source for peak conditions, with a plan to phase it out over time if possible.

For existing buildings, New York should require the sale and installation of energy-efficient and zero emission new equipment for space heating and hot water, when replaced at the equipment's end of useful

life[160] in residential and commercial buildings. The State should further require efficiency upgrades for large buildings through a building performance standard. The development of codes, standards, and regulations should include further analysis of societal and consumer benefits and costs, as well as provide for compliance pathways for existing buildings to account for extenuating circumstances (including, but not limited to, housing affordability-related matters and health and safety/emergency needs).

### Components of the Strategy

NYSERDA, DOS, and DEC should work together to implement standards for building performance, appliances, and equipment. These regulations should be coordinated with action taken by the PSC and DPS to regulate gas utilities. The State should enact legislation to enable these regulatory actions.

- **Regulations to improve energy efficiency in existing buildings:** As soon as possible, the State should pass legislation that enables the establishment and enforcement of efficiency standards for appliances that are sold, leased, or installed in New York State, in order to reduce energy consumption, reduce water consumption, reduce GHG emissions, and/or increase demand flexibility associated with the regulated products. NYSERDA should then set energy efficiency standards for the sale of appliances, in coordination with DOS for enforcement. Subsequent to enabling legislation, NYSERDA also should set energy efficiency standards for buildings, in coordination with DOS and local code officials for development and enforcement.
    - As soon as possible, the State should adopt energy efficiency standards for appliances that are exempt from federal preemption (such as computers, monitors, fluorescent and LED light bulbs, and air purifiers).
    - 2027: Require existing properties larger than 25,000 sq. ft to upgrade to energy-efficient lighting in all commercial spaces and common areas.
    - 2030: Adopt an energy efficiency performance standard for existing commercial and multifamily properties larger than 25,000 sq. ft. (with credit for building electrification). Compliance standards will be informed by statewide benchmarking data and align with New York City's Local Law 97 and across State and local government requirements where appropriate. A phased-in building performance standard could become effective starting in 2027.

[160] The Integration Analysis assumes that the average useful life for hot water and space heating equipment in residential and commercial buildings ranges from 15 to 18 years. In practice, equipment may be kept in service for significantly longer timeframes.

- **Zero emissions standards to phase out fossil fuel combustion equipment:** NYSERDA should set zero emissions standards for the sale of building equipment, in coordination with DOS for enforcement. DEC should set and enforce zero emissions standards tied to the operation of large fuel burning equipment.
    - 2024: The PSC should prohibit utilities from providing new gas service to existing buildings as part of a comprehensive plan to end investments in new gas infrastructure in coordination with municipalities.
    - 2030: Adopt zero emission standards that prohibit gas/oil replacements (at end of useful life) of heating and cooling and hot water equipment for single-family homes and low-rise residential buildings with up to 49 housing units.
    - 2035: Adopt zero emission standards that prohibit gas/oil replacements (at end of useful life) of heating, cooling, and hot water equipment for larger multifamily buildings (4 stories and higher or 50 or more housing units) and commercial buildings.
    - 2035: Adopt zero emission standards that prohibit gas appliance replacements (at end of useful life) for cooking and clothes drying.
    - 2035: DEC should adopt zero emissions standards that prohibit gas/oil use in large fuel burning equipment. The standards should be enforced under a new emissions enforcement regime of large combustion equipment that typically heat buildings 50,000 sq ft or more in floor area, thereby requiring early retirement.

### *B3. Require Energy Benchmarking and Disclosure*

Energy consumption benchmarking provides building decision-makers with information to improve building operations and investment decisions, and the data collected statewide will inform building performance standards. Lack of awareness in the market may limit the effective use of benchmarking data. Education will be needed for consumers, brokers, and building owners on how to use the energy usage and benchmarking information.

The State must also mitigate against and monitor for potential harm to Disadvantaged Communities. Disinvestment could occur if disclosure or labeling of energy performance makes properties less attractive to potential renters and buyers, or conversely, demand for efficient buildings could price people out of the market for healthy housing in their community. Adequate technical and financial assistance for LMI homeowners and building owners will be needed in Disadvantaged Communities to scope and finance energy upgrades. As was emphasized by the CJWG, energy affordability is a challenge for many LMI households and required energy disclosure provides important information when buying or renting a

home, including ongoing energy costs, which informs decision-making and budgeting. The State will ensure consistency and alignment, across State and local government requirements (such as New York City local laws), including in reporting templates and timeframes.

### Components of the Strategy

NYSERDA, DOS, the New York State Department of Taxation and Finance, and the Attorney General's office should work together to implement and enforce energy benchmarking and disclosure requirements, in coordination with PSC direction to utilities under its jurisdiction. The State should enact legislation to enable these regulatory actions.

- Require energy consumption information and disclosures:
    - 2023: Commence a statewide energy benchmarking and disclosure program that requires owners of multifamily and commercial properties larger than 10,000 sq. ft. to annually report whole building energy and water consumption data to NYSERDA for public disclosure. NYSERDA should lead implementation, with support from the Department of Taxation and Finance and the Attorney General's office. Also, the PSC should require electric, gas, and water utilities to provide automatic aggregated whole building uploads of utility customer data directly to EPA's Energy Star Portfolio Manager.
    - 2025: Require multifamily and commercial properties larger than 25,000 sq. ft. to undertake a comprehensive building energy assessment (audit) at least once every 10 years that evaluates the building's systems and identifies opportunities to invest in energy efficiency upgrades, electrification or electrification-readiness for building systems, and resilience measures. Filing an assessment report with NYSERDA would be required on a cycle established by the State or at the time that a building permit is needed for specified work that must conform to Code, whichever comes first. NYSERDA should lead implementation, in close coordination with DOS and local code officials for development and enforcement.
    - 2025: Require owners of all single-family and multifamily residential and commercial buildings to obtain and publicly disclose, as part of sale or lease listing of a building, housing unit, or commercial space, the prior-year energy consumption of the building, unit, or space (at least 12 consecutive months of energy bill data).
    - 2027: Require owners of single-family buildings to obtain and disclose an energy performance rating (such as a Home Energy Rating System index) as part of sale listing.

### *Scale Up Public Financial Incentives and Expand Access to Public and Private Low-Cost Financing for Building Decarbonization*

A substantial infusion of both public resources and private capital will be needed to pay for the building upgrades necessary to decarbonize buildings, while also expanding access to safe and healthy housing and bolstering resilience to climate impacts. The Integration Analysis indicates that to meet New York's GHG emission reduction requirements, more than 250,000 housing units each year will need to adopt electric heat pumps and energy efficiency measures from around 2030 onward—more than a tenfold increase from current market activity—with a comparable pace of transformation in the commercial sector. Across the residential and commercial buildings sectors, annual investment costs for these upgrades are projected to grow over time from roughly $5 billion in 2030 to $30 billion in 2050, based on the incremental cost of building electrification and shell improvements made in each year. This investment will expand jobs in energy efficiency and building electrification in communities statewide—and is projected to add 100,000 new clean energy jobs by 2030. Yet this investment remains a fraction of other building-related expenditures in New York, which annually include roughly $60 billion in buildings investments and over $30 billion on energy costs across the residential and commercial buildings sectors. Significant opportunity exists to re-direct existing spending toward a more sustainable buildings sector.

### *B4. Scale Up Public Financial Incentives*

Financial incentive programs will need to scale up dramatically to motivate millions of homeowners and building owners to install high efficiency electric heat pumps and make energy efficiency improvements such as sealing air leaks, adding insulation, and using building controls. Although many energy efficiency upgrades are cost-effective, these projects can be disruptive for occupants or simply not a priority for owners. For most existing homes and buildings, moreover, the current upfront costs of building electrification upgrades can be significantly higher than costs for replacing fossil fuel equipment. For example, for an older single-family home that is otherwise in good condition, the typical installed cost for a heat pump for whole-home space heating and cooling paired with an air sealing/insulation upgrade is about $21,000 for a cold climate ASHP and $40,000 for a GSHP system (before available rebates and tax credits), as compared to roughly $10,000 or less to replace a fossil fuel boiler/furnace and air conditioner (with no envelope work).[161] A homeowner who switches from home heating oil will see substantial

[161] Average installed equipment costs sourced from the Integration Analysis – Inputs and Assumptions Workbook (updated November 18, 2021) available at: https://climate.ny.gov/Climate-Resources. Energy cost savings modeled separately, finding that a modest single-family home that switches from oil heating to a heat pump (paired with basic air sealing/insulation) annually saves $1,200 (NYC) to $1,700 (upstate) with a ccASHP, or $1,700 (NYC) to $2,100 (upstate) with a GSHP. The same home that switches from gas heating (but maintains gas service) sees only a modest annual cost decrease (NYC) or cost increase (upstate) with a ccASHP, or $700 (NYC) to zero (upstate) annual cost savings with a GSHP.

energy bill savings, so that with currently available incentives through NYS Clean Heat and the federal geothermal tax credit, the project payback could be between 5 to 8 years. For many customers now heating with low-cost gas, however, bill savings do not currently offer a clear economic return on investment for adopting a whole-home heat pump. In considering consumer cost/benefit and equity impacts, it is further important to recognize that some housing is unsafe and unhealthy due to years of underinvestment, such that costly repairs are needed before making energy improvements.

Given the scale of the challenge, public funding must be used strategically to accelerate market adoption, help LMI consumers, expand workforce skills and placement, and advance equity. Expansion of financial incentive programs to motivate early adoption in market-rate housing and commercial buildings will be needed for at least the coming decade. This support should target existing buildings rather than new construction and eventually phase out (once efficient, zero emission codes and standards go into effect), with a longer timeframe for support for low-income households and, as appropriate, for next-generation technologies as they emerge.

Dedicated financial support programs for LMI households, affordable and public housing, and Disadvantaged Communities are essential to enable these households to make and benefit from energy upgrades, with careful attention to impacts on housing and energy affordability. For these households and buildings, grant funding will need to cover most or all the near-term cost premium for building electrification and efficiency upgrades, considering economic realities and to remedy unjust patterns of redlining and underinvestment in Disadvantaged Communities. It is critical to ensure that the phase out of fossil fuel equipment in buildings does not increase low-income residents' cost of housing, nor create undue energy burden. New York has established an Energy Affordability Policy that sets the goal of limiting energy costs for low-income households to no more than 6% of their income. The existing low-income energy bill discount programs administered by the major electric and gas utilities should be expanded. Over the longer-term, regulatory requirements must be coupled with ongoing public financial support for poor and working-class households. Thoughtful policy and programmatic design and coordination of funding sources will be essential to support affordability, safe and healthy housing, consumer protections, and economic opportunities that benefit Disadvantaged Communities.

A salient challenge is marshalling additional State, ratepayer, and federal funding at the needed scale, alongside animating the flow of private capital to low-carbon building construction and improvements. At present, charges levied on electric and gas ratepayers provide the largest source of funding for New York's energy efficiency incentive programs, with heat pump incentives funded by electric ratepayers

specifically. This funding source has the benefit of established precedent and regulatory oversight, which as major new policy initiatives are considered, includes public process and assessment of ratepayer impacts. There is scope for strategic re-direction and some expansion of ratepayer-funded programs. Moreover, the PSC should direct utilities to continue to assess and place priority on investments in clean, DERs (including efficiency, storage, and electrification of heating) that are comparatively cost-effective ways to reduce peak electric or peak gas demand. Even as these avenues are explored, though, new funding sources beyond ratepayer charges will need to be identified.

Two potential economy-wide State policy mechanisms, cap-and-invest and carbon pricing, are discussed in *Chapter 17. Economy-Wide Strategies*. If either policy is implemented and provides a new source of funding for policy actions identified in this Plan, the housing sector should be a priority area for investing that funding to support both equity and emissions reductions. Specific to the buildings sector, levying a "feebate" on fossil fuel equipment and allocating the revenues to support building decarbonization is another possible policy option to provide a market signal that encourages purchase of heat pumps while also providing a new source of funding. And to further encourage homeowners to install GSHPs, New York could provide a geothermal tax credit to offset GSHP system expenditures that is comparable to the State's Solar Energy System Equipment Credit. Critical opportunities exist to leverage federal funding. Though uncertain as of this writing, the proposed Build Back Better legislation could, if enacted, bring billions of additional dollars in federal spending to New York for affordable housing and community development; in tax credits for residential and commercial buildings that install solar, battery storage, geothermal heat pumps, and other clean energy technologies; and via federal rebates for high-efficiency electric homes. The recommendations below identify specific opportunities to leverage existing and potentially expanded federal funding, in particular for affordable housing and low-income households. For example, the EmPower New York program and the federal Weatherization Assistance Program both provide no-cost energy efficiency solutions to income-eligible New Yorkers; these programs can help improve the conditions in existing homes, make homes electrification-ready in some instances, and provide a network of contractors and non-profit community-based organizations to support low-income communities. Scaling up funding and revising Weatherization Assistance Program guidelines to allow for electrification could better serve Disadvantaged Communities through existing program infrastructure. In addition, around 10,000 multifamily units are built or preserved each year with a combination of federal tax credits and subsidy programs provided by HCR, which has a goal to increase subsidies for the full electrification of that unit production, over time.

The CJWG emphasized that regulatory action to phase out fossil fuel equipment in buildings is inadequate without added policy goals and public investments to benefit low-income households and Disadvantaged Communities. The strategies proposed here are consistent with the CJWG's call to front-load and prioritize public investments in efficient appliances and zero emissions heating, cooling, and cooking equipment in Disadvantaged Communities so that poor and working-class households are not left behind, while safeguarding that building electrification does not increase the housing or energy cost burden on low-income residents. Informed by input from the CJWG, the proposed strategy components include attention to New York's existing energy affordability goal, the needs of public housing, and the health benefits associated with building decarbonization. The CJWG further called for additional actions around consumer protection, including "claw back provisions" as part of public subsidies to private landlords to defend against rate increases, gentrification, and displacement. This specific recommendation is not reflected in the proposed strategy because such provisions merit careful consideration in program design.

### Components of the Strategy

Significant coordination will be needed among State and local agencies and utilities, notably to support low-income households and Disadvantaged Communities, with State leadership from the PSC and DPS, NYSERDA, HCR, NYPA, and New York State Office of Temporary and Disability Assistance (OTDA).

- **Scale up incentives for building decarbonization:** The State should scale up direct cash incentives for energy efficiency, electrification, and electrification-readiness in residential and commercial buildings. In incentive program design, place an emphasis on ease of access to available and relevant resources for consumers and installers, particularly for LMI households and buildings in Disadvantaged Communities that may access resources from multiple programs. This includes designing incentive levels to align with value to the energy system and consumers, for example by offering adequate incentives for GSHP systems and for comprehensive retrofits inclusive of energy storage in LMI homes, as such retrofits will mitigate grid impact, increase bill savings, and improve building resilience. The State should also explore a geothermal tax credit to offset GSHP system expenditures (comparable to the State's Solar Energy System Equipment Credit). Where incentives are offered through utility companies, the State should develop a coordinated statewide program to provide a consistent experience and incentive structure that helps installers reach more customers, with a priority to LMI households and Disadvantaged Communities.

- **Support community-scale solutions and community thermal systems:** The State should develop, pilot, and where successful scale-up financial support for portfolio- and community-scale solutions, where hundreds of homes and businesses are contracted for energy upgrades to more efficiently manage and deliver projects, reduce unit costs, incorporate place-based strategies, and drive scale and momentum (as compared to one-off projects). Additionally, the State should develop appropriate regulatory and planning mechanisms to support zero-emissions district and community thermal systems, based on feasibility and design studies and demonstration projects that are underway today. The State should further explore opportunities to convert buildings to heat pumps on a street-by-street or neighborhood-by-neighborhood basis, which could allow decommissioning of gas infrastructure as part of the managed transition of the fossil gas system.
- **Align regulatory frameworks:** The State should identify and pursue modifications to regulatory frameworks for energy efficiency and building electrification programs to further align the programs with Climate Act goals and requirements. This includes, but is not limited to, attention to accounting holistically for the societal costs and benefits of building energy upgrades, including health impacts associated with outdoor and indoor air quality and thermal comfort.
- **Prioritize LMI households, affordable housing, and Disadvantaged Communities:** Create dedicated direct cash incentives and financial support mechanisms for energy efficiency and electrification for LMI households, affordable housing, public housing, and Disadvantaged Communities. Develop new partnerships to effectively deliver programs (such as through housing agencies, community development financial institutions, and local community-based organizations) and adopt inclusive engagement processes that incorporate Disadvantaged Communities and LMI households in program design. Account for New York's existing Energy Affordability Policy, which seeks to limit energy costs for low-income households to no more than 6% of their income, as well as a household's cumulative cost burden related to housing, energy, transportation, and healthcare when assessing affordability impacts.
- **Prioritize energy upgrades and resilience in public housing:** Support and accelerate efficiency, electrification, and resilience in public housing, particularly in New York City Housing Authority buildings and in other Public Housing Authority developments statewide, with attention to the special needs of and jurisdictional issues that affect the State's public housing stock. Support resilience centers (or resilience hubs) in public housing developments that meet community needs and gathering space in non-emergencies (childcare and after school programming space) and provide safety and comfort in acute situations, including during power outages. Such centers shall include back-up power (including solar-storage pilots) for multi-day outages and community

space to coordinate disaster relief. Include refuge spaces within the resilience centers to avoid climate-related deaths by providing a basic livable space that is thermally safe while also providing access to sufficient electricity to meet critical needs (e.g., refrigeration for medications; power for in-home medical processes/equipment, air filters for critical conditions).[162] Refuge spaces should be piloted in public housing and housing for vulnerable populations, with learnings shared to inform broader community- and building-level resilience strategies. Leverage available federal funding and additional funding sources to support community resilience, deeper retrofits, and electrification.

- **Fund non-energy improvements when necessary:** The State should create a new "Retrofit and Electrification Readiness Fund" for LMI households, affordable housing, rent regulated housing, public housing, and residential buildings in Disadvantaged Communities to cover costs of non-energy building improvements that are necessary to install energy measures and broadband installation costs when funding energy projects.
- **Leverage funding for healthy homes and community development**: Leverage services, resources, and funding across housing, health, community/economic development, and energy improvements for low-income households to fund green and healthy housing retrofits. Near-term actions can expand use and coordination of both State and federal funding (such as use of Weatherization Assistance Program funds for health and safety improvements), build on the ongoing pilot to leverage New York Medicaid's Value-Based Payment program for Managed Care Organizations to contribute to healthy housing services and home energy efficiency improvements, and engage with non-profit hospitals in community health needs assessments. Expanding relationships with local housing agencies offers further opportunities to leverage federal resources such as through Community Development Block Grant and U.S. Department of Agriculture (USDA) Home Repair funds.

### *B5. Expand Access to Public and Private Low-Cost Financing*

Mobilizing and focusing private capital at scale will be essential to construct, upgrade, and operate highly efficient, electrified buildings. Modernizing codes and standards to require electrification and efficient construction will drive such investment via existing market activity and the cycle of routine building

[162] Refuge spaces are super-insulated rooms or areas within a residence or community center, where occupants can take shelter during periods of extreme heat or cold, such as a polar vortex event or multi-day heat wave. Similar to high-performance, YETI-style coolers, use of PassiveHouse level super insulation enables maintenance of a livable temperature in the space with no additional heating or cooling. The intention of refuge spaces is to provide conditioned space and sufficient power to cover basic needs during extreme heat or cold events.

improvements. Low-cost financing products for energy efficiency, electrification, electrification readiness, solar PV, energy/thermal storage, and related improvements are also needed so that single-family, multifamily, and commercial and institutional building owners can access low-cost capital at the scale needed to pay for the building upgrades necessary for decarbonization.

At present, there is a general lack of lender interest and awareness around financing building electrification and energy efficiency projects, as well as perceptions of risk in underwriting based on energy performance. New York should help to address this barrier through lender education and outreach, and by making available case studies and modeling tools so that lenders can appropriately underwrite to energy performance standards and applicable regulatory requirements. The largest sources of capital for building investments are in the mortgage industry. NYSERDA and HCR plan to convene the financial industry to explore ways to bring capital to building decarbonization in compliance with the Climate Act.

Another important role for the State is to provide for consumer protection in connection with financial products and services, particularly for products that target LMI consumers. Additionally, the NY Green Bank, HCR, State and local revolving loan funds, and possibly electric/gas utilities offer important mechanisms to strategically deploy public financial resources in ways that can leverage private capital and accelerate the transition to a decarbonized, resilient building stock.

Reflecting on input from the CJWG, the proposed strategy places priority on consumer financing made available by community development financial institutions and credit unions.

### Components of the Strategy

Action and coordination across a range of State agencies and stakeholders is likewise important to expand access to low-cost financing for building electrification and efficiency upgrades, with leadership from HCR, the NY Green Bank and NYSERDA, the Department of Financial Services (DFS), DASNY, and NYPA.

- **Integrate energy requirements and resources into affordable housing deals:** Continue to scale up energy and green requirements in affordable housing deals while ensuring that sufficient resources are available to maintain, preserve and produce housing that is clean, safe, and affordable. For example, by no later than 2023, all new construction projects that receive Tax Credit funding through HCR should be required to be high-performance and all-electric buildings. Continue to streamline access to all incentives and resources for regulated affordable

housing building decarbonization to go through housing agencies making projects affordable, to also make projects energy-efficient, all-electric or electric-ready, and resilient.

- **Integrate energy performance into underwriting:** Provide support for lenders to underwrite to energy performance standards and applicable regulatory requirements.
- **Expand access to financing:** Provide greater access to low-cost financing products for upgrades, including for low-income homeowners and buildings located in Disadvantaged Communities. Explore new mechanisms to deploy public financial resources to enable low-interest financing products coupled with credit enhancement or insurance. Prioritize support for financing products made available by community development financial institutions and credit unions as part of the Community Reinvestment Act regulatory compact.
- **Expand energy savings performance contracting for public sector buildings:** The State should enact enabling legislation to expand the use of energy savings performance contracting to support implementation of emissions reduction upgrades in State and municipal buildings, P-12 schools, and other public facilities. Performance contracting is a financing mechanism in which efficiency upgrades are paid for through savings from reduced utility costs. Changes to existing statute should expand the energy savings performance contracting eligible list of measures, expand the allowable payback term for deep decarbonization performance contracts, allow some fast payback measures to help fund deferred maintenance needs, and allow a State agency or authority to request to keep a portion of cost savings that result from performance contracts. A new statute should allow Design/Build and integrated project delivery methods for public sector buildings that achieve deep decarbonization performance.
- **Create a revolving loan fund:** Create a revolving loan fund for building decarbonization and the reuse of buildings and building materials. For example, the Environmental Facilities Corporation's (EFC) Clean Water State Revolving Fund provides a model for enabling public mandates to be coupled with access to low-cost capital. This would be implemented through a bond-issuing government authority.

### *B6. Align Energy Price Signals with Policy Goals*

The low relative cost of fossil gas compared to electricity is a major barrier to building electrification. Over time, the costs of operating high efficiency electric heat pumps will need to become more attractive compared to heating with fossil gas. *Chapter 17. Economy-Wide Strategies* explores options for a comprehensive economy-wide policy that would price carbon emissions and *Chapter 18. Gas System Transition* addresses a managed transition of the fossil gas system. Such policy actions are expected to increase consumer energy prices for fossil fuels. Moreover, electric rate structures will need to evolve to

be supportive of and appropriate for higher levels of electrification of buildings and vehicles, with attention to equitable rate design.

The CJWG called for a more expansive set of actions related to consumer protection than are proposed below, including a "Utility customer bill of rights" that would include a safety net style guarantee of renewable energy to every household.

### Components of the Strategy

- **Price GHG emissions from fossil fuels:** Members of the Council have identified the value of a comprehensive policy that effectively prices GHG emissions. *Chapter 17. Economy-Wide Strategies* of this draft Scoping Plan identifies three options for public input.
- **Align electric rates:** The PSC and DPS should lead consideration of dynamic underlying electric rate structures and programs (such as dynamic load management) that provide appropriate price signals to customers to incentivize deployment and usage of DERs, including heat pump systems, battery and thermal storage, and other load flexibility measures that promote more efficient utilization of the electric delivery system and help to mitigate summer and winter system peaks. For low-income households, additionally consider subsidized rates or expanded bill discounts for households that adopt heat pumps.

## *Expand New York's Commitment to Market Development, Innovation, and Leading-by-Example in State Projects*

In coordination with financial incentives and regulations, State support for market development and innovation is important for ensuring the delivery of building decarbonization solutions that perform well and make our lives better. Areas of focus should include workforce skills and broad public awareness and engagement that motivates behavioral change. State RD&D investment in building decarbonization solutions also should be structured to help support products that are manufactured in New York.

The CJWG expressed broad support for market development and innovation investments as proposed here. The group called for attention to growing local supply chains and creating jobs in clean energy businesses that serve Disadvantaged Communities, as well as providing dedicated support to MWBE enterprises to innovate and actively participate in the transformation of the buildings sector.

### *B7. Invest in Workforce Development*

*Chapter 7. Just Transition* outlines critical actions to scale up workforce education, training, job placement, and development initiatives that equip New York's current and future workforce for the clean energy economy. Equally important, the chapter describes strategies to increase industry diversity and clean energy job placements for residents of Disadvantaged Communities, low-income residents, veterans, workers in fossil fuel industries, and other priority groups.

Consistent with the just transition framework and implementation partners described in *Chapter 7. Just Transition*, equipping a workforce to design, install, inspect, maintain, and operate healthy, comfortable, zero emission buildings needs to include expanded or new training. For example, many heat pump installers today have knowledge gaps around best practices for sizing, selecting, and installing ASHPs in New York's cold climate, underscoring the importance of workforce development to support quality installations and build market confidence. Overall, there is a shortage of qualified, skilled professionals who are ready to deliver the unprecedented speed and scale of adoption of heat pumps and energy efficiency measures that is needed over this decade to meet New York's climate goals.

#### Components of the Strategy

NYSERDA, DOL, and ESD will work together to support workforce development actions, in a manner that is responsive to industry needs and job placement opportunities and in coordination with educational institutions, training organizations, unions, industry actors, local governments and community-based organizations, workforce one-stops, and foundations.

- **Expand training:** Training for incumbent and new clean energy workers and adjacent industries needs to be increased dramatically, through investments in training infrastructure/delivery, career pathways, on-the-job-training, and industry partnerships. The State should support expanded or new training in the following priority areas:
    - Training and resources for the local government workforce of code officials and building inspectors.
    - Training and resources for contractors, technicians, and designers on sizing, selection, and installation of heat pumps and supporting measures.
    - Training and resources for contractors, technicians, and designers to reduce HFC emissions, addressing both leak reduction and proper disposal of HFCs already in use in building equipment and the transition to low-GWP alternatives for building equipment and spray foam insulation.

- Continuing education on building decarbonization as part of existing or new licensing and/or registration requirements for architects, engineers, trades, contractors, building operators, and real estate professionals, such as brokers and inspectors.
- Training and resources for building operations, maintenance, and service workers, with attention to supporting retention of experienced building service workers.
- Training and resources for planners, designers, and planning boards to understand and engage in planning processes that will support this transition.
- Healthy homes training, to equip energy auditors and health and social workers who make home visits to identify health and safety issues and contractors to address these issues.
- Training and industry partnership to increase the number of qualified geothermal drillers.
- Training for workers in fossil fuel industries to transfer their skills to clean energy opportunities.

- **Curricula and career services:** Require building decarbonization curricula and career services in State-funded education including K-12, technical schools, apprenticeships, and engineering and architecture programs at public universities, and encourage these curricula at private universities.
- **Prioritize Disadvantaged Communities and other priority populations:** The State should prioritize Disadvantaged Communities and low-income residents for training and job placement by creating community-to-employment pipelines and career pathways that are informed by an analysis of the effectiveness of current on-the-job training investments, led by the skills and hiring needs of employers to maximize job placement, and pared with wrap-around services to support job retention. Good wages, benefits, local and targeted training and hiring will be ensured through Community Benefits/Workforce Agreements and On the Job Training Funding where appropriate, feasible and permitted by law. The State should leverage agencies' spending and regulatory influence to advance commitments around job access and job quality for Disadvantaged Communities. The State should increase ranks of MWBEs and SDVOBs and worker cooperatives through increased funding for workforce training, business development support, and certification assistance, so as to provide increased opportunities for MWBE and SDVOB utilization on State contracts, in accordance with Executive Law Article 15-A and 17-B.

### *B8. Scale Up Public Awareness and Consumer Education*

With competing demands on our attention, there is low public awareness about New York's Climate Act in general, and more specifically, low awareness about steps to take to decarbonize buildings. Similarly, most people are not aware that using combustion appliances in their home—particularly fossil gas for

cooking—has negative impacts on indoor air quality[163] in the home (see *Chapter 8. Public Health* for a description of associated health risks), while also contributing to outdoor air pollution and climate change. New York should expand its support for broad public awareness and consumer education, create strategic partnerships with trusted community leaders, and scale-up targeted outreach and decision-making support to increase market demand and accelerate the transition to low-carbon, energy-efficient, all-electric buildings.

### Components of the Strategy

NYSERDA, the PSC and DPS, and utilities will lead these efforts, in coordination with local governments and community-based organizations and leaders.

- **Scale up campaigns:** Support and scale up multilingual public and consumer education efforts through large-scale, coordinated awareness, inspiration, and education campaigns. This would include traditional and broad reaching media, digital communication, "influencer" style campaigns, user-generated campaigns, virtual tours, and mailers. Campaigns would provide specific resources and tools for installers, distributors, the home-visiting workforce, and other supply chain actors to educate consumers.
- **Create strategic partnerships:** Create strategic partnerships that can have broad impact, including with trusted community leaders, religious leaders, and community-based organizations. Partner with utilities to promote decarbonization and to sunset messaging that promotes fossil gas as a "cleaner" choice. Other partners would include cooperative extensions, business councils, industry organizations and leading companies, unions, schools and teachers, film and public venues, and State and local elected officials. This work can build on experience from Heat Smart programs.
- **Prioritize Disadvantaged Communities:** Ensure messages, messengers, and media reflect Disadvantaged Communities in marketing efforts, and prioritize education and technical assistance for Disadvantaged Communities. Build on NYSERDA's development of regional Clean Energy Hubs and on the commitment of NYSERDA and the State's electric and gas utilities to maintain the New York Energy Advisor website as a "one-stop shop" source of information for clean energy, electrification, and energy efficiency programs for LMI households.

[163] Homes with gas stoves have, on average, 50%-400% higher concentrations of air pollutants indoors that those without. Source: EPA. (2008). Integrated Science Assessment for Oxides of Nitrogen - Health Criteria. Research Triangle Park, NC: U.S. Environmental Protection Agency.

Fund and expand community hubs to offer education, resources, local contractors, technical assistance, and program navigator support.

- **Publicize leaders:** Publicize best practices for efficient building operations and recognize leaders and innovators in efficient operations that support building occupants. Create an incentive program/challenge to attract others or encourage others to sign a pledge to commit to neutrality.
- **Provide technical resources:** Provide technical assistance and resource toolkits for building decision-makers and residents including playbooks for low-carbon solutions in common building types, free in-home or virtual audits to homeowners, and capital planning support for large buildings. Provide information resources and tools to support tenant engagement. Demonstrate low-carbon solutions through challenges and case studies. Develop case studies showing the feasibility, performance, and costs for three paths to transition to highly efficient and all-electric buildings: full electrification, phased electrification, and electrification readiness. Support new public-private partnerships or local government entities (such as the NYC Accelerator) to work with building owners and assist with access to useful resources and guidance, where appropriate in coordination with the State's regional Clean Energy Hubs.

### *B9. Support Innovation*

For nearly all buildings in New York, technologies exist today that can dramatically reduce the building's energy use and, with zero-emission electricity, decarbonize the building. However, ongoing innovation with respect to technology, design and planning, and business models is needed to reduce the cost and increase the value of such upgrades in order to make their value proposition competitive with conventional building systems. RD&D also should be pursued to develop and deploy specific technologies, such as long-duration energy storage and ultra-low GWP alternatives to HFCs, including natural refrigerants, for spray foam insulation, HVAC, water heating, and refrigeration technologies. In these areas, federal government RD&D funding and leadership is critical.

Complementary RD&D investment by New York in building decarbonization solutions offers multiple benefits. These include a strong multiplier for jobs and economic development, in-State demonstration projects and case studies for emerging technologies in prevalent building types, and demonstration projects that are located in and benefit Disadvantaged Communities. The State should continue to support RD&D and help to bring new companies and manufacturers to New York that offer innovative solutions for highly efficient, all-electric, and resilient buildings; for grid-interactive buildings; and for reducing embodied carbon in buildings.

### Components of the Strategy

NYSERDA and ESD will lead the State's RD&D investments, in coordination with Regional Economic Development Councils and local economic development agencies (as critical partners to assess innovation opportunities), SUNY, DEC, DPS, and the utilities.

- **Leverage Federal resources:** Advocate for, and leverage, federal and national laboratory resources focused on identifying and commercializing advancements in technologies for building decarbonization and building resilience.
- **Scale up tech transfer:** Scale up resources to identify and promote technology transfer for innovative building decarbonization technologies and design approaches that are in use internationally and could be transferred to the New York market. For example, support adapting technologies for U.S. and New York standards, in-State demonstrations, market research, partnering with New York entities, and manufacturing assistance.
- **Support minority- and women-owned and socially responsible business enterprises:** Provide support and outreach for MWBEs, cooperatives, and B Corps. For example, provide dedicated access to expert advisory services; internships, fellowships, and board placement in innovative companies and access to venture capital for underrepresented women and minority entrepreneurs, via New York Ventures.
- **Support NextGen building decarbonization solutions:** Continue to support RD&D, demonstrations, and technology transfer and commercialization for next generation HVAC systems, building envelopes, and design approaches that meet technical needs, deliver high performance, and lower costs. This includes continued improvement in cold climate performance across a range of heat pump products and sizes; improved domestic hot water heat pump technologies; solutions for harder-to-electrify buildings, including those on the Con Ed steam system; community thermal loops; advanced heat recovery and ventilation; improved thermal storage for HVAC applications; innovative materials, construction approaches, and manufacturing methods that improve building envelopes; and other technologies.
- **Support NextGen grid-interactive buildings solutions:** Support RD&D, demonstrations, technology transfer and commercialization, and development of standards across manufacturers and equipment for Grid-Interactive Efficient Buildings, to deliver energy efficiency, load flexibility, and modulation capabilities that contribute to efficient grid management and grid reliability. Support the development of market signals, including revenue streams for Grid-Interactive Efficient Buildings, via analysis of opportunities to provide grid services and electric/thermal services to neighboring buildings, assessment of market mechanisms for

supporting desired policy outcomes, and pilots and demonstrations to inform rulemaking and ratemaking.

- **Support RD&D for low-carbon fuels:** Assess and then support RD&D needs with respect to the potential for some use of low-carbon fuels in buildings (such as RNG, green hydrogen, wood, and/or high-percentage biodiesel blends) and bioenergy with carbon capture and storage for harder-to-electrify buildings, which may include campuses with district energy systems.
- **Support RD&D for building resilience:** Assess and then support RD&D needs with respect to building resilience, as New York looks toward both widespread building electrification and more frequent extreme weather. Research, develop, and pilot grid-independent, non-fossil fuel approaches for heating and cooling buildings during prolonged power outages, such as long-duration thermal storage, GSHP plus battery systems, and passive cooling approaches. Related RD&D investments (also discussed in *Chapter 13. Electricity*) include the flexibility and resilience of the electrical system and long-term energy and thermal storage solutions.

### *B10. Reduce Embodied Carbon from Building Construction*

A specific area for RD&D and for the State to lead by example is to reduce the embodied carbon associated with building construction, which describes all the GHG emissions that result from the mining, harvesting, processing, manufacturing, transportation, and installation of the products and materials that are used in buildings, as well as end-of-life emissions associated with the disposal of those materials. The most impactful way to reduce embodied carbon is to reuse existing buildings where practical, rather than demolishing and constructing anew. When new construction or renovation occurs, smart and integrated building design processes can significantly reduce embodied carbon at little-to-no added cost of construction. Moreover, in-State manufacturing can grow to produce the low-carbon alternative products. However, there is currently a broad lack of awareness in the industry of embodied carbon impacts from products in use in buildings, including among designers, contractors, and manufacturers.

To lower the embodied carbon of products and materials used in the buildings sector and to create broad carbon literacy regarding the impact of these materials, New York should establish procurement requirements and design specifications for State-funded projects as well as support education, building reuse, building de-construction and material reuse, RD&D, and in-State manufacturing of alternative products. These efforts also will increase industry attention to carbon-sequestering products, such as sustainable wood products and hempcrete.

### Components of the Strategy

Interagency coordination through the GreenNY Council will include DASNY, DEC, OGS, NYPA, NYSERDA, DOS, ESD, and other agencies. State agencies should also explore procurement specifications under Executive Order 4 and potential links to public bid process for construction projects.

- **Lead by example in State projects:** Drive embodied carbon reductions through design and procurement in State-funded new construction projects.
- **Make embodied carbon transparent:** In design specifications, require Environmental Product Declarations for structural building materials where available, and require the use of available modeling software and design tools for calculation of the project's embodied carbon budget.
- **Follow lower-carbon specifications:** Require that State-funded projects follow lower-carbon specifications (see GreenNY) for the most carbon intensive construction materials and products (such as concrete, foam insulations, glass, and window units).
- **Set reduction targets for projects:** Subsequently, set a target embodied carbon reduction level for projects that is below the established mean embodied carbon budget, as illustrated over the previous years.
- **Incorporate embodied carbon budgets into permitting:** Require an embodied carbon budget to be submitted as part of the permit process for all commercial and institutional new construction (and additions and alterations as applicable), immediately for State entities and no later than 2025 for local government entities. Provide State-funded training and resources for designers and for State and local permitting entities to check carbon budgets for completeness at first, and then for accuracy as the market improves in its abilities.
- **Encourage building reuse:** Identify and pursue financial incentives, changes to building codes, and other strategies to encourage building reuse, beginning in urban centers that are returning vacant buildings to use. Maintaining the existing building facade and architectural style can be an additional benefit to the embodied carbon reduction.
- **Support RD&D:** Support RD&D, demonstration projects, and technology transfer and commercialization for enhanced low embodied carbon construction, including preference for reuse of existing buildings. Showcase low embodied carbon designs and undertake industry outreach.
- **Expand in-State manufacturing for products:** Provide assistance to expand in-State manufacturing for products that are lower in embodied carbon or made of carbon sequestering materials (also known as biogenic or agriculture-based materials). The New York State Wood

Products Development Council (WPDC), SUNY College of Environmental Science and Forestry (ESF), and ESD are well positioned to provide and coordinate assistance.

- **Incorporate embodied carbon specifications into incentive programs:** In the design of energy efficiency incentive programs, incorporate lower-carbon specifications for the most carbon intensive products (such as foam insulations in homes).

### *Transition from Hydrofluorocarbons*

### *B11. Advance a Managed and Just Transition from Reliance on Hydrofluorocarbon Use*

HFC use is currently widespread in refrigeration and HVAC equipment, including in heat pumps that are being recommended to electrify space conditioning and water heating, and in foams that provide insulation for higher efficiency buildings.

#### Components of the Strategy

- **Provide education and training:** The State should provide resource toolkits, programs and incentives that make low-GWP refrigerant technologies and low-GWP alternatives available and affordable, including a focus on natural refrigerants. DEC should promulgate regulations regarding proper disposal of HFCs already in use in existing equipment and such regulations should be supported by training installers and contractors on handling, equipment maintenance, and disposal protocols. NYSERDA should support design professional and workforce training and education around low-GWP refrigerants and alternatives, including natural refrigerants, in building equipment and in building/construction spray foam.
- **Update regulations, codes, and standards:** As soon as possible, update the relevant New York codes, including the mechanical code, to allow the use of low-GWP alternatives for HFCs. DEC should promulgate regulations requiring reclamation or destruction of refrigerants from appliances at end-of-life, with verification and reporting, and require leak detection for certain commercial refrigeration. Provide education and training, technical assistance, and economic support (such as, incentives to purchase leak detection and reclamation equipment, or compensation for refrigerant reclamation) to aid local industry with this transition.
- **Phase out high-GWP HFCs:** DEC should expand the scope of 6 NYCRR Part 494, which prohibits certain HFCs in refrigerator/freezers, chillers, commercial refrigeration, and aerosols/foams/solvents end uses, including through the establishment of a GWP threshold that decreases over time as low and ultra-low GWP options become available. DEC should align New York policy with anticipated federal (EPA) policy measures to meet HFC reduction requirements

as well as with other U.S. Climate Alliance states, to send a strong market signal to manufacturers and industry while mitigating costs of the transition.

- **Research health effects and environmental impacts:** Support further research into known data gaps, including an analysis of typical leak rates and charge size in heat pump technologies and research into long term health effects of exposure to new HFC-alternative chemicals in building materials.
- **Support RD&D:** Continue to support demonstration projects for low and ultra-low GWP refrigerants in HVAC and hot-water systems, and for refrigerant leakage detection and reduction strategies. Develop case studies in refrigerant management and alternatives to HFCs, including natural refrigerants, showing the safety, performance, and cost impacts.

# Chapter 13. Electricity

## 13.1 State of the Sector

### *Overview*

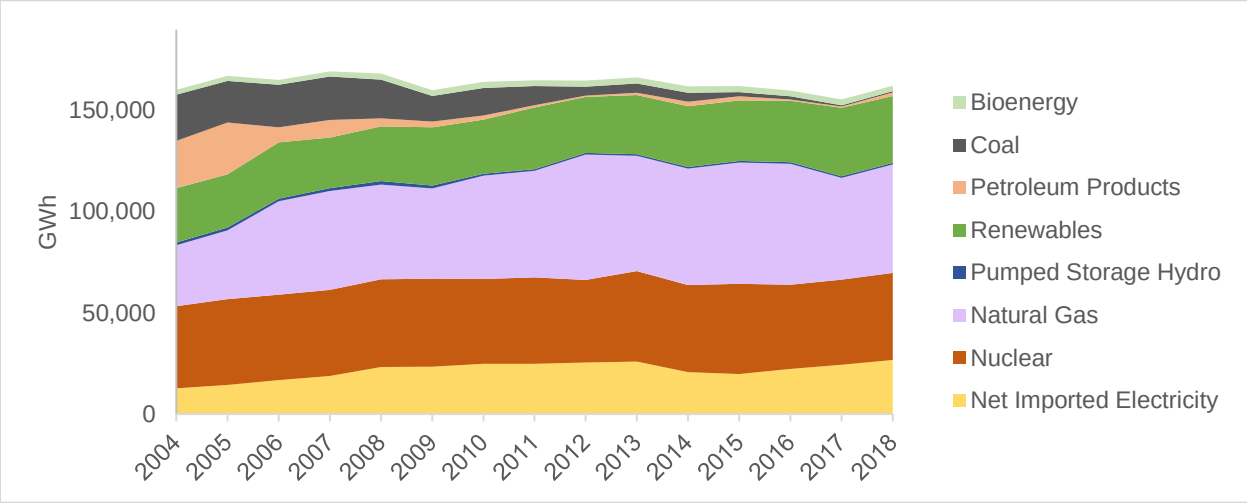
New York's electricity sector is comprised of traditional fossil-fuel fired power generation facilities, nuclear generation facilities, along with clean energy generation such as wind, solar, hydropower, energy storage, and transmission infrastructure. In 2020, renewable resources accounted for approximately 27% of the State's electricity generation. Meanwhile, nuclear resources contributed about 29% of the electricity generation in the State. Fossil fuel generation, including natural gas, oil, and dual fuel generation produced more than 43% of statewide electricity. The reliance on coal has decreased significantly in recent years (see Figure 23) with the last remaining coal-fired power plant closing in 2020, following DEC's adoption of revisions to 6 NYCRR Part 251 to establish $CO_2$ emission limits for existing power plants.[164]

**Emissions Overview:**

The electricity sector comprised 13% of statewide emissions in 2019, including electricity generation within the State (44%), imported electricity (15%), emissions from imported fuels (41%), and the $SF_6$ used in electricity distribution and transmission (<1%). Electricity sector emissions have declined 46% since 1990.

[164] NYSERDA. 2021. Patterns and Trends: New York State Energy Profiles, 2003–2017. Albany. Accessed at https://www.nyserda.ny.gov/about/publications/ea-reports-and-studies/patterns-and-trends.

**Figure 23. Electric Generation by Fuel Type (2004–2018)**




*Source:* NYSERDA Patterns and Trends – New York State Energy Profile.

### *Vision for 2030*

The Climate Act requires that 70% of statewide electricity come from renewable energy sources by 2030. The Climate Act also requires 6,000 MW of distributed solar by 2025 and 3,000 MW of energy storage be installed by 2030.[165] This can be accomplished by aggressive deployment of existing renewable energy technologies such as wind, solar, and energy storage. With the primary procurement mechanisms already established to do just that, the recommendations included here for 2030 look to ensure that the procurement mechanisms lead to construction and operation of renewable energy and accelerate the pace and reduce the cost of decarbonizing the electric grid. These include support for the CES and storage deployment, refined electric grid modeling to improve decision-making, and improved coordination across State agencies.

### *Vision for 2050*

By 2040, the Climate Act requires that the State achieve a zero-emissions electricity system as well as 9,000 MW of offshore wind by 2035. Achieving this will require all of the actions identified for 2030, further procurement of renewables, and a focus on developing new technology solutions. The State will also need market solutions that better align with the 100% emissions-free requirement, allow for a rapid transition away from fossil fuel generation, and maintain reliability and affordability.

[165] In September 2021, Governor Hochul called for an expansion of the State's distributed solar program from 6,000 MW to 10,0000 MW and tasked NYSERDA and DPS with developing a distributed solar roadmap to chart a path to advance the expanded goal in a resilient, cost effective and responsible manner.

As the transportation and buildings sectors transition to electric—due to ZEV sales requirements and incentives and zero-emission building codes—the increased demand will impact the amount of renewable electric generating capacity needed to meet the 70x30 and 100x40 requirements. The State anticipates electricity demand growth of 65% to 80% by 2050, dependent on the scale and timing of electrification and whether there are other clean alternatives for the transportation and building sectors. The level of electrification needed to achieve the GHG emissions reduction requirements will increase overall electric load and shift the system peak demand from the summer to the winter. Given the large amounts of renewables that must be procured and developed to reach the goals, the State needs to incorporate load flexibility and controllability into the electric grid as sectors electrify in order to create a more manageable system. New and upgraded transmission and distribution systems will also be necessary to deliver energy from where the generation is located (both upstate and offshore), to where the load demand exists, downstate.

Recommendations include advancing long-duration storage and designing market mechanisms that promote, support, and do not disadvantage those clean resources needed to meet the requirements.

### *Existing Sectoral Mitigation Strategies*

Prior to the adoption of the Climate Act, the State had existing policy mechanisms and programs in place working to achieve electricity system decarbonization, including NYSERDA's extensive procurement programs for land-based and offshore renewable resources. These efforts continue and have been expanded where necessary to meet the 2030 requirements in the Climate Act. For instance, in the Fall of 2020, the PSC implemented key provisions to align the Clean Energy Standard (CES) with the Climate Act and provide NYSERDA with the authorization to procure the renewable energy needed. These provisions included increased annual Tier 1 renewables procurement targets for NYSERDA to align with the 70x30 mandate, the adoption of the 9 GW offshore wind procurement directive, and the creation of Tier 4 to deliver renewable energy to New York City. NYSERDA procurement for Tier 1 will need to average almost 4,500 gigawatt hours annually over the 2021 to 2026 period to meet the Climate Act's 2030 directive (which includes calculation for load growth). The CES also includes the Tier 2 maintenance program, which is an important mechanism to keep existing renewable facilities operational. These polices and procurement targets will be updated and adjusted over the course of the next decade by both NYSERDA and the Commission. The Climate Act requires the PSC to undertake a biennial review of the CES Program, so that the PSC can adjust Program requirements as necessary (to meet both the 2030 and 2040 directives).

The State also has environmental policies in place to address GHG emissions from the electricity sector. While Part 242, the $CO_2$ Budget Trading Program, or RGGI, implementing regulations have been in place since 2009, the most recent revisions extended the cap reductions out to 2030. In addition to reducing the RGGI cap by 30%, New York expanded the compliance obligation under these revisions to units less than 25 MW to pull in peaking units 15MW and larger. DEC also regulates, new, modified, and non-modified existing major electric generating facilities under Part 251, $CO_2$ Performance Standards for Major Electric Generating Facilities. The most recent revisions to Part 251 were critical to ensuring the State met its commitment to eliminating coal from the electric generating sector by 2020. The regulations also ensure that any new and/or modified sources meet stringent $CO_2$ emissions standards.

Under the Clean Air Act, DEC has also been permitting and regulating emissions of co-pollutants from power plants for over 50 years to address the local and regional impacts from the emissions of PM, $NO_X$, and $SO_2$.

Current DEC regulations that target emissions of fossil fuel-fired facilities include:

- **Subpart 227-3 –** The "Peaker Rule" – Ozone Season Oxides of Nitrogen ($NO_X$) Emission Limits for Simple Cycle and Regenerative Combustion Turbines (peakers). Contains ozone season $NO_x$ emission limits for affected sources for calendar years 2023 and 2025. Also contains provision to extend the compliance dates if NYISO or Local Distribution Owner determine there is a reliability need. Regulations adopted in early 2020.
    - For 227-3, the primary pollutant of concern is $NO_x$ because the peakers regulated are an order of magnitude dirtier than clean combined cycle units. From a climate perspective the targeted peakers represent less than 3% of the $CO_2$ from all regulated electric generating units.
- **Part 242** – $CO_2$ Budget Trading Program. Part 242 is New York's regulation for implementing the RGGI program. The regulation was recently revised in December 2020 to further reduce the $CO_2$ emissions budget or cap by 30% through 2030 and expand applicability to peaking units. Another regional program review is scheduled to begin toward the end of this year.
    - Due to the recent expansion, Part 242 now covers more peaking units of 15 MW and above (previously 25 MW and above).
- **Part 251** – $CO_2$ Performance Standards for Major Electric Generating Facilities. The Department adopted revision to Part 251 to establish $CO_2$ emission rate limits for non-modified existing

electric generating facilities. The current emission limits are 1,800 lbs/MW hour or 180 lbs/million Btu. The regulations were adopted in 2019.

- Part 251 created $CO_2$ emission rate limits. Though this regulation helped to retire the last of New York's coal plants, currently all peaking units meet those rate limits.

DEC's emissions regulatory programs and NYSERDA's procurement programs are the push-and-pull that is designed to safely phase out the use of fossil fuel for electricity and gradually replace it with renewable technologies. In addition, for all decisions such as permitting decisions pertaining to electric generation facilities, State agencies will need to ensure that the proposed actions are not inconsistent with and will not interfere with the attainment of the statewide GHG emission limits established under the Climate Act. Until such time the final Scoping Plan is adopted, and the regulations required under the Climate Act to ensure compliance with the statewide emission limits are promulgated by DEC, agencies will ensure compliance with Section 7(2) by reviewing a decision's consistency with the statewide GHG emission limits established under the Climate Act and set forth under DEC Part 496 Statewide GHG Emission Limits.[166] Still, there are additional actions necessary to ensure we meet the Climate Act requirements for electricity.

### *Key Stakeholders*

Key stakeholders include NYSERDA, DPS and the PSC, DEC, NYPA, LIPA, ESD, the NYISO, utility owners and operators, and both fossil and clean energy generation owners and operators. These groups will have to work together to ensure an effective and efficient transition to a zero-emissions electricity grid, while maintaining reliability and cost-effective implementation.

## 13.2 Key Sector Strategies

The key strategies within this sector are organized into three themes, as shown in Table 10.

[166] 6 NYCRR § 496.4.

**Table 10. Electricity Sector Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Transforming Power Generation | E1. Retirement of Fossil Fuel Fired Facilities<br>E2. Accelerate Growth of Large-Scale Renewable Energy Generation<br>E3. Facilitate Distributed Generation / Distributed Energy Resources<br>E4. Support Clean Energy Siting and Community Acceptance<br>E5. Promote Community Choice Aggregation |
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## *Transforming Power Generation*

With natural gas currently being the principal fossil fuel source for electricity generation in the State, a significant transformation of the power sector is necessary to meet the Climate Act's requirements of 70% renewable electricity by 2030 and 100% emissions-free electricity by 2040. To decrease the use of emitting fuels in the electricity sector, New York must deploy clean energy resources such as land-based wind and solar, offshore wind, hydropower, fuel cells that use renewable fuels, and energy storage. While many programs are already in place to support and encourage these types of resources and significant progress has been made, aggressive deployment of clean resources must continue, and the effectiveness of programs and policies should be continually evaluated and changed if renewable energy is not being deployed at the pace necessary to achieve the goals on time.

## *E1. Retirement of Fossil Fuel Fired Facilities*

Achieving a 100% emissions-free power grid will require phasing out the use of fossil fuel for power generation over time. During the same period, New York will also need to maintain a completely safe and reliable power grid. To address this dual challenge, let's briefly review the system for meeting our electricity needs now.

Currently, to meet daily electricity demand, a combination of generation assets (i.e., power plants) is reserved and then dispatched to meet electricity demand at the lowest achievable cost. This combination of resources is called the "supply stack." Typically, renewable generators run whenever they have supply available. "Baseload" generators are those generators with low per-unit running cost and serve as the bottom of the supply stack (chosen to run first and most often)—typically these are large nuclear, hydroelectric, and some of the more economic fossil fuel power plants. Other generation is used

to meet energy demand beyond that served by baseload plants, which fluctuates throughout the day. When demand increases beyond minimum and average daily load, other "peaking" generators are used to provide the final amount of required. These peak generators are typically the most expensive and polluting units on the system (on an emission rate basis). Peaking generators may also be needed in certain locations (load pockets) where energy delivery into the load pocket may become congested, requiring electricity to be produced and delivered locally (e.g., within the load pocket itself, including areas within sub-transmission and distribution networks).

Transitioning to zero-emissions will require addressing emissions from both baseload and peaking facilities. To facilitate and enable retirement of fossil-fuel fired facilities, New York needs to: continue and accelerate its deployment of new renewable generators (e.g., wind, solar, hydro); maintain the fleet of renewable generators it has now; upgrade its transmission and distribution system to allow for the maximum use of the renewable generators (i.e., get the power where it needs to go); and invest in energy storage technologies.

As described in more detail below as the components of strategy E2, New York should also have a detailed process in place to ensure that the fossil fuel generators are gradually and safely retired, while still maintaining reliability. Studies such as the NYISO Reliability Needs Assessment (RNA) and overall Comprehensive Reliability Plan will inform this process to ensure consumer energy reliability while transitioning away from fossil fuel electricity generation. If a reliability need or risk is identified, emissions-free solutions should be fully explored, such as storage, transmission upgrades or construction, energy efficiency, demand response, or another zero-emissions resource. Only after these alternatives are fully analyzed and determined to not be able to reasonably solve the identified grid reliability need shall new or repowered fossil fuel-fired generation facilities be considered. These should only be considered if the NYISO and local transmission operators confirm that the fossil fuel fired facility is required to maintain system reliability and that need cannot reasonably be met with the alternatives listed above. Even in those cases, the fossil-fueled generation facility should assist in meeting the goals of the Climate Act. That is, its deployment should result in a greater integration of zero-emissions resources; a reduction in fossil fuel generation; a significant reduction of GHG and co-pollutant emissions; a benefit to an environmental justice community; and a benefit to the electric system that addresses the identified reliability need or risk. Additionally, public and stakeholder input must be incorporated into the decision-making process and a thorough analysis of equity considerations, as mandated by the Climate Act, should be completed by DEC and/or other relevant State agency. The CJWG is supportive of strategies to facilitate retirement of fossil fuel fired generation facilities and recommends the Council take the

additional step of placing a moratorium on the permitting of new fossil fuel plants until the final Scoping Plan is in place, or until there is a demonstrated system reliability need that can only be addressed with fossil fuel generation.

### Components of the Strategy

- **Assessment and Determination of Emissions Reduction Targets:** The PSC, DEC, NYSERDA, and the New York State Energy Planning Board should work in coordination to determine the potential for GHG emission and co-pollutant reductions from fossil fuel generation by 2030 and set a corresponding timeline for emissions reduction targets. The timeline from present to 2030 for possible emission reductions should be determined in conjunction with the renewable energy procurement and interconnection schedule and should represent a continual decline in emissions from present to 2040 while ensuring reliability. The process should include effective mechanisms for input and comments by stakeholders (including but not limited to generators, utilities, and environmental, environmental justice, public health, labor, and electricity consumer advocates and organizations, as well as local communities) and the public. When setting emission reduction targets, consideration should be given to the location and emissions profile from fossil generating units across the State, as well as relevant planning studies from involved organizations (e.g., the Power Grid Study, NYISO reliability analyses, etc.) to inform decisions to address these emissions in the most efficient and effective manner possible. Disadvantaged communities shall be considered when determining the emissions reduction targets, as required by the Climate Act. The effectiveness of the emissions reduction targets and progress toward achieving the 2030 goals shall be evaluated every two years and adjusted accordingly to ensure the subsequent 2040 zero-emissions target is achieved. Reviews should coincide with the requirements in the Climate Act, State Administrative Procedures Act (SAPA) 3-year review requirement and resource planning review (see below).
- **Promulgation of Emissions Regulations:** DEC should assess regulatory options to reduce emissions from fossil fuel-fired generating units to the maximum extent practicable to achieve the requirements of the Climate Act while maintaining system reliability. Following the above analysis, and in coordination with PSC, NYSERDA and other interested stakeholders, DEC should examine all potential regulatory options, including new regulations and/or permit requirements or amendment of current regulations and/or permitting requirements, to determine the most efficient, effective, and enforceable format to achieve the determined emissions reduction targets and the Climate Act requirements. The process should include effective mechanisms for input and comments from stakeholders prior to formal proposal under SAPA,

similar to the process used in promulgating the DEC "Peaker Rule," 6 NYCRR Subpart 227-3. Once completed, DEC should follow SAPA in promulgating the identified regulation(s).

- Consistent with SAPA, the effectiveness of the regulations should be evaluated every two years. This evaluation should coincide with the resource planning review (see below on planning).
- Coordination of closures and the necessary reliability assessments should take place between State Agencies (e.g., DEC, PSC, NYSERDA, ESD) and other key stakeholders (e.g., the NYISO, utilities and fossil fuel facility owners and operators; see below on planning).
- Evaluation of GHG emissions and co-pollutants, benefits, reliability needs, cost, and available replacements (and their subsequent impacts) must be executed (see below on planning).
- Specific focus should also be given to emissions of co-pollutants in disadvantaged and environmental justice communities, as required by the Climate Act.

- **Regular and Transparent Resource Planning:** The New York State Energy Planning Board should commence an iterative planning process in order to support and ensure the achievement of the emissions reduction targets and compliance with the promulgated regulations by DEC. The process should:
  - Be performed every two years and timed to serve as a critical input into future Clean Energy Standard, State Energy Plan and/or Council updates and to coincide with the review of any related regulations or Climate Act requirements.
  - Undertaken in cooperation with the NYISO, DEC, PSC, NYSERDA, and utilities and in consideration of relevant studies by these organizations and requirements of the Climate Act
  - Examine options to reduce or eliminate emissions from fossil fuel-fired generation facilities, including behind-the-meter fossil resources as expeditiously as practicable but not later than 2040, identifying the nature, feasibility, cost and avoided costs, risks and risk mitigants, and impacts on emissions and health as well as reliability. These options may include efficiency, storage, load flexibility, DERs, and transmission and distribution upgrades, among others.
  - As part of the resource planning process, undertake planning to address the impacts on communities and workers. Specifically:

- Assess the revenue impacts on school districts and municipalities of fossil fuel plant closures and ensure adequate funding of the Electric Generation Facility Cessation Mitigation Program as plants are retired;[167]
- Ensure that plant owners are responsible for costs of site remediation;
- Focus on repurposing these facilities as necessary to take advantage of their location and infrastructure to ensure reliability while meeting the Climate Act requirements;
- Support a process involving local stakeholders to determine redevelopment of sites as plants are retired.
- Examine options to reduce emissions impacts in environmental justice and Disadvantaged Communities (see Appendix B for details).
- Investigate and implement options to develop market mechanisms to assist in the removal of fossil fuel-fired generating facilities from the system. These options include, but are not limited to, the opportunity for carbon pricing and valuing of environmental attributes either within or external to NYISO markets. Specifically, for a clean dispatch program that creates Clean Dispatch Credits (CDC). Emission-free, fully dispatchable assets that dispatch during peak load times would generate CDCs. Consideration should be given to both capacity and per-MWh payment structures. LSEs would be required to procure increasing amounts of CDCs annually to ensure progress is being made. In developing any such market mechanisms, New York must ensure Disadvantaged Communities benefit and not be negatively impacted.

### *E2. Accelerate Growth of Large-Scale Renewable Energy Generation*

New York needs to get new renewable projects built. This points to the need for efficient processes to deploy large-scale renewable generation and improved transmission and distribution systems. To achieve this, the State has administered successful Clean Energy Standard procurement programs such as Tier 1 and the offshore wind Tier, Tier 4 which looks to increase renewables penetration in Zone J, and Build Ready that prioritizes the pre-construction development of existing but less desirable, abandoned, or underutilized sites for auction, to provide a de-risked project for developers to construct and operate at these locations. New York will continue to rely on the CES to reach the 70% renewable and 100% emissions-free electric generation requirements.

[167] As of April 2021, New York State has appropriated a cumulative total of $140 million for the program.

As previously discussed, the October 2020 Clean Energy Standard increased the number of renewables to be procured in order to meet the Climate Act requirements. NYSERDA's current procurement programs including Tier 1, Offshore Wind, and Tier 4, will expand and continue to procure the renewable energy needed to reach these requirements, and a zero-emissions grid. The State also recently created a dedicated ORES to streamline and expedite the siting of major renewable energy projects. The State also participates in existing planning processes related to transmission projects and recently identified the need for several competitive project solicitations through the NYISO Public Policy Transmission Planning Process. Two of those projects are now under construction.

The CJWG is generally supportive of accelerating the deployment of large-scale renewable energy systems, however they also stress the need to balance this approach to large-scale renewables with significant investment and technical support for Disadvantaged Communities to develop behind-the-meter microgrids to reduce grid strain, increase resiliency and affordability, and diversify the State's energy portfolio. The strategies included in this draft Scoping Plan are aimed at doing just that and the need for support for underserved, LMI, and environmental justice communities has been emphasized in the strategies related to DG and CCA.

### Components of the Strategy

- **Evaluate and adjust:** The State should continue to evaluate and adjust policies and procurement targets as necessary in order to achieve the Climate Act requirements and goals and deploy renewable energy systems including solar, land-based wind, and offshore wind.
- **Support successful programs:** The State should continue to support successful programs and regulatory changes, such as Build Ready and the Accelerated Renewable Energy Growth and Community Benefit Act through funding and hiring adequate staff in the ORES and other relevant State agencies (such as NYSERDA, DPS, DOS, and DEC) to ensure a rigorous but efficient and timely procurement and permitting process.
- **Identify facilitating transmission and distribution needs:** The State should identify key transmission and distribution upgrades, improvements, and new line construction needed to deliver renewable energy from where it is built, to where it is needed in compliment with other transmission and distribution activities described later.
- **Establish permitting goals:** ORES should establish a non-binding metric or goal with respect to MWs of renewable energy that should be permitted each year in such an amount that compliments the Tier 1 request for proposals procurements.

- **Explore:** The State should explore additional areas of openness and engagement with the NYISO and other stakeholders to improve the interconnection/Class Year process.[168]

### *E3. Facilitate Distributed Generation / Distributed Energy Resources*

Clean DG and DERs will continue to be pursued alongside the expansion of large-scale renewables. These resources generate electricity closer to end users, thereby increasing the efficiency and reducing carbon pollution compared to other generation facilities, as well improving grid resiliency and potentially curtailing the need for costly transmission investments.

DG/DER is also a primary way (alongside energy efficiency) to meet the social equity requirements of the Climate Act. In some areas, clean energy from DG/DERs sources can help to provide some of the reliability attributes that would otherwise be met by running existing fossil fuel generation, thereby improving local air quality. When properly developed, clean DG/DER projects can also allow communities to participate in the process, providing economic development and workforce development opportunities, and bolstering resiliency. Increases in distribution system hosting capacity and the pace of interconnection will be important factors in facilitating deployment of DG/DER.

The CJWG is supportive of this strategy. It suggests that there needs to be a process in place to assure that LMI community solar savings do not conflict, interfere, or in any way prevent access to the other LMI energy savings programs such as the Home Energy Assistance Program. It also flagged the point that when designing incentives, use of grants over tax credits is preferred as tax credits may not be beneficial for LMI consumers. These concepts have been included in the Components of the Strategy section below.

#### Components of the Strategy

Physical Needs

- **Hosting Capacity:** The State should make proactive and timely investments in local transmission and distribution infrastructure, and associated cost-sharing/allocation associated with the utilities in these upgrades. The State should also accelerate adoption of innovative technologies and programs that increase hosting capacity such as flexible interconnection, hybrid systems and

[168] The NYISO interconnection/Class Year Process is part of the NYISO's Comprehensive System Planning Process that focuses on the NYISO's responsibility to prepare for the impact of expected changes in supply and demand of power on the reliable operation of the New York transmission system over a ten-year period. The NYISO's Interconnection processes enable parties to pursue construction and interconnection of generation, transmission, and load facilities to the New York State Transmission System and Distribution System.

coupling with energy storage or controlled load, smart inverters, and solutions that enable maximum back feeding at the substation level from distribution to transmission as part of the local transmission and distribution planning process.

- **Interconnection:** The State should speed up the pace of processing interconnection applications and need for right-sizing human resources at utilities to mitigate delays in application processing.

Financial support

- **Rate Design:** The State should consider improvements to dynamic underlying electric rate structures and programs (such as dynamic load management) that provide appropriate cost-based price signals to customers to encourage DER deployment and usage.
- **Compensation:** The State should consider improvements to the value of DER stack to more accurately reflect value provided by DERs such as a more granular (time and location) environmental value and avoided transmission costs.
- **Incentives:** The State should target incentives to stimulate high-benefit DER projects (dual-use solar/ag, multifamily housing, heat pumps/geothermal, collective solar projects) and paired with electrification serving LMI and environmental justice communities. NYSERDA should expand the Solar Energy Equity Framework programs, Low Income Community Solar concept, and adder for Inclusive Community Solar Projects. The State should ensure that participation in incentive programs is effective for the target audiences (e.g., tax credits may not be as effective for LMI consumers) and does not preclude participation in other programs.
- **Ground-Mounted Siting:** The State should address resistance and concerns to siting of ground-mounted solar projects, particularly in upstate and western New York.
- **Rooftop and Parking Lot Solar Permitting:** Need for a streamlined permitting process across authorities having jurisdiction that reduces processing times and soft costs.
- **Zoning:** The State should provide model zoning laws to municipalities for residential/commercial properties to require new construction be designed as “solar-ready.”
- **Resources & Education:** The State should create or expand on regional discussion forums between itself, local communities, and projects to connect communities with resources, information, and address local concerns.
- **Aggregations:** Encouraging aggregations of distributed resources will provide additional value for grid management.

## *E4. Support Clean Energy Siting and Community Acceptance*

New York will need to accelerate the deployment of renewable energy projects (both LSR and DG) in order to achieve the Climate Act's mandates. While NYSERDA's procurement programs and improved permitting processes are critical to deployment of new renewable facilities, other actions are needed to get projects successfully sited and accepted by host communities. New York needs a multi-pronged approach with communities to support the siting and acceptance of renewable energy facilities, including wind, solar, storage, and transmission upgrades. This multi-pronged approach should include strong communication, engagement, and public outreach to communities. It should also include promotion of the benefits that renewable energy projects will provide, while working with communities to maximize these local benefits and minimize impact on lands identified by communities with other competing uses such as farming and agricultural soils.

This approach to fostering community acceptance will differ for smaller, distributed projects in more densely populated locations to larger utility-scale wind and solar projects in more rural areas or offshore. The community concerns and the community benefits for these two types of projects are somewhat different, but both can provide energy cost savings for residents and businesses in the community; local infrastructure improvement; local tax revenue and economic benefits; local job creation; and cleaner air for New Yorkers.

The CJWG supports finding compromise around local control while achieving State targets and emphasizes the need for community education and engagement to inform New Yorkers about the climate crisis and the benefits of shifting to a clean energy economy.

### Components of the Strategy

Clean Energy Development

- **Agrivoltaics:** The State should research and incentivize the viability of agrivoltaics[169] to integrate solar into the agricultural communities and provide habitat improvement for threated and endangered species.
- **Development Mapping:** The State should develop a Clean Energy Development Mapping tool to help municipal representatives and local communities make informed land use decisions and communicate local wants to developers.

[169] Agrivoltaics is the co-location of solar powered projects and agriculture.

- **Fund Planning:** The State should offer State support and funding for Regional Planning Associations to assist municipalities in planning for renewable energy development.
- **Refine NYSERDA Processes:** NYSERDA should continually refine processes, evaluation, and incentives for determining buildable projects and selecting projects for procurement request for proposals.
- **Decommissioning:** The State should study and advise communities on how to best implement options for decommissioning of community-owned projects at the end of their production life.

Public Education and Outreach

- **Public Education:** The State should launch a statewide public education campaign to inform New Yorkers about the climate crisis and the benefits of shifting to a clean energy economy. The campaign should focus on community-based outreach and education on climate science and solutions and could include a K – 12 climate change curricula in schools, supporting non-profits, increasing public awareness about the benefits of renewable energy, connecting people with clean energy programs job training and educational opportunities, and encouraging local and regional land-use and decarbonization planning.
- **Non-profit Outreach:** Based on available funding, the State should provide funding for non-profits and community-based organizations to do education and outreach about clean energy benefits.

Equity & Local Benefits

- **Measure and Publish Benefits:** The State should ensure community benefits and avoided costs are tracked in dollars as outlined under the Climate Act and that this information is accessible through a platform such as Open NY.
- **Cooperative Structures:** The State should determine who needs benefits and then create municipal/cooperative structures in Disadvantaged Communities, as well as examine laws regarding cooperatively owned enterprises and establish consumer protections in this new market.
- **Host Benefits:** NYSERDA should make host community benefits more robust and targeted (such as NYSERDA's Host Community Billing Program).
- **Local Government:** NYSERDA should empower local governments to take a leadership role in educating the community in clean energy.

- **Streamline Incentives:** Based on available funding, NYSERDA should expand and streamline incentives for energy efficiency, including funding for customers based on utility payment history instead of credit scores.
- **Weatherization:** Based on available funding, NYSERDA should invest in local weatherization assistance and energy efficiency programs.
- **Broadband:** Enable host towns to speed up rural broadband expansion.
- **Climate Resilience Hubs:** The State should incentivize local "climate resilience hubs," a central location that has solar and storage and becomes a location the community can gather during power outages.
- **DCAS:** Improve New York City Department of Citywide Administrative Services for more renewable energy projects.
- **Loan Loss program:** The State should create a loan loss reserve program.
- **Subscriber Benefits:** The State should create a benefits program for LMI community subscribers.

Commercial Rooftop & Parking Lot Solar

- **Rooftop / Parking Lot Solar:** The State should conduct further analysis to identify and implement effective ways to build economic or incentive structures to increase development of commercial rooftop and parking lot solar installations paired with storage to take advantage of the available space, especially in urban areas.

### *E5. Promote Community Choice Aggregation*

CCA programs allow local governments to make bulk power purchases on behalf of participating homes and businesses in their jurisdiction, making it easier for residents and employers to benefit from local clean energy projects, while also improving project economics and advancing the Climate Act requirements. Connecting homes, businesses, and community institutions with clean energy products and services through CCA programs, microgrids, district systems, and community-scale campaigns encourages adoption of new, innovative technologies to generate value and savings for consumers in an equitable manner.

Most communities in New York that have implemented CCA procure 100% renewable energy as their default supply. When CCAs integrate opt-out community solar, participating homes and small businesses are enrolled in one or more community solar projects from which they receive credits on their electric bill.

These credits directly reduce the charges on the bill. Customers who are enrolled in community solar typically receive guaranteed savings of 5% to 10%. Opt-out community solar allows CCAs to enroll hundred, or even thousands of people at once. This significantly reduces soft costs associated with solar and makes the economics of solar all the more attractive. This arrangement has potential to continue the downward trend in solar prices and incentives, while the total amount of solar dramatically increases. Many CCA programs are working to capture the economic benefits of clean energy more broadly. For example, some CCAs have developed opportunities around opt-out community solar, energy efficiency, heat pumps, EVs, demand response, and energy storage.

The CJWG is generally supportive of encouraging local climate action, and more specifically sees CCAs as tools for transformative change in the way consumers connect to and purchase their energy. The group adds that for CCAs to be successful, there needs to be removal of barriers to entry, particularly for lower income households, and safeguards for energy burdened households that may have been the target of previous predatory practices related to their energy bills and services.

### Components of the Strategy

- **Support CCA and Community Distributed Initiatives:** NYSERDA should continue to encourage development of CCA programs where communities choose 100% renewable energy as the default supply, and where participants are automatically enrolled in Community Solar. Prioritization of these efforts should be focused on Disadvantaged Communities.
- **Expand CCA Eligibility:** Within a year, DPS should enable county governments to authorize and form CCA programs with local opt-out.
- **Enable Microgrids and District Systems:** Over next 10 years, NYSERDA should work with utilities and campuses to enable the development of microgrids (municipal, schools and private) and district clean energy systems.

## *Enhancing the Grid*

While transformation of the power sector is critical to achieving the State's goals, it also presents the opportunity to make enhancements to the electric grid. Enhancements can improve the efficiency and delivery of electricity, facilitate the integration of renewable energy, and prioritize clean resources consistent with the Climate Act.

## *E6. Deploy Existing Storage Technologies*

A portfolio of energy storage technologies will be needed as intermittent renewable energy generation penetration increases. Existing and newer, long-duration, storage will be needed to maintain reliability as the State approaches 2040; however, these technologies will need to be deployed well before 2040 to reach the State's goals.[170]

In 2018, the PSC issued a landmark energy storage order based on the Energy Storage Roadmap. The Order established a 3,000 MW energy storage goal by 2030 and included deployment mechanisms to achieve the target. However, the goal was established based on a 50% renewable target for 2030. The new Climate Act targets will require significantly higher levels of energy storage as exemplified in the recent Power Grid Study[171] which identified a need for more than 15 GW of energy storage. The Order also included $350 million in bridge incentives to accelerate the energy storage market, including solar-plus-storage projects with NY-Sun and another $53 million in RGGI funds. As of December 2021, these funds have been almost fully allocated. Though the Order was a significant step forward for the energy storage market in New York, deployment needs are most certainly greater than initially envisioned and these existing programs will be insufficient to meet the expanding need.

The CJWG was generally supportive of this strategy and suggested prioritization of energy storage to protect Disadvantaged Communities where the resilience need is greatest, which is contained in the components below.

### Components of the Strategy

- **Update the Energy Storage Roadmap:** NYSERDA and DPS should update the State's Energy Storage Roadmap, as soon as practicable, to update and revise storage deployment goals recognizing the substantially higher requirements identified in the Power Grid Study.
- **Provide increased funding for energy storage deployment:** The PSC should consider methods to create a market for retail and wholesale storage, such as Clean Dispatch Credits or expanding the CES to better integrate storage or initiate a new docket that establishes new binding targets and creates a dedicated funding mechanism similar to the CES for storage as soon as practicable

[170] NYSERDA. 2020. Pathways to Deep Decarbonization in New York State.

[171] NYSDPS and NYSERDA. 2021. New York Power Grid Study. Albany. Accessed at https://www.nyserda.ny.gov/About/Publications/New-York-Power-Grid-Study.

and no later than the end of 2022. Funding should be prioritized to projects that benefit frontline communities where the resilience needs are often the greatest.

- **Incorporate energy storage into energy delivery and transmission planning:** Further refined modeling of the future electrical grid is needed to evaluate the potential system reliability needs anticipated for that future grid. The modeling should identify the need for storage resources with longer durations that may develop with technology innovation, to show the true breakdown of potential storage vs. fully dispatchable generation needs.
- **Work with the NYISO:** The State should continue to work with NYISO on market enhancements that facilitate the resource transition, support investment, minimize costs to consumers, eliminate buyer-side mitigation (BSM) for Climate Act resources, and meet reliability.[172]

### *E7. Invest in Transmission and Distribution Infrastructure Upgrades*

As New York State moves forward in meeting the Climate Act requirements, there will be a need for investments in New York's transmission and distribution electricity system to allow for the utilization of new resources and to meet growing electric load due to electrification. The scope and nature of these investments are expected to vary depending upon the location and type of energy storage and carbon free generation resources that are added to the system.

The most potent of the GHGs identified in the Climate Act is $SF_6$, which is 17,500 times more potent than $CO_2$ based on a 20-year GWP and persists in the atmosphere for thousands of years. $SF_6$ is most commonly used as an insulator in electricity transmission and distribution equipment and its use continues to grow. New York utilities were historically one of the largest emitters of $SF_6$ but are now among the leaders nationwide in reducing leakage rates through voluntary reduction programs. These significant future investments in new transmission infrastructure should include a plan for fully phasing-out $SF_6$ and for transitioning to environmentally friendly and cost-effective alternatives.

The most common current path for transmission to be built in New York is through reliability needs, and Public Policy Transmission Planning process. Continued emphasis on the Public Policy Transmission Planning Process is key to ensuring an electricity system prepared to accept increasing amounts of renewable generation and energy storage resources. In addition, the State also recently finalized contracts

[172] BSM is a mechanism used in the capacity market that is intended to prevent bidders from artificially suppressing capacity prices. However, in practice, this can unintentionally favor fossil generators over clean resources.

that are undergoing public comment (Case Number 15-E-0302) under a competitive procurement through Tier 4 of the CES to increase penetration of renewable energy into New York City, which is particularly dependent on polluting fossil-fuel fired generation.

The CJWG is supportive of this strategy, seeing it as key to building out renewables. It suggests the inclusion of additional actions, including to pro-actively identify key transmission and distribution upgrades, improvements, and new line construction needed to deliver renewable energy across the State and maximize the retirement of fossil fired resources. Furthermore, it suggests interconnection be approached through a justice-oriented lens where community-led and community-supported clean energy projects are facilitated and exempt from the sometimes costly interconnection fees that have proved some such projects uneconomic.

### Components of Strategy

- **Transmission and Distribution Expansion:** The State should expand electricity transmission and distribution systems to support energy delivery, and, building on the Power Grid Study, continue RD&D and rapid deployment of advanced grid technology to:
  - Alleviate transmission system bottlenecks to allow for better deliverability of renewable energy throughout the State
  - Unbottle constrained resources to allow more hydro and/or wind imports and the ability to reduce system congestion
  - Optimize the utilization of existing transmission capacity and right of ways
  - Increase circuit load factor through dynamic ratings
  - Encourage utilities to accelerate investments in their local systems that will facilitate renewables development and enhancing the electrification of transportation, but also grow safety and resiliency
- **Strategic Investment:** NYPA, LIPA and utility companies should continue with strategic long-term transmission and distribution investments for expedited projects needed in the short-term (within ~5 years). Utilities should continue investments for local transmission and distribution investments within a utility's footprint, and public policy needs should be declared in the current NYISO public policy transmission planning process through Federal Energy Regulatory Commission (FERC) Order 1000.
- **$SF_6$ Emissions:** DEC should adopt regulations to reduce $SF_6$ emissions and establish a timeline for phasing out new $SF_6$ equipment. New York should also collaborate with other USCA states to

align policies across the country to drive a market shift toward $SF_6$ alternative technologies nationwide. This will help New York's power grid remain one of the cleanest, lowest emission grids in the country.

- **Hosting Capacity:** The State should focus on increasing hosting capacity with a holistic/top-down approach and to accelerate adoption, while being mindful of the tradeoffs between siting resources in high-cost areas and investments in transmission and distribution infrastructure to reach the most equitable cost option.
- **Renewable Energy Zones:** The State should create a database to track penetration and identify where there may be headroom for Renewable Energy Zones. The database should recommend a process to 1) establish Renewable Energy Zones, 2) determine quantity of renewable energy targeted within each zone, and 3) develop a plan for each renewable energy zone to build sufficient transmission to ensure energy delivery within and out of the zone.
- **Upgrades for Offshore Wind:** The State should conduct further planning and pursue system upgrades on Long Island and in New York City to facilitate 9,000 MW of offshore wind.
- **Multiport Infrastructure:** The State should promote multiport infrastructure investment to support and facilitate the growth of the offshore wind industry in New York. Future offshore wind solicitations should continue to include a multi-port strategy and requirement for offshore wind generators to partner with any of the 11 prequalified New York ports to stage, construct, manufacture key components, or coordinate operations and maintenance activities.
- **Education:** The State should continue engagement, outreach, education, and support for local municipalities, communities, and residents to improve acceptance of energy delivery projects.

### *E8. Improve Reliability Planning and Markets*

Generation resources combined with the transmission and distribution systems, control centers, and wholesale markets provide a continuously operating, reliable system to service New York's electric needs. All of these elements will need to transition and come together effectively to manage the transitioning grid to provide continuity of a reliable power system, while implementing the goals of the Climate Act. A flexible grid also necessitates an interconnected digital system passing data back and forth which increases cybersecurity vulnerabilities and risks. These must be identified and mitigated against.

During the grid transition, several reliability challenges must be successfully managed including resource and resource attribute variety and the anticipation of changing load needs and patterns. Continual study of needs through the NYISO's Comprehensive System Planning Process and expansion of the transmission

system to relieve constrained generation pockets will be needed to help increase electric grid reliability during the transition.

With an increasing supply mix comprised of intermittent generation resources, the grid will face unprecedented challenges to remain resilient to weather events regardless of the supply resources' location. The current system is heavily dependent on existing fossil fueled resources to maintain reliability. To ensure reliability and that generation is available when needed, dual fuel capability currently provides oil back up during periods of high gas and electric demand. To replace these units, dispatchable and emissions-free resources will be needed to balance the system and must be significant in capacity, be able to come on-line quickly, and be flexible enough to meet rapid, steep ramping needs. The importance of developing large amounts of dispatchable generation is echoed in the Power Grid Study, Pathways Study, and NYISO Grid-in Transition and Climate Change Study. Energy storage is one such resource that can provide benefits on the supply side at the generation level by providing dispatchable, flexible capacity which results in lower generation costs and increased system reliability. Energy storage can also provide benefits on the demand side at the customer level by providing flexibility and resiliency benefits for consumers through demand response and backup power supply. In addition, markets that incentivize resources with the desired attributes, provide optimal reliable grid management, and are sufficiently flexible to allow for technology innovation will help achieve the Climate Act requirements, while ensuring benefits for, and reduced impacts on, Disadvantaged Communities. This requires several forward-looking market designs that sends the correct price signal at the appropriate time. Effective markets can help to actively facilitate the clean energy transition while supporting reliability and removing barriers to clean energy deployment.

The CJWG generally supports the call for continued efforts to improve reliability and resiliency to extreme weather events and climate change, but suggests that the NYISO and its processes should be more transparent and information better disseminated with local energy advocates. It also suggests that there is a need to address extreme heat vulnerabilities beyond overcapacity to the grid, such as the increased water demand for cooling of power plant systems and the expansion of metal in power lines as a result of extreme heat resulting in sagging power lines leading to an increased risk of tree strike related fires. Furthermore, the group posits that storm hardening infrastructure investments must be first implemented in historically burdened Black and brown communities, since these communities have less access to cooling for summer storms, heating for winter storms, transportation, or savings.

## Components of the Strategy

Planning and Analysis of Needs

- **Continual Evaluation:** The State should conduct established biennial evaluations to assess the state of bulk power system reliability in consultation with the federally designated electric bulk system operator (NYISO) and the State and federally jurisdictional entity the New York State Reliability Council. These evaluations should ascertain if any program adjustments are needed to ensure continued safe and adequate electric service. They should be informed by the review of the State's power system performance in conformance with established operations requirements and by relevant studies including the NYISO's Reliability Needs Assessment.
- **Assessing Climate Change Impacts:** Power system studies and planning should consider analyses to integrate climate change impacts as needed for reliability and resiliency. Studies should reflect that risks and reliability challenges will change over time due to the impacts of climate change and the changes to the power system.

Resiliency

- **Infrastructure Investment:** The State should continue efforts to improve reliability and resiliency to extreme weather events, which will be exacerbated by climate change. This work should include continued infrastructure investment such as: storm hardening, elevating equipment and substations, and moving lines underground. Additionally, design criteria must change over time and must reflect the impacts of climate change as needed. Given the impacts of storms on communities, investment in community outreach to provide effective communication and support from the time of storm preparation through restoration must be made.

Improving Grid Reliability through Markets

- **Market Flexibility:** The State should update the market products, requirements, and technology standards needed to maintain reliability over time so that all resources can participate in the market, based on their attributes, to provide the products and services needed for reliability. Undue costs should not be imposed that would impair meeting the Climate Act requirements, including creating barriers to renewables. Reliability needs and risks will change overtime and the markets should reflect these changes as well.
- **Market Participation:** The State should work with the NYISO to expand wholesale market eligibility participation rules for new policy resources. The NYISO is in the process of implementing the first part of a Hybrid Storage Model, where hybrid resources will be allowed to

participate as two separate resources located at the same site. The current expectation is for a second potentially more versatile "Aggregated" model market design in 2021. The NYISO should also make changes consistent with FERC Order 2222 requirements.

- **Wholesale Market Improvements:** The State should continue assessing opportunities to improve accuracy and granularity of wholesale market energy price signals, including shortage pricing, congestion relief, and peak/off-peak pricing. This should include the evaluation of the inclusion and valuation of ancillary market services in the context of integrating increasing quantities of renewable resources and other products.
- **Support Flexible Resources:** The State should adapt current ancillary service market designs and look to add products that are needed to incent flexibility as needed to efficiently integrate renewables. The NYISO supports markets for energy, ancillary services, and capacity. The fundamental relationship among these markets will likely need to evolve. For example, more revenue will likely shift to ancillary service markets over time as system needs are reevaluated in the context of integrating increasing quantities of renewable resources. This should include proactive development of new products needed; however, they should be structured properly to only reflect current system needs to not cause unnecessary costs. A balancing act is needed between developing the products and services of the future while not implementing changes before they are needed.
- **Resource Adequacy:** The State and the NYISO should examine all Resource Adequacy options and continue to improve resource adequacy contribution compensation. Consider alternative market structures of procuring Resource Adequacy. The State and the NYISO should ensure that BSM will not be applied to Climate Act resources and should advocate at FERC for alternatives to BSM that maximize access to the capacity market for public policy resources. The State and the NYISO should investigate how best to include all resources in the capacity markets, with the goal of reflecting energy efficiency and dynamic smart loads in resource adequacy. The State and the NYISO should continue to evaluate the capacity market value of all resource types so that resources are paid for capacity consistent with the value they provide to the grid, and allow fair access to the capacity market for energy limited resources and accurately reflect the value of such resources especially as the need for grid flexibility grows over time.
- **Value Environmental Attributes:** Determine most effective approach to incorporate environmental values in market pricing and/or in policy and investment benefit-cost analysis. Consider improvements to current State programs to incentivize Climate Act resources through mechanisms such as Renewable Energy Certificates, Offshore Wind Renewable Energy Certificates, and storage solicitations. Consider changes and/or augmentation to the RGGI

program to more fully reflect the cost and impact of emissions as represented in New York policy. Consider if (electric only) carbon pricing in the wholesale markets will help achieve the Climate Act mandates, including a more rapid increase in renewable and storage build out and a transition of the fossil fleet. If carbon pricing is not adopted, consider alternate mechanisms to fully enable Wholesale Markets to support the grid transition. Consider if an economy-wide carbon charge will help achieve the Climate Act mandates. Consider a Clean Dispatch Credit for emission-free, fully dispatchable assets that dispatch during peak load times.

- **Earnings Adjustment Mechanisms:** The PSC should initiate a generic proceeding for earnings adjustment mechanisms to review and evaluate how the existing mechanisms are working, lay the groundwork and create consistency across the utilities where it makes sense to do so, and consider additional earnings adjustment mechanisms related to the decarbonization and social equity goals of the Climate Act and the process to do so. This review should be done on a periodic basis, and earnings adjustment mechanisms should be adjusted as necessary to encourage the needed outcomes.

Support of Distributed Resources and Demand-Side Opportunities

- **Demand-Side Opportunities:** The State should expand demand-side opportunities and opportunities for flexible resources. It is anticipated that demand response resources will play a more critical reliability role in the future as the grid becomes more electrified and the load shape shifts. Demand response can also supply some amount of needed system flexibility without emitting carbon which is consistent with the 2040 Climate Act requirement. There should be a holistic evaluation of both wholesale and retail demand response programs to identify gaps and opportunities for new programs or program changes to meet the needs of a changing grid. As the grid evolves with State policy, it will become more important that incentives are adequate for the participation of flexible resources in the real-time energy market. An efficient real-time market can create opportunities for resources to compete and meet rapidly changing system needs. The NYISO is evaluating prospective changes to the energy market in the context of its Grid in Transition project.
- **Market Access for Distributed Resources:** Improve access for Distributed Resources and continue improvements to cost causation retail rate price signals through:
    - Continued promotion and improvement of the value of DER Rate Design
    - Continued innovation in DSM and DER programs, with a focus on expanding utility customer enrollment and performance

- Continued promotion and improvement of Standby rates
- Increased deployment and efficient use of DER
- Continued design and implementation of Distributed System Platforms (DSP) and markets for DER products and services

- **Availability of Information:** The State should enhance and augment the availability of public information to assist developers in making informed project development decisions.
- **Proactive Advocacy:** Based on available resources, the State should fund expansion of the existing office and team within DPS that systematically focuses on proactive advocacy at NYISO and FERC to provide the necessary resources to DPS to ensure that wholesale markets and planning processes align with Climate Act requirements and support environmental justice concerns, while maintaining reliability. The expanded office should focus on improved coordination with other essential State agencies including NYSERDA and DEC. The office should also monitor the developments of FERC's soon to be created Office of Public Participation and work with both that office and its Environmental Justice senior advisor to assist and support increased participation by low-income New Yorkers at FERC.

## *E9. Advance Demand Side Solutions*

Responsive demand presents an opportunity to optimize for the lowest system cost and most expeditious deployment of both clean supply and demand solutions by reducing the need for electricity, especially during peak hours. As such, responsive demand should be analyzed and appropriately modeled as part of future generation and energy supply to allow for consideration of those modeled impacts on costs and timelines of power generation by decade and incorporated into system planning.

Reducing demand and creating demand flexibility, especially downstate, can help to prevent infrastructure buildout and will yield GHG reductions, criteria pollutant reductions, and health benefits in the near term by reducing reliance on high-polluting peaker facilities. Load management can also help businesses reduce costs and help avoid dual-fueled peaking units from switching to oil during gas demand peaks.

### Components of the Strategy

Planning and Analysis

- **Cost study:** DPS and NYSERDA, in consultation with utilities, should complete a study on avoiding or reducing grid upgrade costs through the use of demand response and geothermal,

including district thermal systems, especially downstate, with a focus on LMI individuals and Disadvantaged Communities.

- **Data availability:** DPS, NYSERDA, and the NYISO should identify and make available key pieces of data needed for markets to facilitate the clean energy transition in real-time marginal, average emissions, and/or zonal resource/fuel mix data, as needed from the NYISO and as defined by New York City and pertinent State agencies (a number of assumptions including for imports and exports from other regional transmission organizations and independent system operators must be determined) to facilitate cost-effective implementation of the Climate Act, Local Law 97, and to improve value of DER and demand response programs.

Development of Standards and Tests

- **Appliance standards:** NYSERDA should prioritize State and federal appliance standards and adopt State equipment standards (or advocate for the federal government to adopt standards) that require a universal, standardized communication protocol in electric and heat pump water heaters, as well as in space heating heat pumps, EVs, and in-home batteries.
- **Program participation:** The PSC/DPS should develop standards to enable "opt out" programs rather than "opt in." They should make demand flexibility programs opt-out, not opt-in, as long as standards are developed to ensure that customers will see savings on their bills and so that service delivery is not reduced.
- **Benefit cost analyses:** The PSC should reopen the generic benefit-cost analysis proceeding to update costs and benefits, including Climate Act compliance costs (carbon and other environmental impacts), important non-energy benefits (such as localized health impacts and equity), and inclusion (or lack thereof) of customer cost contributions in order to accurately assess the true value of energy efficiency and demand response while complying with the Climate Act.
- **Equity of rules:** The PSC/DPS should ensure that energy storage does not face double rules and unfair charges. The State should consolidate its permitting rules for energy storage so they can be evaluated in one process. Utility commissions should reexamine their tariffs on energy storage resources and ensure they are applied fairly.

Prioritize under-resourced communities

- **Engagement:** Utilities should engage the community and partner with community-based organizations to learn about communities and identify needs and shared objectives.

- **Funding:** New funding should be directed toward low-income and Disadvantaged Communities and existing funds should be made more accessible.
- **Metrics:** In planning for a sustainable future, New York should work with communities to ensure appropriate metrics to track program success and partner with local governments to establish appropriate consumer protections.

### *Investing in New Technology*

To achieve the 70x30 requirement, the focus should be on energy delivery, energy efficiency, and aggressive deployment of existing renewable energy and energy storage technologies. However, the 100x40 goal presents significant challenges that cannot currently be met by the deployment of these existing technologies. Current studies identify that even after full deployment of available clean energy technologies, there is a remaining need for 15 GW to 25 GW of electricity generation in 2040 to meet demand and maintain reliability, although that gap may change over time.[173] This calls for a focus on identifying and developing solutions for dispatchable technologies that can be called on as needed to balance supply and demand.

## *E10. Explore Technology Solutions*

Whether the answer is new long duration storage technology, RNG, green hydrogen, nuclear, or other new technologies that may emerge due to RD&D efforts over the next two decades, the costs are likely to be high and aggressive action and smart planning will be necessary to make these fundamental shifts in our energy systems in the next two decades. While these actions will be costly, the health, societal, and economic benefits of the transition to clean zero-emitting technologies will be significant and the cost of inaction or insufficient action will far outweigh the costs of action.

One technology focus moving forward is long duration energy storage. Achieving the Climate Act's high renewable energy, zero-emission electricity system will require substantial amounts of energy storage operating over various time scales—spanning from minutes to hours, days, weeks and even longer—to maintain grid flexibility, reliability, and resiliency.

When it comes to advanced fuels, the prospects are not quite so clear. While they are often touted as flexible and dispatchable resources, many are also unproven at commercial scale. Of particular interest is

[173] NYSERDA. 2021. New York Power Grid Study. Albany. Accessed at https://www.nyserda.ny.gov/About/Publications/New-York-Power-Grid-Study.

to ensure historically Disadvantaged Communities do not see an increase in co-pollutants or reduction in air quality as a result of use of advanced fuel. Therefore, further analysis, technical development, and research is needed in order to determine the feasibility and climate and health impacts of advanced fuels to ensure they provide net benefit.

Nuclear power generation is a complex technology with potential impacts on host communities as well as questions relating to the impacts of nuclear waste on health and the environment. Yet at the same time, nuclear generation provides a significant amount of baseload resources and is carbon-free, providing a complement to the increasing amount of variable generation renewables being added to the grid. Analysis should occur prior to the end of the Zero Emissions Credit program in 2029 to determine whether subsidizing any of the State's remaining nuclear reactors will be necessary for meeting the 2040 emissions mandate and/or whether more cost effective and environmentally friendly alternatives are available. The analysis should consider the ability of nuclear to contribute to baseload and meet reliability requirements, as well as cost, health, safety, community impact and environmental concerns of nuclear power generation.

The CJWG supports the near-term focus on achievement of 70x30 via deployment of currently available solutions. However, it expresses strong concern about the promotion of some emerging technologies, including green hydrogen, RNG, biofuels, biomass, and waste-to-energy, which it claims can add more GHGs to the environment rather than less, and also leads to more localized pollution which is concentrated in environmental justice communities. The CJWG highlights the need for further research and consideration of lifecycle GHG accounting and potential air quality and health impacts of these technologies prior to supporting demonstration projects. The CJWG also recommends a lifecycle analysis of the environmental, health, safety, emissions, and environmental justice impacts of nuclear fuel be conducted and the State proactively plan for the scheduled shutdown of the four reactors upstate.

### Components of the Strategy

Solutions for Dispatchable Technologies

- **Determine technologies:** NYSERDA should identify, explore, evaluate, and develop dispatchable technologies and solutions as they emerge. This should focus on solutions known to be desirable.
- **Modeling:** NYSERDA should conduct detailed, holistic, modeling within a zero-emissions world. Modeling should include holistic integration of load, generation, and energy delivery, and

be flexible in the solutions chosen. While modeling is being completed, the State should move forward with known needs.

- **Support innovation and demonstration projects:** NYSERDA should act as a hub for technological innovation and convene stakeholders and conduct strategic research on new renewable and storage project technologies. NYSERDA should work with a consortium including but not limited to the NYISO, utilities, developers, and solution providers to bring technologies to large-scale deployment faster and more cost-effectively. This includes support for utility-scale demonstration projects for new technologies, including storage and transmission and distribution.
- **Federal resources:** The State should advocate for, and leverage, Federal and National Laboratory resources focused on identifying and commercializing advancements in transmission and zero carbon dispatchable long duration storage solutions.
- **Market enhancements:** The State should continue market enhancements, such as adjusting capacity market valuation, market rules, and market incentives that better align the markets with the Climate Act to encourage the innovation that will support achievement of the 2040 requirements. Market solutions for these dispatchable technologies, such as long-duration storage, are important to support investment, minimize the cost to consumers, and support reliability.
- **Long-duration energy storage:** NYSERDA should focus programs and funding on research and demonstration projects for the development of large scale and longer duration storage. The State should develop and expand a Storage Center of Excellence so that new technologies can be matured and deployed on the grid for large scale testing, as well as attract and engage relevant parties in collaborative efforts to address the challenges unique to long-duration storage.

Advanced Fuels:

- **Prioritization:** During planning, prioritize emissions-free resources (such as storage, energy efficiency, and renewable energy) where feasible when considering end uses, technology limitations, impacts, and costs. However, should a substitute for natural gas still be needed, advanced green hydrogen and possibly RNG could fill this gap in order to maintain reliability, if scalability, feasibility, and environmental impact and air quality issues can be addressed.
- **Define emissions free:** DPS and DEC should begin a stakeholder process to define “emissions free” compliant with the Climate Act for advanced fuels.
- **Analysis of impact:** Further analysis, technical development, and research is needed in order to determine the feasibility, climate impact, and health impacts of advanced fuels prior to

infrastructure investment. Technological innovation, development, and scaled-deployment is needed in order to prove the effectiveness and economics of the technologies.

  - Determine the lifecycle GHG accounting framework of RNG and advanced green hydrogen. Priority utilization should be provided for feedstocks with the lowest GHG emissions, with strong preference given to zero- or negative-emissions sources.
  - The potential air quality and health impacts of producing and using these fuels and best practices/end uses to minimize these impacts.
  - The safety of advanced green hydrogen, storage, and pipeline operation.

Nuclear Generation:

- **Evaluate the need:** The State should evaluate the contribution of nuclear power to the 2040 resource mix and any additional policy actions needed prior to the cessation of the Zero Emissions Credit program in 2029.
- **Public input:** If public policy mechanisms are proposed for the continuation of nuclear power generation, effective mechanisms for input and comments by stakeholders and the public should be implemented to include but not be limited to representation from customers, environmental interests, environmental justice communities, labor, local communities, and indigenous communities).

# Chapter 14. Industry

## 14.1 State of the Sector

### *Overview*

This chapter contains New York's incentive-based strategies for mitigating the direct GHG emissions attributable to certain industrial activities within the State. In general, the sectoral strategies in this chapter target the direct, on-site emissions that originate from stationary sources in sectors including manufacturing, mining, and quarrying,[174] where such emissions are not already addressed separately in this draft Scoping Plan.[175] Strategies for addressing emissions from the oil and gas sector are discussed in *Chapter 18. Gas System Transition.* Each sector is described in additional detail below.

#### Manufacturing

Manufacturing-based GHG emissions addressed by the strategies in this chapter are those associated with the combustion of fossil fuels and non-combustion industrial processes in the production of goods. The largest share of GHG emissions created by the production of food, paper, bulk chemicals, glass, cement, metals, semiconductors, wood products and plastics.

#### Emissions Overview

Industrial emissions made up 9% of statewide emissions in 2019, including emissions from methane leaks and combustion from the oil and gas system in New York (45%), the direct combustion of on-site fuel (27%), emissions from imported fuels (20%), and non-combustion industrial processes (6%).

As described in *Chapter 4. Current Emissions* of this draft Scoping Plan, most emissions in the manufacturing sector come from a small subset of what are known as energy- or emission-intensive and trade-exposed industries, causing emission mitigation strategies in this chapter to emphasize approaches that are less likely to result in emissions and economic leakage.

[174] Manufacturing, mining, and quarrying are identified as Industrial Sectors by the North American Industry Classification System (NAICS) utilized by the U.S. Census Bureau. More specific production activities, including food, paper, and chemical manufacturing, are considered subsectors within manufacturing.

[175] As an example, the sectoral strategies in the Industry chapter do not address the indirect emissions associated by industry's use of electricity or transportation vehicles.

### Mining and Quarrying

Mining and quarrying activities produce stationary source GHG emissions primarily from grinding equipment and diesel-powered material handling and moving equipment. Only a small share of the State's GHG emissions are produced by mining and quarrying activities, some of which also occur within energy- or emission-intensive and trade-exposed industries and are thus addressed in these strategies similarly to manufacturing activities.

### Other Energy- and Emission-Intensive Industries

Given the thirty-year time horizon of this draft Scoping Plan, it is possible that new potential industrial GHG emission sources may emerge or grow to become significant sources of GHG emissions. For example, energy-intensive operations such as data centers and cryptocurrency mining operations have the potential to consume significant amounts of electricity and, in some cases, generate their own electricity from fossil fuel combustion. While many grid-based electricity-intensive activities will be automatically decarbonized by 2040 in concert with the elimination of GHG emissions from the electricity sector, as covered in *Chapter 13. Electricity*, the additional electricity load could make it more difficult to meet the Climate Act's zero carbon electricity requirement by 2040. In addition, it is possible that new sources of fuel combustion and non-combustion process emissions will also emerge. Accordingly, the State should monitor and evaluate emerging industries and develop policy responses needed to ensure that those industries do not interfere with meeting the statewide emission limits or other Climate Act requirements.

### Industrial Sector Considerations

In formulating sectoral strategies for Industry, this draft Scoping Plan reflects several considerations specific to industrial emissions. The heterogenous nature of industry, and the resulting need for customized solutions on an industry-specific and even factory-specific basis, may result in higher cost per ton of emissions reduced than larger-scale measures in other economic sectors such as power generation or transportation. Additionally, energy- or emission-intensive and trade-exposed industries are likely to represent a high share of industry sector emissions. These industries are both highly sensitive to increases in the cost of energy or emissions, as well as limited in their ability to pass along higher costs to consumers due to trade competition. As a result, non-incentive-oriented approaches are likely to cause leakage, whereby businesses leave or avoid the State and locate in other jurisdictions where they can emit higher levels of GHGs than they would have had they remained in the State. This results in less economic activity in the State but may achieve no progress on reducing global emissions; in fact, it may increase emissions overall. The Climate Act requires that this draft Scoping Plan include mechanisms to limit

emissions leakage, some of which were developed by the JTWG and are described in *Chapter 7. Just Transition*.

Near-term emission reduction opportunities in industry are likely to come primarily from energy efficiencies and some limited electrification for lower temperature processes. Greater emissions reductions (via the use of carbon capture, low-carbon fuels, or other) will likely occur in the longer term as innovation takes place and technologies scale, mature and become more viable. However, significant opportunities for emission reductions currently do exist in industry and can be achieved primarily through increased organizational focus on energy management and efficiencies.

### *Vision for 2030*

The pathway to reducing emissions in the industrial sector between the present and 2030 will involve the following four pillars: energy efficiency, switching to low-carbon fuels (including renewable electricity), decarbonizing the electricity supply, and negative emissions. Achieving the State's Climate Act requirements and goals are expected to require the industrial sector to embrace solutions within each pillar over time as new technologies and innovative solutions are developed.

The Climate Act established an economy-wide 40% GHG emissions reduction requirement relative to 1990 levels and a goal of statewide energy efficiency of 185 trillion British thermal units energy reduction from the forecasted 2025 energy demand. Industry's contribution to meeting these targets would be primarily with continued investment in energy efficiency and some limited electrification within the sector. Energy efficiency has been embraced by the manufacturing sector because it is one of the most cost-effective methods for reducing its GHG emissions. Due to the potential to reduce the amount of energy that must be purchased, and thereby saving money, efficiency measures may at times be able to pay for themselves without government subsidy. Specific efficiency measures can include upgrading motors and drives, making operational changes to improve compressed air efficiency, and adopting smart manufacturing methods and strategic energy management principles. Due to the heterogeneity of the industrial sector, energy efficiency solutions will need to be customized to address specific needs.

### *Vision for 2050*

To meet the Climate Act requirement of an economy wide 85% reduction in GHG emissions by 2050 relative to 1990 and the goal of net zero emission across the economy, the pillars of a decarbonized electricity supply and negative emissions will play a more significant role in the industrial sector. Most industrial facilities need high temperature heat in their manufacturing process, and solutions to reduce

emissions from industrial heat could include green hydrogen and/or other low-carbon fuels, as well as carbon capture, use and storage. A few of these solutions are at the early stage of development and will require investment in RD&D to prove at scale and advance to market. In some limited instances, industrial sources might be able to qualify for the use of an alternative compliance mechanism if DEC has established such a mechanism and if the source can meet the stringent requirements set out in the Climate Act to govern their use. To reduce emissions in the industrial sector by 2050, six key strategies have been identified.

### *Existing Sectoral Mitigation Strategies*

Mitigation strategies are those that directly reduce emissions or sequester carbon. The State has already adopted several mitigation strategies that address industrial GHG emissions. NYSERDA, NYPA, and ESD each offer programs in this area, while DEC employs a regulatory approach.

NYSERDA offers support to industry through a variety of programs, with a goal to promote energy efficiency, GHG emissions reduction, and the deployment of renewable energy. Programmatic support can be broadly categorized into four areas: Technical Assistance and Training; Equipment Incentives; Competitive Grants; and RD&D Support. An example of one of NYSERDA's programs is its Strategic Energy Management Program, through which it offers training to industrial facilities to help optimize energy use through a continuous improvement approach.

NYPA's mission is to lead the transition to a carbon-free, economically vibrant New York through customer partnerships, innovative energy solutions, and the responsible supply of affordable, clean, and reliable electricity. NYPA Energy Services programs develop projects in the areas of energy efficiency, EVs, DERs, such as solar and storage, smart street lighting, data driven energy reduction, as well as support other clean energy initiatives.

ESD offers financial assistance (loans, grants, tax credits, venture investments) to incentivize industry in exchange for investment or job commitments, as well as technical assistance to conceive and scale disruptive technologies. For example, ESD's Division of Science, Technology, and Innovation encourages greater collaboration between private industry and universities in the development and application of new technologies, including alternative energy systems. Another ESD program is New York Ventures, the State's innovation venture capital fund that provides seed and early-stage venture capital funding to support and attract new high-growth businesses.

DEC, as a regulatory agency, reviews air pollutant permit applications for new industrial facilities and significant modifications to existing facilities to ensure that the proposed actions are not inconsistent with and will not interfere with the attainment of the statewide GHG emission limits established under the ECL.

### *Key Stakeholders*

Engaging stakeholder input is critical in the implementation of the various strategies to ensure the solutions will have the intended impact and meet the needs of the market. Included in the dialogue should be entities such as but not limited to industrial trade associations, business associations, universities, manufacturing corporations, energy service and engineering companies, industrial equipment suppliers, New York electric and gas utilities, the U.S. Department of Energy, NYSERDA, NYPA, DPS, DEC, ESD and OGS.

## 14.2 Key Sector Strategies

There are six key strategies highlighted in this sector, as shown in Table 11.

**Table 11. Industry Sector Key Strategies**

| Strategies | |
|---|---|
| I1. | Financial and Technical Assistance |
| I2. | Low Carbon Procurement |
| I3. | Workforce Development |
| I4. | Research, Development, and Demonstration |
| I5. | GHG Reporting |
| I6. | Economic Incentives |

### *I1. Financial and Technical Assistance*

The industrial sector is confronted with many barriers and other challenges to implement emission reduction strategies, the most significant of which include risk aversion that solutions will interrupt manufacturing processes, lack of in-house expertise in new technologies, lack of time to commit to energy savings solutions, lack of trust that the solution will deliver the intended benefits, and intense competition for internal company capital. The State should help overcome these barriers by providing technical and financial assistance in implementing various solutions for decarbonization. Specific solutions could include NYSERDA's engineering study support, financial incentives to buy-down project costs, and, although it is a limited resource, leveraging some portion of NYPA's low-cost clean hydropower.

Implementation of this mitigation strategy would continue from the present until 2050. Most emissions reductions prior to 2030 will be achieved through energy efficiency and low-temperature electrification. As technology advances, support through this mitigation strategy will further enhance emission reductions by 2050 through other means.

The transition for Industry to decarbonize and embrace new technological solutions will take time and require State support. Providing clear market signals of long-term commitments would bolster industry confidence in decarbonizing the sector.

Directing State assistance toward reducing industrial emissions in Disadvantaged Communities would be supported by the CJWG. Industrial facilities often disproportionately affect Disadvantaged Communities, and investments can be prioritized to target industries with the greatest impact on these communities. Additionally, the CJWG noted that emissions reductions strategies for Industry do not mention regulation to drive down industrial emissions as close to zero as is technically possible. Additional regulation on industrial sources must be carefully considered within the Climate Act requirements to limit emissions leakage.

### Components of the Strategy

- **Efficiency and decarbonization programs:** The PSC should continue to support and approve of funding for development of programs that embrace energy efficiency, electrification and decarbonization, and adjust its efforts to ensure alignment with the Climate Act while also focusing investments and their associated benefits in Disadvantaged Communities. State programs administered by NYSERDA and investor-owned utilities should be complimentary and coordinated to maximize market impacts.
- **Low-cost power programs:** The State should continue to provide qualified industries and businesses with lower electric energy cost through allocations of NYPA power.

## *I2. Low-Carbon Procurement*

Another strategy that has been identified to reduce emissions in the industrial sector is to create State procurement incentives so that manufacturers will produce less emission-intensive goods to capitalize on the increased demand for such goods.

The initial focus for this effort should be to incentivize the manufacturing of lower carbon building materials, such as cement, steel, and aluminum. The public sector purchases a large proportion of building

materials produced in the market. This enables the State to exert significant influence on the producers of building materials to develop low-carbon options across its entire range of products. At the same time, the standards for verifying what constitute a low-carbon product are relatively well established for these types of materials.

At present, about 28% of annual emissions associated with buildings can be allocated to the use of construction materials, primarily emissions associated with the production of concrete and steel, as well as aluminum, glass, and insulation material.[176] Demand for greener building materials from the private sector will spur manufacturers to reduce the embodied carbon in their products. However, there is an opportunity to accelerate the growth of this demand via public procurement directives, given that nearly 50% of all cement and 20% of all steel that is purchased in the U.S. is paid for with tax dollars.[177]

There are many available pathways to offer advantages to providers of these low-carbon materials in the public procurement process. The State of California's Buy Clean program, for example, created a system in which selected building materials—structural steel, concrete reinforcing steel, flat glass, and mineral wood board insulation—used in public projects would need to meet minimum GWP standards.[178] Another option to enable low-carbon material procurement is to discount bid prices submitted for public work projects if the bidders are utilizing building materials with low GWP. New York recently passed a law that instructs OGS to examine available incentives, including bid discounts, to encourage the use of low embodied carbon concrete in State agency projects.[179] The exact method of supporting procurement of low-carbon products should be established through coordinated efforts of expert government stakeholders, with the interagency GreenNY initiative, including NYSERDA, DEC, and other State agencies, leading the effort.

Increasing demand for low-carbon building materials with public procurement directives will have a positive impact on the emissions associated with the State's manufacturing sector. Just as the manufacturing sector is generally heterogenous in nature, specific methods of reducing the GWP of a given building material vary by subsector (such as cement, glass, and steel). In general, interventions to

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[176] International Energy Agency and the United Nations Environment Programme. 2018. 2018 Global Status Report: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector.

[177] Rebecca Dell. 2020. Build Clean: Industrial Policy for Climate and Justice.

[178] Buy Clean California Act, accessed September 27, 2021 at https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act.

[179] Chapter 724 of the Laws of 2021.

reduce the GWP of a building material are identical to reducing overall emissions, and principally include, but are not limited to, more energy-efficient production, process changes, greener production inputs, and/or the sequestration or utilization of captured $CO_2$.

The cost implications of providing preferential procurement standards for low-carbon building materials are likely to be marginal given the relatively small share of overall project costs that these materials represent. Cement, for example, represents only an estimated 1.5% of public construction costs. Moreover, even today, many lower-carbon alternative products have comparable cost characteristics to legacy materials, and even more advanced methods of drastically reducing the GWP of building materials are unlikely to have a significant impact on costs.

The CJWG supports this strategy, as well as other demand-side approaches, since State procurement preferences for low-carbon building materials can encourage less energy-intensive manufacturing in some sectors. The CJWG also recommended using a "best value" procurement framework to score bids that commit to climate mitigation efforts and related workforce, training, local hire, and apprenticeship programs targeted to residents in Disadvantaged Communities.

### Components of the Strategy

Given the public sector's significant share of market demand for building materials and the critical need for increased supply of low-embodied carbon building materials, the State should increase purchases of low-carbon materials to provide manufacturers with an economic incentive to increase supply.

- **Identify carbon intense materials:** First, the interagency GreenNY initiative should develop a list of the most carbon intense building materials and products eligible for incentives or preferential treatment in procurement.
- **Develop standards:** After identification of eligible products, the interagency group should work with manufacturers, trade associations, researchers, and other like-minded states or federal agencies to set standards for determining the GWP of each building material.
- **Provide policy support:** The State should implement policy mechanisms that provide advantages to projects or procurement bids utilizing products that meet or exceed GWP targets.

## *I3. Workforce Development*

The workforce development enabling initiative is intended to expand the State's existing green workforce and focus on training workers on existing decarbonization technologies and on newer solutions as they

become available. As of 2019, there were nearly 164,000 clean energy jobs in New York, a 16% increase since 2015. Jobs in this area are expected to continue to grow as skills will be needed for industry to plan, operate, and maintain various clean energy technology solutions.

Industrial companies face several barriers in this area, including the need to invest the time and other resources necessary to provide the training and to maintaining the dedicated in-house expertise to deliver it. However, these barriers can be mitigated by State programs designed to share in the risk of such investment by providing financial support for the training and by developing training programs geared to industry's specific needs. NYSERDA and DOL have a long history of collaborating and delivering successful clean energy workforce development and training programs and can build upon that success to meet the Climate Act requirements and goals between now and 2050.

The CJWG recommends these strategies ensure consideration of individuals in Disadvantaged Communities in business and workforce development efforts.

### Components of the Strategy

The industrial sector will have both short- and long-term needs to train workers to assist in decarbonization. The State should help industry to do this training by taking the following steps:

- **Expand training capacity:** NYSERDA should partner with training organizations and businesses to increase the number of individuals being provided with training, with particular attention to increasing the number of individuals from Disadvantaged Communities being served by these programs.
- **Update training content:** NYSERDA should work with training organization and businesses, to update training content to prepare workers for jobs with both established and newly emerging clean energy technologies and strategies. This could be accomplished by issuing competitive solicitations, developing strategic partnerships with industry organizations, and supporting training activities that meet industry's specific needs.

## *I4. Research, Development, and Demonstration*

While currently available market solutions for reducing industrial GHG emissions can help the State's manufacturers make substantial progress in achieving the State's 2030 and 2050 goals, they will not be

sufficient. Given the heterogeneity of the industrial sector, the specific solutions for subsectors will vary, but they broadly include four main categories:

- Energy efficiency
- Industrial electrification
- Low-carbon fuels, feedstocks, and energy sources (utilizing more renewable electricity)
- Carbon capture, utilization, and sequestration

Given current trends, many of the required technologies for deep decarbonization of the industrial sector will not be available in the timeframe necessary for the State to meet its targets. However, the State could speed the deployment of some of these solutions with a robust RD&D agenda. This agenda should be informed by an analysis of which solutions are will have the greatest impact on the State's emissions. This includes impacts on not only the industrial sector, but the buildings, transportation, and power sectors, which are all likely to benefit from advancement of many of these solutions. Research should also determine guidelines that indicate which solutions should be incentivized and the manner in which they should be deployed. These guidelines should be set to prioritize those with lowest cost and those that will result in the greatest reduction of GHG emissions. The guidelines also should ensure that solutions are pursued only if they meet benchmarks for environmental justice and equity as well as for economic and technical scalability. After this analysis, public capital should be directed at supporting solutions via research funding as well as pilot and demonstration projects.

The CJWG has raised concerns around technology solutions such as carbon capture and storage and hydrogen. The CJWG supports reducing fossil fuel combustion for industrial heat, replacing it with electric heat whenever feasible. The CJWG inquired specifically as to the future use of green hydrogen and made the point that combusting hydrogen has the potential to produce potentially harmful levels of nitrous oxide emissions. The CJWG recognized, however, that some industrial high-heat processes may not be electrifiable, and that in these cases green hydrogen is a potential alternative fuel. Identifying, quantifying, and mitigating these types of harmful effects associated with new technologies and approaches to eliminate hard-to-abate industrial emissions will be a necessary, critical concern of future research efforts.

### Components of the Strategy

The State can speed the deployment of industrial decarbonization solutions with a robust RD&D agenda. This agenda should be informed by an analysis of which solutions are will have the greatest impact on the State's emissions.

- **Develop a scope of work for research:** NYSERDA should develop a research agenda for industrial decarbonization solutions. This research should account for impacts on not only the industrial sector, but the buildings, transportation, and power sectors, which are all likely to benefit from advancement of many of these solutions
- **Issue a solicitation:** NYSERDA should issue a solicitation for third party services to conduct research and provide recommendations on the most appropriate areas for investment in emerging industrial decarbonization solutions.
- **Provide funding for research and pilot/demonstration projects:** Based on the results of the analysis, NYSERDA should work to provide funding to optimally scale identified solutions.

## *I5. Greenhouse Gas Reporting*

The ECL requires DEC to consider establishing a mandatory registry and reporting system for individual sources to obtain data on GHG emissions that exceed an established threshold.[180] DEC should promulgate regulations to establish a GHG registry and reporting system. The system should include sources that currently report emissions to DEC on an annual basis and would expand the universe of facilities that are required to report their annual emissions data to DEC by establishing a reporting threshold that is lower than what currently exists.

Having a more complete picture of the amount of GHGs emitted from a larger percentage of facilities would allow for a more focused effort to reduce GHG emissions from existing industrial sources, which can often be accomplished by reducing fuel combustion. Since fuel combustion also releases other contaminants, including hazardous air pollutants, the communities in which these facilities are located can be expected to experience improved air quality and health outcomes.

The registry and reporting system would allow DEC to collect, review, and make publicly available the submitted GHG emissions data. Facilities required to report GHG emissions to the new system would be responsible for the costs involved in generating the data and reporting it. Reporting of GHG emissions by

[180] ECL 75-0105(4).

industry and verification of reported GHG emissions would not be expected to vary significantly from methods used by the agency for other pollutants or increase administrative costs significantly. DEC would attempt to align, to the extent possible, the new reporting requirements with existing DEC and EPA GHG emissions reporting programs.

### Components of the Strategy

- **Develop internal draft of GHG reporting regulation:** DEC should promulgate regulations to establish a GHG reporting program. When developing the regulatory program, DEC should evaluate existing online reporting systems such as those established by EPA and the California Air Resources Board. DEC should work with the State's Office of Information Technology Services to develop an on-line electronic reporting platform for this regulatory program.
- **Provide training to regulated entities:** DEC should work with impacted facilities to ensure information exchange and to ensure that applicable reporting requirements are clearly understood.

## *I6. Economic Incentives*

The State should continue to develop an in-State supply chain of green economy businesses by offering economic incentives like loans, grants, tax credits, technical assistance programs, or even venture capital investments.

One of the most prominent economic incentives that the State can use in attracting these businesses is the enhanced Excelsior Jobs Program for green economy companies that make products or develop technologies that are primarily aimed at reducing GHG emissions or supporting the use of clean energy. This program awards refundable tax credits to green businesses that commit to hiring workers, undertaking research and development, or making capital investments in the State, with credits provided only after-the-fact under a pay-for-performance model.

NYPA has several economic development programs that support industry, other businesses, and not-for-profits in the State. These programs provide either project funding or low-cost power, including hydroelectric power, primarily in exchange for commitments to retain or create jobs and invest capital in the State. An example of a NYPA financial assistance program is ReCharge New York, a program through which NYPA provides low-cost hydroelectric power to businesses and not-for-profit organizations throughout the State in exchange for investment or job commitments. In late 2020, NYPA adjusted the criteria for evaluating economic development awardees to include the applicants' support of green jobs and manufacturing in the New York.

Directing State assistance toward developing green economy businesses in Disadvantaged Communities would be supported by the CJWG.

### Components of the Strategy

Green economy industries are poised for significant growth. Anchoring an in-State supply chain of growing green businesses will help the State meet its climate goals while also attracting new investments and jobs.

- **Offer economic incentives:** These incentives should operate to secure green economy attraction, expansion, and retention projects. Implementation should include engagement with green economy businesses to identify potential in-State economic opportunities, engagement with awardees and suppliers of State green procurements to discuss potential in-State economic opportunities, and coordination with State partners to identify all relevant incentives.
- **Implement complementary initiatives:** These initiatives should focus on growing the workforce, supplier base, and market demand that will increase the State's attractiveness as a location for these new green businesses.

# Chapter 15. Agriculture and Forestry

## 15.1 State of the Sector

### *Overview*

Agriculture and forestry encompass multiple economic sectors including livestock, crops, dairy, timber, wood products, and bioeconomy products. GHG emission sources include forestry equipment, livestock, cropland, forest fires, decomposition of dead trees, and development of agricultural and forest areas. Emissions from farm equipment are addressed in *Chapter 11. Transportation*. The Agriculture and Forestry sectors are also significant carbon sinks, having the ability to pull $CO_2$ out of the atmosphere and store it in trees, plants, and soils. Additionally, these sectors have the potential to drive emission reductions outside of the State by reducing the demand for imported goods and providing substitutions for more fossil fuel-intensive products. The strategies described in this chapter address mitigation of agricultural GHG emissions, primarily methane and nitrous oxide as well as carbon capture (or sequestration) primarily through the growth of trees and other plants, but also through well managed and healthy soils. Maximizing the carbon sequestration potential in the agriculture and forestry sectors is a key strategy for achieving the Climate Act goal of net zero emissions across all sectors of the economy by 2050.

### *Vision for 2030*

In contributing to the statewide 2030 GHG emissions reduction requirement, the agricultural sector will execute actions to reduce methane and nitrous oxide emissions. To reduce methane and nitrous oxide emissions, the agricultural sector will implement recommendations for livestock operations and cropland management. Both the agriculture and forestry sectors will undertake measures to facilitate broad carbon sequestration. Actions to maintain and increase carbon storage and sequestration on the land base in New York and in agricultural and forestry products through the avoided conversion of farm and forest lands, afforestation and reforestation, improved forest management practices, cropland management practices (such as soil health management practices), and the long-term storage of carbon in harvested wood products (such as mass timber) will achieve approximately 30 MMT $CO_2e$ net sequestered. This chapter will focus on specific management practices and *Chapter 19. Land Use* will discuss strategies related to avoided conversion and afforestation and reforestation.

### *Vision for 2050*

The 2050 goal of the Climate Act is to achieve net zero GHG emissions statewide and a required 85% reduction in GHG emissions. Emissions reductions beyond 85% of 1990 statewide levels can be achieved through approximately 60 MMT $CO_2e$ net sequestration in the Agriculture and Forestry sectors. Additionally, in 2050, agricultural GHG emissions will need to be further reduced from 2030 levels,[181] which will require further development of research, technology, and market solutions where the technical potential has yet to be reached. Support for New York's bioeconomy is recommended to meet the Climate Act requirements and goals and will serve to grow the agriculture and forestry industries in New York by substituting New York-grown and produced products for imported fossil fuel-intensive products avoiding, which will contribute to reducing global GHG emissions and increasing sequestration in New York.

**Emissions Overview:**

Agricultural emissions consisting of methane, nitrous oxide and a small amount of $CO_2$ represented approximately 6% of statewide emissions in 2019 from livestock (92%) and soil management practices (8%). However, agriculture and forestry also provide carbon sequestration benefits and can provide significant contribution toward achieving net zero total emissions from all sectors in the State. For example, the long-term storage of carbon in Harvested Wood Products alone provided 5% of the State's GHG emissions removals in 2019. These benefits are also described in *Chapter 19. Land Use*.

### *Existing Sectoral Mitigation Strategies*

New York has 18.6 million acres of forests and 6.9 million acres of agricultural lands in production.[182, 183] Over the last decade, farmers and foresters in New York have continued their efforts and investments to

[181] Wightman, Jenifer and Woodbury, Peter. 2020. New York Agriculture and Climate Change; Key Opportunities for Mitigation, Resilience, and Adaptation. Cornell University. https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/2/7553/files/2020/07/CarbonFarming_NYSAGM_FINAL_May2020.pdf.

[182] Albright, Thomas A.; Butler, Brett J.; Crocker, Susan J.; Drobnack, Jason M.; Kurtz, Cassandra M.; McWilliams, William H.; Morin, Randall S.; Nelson, Mark D.; Riemann, Rachel; Vickers, Lance A.; Walters, Brian F.; Westfall, James A.; Woodall, Christopher W. 2020. New York Forests 2017. Resource Bulletin NRS-121. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 118 p. https://doi.org/10.2737/NRS-RB-121.

[183] USDA National Agriculture Statistic Service. 2019. 2017 Census of Agriculture, Volume 1, Chapter 1: Part 32 State Level Data: New York. Accessed at https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/New_York/nyv1.pdf.

advance environmental sustainability and efficiency, both of which increase carbon benefits and climate resilience. Some of these efforts include:

- New York dairy farmers made significant strides in reducing the carbon footprint per hundredweight of milk through greater efficiencies in precision feed management, reducing enteric emissions from cow digestion.
- The New York State Methane Reduction Plan (May 2017)[184] identified and set targets for reducing methane emissions from the agricultural sector.
- A suite of technical assistance and planning resources were developed through the Agricultural Environmental Management (AEM) framework on farm and forest GHG emission mitigation opportunities.
- New York's Climate Resilient Farming (CRF) grant program, which demonstrates how climate-responsive efforts can be integrated alongside existing environmental and water quality agricultural programming, has awarded $12 million in project funding, resulting in an estimated 300,000 MT $CO_2e$ reduced/sequestered.
- Assisting thousands of landowners with forest management on more than 2 million acres of private lands through programs like the Forest Stewardship program, Environmental Quality Incentives program (EQIP), the 480a Forest Tax Law program, Partnerships for Regional Invasive Species Management, Forest Health rapid response programs, and the Forest Health Diagnostic Lab.
- The Forest Stewardship Council and Sustainable Forestry Initiative has provided Green certification on 800,000 acres of State forests.

To continue to enable farmers to reduce GHG emissions and increase sequestration in soils through site-specific practices on lands under their management, New York will utilize the AEM framework, overseen by AGM and the New York Soil and Water Conservation Committee (SWCC) and locally led and implemented by county Soil and Water Conservation Districts (SWCD). This existing framework will be coupled with new and expanded initiatives, RD&D of novel approaches to reducing emissions and increasing sequestration capacity and increasing workforce capacity to scale up programs and initiatives.

[184] New York State Department of Environmental Conservation, New York State Department of Public Service, New York State Department of Agriculture & Markets, Soil and Water Conservation Committee, NYSERDA. 2017. Methane Reduction Plan. Albany. Accessed at https://www.dec.ny.gov/docs/administration_pdf/mrpfinal.pdf.

Management of New York's forests, to promote tree health, recreation, wildlife habitat, and wood products, among other reasons, also has many implications for long-term carbon storage and sequestration. DEC will continue to promote programs and work closely with landowners to increase carbon benefits and resilience.

### *Key Stakeholders*

Key stakeholders include landowners, organizations involved in outreach, education, and landowner assistance, forest products, workforce development, research, legislation, and incentive programs. Stakeholders involved in each of these roles are discussed in the following paragraph, however these lists should not be considered all-inclusive. Stakeholders involved in more than one role are only listed once.

Stakeholders that hold forest land in New York include the New York State Office of Parks, Recreation, and Historic Preservation (OPRHP), DOT, NYPA, the New York Forest Owners Association, land trusts, utility companies, municipalities, municipal associations, local communities, and private landowners. Stakeholders involved in outreach, education, and other forms of landowner assistance include USDA, DOS, New York City Department of Environmental Protection, SWCDs, Cornell Cooperative Extension (CCE), the Society of American Foresters, International Society of Arboriculture, New York Society of Arboriculture, New York State Urban Forestry Council, ReLeaf, Master Forest Owners, Arbor Day Foundation, Forest Connect, the Nature Conservancy, hunting stakeholders, arborists, and foresters. Stakeholders involved in the creation, promotion, and use of forest products include NYSERDA, regional economic development councils (REDCs), DASNY, ESD, Empire State Forest Products Association, the WPDC, U.S. Green Building Council, American Society of Civil Engineers, American Institute of Architects, U.S. Department of Energy, PANYNJ, Commercial Aviation Alternative Fuels Initiative, the Business Council of New York State, New York City Department of Buildings, and waste materials stakeholders. Stakeholders involved in workforce development include Paul Smith's College, Boards of Cooperative Education Services, and the Workforce Development Institute. Stakeholders involved in research efforts include SUNY ESF and Cornell University College of Agriculture and Life Sciences (CALS). Stakeholders involved in incentive programs and legislation include the New York State Department of Taxation and Finance and the State Legislature.

Farmers, State and federal agencies, State Legislature, colleges and universities, county SWCDs, CCE, outreach and education agencies/facilitators, non-profits, land trusts, farm organizations, private sector, professional engineers and planners, financial lenders, watershed coalitions, municipalities, NGOs, food processors and co-ops, agricultural associations, and others may be integral as key stakeholders for

implementing strategies of the agricultural sector. Specific implementation leads and stakeholders are listed below for each strategy.

## 15.2 Key Sector Strategies

New York's forests serve as a major carbon sink that hold 1,911 MMT carbon,[185] nearly 10 times the amount of carbon produced by all sectors each year. In addition, forests sequester approximately 26.6 MMT $CO_2e$ annually.[186] Recommended strategies to mitigate GHG emissions and sequester and store additional carbon from the agriculture and forestry sectors are discussed in the sections below. Although also connected to the agriculture and forestry sectors, additional strategies related to land use including avoided conversion of agricultural and forest lands, afforestation, and reforestation are included in *Chapter 19. Land Use*. The recommendations listed in this chapter provide long-term, integrated approaches to achieving GHG emissions reductions while also ensuring food security, creation of wood products, and promoting agricultural and forest adaptation in the face of a changing climate, while minimizing the potential for emissions leakage by farmers and foresters moving operations out of State. Additionally, the policies that will be presented affect many other non-emission goals of the Climate Act and of the State of New York. The key strategies within this sector are organized into four themes, as shown in Table 12.

**Table 12. Agriculture and Forestry Sector Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Sustainable Forest Management | AF1. Identify where Forest Management would Provide the Greatest Benefits<br>AF2. Prevent Forest Pests, Diseases, and Invasive Species and Restore Degraded Forests<br>AF3. Maintain and Improve Sustainable Forest Management Practices and Mitigation Strategies<br>AF4. Assist Landowners in Implementation of Sustainable Forest Management and Mitigation Strategies<br>AF5. Support Local Communities in Forest Protection and Management<br>AF6. Create a New York Forest Carbon Bank<br>AF7. Monitor Progress and Advance Forestry Science and Technology<br>AF8. Conduct Education and Outreach on Forest Management |
| Livestock Management | AF9. Advance Alternative Manure Management<br>AF10. Advance Precision Feed, Forage, and Heard Management |

[185] Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

[186] *Id.*

| Theme | Strategies |
|---|---|
| Soil Health, Nutrient Management, and Agroforestry | AF11. Advance Agricultural Nutrient Management<br>AF12. Adopt Soil Health Practice Systems<br>AF13. Increase Adoption of Agroforestry<br>AF14. Develop AEM Planning for Climate Mitigation and Adaptation<br>AF15. Monitor and Benchmark Agricultural GHG Emissions<br>AF16. Establish a Payment for Ecosystem Services (PES) Program<br>AF17. Bolster Local Agricultural Economies |
| Climate-Focused Bioeconomy | AF18. Develop Forestry Training Programs to Support Expanding Workforce and Climate Knowledge<br>AF19. Expand Markets for Sustainably Harvested Durable Wood Products<br>AF20. Develop a Sustainable Biomass Feedstock Action Plan and Expand the Use of Bioenergy Products<br>AF21. Increase Market Access for New York Low-Carbon Products<br>AF22. Provide Financial and Technical Assistance for Low-Carbon Product Development<br>AF23. Advance Bio-Based Products Research Development and Demonstration<br>AF24. Advance Deployment of Net Negative $CO_2$ Removal |

### *Sustainable Forest Management*

New York has 18.6 million acres of forests, which cover approximately 62% of New York's total land area.[187] Through photosynthesis, forests absorb and store $CO_2$, which can offset GHG emissions and reduce the impacts of climate change. New York's forests hold an estimated 1,911 MMT of carbon,[188] which is equivalent to the $CO_2$ that would be produced to power all the houses in New York for the next 100 years.[189] However, there has been a trend in the loss of forested area in the past 10 years that has contributed to a decline in the net amount of $CO_2$ absorbed by forests each year, from 30.3 MMT $CO_2e$ in 1990 to 26.6 MMT $CO_2e$ in 2019.[190] In addition to forest area loss as New York's forests have aged, their

[187] Albright, Thomas A.; Butler, Brett J.; Crocker, Susan J.; Drobnack, Jason M.; Kurtz, Cassandra M.; McWilliams, William H.; Morin, Randall S.; Nelson, Mark D.; Riemann, Rachel; Vickers, Lance A.; Walters, Brian F.; Westfall, James A.; Woodall, Christopher W. 2020. New York Forests 2017. Resource Bulletin NRS-121. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 118 p. https://doi.org/10.2737/NRS-RB-121.

[188] Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

[189] U.S. Environmental Protection Agency. 2021. Greenhouse Gas Equivalencies Calculator. Division of Energy and Environment. Accessed June 4, 2021: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

[190] Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

carbon sequestration rate has slowed. To maximize New York forests carbon sequestration potential, it is critical that forest management activities increase statewide.

New York's forests are managed for a wide variety of reasons including promotion of tree health, recreation, wildlife habitat, and wood products. Management of forested areas has many implications for long-term carbon storage and sequestration depending on factors like forest age, health, and tree species as well as how the forest is managed and how the wood is utilized following harvest. Additional forest management considerations include promoting a forest's potential adaptation and resilience to climate change. Some potential ways to help increase a forest's adaptation and resilience include maintaining high tree species diversity, genetic diversity of trees within the forest, multiple age classes (uneven-age management), and removing existing barriers for regeneration (ex: competing plants, invasive species, deer).

To increase New York's forests carbon sequestration and storage and the resiliency of New York's forests, guidance is needed to promote forest management regarding carbon storage, climate resilience, and other climate-related issues using the following tactics. The CJWG supports the strategies for Sustainable Forest Management, however suggested there is an over-reliance on voluntary incentive-based programs.

### *AF1. Identify where Forest Management would Provide the Greatest Benefits*

Well-managed forests provide a wide array of benefits to humans and to the natural environment including wildlife habitat, flood mitigation, recreational opportunities, health benefits, reduced heating and cooling costs, protection of air and water quality, and carbon sequestration and storage. Forest management actions will be site specific and targeted to promote the greatest level of benefits to New Yorkers.

Identifying and prioritizing locations for forest management is an enabling strategy that will allow the State to target areas for forest management to maximize carbon sequestration and storage as well as climate resilience. DEC is currently working with SUNY ESF to develop site-specific models of aboveground forest carbon across the landscape, which is expected to be complete in 2022, however updates and improvements will be ongoing. Barriers will include the ability to obtain and update light detection and ranging technology data, quantification of forest benefits such as forest resilience, and mapping of forest benefits.

### Components of the Strategy

- **Prioritization models:** DEC should continue to work with SUNY ESF to select, implement, and develop prioritization models for forests in need of management, including those in urban areas, and small parcels owned by family forest owners.

## *AF2. Prevent Forest Pests, Diseases, And Invasive Species and Restore Degraded Forests*

Invasive species means a species that is nonnative to the ecosystem under consideration, and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.[191] Invasive species may include plants, animals, insects, and diseases. In forests, invasive plants can rapidly change an area's hydrology, displace native species, and prevent forest regeneration. Invasive plants were found in 55% of the most recent forest inventory analysis survey plots[192] and 56% of private landowners were concerned about invasive plants in the most recent National Woodland Owner survey.[193] Invasive insects and diseases such as emerald ash borer and hemlock woolly adelgid, can cause rapid mortality to trees or contribute to a loss in tree health due to increased stress, contributing to mortality in the long-term. In the most recent National Woodland Owner survey, 74% of private landowners were concerned about invasive insects and disease.[194] By altering the forest ecosystem, preventing regeneration, reducing the growth and vigor of trees, and causing direct mortality, invasive species negatively impact the ability of New York's forests to store and sequester carbon.

DEC enforces 6 NYCRR Parts 575 & 576 regulatory programs regarding invasive species and AGM enforces NYCRR Title 1 Chapter III for insect and disease control. These programs seek to accomplish prevention, outreach, rapid response, and research on invasive forest species and diseases through its Invasive Species and Ecosystem Health program, Partnerships for Regional Invasive Species Management, the New York Invasive Species Research Institute, and the Forest Health Diagnostic Lab, as well as partners statewide. Climate change is expected to increase the competitiveness of invasive plants and increase the range and survival of invasive insects and diseases. Prevention, response, and

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[191] 6 NYCRR 575.2(s) & 576.2(e).

[192] U.S. Department of Agriculture Forest Service. 2020. Forests of New York, 2019. Resource Update FS-250. Madison, WI: U.S. Department of Agriculture, Forest Service. 2p. https://doi.org/10.2737/FS-RU-250.

[193] Butler, Brett J.; Hewes, Jaketon H.; Dickinson, Brenton J.; Andrejczyk, Kyle; Butler, Sarah M.; Markowski-Lindsay, Marla. 2016. U.S. Department of Agriculture Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p. https://doi.org/10.2737/NRS-RB-99.

[194] *Id.*

restoration will be ongoing as new invasive species are introduced and the ranges and competitiveness of existing species in New York expand.

### Components of the Strategy

- **Increase prevention of invasive species:** Currently, most of DEC's invasive species prevention takes place through education and outreach activities. To increase efficacy, DEC should increase prevention of invasive forest pests and diseases entering New York and the U.S. (such as SMART trade) through strengthened regulations, inspection, and enforcement of wood packaging material and live plant imports.
- **Expand statutory authority:** The State should enact legislation to expand the scope of Section 9-1709 of the ECL to provide DEC with more statutory authority to strengthen and amend Parts 575 & 576 to allow more rapid listing of invasive species for regulation.
- **Combat invasive species:** DEC already has response and monitoring programs for some of the major forest pests and invasive species in New York including kudzu, hemlock wooly adelgid, oak wilt, and southern pine beetle supported through federal grant funding and EPF, however additional staff resources and funds are needed to further reduce the loss of forest carbon due to forest health issues on private and public forest. DEC should facilitate additional capacity for rapid response teams for forest pest and disease outbreaks and invasive vegetation issues that negatively impact forest carbon (such as forest regeneration). Priority would be on intervening where rapid, extensive loss of forest carbon sequestration capacity could occur.

## *AF3. Maintain and Improve Sustainable Forest Management Practices and Mitigation Strategies*

Forests in New York are managed for many reasons such as promoting tree health, recreation, wildlife habitat, and wood products. This management has implications for long-term carbon storage and sequestration. Improving and expanding the use of sustainable forest management practices and mitigation strategies is ongoing and has direct benefits for carbon storage and sequestration. Current efforts by DEC include sustainability certification on State lands, the Forest Stewardship program, EQIP run by USDA Natural Resources Conservation Service (NRCS), 480a Forest Tax Law program, and Regenerate NY cost share grant program.

## Components of the Strategy

- **Invest in forest carbon research:** DEC should work with SUNY ESF and Cornell CALS to support research, develop best management practices (BMP), guidance documents, and decision trees to inform forest management regarding carbon storage, carbon sequestration, climate resilience, and other climate-related issues including on improving forest resilience and vigor, regeneration, forest soils, and prevention of high-intensity wildfire.
- **Invest in forest carbon research:** DEC should work with Cornell CALS and SUNY ESF to expand funding for and conduct peer reviewed climate, forest carbon, and applied forest management research in New York such as improving forest resilience, vigor, regeneration, and forest soil carbon storage.
- **Develop best practices:** DEC and AGM should develop enhanced forestry management practices to maintain or increase forest carbon stocks while producing an annual sustained yield of bio-based feedstocks from the forest.
- **Implement forest carbon certification program:** DEC should develop and implement a Forest Carbon Certification Program, where qualified participants with a certification credential would be able to work under State funded forest programs and forest carbon programs.
- **Restore degraded forest assets:** DEC should implement restoration measures in degraded forests that have the potential for improved carbon storage, carbon sequestration, and climate resilience such as extending harvest intervals, uneven aged harvests, rehabilitating high graded and under stocked stands, and invasive species management and prevention. With current estimates of 1.1 million acres of understocked forests in NY immediate action and substantial funding is necessary to rehabilitate these acres to increase their carbon sequestration potential.
- **Invest in financing options for upgrades and best practices:** DEC should work with the WPDC, and NGOs to provide funding for low interest loans or grants for upgrading to new logging or manufacturing equipment to facilitate, increased utilization, improved forest management or BMPs to lower site impacts (such as machine tracks for wheeled harvesters to lower soil impacts).

### *AF4. Assist Landowners in Implementation of Sustainable Forest Management and Mitigation Strategies*

Of New York's forests 73%, or 13.7 million acres, are owned by private landowners.[195] The majority of all the carbon sequestration and storage occurs on these lands. Of privately-owned forests, only about 27% received professional advice within the past five years, only 18% had a written management plan,[196] and only 9% (1.2 million acres) were under professional forest management through the 480a Forest Tax Law Program, which provides tax incentives to landowners for forest management.[197] In addition, the costs of maintaining a healthy forest, forest dieback due to pests and diseases, annual taxes, and shifts to smaller parcel sizes, these landowners have been facing increasing pressures to subdivide and develop their forested lands.[198] New programs should focus on landowners with smaller land holdings to increase the target audience and allow for diverse management objectives beyond strictly timber management. In addition to the 480a program, other ongoing DEC programs that assist forest landowners include the Forest Stewardship program, Regenerate NY cost share grant program and USDA NRCS-run EQIP. The huge number of private landowners that need to be reached could present a possible barrier to this strategy, however improving sustainable forest management and mitigation strategies will help improve carbon storage and sequestration in New York—as well as climate resilience.

#### Components of the Strategy

- **Expand education and outreach:** DEC, CCEs, SWCDs, NGOs, SUNY ESF, Cornell CALS, and other organizations and universities across the State should continue to provide, expand, and improve outreach and technical assistance on forest carbon and forest management to landowners including information about estate planning, intergenerational transfer, and the importance and contribution of working forestlands through programs such as the Forest Stewardship Program, AEM, Partnerships for Regional Invasive Species Management, and Master Forest Owners.
- **Amend Real Property Tax Law 480a:** The State should enact legislation to amend Real Property Tax Law section 480a to create tracks for forest carbon management, induce greater

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[195] USDA Forest Service 2020.

[196] Butler, Brett J.; Hewes, Jaketon H.; Dickinson, Brenton J.; Andrejczyk, Kyle; Butler, Sarah M.; Markowski-Lindsay, Marla. 2016. USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p. https://doi.org/10.2737/NRS-RB-99.

[197] New York State Department of Environmental Conservation. 2020. New York State Forest Action Plan: December 2020. Albany. Accessed at https://www.dec.ny.gov/docs/lands_forests_pdf/nysfap.pdf.

[198] Malmsheimer, Robert & Heffernan, Patrick & Brink, Steve & Crandall, Douglas & Deneke, Fred & Galik, Christopher & Gee, Edmund & Helms, John & McClure, Nathan & Mortimer, Michael & Ruddell, Steve & Smith, Matthew & Stewart, John. 2008. Forest management solutions for mitigating climate change in the United States. Journal of Forestry. 106.

landowner participation and integrate stronger sustainability provisions (such as forest regeneration) with the primary goal to remain unchanged and encourage sustainable timber management. Tax abatement benefit for landowners should remain unchanged with up to 100% reimbursement to municipalities.

- **Enact new legislation:** The State should enact legislation to create a new real property tax incentive (Real Property Tax Law 480b) to allow private forest landowners to manage for multiple benefits (such as wildlife habitat, wood products, and carbon sequestration) and, if desired, conserve their forests in natural conditions to participate in tax programs. Tax benefit to landowners should increase as the year of commitment increase, recognizing the accumulated sequestration benefits over time. This program should require a forest management plan written by a certified forester if harvesting is required and has a 15-acre eligibility requirement. Initial benefits should start at a lower level than 480a and 480c with up to 100% reimbursement to municipalities.
- **Enact new legislation:** The State should enact legislation to create a real property tax incentive (Real Property Tax Law 480c) to provide forest landowners a tax incentive to undertake practices that increase carbon storage, carbon sequestration, and climate resilience while addressing the need for additionality. This program should be practice and carbon inventory based and require a forest management plan written by a carbon certified forester if harvesting and have a 15-acre eligibility requirement. Tax benefit to landowners should increase as the years of commitment increase to recognize accumulated sequestration benefits over time. Up to 100% reimbursement to local municipalities.
- **Expand funding:** The State should expand the funding for cost share programs, such as Regenerate NY and AEM to assist forest landowners in increasing carbon storage, carbon sequestration, and climate resilience on private forestland, including restoration of degraded forests and implementing BMPs for forest carbon. The first round of the Regenerate NY program will help restore and afforest 503 acres of land to forest, however support for this program will need to substantially increase to have a measurable impact on forest carbon benefits. The formal addition in 2019 of Forest Conservation Planning and BMP implementation into the AEM framework now provides technical assistance and funding from Soil and Water Conservation Districts to farmers with forestland to improve management of forest resources for multiple benefits, including carbon storage and sequestration. With millions of forestland acres in New York owned by farmers, continuing to expand SWCD capacity for forestry technical assistance and practice funding through AEM programs will be critical to meet these goals.

- **Establish equipment caches:** DEC, SWCDs, NGOs, and the WPDC should establish equipment caches across the State to allow landowners and operators to borrow forestry and logging equipment to implement low impact forest management for approved practices.

### *AF5. Support Local Communities in Forest Protection and Management*

Local governments including counties and municipalities own approximately 1% of forested areas large and productive enough for wood production and have jurisdiction over land use planning and restrictions for forests within their boundaries.[199] In addition, tree canopy covers 1.3 million acres of urban and community areas, storing about 32.1 MMT of carbon (equivalent to the $CO_2$ that is produced to power all the houses in New York for 1½ years) and contribute to 1 million tons gross carbon sequestration each year (equivalent to the $CO_2$ that is produced to power 400,000 homes for 1 year).[200] Increasing forest protection and management in local and urban communities will increase carbon sequestration and storage as well as climate resilience. In addition, trees in urban areas reduce the need for, energy use, and emissions from air conditioning. Current efforts by DEC include the urban and community program, which provides education, outreach, guidance, and a grant program to local and urban communities. An additional community forest conservation grant program is expected to be released in 2022. However, urban and community tree cover is declining by about 6,720 acres annually.[201] In addition, many municipalities lack a comprehensive plan and/or zoning ordinance or laws for forests, and often these documents do not clearly address forest retention and/or uses. In some cases, restrictions within municipal jurisdictions on forest management drive local landowners to develop their land.[202] In addition, due to the costs of maintaining a healthy forest, forest dieback due to pests and diseases, annual taxes, and shifts to smaller parcel sizes, landowners and municipalities have been facing increasing pressures to subdivide, develop or allow development on their forested lands.[203]

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[199] Daniels, Katherine H. 2005. A Municipal Official's Guide to Forestry in New York State. New York Planning Federation, Department of Environmental Conservation and Empire State Forest Products Association. 31p. Accessed June 9, 2021: http://cceonondaga.org/resources/municipal-officials-guide-to-forestry-in-new-york-state.

[200] Nowack, David J., Eric J. Greenfield, Robert E. Hoehn, and Elizabeth Lapoint. 2013. Carbon storage and sequestration by trees in urban and community areas of the U.S. Environmental Pollution, 178, 229-236.

[201] Nowack, David J., & Greenfield, Eric J., 2018a. Declining urban and community tree cover in the United States. Urban Forestry & Urban Greening, 32, 32-55.

[202] Malmsheimer, Robert W. and Donald W. Floyd. 1998. The Right to Practice Forestry: Laws Restricting Nuisance Suits and Municipal Ordinances, Journal of Forestry 96(8): 27-32. https://doi.org/10.1093/jof/96.8.27.

[203] Malmsheimer et al. 2008.

### Components of the Strategy

- **Provide guidance and support:** DEC should work with SUNY ESF and Cornell CALS to provide guidance, support, and funding to local communities to plan and implement forest maintenance projects that help communities adapt to climate change.
- **Provide BMPs:** DEC should work with Cornell CALS, and SUNY ESF to provide BMP's for urban forests including what trees to plant for carbon sequestration and climate resilience and ways to increase the lifespan of urban trees through improved maintenance.
- **Increase funding:** The State should increase funding levels and scope of Urban and Community Forestry Grants to assist local municipalities and private landowners in the management of the urban forests, including planning, planting, and maintenance of trees. Round 15 of DEC's Urban and Community Forest Grants funded 38 projects across the State, however support for this program will need to increase to have a greater impact on urban forest carbon benefits.
- **Develop guidance and support:** DEC and SWCDs should develop guidance for and provide support to local communities to establish or expand youth and young adult conservation corps to employ, and train youth for maintaining and improving urban forest management.
- **Support research:** DEC should work with Cornell CALS and SUNY ESF to increase urban forestry and forest carbon research on ways to maximize the carbon and other benefits of establishing and maintaining urban forests.

## *AF6. Create a New York Forest Carbon Bank*

Due to their ability to sequester and store carbon, forests and forest management can be leveraged to offset $CO_2$ produced by other sectors through $CO_2$ emissions reduction credits. In carbon market programs, $CO_2$ emitters are incentivized to reduce their emissions. If their emissions are not reduced, emitters must offset their emissions by purchasing emission reduction credits from a project that enhances carbon sequestration and storage such as afforestation, reforestation, purchase of forested lands, or enhancing forest management. Purchase of these emissions reduction credits in turn allow forest owners to receive additional income which will allow them to conduct necessary forest management to increase forest resilience and carbon sequestration. Creation of a New York Carbon Bank would allow the State to finance GHG emissions reduction and carbon sequestration activities in New York's farms and forests and would take several years to set up and implement. Currently, New York emitters may participate in voluntary carbon markets like the RGGI or participate in compliance markets like the cap-and-trade program run through California's Air Resources Board.

### Components of the Strategy

- **Enact forest carbon bank legislation:** The State should enact legislation for the creation of a New York forest carbon bank that would allow New York to finance GHG emissions reduction and carbon sequestration activities by New York farm and forest landowners. Limitations may need to be placed on the types of projects and/or the types of industries that can participate to ensure any carbon offsets align with the goals of the Climate Act.

## *AF7. Monitor Progress and Advance Forestry Science and Technology*

Tracking the carbon sequestered and stored by New York's forests is critical to enabling and evaluating the success of carbon sequestration and storage. Monitoring forest carbon progress will help the State identify successful forest management strategies and provide further insight into what land use patterns can lead to the greatest carbon sequestration and storage. Monitoring will also help identify areas of the State that have low regeneration or stocking and areas that have been impacted by invasive species, wildfire, and other disturbances that need restoration efforts. DEC is currently working with SUNY ESF to develop a satellite image-based monitoring platform for statewide forest carbon that is expected to be completed in 2022, however improvements, evaluation, and maintenance of this platform will be ongoing.

### Components of the Strategy

- **Monitor forest carbon:** DEC should continue to work with SUNY ESF and Cornell CALS to monitor forest carbon and evaluate tactics to determine efficacy and maximize efficiency.
- **Create science-based decision tools:** DEC should work with SUNY ESF and Cornell CALS to create science-based decision tools to help make the most efficient and cost-effective decisions on forest-based climate change initiatives.
- **Research seedling technologies:** DEC should research seeding technologies, such as use of drones for planting in small forest gaps.
- **Conduct research:** DEC should work with Cornell CALS, SUNY ESF, and WPDC to conduct research on emerging forest products and markets related to bioeconomy and harvested wood product initiatives.

## *AF8. Conduct Education and Outreach on Forest Management*

To ensure and enable the success of the strategies listed within this chapter, education and outreach is needed to reach New York's private and public landowners who can implement forest management practices and mitigation strategies, which will increase carbon sequestration and storage and climate

resilience. In addition, the benefits forests and wood products provide should be promoted to the public to increase their use and for a better understanding of why protecting and managing forests is beneficial for carbon sequestration, wildlife, and the people of New York. DEC currently conducts education and outreach through individual programs such as the Forest Stewardship program, EQIP run by USDA NRCS, Regenerate NY cost share grant program, the Urban and Community Forest program, and partners like SWCC, and through efforts like #ForestryFridays on social media, however additional proactive education efforts could be beneficial for reaching new audiences.

### Components of the Strategy

- **Promote forest management:** DEC should work with Cornell CALS and SUNY ESF to build public acceptance for forest management and increase the adoption of climate focused forest management on all landownership types.
- **Expand outreach:** DEC should continue to provide stewardship, cooperating foresters, urban foresters, city planners, and local officials with outreach training, technical assistance, resources, and toolkits to better engage landowners and other stakeholders on climate change.
- **Support urban forestry:** DEC should continue to increase the promotion of urban forestry and tree care through TreeLine USA for utilities, TreeCity USA for communities, Tree Campus for college campuses, and ReLeaf efforts in communities across the State.
- **Support education and outreach:** DEC should bolster urban forestry and natural resource education and outreach, especially in underserved communities by identifying and working with local partners.
- **Promote New York wood products:** WPDC and SUNY ESF should engage social media influencers and wood product manufacturers to promote New York wood products as trendy, local, and sustainable, including traditional and emerging wood products and utilization.
- **Provide education and outreach:** Cornell CALS and SUNY ESF should provide education and outreach to the construction industry and public on mass timber construction and harvested wood product applications and carbon mitigation benefits of substituting wood products instead of those that are fossil fuel based.

## *Livestock Management*

The highest level of agricultural emissions is attributed to livestock - primarily methane and secondarily nitrous oxide. Therefore, the following strategies contribute to the deepest reductions in agricultural emissions, addressing methane reduction from manure management practices and from animal feeding.

Alternative manure management strategies rely heavily on the advancement of current programs led by the AGM, SWCC, NYSERDA, and county SWCDs. Precision feed, forage and herd management strategies rely mainly on increased training and support to the farm community by Cornell CALS, CCE, nutritionists and feed industry professionals, expanded use of monitoring and decision tools, as well as continued and enhanced research and development of feed supplements and additives for further methane reductions.

### *AF9. Advance Alternative Manure Management*

The storage of manure is an important practice to facilitate nutrient management, reducing the need for synthetic fertilizers, and preventing runoff for the improvement of water quality. However, the treatment and storage of livestock manure can produce methane through the anerobic decomposition of the manure. Manure storages have caused the single highest increase in agricultural emissions from the 1990 baseline year to today.[204] Mitigation of this source of emissions range from technically feasible to challenging depending on the use of available strategies and technologies or through more innovative and advanced manure management system approaches. Manure methane reductions require an evaluation of new processes, technologies, and costs; overcoming storage retrofit and livestock bedding challenges; operating and maintaining systems for methane prevention or optimal capture and destruction to minimize methane loss and leakage; filling gaps in applied research as well as in-field leak monitoring processes; balancing nutrients and methane inputs with increases in imported organic waste processing; and improving quantification and verification of outcomes.

This strategy will reduce methane emissions by implementing practice systems specifically planned and designed for each farm, such as cover and flare systems, anaerobic digester systems, composting, and other innovative systems that collect, capture, and destroy methane from manure storages or prevent methane production through improved manure management. Specific components of this strategy that include utilizing existing State programs and planning tools through AGM and the SWCC, can begin implementation immediately and can scale with additional resources dedicated to these programs. The Climate Resilient Farming Program through five rounds of funding has awarded $4.3 million for manure storage cover and flare systems assisting sixteen farms. Resources for this program will have to significantly increase to have a greater impact on methane reductions. Longer timeframes will be required for other components relating to education, outreach, research, and market connections with NYSERDA

[204] Wightman, J.L. and P.B. Woodbury. 2016. New York Dairy Manure Management Greenhouse Gas Emissions and Mitigation Costs (1992–2022). Journal of Environmental Quality 45: 266-275.

and SWCDs as key partners. These strategies rely on the New York AEM Framework and strong incentives to implement alternative manure management systems. The CJWG favor imposing regulations on dairy and other livestock farmers to reduce emissions. The strategies outlined below rely more heavily on long established technical assistance and cost-share programs to achieve methane reductions from manure management. Feedback from the CJWG indicates a preference for manure management strategies upstream of the manure storage or that reduce animal waste generation at its source.

### Components of the Strategy

- **Expand funding for current programs:** AGM and SWCC should significantly expand CRF program funding to assist farmers in implementing alternative manure management practice systems that reduce methane emissions.
- **Expand farmer access:** AGM and SWCC should increase farmer access to technical and financial assistance. Prioritize Disadvantaged Communities and historically underserved farmers including BIPOC, women, LGBTQIA+ (lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual, and other), low income, veteran, and beginning farmers.
- **Strengthen program policies:** AGM and SWCC should refine current grant program policies to encourage manure management systems funded through State programs incorporate methane prevention or mitigation strategies including retrofit capacity
- **Expand SWCD capacity:** The State should expand capacity of SWCDs and partners to aid on-farm implementation of GHG emissions reduction and sequestration management practices.
- **Expand technical assistance:** AGM along with stakeholders should increase technical assistance and engineering capacity for feasibility assessment, planning, design, operation, maintenance, and monitoring of alternative manure management systems.
- **Expand training:** AGM and SWCDs should expand training to technical service providers and farm staff to design, build, operate, and maintain alternative manure management systems.
- **Develop new funding opportunities:** AGM should develop a State-funded loan guarantee program to stimulate investment in alternative manure management systems.
- **Expand purchasing opportunities:** AGM and SWCC should develop State-bulk buying programs to reduce core material and equipment costs (such as covers, flares, separators, standardized controls, and other components), similar to the solar industry and energy-efficient heating programs.
- **Advance energy production:** NYSERDA along with AGM should expand funding for advancement of energy production and methane mitigation, including measurement and

abatement of methane leakage, and future innovations based upon the recommendations from the biomass action plan.

- **Minimize fugitive methane emissions from energy production:** AGM and NYSERDA should develop and apply standards for leak detection and repair from energy production systems. These standards will also include monitoring to guide management to minimize losses and optimize GHG emissions reduction benefit.
- **Align market opportunities:** AGM and NYSERDA should align manure management systems designed for energy production, organic waste management, and methane mitigation with markets (existing or future, Low Carbon Fuel Standard, industry net zero initiatives, and other) and private-sector investment.
- **Make market connections:** AGM and NYSERDA should improve connections and markets between farms with alternative manure management systems and other businesses able to supply organic co-products or use products generated by such on-farm systems (such as electricity, heat, gas, and organic soil amendments).
- **Support research and outreach:** AGM should implement long-term funding support for alternative manure management applied research and outreach, including evaluation of new processes, technologies, and GHG quantification and verification methodology for manure management systems, quantification of methane leakage and detection, processes for realizing additional value from manure and analyses for strategic development/siting of methane mitigating manure and organic waste management systems.

### *AF10. Advance Precision Feed, Forage, and Herd Management*

Methane is produced as part of normal digestive process in animals, especially ruminants. During digestion, microbes present in the animal's digestive system ferment feed consumed by the animal. This microbial fermentation process, referred to as enteric fermentation, produces methane as a biproduct, which can be exhaled or eructed by the animal. Although methane from feed digestion represents the highest percentage of agricultural emissions, dairy and other livestock farms have improved feed efficiency, reducing methane emissions per unit of milk and other products since the 1990 baseline.[205]

[205] Capper, J. L. and R. A. Cady. The effects of improved performance in the United States dairy cattle industry on environmental impacts between 2007 and 2017, Journal of Animal Science, Volume 98, Issue 1, January 2020, skz291, https://doi.org/10.1093/jas/skz291;
Capper, J. L., R. A. Cady, and D. E. Bauman. 2009. The environmental impact of dairy production: 1944 compared with 2007. J. Anim. Sci. 87:2160–2167. doi:10.2527/jas.2009-1781;
Wightman, J.L. and P.B. Woodbury. 2016. New York Dairy Manure Management Greenhouse Gas Emissions and Mitigation Costs (1992–2022). Journal of Environmental Quality 45: 266-275.

Additionally, over time, New York dairy farmers have made significant strides in reducing the carbon footprint per hundred weight of milk through greater efficiencies in precision feed management, reducing enteric methane emissions from cow digestion.[206]

Deep reductions are required for New York agriculture to meet the Climate Act emission limits. Mitigation of methane emissions from enteric fermentation range from feasible to challenging from the implementation of precision feed, forage, and herd management through continued and enhanced training and support to the farm community to the expanded research, testing, and scalability of feed additives designed to dramatically reduce enteric fermentation.

To reduce methane and nitrous oxide emissions while achieving desired ruminant growth and lactation goals, this strategy requires the evaluation of new processes, technologies, costs, and returns; demands sustained adaptive management by farmers and advisors, flattening the learning curve by farmers, advisors, and the feed industry; filling gaps in applied research; overcoming weather and market disruptions that can lower performance (producing lower quality forage). This strategy acknowledges that additional methane emission reduction may be realized from feed additives developed in the future and supports research to evaluate their potential. Research in combination with incentives may lead to substantial reductions in emissions. Some components of this strategy that include utilizing existing programs and planning tools can begin implementation immediately and be scaled up with additional resources dedicated to them. Longer timeframes will be required for other components relating to applied research and market development of feed additives with Cornell CALS and CCE as key partners for implementation.

### Components of the Strategy

- **Expand precision feed and forage education:** Cornell CALS and CCE should expand outreach and education of precision feed and forage management to more ruminant livestock farmers, nutritionists, and feed industry professionals. Other stakeholders essential to this effort include milk cooperatives, and processors.
- **Expand access to monitoring tools:** Cornell CALS should expand access to precision feed and forage management monitoring and decision tools (such as the Cornell Net Carbohydrates and Proteins System) applicable to a range of farm conditions and management. Farm use of the

[206] *Id.*

methane module within Cornell's system should be increased and statewide benchmarks should be developed to gauge improvement overtime.

- **Support research and outreach:** AGM and SWCC should implement long-term funding support for precision feed, forage, and herd management basic and applied research and outreach, including research for methane mitigating feed additives and outreach, training, and other forms of assistance to nutritionists and industry professionals regarding GHG reductions through feed management.
- **Expand SWCD capacity:** The State should expand capacity of SWCDs and partners to aid on farm implementation of precision feed and forage management practices.
- **Establish co-product markets:** DEC should explore establishment of a co-product market for food "wastes" supplied from food processors, retailers, or institutions for best uses, including as livestock feed.
- **Invest in science-based herd management:** AGM and Cornell CALS should develop a science-based strategy focused on improving herd management decision making which positively impacts cow efficiency to reduce GHG emissions while optimizing milk yield and return on investment.
- **Facilitate technical assistance:** AGM and Cornell CALS should facilitate technical assistance to improve access to programs, planning and monitoring tools, and financial assistance for on-farm implementation of precision feed-forage and herd management practices.

### *Soil Health, Nutrient Management, and Agroforestry*

Healthy soils and nutrient management provide for many functions and ecosystem services including sustaining the biological activity and diversity of the soil, water quality protection, nutrient cycling, and carbon sequestration. Practices that improve soil health help to buffer many of the impacts of climate change also increasing a farm's resiliency. The following strategies focus on nitrous oxide reduction and increasing carbon sequestration.

$NO_x$ makes up approximately 9% of all agricultural GHG emissions in New York. Improving nitrogen fertilizer management is an effective GHG emissions reduction strategy that also provide other environmental and economic benefits. Efficient use of nitrogen fertilizer can reduce nitrous oxide emissions from cropland, improve water quality, and can save the farmer money.

Improving soil health can increase soil organic matter to sequester carbon as well as maintain and enhance soil structure to increase water infiltration reducing drought stress; decreased runoff after heavy storms leads to better water quality; proper uptake of nutrients by plants reduces access nutrients entering

waterbodies; and maintaining or potentially increasing crop yields promotes food security. Existing soil health and water quality initiatives can be utilized to include GHG mitigation taking a comprehensive approach to meeting multiple State environmental management goals.

Agroforestry practices systems that add trees into areas of agricultural production have the potential to elevate local food production and resiliency, improve water and air quality, provide storm and flood mitigation, increase drought resiliency, provide habitat, scenic vistas and agritourism, increase economic development and jobs. Some emission and sequestration strategies are long-term approaches. It can take decades to develop additional tree cover and years to build soil carbon.

These strategies rely mainly on the continuation and expansion of current State efforts with implementation beginning immediately. Leads for these strategies include AGM, SWCC, DEC, SWCDs, Cornell CALS and CCE. Other key stakeholders include but are not limited to American Farmland Trust, land trusts, the Nature Conservancy, the Farm Bureau, and the fertilizer industry.

### *AF11. Advance Agricultural Nutrient Management*

Farmers in New York have improved nutrient management on lands while increasing crop yields. Comparatively, nitrous oxide emissions from farms in New York are lower than in many other agricultural systems nationally and globally making this mitigation strategy relatively easy to implement. However, continued emission reductions, including improved measurement of existing and future efforts require comprehensive training in the use of nutrient management tools and in some cases new equipment and data collection. Implementation of this strategy also requires sustained, adaptive management by farms and crop advisors.

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments is the continual process of nutrient management. Farms across New York will continue to reduce nitrous oxide emissions and nitrogen pollution to waterways while achieving desired yield and quality through continued and expanded nutrient management planning and implementation on crop fields, hay fields, pastures, orchards, vineyards, and other agricultural lands receiving nutrients. Agricultural productivity and food security are important drivers for climate policy. Nutrient management monitoring and tracking programs, like those led by Cornell's Nutrient Management Spear

Program,[207] have aided farms to decrease nitrogen and phosphorus imports resulting in lower losses to the environment. Dairy and crop farmers will need additional applied research and aid to deploy effective tools to reduce GHG emissions on crop lands from fertilizer use. CJWG is supportive of efforts to reduce nitrous oxide emissions through more efficient use of nitrogen fertilizers and have suggested consideration of a fee on such fertilizers as a potential mechanism to reduce their use.

### Components of the Strategy

- **Expand funding and technical assistance:** AGM and SWCC should increase support for planning, technical assistance, and soil health or nutrient management practice implementation through the AEM Framework and associated programs, including the CRF and Agricultural Nonpoint Source Abatement and Control (AgNPS) water quality program.
- **Engage with and expand program participants:** AGM, SWCC, and SWCDs should seek feedback from groups, such as but not limited to BIPOC, women, LGBTQIA+, low income, veteran, and beginning farmers, that are not currently engaged in practices and programs to remove obstacles for participation (such as holding focus groups, surveys, and farm-to-farm education).
- **Expand cost-share eligibility for historically underserved farmers and capital-intensive equipment:** AGM and SWCC should expand cost-share eligibility for equipment needed by farms to implement more advanced soil health and nutrient management practices. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers.
- **Expand SWCD capacity:** New York should expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.
- **Enhance workforce training:** AGM and SWCC should continue and enhance training for agricultural planners and farmers.
- **Support implementation services:** AGM and SWCC should support expanding capacity of custom farming service providers to aid on farm implementation of nutrient management practices.

[207] Cornell University's Nutrient Management Spear Program works to conduct applied, field and laboratory-based research, facilitate technology and knowledge transfer, and aid in the on-farm implementation of beneficial strategies for field crop nutrient management, including timely application of organic and inorganic nutrient sources to improve profitability and competitiveness of New York State farms while protecting the environment. Accessed at http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/DairySustainabilityIndicators.html.

- **Increase use of existing tools:** Cornell CALS and CCE should increase use of improved methods of monitoring performance via crop yield measurement, nitrogen use efficiency, and Whole Farm Nutrient Mass Balances (for farm-wide nitrogen management). Document benefits of Nutrient Management to farmers, policymakers, and public.
- **Collaborate with industry led initiatives:** Cornell CALS and AGM should collaborate with industry led nutrient management initiatives and services, such as the 4R Nutrient Stewardship Program.[208] Initiate and expand nitrogen efficiency and yield crop contests for peer-to-peer competition and informational opportunities.
- **Increase funding for applied research:** AGM should implement long-term funding support for nutrient management applied research and outreach (such as management approaches and technology).
- **Increase outreach:** Cornell CALS and CCE should increase outreach to all farmers that is consistent with the research and technical standards used in New York. Communicate to consumers the steps taken by farmers for nutrient management including co-benefits to water quality improvements.

### *AF12. Adopt Soil Health Practice Systems*

This strategy focuses on reducing net GHG emissions as well as increasing carbon sequestration and other environmental benefits through adoption of soil health management practice systems (such as combinations of cover and double crops, conservation crop rotations, perennial crops, prescribed grazing, nutrient management with fertilizer/manure application, and conservation tillage practices), also referred to as regenerative agricultural practices. New York's CRF program launched as a pilot in 2015 to address climate change on farms has awarded $12 million in project funding. Integrated into the AEM planning framework and modeled after the AgNPS grant program, the CRF program demonstrates how climate-responsive efforts can be integrated alongside existing environmental and water quality agricultural programming.

The State's AEM framework provides cost-share funding and technical assistance for GHG emissions reduction activities for the practices described in the paragraph above, as well as other soil health management practices. Increasing funding opportunities for existing efforts such as the CRF program and enhancing technical assistance provided through County SWCDs, will result in a higher rate of

[208] 4R Nutrient Stewardship provides a framework to achieve cropping system goals to incorporate the Right fertilizer source at the Right rate, at the Right time and in the Right place. Accessed at https://www.nysaba.com/4r-ny.

implementation, and provide a familiar process to farmers within an infrastructure that already exists. CRF has awarded projects through five rounds of funding that are estimated to reduce emissions on farm by 320,000 metric tons of $CO_2e$. A significant amount of funding will be necessary to make an impact on emission reductions. The CJWG supports soil health and climate resiliency and emphasizes removing barriers for underserved farmers which align with components of this strategy.

### Components of Strategy

- **Expand funding for current programs:** AGM and SWCC should increase financial support for currently available and implemented practices. Expand funding for CRF, AEM Base, AgNPS; increase payment rates, increase access, build equity into programs, increase technical assistance, encourage adoption of a system of practices, develop soil health standard, establish annual goal for common practices. Increase awareness and support for urban soils and agriculture.
- **Engage with and expand program participants:** AGM and SWCC should seek feedback from groups/communities not currently engaged in practices and programs (such as holding focus groups, surveys, farm-to-farm educational events, addressing urban soils and urban agricultural operations). Improving access reflects the need to ensure that all farmers can take part in these practices and programs.
- **Increase adoption of soil health practices on rented lands:** AGM should increase practice adoption on rented and leased land. Seek feedback regarding support needed for farmers not currently engaged in practices and programs. Engage, educate, and incentivize landowners to increase adoption of practices on land they rent to farmers.
- **Expand capacity of SWCDs:** The State should expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices.
- **Increase perennial plant systems:** AGM and SWCC should support converting annual cropland to perennial hay land/pasture and where appropriate (such as steep slopes and highly erodible lands). This is a current effort supported through the State's AgNPS and CRF programs.
- **Increase integrated planning efforts:** AGM and SWCDs should conduct comprehensive on-farm planning to include carbon sequestration goals, GHG emission, nutrient management, water quality and soil health.
- **Increase use of precision and digital agricultural tools:** AGM should support continued development and implementation of precision/digital agricultural tools and sustainable intensification, which is the sustainable increase in yields on current cropland to reduce stress on marginal cropland to support this mitigation strategy.

- **Develop tools for quantification of benefits:** AGM, SWCC, and Cornell CALS should develop tools for verification of benefits, invest in remote sensing to quantify adoption of practices and environmental benefits.
- **Support research for monitoring and verification:** AGM, SWCC, and Cornell CALS should establish and maintain a comprehensive RD&D strategy for monitoring and verification of soil health that address additionality and permanence to support State climate goals and enable federal and private funding of GHG mitigation practices.
- **Support research for new innovative practices:** AGM and Cornell CALS should establish and maintain a comprehensive research strategy in soil health to bring new practices and approaches (such as enhanced rock weathering and biochar) that increase sequestration rates, productivity, other environmental benefits, and scale for adoption.
- **Develop a business case for practices:** The State should identify practice systems that can generate revenue and/or added value to the farm, identify variety of public and private funding sources.
- **Educate consumers:** AGM and CCE should make efforts visible to the public through outreach campaigns making information more available, expand regenerative agricultural practices in marketing programs (such as New York Grown & Certified), improve information provided to public to help customers understand practices involved in products they purchase.
- **Educate farmers:** AGM, SWCC, and SWCDs should expand education and outreach to include all farmers and to support practice adoption and encourage coupling of practices into systems for maximum benefit. Support farm to farm and peer to peer networking to elevate long-term adoption of soil health practices (local farmer discussion groups).
- **Educate students:** AGM, SWCC, SWCDs, and Cornell CALS should support agricultural and soil health instruction in schools to connect students with farms and farmers and knowledge of ecological benefit of healthy soils.

### *AF13. Increase Adoption of Agroforestry*

Adding trees into areas of agricultural production increases carbon sequestration and other environmental benefits. Some examples of these production and conservation practices exist in New York. Current programs, technical services, and support will be leveraged to increase agroforestry adoption while new programs, increased investment in technical support, and capacity will be necessary. Challenges and barriers to wider adoption exist and must be overcome, including addressing the upfront costs to practice adoption, addressing land access and transfer issues/opportunities, filling gaps in research, field trials,

pilot projects, and market analysis in agroforestry systems, addressing long term management and maintenance needs, and availability of appropriate tree species and survivability.

Agroforestry practice adoption can contribute toward the afforestation/reforestation goals, hence having a high mitigation potential. Implementation leads for this strategy include AGM, SWCC, Cornell CALS, SWCDs and CCE. Other key stakeholders include American Farmland Trust, land trusts, The Nature Conservancy, New York Farm Bureau, and other farm led organizations. The CJWG supports aiding BIPOC farmers in opportunities for securing farmland aligning with strategies for long-term farm leases and land transfers necessary for perennial systems.

### Components of Strategy

- **Increase adoption of practices:** AGM and SWCC should expand CRF program to incentivize agroforestry and set acreage targets for priority practices.
- **Increase riparian buffers:** AGM and SWCC should continue its emphasis on forested buffers through the State's AgNPS and Source Water Buffer Program and federal, USDA Conservation Reserve Program (CRP)/Conservation Reserve Enhancement Program.
- **Increase silvopasturing:** AGM, SWCC, SWCDs, and CCE should expand programs that plan, design, and implement silvopasture systems which are systems that integrate tress, livestock, and forage in intensively managed rotational grazing systems with a focus on proper site and species selection for adding trees.
- **Expand funding for existing programs:** DEC should expand Trees for Tributaries Program, Non-Ag NPS, DEC Division of Fish and Wildlife Programs.
- **Advance alley cropping practices:** AGM, SWCC, SWCDs, Cornell CALS, and CCE should conduct field trials and pilot projects, expand education and technical assistance for alley cropping.
- **Increase SWCD capacity:** The State should expand capacity of SWCDs and partners to aid on farm implementation of GHG emissions reduction and sequestration management practices.
- **Expand education and technical assistance:** AGM, Cornell CALS, CCE, and SWCDs should expand education and technical assistance for agroforestry practices for beginning farmers and farmers experiencing or planning for generational transfer. Long term planning is required for perennial systems.
- **Support long-term agricultural land transfers:** AGM, AFT, and land trusts should assist farmers in securing long–term leasing and farm transfer to BIPOC, women, LGBTQIA+, low

income, veteran, and beginning farmers; long-term leases are required for long term perennial systems.

- **Support business planning and market development:** AGM and SWCC should assist farmers with business planning and modeling for value added practices in agroforestry. Expand supply chain development for new products in agroforestry.
- **Conduct outreach to financial lenders:** AGM, CCE, and Cornell CALS should conduct outreach on the environmental and potential economic benefits of agroforestry systems to financial lenders and insurance providers.
- **Collaborate with federal partners:** The State should collaborate with federal partners to better align federal and State policy priorities.

### *AF14. Develop Agricultural Environmental Management Planning for Climate Mitigation and Adaptation*

New York's AEM framework, overseen by the AGM and the SWCC and locally led and implemented by County SWCDs, will continue to enable farmers to reduce GHG emissions and increase sequestration in soils and forests through site-specific practices on lands under their management.

AEM Planning for Climate Mitigation and Adaptation or the development of "Carbon Farm" Planning has the potential, when plans are implemented, to elevate local food production and resiliency, water quality, air quality, storm and flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas, tourism, economic development, and jobs. A suite of technical assistance and planning resources will be developed through the AEM framework on farm and forest GHG mitigation and carbon sequestration opportunities, allowing for further planning and implementation of regenerative agricultural practices. This strategy is essential to the successful planning and implementation of practice systems that are tailored farm by farm for the reduction of GHG emissions and the increase of carbon sequestration potential on farmland. AEM planning resources will continue to be designed and made available in ways that are accessible and applicable to all farmers.

#### Components of the Strategy

- **Develop carbon farm planning protocols:** AGM and SWCC should develop planning protocols for Carbon Farm Planning. Identify gaps for future development. Strive for compatibility among State and federal programs. Design methods for collection and aggregation of outcomes from planned and implemented practice systems (such as estimates for GHG emissions, sequestration, and metrics for adaptation).

- **Pilot carbon farm planning:** AGM, SWCC, and SWCDs should conduct on-farm piloting of Carbon Farm Plans.
- **Conduct outreach and education:** AGM, SWCC and SWCDs should provide communication of AEM Planning for climate mitigation and adaptation with farmers (such as case studies, learning from pilot farmers, training on farmer developed planning protocols/tools, and other).
- **Integrate carbon farming with existing programs:** AGM should include planning protocols in AEM Base Programs and compatibility with federal programs. Priority practice systems from plans lead to implementation via direct investment by farmers, other private investors/lenders, as well as State and federal cost-share programs.

### *AF15. Monitor and Benchmark Agricultural Greenhouse Gas Emissions*

Annual monitoring and benchmarking of GHG emissions mitigation, carbon sequestration, and adaptation performance across applicable areas of management on farms in New York is critical to determining success in meeting targets and provide further insight into what strategies lead to the greatest achievements. Information products provide useful, farm-level data for confidential benchmarking by farmers as well as publicly available data through farm case studies (with farmer agreement) and aggregated datasets (at the State level, rather than the farm level) to support future policy, research, and implementation. Like the farm level AEM planning strategy, this enabling strategy is central to the success of all other agricultural mitigation efforts.

#### Components of the Strategy

- **Establish funding:** AGM and DEC should establish funding for an agricultural benchmarking and monitoring program for GHG emissions. This should be a partnership effort among Cornell CALS, CCE, SWCDs, famer groups, and agricultural industry groups.
- **Monitoring and benchmarking:** AGM should develop methods for monitoring and benchmarking (including program staff and advisory committee). Benchmarking at the farm level for farmer use should be based on comparisons with their historical performance as well as the performance of similar types of farms (each kept anonymous). Benchmarking should also occur at the State level with aggregated, anonymous data based on comparisons with our historical performance.
- **Outreach:** AGM and SWCC should introduce monitoring and benchmarking program with farmers and farm advisors.

- **Make data available:** AGM should deliver data summaries of BMPs implementation and associated estimates of GHG mitigation or sequestration levels for confidential farm-scale use and aggregated summaries for public use. Additional key performance metrics will be developed by the advisory committee/expert panel.

### *AF16. Establish a Payment for Ecosystem Services Program*

Currently, farmers do not capture direct financial benefits from generating ecosystem services through their land management techniques. Agricultural lands implementing conservation BMPs provide countless environmental benefits for surrounding communities including improved water quality, climate mitigation, carbon sequestration, increased biodiversity, and pollinator services. Establishing a PES mechanism to provide a new structure for establishing and maintaining practice systems that reduce GHG emissions and sequester carbon in addition to providing other environmental benefits would provide incentive to farmers and landowners. A PES program can be designed to address multiple services and evolve with changing needs and priorities of the State. This strategy supports the implementation of other strategies that rely on increased adoption of regenerative agricultural practices.

#### Components of the Strategy

- **Dedicate funding:** AGM should establish funding for a PES program to be developed for agricultural producers and landowners.
- **Develop and design program:** AGM and SWCC should research and design a PES approach that will sustain our natural capital providing ecosystem services of water quality, flood resilience, and climate stability and includes and fair compensation for program participants.
- **Conduct outreach:** AGM and SWCC should conduct education and outreach regarding PES program and benefits to local communities.
- **Pilot PES program:** AGM and SWCC should pilot a PES program for agricultural producers to ensure continued implementation of practices or actions that lead to increased ecosystem services.

### *AF17. Bolster Local Agricultural Economies*

This strategy supports emission reductions by enhancing existing programs, and promoting the expansion of those programs, that encourage farm viability and resilient communities through the production and consumption of local food. Climate impacts, as well as COVID-19 impacts, have shown an elevated importance in the need for food security. This strategy is designed to enhance the expansion of markets and support for New York's farming community. This strategy will help to enhance viability of New York's diverse agricultural enterprises. To realize the full goals of our mitigation and sequestration

strategies, the economic solvency of the agricultural community must be addressed. Much of this strategy relies on bolstering existing programs and initiatives. Implementation of these strategies are ongoing and will be scaled with increasing resources made available. AGM, OGS, ESD, and CCE are implementation leads and main partners in this strategy. This strategy speaks directly to the support of diverse farm operations including BIPOC, women, LGBTQIA+, low income, veteran, and beginning farmers, the CJWG should be supportive of the goals of this strategy.

### Components of the Strategy

- **Expand procurement programs for New York products:** AGM, OGS, and ESD should expand existing programs in the State that support local procurement of New York agricultural products (such as the Fresh Connect Checks Program, Farmers Market Nutrition Program, Farm-to- School, and Nourish NY).
- **Increase engagement and participation in State programs:** AGM, New York State Council on Hunger and Food Policy, and ESD should engage with communities and producers to advertise these opportunities.
- **Expand education and outreach for new farmers:** AGM and CCE should expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling.
- **Support new agricultural products:** The State, led by AGM, should help expand supply chain development for new agricultural products in New York such as maple and other agroforestry products.

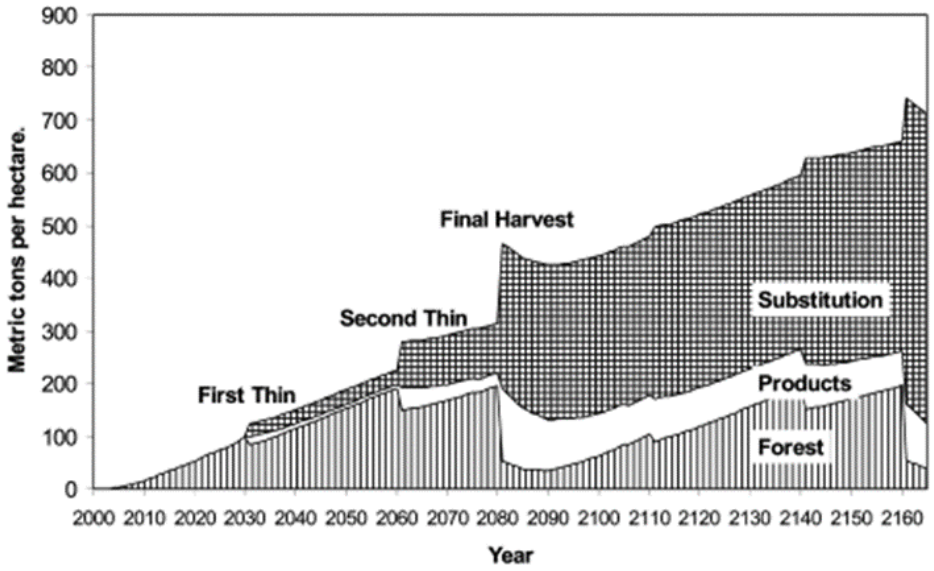
## *Climate-Focused Bioeconomy*

The bioeconomy is the part of an economy that produces sustainable, renewable bio-based feedstocks, rather than fossil fuel-based feedstocks, to produce products that achieve the climate and social justice requirements of the Climate Act. New York's forest product industry produces a diverse range of products and jobs. New York's forests and wood products industries are directly responsible for nearly 40,000 well-paying jobs and more than $13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly $10 billion of economic activity.[209] In addition, there is an opportunity for enhanced carbon storage as long-term, durable wood products store carbon. Furthermore, substitution of

[209] New York State Department of Environmental Conservation. 2020. New York State Forest Action Plan. Albany. 144p. Accessed at https://www.dec.ny.gov/docs/lands_forests_pdf/nysfap.pdf.

wood products for fossil fuel based and fossil fuel-intensive products displaces GHG emissions, such as in housing construction[210] (see Figure 24).

**Figure 24. Carbon in Forests, Wood Products, and Concrete Substitution Benefits**




*Source:* Perez-Garcia, J., B. Lippke, J. Comnick, and C. Manriquez. 2005. An assessment of carbon pools, storage, and wood products market substitution using life-cycle analysis results. Wood and Fiber Science 37: 140–148.

However, there has been a decline in the number and diversity of primary wood products manufactured directly from logs such as paper, veneer, pallets, boards, and firewood over the last two decades, which has limited management options for forest landowners. To expand the wood products industry to store more carbon and facilitate sustainable forest management, additional wood product markets, further use of wood feedstock and residues, and more training is needed in these industries.

### *AF18. Develop Forestry Training Programs to Support Expanding Workforce and Climate Knowledge*

As additional wood product markets and expansion of afforestation, reforestation, and other forest management efforts to enhance the long-term storage of carbon increase, an expansion in New York's forestry workforce will be needed. To help encourage this, information on forest carbon management and climate resilience needs to be incorporated into existing forestry trainings and education programs. Additionally, training programs focused on carbon sequestration, carbon storage, wood product development, and other carbon and climate-related areas need to be developed and promoted within the

[210] Perez-Garcia, J., B. Lippke, J. Comnick, and C. Manriquez. 2005. An assessment of carbon pools, storage, and wood products market substitution using life-cycle analysis results. Wood and Fiber Science 37: 140–148.

forestry sector to meet ongoing new demands. Information presented by existing programs will need to be aligned based on BMPs.

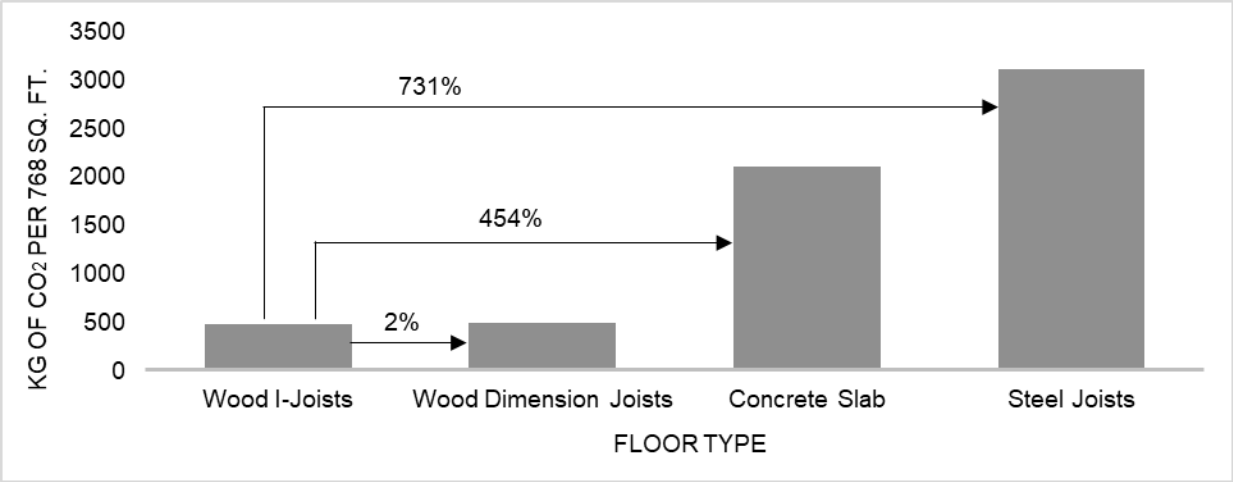
### Components of the Strategy

- **Support workforce development and training:** WPDC should develop and support workforce development and training programs for the forest sector, including incorporating forest carbon management into curriculums at the high school (such as the Boards of Cooperative Education Services) and college level and supporting existing training apprenticeship programs for careers in forestry and the forest product supply chain.
- **Integrate forest carbon into education and outreach:** DEC should integrate and support forest carbon, forest carbon management, climate change, and climate resilience into existing forestry training and continuing education programs.
    - **Enhance cooperating consulting forester policy:** DEC should add a requirement for continuing education in forest carbon or forest carbon management to Cooperating Consulting Forest Policy, CP-36, and approve rigor and accountability of the program.
    - **Integrate forest carbon management:** DEC should integrate forest carbon and forest carbon management into urban forestry and utility forestry training programs.
    - **Bolster Logger Training:** DEC and New York Logger Training should bolster support for the Trained Logger Certification Program and implement new training modules including forest carbon BMPs into the Trained Logger Certification program, including increasing carbon sequestration.
- **Lower fee:** The State should enact legislation to lower the initial fee or provide cost share dollars for forestry workers to obtain their New York State Pesticide Applicator's license.
- **Provide outreach and education:** SUNY ESF and Cornell CALS should provide outreach and education to the construction industry and public on mass timber construction and use of harvested wood products (fire safety, high-rise applications).

## *AF19. Expand Markets for Sustainably Harvested Durable Wood Products*

Use of durable, long-lasting wood products especially as a substitution for fossil fuel intensive products like steel, concrete, brick, or vinyl can reduce overall emissions for construction projects. Use of long lasting, durable wood products can reduce GHG emissions when they replace fossil fuel-based products, as illustrated in Figure 25.

**Figure 25. GWP per Floor Component**




*Source adapted from:* Lippke, B., and L. Edmonds. 2006. Environmental performance improvements in residential construction: The impact of products, biofuels, and processes. Forest Products Journal 56(10):58–63.

These products reduce net building and infrastructure GHG emissions and provide long duration carbon storage. In addition to substituting emissions for fossil fuel intensive products, use of wood products benefits forest landowners and provides an economic driver for conservation of forests. The use of high value timber for long lasting products should occur in areas it would be most beneficial to advance forest health and forest carbon sequestration. Execution of and carbon impacts from the components listed below is expected to take five or more years so implementation of these components should begin as soon as possible to help reach long-term carbon sequestration goals.

## Components of the Strategy

- **Promote carbon sequestrating materials:** SUNY ESF and WPDC should promote carbon sequestering materials that are substitutes for energy efficiency materials that are fossil fuel based (such as hemp insulation replacing foams and research potential on uses for residues from hemp product creation).
- **Advance building code changes:** DOS and the New York City Department of Buildings should advance building code changes to adopt the International Code Council 2021 International Building Code.
- **Develop standards:** NYSERDA should work with SUNY ESF and Cornell CALS to set standards and specifications for a minimum portion of harvested wood products, such as mass timber or wood flooring, in new construction in certain State-funded/supported buildings and infrastructure projects when New York supply chain can cost effectively meet the demand.

- **Revise State procurement standards:** OGS, DEC, GreenNY, and DASNY should revise State procurement specifications that limit the eligibility of wood products that meet the technical performance standards and set minimum standards for use of wood products in new State-funded construction and infrastructure projects as feasible.
- **Remove barriers:** DOT, DEC, PANYNJ, and EFC should remove barriers and create incentives for using wood for infrastructure applications, including bridges, sound barriers, transportation hubs, utility poles, marine and foundation pilings, retaining walls, docks, and piers.
- **Enhance supply chain:** NYSERDA, SUNY ESF, and Cornell CALS should enhance New York State supply chain for harvested wood products; fund innovation to develop mass timber applications using northern hardwoods.
- **Support research:** NYSERDA, DEC, AGM, SUNY ESF, and Cornell CALS should support research and development demonstration, and technology transfer of wood utilization and wood innovations to scale the use and climate benefits of wood in the built environment.

### *AF20. Develop a Sustainable Biomass Feedstock Action Plan and Expand the Use of Bioenergy Products*

Wood-based bioenergy products such as ethanol, bio-oil, syngas, charcoal, pellets, and briquettes can be used to substitute for fossil fuel products like coal, natural gas, gasoline, diesel oil, fuel oil for heating and cooling, and transportation fuels. Use of these bioenergy products can reduce GHG emissions from long-distance transportation and fossil fuel combustion and improve environmental quality—especially if bioenergy products are developed from wood residues, waste materials, and processing. A Sustainable Biomass Feedstock Action Plan will identify feedstock volumes and production methods that utilize New York State biomass resources in a sustainable, sequestration maximizing manner to create replacements for hard to decarbonize processes while considering other uses for these feedstocks (see recommendation on low-carbon product development). Fuel derived from biomass will likely have a limited but strategic role in New York's 2030 and 2050 needs. The CJWG expressed concerns about the combustion of biomass and biofuels due to their release of emissions. Strategies related to the use of biomass and biofuels are included in this strategy because of the value they provide for displacing carbon emitted from traditional fossil fuels and the potential use for some hard-to-replace carbon emission sources. Biomass and biofuel emission concerns raised by the CJWG are addressed through sustainability guidelines and standards presented in the components below.

### Components of the Strategy

- **Develop sustainability guidelines:** NYSERDA, AGM, and DEC should establish rigorous energy, GHG, and environmental sustainability guidelines and metrics for bioenergy products.
- **Define sustainable feedstocks:** NYSERDA should define sustainable feedstock production for bio-based processing to determine feedstock volume and practices that maximize sequestration, part of biomass action plan.
- **Incentivize residue feedstock use:** NYSERDA, AGM, and DEC should work with SUNY ESF and Cornell CALS to establish preferential pricing to prioritize use of feedstocks that are residues from existing agricultural, forest, and waste systems.
- **Evaluate underused lands for productivity:** DEC and AGM should assess and activate former agricultural and underused lands (including former industrial lands) for more productive uses, one of which could be purpose-grown biomass.
- **Research cost effectiveness:** DEC and AGM should work with SUNY ESF and Cornell CALS to research the most cost-effective methods of using trees and short rotation woody crops (such as shrub willow and miscanthus) to sequester carbon on marginal lands.
- **Develop net-zero energy systems:** NYSERDA and DPS should develop energy systems that can best support a net-zero carbon economy in New York, including programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products
- **Identify efficient bioenergy pathways:** NYSERDA should work with Cornell CALS and SUNY ESF to identify bioenergy pathways with high lifecycle energy efficiency and high emissions reductions (from land-harvest, conversion, and delivery to the end user) that replace fossil fuels and complement next generation energy delivery systems
- **Address hard to decarbonize fuel needs:** NYSERDA and DPS should work with SUNY ESF and Cornell CALS to identify 2050 hard to decarbonize fuel needs (such as high-quality distillate jet fuels) and incentivize appropriate bioenergy development (feedstock supply chain, conversion systems, and end use markets) to meet these needs.

## *AF21. Increase Market Access for New York Low-Carbon Products*

Emerging low-carbon products could be used to substitute for fossil fuel products and fossil fuel-based products to reduce overall GHG emissions—especially for products that are hard to electrify. However, production capabilities for low-carbon products are lacking in the Northeast and additional defining, monitoring of markets, research, and education are needed for use and promotion of these products.

Efforts would take many years before implementation, and monitoring and promotion would need to be ongoing.

### Components of the Strategy

- **Track low-carbon product market:** ESD and NYSERDA should begin tracking and reporting on this market to spot emerging trends, innovative applications, external market opportunities, growth opportunities to guide the development.
- **Incentivize innovation:** ESD should spur innovation through lead by example in low-carbon procurement requirements for State government (such as bio-based products and low-carbon concrete).
- **Identify substitutes that can be used now:** NYSERDA should commence a technology readiness level analysis of low-carbon substitutes for fossil fuel-based products and fuels; Identify the high value products from bio-based processing of New York grown feedstocks and invest in production facilities.
- **Incentivize low-carbon products:** NYSERDA should provide strategic use of incentives to drive scale-up of high-demand products when the low-carbon alternative is not yet cost competitive with the fossil fuel-based option.
- **Define standards for low-carbon products:** DFS, NYGB, and ESD should develop standards and guidelines for defining a low-carbon product, including ensuring sustainable feedstock production (biomass action plan).
- **Incentivize existing businesses:** NYSERDA, ESD, and DFS should expand access to low interest loans or grants for existing New York State businesses to develop new low-carbon products lines by educating local banks on emerging biotechnologies and offering NY Green Bank loan guarantees.
- **Connect suppliers to corporations:** NYSERDA should create a low-carbon products portal to facilitate connecting New York State producers to corporations and other buyers that have made GHG emissions reduction commitments, expand the NY Grown program to cover more products and adding a low-carbon aspect to this program.
- **Expand agroforestry forest products:** AGM should help to expand production of high-value agroforestry products that contribute to maintaining healthy forests (sap/syrup production, nuts, mushroom cultivation, and ginseng production).
- **Provide education and outreach:** DEC, AGM, with ESF should enhance the public's understanding of the bioeconomy and its role in reducing GHG emissions.

- **Develop strategies for hard to electrify applications:** NYSERDA and DEC should develop low-carbon fuel strategies for hard to electrify applications.
- **Build buyer confidence:** NYSERDA should provide consumer and business-to-business education on bio-based products and low-carbon products, build buyer confidence.

### *AF22. Provide Financial and Technical Assistance for Low-Carbon Product Development*

In addition to State support for increasing market access, financial and technical assistance is needed to grow bioprocessing industries for low-carbon products from low-grade wood and other biomass residuals to create bio-based substitutes for fossil fuel-based products. This assistance must also include an evaluation for any potential emissions of co-pollutants from these processes and measures to reduce or avoid those emissions. Providing this assistance will ensure this strategy mitigates GHG emissions without unintentionally emitting co-pollutants.

#### Components of the Strategy

- **Quantify bioprocessing investments:** NYSERDA should develop criteria for qualifying near-term bioprocessing capacity investments.
- **Promote high value outputs:** NYSERDA, DTF, and ESD should provide financial and technical initiatives to identify and promote the high value outputs from New York bioprocessing inputs.
- **Attract bioprocessing and bio-based products to the State:** ESD should create an economic development initiative focused on attracting bioprocessing/bio-based product businesses to New York State.
- **Incentivize low grade feedstocks:** DEC and AGM should have preferential pricing for in-State low grade feedstocks that maximize carbon sequestration (organic waste streams, wood residues, marginal land).
- **Invest in conversion technology:** NYSERDA and the Green Bank should develop programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products.

### *AF23. Advance Bio-Based Products Research Development and Demonstration*

Bio-based products have the potential to replace fossil fuel and fossil fuel-based products, including hard-to-decarbonize uses, to lower GHG emissions. Currently, incentives are required to make bio-based and low-carbon products economically competitive for use by industries. In addition, there is a potential for improved efficiency in bio-based and low-carbon products and further development of new products. To

drive research and development, this strategy recommends developing a demonstration and pilot project portfolio to drive investment in the areas of biobased low-carbon fuels, products, and related sequestration that considers intersection of industrial or manufacturing, agriculture, transportation, and power generation sectors and funding innovation challenges and projects that can scale beyond business as usual to provide GHG emissions reduction benefits. These strategies are not currently underway in New York and it is expected to take several years to develop products and complete research activities. Research must quantify criteria pollutant emissions, ecosystem services, and bioremediation potential of deep decarbonization and net sequestration pathways analyzed under roadmap. This will enable pathways that contribute to improvements in these areas to be considered for pilot funding.

### Components of Strategy

- **Determine product gaps:** NYSERDA, with SUNY ESF and Cornell, should develop a research agenda scope for bio-based products by compiling a list of existing products and product efficiencies and evaluating these for gaps and potential improvements
- **Solicit demonstration projects:** NYSERDA should develop solicitation to perform research and identify promising pilot/demonstration projects.
- **Fund demonstration projects:** NYSERDA should fund research and pilot/demonstration projects identified in the research agenda scope as listed in the component above.

## *AF24. Advance Deployment of Net Negative Carbon Dioxide Removal*

Carbon dioxide removal (CDR) pathways create a negative emissions profile for bioeconomy products and other economic sectors (long duration carbon storage beyond net zero), helping to ensure that replacement of fossil fuel and fossil fuel-based products results in lowered GHG emissions. Net negative CDR can provide permanent storage of atmospheric carbon.

Many CDR feedstocks (such as agricultural waste and dedicated energy crops) provide ecosystem and bioremediation services during growth. CDR technology biochar is being used in the western U.S. to remove residual waste products from forest thinning to reduce wildfire risk, and shows promise for urban organics management, or as a replacement for fly ash in concrete. However, CDR biochar has not been widely used in the northeastern forests and may be the most useful in ecosystems that need to have residual wood removed due to high wildfire risk. Carbon capture directly from the atmosphere is currently extremely expensive and, as such is not widely used. Several years will be needed for DEC and NYSERDA, with assistance from SUNY ESF and Cornell, to begin to set up standards, identify CDR technologies and pathways, and identify research and development priorities.

### Components of Strategy

- **Set goals and standards for $CO_2$ removal:** NYSERDA and DEC should set clear goals and standards regarding the need for net negative removal, evaluate solutions viable today and monitor solutions that could be viable in the future.
- **Identify CDR technologies:** NYSERDA with SUNY ESF should support the identification of verifiable and maintainable CDR technologies and pathways, such as direct chemical carbon capture and CDR options for biomass energy generation (biochar, capture and storage).
- **Prioritize research needs:** NYSERDA and DEC with SUNY ESF and Cornell should develop RD&D agenda and priorities, Initial work to focus on nature-based CDR pathways while examining the role of technology-based pathways in the future.
- **Fund demonstration projects:** NYSERDA should fund demonstration projects of CDR technologies, such as such as direct chemical carbon capture and CDR options for biomass energy generation (biochar, capture and storage) to show the GHG benefits of these techniques over the lifecycle of projects.

# Chapter 16. Waste

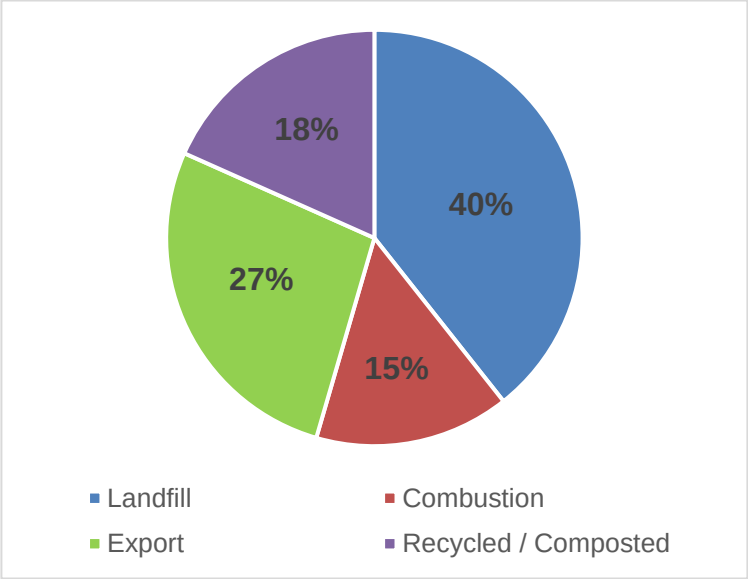
## 16.1 State of the Sector

### *Overview*

The waste management sector, for the purposes of the climate analysis, includes all aspects of materials management and wastewater treatment. Materials management includes waste reduction, reuse, recycling (including organics recycling), combustion, and landfilling. In New York, more than 18 million tons of municipal solid waste (MSW) is generated each year, or 1,850 pounds for every person that lives in the State.

MSW generated in New York is managed through recycling (including composting and other organics recycling), combustion, landfilling in-State, and export for landfilling or combustion out-of-State. As outlined in Figure 26, 18% of the MSW generated was recycled, 15% combusted, 40% landfilled in New York, and 27% was exported to other states for landfilling or combustion in 2018.

**Figure 26. End Use of MSW Generated in New York (2018)**




| MSW Destination | Tons (2018) |
|---|---|
| Landfill | 7,174,868 |
| Combustion | 2,764,004 |
| Export | 4,954,487 |
| Recycled/Composted | 3,341,051 |
| Total MSW Generated | 18,234,411 |

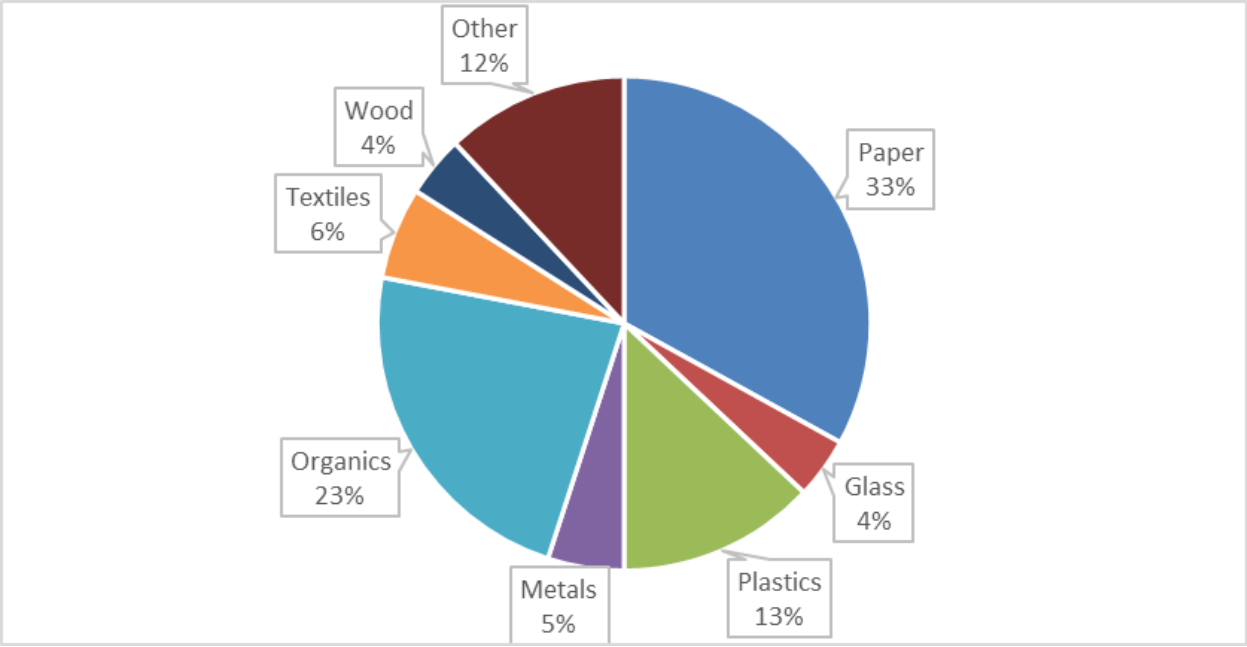
*Source:* DEC Solid Waste Annual Report.

To manage the MSW generated and handled in New York, many facilities are needed. There are a variety of facilities found in the State, including MSW and industrial landfills; combustors; recycling facilities, including organics and recyclables handling, and recovery facilities; construction and demolition debris handling and recovery facilities; and transfer facilities.

The number of MSW landfills has dropped significantly since 1988 and has remained roughly consistent since 2000. In the past, MSW landfills were smaller, local, and less complex. Modern landfills tend to be regional and are sophisticated engineered structures. While many New York State communities dispose of their waste within the State, a significant amount of waste is transported for disposal across State borders, both out of and into the State. The flow of waste is influenced by economic and market forces as well as regulatory and policy directives. However, movement of waste across State borders is considered interstate commerce and is therefore governed by federal authority under the U.S. Constitution. Congress has considered legislation that would allow states to constrain the movement of waste from other states, but no such laws have passed. In the absence of action on the federal level, the export and import of waste across State borders is expected to continue.

In addition to the quantity of waste generated and how it is managed, the characteristics of the waste stream itself have a major impact on possible climate change impacts. The MSW waste stream in New York is depicted in Figure 27.

**Figure 27. MSW Generated – Material Composition**




*Source:* Beyond Waste (DEC).

Municipally owned wastewater treatment plants (water resource recovery facilities) perform a critical function in protecting water quality. There are 612 publicly owned treatment works (i.e., wastewater treatment facilities) that are owned by public entities, in New York that serve 1,610 municipalities. The total design flow for all facilities is approximately 3,800 million gallons per day (mgd), while the reported

actual flow rate is approximately 2,400 mgd. Over 70% of the facilities report actual flow rates that are less than 1 mgd. The facilities range in size from New York City's vast system that processes 1.3 billion gallons of wastewater per day through 14 facilities, to small village systems that process less than 100,000 gallons per day.[211]

According to EPA, on a life-cycle basis, 42% of the national GHG inventory is influenced by the energy and fuel consumed in the production, use and management of the materials that become waste.[212]

**Emissions Overview**

GHG emissions from the waste sector represent about 12% of statewide emissions, including landfills (78%), waste combustion (7%), and wastewater treatment (15%). Most of these emissions represent the long-term decay of organic materials buried in a landfill, which will continue to emit methane at a significant rate for more than 30 years. It also represents both waste landfilling in New York and waste export to landfills in other states.

The most obvious and well-documented contribution to GHG emissions from the management of waste is from the uncaptured emissions of methane from landfills. As organic materials break down in a landfill's anaerobic environment, they generate methane, a GHG 84 times more potent than $CO_2$ (20-year GWP basis). MSW landfills in New York have gas collection systems in place that greatly reduce emissions, but gases still escape through the landfill cap and leak during the active placement of waste. In addition to landfills, there are other waste handling practices that produce GHG emissions, including combustion and anaerobic digestion. Although anaerobic digestion is recognized as a method for recycling organic waste, if there are leaks from the gas handling system methane can be lost to the atmosphere. Wastewater treatment plants have GHG emissions through wastewater processing systems and from anaerobic digesters (if present).

Greenhouse implications of waste go beyond waste handling considerations. More than 70% of municipal waste is made up of discarded products and packaging, the production, distribution, and disposition of which generate emissions. Every step of the process—mining, harvesting, manufacturing, and distribution—consumes energy and generates pollution. Thus, to the extent that waste can be reduced

[211] New York State Department of Environmental Conservation. 2018. Biosolids Management in New York State. Albany. Accessed at https://www.dec.ny.gov/docs/materials_minerals_pdf/bsmgmt2015.pdf.

[212] U.S. Environmental Protection Agency. 2009. Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices.

through extended use of products and materials and through various recovery strategies, they will not have to be replaced with new materials requiring an equivalent demand on resources and the environment.

The lifecycle impacts of waste are described in EPA's report, *Solid Waste Management and Greenhouse Gases: A Life Cycle Assessment of Emissions and Sinks*. For many wastes, the materials in the waste represent what is left over after a long series of steps, including extraction and processing of raw materials, product manufacturing, transportation of materials, consumer use, and waste management.

The most significant GHG emissions impact during the lifecycle of products and packaging result not from disposal, but production of the products and packaging that eventually become waste. According to the U.S. Department of Energy's Energy Information Administration, industry worldwide uses more than 50% of the energy consumed.

Waste prevention and recycling can significantly reduce industrial energy consumption. For example, a lifecycle study on the paper industry found that recycling paper and using that recycled paper in production reduces the greenhouse impacts of paper manufacturing by two to six times (depending on the paper grade) as compared to virgin manufacturing and landfilling or combustion. Using recycled materials in paper production can also reduce demand for virgin timber, conserving trees that absorb $CO_2$. The potential for positive impacts of material recovery and reuse in the metals industry is even greater. When manufacturing aluminum, 95% of the GHG emissions can be avoided by substituting scrap vehicle aluminum for virgin feedstock.[213] The GHG emissions reductions related to manufacturing with recycled materials in place of virgin are so substantial that the GHG emissions from transportation of materials for recycling are not a significant factor in the overall carbon footprint of recycling.

There are significant opportunities to reduce or avoid GHG emissions by improving both materials themselves and our materials management practices. Strategies to do this are discussed later in this chapter.

### *Vision for 2030*

For solid waste management and water resource recovery facilities (WRRFs), the major contributors to emissions are associated with landfill emissions, though sources are also found at WRRFs and other

[213] The International Aluminum Institute, "Sustainability," Aluminum for Future Generations, Accessed November 2021, https://recycling.world-aluminium.org/review/sustainability/.

facilities. To reduce emissions to achieve the required 2030 GHG emission reductions, significant increased diversion from landfills as well as emissions monitoring and leak reduction will be needed.

### *Vision for 2050*

The Climate Act requires a more dramatic decrease in GHG emissions by 2050, achieving at least an 85% reduction (compared to 1990 levels). For solid waste and WRRFs, this necessitates a dramatic shift in the way waste is managed, to the point that landfills are only used sparingly for specific waste streams, and reduction and recycling are robust and ubiquitous. Also, methods to monitor leaks and emissions are well developed and implemented, and those emissions are significantly reduced.

### *Existing Sectoral Mitigation Strategies*

In 1988, the Solid Waste Management Act (Section 27-0106 of the ECL) established in law the preferred hierarchy of solid waste management. The hierarchy established the following priorities to guide the programs and decisions of DEC and other State agencies:

- First, to reduce the amount of solid waste generated;
- Second, to reuse material for the purpose for which it was originally intended or to recycle the material that cannot be reused;
- Third, to recover, in an environmentally acceptable manner, energy from solid waste that cannot be economically and technically reused or recycled; and
- Fourth, to dispose of solid waste that is not being reused or recycled, or from which energy is not being recovered, by land burial or other methods approved by the department.

In addition to the hierarchy, the Solid Waste Management Act established:

- Structure and expectations for regional solid waste management planning units to encourage regional cooperation;
- Requirements and funding for local solid waste management plans in accordance with the hierarchy of solid waste management methods;
- A mandate that municipalities adopt and implement source separation laws or ordinances for recyclables from all generating sectors by 9/1/92 (less than five years from enactment); and
- DEC's role in fulfilling these requirements.

The Solid Waste Management Act's requirements were intended to ensure that both State and local governments work actively toward establishing environmentally sound solid waste management systems

that integrate the hierarchy of solid waste management methods and emphasize waste reduction and recycling, using landfills only for materials that could not be managed in a more productive way.

Since the enactment of the Solid Waste Management Act, businesses, municipalities, and individuals have embraced recycling and have built infrastructure and systems to further these efforts. In recent years, many businesses have developed formal sustainability goals and programs. These efforts are encouraged and envisioned to continue, but there are limitations to their ability to succeed without dramatic changes to materials management systems.

To enhance waste reduction, reuse, and recycling programs, DEC has initiated a number of actions, including grants, product stewardship, organics recycling, education initiatives, and others.

### Grants

The Municipal Waste Reduction and Recycling (MWRR) Program, funded by the Environmental Protection Fund (EPF), is the financial backbone of municipal recycling infrastructure in New York, with $83.5 million allocated since 2010. The MWRR program provides a recycling grant program for municipalities that covers equipment, recycling coordinator salaries, education, outreach, and planning projects, and household hazardous waste collection.

### Product Stewardship

The New York State Electronic Equipment Recycling & Reuse Act (E-waste Law) was signed into law on May 28, 2010. The E-waste Law requires manufacturers who sell or offer for sale covered electronic equipment (such as computers, computer peripherals, televisions, small scale servers, and small electronic equipment) in the State to register their brands of covered electronic equipment with DEC, and establish a convenient acceptance program for the collection, handling, and recycling or reuse of electronic waste, free of charge to most consumers.

From April 2011 through December 2018, over 725 million lbs of electronic waste from New York consumers were sent for recycling or reuse, rather than being sent to landfills, waste combustion facilities or other improper disposal methods. In addition to electronic waste, New York has programs that require manufacturers to collect and recycle rechargeable batteries, retailers to incentivize lead battery return, and manufacturers to collect and manage mercury thermostats, requirements to collect and recycle post-consumer paint, and to recycle cell phones.

### Green Products

The procurement of green products by government entities can drive the market for products made with recycled content and reduce waste. Through the GreenNY initiative, New York leverages tremendous purchasing power to drive markets to produce products that utilize recycled content, generate less waste, and adhere to circular economy principles. The GreenNY initiative drives State procurement of green products.

With these State programs, purchasing green, post-consumer products are made easier and more accessible. OGS Procurement Services manages about 1,500 State purchasing contracts, many of which contain environmentally friendly products and services. The GreenNY initiative has established a total of 53 green procurement specifications covering approximately 94 different commodity, service, or technology products to be purchased by the State.

### New York State Bag Waste Reduction Act

In 2017, it was estimated that New Yorkers used 23 billion bags annually. As of March 1, 2020, all plastic carryout bags (other than an exempt bag) became banned from distribution by anyone required to collect New York sales tax. For sales that are tax exempt, plastic carry out bags are still not allowed to be distributed by anyone required to collect New York State sales tax (unless it is an exempt bag).[214]

### Outreach and Education

DEC initiated a number of outreach and education programs to enhance recycling. These include the Recycle Right NY campaign, using social media and other means to educate the public on recycling, the DEC Delivers platform to publicize information, education for students, and market development. To research ways to increase recycling, DEC is funding multiple State colleges to look at paper, glass, waste composition, public attitudes, and other aspects of recycling.

### Food Donation and Food Scraps Recycling Law

In 2019, New York passed the Food Donation and Food Scraps Recycling law. Effective January 1, 2022, large generators of food scraps (defined as generating an annual average of two tons per week or more) must donate edible food and recycle all remaining food scraps if they are within 25 miles of a viable

[214] ECL Article 27, Titles 27 and 28; 6 NYCRR Part 351.

organics recycler. In addition to the Law, DEC has implemented grants programs and multiple outreach efforts to increase food donation and food scraps recycling.[215]

### *Key Stakeholders*

Key stakeholders include environmental NGOs, municipalities, State agencies, emergency food relief organizations, businesses, solid waste management facilities, and solid waste transporters.

## 16.2 Key Sector Strategies

The key strategies within this sector are organized into three themes, as shown in Table 13.

**Table 13. Waste Sector Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Waste Reduction, Reuse, and Recycling | W1. Organic Waste Reduction and Recycling<br>W2. Waste Reduction, Reuse, and Recycling<br>W3. Extended Producer Responsibility / Product Stewardship<br>W4. WRRF Conversion<br>W5. Refrigerant Diversion |
| Fugitive Emissions Monitoring, Detection, and Reduction | W6. Reduce Fugitive Emissions from SWMFs<br>W7. Reduce Fugitive Emissions from WRRFs |
| End Markets and Biogas Utilization | W8. Recycling Markets<br>W9. Biogas Use |

### *Waste Reduction, Reuse, and Recycling*

Waste reduction, reuse, and recycling is critical to achieve the targets and goals of the Climate Act. The strategies described below are ambitious, fundamentally shifting the way New York currently produces, uses, and handles products and materials at end-of-life. Significant GHG impacts from this sector include the uncaptured emissions of methane from landfills, specifically from organic materials. There are also significant GHG impacts from the creation and distribution of products and packaging. Therefore, the following strategies are aimed at addressing the full lifecycle of materials and products from product creation to the beneficial use of materials that would have otherwise been wasted. For waste management facilities located in Disadvantaged Communities, reducing the volume of material handled and capturing methane reduces odors that significantly impact quality of life for those communities and pose potential health impacts. Reducing waste volumes will also reduce the need for transfer facilities and will reduce

[215] ECL Article 27, Title 22; 6 NYCRR Part 351.

truck traffic from waste hauling that can impact Disadvantaged Communities. The strategies recognize that combustion and landfilling of some components of the waste stream will continue beyond 2050, although the amount of material disposed will be dramatically reduced, and ultimately facilities needed for disposal will be few. The applicability of the zero-emission electricity requirement and the specifics of how it will be implemented after 2040 will be addressed by the PSC, including how waste combustion will be handled.

### *W1. Organic Waste Reduction and Recycling*

Reducing the disposal of organics, including food scraps, is key to reducing the methane and $CO_2$ emissions at landfills and combustion facilities. Food scraps make up 18% of the total MSW stream in New York. A portion of this is wholesome, edible food that should first be source-separated and provided to people in need. This can be achieved by introducing and implementing legislation, new regulations, and financial support statewide. Proven technologies exist and successful existing systems for managing these materials can be replicated, but there are challenges related to financial limitations, behavioral change, and logistics. The relatively low cost of landfilling (particularly in Western New York) makes recycling less attractive to both the private and municipal sectors. The development of infrastructure for additional organics recycling capacity and improving food donation systems is costly. However, when implemented correctly, these costs can be partially shifted from existing waste disposal costs. Economically viable markets must also exist for the soil amendments and other resultant products of organics recycling to make sustainable systems. The CJWG agrees that ending the disposal of food scraps and yard waste at landfills and incinerators is probably the single most important action the State can take to cut emissions from this sector. The CJWG recommends stronger programs to require major food generators, farms, supermarkets, restaurants and institutions like universities, hospitals to all develop sophisticated programs that transfer excess edible foods to local food banks and other programs designed to feed the hungry.

#### Components of the Strategy

- **Significantly reduce the disposal of organics:** The State should enact legislation to amend and expand the existing Food Donation and Food Scraps Recycling Law (2019) to phase in organics source-separation requirements, eventually ban combustion and landfilling of organics, and require a surcharge (fee per ton) on all waste generated in New York to provide financial support for reduction, reuse, and recycling.
- **Financial assistance:** The State should expand existing financial assistance programs, and use funding provided to implement the Climate Act, for emergency food relief organizations,

organics recycling facility infrastructure, municipalities, non-profits, and food scraps generators. This includes incentivizing public-private partnerships for organics recycling facility development.

- **Use existing organics models:** DEC and appropriate housing authorities should expand and replicate successful models of organics collection programs inclusive of multi-family buildings and public housing. The State should expand education and outreach for residents, schools, and generators of food scraps.
- **Simplify regulations:** DEC should simplify regulatory requirements through registrations versus permits and other actions, for co-location of solid waste infrastructure operation as well as siting for small-scale, non-profit facilities.
- **Requirements for local plans:** DEC should require local solid waste management planning units to emphasize food scraps recovery programs.
- **Facilitate research and development:** DEC should facilitate research for and development of recycling markets for organics/soil amendment products and end uses.

### *W2. Waste Reduction, Reuse, and Recycling*

Waste reduction, reuse, and recycling initiatives significantly reduce the methane and $CO_2$ emissions at landfills and combustion facilities by avoiding disposing of waste in the first place. Outside of direct State agency impact, municipalities and non-profit organizations are already implementing successful and replicable waste reduction, reuse, and recycling programs. However, having consistent and sufficient funding, staff, and technical support to establish and operate will lead to greater success. The CJWG is supportive of policies that reduce waste and encourage recycling. CJWG recommends convenient recycling collection programs throughout the State and that these programs receive adequate funding.

#### Components of the Strategy

- **Fee per ton on waste:** The State should enact legislation to establish a surcharge (fee per ton) on all waste generated in New York to provide financial support for reduction, reuse, and recycling.
- **Enact legislation:** The State should enact legislation requiring “By Request Only” policies for single-use products and require reusable/refillable options for consumer goods in retail stores.
- **Phase out single use packaging:** The State should enact legislation that supports the reduction and eventual elimination of single use packaged items for use in stores.
- **Container deposits:** The State should enact legislation to implement deposit container programs where feasible.

- **Support for local facilities:** The State should provide financial support from new funding provided to implement the Climate Act and other sources, for local reuse centers, material exchanges, and repair shops to move beyond volunteer-run operations.
- **Workforce development:** The State should support workforce development, job training and trade skills in repair, refurbishment, remanufacturing, recycling, and innovative materials reuse.
- **Textile recycling:** The State should implement comprehensive textile waste reduction and recycling programs.
- **Buildings solutions:** The State should expand and replicate successful models of recyclables collection and outreach programs inclusive of multi-family buildings and public housing and fund infrastructure development (such as eco-hubs) to increase access to reuse and recycling opportunities for multi-family housing and campuses.
- **Outreach:** The State should implement new and expand existing statewide campaigns for reduction, reuse, and recycling targeting New York residents and businesses and increase research collaborations and expand upon existing partnerships to improve outreach and education efforts. The State should also support peer-to-peer education and outreach campaigns in underperforming and BIPOC communities around reduction, reuse, and recycling.
- **Support municipalities:** The State should support coordination between local and regional municipalities to enhance regional recycling initiatives and provide funding to hire local enforcement officers for municipal recycling programs, encouraging cross-jurisdiction and multi-planning unit collaboration.
- **State procurement standards:** The State should enact legislation to require State procurement standards for recyclable products (such as textiles, paper, and packaged products).
- **Research and evaluation of current standards:** The State should evaluate the feasibility of requiring deposit-driven, universal restaurant reusables, evaluate the feasibility of requiring reusable shipping containers and padding to replace packaging material from online retailers, support innovative zero-waste product development and business projects, and support digital demand software and technologies to monitor and reduce over-production across all sectors.
- **Tool development:** The State should develop lifecycle analysis model and solid waste management decision making tool.

### *W3. Extended Producer Responsibility/Product Stewardship*

Enacting broad extended producer responsibility (EPR) or product stewardship requirements to cover end-of-life management of post-consumer products will allow the State to ensure their sustainable management. Successful EPR legislation and programs already exist in New York for beverage

containers, electronic waste, mercury thermostats, post-consumer paint, cell phones, pharmaceuticals, and rechargeable and lead-acid batteries. Products that could benefit from new EPR legislation include packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, and other methane-generating wastes. Paper and wood comprise more than a third of the waste stream and they will produce methane as they degrade in a landfill, so EPR and other means to recycle these materials are crucial. While it may require the development of additional infrastructure to collect and recycle additional materials, EPR strategies shift responsibility for the end-of-life management onto the producers and manufacturers of consumer goods and away from the general public. This also encourages sustainable product design and waste prevention measures higher up the product chain.

While opposed by some industries, legislation to create a framework for EPR, or individual legislation targeting products with the greatest GHG reduction impact, can significantly reduce these potent gases that are generated when consumer goods and packaging are disposed in landfills and at combustion facilities. Additionally, the end-of-life management of solar panels and large-scale batteries will become more of a concern as renewable energy technologies are implemented and grow. The CJWG is strongly supportive of policies focused on waste reduction and have expressed support for EPR, indicating that passage of an EPR bill should be a priority for addressing emissions from the waste sector.

### Components of the Strategy

- **Enact legislation:** The State should enact and implement new legislation that creates an EPR/product stewardship framework. Alternatively, individual legislation should be enacted targeting products with the greatest GHG impact (such as packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, batteries, appliances [especially those containing refrigerants], and mattresses).
- **Research end-of-life:** DEC should research end-of-life management for difficult to manage materials, such as solar panels.

## *W4. Water Resource Recovery Facility Conversion*

Transforming wastewater treatment plants from a waste disposal priority to WRRFs that emphasize the capture of beneficial products is a key component of the circular economy. WRRFs, which represent much of the existing capacity for organics materials management in New York, present tremendous opportunity for reducing GHG emissions. However, the funding for WRRFs is tied to municipal water and sewer rates, is generally constrained, and is largely dedicated to improving water quality, making it

difficult to self-fund beneficial reuse projects. Additionally, currently market conditions and regulations favor the landfilling of biosolids and digestate byproducts over beneficial reuse. Rising landfilling prices may push some municipalities to beneficially reuse naturally, but others that have agreements with local landfills and will require additional incentives to transition to recycling systems. Many municipalities are already working toward these goals and would benefit from additional State support.

Capital investments will be necessary to unlock the GHG emissions reduction potential of new resource recovery approaches and fully utilize the infrastructure as well as maintain a state-of-good-repair. Biogas and digestate products resulting from beneficial reuse can be valuable if markets are aligned with GHG emission reducing priorities, and incentivizing biogas production could reduce costly infrastructure upgrades at WRRFs. Existing treatment plants have high thermal demands to operate digesters used to stabilize sludge. Boilers and engines on site are often able to replace natural gas with a WRRF's own digester gas. Some facilities may be well situated to provide local communities and co-located facilities with limited but strategic quantities of biogas. The CJWG favors on-site use of biogas captured from waste management and that no significant new transmission infrastructure should be allowed to support additional biogas.

### Components of the Strategy

- **Beneficial use:** The State should support beneficial use of biosolids and renewable biogas, recognizing that water treatment process waste generation is unavoidable.
- **Optimize anerobic digestion:** The State should operate co-digestion programs at anaerobic digesters with existing capacity and include difficult to compost organics such as post-consumer food scraps and fats, oils, and grease.
- **Implement co-digestion:** The State should support increased pre-processing and de-packaging capacity throughout the State to capture more organic waste from products that are packaged, but are no longer suitable for public sale.
- **Research co-pollutants:** The State should evaluate the extent and impact of co-pollutants such as emerging contaminants.

## *W5. Refrigerant Diversion*

HFCs, widely used as refrigerants in appliances, are potent GHGs with very high GWPs. HFCs contained inside well-maintained appliance systems pose minimal threat to the environment, however 90% of fugitive emissions of these gases happen during end-of-life management of the appliance. Policies incentivizing the destruction of refrigerants at end-of-life would encourage the retirement of old, energy-

inefficient equipment so that these materials are not released to the atmosphere. These policies should be coupled with continued alternative refrigerant and system efficiency research and production.

An EPR program has the potential to be cost-effective and its impact easily quantified with reporting requirements. There are a wide range of manufacturers, products, and types of refrigerants used in new and existing appliances. Enforcement may be challenging due to the large number of facilities managing these end-of-life appliances, and there is currently a lack of comprehensive disposal data.

### Components of the Strategy

- **End of Life:** DEC should promulgate regulations requiring reclamation or destruction of refrigerants from appliances at end-of-life and institute requirements for verification and reporting. The Legislature should enact EPR legislation for refrigerant-containing appliances.
- **Appliance Servicing:** DEC should promulgate regulations banning the sale of virgin high GWP refrigerants for servicing with an exception for reclaimed refrigerants.
- **Reporting:** DEC should create a registry and reporting requirements (to track sales, stockpiles, and leaks) for large refrigeration and HVAC systems and refrigerant wholesalers and distributors.
- **Research:** DEC should research end-of-life management for various refrigerants and their alternatives.

## *Fugitive Emissions Monitoring, Detection, and Reduction*

The quantification of GHG impacts from fugitive emissions at solid waste management and WRRFs are currently under-reported and will vary based on several site-specific factors such as waste composition and facility design. Assessing these systems both during and beyond the active life of operation as well as minimizing/repairing equipment releasing fugitive emissions (leaks) can significantly reduce sector GHG emissions. The CJWG strongly supports controlling fugitive emissions from landfills, sewage plants and other methane sources as a critical step in reducing emissions from the waste sector.

## *W6. Reduce Fugitive Emissions from Solid Waste Management Facilities*

The anaerobic decomposition of organic materials in MSW landfills and digesters generate a combination of gases, predominately methane and $CO_2$. Existing regulations require landfills to install gas collection systems and provide continued monitoring well beyond the active life of the facility. Fugitive GHG emissions have also been detected at anaerobic digestion facilities from operation, malfunctioning flares, or gas management systems during the downtime or maintenance on the units, or from the storage of various undigested materials on-site. The current GHG emissions levels from these point sources can vary

significantly among individual facilities and are likely being under-reported (as shown in a study on California's methane super-emitters).[216] While monitoring technologies continue to improve, there are significant technological and financial limitations on the facilities and municipalities. The ability to accurately measure methane leakage is currently limited.

Identifying and reducing fugitive emissions of methane from landfills and anaerobic digesters through baseline measurement, increased monitoring, and engineering and regulatory programs can reduce leaks and provide facilities with comprehensive data on their operations.

### Components of the Strategy

- **Landfill gas capture:** DEC should enhance existing regulations for landfills to require installation of landfill gas collection systems sooner after waste placement and expand monitoring requirements beyond existing criteria
- **Enhanced landfill cover systems:** DEC should develop regulations for enhanced landfill covers to increase oxidation of methane, specialty landfill gas collectors for difficult to access areas, and gas dewatering to increase collection efficiency.
- **Maintenance:** DEC should improve maintenance on methane collection systems at anaerobic digesters.
- **Monitoring:** DEC should incorporate improved emissions monitoring programs, utilizing new technologies (such as drones).
- **Research:** DEC should research comprehensive landfill GHG emissions to evaluate monitoring techniques, quantify fugitive GHG emissions, and evaluate most appropriate uses for the gas during the transition to statewide electrification.

## *W7. Reduce Fugitive Emissions from Water Resource Recovery Facilities*

Similar to solid waste management facilities, comprehensive data on existing fugitive GHG emissions WRRFs is not available, and additional regulations and funding sources will be critical to address wastewater sector impacts. Wastewater infrastructure was not always designed to mitigate GHG emissions. Municipalities will need to measure and reduce GHG emissions from WRRFs, septic, and

[216] Duren, R.M., Thorpe, A.K., Foster, K.T. et al. California's methane super-emitters. Nature 575, 180–184 (2019). https://doi.org/10.1038/s41586-019-1720-3

sewer systems, which can be difficult without the proper equipment and training. There is very limited data currently available concerning the quantity of emissions from these facilities.

Where density and local conditions allow, septic tanks should be eliminated and converted to municipal sewer collection systems or advanced onsite treatments. Larger municipalities may be able to absorb some of these costs, but medium and smaller municipalities do not have the funding to accomplish this without State support. Total sewering costs will vary based on the availability and proximity of a local WRRF, local soil conditions, and other factors. Fortunately, some larger municipalities are already implementing these techniques and can provide guidance for others to replicate successful programs. Some communities have high septic costs because of soil conditions and may be willing to transition. Emissions from wastewater treatment plants lead to odors and potential health impacts which have a significant impact on neighboring communities. Prioritizing reducing these leaks in Disadvantaged Communities will improve air quality in these communities.

### Components of the Strategy

- **Capture and beneficially reuse fugitive biogas:** DEC, EFC, and NYSERDA should work with local utilities and municipalities to repair and consistently operate WRRF flares, boilers, engines, or other equipment on-site and evaluate captured biogas potential to identify strategic beneficial uses before flaring excess capacity. DEC should also require additional emissions monitoring regulations and oversight.
- **Monitoring:** DEC should perform emissions monitoring and updates at WRRFs and septic systems.
- **Ensure proper maintenance of septic systems at the municipal level:** The State should enact legislation to establish a municipal funding mechanism (paid for by homeowners) to allow contractual services for routine maintenance on septic systems.
- **Encouraging transition to sewer:** EFC should repurpose existing septic sewer assistance programs to include sewer hookups to defray high up-front costs of sewering.
- **Operator training:** The State should provide financial support and job training to wastewater system operators.
- **Research:** DEC should research nitrous oxide emissions profile of WRRFs.

## *Markets for Recovered Resources and Biogas Utilization*

The recycling industry needs viable and consistent markets to continue to capture the economic value of materials and promote them for their highest and best use. Support for domestic recycling facilities and

markets for the resulting recovered resources is critical in keeping the recycling strategies in this Plan financially feasible and easy to replicate.

While solid waste management and WRRFs are recommended to follow all other strategies in this draft Plan to achieve the maximum reduction, reuse, and recycling of waste, it is recognized that some wastes (including biosolids) are unavoidable. Additionally, the organic fraction of waste already disposed of in landfills will produce methane in-place for many years. Capturing these unavoidable gases for strategic and local use while the State transitions to electrification will help meet the goals of the Climate Act while avoiding future reliance on fossil fuels.

### *W8. Recycling Markets*

Some markets may exist currently, but the prices paid for secondary materials are rarely enough to sustain the cost of the collection and processing systems. Additionally, developing more local and regional opportunities for materials management can lessen the impact of global economic market fluctuations (such as China's National Sword policy).[217] In support of this market development work, New York has entered into contracts to fund SUNY research in overall domestic recycling markets development, plastics recycling research, and glass processing innovations. OGS implements existing green procurement rules to obtain recycled content materials at State agencies and ESD has previously assisted with funding recycling markets for materials such as glass and tires. Implementing additional funding resources for municipalities and implementing sound post-consumer content requirements across different sectors can make secondary material processing cost competitive with virgin materials, conserve resources, and reduce the GHG emissions impact from the disposal of otherwise recyclable materials. The CJWG are supportive of recycling programs that cut the need for virgin materials and reduce emissions from the manufacturing of consumer goods.

#### Components of the Strategy

- **Market development for recovered resources:** The State should support domestic recycling facilities and markets for recovered resources (including compost, digestate, and recycled aggregate/building deconstruction materials) and incentivize public-private partnerships for

[217] China's National Sword policy, first announced in 2017, implemented bans on the import of certain recyclable materials, including mixed plastics, unsorted mixed paper, and textiles, impacting global recycling markets.

recycling facility development. The State should also enact legislation to require a minimum level of recycled content in certain products and packaging.

- **Reuse of building materials:** DEC should provide financial assistance to research the increase of capture and reuse of building deconstruction materials and recovered aggregate. DEC should also change requirements (such as procurement standards and bid specifications) to include recycled or reused deconstruction materials.
- **Recyclables in green procurement:** DEC and OGS should enhance and implement new green procurement programs to require the use of recyclables (such as compost and construction aggregate) by State and local entities and those contracting with the government.
- **Production tax credit for recycled products:** The State should enact a production tax credit similar to the credit for clean energy systems, that is applied to companies that turn recycled materials into intermediate products, if they locate their facilities in New York.
- **Organics roadmap:** DEC should conduct a market study of the quantity and characteristics of organics (food waste, biosolids, other high strength waste) produced statewide, including possible end uses of such products (such as agriculture, mine reclamation, roadside soil amendments, and erosion control).

### *W9. Biogas Use*

During the implementation of aggressive waste reuse, reduction, and recycling techniques, it is recognized that some amount of waste generation will be unavoidable. Biogas generation from landfills and from anaerobic digestion will continue and a viable use for the biogas is needed. Determining limited and strategic best uses for energy produced from biogas derived from organic waste is needed. Assessing use in the waste transportation sector, electric co-location, or cogeneration opportunities for energy and heat intensive industries and hard to electrify users is an avenue for biogas use. End use should be focused on applications where no new gas transmission infrastructure will be needed. Alternative revenues at organics recycling facilities, such as biogas revenue, will allow lower tip fees to attract organics at competitive levels. Stable, enhanced energy revenue will attract investment to aggressively manage methane in existing disposal facilities and existing and new organics recycling facilities. The CJWG expressed that biogas could play a role in environmentally sound waste disposal, but caution should be taken to avoid biogas use intentionally or inadvertently leading to the extended use of fossil fuels.

#### Components of the Strategy

- **Strategic use of biogas:** NYSERDA and PSC, along with utilities, should evaluate strategic and local uses of generated fuels, electricity, or other energy produced from biogas for essential needs

during the transition to electrification and other low-emissions energy sources. This evaluation should stress the use of fuel cells for electricity in lieu of generators or pipeline use, fuel uses in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries, hard to electrify users, heat for buildings, and difficult to electrify medium- and heavy-duty transportation.

- **Funding for organics recycling infrastructure:** NYSERDA and PSC, along with utilities, should identify energy pricing models and conduct a market-based study for waste-generated biogas. The State should also provide a funding mechanism to support an organics recycling infrastructure.
- **Research:** DEC should complete a comprehensive landfill gas and WRRF emissions research study. The study should evaluate emissions monitoring techniques, quantify fugitive emissions, and evaluate the most appropriate uses for the gas during the transition to statewide electrification.

# Statewide and Cross-Sector Policies

# Chapter 17. Economy-Wide Strategies

## 17.1 Overview

Members of the Council have identified the value of a comprehensive policy that effectively prices GHG emissions. Such a policy could fulfill at least three purposes:

- It could serve as an overarching program to ensure collective statewide GHG emission reductions, as required by the Climate Act.[218]
- It could provide an additional source of funding to implement policies identified in this Plan, particularly policies that require State investment or State funding of incentive programs, including investments to benefit disadvantaged communities. Statewide support should be considered alongside other funding sources, including federal funding programs.
- It would provide a consistent market signal across all economic sectors to yield additional emission reductions as individuals and businesses make decisions that reduce their emissions, as well as support clean technology market development that could be fostered in the regional economy.

In addition, a well-designed program could support economic development and innovation in New York and reduce existing disproportionate burdens of GHG and other emissions in Disadvantaged Communities.

On the other hand, a poorly designed program could increase economic burdens on New Yorkers and New York businesses, reducing New York's competitiveness. If the purpose of setting a price on carbon is the means to achieve the emissions reductions of the Climate Act, the challenge in establishing a price on carbon is that it needs to be designed to bring about change in the market and promote equity, but in a way that does not unduly burden New Yorkers and create disadvantages to New York's competitive position—with other states, with the nation as a whole, or with the global economy.

This chapter identifies three options for public input: (1) a tax or fee establishing a carbon price, referred to as a *carbon pricing*; (2) a program that caps emissions across the economy, or within particular sectors, and allocates emissions primarily through an auction mechanism that provide revenues for investment,

[218] ECL § 75-0109.

known as *cap-and-invest*; and (3) a *clean energy supply standard*, which would require providers of liquid and gaseous fuels across the economy to reduce the carbon intensity of fuels they introduce into commerce. Both carbon pricing and a cap-and-invest program would charge the entity emitting GHGs for the pollution it produces, with a primary distinction being price certainty as compared to emission certainty, as described further below.

A carbon pricing program establishes the price per ton of GHG emissions that regulated entities would pay. Examples of carbon pricing include several proposals put forward by the New York State Legislature as well as a proposal from the NYISO for a fee on every ton of $CO_2$ emission from the electricity sector. Most carbon pricing proposals would likely have to be enacted by the Legislature, particularly to address how revenues may be appropriated. Establishing the level of the carbon price is a policy decision, balancing the level of reductions that would be achieved with the economic impacts of the price. One possible approach would be to base the price on the level expected to reduce emissions to match the Climate Act GHG emission limits. Doing so would require modeling to determine what prices are required to elicit consumer behavior changes that advance progress to the 2030 and 2050 GHG emission limits and the trajectory of the price needed to achieve those limits. This evaluation would also consider where the resulting revenues would be spent, which could include additional measures to reduce GHG or co-pollutant emissions or to provide other benefits to Disadvantaged Communities.

A cap-and-invest program would also price emissions, but indirectly as the price is established by the market based on the available supply of and demand for emission allowances, rather than directly by the government entity. It would require regulated entities to purchase emission allowances, usually at an auction, to match their emissions. The difference from carbon pricing, however, is emissions certainty. A cap-and-invest program would limit the number of allowances sold, with the available amount decreasing year-by-year to ensure that overall aggregate emissions decline. Instead of setting the price directly, the price would be set by the market. If there were more demand for allowances, market prices would increase, providing more revenues for investment in strategies that reduce emissions. Cap-and-invest programs have been implemented economy-wide in California and Quebec, and Washington also recently passed legislation to establish such a program. There are also sector-specific cap-and-invest programs such as RGGI, which covers emissions from the electricity sector and includes New York as a participant. DEC could promulgate regulations establishing a cap-and-invest program using its existing authority to adopt regulations that reduce emissions.

Both carbon pricing and cap-and-invest programs would provide a price signal stimulating lower emission choices and a source of funding for public investment and incentive programs. Both would likely regulate at least power plants and providers of fossil fuels for heating and transportation purposes. Both would be structured to comply with ECL § 75-0117, which requires that at least 35% of the overall benefits of spending be directed to Disadvantaged Communities, with a goal of at least 40%. But they have one fundamental difference: while both types of programs place a *charge* on emissions and *invest* the revenues, only a cap-and-invest program would implement an enforceable *cap* on emissions overall, which would operationalize the Climate Act's economy-wide limit on emissions. Carbon pricing would provide a revenue stream that could be used to support the multitude of needs identified in the Scoping Plan and would work in concert with the statutory emission reduction requirements of the Climate Act. The level at which the carbon price is set could impact the rate of achieving the emissions reductions requirements of the law.

The third approach of a clean energy supply standard is a type of policy known more generally as a tradeable performance standard. Under this model, each provider of liquid or gaseous fuels would be required to reduce the carbon intensity of the fuels provided over time. They can accomplish this by directly blending lower carbon renewable fuels or by acquiring credits from providers of electricity to displace the use of liquid or gaseous fuels. As more vehicles and buildings are electrified, the use of electricity as a transportation or heating fuel would generate credits for the providers of gaseous or liquid fuels to acquire. Eventually the carbon intensity performance standard could be reduced to zero, and all fossil fuels would be replaced by zero carbon energy sources.

## 17.2 Criteria for Evaluation

The Council has identified a number of considerations for evaluating the potential policy mechanisms:

- Would the policy ensure compliance with emission limits as required by ECL § 75-0109 (that is, does the policy provide legally binding emission certainty)?
- Would the policy provide price certainty?
- How would the policy prioritize emission reductions of GHGs and co-pollutants in Disadvantaged Communities and alleviate and prevent the formation of co-pollutant hotspots?
- Is there any difference between policy mechanisms in the sufficiency of funding or use of proceeds? Would each policy address a gap in other funding sources?
- How affordable would the policy be for average New Yorkers? Could it be designed to avoid regressive impacts?

- Could the policy be designed to minimize leakage or any economic disadvantage to the New York economy compared to the regional economy?
- How would the policy interact with other applicable regulatory standards?
- Should the policy be adopted economy-wide or for selected sectors? How would it be applied economy-wide?
- Is the policy equitable across regions of the State?
- Could the policy be designed to stimulate economic development and innovation?
- Could and should the policy integrate with regional policies like RGGI?

In addition, members of the Council have emphasized that an economy-wide program should not be considered in a vacuum. Instead, other policy initiatives or regulatory changes by various agencies may complement and facilitate the efficient and effective implementation of an economy-wide regulatory approach to reducing GHG emissions. In addition, the need for and scope of an economy-wide program may depend in part on the availability and sufficiency of federal funding appropriated by Congress, or on other federal emission reduction initiatives.

### *Certainty of Emission Reductions*

One benefit of a cap-and-invest program is that it caps and reduces emissions, providing legally binding emission certainty. Because an economy-wide cap can be set at a level corresponding with the Climate Act's emission limits, it can provide certainty that those emission limits will be met, while also providing a mechanism for State enforcement of such limits against individual GHG emission sources.

Although a carbon pricing program would likely reduce emissions, it would not ensure a particular level of emission reductions from all affected sources. The reductions achieved through imposing a price could vary based on multiple factors including market conditions, weather, technological developments, and the effect of other policies. If the price were set too low, the program might not yield the desired or required level of emission reductions, which could thereby necessitate additional enforceable regulatory actions by DEC to ensure compliance with the Climate Act. Greater certainty in the level of emission reductions can be achieved by including mechanisms to adjust the price upward or downward in response to emission reduction levels.

The inclusion of offset programs in some cap-and-invest programs, such as RGGI, has engendered some criticism, particularly from environmental justice organizations that contend that the availability of offsets reduces the certainty of emission reductions from the regulated sources. In any cap-and-invest program

adopted to meet Climate Act requirements, the role of offsets would have to be strictly limited or even prohibited in accordance with the requirements of ECL §75-0109(4). Therefore, offsets would have little if any role under a cap-and-invest program designed to comply with the Climate Act.

A clean energy supply standard would ensure a reduction in average emission intensity of the State's energy supply but, like carbon pricing, it would not limit the amount of energy used. Eventually, however, when the average carbon intensity approaches and reaches zero, it would provide certainty of near zero emissions.

### *Price Certainty*

Carbon pricing would provide the most price certainty, which would be beneficial for business and investor decision-making. Because renewable energy and other non-emitting energy sources would not bear the cost, potential investors in those technologies could calculate the market advantage attributable to the carbon price in making investment decisions. Likewise, an entity considering investing in emission-reducing technologies could calculate the savings that would result from those investments. Relatedly, the owner of an emitting source could use the certainty of the future price to make an informed decision about when the source would become uneconomic. The certainty of the future prices might also allow consumers to make more informed decisions.

Although a cap-and-invest program would not establish a firm price, measures could be implemented to provide some level of certainty: examples include establishing a minimum allowance price or an emission containment reserve under which fewer allowances were made available if prices are below a specified level, as provided by the RGGI program. Cap-and-invest programs could also include soft price ceilings to limit costs. RGGI, for example, includes a cost containment reserve mechanism that releases additional allowances at higher price levels. Depending on how these measures are structured, however, they might have the effect of reducing the certainty of achieving a desired emission level, such as compliance with the Climate Act's overall statewide emission limits.

A cap-and-invest program has the benefit of minimizing the costs associated with ensuring any specific level of GHG emission reductions. Where a government is implementing standards and other regulations to require emission reductions on a sectoral basis, or making investments to support emission reductions, the declining emissions result in a lower cost to the public for the cap-and-invest program. That has happened in the RGGI program, where complementary clean energy policies have led to reduced emissions, keeping allowance prices low even with a cap that declines substantially over time.

A clean energy supply standard would not establish a price per ton of carbon emissions. As with a cap-and-invest program, the market would establish the value of reductions in carbon intensity.

### *Prioritizing Emission Reductions and Avoiding Hotspots in Disadvantaged Communities*

The Climate Act requires the Scoping Plan to "identify measures to maximize reductions of both GHG emissions and co-pollutants in disadvantaged communities."[219] Likewise, DEC's regulations to achieve the statewide emission limits must "prioritize measures to maximize net reductions of GHGs and co-pollutants in disadvantaged communities."[220]

Although both carbon pricing and cap-and-invest programs have been designed primarily to achieve economy-wide reductions in GHGs, the investment of revenues or auction proceeds could be directed to reducing GHG and co-pollutant emissions in Disadvantaged Communities. Indeed, both would be subject to the Climate Act's goal of 40% of the benefits of clean energy investments flowing to Disadvantaged Communities. Either type of program could include mechanisms to ensure compliance with the Climate Act, including a process for obtaining input in investment decisions from Disadvantaged Communities.[221]

Hotspots occur when certain sources maintain or increase higher levels of co-pollutant emissions despite the reduction of economy-wide emissions. The CJWG has expressed opposition to New York's potential participation in the TCI program cap-and-invest program based on its position that such programs do not guarantee reductions at individual facilities, raising the potential for pollution hotspots. That criticism is equally applicable to carbon pricing, which would not impose emission limits on individual facilities or on statewide emissions overall.

Both types of programs could be designed to prevent the formation of hotspots by including program elements that discourage emissions in Disadvantaged Communities, in addition to prioritizing investments in those communities. Examples could be imposing a higher price on sources in those areas or requiring those sources to obtain extra allowances if they do not maintain a specified level of progress in reducing emissions. In the alternative, a cap-and-invest program could be structured to include

[219] ECL § 75-0103(14)(d).

[220] ECL § 75-0109(3)(d).

[221] ECL § 75-0117.

declining hard caps on sources located in disadvantaged communities. In addition, other DEC regulatory requirements limit emissions of criteria and toxic pollutants from individual facilities and vehicles.

Finally, in the case of a clean energy supply or other tradeable performance standard, it is possible that some providers of fuels for buildings and transportation would rely more heavily on acquiring credits from clean energy providers or other fuel providers that are over-complying. Because no revenues are being generated for public investment, the investments of revenues would not provide a mechanism for addressing any hotspots that would otherwise be created.

### *Affordability and Avoiding Regressive Impacts*

Because the regulated entities would likely pass on at least a portion of the program cost in the form of increased energy prices, the governmental entity would have to consider the economic impact on New York consumers in establishing the stringency of the programs. One concern often expressed about either pricing mechanism is the potential for regressive economic impacts, due to lower-income households spending a higher portion of their income on electricity, heating, and transportation fuel, which would all become more expensive if the resulting emissions bear a cost. Both carbon pricing and cap-and-invest policies could be designed to address those regressive impacts, such as with rebates funded by the revenues or other investments to reduce regressive impacts. In addition, a substantial portion of revenues under both types of programs would be directed to investment in Disadvantaged Communities in accordance with the Climate Act's requirement.[222]

It would be more difficult to mitigate any regressive impact of a clean fuel supply standard because no revenues are generated that could be used for rebates. Other programs, however, like New York's Weatherization Assistance Program, could mitigate price impacts to low-income New Yorkers.

### *Sufficiency of Funding and Use of Proceeds*

A carbon pricing program would provide government with more certainty regarding the revenues that will be available than a cap-and-invest program, allowing more certain budget decisions. The only variables causing some uncertainty regarding revenues would be the amount of emissions in any given year, which would decline over time, and any mechanisms included to increase emission certainty.

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[222] *Id.*

In a cap-and-invest program, the amount of allowances available is set, but a fairly small variation in demand for allowances due to weather, the economy, and bulk fuel prices can result in fairly substantial variations in allowance prices. In RGGI, for example, the price of allowances at auction increased approximately 79% from September 2019 to September 2021, after declining by around one-half between 2015 and 2017.[223] Variation in auction proceeds could be reduced somewhat in either direction by price containment measures discussed above.

Both types of programs could be designed to account for revenues from other sources, including federal funds available for investment. The amount of a carbon tax could be expressly calibrated to fill the gap remaining after considering the available federal funding. While that would not be possible with a cap-and-invest program designed to cap emissions at levels consistent with the Climate Act statewide limits, price containment measures could be structured accordingly, and any excess revenues could be returned to the public in the form of rebates.

A significant drawback of a clean energy supply standard is that it would provide no revenues to fund other Scoping Plan strategies.

### *Mitigating Risk of Leakage*

Both carbon pricing and cap-and-invest programs present the risk of emission leakage, which may differ among sectors or industries covered. For example, a carbon cap or price on electricity producers could lead to increased imports of electricity from outside the State, thereby increasing emissions outside New York, which must be included in calculating in-State emissions. On the other hand, a price on natural gas used for heating would not likely result in substantial leakage because buildings are not mobile. Including industries that are energy intensive and trade-exposed in either type of program poses the greatest risk of emission leakage.

The Climate Act requires programs to be designed to limit leakage. Policies have been considered and implemented elsewhere, however, that alleviate this risk by exempting certain industries from coverage or providing free allocation of allowances, sometime for only a multi-year phase-in period. Such allocation could be based on output and on benchmarking to an industry standard, thereby maintaining the incentive for these sources to reduce emissions. Other possibilities would be to include border carbon adjustments,

[223] See https://www.rggi.org/Auctions/Auction-Results/Prices-Volumes.

to the extent legally feasible, or to participate in multistate regional programs that may exist or be developed.

Although a clean energy supply standard may raise a similar risk of leakage, further evaluation and research would be needed to fully understand the dynamics. Partnering with neighboring states on such a standard would help to address any risks of leakage.

### *Consistency with Other Regulatory Programs*

Many of the regulatory programs recommended in this draft Scoping Plan that reduce emissions from covered sectors would complement the operation of economy-wide programs. Because a cap-and-invest program caps overall emissions, complementary regulatory measures would not result in additional reductions but would reduce the cost of meeting the cap by reducing demand for emission allowances. On the other hand, the level of a carbon price would not ordinarily vary depending on the emission reductions yielded by other programs. Therefore, the emissions reduced by a direct carbon price would be in addition to the emissions reductions from the regulatory standards. Of course, as those regulatory standards reduce emissions, the carbon price would be applied to a smaller amount of emissions, reducing revenues. As noted above, in the event a carbon price does not provide the required level of statewide emission reductions under the Climate Act, additional legally enforceable regulatory measures on certain source categories or sectors may be necessary.

Other regulatory standards would likely be complementary to a clean energy supply standard, resulting in additional emissions reductions, similar to carbon pricing.

### *Application Economy Wide or to Specific Sectors*

Each of these policy approaches could be designed to apply economy wide or just to specific sectors or source categories. An economy-wide approach would have the benefit of eliminating inefficient distortions between sectors subject to regulation. For example, in New York, the use of electricity as fuel for an EV is subject to a carbon price under RGGI, but other transportation fuels do not bear a carbon price. The Council could decide to exclude sectors subject to specific regulatory programs that are sufficient to ensure a specific level of emission reductions from those sectors. For example, it may not be necessary to include the electricity sector because the Climate Act's clean electricity requirements ensure emission reductions from the electricity sector, culminating in zero emissions from electricity generation electricity by 2040.

Other sectors or pollutants may be excluded because of the difficulty of regulation. For example, the difficulty in monitoring with certainty the methane emissions from farms or landfills may be a reason to exclude those source categories from the scope of a program, provided that some other regulatory mechanism is available to ensure emission reductions from these sources. It may be impractical to include other source categories, such as refrigerants used in cooling equipment, because of the number of potential regulated entities. Such source categories may be more amenable to performance standards than to programs that require determination of a specific emission level.

A clean energy supply standard would only limit emissions from energy generation, thus excluding most of the waste, agriculture, and forestry sectors. In addition, the electricity sector is already covered by the Clean Energy Standard. A clean energy supply standard would therefore primarily cover emissions from transportation, buildings, and industry.

### *Regional Equity*

Members of the Council have identified the need to ensure that an economy-wide program does not place a disproportionate burden on particular geographic portions of the State. This could occur, for example, if carbon-intensive sources are concentrated in portions of the State, if particular areas have less access to technologies to reduce GHG emissions, or if the residents of particular areas are more reliant on higher-carbon fossil fuels to meet their energy needs. Further analysis of the effect of any policy design, and methods to mitigate any adverse impacts, would need to be developed in the specific design of a particular program.

### *Supporting Economic Development and Innovation*

Economy-wide programs should be designed to support low-carbon economic development, to the extent possible. In general, a market-based approach would be expected to provide a competitive advantage to lower- or zero-carbon industrial operations or vehicle fleets using zero-emission technologies. Accordingly, a policy could have the effect of stimulating private investment in lower-carbon sources and technologies. In addition, auction proceeds or revenues could be invested in ways that support sustainable low-carbon economic development.

A clean energy supply standard may be most effective in stimulating private investment because the value of generating credits flows directly to the entities generating the credits. In California, the low-carbon fuel standard has effectively stimulated the reduction in carbon intensity of renewable fuels consumed.

### *Incorporating Multi-Jurisdiction Programs*

Participating in one or more multi-jurisdiction regional programs could have the benefit of assuring competitive neutrality across the region, reducing emission leakage, and, if New York's participation induces other states to participate, increasing the overall GHG emission reductions. Carbon pricing and cap-and-invest programs could be structured to accommodate regional sector-based programs like RGGI. One mechanism applicable to both types of programs would be to credit the cost of allowances under a regional program toward the payments under the State-specific program. In the alternative, compliance with a regional program could govern a particular sector in place of the State-specific program. A downside to participating in a multi-jurisdiction program, however, is that it would reduce the certainty of the emission reduction level in New York because New York sources could acquire allowances issued by other participating states. As mentioned above regarding leakage, a clean energy supply standard could be adopted on a regional basis.

## 17.3 Process Going Forward

The Council would plan to make recommendations in the final Scoping Plan after considering input from the public, additional analysis that may be undertaken, and the adequacy of federal and other funding sources. If the Council includes an economy-wide policy in the final Scoping Plan, it may make recommendations about the structure of the program:

- **Type of policy:** The Council would evaluate which approach is best targeted to ensure compliance with Climate Act statewide GHG emission limits and other Climate Act requirements, including benefits to Disadvantaged Communities from investments and maximizing co-pollutant reductions in such communities.
- **Level of ambition:** The Council would consider both meeting the GHG emission limits and associated costs and benefits.
- **Equity:** Consistent with the Climate Act, State agency investment decisions must ensure that at least 35%, with a goal of at least 40%, of the benefits of investments accrue to Disadvantaged Communities. The Council could consider recommending a process to obtain input from residents of Disadvantaged Communities in those investment decisions.
- **Sectors covered:** Each type of program could be designed to cover only a portion of economic sectors. Decisions about the scope of coverage could be informed by factors such as the level of reductions achieved by other policies applicable to that sector, the ease of determining sources' emissions in the sector, and the potential for competitive impacts and emission leakage.

- **Economic considerations and leakage:** The Council may recommend design elements to support innovation and have positive impacts on New York's economy while limiting leakage to the extent feasible.
- **Investment of revenues/proceeds:** The Council may include recommendations for how to invest proceeds to support goals of the Climate Act in addition to achieving equity. In addition to investing for the benefit of Disadvantaged Communities, potential strategies could be targeting investment to support sustainable economic development or alleviate disproportionate burdens in particular areas of the State.
- **Incorporating regional programs:** A decision on whether to incorporate a multi-jurisdiction regional program into the economy-wide approach may depend in part on the comparable stringency of the regional program, the competitive benefits of participating in a regional program (including impacts on emission leakage), and the degree to which participation in a regional program reduces the certainty that economy-wide emissions would comply with the Climate Act's GHG limits.
- **Complementary programs:** The Council may make recommendations regarding the adoption of programs that would complement and improve the functioning of an economy-wide approach.
- **Federal programs:** The Council may consider the level of investment being supported by federal legislation.

# Chapter 18. Gas System Transition

## 18.1 Overview

All the information before the Council indicates that achievement of the emission limits will entail a downsizing of the fossil gas system. The Integration Analysis scenarios and Advisory Panel recommendations show a greatly diminished use of fossil gas. However, the Council is still considering the scenarios presented in the draft Plan, which has a direct relationship to how to decarbonize the fossil gas system. Under all scenarios, the vast majority of current fossil gas customers (residential, commercial, and industrial) will transition to electricity by 2050. The current gas distribution system was developed to meet current demand for fossil gas and will need to be downsized substantially as this transition proceeds. A well-planned and strategic transition of the system, requiring coordination across multiple sectors, is needed to ensure the transition is equitable and cost effective for consumers without compromising reliability and safety.

It is important that the strategic transition to a decarbonized fossil gas system in New York State not impose undue cost burdens on customers that currently rely on this fuel for home heating, especially those who can least afford cost increases. Demand reduction measures that reduce customer reliance on fossil gas, including energy efficiency and demand response programs, must be increased. New York State must explore whether electrification of heating load is possible for all customers, for instance steam heating customers in New York City. The strategies described elsewhere in this draft Scoping Plan particularly are intended to leverage existing, emerging, and new technology to rapidly reduce and eventually eliminate the need for fossil gas in New York State.

Unlike other sectors, such as electricity generation, transportation and energy efficiency, the gas system does not a have a long history of analysis and policy development on emissions reductions to inform the strategies in this draft Plan. New York State will need to implement an ongoing effort to plan for and manage the strategic decommissioning of much of the fossil gas distribution system as the transition to electrification proceeds. That ongoing effort would include identification of opportunities to retire existing pipelines as demand declines explore the safest, most reliable, and least expensive approaches for an orderly transition. One scenario to explore would be moving whole streets or neighborhoods at a time from gas infrastructure to a community-based heat exchange system that support heat pumps. A utility could own and run the exchange system which would support heat pumps in individual buildings, with the pumps owned by the building owner. During the transition to the decarbonized systems, some investments in traditional infrastructure may still be necessary to maintain reliability and safety for

remaining fossil gas customers, but greater scrutiny of such investments is warranted to ensure that utilities do not exacerbate the problem of stranded assets and make it more expensive to fully decarbonize the fossil gas sector.

While the managed transition away from fossil gas proceeds, it will be essential to quickly mitigate methane emissions from this sector, which have been relatively flat since 2005. This need is amplified because of the Climate Act's use of a 20-year GWP and the inclusion of upstream emissions in the accounting methods. Current reporting indicates higher fugitive emissions from certain downstate utilities that also have very high inventories of leak prone pipe yet to be replaced. System repair will provide near-term reductions in these emissions. The PSC's existing policy is to require utilities to remove leak-prone pipes from service and the aggressive reduction of known leaks on fossil gas distribution systems; much of the leak prone pipe replacement is necessary for safety reasons, and will continue to produce real reductions in emissions, while additional replacements may be necessary for further emission reductions. In 2021, DEC proposed a new rule (6 NYCRR Part 203 – "Oil and Natural Gas Sector") to address methane leakage from the oil and gas sector. In addition to rigorous leak detection and repair requirements, the proposed regulations aim to reduce or prohibit the venting of fossil gas at wells, compressor stations, storage sites, and metering and regulating stations.[224] The regulations are projected to reduce 1.2 million metric tons $CO_2e$ of methane emissions, the equivalent of taking 236,753 cars off the road.[225] This proposed regulation is a major step forward in reducing methane emissions from the gas infrastructure, but there is still much to be done to fully reduce emissions as New York strategically decommissions the gas system, consistent with DEC's proposed regulations discussed above.

### *Key Stakeholders*

Decarbonizing the fossil gas system in New York State will be a complicated undertaking affecting a broad range of stakeholders: the utilities that need to transform their business models; gas utility customers that need to retrofit heating, hot water and cooking appliances in their homes and businesses; local governments that need to consider building code changes; commercial and industrial gas customers that need to consider changes to their business operations; regulators that will need to equitably and legally balance shareholder and customer interests when deciding, for example, how to handle assets tied

[224] New York State Department of Environmental Conservation. Proposed Part 203 Oil and Natural Gas Sector. Accessed at https://www.dec.ny.gov/regulations/122829.html.

[225] New York State Department of Environmental Conservation. DEC Announces Proposed Regulations to Reduce Methane Emissions from Oil and Natural Gas Sector. 2021. Accessed November 2021 at https://www.dec.ny.gov/press/122850.html.

to fossil fuels that are no longer able to generate an economic return because of changes associated with decarbonizing the economy, commonly referred to as stranded assets. Accordingly, key stakeholders for transitioning the gas system will also include federal and State regulators (FERC, Pipeline and Hazardous Materials Safety Administration, DEC, DPS, and PSC), gas industry workers, DOL, gas infrastructure owners, power plant owners, and NYSERDA, municipalities that adopt and enforce building codes, and industrial, commercial, and residential gas customers. The adoption of measures to transition the fossil gas system will be heavily dependent on end-use customer adoption of enhanced energy efficiency, demand response, and electrification. That is, utilities have an obligation to continue to provide safe and reliable service, so the speed of end-user adoption of fossil gas alternatives will affect the speed with which the utility will be able to transition its own infrastructure.

## 18.2 Key Considerations

### *Transition Away from Gas*

The transition away from fossil gas should be carefully managed, phased, and conducted with a focus on just transition principles while maintaining safety and reliability for those who still depend on the energy being delivered. However, the transition should take place as quickly as possible and to the maximum extent possible and include the production, transmission, and distribution components of the system.

The State has already taken action toward this transition. The PSC has initiated the Gas Planning Proceeding (Case 20-G-0131) to ensure safe and reliable long-term fossil gas planning, which will also require consideration of GHG emission limits in the Climate Act. Furthermore, utility rate case proceedings that appear before the PSC are now required to incorporate a demonstration of how the cases comply with the requirements of the Climate Act, including some of the emerging strategies contained within this draft Scoping Plan, such as no marketing of natural gas and positive marketing of electrification. Additional regulatory actions by PSC will likely be necessary to effectuate the required transition away from gas.

There are, however, limits to the action the PSC as regulator of fossil gas utilities can take toward this transition under current law. For instance, existing Public Service Law states that it is “policy of this state that the continued provision of all or any part of such gas, electric and steam service to all residential customers without unreasonable qualifications or lengthy delays is necessary for the preservation of the health and general welfare and is in the public interest.” Transportation Corporations Law section 12 also requires that gas and electricity service be supplied on application of a building owner or occupant. Laws such as these that seem to be in conflict with the requirements of the Climate Act must be updated and

brought into alignment with the Climate Act as soon as possible to ensure that regulators do not have conflicting directives from the Legislature, and have the authority required to take action consistent with the State's climate goals and requirements.

The CJWG supports the transition away from gas infrastructure and stresses the need for cost-effectiveness and equity to ensure the transition is just. The CJWG recommends that progress be prioritized in Disadvantaged Communities, where co-pollutants pose a high cumulative burden, and that any progress support the denial of fossil gas infrastructure permits. The strategy of prioritizing Disadvantaged Communities may drive the cost of the transition higher due to the scattered nature of these communities on a distribution system and the need to maintain system integrity, reliability, and the sequence of deconstructing supply assets. Regardless, any transition must be carefully planned, detailed, and clearly communicated to ensure that expectations are aligned across stakeholders, the electric distribution has sufficient capacity for the increased electric load due to electrification of heating and transportation, and that meaningful contractions of the gas system (and associated operations and maintenance cost savings) can be realized. Without this level of planning, the transition will likely be more challenging, take longer to implement, and be more costly than it would have otherwise been.

The following recommendations, developed by the Advisory Panels, will help navigate a reasonable transition away from fossil gas.

- **Analysis and planning:** Develop a detailed analysis to determine the most equitable and cost-effective strategy for transitioning from fossil gas while maintaining affordable, safe, and reliable service. Transitioning and decommissioning substantial portions of the gas system will require significant planning due to the complexity of the system, and the need to coordinate with building electrification while maintaining reliable and safe service. To ensure grid reliability needs are met, complete the transition in parallel with the NYISO's Reliability Needs Assessment. Ensure that the analysis informs a detailed and strategic approach to decommissioning and contracting the distribution system while considering end-use customers who are highly reliant on gas and consider the economic impacts, feasible alternatives, and growth in the power generation sector with electrification (including the Consolidated Edison Steam System).
    - The strategy for transitioning away from fossil gas usage must include energy efficiency and demand response programs, which, to date, have mainly been used specifically in gas constrained areas within existing natural gas service territories. Commercial and industrial customers who can shift fossil gas usage away from peak periods of consumption without

using an alternative fossil fuel present an untapped opportunity. Research must be done on other demand response programs, such as utility control of large commercial water heaters that could shift fossil gas usage away from peak periods. The capture of waste heat from water heated for industrial or commercial purposes could reduce fossil gas load. Use of the proper incentives could ensure that these programs are pursued in an extremely cost-effective manner.

  - An emphasis and focus needs to be placed on permanent load reduction measures that can significantly reduce fossil gas usage and demand in the short term, while also providing benefits for the end users if and when buildings are electrified in the mid to long term. Building envelope measures provide these benefits and must be implemented efficiently and effectively. Point of use energy storage and advanced metering could also be used to help control consumer energy bills during the transition away from fossil gas. This will require coordination on various levels across the State from the agencies and entities that provide support for LMI customers, weatherization programs, building electrification programs, and other energy efficiency programs to develop a comprehensive approach.
  - This analysis must be a continuous process to strategically manage the transition away from fossil gas as it proceeds, enabling adjustments to respond to technological, scientific, and economic developments.

- **Inclusion of LMI and the gas industry workforce:** The State should develop a comprehensive equity strategy to prioritize the needs of LMI households and Disadvantaged Communities in the transition, ensuring they are not left behind. This will require meaningful engagement of LMI households and residents of Disadvantaged Communities in the transition process and prioritizing technical and financial assistance to enable these households to make energy efficiency upgrades and electrify affordably. Create an equitable transition plan for the gas industry workforce, including protections, retraining and training that leverages transferrable skills, and job transition opportunities with attention to opportunities at dual-commodity utilities. This requires both a comprehensive system-wide equity strategy and utility-level equity strategies that include adequate accountability and oversight.

  Special consideration will need to occur for the workforce at gas only utilities. Since transitioning away from fossil gas will likely result in consolidation and the ultimate close of fossil gas utilities, the existing workforce will need a path to transition careers. Electric utilities benefitting from the increased revenue of electrification of heating load should absorb some of the potential burden of the stranded costs. Bankruptcy of gas utilities should be avoided. Amending the Public Service Law to allow gas-only utilities to become holistic energy providers

rather than gas only thermal energy providers may provide a path to their exit from the fossil gas business, including new businesses models such as community-scale geothermal systems.

- **Regulation development and emissions reduction targets:** The State should support the current DEC effort to promulgate regulations to decrease methane emissions from gas infrastructure, including upstream emissions, and, in coordination with the PSC, develop specific emission reduction targets (including interim targets) for transmission, storage, and gas distribution utilities upstream of the meter. These targets are necessary to guide utility gas system planning.
- **Permitting and service requirements:** The State should enact legislation to amend the Public Service Law and the Transportation Corporations Law to move away from promoting fossil gas system expansion by marketing fossil gas to prospective customers or providing gas service lines and extensions of natural gas mains at no cost to new customers (such as the "100-foot rule"). As soon as possible, the legislation should eliminate the existing requirement that gas service be supplied on application of a building owner or occupant, and have each utility regularly file a proposal for how it will meet the State's emission-free by 2040 electricity generation requirement and 2030 and 2050 emissions reduction requirements within its customer base. Incentives and rebates for gas equipment offered by utilities or NYSERDA should be ended immediately, particularly for sectors and building typologies in which electrification is a near-term solution. To the extent consistent with reliability and safety, the State should deny as inconsistent with the Climate Act additional gas infrastructure permits to avoid creating additional stranded assets and exacerbating GHG emissions. Furthermore, the State should advocate to FERC for denial of unnecessary and unjustified gas infrastructure projects that will exacerbate GHG emissions.
    - Revisions to building codes and standards should be among the first measures undertaken. New building codes must limit the use of fossil gas and other fossil fuels in new construction, as laid out in *Chapter 12. Buildings*.
    - The PSC has jurisdiction over the rates and operations of a number of electric and fossil gas municipal energy systems and can direct the entities to implement decarbonization measures. Additionally, the PSC has jurisdiction over the State's privately-owned water utilities. While many water utilities have fewer than 50 customers, some could be ordered to implement water usage reduction measures that would translate to reductions in both energy usage and emissions.

### *Reduce Fugitive Emissions from Gas Infrastructure*

The transition from oil and gas will take time and, during that time, the State will continue to rely on oil and gas infrastructure to deliver safe and reliable energy. To ensure reduced emissions during this period,

the State should develop systems to minimize methane leakage from this sector. Below are a set of actions developed by the Advisory Panels that could be implemented to achieve meaningful reductions in fugitive emissions from the system.

- **Regulatory action:** In addition to DEC's ongoing oil and gas methane rulemaking, the State should support future efforts from DEC to further control, reduce, and eliminate methane emissions from gas infrastructure. This may include implementing the use of innovative leak detection and repair–enhanced technology, developing an inventory of all infrastructure and sources of methane emissions potentially subject to State regulation, and operation and maintenance requirements resulting in reduced methane emissions. DEC should coordinate with the PSC to develop specific targets to guide utility system planning in this regard that would be incremental to existing regulations. This should include consideration of methane leaks resulting from excavator damage and whether the current fines for damages are sufficient. The PSC Gas Planning Proceeding, Case 20-G-0131, will address long-term gas utility planning.
- **Research and development:** The State should continue conducting research and development of leakage detection technologies, including continuous monitoring technologies and survey (aerial or land) for the production, transmission, and storage of fossil gas.
- **Reporting and inventory:** The State should develop a program to accurately characterize gas infrastructure components through information requests to better estimate emissions and improve inventory reporting. DEC should develop an online registry to collect and organize data and information in a manner that informs and directs infrastructure decommissioning. The online registry should have a transparent planning and reporting process, include emissions from the gas industry (from wells to end of distribution network pipes/burner tips) and lists of fugitive methane from sources such as landfills and wastewater treatment. The registry should track and collect data needed for interim targets. The registry should account for, report, and track environmental attributes of any advanced fuel project or fugitive methane avoidance project that ensures no double counting of reductions or environmental benefits. In addition, the PSC should ensure that all rate agreements it reviews comply with the Climate Act, and its proceeding focused on modernizing fossil gas planning (PSC Gas Planning Proceeding [Case 20-G-0131]) should require fossil gas utilities to monitor and report emissions as well as develop strategies for reducing emissions within their individual service territories.
- **Leakage detection and repair and abandoned wells:** The State should develop an integrated plan and coordinate efforts to with utilities, gas producers, infrastructure owners, and local municipalities to deploy advanced leak detection technology and to repair leaks in remaining gas infrastructure while maintaining affordable, safe, and reliable service. The program should be

designed with measures to limit leakage to the extent feasible, particularly with regard to higher-emitting infrastructure and EITE industries, where leakage would be most likely to occur in the absence of such measures and should identify appropriate funding sources to locate and cap abandoned wells. The PSC Gas Planning Proceeding (Case 20-G-0131) should require utilities to identify leak-prone pipe for replacement, quantify leakage, consider Non-Pipe Alternatives, and maintain safe and reliable service. To cap abandoned wells, the CJWG suggests that public funds be used as a last resort and that the State consider ways the oil and gas industry could contribute to reducing emissions from these sources.

## 18.3 Process Going Forward

The Council will work to include in the final Scoping Plan a framework through which agencies can develop a coordinated plan for the orderly downsizing of the gas system. This framework will be informed by input from the public, additional analysis, and work that may be undertaken. Development of the plan should be led by DPS, and supported by NYSERDA, LIPA, NYPA, and DEC. The plan should be developed in consultation with utilities, environmental justice groups, and sectoral experts and draw upon successful plans in other jurisdictions. This plan should also include a mechanism through which it can be adapted as technology and system conditions change and as New York increasingly electrifies end use applications such as transportation and space heating.

# Chapter 19. Land Use

## 19.1 Overview

The way we use land, whether for development, conservation, or a mix of uses, directly affects the State's carbon emissions, sequestration, and storage. Smart growth land use patterns reduce transportation-based GHG emissions by reducing automobile use and thus reducing VMT; sustainable land use planning and zoning can facilitate optimal siting of renewable energy; and protection of forests, cropland, and wetlands is critical for natural carbon sequestration. Deciding where to conserve land, where to develop and how to arrange and design that development constitutes the critical first steps in addressing climate change in land use. These decisions directly impact the ability to achieve carbon mitigation, sequestration and adaptation and resilience goals.

The dense and targeted development patterns that result from implementation of smart growth land use principles can support land conservation strategies that are critical to climate change mitigation. Strategic open space conservation can help contain sprawl and direct development into more appropriate areas, and maintain large, vegetated natural lands that contribute to carbon sequestration and storage, while providing an array of additional benefits including wildlife habitat, agricultural production, flood protection, clean water, wood products, and recreation.

Land use and land management decisions that seek to maximize carbon sequestration in our natural and working lands is a key component to realizing the Climate Act goal of net zero emission across all sectors of the economy. Not only are natural and working lands critical for carbon sequestration, avoiding conversion of such lands eliminates the prospect of additional GHG release.

Smart growth and local government planning are important enabling actions that are needed to balance the protection and restoration of natural and working lands, development, and clean energy siting. New York State envisions a significant shift to infill development and redevelopment of existing buildings in municipal centers with existing infrastructure to proliferate compact, mixed-use, mixed income development, which will attract future population growth, support Disadvantaged Communities, and accelerate TOD. This development pattern would create new opportunities for open space conservation and be fully aligned with the State's transportation and other infrastructure investments, resulting in far less automobile use and dependence and a concomitant reduction in GHG emissions from vehicles.

While land use decision-making falls largely within the jurisdictions of municipalities (cities, towns, villages), State policies, programs and incentives can influence and inform those local decisions to achieve more sustainable, climate-friendly land use outcomes.

To ensure zero-emissions electricity while increasing sequestration to reach net zero by 2050, local governments will be challenged with balancing these different types of land use. Smart growth and local clean energy siting assistance will be necessary immediately and long-term to help communities meet local needs while balancing land use priorities and pressures.

### *Existing Strategies*

There are more than 28 million acres of natural and working lands in New York.[226, 227, 228] Smart growth and local planning and decision making are needed to inventory and maintain existing wetlands, high value conservation areas, and agricultural production for GHG emissions mitigation, resilience, and adaptation benefits while balancing the increased demand for areas devoted to renewable energy production, forest land, and development. As discussed in *Chapter 3. New York's Climate Leadership,* New York has worked for decades on climate action. In addition to the aforementioned actions, there are several existing strategies that protect natural and working lands and promote smart growth. Over 75,000 acres of farmland has been protected from development through the Farmland Protection Implementation Grant Program and tens of thousands more acres of forestland have been protected from conversion through land purchases and easements with funds from the EPF. Programs like Regenerate NY, AgNPS, the Hudson River Estuary Program, and the annual spring seedling sale assist landowners with tree planting efforts and have resulted in the planting of tens of thousands of trees. The Downtown Revitalization Initiative (DRI) promotes compact, mixed-use development that is energy-efficient, focuses development in its downtown, and promotes the use of public transit and reduced dependence on the automobile. Since 2016, forty communities have completed the DRI planning process. The

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[226] Albright, Thomas A.; Butler, Brett J.; Crocker, Susan J.; Drobnack, Jason M.; Kurtz, Cassandra M.; McWilliams, William H.; Morin, Randall S.; Nelson, Mark D.; Riemann, Rachel; Vickers, Lance A.; Walters, Brian F.; Westfall, James A.; Woodall, Christopher W. 2020. New York Forests 2017. Resource Bulletin NRS-121. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 118 p. https://doi.org/10.2737/NRS-RB-121.

[227] USDA National Agriculture Statistic Service. 2019. 2017 Census of Agriculture, Volume 1, Chapter 1: Part 32 State Level Data: New York. Accessed at https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/New_York/nyv1.pdf.

[228] Huffman & Associates, Inc. (August 1999) Finalized June 2000. Wetlands Status and Trend Analysis of New York State - Mid-1980's to Mid-1990's. Prepared for New York State Department of Environmental Conservation. June 2000. Larkspur, California. l7pp. plus attachments. Accessed at https://www.dec.ny.gov/docs/wildlife_pdf/wetstattrend2.pdf.

Brownfield Cleanup, Environmental Restoration, and Brownfield Opportunity Area (BOA) programs offer incentives, planning and technical assistance, tax credits, and liability relief for brownfield cleanup and redevelopment. DOS promotes smart growth through the Local Waterfront Revitalization Program, the Smart Growth Comprehensive Planning Grant Program, and the Countywide Resiliency/Smart Growth Planning Grants Program. DEC offers the Adirondack and Catskill Smart Growth Grants Program and the Climate Smart Communities Program.

### *Key Stakeholders*

Stakeholders that promulgate and enforce land use regulations include municipalities at every level, including cities, towns, villages, counties, and special districts. Stakeholders that guide land use policy and investment include MPOs, county planning boards, regional planning councils, REDCs, industrial development agencies and authorities, and local and regional authorities, such as the Adirondack Park Agency. Stakeholders that hold forest land in New York include DEC, AGM, OPRHP, DOT, NYPA, New York Forest Owners Association, land trusts, utility companies, municipalities, municipal associations, local communities, and private landowners. Stakeholders involved in outreach, education, and other forms of landowner assistance include USDA, DOS, DEC, the NYC Department of Environmental Protection, SWCDs, CCE, the Society of American Foresters, International Society of Arboriculture, New York Society of Arboriculture, New York State Urban Forestry Council, education and conservation non-profits, hunting stakeholders, arborists, and foresters. Stakeholders involved in research efforts include SUNY ESF and Cornell CALS. Other stakeholders involved in developing and administering incentive programs and legislation include the New York State Department of Taxation and Finance and the Legislature.

## 19.2 Key Strategies

The key strategies for reducing GHG emissions through land use practices are described below and organized into three themes, as shown in Table 14.

**Table 14. Land Use Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Protection, Restoration, and Monitoring of Natural and Working Lands | LU1. Mitigate Carbon Emissions by Protection of Forest Lands<br>LU2. Afforestation and Reforestation<br>LU3. Avoid Agricultural and Forested Land Conversion<br>LU4. Protect and Restore Wetlands<br>LU5. Mapping, Research, Planning, and Assistance |

| Theme | Strategies |
|---|---|
| Forests and Farmland in Municipal Land Use Policies | LU6. Provide Guidance and Support for Afforestation and Reforestation to Local Communities<br>LU7. Increase Forest and Farmland Protection in Municipal Comprehensive Plans<br>LU8. Provide Guidance and Support on Clean Energy Siting to Localities |
| Smart Growth | LU9. Regional and County Planning and Technical Assistance<br>LU10. Direct Planning, Zoning, and Pre-Development Assistance to Municipalities<br>LU11. Align State Funding Priorities<br>LU12. Accelerate TOD |

### *Protection, Restoration, and Monitoring of Natural and Working Lands*

Natural and working lands in many parts of the State are under pressure from development and conversion, which is causing a steady decline in the amount of $CO_2$ being absorbed each year.[229] Over 13.7 million acres, or 73% of New York's forests are owned by private landowners.[230] When surveyed, private landowners owning 91.7% of these forested acres stated that they want to keep their forests as forests.[231] However, due to the costs of maintaining a healthy forest, forest dieback due to pests and diseases, annual taxes, and shifts to smaller parcel sizes due to inheritance laws, private landowners have been facing increasing pressures to subdivide or develop their forested lands.[232]

Afforestation and reforestation have the potential to greatly increase the carbon sequestration and storage capacity in New York State. In New York, there are 3.9 million acres that have the potential for reforestation and afforestation, including 1.6 million acres of marginal cropland and pastureland and 27,000 acres of natural lands, which would help mitigate 13.1 MT $CO_2$ per year, with the greatest mitigation potential for pasturelands (9.9 MT $CO_2$ per year), urban areas (1.7 MT $CO_2$ per year), and biological corridors (1.49 MT $CO_2$ per year). However, there may be competing uses for these lands, such

[229] Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

[230] USDA Forest Service. 2020. Forests of New York, 2019. Resource Update FS-250. Madison, WI: U.S. Department of Agriculture, Forest Service. 2p. https://doi.org/10.2737/FS-RU-250.

[231] Butler, Brett J.; Hewes, Jaketon H.; Dickinson, Brenton J.; Andrejczyk, Kyle; Butler, Sarah M.; Markowski-Lindsay, Marla. 2016. USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p. https://doi.org/10.2737/NRS-RB-99.

[232] Malmsheimer, Robert W., Patrick Heffernan, Steve Brink, Douglas Crandall, Fred Deneke, Christopher Galik, Edmund Gee, John A. Helms, Nathan McClure, Michael Mortimer, Steve Ruddell, Matthew Smith, John Stewart. 2008. Forest Management Solutions for Mitigating Climate Change in the United States. Journal of Forestry, Volume 106, Issue 3, April 2008, Pages 115–117, https://doi.org/10.1093/jof/106.3.115.

as agriculture, renewable energy project siting, and development that will likely make much of this land unavailable for afforestation and reforestation efforts. Identification of areas for reforestation and afforestation is a first step to increasing forest area, as well as carbon sequestration and storage.

### *LU1. Mitigate Carbon Emissions by Protection of Forest Lands*

New York has 18.6 million acres of forests,[233] which hold an estimated 1,911 MMT of carbon.[234] In addition to carbon sequestration and storage, New York's forests provide wildlife habitat, forest products, flood mitigation, recreational opportunities, and mental health benefits, and protect the State's air and water quality. Forestlands in many parts of the State are under pressure from development and forest conversion, which is causing a steady decline in the amount of $CO_2$ being absorbed each year. Keeping forests as forests is critical to maintaining and increasing levels of carbon sequestration and storage and preventing emissions, as forests sequester and store much more carbon than any other land use in New York. State and municipal land acquisition provide the most reliable long-term protection of forested areas from land conversion. There are currently 4.8 million acres of forestland owned by the State, local municipalities, or land trusts in New York. In 2020, 6,005 acres of land were protected through acquisition by DEC and OPRHP and 14 grants were awarded to protect forests through the Conservation Partnership Program. To maintain the State's carbon storage and sequestration levels, additional protection is needed, which can be accomplished through land acquisition and conservation easements.

The State should implement the following tactics that keep forests as forests to maintain New York's forest carbon sequestration and storage levels and prevent emissions from development. Many of the strategies and components listed below will take several years to implement and receive carbon benefits, so actions to keep forests as forests should begin as soon as possible to prevent emissions and slip back of current carbon sequestration in NY forests. Comments from the CJWG were supportive overall of the strategies listed below for mitigating carbon emissions by the protection of forest lands.

[233] USDA Forest Service. 2020. Forests of New York, 2019. Resource Update FS-250. Madison, WI: U.S. Department of Agriculture, Forest Service. 2p. https://doi.org/10.2737/FS-RU-250.

[234] Domke, Grant M.; Walters, Brian F.; Nowak, David J.; Smith, James, E.; Ogle, Stephen M.; Coulston, J.W.; Wirth, T.C. 2020. Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2018. Resource Update FS-227. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/FS-RU-227.

### Components of the Strategy

- **Enact "Keep Forests as Forests" law:** The State should immediately enact legislation to "keep forest as forests" requiring developers to purchase and set aside forested land when forest carbon is lost during development following the principals of avoid, minimize, and mitigate.
- **Establish programs to support local land acquisition:** DEC should considerably enhance support for local land acquisition and conservation easements by municipalities and land trusts through mechanisms such as the Community Preservation Act, Conservation Partnership Program (CPP), Forest Conservation Easements for Land Trusts and Community Forest programs.
- **Maintain and increase State land acquisition:** DEC should continue to maintain and significantly increase land acquisition (fee and conservation easement) by State, municipalities, and land trusts.
- **Require participation in carbon markets:** The State should enact legislation to establish and/or require participation in a forest carbon market for GHG emission sources in the State.

## *LU2. Afforestation and Reforestation*

Following European settlement in the 1600s, New York's forest cover began to drop. This trend increased rapidly during the Industrial Revolution, and by the 1880s, less than 20% of New York State was forested. With the recognition that New York must restore its forested resources, the New York State Conservation Department began widespread planting efforts in the early 1900s. Planting efforts continued with the Civilian Conservation Corps in the 1930s and following World War II. New York is now 63% forested, but opportunities remain for additional afforestation and reforestation efforts to improve carbon sequestration, carbon storage, and all the other benefits that forests provide,[235] especially on New York's 1.6 million acres of marginal lands and areas otherwise lacking sufficient natural regeneration. The strategies within this theme propose an increase in tree planting and efforts to encourage natural regeneration of trees, which will increase carbon sequestration and storage. Seedlings take up to 5 years to become established after planting or natural regeneration, at which time they begin to grow more rapidly and have a greater impact on carbon sequestration.

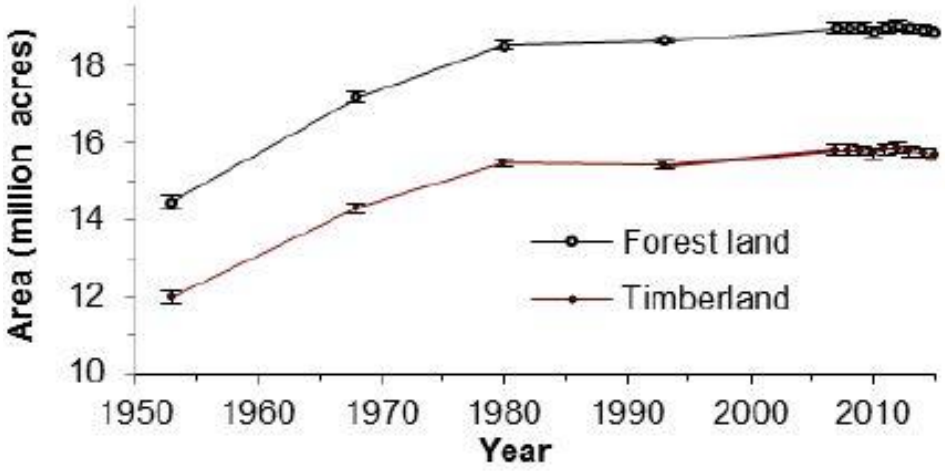
The New York State tree nursery system was founded in 1902 to reforest areas of the State that were subject to erosion, flooding, and sedimentation. Numerous tree nurseries were established across the State

[235] Verschoor, K. and Van Duyne, G. Tree Planters' Notes 55(2):4-13. 2012. Accessed at https://rngr.net/publications/tpn/55-2/forestry-and-tree-planting-in-new-york-state/at_download/file.

to grow seedlings for afforestation and reforestation efforts. By 1973, all State nurseries were consolidated to the Tree Nursery at Saratoga, which produces 1.2 million bareroot and plug seedlings annually, of which only 200,000 are used for planting on State forests.[236] If only marginal lands are considered for afforestation and reforestation, 872 million trees will be needed over the next 30 years (more than 29 million/year.[237] However, if all potential locations are considered, a total of 2.2 billion seedlings will be needed (73 million/year).[238]

If reforestation and afforestation are going to be a part of GHG emissions mitigation strategies by 2030 and 2050, these efforts need to be started as soon as possible to allow time for seedling establishment. The CJWG feedback was supportive overall of the strategies listed below for the Afforestation and Reforestation strategy.

**Figure 28. New York Forest Land Cover Over Time**




*Source:* Figure showing forest land (at least 10% tree canopy cover) and timberland (forestland capable of producing wood crop) by year, New York, 1953 to 2016 (Albright et al. 2020).

[236] Verschoor, K. and Van Duyne, G. Tree Planters' Notes 55(2):4-13. 2012. https://rngr.net/publications/tpn/55-2/forestry-and-tree-planting-in-new-york-state/at_download/file.

[237] Fargione J, Haase DL, Burney OT, Kildisheva OA, Edge G, Cook-Patton SC, Chapman T, Rempel A, Hurteau MD, Davis KT, Dobrowski S, Enebak S, De LaTorre R, Bhuta AAR, Cubbage F, Kittler B, Zhang D and Guldin RW. 2021. Challenges to the Reforestation Pipeline in the United States. Front. For. Glob. Change 4:629198. https://doi.org/10.3389/ffgc.2021.629198.

[238] Cook-Patton SC, T Gopalakrishna, A Daigneaul, SM Leavitt, J Platt, SM Scull, O Amarjargal, PW Ellis, BW Griscom, JL McGuire, SM Yeo, and JE Fargione. Lower cost and more feasible options to restore forest cover in the contiguous United States for climate mitigation. One Earth, V 3(6): 739-752. https://doi.org/10.1016/j.oneear.2020.11.013.

### Components of the Strategy

- **Prioritize locations:** DEC should identify areas where afforestation and reforestation are the most likely to succeed using data provided by the Reforestation Hub,[239] experts, and other authorities. Of the potential land available, factors that may impact afforestation and reforestation success include the soil and site conditions, the level of deer browse, the presence of invasive species or other competing vegetation, and limitations on lands with other important uses such as rights-of-way and utility corridors.
- **Reforest rights-of-way:** DOT should work with public and private partners on reforestation efforts in right-of-way areas of the State. These partnerships should determine and focus on tree and shrub species compatible with power transmission and distribution rights of way, roadside areas, pipelines, railroads, and other right-of-way areas and develop programs for afforestation and reforestation in these locations. Public outreach for right tree, right place is needed.
- **Invest in planting technologies:** DEC should invest in seeding technology to fill in smaller forest gaps where needed. These may include the use of drone and robotic technology to distribute seeds in areas regeneration needs to be supplemented.
- **Invest in and update the Colonel William F. Fox Memorial Saratoga Tree Nursery:** The State should provide funding to increase the State tree nursery's capacity to support large scale afforestation and reforestation efforts, including expanding tree species offerings to meet adaptation and resiliency challenges and implementing upgrades to enhance seed collection, seed storage, seedling production, workforce development, and pre-and post-planting practices.
- **Increase grant program funding:** The State should increase of funding for the Urban and Community Forestry Grants to assist local municipalities in the management of the urban forest which can reduce risks associated with extreme heat, drought, and flooding. This would include funding for planning, planting, and maintenance of trees. The State should also provide funding opportunities for private individuals to establish and maintain privately owned trees. This component aligns with adaptation and resilience strategies discussed in further in *Chapter 21. Adaptation and Resilience* and Appendix H.

[239] Cook-Patton SC, T Gopalakrishna, A Daigneaul, SM Leavitt, J Platt, SM Scull, O Amarjargal, PW Ellis, BW Griscom, JL McGuire, SM Yeo, and JE Fargione. Lower cost and more feasible options to restore forest cover in the contiguous United States for climate mitigation. One Earth, V 3(6): 739-752. https://doi.org/10.1016/j.oneear.2020.11.013.

- **Prioritize locations:** Urban and community forest cover is declining by about 6,720 acres annually.[240] As urban and community forest cover decreases, so do the critical benefits that these trees provide, such as carbon sequestration, reduced heating and cooling costs, air and water quality improvement, and flood mitigation. In addition to the Urban and Community Forestry program, DEC should develop an opportunity assessment to focus tree establishment and maintenance efforts within urban areas and communities where the most climate, societal, and public health benefits are likely to be achieved.
- **Provide guidance and support:** DEC should work with SUNY ESF to develop guidance and provide support and funding to local communities for planning and implementing planting and maintenance projects that help communities adapt to climate change. This may include sharing resources (like equipment, staff, and bulk ordering). This will help communities maintain critical ecosystem services like flood mitigation, clean air, clean water, reduced sediment and nutrient runoff, reduced energy use, shade, reduce risks associated with extreme heat, and improve human health. This component aligns with adaptation and resilience strategies discussed in further in *Chapter 21. Adaptation and Resilience* and Appendix H.
- **Fund cost-share programs:** The State should continue to expand the funding for cost share programs, such as Regenerate NY, to assist forest landowners in widespread implementation of reforestation and afforestation efforts. These existing programs can help move reforestation/afforestation efforts forward while larger efforts, such as the NY Tree Corps become established.
- **Develop equipment loan program:** The SWCC should develop a tree planting equipment loan program to give landowners and operators access to specialized equipment for small-and large-scale tree planting projects.
- **Provide free tree seedlings:** DEC should expand or create new, free tree seedling programs such as Trees for Tributaries and Buffer in a Bag programs to assist landowners with planting projects. DEC should also explore partnerships with local governments and regional organizations to scale up programs.
- **Establish NY Tree or Climate Corps:** DEC should establish NY Tree or Climate Corp to provide direct tree establishment and maintenance services to public and private landowners. Staff for a NY Tree or Climate Corps would be regionally based and work with DEC Lands and Forests and local SWCDs, trees for tributaries, and other restoration programs to coordinate

[240] Nowack, David J., & Greenfield, Eric J., 2018. Declining urban and community tree cover in the United States. Urban Forestry & Urban Greening, 32, 32-55.

location selection, site needs, and implementation. A regionally-based Tree Corps would be provided with several teams of staff (at least 1 team per DEC region) and equipment to establish and maintain seedlings at no or low cost to landowners.

### *LU3. Avoid Agricultural and Forested Land Conversion*

The objective of this strategy is to maintain and protect the State's potential for carbon sequestration on agricultural and forested lands through avoided conversion. It will also help to enhance farm viability, increase food security, and implement smart growth measures to reduce future GHG emissions from VMT, protect forest carbon sequestration, and forest benefits including wildlife habitat, local forest products, and flood protection.

In the past 5-10 years, 65,327 acres of forest land have been converted to other uses each year, such as development, renewable energy production, or agriculture, while only 37,909 acres of non-forest have reverted to forests annually.[241] This strategy proposes additional research and legislation to keep forests as forests. Research activities would include determining and prioritizing the most efficient and effective conservation activities and policies to keep forests as forests and prevent emissions. Legislation changes could take several years and would support forestry activities and require mitigation following development of forests to offset forest conversion emissions and sequestration loss.

Agricultural land protection captures carbon in the land base and prevents future emissions from vehicle use by preventing sprawl development. Protecting farmland has the potential to maintain or improve local food production, community resilience, water quality, air quality, storm and flood mitigation, public infrastructure protection, drought resilience, wildlife habitat, economic development, and employment. All of these may have associated health benefits. This strategy requires continued support from public policy and funding for land acquisition, conservation easements and tax incentives; outreach to landowners for interest in selling lands or conservation easement opportunities; coordinating with vast numbers of municipalities with different zoning and planning goals (home rule); improved data connecting land conversion and quantification of GHG emission reduction; understanding the opportunities for land access and intergenerational land transfer.

[241] USDA Forest Service. 2020. Forests of New York, 2019. Resource Update FS-250. Madison, WI: U.S. Department of Agriculture, Forest Service. 2p. https://doi.org/10.2737/FS-RU-250.

### Components of the Strategy

- **Increase funding and capacity of existing programs:** The State should increase funding for Farmland Protection programs to plan for agriculture and purchase Development Rights (through conservation easements) by State, municipalities, and land trusts.
- **Increase support for historically underserved farmers:** AGM should assist farmers in securing long-term leasing and farm transfer to historically underserved including, BIPOC, beginning farmers, socially disadvantaged, limited resources, and women farmers. This should support youth engagement, internships, and educational opportunities.
- **Strengthen State programs that support agriculture:** AGM should continue and strengthen agricultural assessment and agricultural districts programs.
- **Enhance local capacity to conserve lands:** The State should increase local capacity to conserve agricultural, forested, and other natural lands through statewide authorization of the Community Preservation Act, for the purposes of land conservation for carbon sequestration, and to support land use patterns that reduce GHG emissions such as transit-oriented development. Consideration should also be given to elevating the CPP Forest Conservation Easements for Land Trusts, Community Forests program, and other programs that facilitate land acquisition/conservation.
- **Expand legislation:** The State should expand legislation to secure local government ability to designate Minimum Maintenance Roads to reduce subdivision and development pressure on those roads that may result in conversion of farmland to other land uses.
- **Research avoided conversion impacts:** DEC and AGM should continue researching ways to support avoided conversion of forest lands and farmland, respectively, including by quantification of No Net Loss, prioritizing conservation activities, and monitoring to quantify policy impacts.
- **Increase support for succession and farmland access:** AGM should support farmland access and succession with the advancement and development of programs that make farmland more affordable and assist farmers to navigate generational transfer issues. AGM should also expand education and technical assistance for beginning farmers and generational transfer. These efforts should focus on assisting farmers with business planning and modeling and expanding supply chain development for new products.
- **Link farmland protection with environmental management programs:** AGM, DEC, USDA NRCS, and USDA Farm Services Agency should make connections between existing programs (such as AEM, CRF, and AgNPS) to increase co-benefits. This action should target protected farmland for agricultural BMPs that reduce GHG emissions and sequester carbon like soil health management practice systems.

- **Foster new datasets to support decision making:** AGM and DEC should work with Cornell CALS and SUNY ESF should develop new data sets to support avoided conversion and develop monitoring and quantification methodologies to measure the impacts of avoided conversion.
- **Strengthen Right to Practice Forestry law:** The State should enact legislation to strengthen the Right to Practice Forestry law (ECL Section 9-0815) to prevent municipalities from unreasonably restricting or regulating forestry operations on private land.
- **Mitigate impact from renewable energy projects on forests:** DEC should work with NYSERDA to facilitate the siting of renewable energy projects including solar on appropriate sites to avoid adverse impacts New York forests in order to mitigate impacts to carbon storage and sequestration. In some cases, this may include rejection of State subsidy, tax credits, and RECs in forests with high carbon, climate, or other related benefits.

### *LU4. Protect and Restore Wetlands*

This strategy focuses on maintaining and enhancing the carbon sequestration potential of freshwater, non-tidal, coastal and estuarine tidal wetlands, submerged aquatic vegetation, and other coastal habitats in New York through protection, restoration, and monitoring. Suggested legislative and regulatory actions and increased funding would address these gaps and provide opportunity for comprehensive protection, restoration, and monitoring of wetlands. While GHG emissions reduction by wetlands may be low compared to forests in New York, it is important to note that many of the State's wetlands are forested, and all wetlands are part of the natural infrastructure necessary for climate adaptation and resilience and collectively contribute to overall carbon storage and sequestration strategies.

Protection of New York's 2.4 million acres of freshwater, non-tidal wetlands[242] (1990s estimate) can contribute to sequestration goals necessary to reach the State's net zero goal. Today, some freshwater wetlands receive protection from Article 24 of the New York ECL and from Section 404 of the federal Clean Water Act. However, many remain vulnerable to alterations that can diminish or destroy their ability to store and sequester carbon, provide habitat, filter water, and mitigate flooding. At the federal level, recent changes to the 2020 promulgated Navigable Waters Protection Rule removed protections for a significant number of wetlands. At the State level, the New York Freshwater Wetland maps are inaccurate and based on outdated technology, leaving approximately 1,000,000 acres of wetlands

[242] Huffman & Associates, Inc. (August 1999) Finalized June 2000. Wetlands Status and Trend Analysis of New York State - Mid-1980's to Mid-1990's. Prepared for New York State Department of Environmental Conservation. June 2000. Larkspur, California. l7pp. plus attachments.

unprotected, despite meeting the regulatory criteria of Article 24.[243] Restoration and monitoring can further expand the role of wetlands and our understanding of their sequestration potential and opportunities. Estimates suggest that more than half of New York's historic wetlands were lost due to activities like filling, draining, and dredging; preventing similar trends is critical in the face of climate change and continuing pressure from development and incompatible land-use change.

These recommendations are expected to be moderately difficult to implement. Risks to consider include potential opposition to increased regulation or municipal resistance to land protection. Institutionally, there may be insufficient funding and staff, or policy differences in permitting agencies. Additionally, there may be competing interests (such as agriculture and renewable energy) and variable landowner interest in selling or easements. Collectively, these potential barriers could be addressed through new funding (like the Environmental Bond Act), partnerships, and prioritizing and increasing funding for the New York Open Space Plan to support climate strategies. Other possible mitigants include cross-agency and cross-industry communication and coordination, stakeholder engagement, outreach, and education; and reimbursement programs for lost municipal tax revenue.

### Components of the Strategy

Efforts in this area can expand and enhance existing programs at relatively low cost, with funding primarily for increased agency staff and land acquisition.

- **Incentivize the use of natural and nature-based features through Army Corps of Engineers regional permits:** DOS, DEC, and DOT should develop regional permits (or specific Nationwide Permit 54 regional conditions) with Army Corps of Engineers to incentivize use of natural and nature-based features to enhance resilience and ecosystem benefits of freshwater and tidal wetlands.

Freshwater Wetlands

- **Improve and expand the regulation of New York Freshwater Wetlands:** The State should enact legislation to improve and expand regulation of all freshwater, non-tidal wetlands, and adjacent areas by fundamentally changing New York's statutory system for regulating these wetlands, including shifting wetland maps from regulatory to informational, and establishing jurisdictional boundaries through field delineation. Implementation of a regulatory program

[243] DEC Estimate (2020).

should be further improved by updating State regulations and developing internal and external guidance.

- **Ensure regulatory oversight for wetlands and waterbodies removed from federal protection:** The State should enact legislation to ensure regulatory oversight for wetlands and waterbodies that were removed from federal protection under the Navigable Waters Protection Rule and explore expanded use of Unusual Importance designation to restore oversight to a portion of the wetlands that lost protections under the rule. This should be accomplished within three to five years in collaboration with DOS, ORES, DPS, and the Attorney General. This component aligns with adaptation and resilience strategies discussed in further in *Chapter 21. Adaptation and Resilience* and Appendix H.
- **Increase investment in freshwater wetlands:** The State Legislature, DEC, and DOS should increase investment in the protection, restoration, and monitoring of freshwater, non-tidal wetlands, and adjacent areas, including riparian areas, to maximize carbon sequestration potential (such as an Environmental Bond Act, the EPF, and grants programs like DEC Water Quality Improvement Program and New York State CPP). This should be accomplished within 10 years with assistance from stakeholders that may include OPRHP, conservation NGOs, counties, municipalities, land trusts, and SWCDs.
- **Prioritize protection and restoration of wetlands with the potential to sequester carbon:** The State should fund research that will evaluate the methane emissions and carbon sequestration associated with freshwater impoundments and the impact of their specific water-level and salinity management strategies. DEC should also identify historically drained freshwater wetlands where the oxidation or organic carbon in drained soils in an ongoing source of $CO_2$ to the atmosphere. These areas should be prioritized for any voluntary buyouts and restoration to wetland status.

Tidal Wetlands

- **Address sea-level rise in State coastal regulations:** DEC should revisit implementation of the tidal wetlands and coastal erosion hazard areas regulatory programs in light of sea-level rise projections, develop internal and external guidance, and determine whether changes in law and regulations are necessary (such as a review of NYCRR Part 661 to consider whether existing elevation, distance, and setback limits on tidal wetlands and adjacent area jurisdiction will remain adequate as sea level rises).
- **Increase planning and investment in existing tidal wetlands and other coastal habitats:** The State Legislature, DEC, and DOS should increase investment in the protection, restoration, and monitoring of existing tidal wetlands, including submerged aquatic vegetation), to protect their

ability to sequester carbon from declines due to marsh drowning, sediment starvation, and seagrass die offs caused by pollution in runoff and coastal water quality (such as an Environmental Bond Act or the EPF, and grants programs like New York State CPP). DEC should develop a portfolio of design-build and shovel-ready marsh restoration projects so that New York can compete with neighboring coastal states for high-quality dredge material from Army Corps of Engineers and is ready to take advantage of federal cost-sharing opportunities.

Enable Marsh Migration

- **Plan for sea-level rise and allow marshes to migrate in the future:** DEC should work with municipal partners to create mitigation banks that acquire, restore, and monitor larger tracts of tidal wetland habitat by bundling credits purchased by applicants for State tidal wetlands permits when their projects cause smaller amounts of unavoidable habitat loss, such as the Sawmill Creek wetland mitigation bank.[244] DEC should identify future potential marsh migration routes as sea-level rises and prioritize these parcels for purchase and restoration; fund municipal coastal debris removal efforts, map and remove historical fill and other obstacles to marsh migration on public land, and remove abandoned boats and other large marine debris that smother and damage existing tidal wetlands; and create an insurance program that defrays the financial risk associated with cleaning up legacy pollutants when municipalities acquire coastal properties for marsh restoration and protection.

### *LU5. Mapping, Research, Planning, and Assistance*

This enabling strategy focuses on maintaining and enhancing the carbon sequestration potential of natural areas in New York, including wetlands, coastal habitats, forests, and grasslands, through improved mapping (both regulatory and non-regulatory), research, conservation planning guidance, stewardship, and assistance for local governments and landowners.

Regulatory programs and land acquisition are two important strategies for maintaining and restoring carbon sequestration potential. These programs must be enhanced with current science, conservation guidance, and increased capacity of partners like local government planners and landowners who routinely make decisions that have lasting impacts on natural areas, including those that have little protection like small wetlands and forests. These strategies are needed to pair priority conservation areas

[244] New York City Economic Development Corporation, "Saw Mill Creek Wetland Mitigation Bank Credits," Accessed November 2021 at https://edc.nyc/project/marshes-initiative.

with priority growth areas—a key component of smart planning and smart growth that can sustain large, functioning natural areas that provide health benefits to people and other ecosystem services like flood mitigation, habitat for plants and animals, and opportunities for outdoor recreation for residents and visitors.

Newly available technologies and non-regulatory models from other regions and states can inform these enabling strategies and include relatively low-cost mapping, analysis, research, technical assistance, and funding. Success will require agency staff to provide technical assistance, training, and project management; and funding for small grants, research, mapping, analysis, development of implementation material and tools, and stewardship initiatives. Also important are sufficient funding and partnerships to ensure adequately resourced programs, additional education and outreach to communities, and targeted training and technical assistance for key decision-makers and stakeholders.

### Components of the Strategy

- **Update wetland and natural resource mapping:** DEC should apply the best available technology to update maps of wetlands (regulated and unregulated; tidal and non-tidal); shallow water habitats; Significant Coastal Fish and Wildlife Habitats; Coastal Erosion Hazard Areas; and priority forests and natural areas. DEC should also ensure all maps and inventories are accurate and publicly available; schedule recurring updates using the best available technology; and replace Article 24 wetland maps with updated informational Article 24 wetland maps. This effort should engage OPRHP, DOS, conservation NGOs, research partners, SWCDs, and other State agencies in the process.
- **Consider technologies:** Consider emerging and tested mapping technologies, included those applied in light detection and ranging technology Enhanced Wetlands Mapping in the New York City Watershed, Land Cover Mapping and Modeling Initiatives in Chesapeake Bay Watershed and Delaware River Basin, and Object-based Wetland Mapping Approach for Pennsylvania; and National Oceanic and Atmospheric Administration’s new high resolution land cover data products.

- **Develop a statewide conservation framework:** DEC should develop a statewide conservation framework[245] that incorporates current, accurate spatial data on critical ecosystems (terrestrial and aquatic), including priority ecosystem complexes and future needs that address climate adaptation needs (such as landscape connectivity, wetland migration pathways, and source water areas); and provides basis for prioritizing State funding, tax relief, land acquisition, and technical assistance programs to conserve priority natural areas and promote smart growth. This should be publicly accessible and DEC should also provide outreach and assistance to ensure appropriate and effective use of framework. This effort and should engage stakeholders such as OPRHP, DOS, conservation NGOs, research partners, SWCDs, regional planning commissions, and land trusts. This component aligns with the adaptation and resilience strategies discussed in further in *Chapter 21. Adaptation and Resilience* and Appendix H.
- **Assist local governments to create land-use policies:**[246] DOS, DEC, and the Legislature should assist county and local governments to create land-use policies, land conservation programs, and smart growth strategies that prioritize and protect wetlands, forests, grasslands, stream buffers, and other natural areas (such as the statewide authorization of Community Preservation Act; training and support on use of CRRA model local laws, comprehensive planning language, zoning, and other conservation planning approaches; and funding for Conservation Advisory Committees and Environmental Management Councils). Key stakeholders should include regional and county planning commissions, counties, municipalities, conservation NGOs, and SWCDs.
- **Provide conservation incentives to landowners:** The State should enhance and create landowner incentives and other techniques to conserve and restore tidal and non-tidal wetlands, forests, grasslands, and natural areas and utilize living shoreline and nature-based solutions (such as tax abatement programs, tax incentives, land conservation programs, and PES).
- **Research and monitor carbon storage and sequestration potential:** The State should fund research, analysis, and monitoring to determine carbon storage and sequestration potential of tidal and non-tidal wetlands, submerged aquatic vegetation, forests, and other priority natural areas, to

[245] Example of regional conservation frameworks in New York include the Hudson River Estuary Wildlife and Habitat Conservation Framework and the Tompkins County Unique Natural Areas, Conservation Plan and Strategy. A statewide example is the Florida Critical Lands and Waters Identification Project. An increasing number of statewide data sets are available to inform a New York framework; examples include the Open Space Institute's Climate Resilient Landscape Initiative and NY Natural Heritage Program databases and models.

[246] Existing outreach and extension programs and partnerships can serve as models: DOS Local Government Training Program; Hudson River Estuary Program's Conservation and Land Use Team; and county planning federations.

increase understanding of mitigation opportunities and to establish siting protocols and priorities for conservation and restoration.

- **Develop new benefit-cost analysis tools:** DEC, in collaboration with DOS and research partners, should develop benefit-cost analysis tools that incorporate the value of carbon for use in planning, environmental assessment, and permitting of conservation and restoration projects.
- **Develop demonstration projects:** DEC and DOS should initiate climate resilient demonstration projects by working with existing wetland protection, restoration, or natural and nature-based features projects to add additional components for maximizing climate resilience and carbon sequestration capacity, developing quantification models and best practices, and monitoring effectiveness.
- **Develop a service corps program:** DEC and OPHRP should create a conservation and restoration service corps program[247] for early and experienced professionals and a youth climate conservation corps for unemployed young people ages 18 to 25. The programs should focus on ecosystem stewardship, management, and restoration activities to maximize carbon sequestration in natural and developed areas (such as tree plantings in lower-income neighborhoods, wetland restoration, and native grassland establishment in municipal parks). These programs would support a just transition and "green job" career training. This component aligns with adaptation and resilience strategies discussed in further in *Chapter 21. Adaptation and Resilience* and Appendix H.

### *Forests and Farmland in Municipal Land Use Policies*

Local governments and organizations provide planning, guidance, and support for land use and to residents. However, many municipalities lack a comprehensive plan and/or zoning that clearly address afforestation or reforestation. Municipal comprehensive plans are used to proactively guide development and other community planning, and while these plans often include information from natural resource inventories, critical barriers, and other local and regional smart growth planning resources to help inform the plan, they often do not include forestland and farmland. The following strategies discuss how to better equip municipalities with the proper tools to ensure the protection of New York's natural and working lands, while still advancing renewable energy.

[247] GulfCorps is an example of a conservation corps focused on creating resilient coasts and communities in five Gulf Coast states.

### *LU6. Provide Guidance and Support for Afforestation and Reforestation to Local Communities*

Some municipalities may lack the expertise and capacity to support afforestation and reforestation projects, which may result in land being put toward other uses. This strategy involves providing funding and personnel resources to directly support communities in their planning and planting efforts as well as developing trainings and materials to increase outreach and education to local municipalities and organizations. This strategy would take several years to get in place, so it needs to be started as soon as possible to allow time for seedlings to become established in time to be a part of GHG emissions mitigation strategies by 2030 and 2050.

#### Components of the Strategy

- **Provide guidance for local communities:** DEC should develop guidance and provide support for local communities to plan and implement planting projects that help adapt to climate change.
- **Increase landowner assistance:** DEC should enhance agency and partner capacity to deliver technical assistance and education programs including planting plans and species selection for landowners. This includes assisting with planting plans and site and species selection, promoting tree planting programs, and increasing capacity through partnerships to meet requests, ensure minimal overlap of services, capture accomplishments, and coordinate efforts.
- **Establish NY Tree or Climate Corps:** DEC should establish NY Tree or Climate Corp to provide direct tree establishment and maintenance services to public and private landowners. Staff for a NY Tree or Climate Corps would be regionally based and work with DEC Lands and Forests and local SWCDs, trees for tributaries, and other restoration programs to coordinate location selection, site needs, and implementation. A regionally-based Tree Corps would be provided with several teams of staff (at least 1 team per DEC region) and equipment to establish and maintain seedlings at no or low cost to landowners.

### *LU7. Increase Forest and Farmland Protection in Municipal Comprehensive Plans*

This strategy proposes creation of tools to help municipalities identify and fund inventories of forest and farmland, development of BMPs, and a requirement to include forestland and farmland in planning efforts, which will help communities target lands for conservation and prevent emissions from land use conversion. Development of tools and BMPs would take several years.

### Components of the Strategy

Identify Land Resources

- **Survey land resources:** DEC, in partnership with AGM and DOS, should conduct a quantitative survey of land resources across the State and identification of critical barriers including options of using idle and underutilized lands.
- **Support the development of local natural resource inventories:** State agencies, such as DEC, DOS, and/or AGM, should provide funding to further development of natural resource inventories, critical barriers, and other local and regional smart growth planning and decision-making resources (such as maps to identify suitable reforestation locations) that include forestland and farmland. These resources should support local and regional smart growth planning and decision-making (such as maps to identify suitable reforestation locations, highest value cropland, and idle lands for farming).

Support Best Practices in Planning

- **Develop guidance for BMPs:** DOS and DEC should develop guidance and BMPs for the inclusion of forestland protection in municipal comprehensive plans, including strategies and best practices for land conservation, and identifying priority areas for conservation. DOS should fund technical assistance to implement guidance and BMPs effectively.
- **Require forest inclusion in planning:** State funding agencies should require the inclusion of forestland and farmland protection in State funded municipal comprehensive plans.

## *LU8. Provide Guidance and Support on Clean Energy Siting to Localities*

The Climate Act contains significant requirements for clean energy development, such as the distributed solar and energy storage targets. Local land use decisions are an important part of meeting these requirements in ways that revitalize communities and grow the economy. As discussed further in *Chapter 20. Local Government*, communities often do not have the capacity to plan for renewable energy siting. The following components would better equip local municipalities with the tools they need to effectively consider natural and working lands when planning for clean energy projects in their communities.

### Components of the Strategy

- **Develop new planning tools and resources:** NYSERDA should collaborate with community stakeholders, the agriculture and forestry sector, the solar industry, and utilities to develop new planning tools and resources. These tools would include mapping to help municipalities

undertake a comprehensive evaluation of the potential for clean energy development in their communities and to plan proactively for deployment that maximizes local benefit and minimizes impact on lands with high-quality soils, forests, and other competing uses.

- **Enhance technical and financial support:** NYSERDA should collaborate with regional planning boards to provide technical and financial support to help local governments plan for and review clean energy projects including wind, solar, transmission, distribution, storage, and vehicle charging. Incentives should be based on proximity of generation to current load centers and/or economic development sites that could combine infrastructure planning to incorporate renewable energy, storage, increase electric capacity and/or need for infrastructure to both achieve Climate Act requirements and to ensure site readiness of select locations for economic growth.

### *Smart Growth*

Smart growth is compact, mixed-use, mixed-income community development that is walkable, bikeable and transit-accessible and contains a diversity of housing choices, open spaces, and public gathering places accessible to people of all ages, incomes, backgrounds, and mobility capabilities. Smart growth promotes locational precepts that seek to direct and concentrate development in what are referred to as priority development areas—such as downtowns, main streets, municipal centers, transit-oriented areas, abandoned manufacturing facilities, and Disadvantaged Communities, among others. Complementarily, smart growth seeks to prohibit or restrict development in what are called priority conservation areas, where development is less desirable for ecological, agricultural, hydrological, or recreational reasons, among others. Smart growth land-use patterns reduce GHG emissions largely in the transportation sector by reducing automobile use, measured as VMT. More specifically, automobile travel is reduced by decreasing the travel distance between daily locations through a denser concentration of different land uses that we regularly access; reducing the number of car trips necessary for daily activities by concentrating that mix of destinations within walking, biking, or transit distance of one another; and providing mobility alternatives to the automobile, such as walking, biking and public transportation (also known as mode-shifting).

The State has taken several steps to promote smart growth and re-investment in downtowns, cities, and other municipal centers. The DRI, for example, provides $100 million annually to redevelop and revitalize 10 downtowns, awarding $10 million to one community in each of the State's 10 economic development regions. The State has also funded smart growth, sustainability and climate mitigation and resiliency planning through a number of programs, including DOS' Countywide Resiliency Planning

program, DEC's Climate Smart Communities and Adirondack/Catskill Smart Growth grant program, and NYSERDA's Cleaner, Greener Communities initiative. And most recently, DOS piloted a Smart Growth Comprehensive Planning grant program to provide much-needed resources to municipalities to develop updated comprehensive plans to guide future development and promote smart growth at the local level. The New York land bank law has yielded the most robust set of land banks in the nation, redeveloping vacant properties, and combating blight disinvested neighborhoods. The State's historic preservation tax credit has generated significant investments in historic buildings in traditional downtowns. The Complete Streets law has helped to create walkable, bikeable, transit-friendly communities for all users. And the State passed the Smart Growth Public Infrastructure Policy Act to curtail State investments in sprawl. Continuing and expanding upon the implementation of municipal, county, and regional smart growth plans, policies, zoning, and projects will play a critical role in continuing to achieve the mandates of the Climate Act through reduced VMT.

The following smart growth recommendations seek synergies that result in a proliferation of smart, equitable planning, zoning, and projects, while synchronizing with supportive transportation and housing policies and practices. In particular, the strategies and recommendations align with related transportation goals such as doubling public transportation service outside the MTA service area by 2035 and significantly expanding service within the MTA's service area, E-TOD, and shifting to low- or no-carbon transportation alternatives to a single occupancy automobile. State agencies and local government officials responsible for implementing these smart growth recommendations should reference California's Senate Bill 375 as a guide for integrated land use, housing, and transportation planning, recognizing Senate Bill 375's shortcomings and the different governance structures of California and New York.

These strategies and recommendations acknowledge and respect the fact that land use zoning falls largely within the authority of municipalities (cities, towns, and villages). The State, however, can influence those local land use decisions through direct planning grants, regional/county planning, technical assistance and capacity-building, and State and local incentives, disincentives and, where appropriate, mandates. Counties and regional planning entities can provide support to municipalities to develop local land use plans and local laws that promote smart growth. It is also critical to recognize the prioritization of Disadvantaged Communities in the development of these recommendations. Communities of color have been historically disenfranchised by discriminatory land use policies and smart growth strategies and recommendations represent part of a decades-long effort to reverse past discrimination and level the playing field.

## *LU9. Regional and County Planning and Technical Assistance*

Regional and county planning should guide future growth, redevelopment, and conservation at the multi-municipal scale. There should be facilitation and support of collaborative multi-municipal smart growth comprehensive planning at the county and regional scales to inform and guide land-use decisions, including designation of priority development areas and priority conservation areas. While land use zoning, which determines final land use and development decisions, falls within the jurisdiction of municipalities, this broader regional lens is necessary to inform those local decisions to serve broader land use goals that transcend municipal boundaries--i.e., regional economies, daily travel patterns and transportation systems, housing needs (particularly the availability of permanent affordable housing to meet the entire region's needs and avoid displacement and gentrification, as highlighted by the CJWG) hydrologic functions, open space preservation, and ecosystem health, among others.

### Components of the Strategy

- **Achieve alignment with regional sustainability plans and principles:** State funding agencies and sources should align selection criteria with the priorities and principles contained in the Cleaner, Greener Communities Regional Sustainability Plans, to the extent practicable.
- **Achieve alignment with REDC plans and projects:** ESD, DOS, DEC and NYSERDA should identify opportunities to increase coordination with REDCs and alignment of REDC regional strategic plans with sustainability/smart growth/equity principles.
- **Support county-based resiliency planning:** DOS should expand Countywide Resiliency Planning grants to incentivize county-wide smart growth comprehensive plans that adhere to clear State goals and outcomes. These plans should include health impact assessments where feasible and relevant, particularly in Disadvantaged Communities that have experienced health disparities.
- **Prioritize areas for development and conservation:** The State, particularly DOS and DEC, should develop criteria and incentives for regional entities and counties to identify priority development areas (including areas appropriate for clean energy siting) and priority conservation areas in consultation with local jurisdictions and communities. The following definitions of priority development areas and priority conservation areas were developed in consultation with the Land Use and Local Government Advisory Panel and the CJWG.
    - Priority development areas are areas appropriate for a concentration of compact, mixed-use, mixed-income development with a variety of housing options at all levels of affordability. Priority development areas should have the proper infrastructure in place to accommodate greater density and should be walkable, bikeable and transit-accessible. Primary examples

may include BOAs, downtowns, central businesses districts, municipal centers, hamlets, former industrial districts, infill projects in developed areas, obsolete fossil fuel-based power plants, re-development/adaptive-use of existing buildings, TOD/E-TOD, Disadvantaged Communities, dead/dying malls, and vacant property clusters designated by land banks, among others.

  - Priority conservation areas are areas that preserve and restore vital habitats, landscape connectivity, biodiversity, natural water movement, local food security and passive recreation. They may include wetlands, riparian areas, Critical Environmental Areas (as defined by New York's State Environmental Quality Review Act [SEQRA]), forests, agricultural lands and other natural areas and working lands, among others.

- **Expand State funding eligibility for regional and community-based organizations:** The State, particularly DOS, should extend eligibility for funding in program solicitations for select smart growth-related planning and implementation grants to regional planning councils and, where appropriate, qualified community-based organizations.
- **Further empower counties to implement shared regional smart growth priorities:** DOS, in collaboration with counties and local governments, should evaluate opportunities through the use and potential expansion of General Municipal Law Section 239 County Review to further empower counties to implement shared regional smart growth priorities throughout metropolitan and micropolitan statistical areas in municipal planning, zoning, and subdivision proposals.
- **Encourage local tax incentives for infill and downtown redevelopment:** DOS should work with the industrial development agencies and authorities in each region to proliferate tax incentive policies in their Uniform Tax Exemption policies to incentivize infill and downtown redevelopment.

### *LU10. Direct Planning, Zoning, and Pre-Development Assistance to Municipalities*

The State should provide direct planning and zoning assistance to local communities and promote municipal implementation of mitigation strategies through enhanced technical assistance, increased support for local adoption of zoning and land use regulations consistent with smart growth principles, and local policies that support sustainable, equitable development and the accelerated expansion of local clean energy while also ensuring and enhancing public outreach, education and engagement, particularly in frontline communities that have historically been disenfranchised and discriminated against in the local land use decision-making process. This strategy aims to empower local governments to achieve smart growth planning and development.

### Components of the Strategy

- **Provide State support for comprehensive plans:** DOS should expand the Smart Growth Comprehensive Planning grant program to assist municipalities in the efficient development and adoption of smart growth-focused comprehensive plans, district/corridor plans and zoning, including form-based codes. Assistance should extend to compliance with SEQRA, including completion of GEISs and should include providing guidance to communities undertaking comprehensive planning and/or re-zoning to put moratoria on projects such as new gasoline stations, underground storage or sprawl-type subdivision and development that may be counter to smart growth and climate goals. Particular attention should be given to disadvantaged and smaller rural communities that have less capacity, funds, or staff for comprehensive planning.
- **Expand technical assistance programs to support municipal smart growth planning:** The State should expand the roles and responsibilities of DOS Smart Growth planning, NYSERDA Clean Energy Communities Regional Coordinators, and DEC Climate Leadership Coordinators to provide smart growth planning and zoning technical assistance and capacity-building to municipalities, which would include the integration of land use, transportation, economic development, and housing planning and projects.
- **Develop model smart growth local laws:** DOS should collaborate with other State agencies as appropriate, including DEC, HCR, OTDA and NYSERDA, to develop model local laws to assist municipalities of various sizes and capacities to implement smart growth plans and zoning laws, including model inclusionary zoning to address gentrification, displacement, and the concentration of poverty. Model local laws to address density and affordability should also be developed, including zoning and site plan review laws that accommodate a variety of densities and uses for localities as a baseline. Such laws should also make available siting for supportive housing, group homes, homeless shelters, multi-family housing, accessory dwelling units, and other affordable housing, and expedited local review of supportive housing or affordable housing where at least 20% is affordable at 80% Area Median Income or below.
- **Consolidate all State funding opportunities:** All State funding programs should be included in the annual Consolidated Funding Application, to the extent practicable, and the State should provide a centralized source of information on all State funding opportunities for municipalities and not-for-profits.
- **Enhance the awareness of State resources by publishing a Sustainable Development Resource Guidebook:** The State should develop a Sustainable Development/Climate Act Resource Guidebook to serve as a resource to assist regional entities, counties, municipalities, and

developers in navigating, accessing, and integrating State programs relevant to sustainable community and clean energy development. This should improve accessibility and ease coordination across programs.

- **Provide municipalities with baseline data for planning:** The State should build on existing State data portals such as NYSERDA's Climate Science Clearinghouse and DOS's GIS Gateway to provide a centralized, user-friendly digital repository of data resources useful to regional/county/local planners in the development of smart growth land use plans, zoning codes and projects, including data on affordability and other equity matters, Disadvantaged Communities, climate change projections, affordability, poverty, and public health. This data resource should be framed as a one-stop shop to consolidate data and planning tools related to climate change mitigation and adaptation, disaster risk reduction, and regional and local land use planning and clean energy siting.
- **Expand site/facility re-use planning:** NYSERDA and DOS should support community-based planning to inform redevelopment of obsolete power plant sites and brownfields, particularly through NYSERDA's Power Plant Re-use initiative and DOS's BOAs program, in furtherance of the principles developed by the JTWG.
- **Ensure equitable development while avoiding displacement and gentrification:** DOS and other State agencies should explore opportunities to address displacement, gentrification, the concentration of poverty, segregation, and inequitable access to opportunity by providing assistance and resources for community land trusts, land banks, and inclusive zoning that promotes mixed-income, affordable, rental and supportive housing, and shared/community-centered ownership models.
- **Provide outreach and educational materials to support equitable development:** The State should provide model outreach materials and other tools and guidance to support pre-development community outreach, engagement, and education for smart growth projects to generate support, awareness, and buy-in prior to a developer filing the project with a municipal board. This model should be created in coordination with community-based organizations, local government officials, universities, and others, as needed.
- **Increase the role of community-based organizations in local planning:** DOS should provide grant funding to support community-based organizations to develop local land use plans for Disadvantaged Communities that can inform and guide development to reduce emissions, adapt to climate change, and achieve a just transition. Examples of such plans include UPROSE's Green Resilient Industrial District, El Puente's Green Light District, THE POINT Community

Development Corporation's South Bronx Community Resiliency Agenda, and PUSH Buffalo's PUSH GREEN / PUSH BLUE.

### *LU11. Align State Funding Priorities*

State funding should align with smart growth and equity goals and seek to eliminate funding that induces sprawl, particularly with new infrastructure. This is the stated purpose goal of the Smart Growth Public Infrastructure Policy Act. This Act, however, has been utilized primarily in a review and advisory capacity, rather than as a basis for granting funds for smart growth and, just as importantly, denying funds for sprawl. An interagency working should develop amendments to this Act to implement its goal and the requirements of the Climate Act more fully. The amendments should include definitions of priority development areas, priority conservation areas, E-TOD, and climate justice, along with stronger requirements for State spending beyond the limited existing scope of public infrastructure to comport and align with these definitions.

#### Components of the Strategy

- **Refine/align State smart growth public infrastructure act criteria:** The State should enact legislation to amend the 11 Smart Growth criteria contained in the State Smart Growth Public Infrastructure Policy Act to define public infrastructure and more accurately identify infrastructure projects that enable both smart growth and sprawl, as well as align those criteria more directly with the Climate Act, with an emphasis on equity and affordability. These amendments should include definitions of priority development areas and priority conservation areas. The amendments should also expand the purview of the law to apply to all State agencies and authorities and all relevant State programs, including planning and design grants (not just infrastructure).
- **Priority funding for smart growth:** State programs should prioritize funding for infrastructure projects that most clearly support smart growth principles and outcomes, as determined through the smart growth review that agencies must conduct through the Smart Growth Public Infrastructure Policy Act, particularly projects in priority development areas.
- **Stable funding for Restore NY and the Environmental Restoration Program:** The State should provide regular funding for Restore NY and DEC's Environmental Restoration Program to ensure dependable availability of support for the restoration of distressed, vacant, abandoned, contaminated and/or brownfield areas.

- **Expand priority State support for BOA projects:** The State should expand and enforce the "priority and preference" provision in the BOA statute to include other relevant grants beyond those already identified in statute.

### *LU12. Accelerate Transit-Oriented Development*

Smart Growth planning should accelerate mixed-use, mixed-income TOD, with an emphasis on E-TOD, around key transit hubs served by rail and bus rapid transit.

TOD creates compact, mixed-use, mixed-income, walkable communities within a half-mile of rail or transit hubs. TOD decreases dependence on cars, expands mobility options such as walking and biking and generates the critical mass of residents and commuters needed to support an expansion of public transit services. TOD also presents an ideal opportunity to meet equity and climate justice goals of the Climate Act by incentivizing green affordable housing near transit, which also reduces transportation costs for lower-income households. E-TOD ensures that affordability, climate justice and environmental justice play a prominent role in the TOD equation in planning, zoning, funding, project implementation and public policies on the State and local levels.

Several State programs have sporadically funded TOD, including HCR's Low-Income Housing Tax Credit program, DRI, Better Buffalo Fund, Local Waterfront Revitalization Program and REDC Strategic Plans and priority projects, among others. The State should, however, provide dedicated and priority funding, in existing and new programs, specifically to support TOD because TOD/E-TOD shows the greatest promise of reaching the Climate Act's GHG emission reduction and equity goals in land use. While land use patterns generally take time to shift and produce measurable climate results, TOD can be expedited with State support given its defined geographic scope and focus; TOD also produces more measurable GHG reduction outcomes. The CJWG recommended a statewide program to plan and develop E-TOD.

#### Components of the Strategy

- **Support TOD planning and zoning:** The State should support municipal E-TOD plans and zoning, including form-based codes, through a grant program and guidance and technical assistance (including model local laws).
- **Promote equity tools and resources:** The State should promote and support equity tools and models, such as community land trusts, land banks, inclusionary zoning and shared/community-

centered ownership, and equity models to address displacement, gentrification, and the concentration of poverty.

- **Require TOD plans around commuter rail:** The State should require communities with commuter rail stations to have an adopted TOD plan that meets State criteria to be eligible for supportive State TOD resources, with due consideration for smaller rail stations that may not have a full TOD or TOD plan.
- **Prioritize TOD in the Smart Growth Public Infrastructure Policy Act:** The State should enact legislation to amend the State Smart Growth Public Infrastructure Policy Act to more effectively direct State resources to projects that advance TOD, as well as add a definition of, and criteria for, TOD that includes rail and bus and the particular transit needs of rural areas. Amendments should extend applicability of this law to all State agencies and authorities and all relevant State programs, including planning and design grants (not just infrastructure).
- **Provide subsidies for E-TOD:** The State should explore enhanced subsidies for TOD projects, especially those that include a meaningful threshold level of affordable housing and incorporate tools and measures such as community land trusts, land banks, inclusionary zoning, and shared/community-centered ownership models.
- **Expand TOD as a State housing goal:** The State should include the TOD State Housing Goal in HCR's 9% Low-Income Housing Tax Credit program in all relevant State solicitations, consider other opportunities for tax credits for projects in TOD areas that are consistent with an adopted TOD plans, and meet State criteria for equity and affordability, such as an additional "bump up" of Brownfield Cleanup Program tax credits in designated BOAs that are also TODs.
- **Support for GEISs:** The State should fund and support GEISs to streamline the review process in TODs. This can be accomplished by creating a revolving fund for municipalities to undertake GEISs for TOD zoning and projects; if a developer agrees to build according to the TOD zoning and accepts certain community benefits components, such as affordable housing, green infrastructure, green building or public spaces, the developer will pay back into the fund a portion of the cost of the GEIS (consider using tax increment financing for this purpose).
- **Support local parking management policies that reduce automobile-dependence:** DOS, in collaboration with municipalities, MPOs, and affected agencies, should explore opportunities to support and incentivize lower municipal parking minimums and/or parking maximums in consideration of decreased household need, given proximity and accessible of transit. State programs, for instance, can recognize and reward applications for TOD funding in municipalities that have enacted such parking management reforms.

- **Structured parking:** The State should support planning to facilitate appropriate structured parking to achieve a desired TOD density and explore opportunities to defray the cost of structured parking in conjunction with TOD development—e.g., State funding, low-cost financing, and tax credits, as well as the development of best practices for design and construction of structured parking that integrates ground-level retail and that can be retrofitted for other uses should the demand for parking decline in the future.
- **Improve municipal coordination with transit entities:** The State should require municipalities to notify the relevant transit entities of planning, zoning and projects that will impact transit ridership and parking needs to allow transit agencies an early opportunity to offer input on such potential impacts.

# Chapter 20. Local Government

## 20.1 Local Government and the Climate Act

Local governments in every region of the State—small and large, urban, rural, and suburban—are taking significant action in ways that contribute directly to meeting the requirements of the Climate Act. Local governments are well positioned to have a far-reaching impact on community action. State programs that partner with communities and local governments are helping drive rapid adoption, widespread participation, and big impact.

Partnership with local governments is a keystone of the State's clean energy, adaptation and resilience, and GHG mitigation strategies, and support for local efforts will help ensure access to the benefits of these actions for all New Yorkers. Local governments have an important role to play in meeting Climate Act mandates. They control assets like street lighting systems, wastewater treatment plants, landfills, and public transit systems. They enact codes, develop projects, adopt policies, and regulate land use. When communities lead by example, clean energy and sustainability are more likely to be priorities for residents, businesses, and institutions.

In developing the following recommendations, several discussion sessions were held with local officials from across the State to gather input. A number of important themes emerged from these discussions. Counties and regional organizations have important roles as leaders and conveners in efforts to address GHG mitigation. Local governments are increasingly engaged in providing education and training, outreach, and technical assistance. Many local governments are motivated by a desire to achieve cost savings that come from efficiency in municipal operations and facilities. Local governments also face challenges with aging infrastructure and housing stock. Local officials stressed the importance of existing State technical assistance, incentives, and resources provided to local governments for GHG mitigation actions. They also identified the need for uniformly applied State mandates in accelerating change at the local level and reducing competition between local governments and between regions. Leaders suggested a regional approach that acknowledges the different needs of municipalities, based on geographic location, population size, and density, to support meeting Climate Act requirements.

State programs, including Clean Energy Communities and Climate Smart Communities, were identified as providing value to local governments, whether through grants, free technical assistance, or recognition for local leadership. NYSERDA's Clean Energy Communities program creates a clear path forward for communities to implement clean energy actions that have the greatest potential for impact. To date, 639 communities, representing more than 18 million New Yorkers, have completed more than 2,200 high-

impact actions. These actions empower the constituents of participating communities to choose clean and efficient energy as part of their everyday lives. The Climate Smart Communities program is jointly sponsored by seven State agencies: DEC, NYSERDA, NYPA, DOS, DOH, DOT, and DPS. Started in 2009, the program provides guidance, and financial and technical support to local governments to take locally driven climate action. The first step is to register by pledging to reduce emissions and adapt to climate change.

These programs are supported by a Statewide coordinator network consisting of regional planning and development boards, associations, and councils, like the Central New York Regional Planning and Development Board and the Genesee/Finger Lakes Regional Planning Council. These organizations have long-standing relationships with local governments in their regions, and State programs can leverage those relationships for the benefit of the programs. These coordinators are trusted local partners to the government officials and staff in their regions. In addition to free, on-demand technical support, State programs offer online toolkits that include step-by-step guides, calculators, case studies, and model language that communities can incorporate into legislation.

## 20.2 Key Strategies to Support Local Climate Action

There are five key strategies highlighted in this sector, as shown in Table 15.

**Table 15. Local Government Sector Key Strategies**

| Strategies |
|---|
| LG1. Clean Energy Community Dashboard |
| LG2. Local Energy Policies |
| LG3. Clean Energy Siting Support for Local Governments |
| LG4. Community Clean Energy Initiatives |
| LG5. State Support and Guidance |

### *LG1. Clean Energy Community Dashboard*

The strategy for supporting local climate action is to develop a statewide dashboard of community GHG emissions inventories to promote local climate action planning, monitor equity considerations, measure progress, and ensure data consistency at the county and municipal levels.

This strategy calls for a community dashboard that local governments and other stakeholders can use to understand energy use trends and identify opportunities for improvement. The dashboard would bring together data from several sources to describe the community energy picture.

Not all required data like fuel oil, gasoline, and diesel consumption, as well as VMT and fuel mix is currently reported at the county, city, town, and village levels. The dashboard must be easy to use and provide good, actionable information that local government officials and staff, and community stakeholders can use to inform decision making at the local level. The process could establish aggregated data reporting requirements for suppliers of fuels in a manner similar to the PSC requirement that electricity and natural gas consumption data be reported by utilities (see PSC "Order Adopting the Utility Energy Registry" in CASE 17-M-0315 issued April 20, 2018). The dashboard could include data on energy production and clean energy actions. As part of the effort, the State will explore methods for estimating GHG emissions associated with transportation at the county, city, town, and village levels.

### Components of the Strategy

- **Form a community GHG working group:** NYSERDA should establish a Community GHG Working Group consisting of MPOs, utilities, State agencies, academic institutions, consultants, and regional and municipal officials. The group may consider several activities:
  - Review existing guidance including the International Council for Local Environmental Initiative's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions to identify methods.
  - Work with State agencies, MPOs, utilities, and other stakeholders to identify and secure New York-specific data needed to complete the emission inventories.
  - Develop standard GHG inventory reporting formats for regional and local community inventories.
- **Support modernization of carbon and methane accounting to facilitate data accessibility:** Incentivize software developers to create new software and other tools that allow for clear and transparent accounting of carbon and methane to inform and support local climate action.
- **Launch the community dashboard:** NYSERDA, working with community stakeholders, should launch and maintain the dashboard, ensuring it is accessible to all communities.

## *LG2. Local Energy Policies*

This strategy is intended to encourage local governments to demonstrate leadership in energy efficiency by developing model above-minimum energy conservation codes and construction policies. This includes adopting the NYStretch Energy Code and promoting its adoption, enhanced code enforcement including streamlined permitting, third party inspections, and shared enforcement, and Property Assessed Clean Energy financing.

Many local governments, especially small, resource-constrained communities, struggle with tight budgets and limited staff capacity, which limits their ability to take local climate actions. State programs, like Clean Energy Communities and Climate Smart Communities, that offer clear guidance, grants, technical assistance, and recognition can motivate communities to take local climate action and demonstrate climate leadership with a focus on equity.

### Components of the Strategy

- **Leverage existing NYSERDA and DEC programs:** NYSERDA and DEC should continue to update the Clean Energy Communities and Climate Smart Communities programs to encourage adoption of emerging local energy policies and pro-active climate action.
- **Expand NYPA Clean Energy Services Program:** NYPA should continue the existing Clean Energy Services program and expand the program to reach more communities.
- **Expand the Regional Coordinator Network**: NYSERDA and DEC should expand the type of services offered by the regional coordinator network to enhance and strengthen assistance to local governments and related entities across a range of climate actions within. This expansion should increase support to small, resource-constrained, and underserved communities.

## *LG3. Clean Energy Siting Support for Local Governments*

This strategy facilitates clean energy siting through development and promotion of model local laws and streamlined permitting. Local governments often have limited capacity to anticipate and plan for solar and energy storage development in their communities. State programs like Clean Energy Communities and Climate Smart Communities that offer clear guidance, grants, technical assistance, and recognition can motivate communities to adopt appropriate siting policies at the local level.

### Components of the Strategy

- **Create model local laws and regulations:** NYSERDA, DEC and DOS should work with community stakeholders and the solar industry to develop and promote model local laws and development regulations through the Clean Energy Communities and Climate Smart Communities programs.
- **Promote New York State Solar Permit Adoption:** Within one year, NYSERDA and DOS should work with code enforcement officers to promote local adoption of the New York State Solar Permit and other local actions to streamline the permitting process for clean energy technologies, including energy storage, at a variety of scales.

### *LG4. Community Clean Energy Initiatives*

This strategy connects homes, businesses, and community institutions with clean energy products and services through CCA programs, microgrids, district systems, and community-scale campaigns to encourage adoption of innovative technologies to generate savings for consumers in an equitable manner.

To achieve Climate Act mandates, broad-based consumer demand for clean energy products and services is necessary. Communities have tremendous capacity to use bulk purchasing, shared-services, community campaigns, and other forms of aggregation to drive this demand to new heights. This strategy calls for State programs to encourage local governments to adopt policies aimed at the widespread deployment of clean DERs. The intent is to allow more consumers to participate in the energy markets in ways that advance Climate Act goals and requirements while improving project economics, saving money, and generating new sources of revenue and ownership for consumers.

This strategy also calls for State programs to support policies, including CCA, which is a local program to purchase power in bulk for virtually all homes and small businesses in a participating community. CCA allows local elected officials to choose the source of energy for their communities. Most communities that have implemented CCA procure 100% renewable energy as their default supply. Many CCA programs are working to capture the economic benefits of clean energy more broadly. CCAs, including Sustainable Westchester's Westchester Power program, have developed opportunities around opt-out community solar, energy efficiency, heat pumps, EVs, demand response, and energy storage.

#### Components of the Strategy

- **Encourage the adoption of clean technologies:** NYSERDA should work with community stakeholders to promote community-scale campaigns to encourage the adoption of clean technologies to generate value and savings for consumers.
- **Expand workforce development for the clean energy economy:** NYSERDA, in collaboration with unions and the clean energy industry, should expand workforce development programs focused on training and job placement in clean energy and emerging technologies.

### *LG5. State Support and Guidance*

This strategy discusses continuing and expanding program opportunities, incentives, technical assistance, and centralized procurement services to motivate local governments and related public entities to improve assets they control with high-impact actions. This includes LED lighting, energy efficiency upgrades, heat

pump projects, methane recovery for energy production from wastewater treatment and landfills, solar on municipal premises, and municipal and school district fleet electrification.

Local governments and related public entities could achieve greater savings if they worked through shared services models. State programs that offer clear guidance, grants, technical assistance, and recognition can motivate local governments and related public entities to improve the assets they control. Shared services can come in different forms. For example, to accelerate adoption of clean technologies and policies, local governments may be encouraged to work together through intermunicipal conference calls, planning institutes, roundtables, or work groups

### Components of the Strategy

- **Technical support for clean energy projects:** NYSERDA should work with community stakeholders to provide technical support to help local governments and related public entities develop and implement clean energy projects.
- **Reduce grid interconnection costs:** NYSERDA, in collaboration with the solar industry, should evaluate options to reduce interconnection costs for municipally owned priority sites.
- **Prioritize methane recovery:** NYSERDA, working with community stakeholders, should prioritize funding for projects that recover methane from wastewater treatment and landfills for on-site energy production. Consideration should also be given to alternative uses for biofuels generated from methane recovery, such as in heat for buildings, difficult to electrify medium- and heavy-duty transportation, and industrial applications.
- **Support direct energy purchasing:** NYSERDA and DPS should develop tools and resources to help municipalities procure energy and enable direct purchases of energy by municipalities from the wholesale market.
- **Support fleet electrification:** NYSERDA and DEC should support electrification of municipal and school district fleets while increasing fleet-wide fuel economy.
- **Support building electrification:** NYSERDA should provide policy guidance and financial support to municipalities that adopt building electrification policies that incorporate insights from cities like Ithaca that have made ambitious commitments and developed innovative decarbonization plans.
- **Encourage energy benchmarking:** NYSERDA should encourage local governments to track and report the energy use of municipal buildings and facilities (benchmarking).
- **Increase recycling and reduce waste:** DEC should seek to increase waste reduction and recycling rates in municipal operations and in the community.

# Chapter 21. Adaptation and Resilience

## 21.1 Adaptation and Resilience Overview

Even with strong and innovative strategies in place to curb GHG emissions, the impacts of climate change are already being felt and are only projected to accelerate. Climate change mitigation strategies alone are not sufficient to prepare for the impacts of present and future climate change. Therefore, New York State must take bold action to adapt to climate change and enhance resilience in communities, infrastructure, and systems. Resilience is the capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption. For energy systems resilience is the ability of the energy infrastructure to be prepared for, withstand, adapt, and quickly recover from disruptions such as severe weather, natural, and man-made disasters. Adaptation is the process of adjusting to new climate conditions to reduce risks to valued assets.[248]

This chapter contains strategies to enhance climate resilience and adaptation organized under the following three themes:

### *Building Capacity*

The "Building Capacity" theme comprises four strategies related to statewide planning, consideration of future conditions in State decision making, enhancement of general understanding of climate change, improving the public's adaptive capacity, and identifying options for financing adaptation actions and reducing or shifting risk.

### *Communities and Infrastructure*

Enhancing resilience of communities and infrastructure includes strategies to assist municipalities to prepare for and react to increasingly severe climate hazards. The strategies include recommendations to expand State support for regional and local planning, assist municipalities in their efforts to incorporate future conditions into local planning and regulatory decisions, recommendations to address risks due to flooding and extreme heat, and recommendations to ensure resilience of the energy system.

### *Living Systems*

As used in this document, the term "living systems" refers to the State's natural ecosystems, its agricultural systems, and its forested lands. Strategies recommended to enhance resilience of living

[248] United States Global Change Research Program. 2021. U.S. Climate Resilience Toolkit. Glossary. Accessed at https://toolkit.climate.gov/content/glossary.

systems include addressing risks to ecosystems and biodiversity, enhancing resilience and adaptation of the agricultural sector, and protecting the ability of forests to serve as carbon sinks.

## 21.2 Key Strategies

The components of the key strategies are derived from the initiatives and their respective components recommended to the Council by the Land Use and Local Government Advisory Panel. A detailed description of the strategies and components can be found in Appendix H. The adaptation and resilience strategies are organized into three themes, listed below in Table 16.

**Table 16. Adaptation and Resilience Key Strategies by Theme**

| Theme | Strategies |
|---|---|
| Building Capacity | AR1. Commit to Creating, Implementing, and Updating a Comprehensive and Equitable State Climate Change Adaptation and Resilience Plan<br>AR2. Incorporate Equitable Adaptation and Risk-Reduction Considerations into Relevant State Funding and Regulatory Programs, Projects, and Policies<br>AR3. Strengthen Meaningful Community Engagement and Public Education and Build Adaptive Capacity across All Sectors<br>AR4. Identify and Evaluate Options for Supporting Equitable Adaptation and Resilience Practices and Projects, and to Enhance Insurance Protection |
| Communities and Infrastructure | AR5. Provide State Agency Planning and Technical Support for Equitable Regional and Local Adaptation and Resilience Plans and Projects<br>AR6. Evaluate Opportunities to Ensure Equitable Consideration of Future Climate Conditions in Land-Use Planning and Environmental Reviews<br>AR7. Develop Policies, Programs, and Decision Support Tools to Reduce Risks Associated with Coastal and Inland Flooding<br>AR8. Develop Policies and Programs to Reduce Human Risks Associated with New Patterns of Thermal Extremes<br>AR9. Ensure the Reliability, Resilience, and Safety of the Energy System |
| Living Systems | AR10. Develop Policies and Programs to Reduce Risks Threatening Ecosystems and Biodiversity<br>AR11. Enhance Climate Resilience and Adaptive Capacity of the Agricultural Sector, while Preparing to Take Advantage of Emerging Opportunities<br>AR12. Preserve and Protect the Ability of Forest Ecosystems to Sequester Carbon |

### *Priority Actions*

Each strategy comprises several actionable components. Actions that provide the leadership, direction, and resources necessary for New York to fully address its substantial vulnerabilities, while prioritizing equitable treatment for all are listed here as the highest priority for implementation. These highest-priority actions are to appoint a chief State resilience officer (CSRO); convene an adaptation and resilience sub-cabinet; develop a comprehensive State climate change adaptation and resilience plan, based on a common vision of resilience; develop a policy on evaluation of equity and justice impacts of State

adaptation and resilience decisions and of existing impacts of displacement and harm, and provide guidance on use of such evaluation to prioritize action in Disadvantaged Communities; establish a campaign to build student and public awareness of climate change effects and solutions; and create a resilient infrastructure fund through bonding.

Additional actions that are important to ensure availability of information, financial resources, and regulatory authority to adapt to reduce risks associated with climate hazards are listed here as high priority. High-priority actions include continuing the ongoing update to New York's climate change assessment and initiating other research; adopting a process to ensure integration of State infrastructure investments to ensure efficient use of land and other resources, and consideration of adaptation and resilience; reporting on options to enhance hazard mitigation funding and to prefund disaster recovery, and to transfer catastrophic risk to the insurance and capital markets; supporting development of local resilience, continuity and adaptive capacity; facilitating consideration of climate change in local regulatory and planning programs; and developing or updating guidance for mitigation of climate change risks in permit and SEQRA reviews.

State agencies must pay particular attention to ensuring the availability of resources to enhance climate resilience in Disadvantaged Communities. Interagency coordination to ensure effective delivery of these resources to Disadvantaged Communities will be critical to their success.

### *Indicators, Metrics and Monitoring*

Development and tracking of indicators and metrics will be critical components of planning and implementation of the recommended actions. Process metrics should be developed during work planning, and program plans and policies should include descriptions of indicators and metrics to be tracked and, where appropriate, reported. However, as most of the following strategies comprise recommendations to develop plans, detailed discussion of indicators and metrics, and the means to monitor them, is beyond the scope of this document and premature for most of the recommended actions. Indicators, metrics, and monitoring programs should be developed during work planning for each recommended action. Resilience Metrics is one of numerous resources available regarding selection of indicators and metrics.[249]

[249] Resilience Metrics can be accessed at http://resiliencemetrics.org/.

## *Building Capacity*

### *AR1. Commit to Creating, Implementing, and Updating a Comprehensive and Equitable State Climate Change Adaptation and Resilience Plan*

New York is vulnerable to a variety of climate hazards, many of which will become more severe as the climate changes, and suffers substantial property loss, as indicated in Table 17. Note that the values reported in the table include only personal and public property losses and do not include long-term economic losses, medical costs, or loss of life. Despite this vulnerability, New York has not committed substantial resources to comprehensive adaptation planning and coordination. The Council recommends that the State couple its nation-leading goals to mitigate climate change with similarly ambitious goals to adapt to it.

**Table 17. Average Annual Property Loss from Severe Hazard Events in New York, 1996–2017**

| Hazard | Avg. loss | Hazard | Avg. loss | Hazard | Avg. loss |
|---|---|---|---|---|---|
| Flooding | $67,100,000 | Ice Storm | $1,670,000 | Lightning | $176,000 |
| Wind | $11,300,000 | Coastal Hazards | $1,620,000 | Heat Wave | $86,000 |
| Snowstorm | $9,400,000 | Cold Wave | $836,000 | Tsunami/Seiche | $18,000 |
| Hail | $3,330,000 | Hurricane | $470,000 | Wildfire | $4,640 |
| Tornado | $1,810,000 | | | | |

### Components of the Strategy

- **Provide executive-level coordination of adaptation and resilience activities:** The Governor should appoint a chief State resilience officer (CSRO), who would convene an adaptation and resilience sub-cabinet. Importantly, the CSRO's portfolio must include all State adaptation and resilience activities, including oversight of relevant bond fund expenditures, and not be limited to disaster response.
- **Develop an adaptation and resilience plan:** The CSRO and adaptation and resilience sub-cabinet should oversee development of a comprehensive State climate change adaptation and resilience plan.
- **Complete vulnerability assessments and adaptation plans:** DEC, with support from OGS and AECOM, should complete preliminary agency vulnerability assessments and adaptation plans, and identify and prioritize State adaptation and resilience projects.
- **Continue assessments and research:** NYSERDA should continue its ongoing update to New York climate change assessment, and DEC or other agencies should initiate or fund additional research.

### *AR2. Incorporate Equitable Adaptation and Risk-Reduction Considerations into Relevant State Funding and Regulatory Programs, Projects, and Policies*

Incorporating equity into adaptation considerations in State programs is important for ensuring Disadvantaged Communities are protected against the effects of climate change. Implementation of this strategy would include incorporating equity and justice considerations into these programs, consistent use of science-based projections in State decision making, and development of climate-resilient design guidelines for State-funded projects, among others.

#### Components of the Strategy

- **Provide guidance on use of climate change projections:** DEC should release guidance describing projected climatic changes to support relevant decision making.
- **Coordinate infrastructure investments:** The CSRO should provide recommendations to the Executive Chamber to adopt a process to ensure integration of federal, State, and local infrastructure investments to ensure efficient use of land and other resources, and consideration of adaptation and resilience.
- **Evaluate equity and justice:** The CSRO should develop a formal policy on evaluation of equity and justice impacts of State adaptation and resilience decisions and provide guidance on use of such evaluation to prioritize action in Disadvantaged Communities.
- **Adopt resilient design guidelines:** OGS and DEC should convene a work group to adopt climate resilient design guidelines for State-funded projects.
- **Amend the Smart Growth Public Infrastructure Policy Act:** The State should amend the Smart Growth Public Infrastructure Policy Act and similar statutes to require consideration of climate hazards and development of guidance by relevant agencies.
- **Enhance design capacity:** OGS should convene a work group to establish policies and procedures to require design professionals and contractors on State-funded projects to consider future climate conditions.
- **Assess climate vulnerabilities during land and water planning:** DEC, DOS and other agencies that fund land or water planning activities should adopt policies to ensure all State-funded land and water use plans include assessment of climate vulnerabilities and, as appropriate, strategies to promote resilience and reduce risk.

### *AR3. Strengthen Meaningful Community Engagement and Public Education and Build Adaptive Capacity across all Sectors*

Public awareness of the need for the Climate Act and its implementing actions is critical to its ultimate success. Ensuring individual and household resilience will be crucial in reducing risks associated with climatic events. Climate adaptation provides significant opportunity for vocational training and job growth that can be targeted to vulnerable communities and those in transition from reliance on fossil-fuel based industries.

#### Components of the Strategy

- **Raise student and public awareness:** The State Education Department should convene a work group to establish a campaign to build student and public awareness of climate change effects and solutions.
- **Provide disaster preparedness and response training for building operations staff:** NYSERDA and partner agencies should establish a program to train building operations staff in disaster preparedness and response.
- **Establish a resilience audit program:** NYSERDA, in consultation with DEC, HCR, OTDA, and the New York State Division of Homeland Security and Emergency Services (DHSES) should establish a residential and small business resilience audit program.

### *AR4. Identify and Evaluate Options for Supporting Equitable Adaptation and Resilience Practices and Projects, and to Enhance Insurance Protection*

The costs of dealing with the effects of climate change will be significant and will continue to rise as the planet warms. These costs may include investments to reduce risk or costs to respond to, and recover from, natural events, exacerbated by climate change. Unfortunately, the benefits of these investments are often difficult to quantify as they generally consist of avoided remedial costs, and the payback is generally realized only after an event occurs, or some dangerous threshold is crossed. Although insurance can serve to spread risk, strategies to enhance insurance coverage must include consideration of renters and owners of at-risk properties who do not participate in the National Flood Insurance Program, and the potential effects of insurance premium increases on low-income households. The components of this strategy are intended to secure the funds necessary to make necessary investments in resilience and enhance insurance protection.

### Components of the Strategy

- **Create a resilient infrastructure fund:** The State should create a resilient infrastructure fund through bonding.
- **Establish an insurance-premium surcharge for high-value, high-risk properties:** Impose a surcharge on insurance premiums for select lines of insurance to support risk-reduction and adaptation projects.
- **Authorize community preservation funds for all municipalities:** The State should enact legislation authorizing all municipalities to establish community preservation funds.
- **Focus anchor-institution investment on community benefit and wealth building:** DOH should encourage anchor institution (large, usually nonprofit organization tethered to their communities, like universities, medical centers, or local government entities) to focus community benefit investments on projects to equitably address climate change and build local community wealth.
- **Explore hazard mitigation funding alternatives:** The Division of Budget, or other appropriate agency, should report on options to enhance hazard mitigation funding and to prefund disaster recovery, and to transfer catastrophic risk to the insurance and capital markets.
- **Improve insurance coverage:** DEC and partners at all levels of government should implement strategies to increase take-up rates of flood insurance and other coverage related to climate hazards.
- **Restrict anti-concurrent causation clauses:** The State should adopt legislation to prohibit or restrict anti-concurrent causation clauses for sewer backup insurance coverage where flooding is the cause.

## *Communities and Infrastructure*

### *AR5. Provide State Agency Planning and Technical Support for Equitable Regional and Local Adaptation and Resilience Plans and Projects*

Local officials have consistently advised that they lack resources, including not only funds, but technical expertise and access to information and decision-support tools to support effective adaptation planning. This strategy would accelerate current efforts to provide guidance, and financial and technical support for community and regional planning and implementation, for mainstreaming of climate change considerations into local planning and regulatory programs, and for consideration of local economic resilience under future climate conditions in planning decisions. This strategy would also provide planning for climate-induced migration, both into and within the State.

### Components of the Strategy

- **Develop local adaptation capacity:** DEC, DOS and other agencies should support development of local resilience, continuity and adaptive capacity; and consideration of climate change in local regulatory and planning programs.
- **Promote local economic resilience:** DOS, ESD, and other relevant agencies should support development of local economic resilience strategies, climate-adapted economic development, business continuity planning, and local government climate financing and budgeting.
- **Deploy online tools:** DEC and partner agencies, including DOS, NYSERDA, DHSES, and the Office of Information Technology Services, should support deployment of online tools to facilitate vulnerability assessments, adaptation planning and implementation.
- **Support recovery planning:** DOS and DEC should support community-led pre-event, long-term recovery planning.
- **Consider relocation and buyouts:** NYSERDA, in consultation with DEC, HCR, and DOS, should analyze relocation and buyout of properties as potential alternatives to electrification of at-risk buildings.
- **Establish post-disaster strike teams:** The CSRO should establish strike teams to equitably assist municipalities with resilient post-disaster recovery.
- **Plan for climate migration:** DEC should convene a work group, to include NYSERDA, DOS, HCR, DHSES, Governor's Office of Storm Recovery, subject experts from SUNY or other universities, and refugee resettlement agencies, to develop a strategy to address climate migration, including consideration of differential effects of relocation strategies in disadvantaged communities.

## *AR6. Evaluate Opportunities to Ensure Equitable Consideration of Future Climate Conditions in Land-Use Planning and Environmental Reviews*

Work to mainstream consideration of climate change in environmental reviews is ongoing, but much remains to be done, and local governments require more explicit authority to consider climate change and biodiversity in comprehensive plans.

### Components of the Strategy

- **Provide guidance on assessment of climate risks:** DEC should accelerate ongoing efforts to develop or update guidance for mitigation of climate change risks in permit and SEQRA reviews; and amend the SEQRA Handbook and workbooks.

- **Facilitate adaptation projects:** DEC should amend the project review process to facilitate approval of climate adaptation projects.
- **Consider climate and biodiversity in comprehensive plans:** Amend relevant legislation to include consideration of climate mitigation, adaptation and resilience, and biodiversity as potential topics in comprehensive plans.

### *AR7. Develop Policies, Programs, and Decision Support Tools to Reduce Risks Associated with Coastal and Inland Flooding*

Flooding is New York's primary climate hazard, and we can expect both insured and uninsured losses to increase as sea level continues to rise and more frequent extreme precipitation events result in more extensive and deeper floods, including dangerous flash flooding in urban areas not previously considered flood prone. Components of this strategy would provide improved map and other information resources, funding, and regulations to reduce flood risks.

#### Components of the Strategy

- **Increase pace of floodplain assessments:** DEC should increase the pace of local floodplain assessments to identify flood hazards.
- **Right-size infrastructure:** DEC should hire a statewide technical assistance coordinator to support municipalities in right-sizing culverts and bridges to reduce flood risk and improve habitat connectivity.
- **Support Community Rating System participation:** DEC and DHSES should provide support and incentives for municipal participation in the Federal Emergency Management Agency's Community Rating System.
- **Strengthen State building code:** DOS should amend State building code to account for sea-level rise and enhanced riverine flooding, and potential use of innovative structures, such as amphibious buildings.
- **Develop statewide mapping strategy:** DEC should develop a statewide flood-risk mapping strategy.
- **Digitize dam failure inundation maps:** DEC should digitize dam failure inundation maps and integrate with other geographic resources to improve emergency planning and response, and explore approaches to use these maps to enhance public information and outreach efforts.
- **Support dam removals:** DEC should support dam removals that reduce flood risk and improve aquatic habitat quality.

### *AR8. Develop Policies and Programs to Reduce Human Risks Associated with New Patterns of Thermal Extremes*

In most years, more Americans die from the effects of extreme heat than from flooding and frequency of extreme heat events is one of the most direct effects of global warming. At the same time, changes in atmospheric circulation patterns, perhaps precipitated by loss of sea ice, may lead to periods of extreme cold in New York. Components to this strategy include support for cooling centers, heat emergency planning, weatherization, and access to thermal resilience programs for vulnerable populations.

#### Components of the Strategy

- **Develop cooling centers and enhance accessibility:** DEC and DOH should continue to support development and operation of cooling centers, including assessments to increase accessibility via public transportation.
- **Develop regional and local heat emergency plans:** DOH should support development of regional and local heat emergency plans that prioritize the health and stability of vulnerable communities.
- **Strengthen weatherization requirements:** DOS should amend the State building code to require more effective weatherization from thermal extremes.
- **Enhance thermal resilience in vulnerable populations:** OTDA and NYSERDA should promote and facilitate access to programs that provide cooling, weatherization, and solar assistance to vulnerable populations.
- **Conduct outreach to reduce risks of extreme heat:** DOH and others should assess adequacy of current advisories and adopt a plan to address deficiencies.
- **Adopt a green infrastructure plan:** DEC and others should develop a strategy to promote and incentivize use of green infrastructure and natural resources, including urban forests, to reduce climate risks.

### *AR9. Ensure the Reliability, Resilience, and Safety of the Energy System*

The increasing frequency of severe climatic events has exposed vulnerabilities in the State's energy system and the need to improve the reliability and resilience of the energy system, as well as the resilience of those who depend on that energy system in buildings and for transportation. Assessment of system vulnerabilities to increasing climate hazards and investment to ensure system resilience will be required. Energy system providers must continually reassess infrastructure vulnerabilities across the entirety of their service territories to determine appropriate resilience initiatives to mitigate potential

disruptions due to the effects of climate change and make their infrastructure more adaptable to weather extremes.

### Components of the Strategy

- **Establish energy system resilience standards and assess vulnerabilities:** The PSC should establish resilience standards and require public and investor-owned utilities and generators to assess vulnerabilities to climate hazards and to develop and implement agency-approved risk-reduction plans.
- **Develop strategies for grid outages and extreme weather events:** The CSRO or other designated individual should convene a work group, comprising DPS, DHSES, DOT, DEC, NYSERDA, NYPA and other relevant entities, to develop strategies to ensure availability of fuel and power for emergency vehicular fleet operations and essential public transportation during power grid outages. This work group should also establish a resilience plan for EV-charging infrastructure to ensure access to transportation, including evacuation during extreme weather events.
- **Promote capital improvements:** NYSERDA, in consultation with DPS, DOS, and other relevant entities, should promote capital improvements in buildings to endure grid failures and to facilitate buildings' ability to accept power when system re-energized.
- **PV and EV-charging in building code:** DOS, in consultation with NYSERDA, should include requirements for PV and EV-charging readiness in the building code.
- **Support local renewable systems:** NYSERDA, in consultation with DPS, DHSES, and local governments should develop a comprehensive strategy to support development of islandable microgrids and district systems using renewable sources of energy to provide locally generated power, especially in critical facilities during grid emergencies.

## *Living Systems*

### *AR10. Develop Policies and Programs to Reduce Risks Threatening Ecosystems and Biodiversity*

The components of this strategy provide for a variety of mechanisms to ensure conservation or protection of the most important pieces of our life-sustaining ecosystems. These initiatives include a focus on intentional planning to identify and protect critical ecosystems and to establish and protect connectivity at several scales, ranging from the landscape scale to enable populations to migrate northward and upward as the climate warms, to project-specific planning to ensure wildlife and aquatic organism connectivity.

### Components of the Strategy

- **Improve local wildlife and aquatic connectivity:** DEC and DOT should improve local wildlife and aquatic connectivity, including through use of standardized environmentally friendly design features, during transportation infrastructure improvement projects, as practicable, and as identified by statewide critical terrestrial and aquatic habitat and conservation planning efforts.
- **Expand conservation easements to include other areas:** DEC and AGM should expand development of conservation easement and incentive programs (such as the Source Water Buffer Program) to include areas of farms set aside for conservation of wetlands, stream corridors, riparian buffers, or wildlife corridors.
- **Incorporate BMPs from species management plans:** DEC, ORES, NYSERDA, DOS, and DOT should incorporate BMPs from species management plans into State and federally funded or regulated projects, including renewable energy projects, in or near occupied habitats to reduce and mitigate ecosystem impacts.
- **Amend Real Property Tax Law to incentivize private forest stewardship:** The State should enact legislation to amend Real Property Tax Law to incentivize private forest stewardship for a broader range of goals, including biodiversity, wildlife habitat protection, water resource protection, outdoor recreation, and carbon sequestration.
- **Prioritize biodiversity and carbon sequestration:** DEC should heighten consideration of biodiversity and enhancement of carbon sequestration among the priorities in State forest land planning and adopt guidance for development of unit management plans that includes conservation of biodiversity and increased carbon sequestration as priorities.
- **Expand implementation of ISCMP:** DEC and AGM should advance biocontrol of forest pests, and expand implementation of relevant parts of the ISCMP, including two key ISCMP priorities: advance prevention and early detection, and improve the response to invasive species.
- **Ensure protection of stream buffers:** The State should create a regulatory program to ensure protection of stream buffers to protect and enhance water and habitat quality, reduce flood risk, and prevent soil erosion.

## *AR11. Enhance Climate Resilience and Adaptive Capacity of Agricultural Sector, while Preparing to Take Advantage of Emerging Opportunities*

Included below are recommendations to improve water and energy efficiency on farms, incorporate other climate-resilient practices into farm operations, and continue research and outreach to help farmers prepare for the effects of a changing climate. However, these recommendations do not address the entire

gamut of climate hazards New York growers face and should not be interpreted as a complete agricultural adaptation plan.

### Components of the Strategy

- **Establish a farm water and energy efficiency program:** AGM and NYSERDA should develop and support a water and energy efficiency realization program to meet agricultural needs related to climate change, including decision-support tools, power upgrades and strategies to reduce equipment costs.
- **Promote resilient crops:** The State should expand support for research and outreach on climate-resilient crop varieties; technology to provide freeze and frost protection; strategies to address invasive species, pathogens and pests; and increased use of perennial crops for food and feed.
- **Promote agricultural and watershed-based BMPs:** AGM should assess, develop, and promote agricultural and watershed-based BMPs for flood attenuation, drought mitigation, and water quality protection.

## *AR12. Preserve and Protect the Ability of Forest Ecosystems to Sequester Carbon*

In recognition of the important role healthy forests play in sequestering carbon, ensuring forests retain their sequestration potential under future conditions should be considered in State acquisition programs. As with agriculture, this strategy does not constitute a complete adaptation plan for our forests. Many recommendations described in strategy 21.2.10, Develop Policies and Programs to Reduce Risks Threatening Ecosystems and Biodiversity, also address the goal of protecting the ability of our forests to continue to sequester carbon. This strategy complements the strategies described in *Chapter 15. Agriculture and Forestry*, which serve to enhance the ability of our forests to remove $CO_2$ from the atmosphere and sequester it in healthy trees and forest soils.

### Component of the Strategy

- **Consider resilience in land acquisition:** DEC, OPRHP, AGM, and other agencies and authorities should include resilience criteria in State acquisition programs.

# Measuring Success

## Chapter 22. Essential Elements

With State-level actions such as the passage of the Climate Act and continued procurement of large-scale renewable energy resources, New York has proven to be a leader in addressing climate change. The development of this draft Scoping Plan advances New York to the next level. It has been well established that the threat of climate change is great and can only be fully addressed when stakeholders are in alignment and coordinate mitigation efforts. Success of this Plan requires active engagement across several essential elements including partnerships, outreach and education, and workforce development.

### 22.1 Partnerships

New York witnessed the importance of partnerships firsthand in the response to the COVID-19 pandemic. From supply chains, businesses, and people to science, resources, and policies, New York is inextricably linked to the international community. When New York leads, the results echo loudly to its peers, but it cannot stand alone. Partnerships with a wide range of entities will be critical to ensure the success of this draft Scoping Plan and reaching the State's climate mandates. New York has long been part of collaborative environmental projects and programs at the federal, regional, and local levels. Programs such as the RGGI and participation in the USCA have enabled New York to make progress at the State level while having a greater regional and national impact.

Climate change is a global issue and impacts in one region can affect the entire system. Collaborative efforts are critical to ensure successful and consistent climate policy on a greater scale. While New York continues to act at the State level, federal action, and continued cooperation at the regional and national levels, is vital to increase overall policy effectiveness and minimize leakage to the greatest extent. When all levels of government work together, climate action is accelerated, resources are shared more efficiently, and jurisdictions can address the impacts in a more wholistic way.

Climate change also presents a unique need and opportunity for interagency collaboration at the State level. New York recognizes that communication and collaboration are essential to the success of our efforts. State agencies came together as a team in supporting the development of this Plan. DEC and NYSERDA will continue to lead in the implementation of the Climate Act, but the collaboration must continue and expand as we move forward with implementing the Scoping Plan. Actions will be required by all State agencies in order to meet GHG reduction requirements and build resiliency to adapt to the changing climate, as noted in the sector strategies. Continued cooperation between the Legislature,

agencies, and authorities will be important to ensure that the appropriate authority exists to carry out the different initiatives laid out in this draft Scoping Plan.

### *Federal Action*

While New York will continue to lead on addressing climate change, action is needed at the federal level to reduce nationwide GHG emissions and protect businesses and communities from the harmful effects of global climate change. Only a national approach will provide the emission reductions of a scale necessary to mitigate potentially catastrophic climate change. The federal government has taken measures to address climate change and reduce GHG emissions through the Clean Air Act and related actions, such as the regulation of GHGs from cars, trucks, and buses. While other initiatives such as the Clean Power Plan are no longer being developed, the Biden Administration has set a target to reduce economy-wide GHG emissions by 50% to 52% of 2005 levels by 2030. Recent action to implement the American Innovation and Manufacturing Act and phasedown HFCs is reassuring to see the federal government once again taking responsibility for controlling HFC emissions and reinstating its leadership role in international policy.

The federal government's strides to increase offshore renewable energy development and expand transmission capacity is critical to the transition to a clean economy. New York will continue to advocate for additional statutory and regulatory measures to reduce GHG emissions and to green the electricity grid while communicating the importance of avoiding federal preemption and allowing states to take additional action.

The Biden Administration's Justice40 Initiative seeks to address the history of national environmental policy decisions that have failed to adequately account for environmental injustice, including the disproportionate, disparate, and cumulative impacts pollution and climate change have on low-income communities and communities of color. The consideration of environmental justice and impacts to overburdened and underserved communities at the national level amplifies the benefits New York's Disadvantaged Communities will realize from the Climate Act.

EPA initiatives such as the State and Local Climate and Energy Program offer tools and data that can help states make informed energy efficiency and renewable energy decisions. Building on such a framework and expanding incentive opportunities is another way that federal partners will be critical to ensuring climate action on a greater scale.

A less direct federal program, such as the EPA's Clean Water State Revolving Fund, is another example of federal action that promotes climate change mitigation and adaptation. Providing these funds enables states to make critically needed improvements to wastewater and drinking water infrastructure, which in turn allows communities to be more prepared for increased heavy precipitation events.

New York has also recognized gaps that have been left by the federal government and has taken action to address those gaps. When the federal government withdrew from the Paris Agreement, New York worked collaboratively and formed the USCA, which enables states to set similar goals and share data and best practices to set and achieve climate goals.[250]

### *Regional Collaboration*

Northeast and Mid-Atlantic states have a history of working together to explore regional policies to reduce carbon emissions and other pollutants. Most states in the region, as well as the District of Columbia, have set economy-wide GHG reduction goals through statute, executive order, or in climate change or energy plans. Working in partnership with other jurisdiction can magnify the benefits and reduce the costs of climate action.

As a member of RGGI, the first cap-and-invest program in the United States, New York has used this regional market-based mechanism to drive down GHG emissions in the power sector, while raising funds for environmental initiatives statewide. New York has also taken more recent regional action, including signing a MOU with 14 other states and Washington, D.C. to commit to a goal that 100% of all new sales of MHD trucks be ZEVs by 2035.

New York also participates in several and various regional research initiatives and programs:

- Great Lakes Commission
- Great Lakes St. Lawrence Governors and Premiers[251]
- Great Lakes Wind Feasibility Study

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[250] United States Climate Alliance. 2020. Leading the Charge: Working Together to Build an Equitable, Clean, and Prosperous Future. Accessed November 2021 at https://static1.squarespace.com/static/5a4cfbfe18b27d4da21c9361/t/5f6cacb1258a2d77dedbf60c/1600957656553/USCA_2020+Annual+Report_Leading+the+Charge.pdf.

[251] Members of Great Lakes St. Lawrence Governors and Premiers work as equal partners to grow the region's $6 trillion economy and protect the world's largest system of surface fresh water.

- Chesapeake Bay Watershed Program[252]
- The Peconic Estuary Partnership
- Hudson River Estuary Program
- Hudson River National Estuarine Research Reserve[253]

These initiatives enable governments to share data and collaborate on potential solutions to climate-related issues facing various communities. It illustrates that there are several different ways for states to participate on a regional scale. New York will continue to strive for regional participation in order to use the most cost-effective and efficient options for GHG mitigation.

### *Supporting Local Governments*

Local governments are on the frontlines of addressing climate change. Local leaders are the most well-equipped to understand community needs and are uniquely positioned to take action that will reduce GHG emissions. Implementing many of the strategies in this draft Scoping Plan will require action by local governments. New York's local governments have their hands full meeting the day-to-day needs of their communities. These strategies will not be successful without providing adequate support for local governments. New York has worked to address this through programming across several agencies. The Climate Smart Communities program at DEC offers technical assistance and guidance, as well as grant opportunities to local governments. It enables participating governments to transition to a clean economy and improve their climate resiliency. Through its NY-Sun program, NYSERDA offers guidance and technical assistance to local governments to facilitate the expansion of solar development, and through its Clean Energy Communities program NYSERDA distributes grants to local communities that showcase actions that have a high impact on the community's ability to become more sustainable overall.

New York also supports local governments through the REDC initiative. Through a consolidated funding process, regional councils can apply for grants for different projects and programs, many of which are geared toward environmental protection.

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[252] The Chesapeake Bay is the largest estuary in the United States. It is home to more than 2,700 species of plants and animals and produces about 500 million pounds of seafood per year. The Bay's watershed covers portions of six states and Washington, D.C.

[253] Information regarding the partnership between the National Oceanic and Atmospheric Administration, DEC's Office of Climate Change, and the U.S. Climate Alliance can be accessed at https://www.hrnerr.org/usca-prioritizing-nys-coastal-wetlands-for-resilience-and-blue-carbon/.

Continued support of New York's local governments is critical to enable the State to take climate action. Strategies in *Chapter 19. Land Use* and in *Chapter 20. Local Government* of this Plan provide a solid foundation to support local government decision making to meet the emission limits. Initiatives in these chapters include the development of a community dashboard to promote local planning and measure progress and strategies to enable the deployment of renewable energy resources across the State.

### *Other Partnerships*

Partnerships will need to expand beyond governmental actors in order to successfully mitigate and adapt to climate change. The sector strategies discuss the dozens of stakeholders that should be engaged when considering and implementing the GHG emissions mitigation strategies in this Plan. Stakeholder engagement in the implementation of the Scoping Plan is essential to ensure the policies and programs are responsive to the needs of the stakeholder community and meet the equity requirements of the Climate Act. New York will continue to seek collaborators such as educational institutions, community-based organizations, labor, industry, and not-for-profit organizations, as well as engage in public/private partnerships. The New York SmartGrid Consortium is one example of a wide variety of entities working together to improve the reliability and resiliency of the electric grid.[254]

Economy-wide cooperation is critically necessary to address climate change. These partnerships have proven successful and will need to expand moving forward. While New York can and will continue to set examples for other states through statewide action, this Plan recommends advocacy for additional action at the federal level, as well as cooperation with regional and local governments, and the broader stakeholder community to ensure that GHG reduction requirements are met.

## 22.2 Outreach and Education

Outreach and education to empower every New Yorker to take part in the transition to a low-carbon economy are essential elements to ensure successful implementation of the Climate Act and the strategies described in this draft Scoping Plan. Throughout this Plan there is the acknowledgement of the need for outreach and education, from increased outreach to farmers about nutrient management in the agricultural sector to engaging the public through marketing campaigns about the transition to energy-efficient and all-electric buildings. The scale of change outlined in this Plan requires a coordinated effort on outreach and education across all sectors of the economy. There are efficiencies of cost and time to be gained by developing a comprehensive outreach and education campaign rather than conducting this outreach by

[254] Information regarding the New York SmartGrid Consortium can be accessed at http://nyssmartgrid.com/.

sector or by programs. Avenues to accomplish this include public education campaigns, targeted outreach to current or potential regulated entities, engagement with researchers and innovators, and general engagement and outreach to the key stakeholders that will be involved in the implementation of the various strategies. Recommendations presented by the Advisory Panels to the Council related to outreach and education included commonalities across sectors such as developing new curricula in higher education and ensuring coordination between the State and local governments when engaging residents about climate action.

## 22.3 Workforce Development

Another essential element to the success of this Plan is workforce development. In addition to the recommendations from the JTWG in *Chapter 7. Just Transition*, there are other sectors of the economy that will need to transition their workforce to meet the needs of the low-carbon economy envisioned by this draft Scoping Plan. The chapter discussed the mechanisms that the State uses and should continue to use or expand upon to develop a skilled workforce that will be able to implement the strategies included in the electricity, industry, and buildings sectors, among others. Workforce development will also be essential in the transportation, agricultural, forestry, and waste sectors.

The strategies and principles detailed by the JTWG can be applied to these sectors to ensure a just and equitable transition across the whole economy and will generate numerous opportunities for New York's existing and emerging workforce.

# Chapter 23. Reporting

Successful implementation of this draft Scoping Plan strategies requires monitoring and reporting on the results of our efforts and a robust public process. Reporting requirements are structured to provide transparency and public access to information and awareness of where improvements can be made in our emissions reduction activities. Information ranging from annual GHG emissions to how well the policies implemented are working to meet the GHG emission limits will be released in a range of reports that are required by the Climate Act. Some of these reports are annual while others have a longer process. Reporting will be important for tracking how New York is meeting the GHG emission limits.

## 23.1 Annual Inventory

DEC will issue an annual inventory of GHG emissions in New York starting no later than January 1, 2022, as required by the Climate Act.[255] Due to the nature of emissions reporting and data collection, there is a lag in when emissions for a certain year are available to be incorporated into the inventory. This time lag is related to the cycles of reporting and processing of the data. This information delay will result in each inventory reporting the emissions from two years prior, as the most recent information available.

This annual inventory report will include information on all GHG emission sources in the State, including the relative contribution of each type of GHG and each type of source to the statewide total. The report will also include, as part of the statewide total, an estimate of GHG emissions from the generation of electricity imported into New York and from the extraction and transmission of fossil fuels imported into the State.[256] DEC will continually refine and improve the methodology used by the annual inventory report based upon the best available information and informed by public feedback.

## 23.2 Implementation Report

Every four years DEC will issue a report, after consultation with the Council and the CJWG, on the implementation of GHG reduction measures, as required by the Climate Act. The first implementation report will be released no later than January 1, 2028.[257]

[255] ECL § 75-0105(1).

[256] ECL § 75-0105(3).

[257] ECL § 75-0119.

The implementation report will include, but is not limited to, an analysis of whether New York is on track to meet the statewide GHG emission limits and if the existing regulations are sufficient to meet the limits or require modifications. Information on the social benefits from the regulations and on the compliance costs for regulated entities, DEC, and other State agencies will also be included. The report will also highlight the impacts from regulations on Disadvantaged Communities and their access to or community ownership of services and commodities identified in the Barriers and Opportunities Report. The Implementation report will provide information to the public on the progress toward achievement of the Climate Act requirements and will also serve to inform the regular updates to the Scoping Plan that are required under the Climate Act.

## 23.3 Review of Renewable Energy Program

Every two years, starting no later than July 1, 2024, the PSC will issue a comprehensive review of the renewable energy program established by the Climate Act. In this review, the PSC will evaluate the progress in meeting the overall targets for deployment of renewable energy systems and zero emission sources including factors that will, or are likely to, frustrate progress toward the targets. It will also examine the distribution of systems by size and load zone, and annual funding commitments and expenditures.

## 23.4 Air Quality Monitoring

The Climate Act establishes a Community Air Monitoring Program to be established by DEC by October 1, 2022. The Climate Act requires that DEC deploy community air monitoring systems in no less than four Disadvantaged Communities that have been identified as the highest priority for exposure to toxic air contaminants and criteria air pollutants. Information collected by these systems will be shared with the public and be used to inform the development of a strategy by June 1, 2024 to reduce emissions of these pollutants in Disadvantaged Communities affected by a high cumulative exposure burden.

This is an historic, new effort to monitor air quality in Disadvantaged Communities across the State and use the data collected to develop strategies to reduce pollution in these communities, including the GHGs that contribute to climate change. This statewide community air monitoring effort is the largest ever undertaken in the United States.

In consultation with the CJWG and community leaders, DEC and NYSERDA will identify 10 areas to deploy hyperlocal air monitoring technology to collect air quality data. Locations will include multiple Disadvantaged Communities statewide. Monitoring will include climate-altering GHG emissions and

other co-pollutants that affect public health. In total, the monitoring will provide a comprehensive picture of air quality in communities that are home to up to five million New Yorkers. The results of this monitoring effort will advance the Climate Act’s directive to reduce emissions in communities heavily impacted by air pollution and help to address the public health impacts due to this pollution, including higher rates of lung disease, asthma, heart disease, and premature death.

DEC will oversee the community air monitoring program, which will identify the areas experiencing the highest air quality impacts and help the State to better target mitigation activities, including a portion of carbon-free investments, to areas where these investments will provide the greatest public health and climate benefit. The monitoring will collect air pollution and GHG measurements to produce hyperlocal air quality insights for municipalities and researchers. To ensure robust community participation in the in the Community Air Monitoring program, DEC's Environmental Justice Program will provide Community Air Monitoring Capacity Building Grants to improve the ability of community groups working on the ground in these areas to contribute to the development and operation of air quality monitoring networks across the State. The increased capacity of community groups will also allow greater contribution in the identification and selection of carbon-free technology investments in their local neighborhoods.

# Chapter 24. Future Work

This draft Scoping Plan is designed to lay out the policies and programs necessary to help New York meet the emission limits established in the Climate Act. Following the release of this draft, the Council is required to hold at least six regional public hearings, with three located in the upstate region and three located in the downstate region. There will be at least 120 days to submit public comments on this draft Scoping Plan, providing meaningful opportunity for all segments of the population that will be impacted by this Plan, including New Yorkers living in frontline communities. Once the Council has conducted public outreach and the comment period has ended, it will evaluate the input received and make any appropriate changes. The final version of the Scoping Plan will be released no later than January 1, 2023. Going forward, New York will promulgate regulations, enact new laws, and adopt policies program to implement the strategies and recommendations in the final Scoping Plan.

The next State Energy Plan adopted by the State Energy Planning Board will incorporate the recommendations included in the final Scoping Plan. These recommendations will ensure that New York continues to reduce GHG emissions while also maintaining an affordable and resilient energy system.

The Climate Act requires that the final Scoping Plan be updated at least once every five years. As updated information about New York's progress on the GHG emission limits is reported, an updated Scoping Plan will be released to ensure that the policies in place will keep New York on the path to meet the requirements of the Climate Act.

# Appendices List

**Appendix A: Advisory Panel Recommendations**

**Appendix B: CJWG Feedback on Advisory Panel Recommendations**

**Appendix C: JTWG Recommendations to the Council on Measures to Minimize the Carbon Leakage Risk and Minimize Anti-Competitiveness Impacts of Potential Carbon Policies and Energy Sector Mandates**

**Appendix D: Power Generation Sites Identified by the JTWG**

**Appendix E: JTWG Recommendations to the Council on Issues and Opportunities Related to the EITE Entities**

**Appendix F: Environmental and Health Data for Quantifying Health Benefits of Climate Policy**

**Appendix G: Integration Analysis Technical Supplement**

**Appendix H: Adaptation & Resilience Recommendation Components**

# Appendix A: Advisory Panel Recommendations

# Transportation Advisory Panel

## Recommended Strategies

May 3, 2021

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## Transportation Advisory Panel members

- Marie Therese Dominguez, Chair, NYSDOT
- Jared Snyder, NYSDEC
- Julie Tighe, New York League of Conservation Voters
- Kerene Tayloe, WE ACT for Environmental Justice
- Nick Sifuentes, *formerly TriState Transportation Campaign**
- Bob Zerrillo, New York Public Transit Association
- Porie Saikia-Eapen, Metropolitan Transit Authority
- Steve Finch, AAA Western & Central New York
- Nancy Young, Airlines for America
- Dimitris Assanis, Stony Brook University
- Craig Turner, Buffalo Niagara International Trade Gateway Organization
- Paul Allen, M. J. Bradley & Associates
- John Samuelsen, Transport Workers Union of America AFL-CIO
- Kendra Hems, Trucking Association of New York
- Elgie Holstein, Environmental Defense Fund
- Renae Reynolds, *formerly New York City Environmental Justice Alliance*
- Albert Gore, Tesla

# Public and Stakeholder Input Process

**Panel Meetings:** The Transportation Advisory Panel held 12 full Panel meetings that were open to the public; all meeting presentations and notes have been posted to climate.ny.gov.

**Public Engagement Sessions:** Input from the public received during virtual forums in December 2020 and February 2021 and written comments are being received via email and mail.

**Climate Action Council Engagement:** Input from the CAC received in December 2020.

**Cross Panel Coordination:** Input from Ag & Forestry, Waste, Power Gen. and LULG Advisory Panels January – March 2021; input from the Climate Justice Working Group and Just Transition Working Group in February 2021.

**Expert Participant Engagement:**

December 2020: Public Transportation, Smart Growth and Electrification & Fuels round tables

January 2021: Market Based & Finance round table

March 2021: Environmental Justice and Health round table.

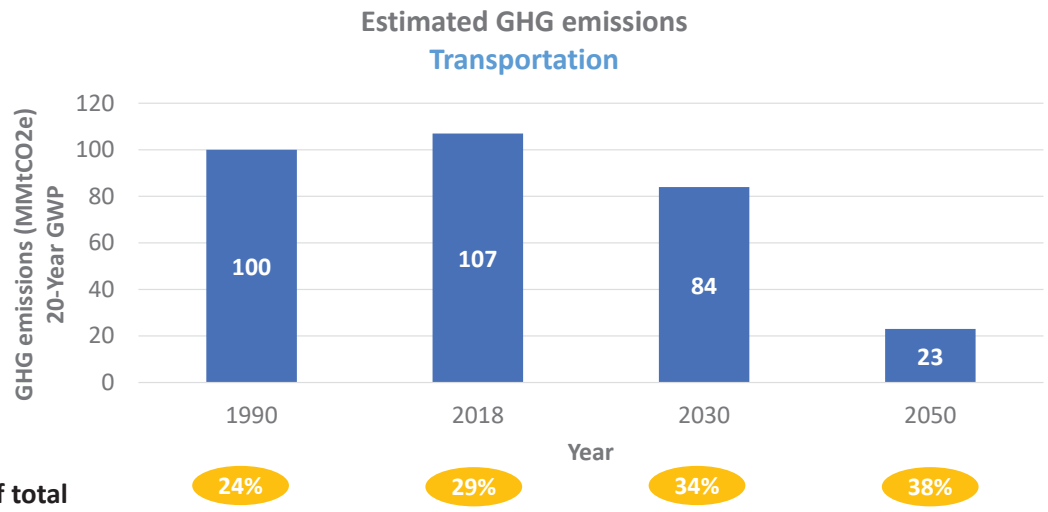
April 2021: Freight and Logistics round table.

Written comments will continue to be accepted through 2021: E-mail: transportation.publiccomment@dot.ny.gov

Letter: Transportation Advisory Panel: C/O Abigail Schultz, 6th Floor, Room 6N23, 50 Wolf Road, Albany, New York 12232



# Aggregate GHG emissions impact of Transportation panel recommendations




**% of total NY emissions**

**Scope (2018 Subtotal):**

- Fuel Combustion (80mmt)
- *Imported Fossil Fuels (27mmt)*

2018 emissions data are preliminary draft

# Electrification

## Mitigation strategy summary

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Transition to 100% zero-emission light duty vehicle sales | Regulatory, Financial, Legislative | High | Medium | $$$ |
| 2 | Transition to zero emission Medium/Heavy Duty Vehicles & Non-Road Vehicles | Regulatory, Financial, Legislative | High | Medium | $$$ |

*Note: Draft recommendations and associated timeframes that include regulations will depend on the type of regulation and its governing body and legislation, State Administrative Procedure Act rulemaking requirements and timelines, an ongoing assessment of feasibility, impacts and analysis of what timeframes are needed to meet New York State's climate goals.

# Mitigation strategy: 100% Zero Emission Passenger Vehicles - Overview

| | | | |
|---|---|---|---|
| **Description:** | Transition to 100% zero-emission light duty vehicle sales | | |
| **Action type:** | Regulatory, Financial, Legislative | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$$ - Nearly $1B in ratepayer and NYPA funding is already committed for EV charging station installations. ZEV incentives can be supported through a revenue-neutral feebate, but additional assistance may be needed to help LMI New Yorkers replace old gasoline vehicles with ZEVs | | |
| **Ease of implementation:** | Medium – some elements of this strategy have already been implemented in NYS; others are new to NYS but have been tried elsewhere | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Lack of consumer awareness/interest and consumer concerns about technology & charging/fueling<br>2. Potentially high cost of supporting charging/fueling infrastructure and ZEV incentives<br>3. Unmanaged charging could have significant costs for electric grid operators/ratepayers | 1. Coordinated and cooperative marketing campaign with industry partners<br>2. ZEVs are expected to reach price parity with gasoline cars by 2028; charging stations and fueling stations are better investments with more ZEVs on the road<br>3. Utility managed charging programs and TOU rates can help shift charging to lower cost off-peak times |



# Mitigation strategy: 100% Zero Emission Passenger Vehicles – Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Adopt Zero Emission Vehicle sales regulations | DEC | 1-2 years | NYSERDA, OEMs, car dealers, utilities |
| Feebate/ZEV purchase incentives: feebates would offer a rebate for ZEVs funded by a small fee on gasoline vehicles; higher rebates for LMI customers who buy new or used ZEVs. For LMI consumers. complement rebates with affordable financing options | DEC, NYSERDA, DOB | 1-2 years | Car dealers, OEMs |
| ZEV Awareness-Building Activities: jointly fund consumer engagement activities (advertising, educational events, dealer engagement) with local partners and OEMs | NYPA, NYSERDA | 6-12 months | Car dealers, OEMs, utilities, local businesses |
| Reduce ZEV sales barriers: allow direct-to-consumer sales by ZEV-only manufacturers, offer dealer incentives for franchise dealers | Legislature, DMV | 6-12 months | OEMs, car dealers |
| Electrify for-hire vehicles: provide incentives or requirements for FHV owners to purchase ZEVs, support charging/fueling stations for FHVs | DEC, NYSERDA, NYPA, NYC | 1-3 years | Taxi owners, ridehailing companies, charging station providers |

# Mitigation strategy: 100% Zero Emission Passenger Vehicles – Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Clean fuel regulations, such as a Low Carbon Fuel Standard for example, that support ZEV technology deployment | DEC, NYSERDA | 1-2 years | Fuel producers, utilities, fleet users |
| EV Charging/Fueling Station investments, focused on disadvantaged communities, multi-unit dwellings, fast charging, EV-ready building codes: provide rebates and additional direct investment in EV charging stations and hydrogen filling stations | DPS, NYPA, Utilities, NYSERDA, NYGB, DOS | 3-12 months | EV charging station developers |
| Utility Rate Design Changes: direct utilities to implement programs that encourage off-peak charging and/or controlled, managed charging, and to create appropriate rate options for high-powered charging | DPS | 6 months-2 years | NYPA, NYSERDA, utilities, technology providers, EV charging station developers, fleet owners |



# Mitigation strategy: 100% Zero Emission Passenger Vehicles – Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Enhanced incentives for residents of disadvantaged communities are essential for faster ZEV adoption in disadvantaged communities. Incentives that support used ZEV purchases and EV charging at multifamily buildings can be especially effective at increasing ZEV adoption among underserved populations. Local ownership of EV charging stations and workforce development can support economic opportunities in disadvantaged communities. |
| **Health and co-benefits** | Zero emission vehicles improve local air quality, with public benefits including improved public health, including a reduction in asthma and other respiratory illnesses. Complement electrification with power sector strategies to phase down reliance on peaking units in or near overburdened communities. |
| **Just transition: businesses and industries, workers** | Some ZEV components are made in NYS. New jobs will be created to service and fuel EVs. Installing charging stations will provide employment opportunities. Current repair technicians will likely need to be trained to service EVs. Businesses such as vehicle dealerships, parts manufacturing, gas stations, repair shops, and parts retailers may be adversely impacted as vehicle sales shift from internal combustion vehicles to ZEVs. Workforce development in disadvantaged communities. |
| **Other** | Regulatory strategies are aligned with other jurisdictions. |

# Mitigation strategy: Zero emission trucks, buses and heavy equipment – Overview

| | | | |
|---|---|---|---|
| **Description:** | Transition to zero emission Medium/Heavy Duty Vehicles & Non-Road Vehicles | | |
| **Action type:** | Regulatory, Financial, Legislative | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$$ - Incentives will be needed to encourage fleets to buy zero-emission trucks and help them install ZEV charging/fueling infrastructure until total cost of ownership improves compared to diesel trucks and private financing becomes more widely available | | |
| **Ease of implementation:** | Medium – some elements of this strategy have already been implemented in NYS; others are new to NYS but have been tried elsewhere | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. High upfront costs of electric trucks, buses, and equipment<br>2. Fleets and private financial institutions have very little experience with the technology<br>3. High-powered charging and hydrogen fueling can be expensive to install and can lead to high demand charges that make operating ZEVs expensive compared to diesel | 1. Total cost of ownership parity is expected by 2030 or sooner; private financing can mitigate upfront costs<br>2. Data collection and reports from early state-funded projects<br>3. Support for installing charging infrastructure from utilities, others; creative approaches to utility rates that create appropriate rate options for high-powered charging |



# Mitigation strategy : Zero emission trucks, buses and heavy equipment -- Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Adopt Zero Emission Vehicle sales regulations | DEC | 1-2 years | NYSERDA, OEMs, utilities |
| ZEV purchase incentives:<br>- Provide incentives for the purchase of ZEV trucks and buses, with a focus on fleets operating in disadvantaged communities, small fleets, and school buses<br>- Provide incentives for the purchase of non-road ZEVs, including airport GSE, cargo handling equipment, construction and farm equipment<br>- Provide incentives or offer buybacks for small engines, including electric yard and garden equipment and small marine vessels, and encourage local electrification requirements | DEC, DOT, NYSERDA, PANYNJ, SED, other port facilities | 1-5 years | OEMs, fleet operators, airlines, port operators, school bus operators, construction companies, agriculture industry, yard maintenance/lawncare industry, Ag & Markets |
| ZEV Equipment Use Requirements for State Fleet, Contractors: require an increasing % of equipment and vehicles used for state-funded projects to be ZEVs, up to 100% by a set date, to be determined based on product and related infrastructure availability | DEC, DOT, OGS, Other State Agencies | 3-5 years | Construction companies, manufacturers |
| Fleet-based ZEV Use Requirements (e.g. ports): require trucks in use at certain types of facilities, such as ports or airports, to be ZEVs by a set date, to be determined based on product and related infrastructure availability, and consider adoption of CA Advanced Clean Fleets rules or portions thereof | DEC, PANYNJ, other port facilities | 3-5 years | Fleet operators, airlines |

# Mitigation strategy : Zero emission trucks, buses and heavy equipment -- Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Clean fuel regulations that support ZEV technology deployment | DEC, NYSERDA | 1-2 years | Fuel producers, utilities, fleet operators, airlines |
| Utility Rate Design Changes: direct utilities to implement programs that encourage off-peak charging and/or controlled, managed charging, and to create appropriate rate options for medium-duty and heavy-duty vehicles and fleets | DPS | 6 months-2 years | NYPA, NYSERDA, utilities, technology providers, fleet operators |
| ZEV Charging/Fueling Station investments: provide rebates and additional direct investment in EV charging stations and hydrogen filling stations | DPS, NYPA, Utilities, NYSERDA, NYGB | 3-12 months | Fleet operators |
| Support electrification-based solutions to idle reduction:<br>- Work with utilities to increase use of cold ironing/shorepower for ships<br>- Support the use of technologies to enable idle reduction<br>- Reduce generator use on construction sites through temporary on-site power and DERs | NYSERDA, DPS, Utilities, OGS, DASNY | 3-5 years | Fleet operators, marine operators, construction companies, developers |
| Develop strategies to ensure availability of fuel and power for emergency fleet operations and essential public transportation during power outages | DOT, DPS, utilities, Transit operators | 3-5 years | Fleet operators |



# Mitigation strategy: Zero emission trucks, buses and heavy equipment – Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Diesel trucks and port equipment are one of the largest sources of local air pollution in disadvantaged communities. Removing diesel trucks and port equipment from use and replacing them with ZEV trucks and equipment would have a sizable impact on improving air quality in disadvantaged communities. Local ownership of electric trucks and buses and their associated infrastructure can support economic opportunities in disadvantaged communities. Incentives can be targeted to disadvantaged communities, guided in part by results of community air monitoring. |
| **Health and co-benefits** | Although they comprise only a small portion of total vehicles in the state, diesel trucks and buses are responsible for 30% of total PM and NOx emissions from mobile sources. Policies that encourage electrification of trucks, buses, and non-road equipment will generate significant public health benefits. These benefits will accrue across the state but will be especially noticeable along major highways and thoroughfares and in areas proximate to heavy industrial traffic, such as warehouse districts and ports which are often located near disadvantaged communities. Adopt complementary in-use standards to reduce emissions from existing diesel fleet. |
| **Just transition: businesses and industries, workers** | Some ZEV trucks, buses, and construction equipment and their components are made in NYS. New jobs will be created to service and fuel ZEVs; training needed for current service technicians. Installing charging stations will provide employment opportunities. Businesses such as vehicle dealerships, parts manufacturing, gas stations, repair shops, and parts retailers may need to adapt as vehicle sales shift from internal combustion vehicles to ZEVs. Workforce development in disadvantaged communities. |
| **Other** | Regulatory strategies are aligned with other jurisdictions. |

# Public Transportation

## Mitigation Strategy – Enhanced Public Transportation/Mobility

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Identify implementable strategies to significantly enhance the availability; accessibility; reliability; and affordability of public transportation services with an emphasis on unserved/underserved communities. This includes:<br>• Doubling the service availability/accessibility of municipally sponsored upstate and downstate suburban public transportation services statewide; and.<br>• Implementing policies and programs that support system reliability/network expansion projects identified by the Metropolitan Transportation Authority (MTA) in their current five-year capital pan/twenty-year needs study. | Legislative, Regulatory, Financial | Low/Medium | Medium | $$$ |

# Transportation Oriented Development - Overview

| | | | |
|---|---|---|---|
| **Description:** | Transportation Oriented Development | | |
| **Action type:** | Legislative, Regulatory, Financial | | |
| **GHG reduction by 2030:** | Low/Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | • Requires new incentives to incorporate community/public transportation friendly development/redevelopment.<br>• Disincentivizing auto dependency/congestion through pricing/parking strategies.<br>• Compels - as a condition of funding/environmental approval - Industrial Development Agencies (IDA) and Metropolitan Planning Organizations (MPO) to participate in the development/implementation of integrated transportation/land-use plans. | | |
| **Ease of implementation:** | Medium/Hard – May infringe upon exiting local "Home Rule" governance authority. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Requires fundamental changes to local land use planning/local home rule.<br>2. May separate the construction/purchase of parking spaces from residential/commercial development.<br>3. Funding and finance policies to support recommended strategies. | 1. Rely on incentives to encourage community-based development approach as opposed to requirements.<br>2. Develop integrated transportation/land-use plans.<br>3. Create special assessments/districts to support projects (e.g., TIF, Congestion/Parking Pricing, proceeds from market-based policies). |

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# Convenience/Connectivity - Overview

| | | | |
|---|---|---|---|
| **Description:** | Convenience/Connectivity | | |
| **Action type:** | Legislative, Regulatory, Financial | | |
| **GHG reduction by 2030:** | Low/Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | • Operating and capital costs to:<br>▪ Provide first mile/last mile connectivity through accessible and integrated infrastructure.<br>▪ Increase the number of destinations that are accessible by public transportation, walking and biking.<br>▪ Increase service frequency, reliability and hours of operations.<br>▪ Increase the number of mobility options (e.g., micro-transit, micro-mobility).<br>▪ Provide high-quality amenities at public transportation facilities/stops.<br>▪ Accelerating new phone/app-based application technologies that provide real-time schedule information/makes transit easier to use. | | |
| **Ease of implementation:** | Medium – Requires expanding travel technology development/deployment to public transportation. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Access to/understanding of new technology/trip planning platforms.<br>2. Funding and finance policies to support recommended strategies.<br>3. Influences of emerging technologies on services, workforce, deployment of new technologies. | 1. Partner with State/county departments of labor and health and human service organizations to create neighborhood-based mobility management/travel training centers.<br>2. Create special assessments/districts to support projects (e.g., Tax Increment Financing, Congestion/Parking Pricing, proceeds from market-based policies).<br>3. Develop/partner with existing community-based organizations on STEM initiatives. |

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# Fleet Modernization - Overview

| | | | |
|---|---|---|---|
| **Description:** | Fleet Modernization | | |
| **Action type:** | Legislative, Regulatory, Financial | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | • Procuring new zero-emission public transportation vehicles appropriate for the community being served.<br>• Partnering with utility companies to consider opportunities for transportation right-of-way to generate energy for public transportation services.<br>• Investigating developments in hydrogen fuel cell bus technologies/other renewable fuels. | | |
| **Ease of implementation:** | Medium – Requires new workforce skills to operate/maintain rollingstock; manufacturer capacity/capability to support. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Funding and finance policies to support recommended strategies.<br>2. Influences of emerging technologies on services, workforce, deployment of new technologies.<br>3. Costs related to infrastructure/availability of parts/supplies.<br>4. Availability of alternative fuels (e.g., electricity, hydrogen).<br>5. Federal "payback" if vehicle replaced prior to FTA-rated service-life. | 1. Create special assessments/districts to support projects (e.g., TIF, Congestion/Parking Pricing, proceeds from market-based policies).<br>2. Develop/partner with existing community-based organizations on STEM initiatives.<br>3. Establish price signals to suppliers/manufactures to ensure availability.<br>4. Provide direct capital subsidies to address incremental costs of zero-emission vehicles.<br>5. Petition USDOT to waive repayment for vehicles replaced prior to the expiration of the rated-service life, provided replacement vehicle is zero-emission. |



# Mitigation strategies – Enhanced Public Transportation/Mobility - Components of the Initiatives

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Procure/deploy all-electric/zero-emission – expansion and replacement - public transportation vehicles/recharging capacity. | DOT, OGS | 7-10 years | NYSDEC, NYSOGS, NYSERDA, Manufacturers utilities, municipal sponsors/authorities. |
| Provide new incentives to incorporate community-based/public transportation friendly development/redevelopment that mitigates harmful GHG emissions. | DOS, NYSERDA | 1-2 years | DEC, DOT, OGS, municipal sponsors/authorities, NYS Commercial Association of Realters, Environmental Justice Alliance, NYS Association for Affordable Housing, other. |
| Enhance service availability; accessibility; and affordability. | DOT, municipal sponsors/authorities | 2-5 years | Federal Transit Administration, Industrial Development Agencies. |
| Make ready costs for support facilities. | NYPA, DPS, Utilities | 1-2 years | DEC, NYSERDA, DOT. |
| Utility Rate Design Changes | DPS | 6 months-2 years | NYPA, NYSERDA, Utilities. |
| Require inclusion of public transportation considerations early in local/regional planning and development processes. | DOS | 3-years | DOT, municipalities, developers/realters. |

# Mitigation strategies - Enhanced Public Transportation/Mobility - Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Mitigating transportation related pollution levels in overburdened communities by accelerating the deployment of zero-emission bus fleets/modernizing rollingstock support facilities; engage impacted communities in development of strategies<br>• Enhancing service availability; accessibility; and affordability; of public transportation services for individuals in rural and urbanized areas.<br>• Making public transportation easier to use/understand.<br>• Providing direct connectivity to longer-distance bus/passenger rail services.<br>• Avoid policies that lead to gentrification |
| **Health and co-benefits** | • Reducing harmful pollutants/enhancing air quality.<br>• Mitigating higher asthma/other respiratory illnesses caused by carbon/pollutants.<br>• Facilitating a holistic approach to community development/reducing the environmental footprint of transportation on communities.<br>• Reducing per capita growth in vehicle miles traveled. |
| **Just transition: businesses and industries, workers** | • Creating new targeted opportunities/investments in STEM initiatives/disadvantaged communities.<br>• Developing new supply chain/manufacturing capability/capacity and workforce.<br>• Accelerating deployment/implementation of new technologies that support travelers/makes transit easier to use.<br>• Developing/implementing new sustainable building practices and renewable energy innovation into stations/support facilities. |
| **Other** | • Provide increased access to existing/attract new retail, hospitality, entertainment venues located within an enhanced transportation improvement district. |



# Smart Growth

# Mitigation Strategies – Smart Growth and System Efficiency

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Support Transportation-Oriented Development (TOD) that enables greater use of public transportation and other low-carbon modes | Legislative, Agency/Program, Financial | Low/Medium | Hard | $$ |
| 2 | Expand the availability of low carbon transportation modes (biking, walking, carpooling, ride-sharing, micro-transit) statewide | Agency/Program, Financial | Low/Medium | Medium | $ |
| 3 | Increase Smart Mobility and connected & automated vehicle deployments across NYS to improve transportation system efficiency | Agency/Program, Regulatory, Financial | Low/Medium | Medium | $ |



# Mitigation strategy: Transportation Oriented Development – Overview

| | | | |
|---|---|---|---|
| **Description:** | Broaden the traditional concept of Transit-Oriented Development into the concept of Transportation-Oriented Development (TOD) for purposes of aligning land use, development and transportation funding with the goals of doubling public transportation upstate and significantly increasing services downstate by 2035. | | |
| **Action type:** | Legislative, Agency/Program, Financial | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $$ - will require considerable alignment and coordination and inclusion of supportive services in programs | | |
| **Ease of implementation:** | Hard | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Will require a great deal of inter-governmental, inter-program coordination. The regional, multi-municipal nature of the effort may invoke Home Rule concerns. | Consider building off of existing regional entities and plans, such as the REDCs, NYSERDA Regional Sustainability Plans, NYSERDA Clean Energy Regional Coordinators and DEC Climate Smart Regional Coordinators. |

# Mitigation Strategy – Transportation-Oriented Development – Components of the Strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Create policies that support local efforts to reduce or eliminate parking requirements to support infill development near public transportation. | DOT, DOS | 1-2 years | Municipalities |
| Encourage and/or require local governments to offer density bonuses around transit, reduced parking requirements, complete streets, other programs that improve transportation system. Expand/emulate NYC Dept of City Planning policies that require easements and access improvements in exchange for density bonuses for projects around rail to other areas and transit entities in the State | DOS, DOT, MTA, NYC | 1-3 years | Municipalities, planners, developers |
| Create a revolving fund or grant program to support GEIS' for re-zonings and projects in TOD districts or overlay zones—if a developer agrees to build according to the TOD zoning and accepts certain community benefits components, such as affordable housing, green infrastructure, green building or public spaces, the developer will pay back into the fund a portion of the cost of the GEIS. | DOT, DOS | 1-2 years | Municipalities |
| Provide technical support (possibly through DOS Smart Growth, NYSERDA Regional Clean Energy Coordinators or DEC Climate Leadership Regional Coordinators and planning grants to local governments to improve their planning and zoning process to reflect transportation- and transit-oriented development. | DOT, DOS | 1 year | REDCs, Chambers, planners, transit operators |



# Mitigation Strategy – Transportation-Oriented Development – Components of the Strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support the inclusion of freight considerations in planning and zoning decisions<br>• Incentivize location of intermodal facilities (i.e. rail/truck) near transportation corridors eliminating need for longer- distance deliveries<br>• Develop policies on last-mile freight delivery/warehousing in the context of community planning | DOS, DOT | 2-3 years | Freight operators, municipalities |
| Establish a definition and criteria for TOD to be used by state, regional and local entities to evaluate projects and project funding and include in definitions of Priority Development Areas (see LULG initiatives); incorporate the definition of TOD into the State Smart Growth Public Infrastructure Policy Act. | DOT, DOS | 6-9 months | Transit agencies, developers |
| Produce research and materials that demonstrate links between planning & transportation, impacts on local finances<br>• Develop public relations and marketing materials for the public, municipalities and stakeholders that cogently explain the benefits derived from linking municipal/county/regional planning and public transportation infrastructure, jobs, housing, equity and climate change, among others. Incorporate these materials and messages into all relevant state, regional and local venues.<br>• Work with and support the LULG AP's recommendation to create an on-line, iterative, interactive Sustainable Development/Climate Handbook with case studies to help municipalities, CBOs and developers navigate and integrate state assistance<br>• Help develop fiscal impact analyses of smart growth compared with sprawl, regarding both public infrastructure investments for each and tax revenues generated. | DOT, DOS, DEC, NYSERDA | 1-2 years | REDCs, Chambers, municipalities, developers, transit operators |

# Mitigation Strategy – Transportation-Oriented Development – Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding Public transportation, with concomitant land use alignment and coordination, will help lower-income households that spend a disproportionate amount of income and time commuting. Both TOD provides enhanced opportunities for affordable/mixed-income housing within existing communities, which helps address displacement and gentrification. Engage communities in decision-making. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution. Communities that are walkable/bikeable and provide safe and accessible outdoor spaces promote greater physical activity, which yields enhanced wellbeing and reduces the risk of chronic disease (often referred to as "Active Living by Design"). Communities that enable and promote social interaction, partly through safe and accessible public gathering spaces and walkable design, will generate positive mental health benefits by reducing social isolation, particularly for older New Yorkers who suffer greater incidences of depression and anxiety due to isolation.<br><br>Access to health care facilities will also be enhanced. The health care system, like the energy system, has become more dispersed and distributed. Locating health clinics and other facilities within communities, and ensuring proximity and access to such services through walkable, bikeable and transit-friendly infrastructure, will help overcome health disparities of disadvantaged communities/communities of color. |
| **Just transition: businesses and industries, workers** | As jobs and job locations shift, public transportation and land use will need to align with those changes. In the past, lower-paying/-skilled jobs were an afterthought, leaving disadvantaged communities behind; this initiative allows the state to plan for job shifts to occur simultaneously with the transition to a clean energy economy. |
| **Other** | Investments in smart growth—particularly re-development of existing buildings in developed areas—yields significantly greater tax revenues per acre for a municipality and requires significantly less infrastructure costs (construction and maintenance) than sprawling development. |



# Mitigation strategy: Low-Carbon Modes – Overview

| | | | |
|---|---|---|---|
| **Description:** | Facilitate creation of a multi-modal ecosystem with focus on connectivity, accessibility and first/last mile options | | |
| **Action type:** | Agency/Program, Financial | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $ - requires inter-agency coordination and public/private coordination. | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Required coordination among multiple parties (state, local government, transit, operators of other modes)<br>2. Challenging business model for shared mobility outside large cities | 1. Show state leadership and provide the appropriate tools to other stakeholders that make it easier for them to coordinate<br>2. Provide operating support where appropriate and support local infrastructure improvements to make multiple modes possible |

# Mitigation Strategy – Low-Carbon Modes – Components of the Strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Prioritize, incentivize and expand access to funding for bike, pedestrian, transit, and complete streets projects that serve employment centers.<br>• Expand micro-transit options and ride-sharing<br>• Facilitate development of electronic mobility platforms offering seamless multi-modal trip planning and payment options to make public transportation more attractive, accessible and user-friendly<br>• Require that TNCs, bike-share companies and micro-transit operators provide booking APIs to transit agencies operating electronic mobility platforms at transit agencies' request allowing seamless multi-modal trip planning and payment options for customers. | DOT, MTA, Transit operators | 1-3 years | Transit operators, mobility providers, municipalities |
| Support the infrastructure required to shift freight to lower-emission modes, like rail | DOT | 1-2 years | Freight operators, municipalities |
| Prioritize local projects that establish low-emission transportation zones, car-free streets, and similar concepts | DOT, DOS, NYSERDA | 2-3 years | Municipalities |
| Support and inform the MTA's efforts to develop a "First-Mile/Last-Mile Toolkit"; adapt the tool-kit to Upstate transit areas. | DOT | 2 years | Truckers, municipalities |



# Mitigation Strategy – Low-Carbon Modes – Components of the Strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support Transportation Demand Management behavioral and perceptual changes, such as public art and aesthetic architectural design of stations. | DOT, NYSCA | 1 year | Transit agencies |
| Support businesses in providing low-carbon transportation options:<br>• Encourage and provide technical assistance to businesses seeking economic development incentives (local or state) to consult transit agencies early when seeking to locate or expand in areas with existing multi-modal options and provide services for employees (employee-based trip reduction programs, transit/micro-transit services, ride-sharing, bike-sharing, cycling accommodations, free/reduced transit passes)<br>• Offer local and state tax credits for businesses that accommodate employee public transportation and TDM alternatives and for employees who use alternative mobility options. | DOS, DOT, NYSERDA, DEC, ESD | 2-3 years | REDCs, Transit operators, planners, regional planning councils, Chambers, freight operators, economic development authorities |

# Mitigation Strategy – Low-Carbon Modes – Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Providing and expanding access to public transportation in the context of business location and economic development will largely help provide access to jobs among lower-income/lower-skilled employees since those individuals often need to travel the farthest and spend more money to commute to those jobs. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution. Communities that are walkable/bikeable and provide safe and accessible outdoor spaces promote greater physical activity, which yields enhanced wellbeing and reduces the risk of chronic disease (often referred to as "Active Living by Design"). Communities that enable and promote social interaction, partly through safe and accessible public gathering spaces and walkable design, will generate positive mental health benefits by reducing social isolation, particularly for older New Yorkers who suffer greater incidences of depression and anxiety due to isolation.<br><br>Access to health care facilities will also be enhanced. The health care system, like the energy system, has become more dispersed and distributed. Locating health clinics and other facilities within communities, and ensuring proximity and access to such services through walkable, bikeable and transit-friendly infrastructure, will help overcome health disparities if disadvantaged communities/communities of color. |
| **Just transition: businesses and industries, workers** | As jobs move and change in the transition to a clean energy economy, businesses will need to accommodate their employees' commuting needs. |
| **Other** | |



# Mitigation strategy: Smart Mobility & Connected / Automated Vehicles – Overview

| | | | |
|---|---|---|---|
| **Description:** | Improve transportation system efficiency through policies, technologies, and investments that reduce congestion and increase safety using connectivity, automation, and other innovative approaches | | |
| **Action type:** | Regulatory, Financial | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $ - Implementing connected and automated technologies for transportation will require new infrastructure investments but will generate GHG, economic, safety, and congestion reduction for mobility users statewide | | |
| **Ease of implementation:** | Medium – some elements of this strategy have already been implemented in NYS; others are new to NYS but have been tried elsewhere | | |
| **Example case studies:** | 15-20% fuel efficiency improvements shown to be achievable through connected vehicles | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Unproven technologies for connected, automated vehicles<br>2. Automated vehicles could increase overall VMT, including "empty VMT," increasing energy use and emissions<br>3. Multijurisdictional challenges for coordinating infrastructure compatibility across municipal boundaries | 1. Support for R&D, pilot/demonstration projects<br>2. Policy measures to encourage/require automated vehicles to be ZEVs, discourage empty VMT<br>3. Need for state leadership from DOT to encourage collaboration, interoperability, data sharing across jurisdictions |

# Mitigation strategy: Smart Mobility & Connected / Automated Vehicles – Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Invest in R&D, demonstrations of emerging intelligent transportation systems (ITS), connected and automated vehicles | NYSERDA, DOT | 1-5 years | Technology providers, local governments |
| Fund the broader adoption of technologies that prove effective in improving transportation system efficiency, such as smart parking systems, adaptive traffic lights, IoT-enabled streetlights | DOT, NYPA, NYSERDA, DPS | 1-5 years | Technology providers, local governments, utilities |
| Enact policies discouraging "empty" AV miles traveled and requiring AVs used as for-hire vehicles to be ZEVs | DOT, DEC, Legislature | 3-5 years | Auto industry, ridehailing industry |
| Support the adoption of open-source technologies and standard data collection protocols for transportation data and connected infrastructure | DOT, Thruway, local governments | 1-3 years | Technology providers |



# Mitigation strategy: Smart Mobility & Connected/ Automated Vehicles – Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Smart mobility solutions have the potential to improve quality of life in communities across New York, including disadvantaged communities. Reducing congestion in high-traffic areas will reduce local air pollution. ITS solutions that enable greater transit use and more shared mobility options could reduce the cost of transportation generally, making more transportation options more affordable to lower income New Yorkers. |
| **Health and co-benefits** | Congestion is a major source of local air pollution and alleviating major bottlenecks could have significant impacts on health and local air pollution. Connected and automated vehicles have the potential to greatly increase transportation safety, saving thousands of lives each year. |
| **Just transition: businesses and industries, workers** | New smart mobility technologies like connected and automated vehicles offer the potential for the growth of new industries in New York. Some leaders in smart mobility technologies are based in New York or have operations here. Automated vehicles may replace drivers in limited circumstances for specific types of transportation jobs. |
| **Other** | |

# Enabling Strategy Summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1 | Create and expand partnerships with businesses, economic development authorities such as IDAs, and local and regional planners to increase smart growth and transit use; encourage the business and economic development community to work more closely with public transportation officials in business location and expansion projects | Agency/Program | Medium | $ |



# Enabling Initiative – Planning & Collaboration Overview

| | |
|---|---|
| **Description:** | Encourage the business and economic development community to work more closely with local planners, public transportation officials, and other transportation providers in business location and expansion projects.<br>Launch an Expansive, Multi-Dimensional, Grass-Roots Public Education Campaign on the Links Among Land Use (Smart Growth), Public Transportation and Housing and their roles in reversing climate change. |
| **Action type:** | Agency/Program |
| **Cost and funding considerations:** | $; will utilize existing programs and resources, but would likely require consultant services. |
| **Ease of implementation:** | Medium |
| **Example case studies:** | See Appendix |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Some might view this as an impediment to business recruitment by adding another requirement or consideration as businesses make location decisions. Absence of a dedicated funding source. | Handle this as an educational matter, not a mandate; provide incentives, where feasible, such as in IDA tax policies, local planning/zoning incentives and enhanced programmatic assistance. |

# Enabling Initiative – Planning & Collaboration – Components of the Strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Encourage and/or require collaboration among local authorities, transit operators, freight operators, local and regional planners and economic development entities to more closely incorporate public transportation options into land use planning, transportation planning, and economic development decisions | DOS, DOT | 1-2 years | Municipalities, planners, developers, Chambers, transit operators, freight operators, economic development authorities |
| Achieve Horizontal, Regional coordination among Public Transportation entities and Planning, Economic Development and Sustainability/Climate interests (including DOS Smart Growth, REDCs, Regional Planning Councils, NYSERDA and DEC Regional Coordinators, universities, CBOs and other relevant public and private entities). | DOS, DOT, NYSERDA, DEC | 1 year | REDCs, Chambers |
| Increase communication, coordination and mutual assistance among ESD, the IDAs, local transit entities and local planners early in the business recruitment and location process to incorporate public transit planning expertise, service and accommodations into projects and locate along existing transit routes. | ESD | 1 year | REDCs, Transit agencies, planners, regional planning councils |
| Develop partnerships with truck freight in community planning, particularly complete streets, and share the trip data to find a balance between walkable/bikeable streets and trucking accommodations. | DOT | 1 year | Freight operators, municipalities |
| Work with IDAs to and transit agencies to develop and proliferate tax incentive policies that incentivize transit planning, infrastructure and access. | ESD, DOT, Transit Agencies | 1-2 years | IDAs, Chambers, developers, planners |
| Ensure that transit entities and MPOs (where relevant) are consulted on any plan or GEIS/EIS being produced by a municipality for a development project or re-zoning that is proximate to, or impacts, public transit (rail station or BRT hub). | DOS, DOT | 1 year | Transit agencies, planners/regional planning councils |



# Enabling Initiative – Planning & Collaboration Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Smart growth and expanded public transportation provides enhanced opportunities for affordable/mixed-income housing within existing communities, which helps address displacement and gentrification. A comprehensive, aggressive and persistent educational and awareness campaign provides greater opportunities to teach and infuse the concepts of equity into planning, development and public transportation. Engage communities in decision-making. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution. Communities that are walkable/bikeable and provide safe and accessible outdoor spaces promote greater physical activity, which yields enhances wellbeing and reduces the risk of chronic disease (often referred to as "Active Living by Design"). Communities that enable and promote social interaction, partly through safe and accessible public gathering spaces and walkable design, will generate positive mental health benefits by reducing social isolation, particularly for older New Yorkers who suffer greater incidences of depression and anxiety due to isolation.<br><br>Access to health care facilities will also be enhanced. The health care system, like the energy system, has become more dispersed and distributed. Locating health clinics and other facilities within communities, and ensuring proximity and access to such services through walkable, bikeable and transit-friendly infrastructure, will help overcome health disparities if disadvantaged communities/communities of color. |
| **Just transition: businesses and industries, workers** | As jobs and job locations shift, public transportation and land use will need to align with those changes. In the past, lower-paying/-skilled jobs were an afterthought, leaving disadvantaged communities behind; this initiative allows the state to plan simultaneously with the transition to a clean energy economy. An educational component to this transition will raise public awareness about this esoteric and misunderstood concept. |
| **Other** | This educational campaign provides an ideal forum in which to raise awareness of the fiscal benefits of smart growth. |

# Market-Based Policies and Financing

## Mitigation strategy summary Financing and Market-Based Policies

| Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|
| Facilitating Private Financing | Enabling | N/A | Medium | $ |
| Cap&Invest (TCI-P) or Carbon Pricing | Mitigation/Enabling | Medium | Medium | $ |
| Clean Fuel Standard | Mitigation/Enabling | Medium | Medium/Hard | $ |
| Feebates (listed under Electrification) | Enabling | N/A | Medium | $ |
| Curb Pricing | Mitigation | Low | Medium | $ |
| Congestion/Variable/Demand Parking Pricing | Mitigation/Enabling | Low | Hard | $ |
| Mileage Based User Fees | Enabling | N/A | Hard | $$ |
| Tax Increment Financing/Special Assessment Districts | Enabling | N/A | Medium | $ |
| Registration Fees | Enabling | N/A | Easy | $ |

# Mitigation Strategy – Clean Fuel Standard Overview

| | | | |
|---|---|---|---|
| **Description:** | Implement a Clean Fuel Standard to support electrification of transportation, achieve near-term emission reductions while the transition to electrification is underway and provide cleaner fuels for hard-to-electrify subsectors such as aviation; freight and passenger rail; and long-haul trucking. A clean fuel standard generally considers total fuel cycle emissions. | | |
| **Action type:** | Regulatory (DEC); potentially legislative | | |
| **GHG reduction by 2030:** | Medium (and enables electrification) | **GHG reduction by 2050:** | Low (enabling for electrification) |
| **Cost and funding considerations:** | Agency costs for program management and additional staff will be sizable if using NY-specific methodology. A substantial annual transfer would be expected from fossil fuel producers/ consumers to bioenergy producers, electric/hydrogen vehicle owners, charging infrastructure owners, and transit operators. | | |
| **Ease of implementation:** | Hard if using NY-specific carbon intensity calculations instead of CARB pathways. | | |
| **Example case studies:** | California Low Carbon Fuel Standard and Oregon Clean Fuel Standard | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Some biofuels would not generate credits under CLCPA accounting; out-of-state waste emission reductions/sequestered emissions may not be creditable towards NY's emission limits under CLCPA methodology<br>2. Potential cost impacts on low income citizens, who are less able to afford electric vehicles.<br>3. Lack of regulatory infrastructure (staff/ITS systems) | 1. Consider adopting CARB carbon intensity or set program stringency to align with achievable reductions.<br>2. Provide enhanced ZEV incentives for lower-income consumers; disadvantaged communities will benefit from ZEV and ZEVSE deployment for medium and heavy duty fleets.<br>3. Staff will need to be increased and IT systems developed; adoption of CARB carbon intensity would reduce the burden. |



# Mitigation Strategy – Clean Fuel Standard - – Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Program Development | DEC, DPS, NYSERDA | 1 year | Fuel producers and suppliers, airline industry, utilities, public transit operators, PANYNJ |
| Regulation Promulgation | DEC | 1 year | Regulated industry |
| Develop staff and IT systems | DEC | unknown | ITS, DOB |
| Investment in fueling infrastructure for advanced fuels, such as green hydrogen, that have zero emissions (tailpipe and production) | NYSERDA | 2-5 years | Fuel distributors, service station owners, clean energy providers |

# Mitigation strategy – Clean Fuel Standard – Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Reduction in localized air pollution in disadvantaged communities from electrification and lower-emission fuels. Benefits will be enhanced by complementary policies to support LMI access to affordable EVs and medium- and heavy-duty vehicle electrification. |
| **Health and co-benefits** | In the near term there may be modest reductions in some air pollutants (particularly particulate matter) due to fuel changes. Long term major health benefits will follow from vehicle electrification, the expansion of which may be accelerated by a Clean Fuel Standard |
| **Just transition: businesses and industries, workers** | Little initial impact on transportation fuel supply industries. Long term, fossil fuel industries will contract due to increased deployment of low carbon fuels, including vehicle electrification, with electricity and biofuels (and possibly hydrogen) supply industries expanding in their place. Workers from the conventional fossil fuel industry can transition to employment in the low carbon fuel industries, especially liquid biomass-based diesel substitutes. |
| **Other** | Implementation of CARB approach would be much simpler from an administrative perspective; CLCPA methodology would still have to be applied in determining progress towards CLCPA emission limits. Transfer of money from petroleum suppliers to electric rail transit operators (primarily MTA) would help fund transit priorities. Option for aviation fuels to opt in would create an opportunity to reduce aviation emissions; would require legislation. |



# Enabling initiative – Electrification Financing: Overview

| | |
|---|---|
| **Description:** | Public & private approaches to electrification financing |
| **Action type:** | Financial; NYS agencies' programs & policies that augment public & private fleet electrification financing and EVSE investment and expansion. |
| **Cost and funding considerations:** | $$; A combination of existing funding (MHD EV incentive programs, NY Green Bank financing, PSC Make-Ready Program) and new funding (additional MHD EV incentives targeting DACs, financial support to subsidize FLPP, support for electrification transition feasibility studies, support for residual value risk analysis, and financing market gap solutions) will support this effort. |
| **Ease of implementation:** | Medium; new programs need to be established, but can be based on proven models |
| **Example case studies:** | Financial markets (first loss protection); NY Green Bank financing of distribution center electrification project; Highland Electric: Maryland school bus electrification program |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Need to find the right NYS entity to serve as product sponsor for first loss protection (FLP)<br>2. Current MHD EV program qualifications and restrictions are difficult for lower-income truck owners and small fleets to meet.<br>3. School districts & transit agencies' hesitancy to transition; statutory inability to 1) convert from CapEx-oriented procurement to OpEx long term service procurement; and 2) commit to long term bus electrification projects.<br>4. EV stakeholders find NY Green Bank's financing products & terms unattractive. EVSE projects have unfinanceable utilization risk.<br>5. Extending future transit fuel/maintenance operations savings to support recapitalization not a viable strategy given operations are highly subsidized by federal, State and local funds. | 1. Enabling rules/legislation; collaboration with existing private market FLP providers.<br>2. Liberalized income-criteria & scrappage voucher-program qualifications to facilitate financing in disadvantaged communities.<br>3. Offer grants for evaluation/feasibility studies; enabling legislation for multi-year Energy Services Agreement (ESA) commitments.<br>4. Expansion of NYGB programs (incl. beyond NY State-only nexus); capital allocations (through expanded charter) to higher-risk electrification categories. NYSERDA provides a minimum level of revenue certainty to EVSE projects with high level of utilization risk.<br>5. Alternative financing models for public transit fleets may be needed. |

# Enabling initiative – Electrification Financing: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Establish a First Loss Protection product based on existing financial market instrument and practice<br>• Identify a product sponsor (NY State agency/entity) and identify size and type of subsidy/incentive/authorization required to make this product marketable<br>• Conduct Residual Value (RV) risk analysis to price the insurance product<br>• Secure private-market practitioner involvement | NYSERDA, NY Green Bank | 1-2 years | Commercial banks & insurance co's; fleet operators; EVSE developers, US DOE LPO; National Climate Bank |
| Expand MHD EV incentive programs, with a focus on higher incentives for fleets in DACs and small fleets | NYSERDA, DEC, NYSDOT | 1-3 years | Fleet operators; EJ stakeholders |



# Enabling initiative – Electrification Financing: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support feasibility studies for MHD fleets, including school districts & transit agencies, to identify benefits, costs, logistical challenges, financing options, other barriers to electrification<br>• In addition to utility fleet assessment services, which focus primarily on charging of EVs | NYSERDA, State Ed, NYSDOT | 6 months - 1 year | Utilities, OEMs & EVSE stakeholders; fleet operators; engineering firms; ESD & REDCs |
| Support additional financing options that expand EVSE adoption<br>• Expand NYGB's mission to take on more risk in defined categories of electrification financing<br>• Supplement CapEx financial support for EVSE (e.g., rebates) with revenue support (e.g. minimum revenue coverage) to qualifying EVSE infrastructure projects | NYSERDA, NY Green Bank, DPS | 1-2 years | OEMs & EVSE stakeholders; commercial banks; utilities |

# Enabling initiative –Electrification Financing: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Liberalizing voucher qualifications for low-income applicants will drive EV adoption in these communities, and accelerate development of a liquid & deep used-EV commercial vehicle market. |
| **Health and other co-benefits** | Collectively, these initiatives will accelerate fleets' electrification transition. Since air quality around ICE/diesel fleet depots is generally impaired by diesel truck emissions, this will bring cleaner air and related health benefits to populations living in vicinity of depots (which are generally disadvantaged communities). |
| **Just transition: businesses and industries, workers** | Collectively, these initiatives will bring economic, employment and health benefits to disadvantaged communities: their businesses, employees, and populations. Job training programs are to be considered as complementary initiatives. |
| **Other** | These strategies complement public funding to support electrification and modernize transit bus fleets; more successful financing strategies can reduce the public funding needed for electrification incentives. |



# Mitigation strategy –Cap & Invest/Carbon Pricing Overview

| | | | |
|---|---|---|---|
| **Description:** | Policies reduce emissions directly and support further emission reductions and the transition to a cleaner, more efficient transportation system. Transportation Panel recommends potential participation in the Transportation and Climate Initiative program (TCI-P) unless the Climate Action Council opts for a multi-sector carbon pricing approach that provides at least the same level of support for reducing transportation sector emissions. | | |
| **Action type:** | Regulatory (NY Joins TCI-P); legislative (economy-wide carbon pricing policy) | | |
| **GHG reduction by 2030:** | Medium (and enables other strategies) | **GHG reduction by 2050:** | Medium (and enables other strategies) |
| **Cost and funding considerations:** | This policy will directly reduce emissions and raise revenues by placing an auctioned allowance fee on fossil fuel component of on-road motor fuels. Fuel providers may choose to pass this cost onto consumers. Proceeds from the auction of allowances would be reinvested into improving infrastructure and reducing emissions. Efficient investment of revenues would yield a net positive to society, including improved public health. These policies would constitute an inter-economy transfer and would not impose a net resource cost. | | |
| **Ease of implementation:** | Medium to hard. Transportation has been part of economy-wide cap-and-invest programs and the TCI-P program provides a regional transportation sector model to adopt, similar in many ways to RGGI. Many stakeholders are supportive with notable exception of some environmental justice organizations and their allies. | | |
| **Example case studies:** | Carbon prices in Canada and Europe. Economy-wide cap-and-Invest in California and Quebec. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Potential for funds to be used for unrelated purposes.<br>2. Some EJ stakeholders are distrustful of market-based programs, which may not deliver equitable benefits to their communities.<br>3. The level of the TCI-P cap may fall short of the level of transportation reductions needed to meet CLCPA targets and may not raise enough proceeds to fully fund the TAP recommendations that require funding.<br>4. May increase fuel costs for rural and small city community transit systems | 1. A legislative "lock box" could ensure that proceeds can only be spent on clean transportation or other program purposes.<br>2. Engage impacted communities in decision-making and ensure investments reduce emissions and provide other benefits in disadvantaged communities and areas with high levels of transportation emissions.<br>3. Increase program stringency at program review or establish a separate program; target funding to most impactful investments.<br>4. Support electrification of smaller rural/city transit systems or consider exempting fuel used in small transit fleets |

# Mitigation strategy –Cap & Invest/Carbon Pricing Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Rulemaking process would be necessary for New York to join TCI-P | DEC, NYSERDA, DOT | 1 year | Fuel industry, disadvantaged communities, public health practitioners |
| Alternative policy: multi-sector economy-wide carbon pricing or cap-and-invest policy – if included by Climate Action Council in Scoping Plan. At least one Panel member prefers enactment of the Climate and Community Investment Act (CCIA) to participation in TCI-P. | NA | NA | NA |



# Mitigation strategy – Cap & Invest/Carbon Pricing Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Although a cap-and-invest policy does not necessarily achieve emissions reductions in specific locations, the investments can be targeted to achieve that goal. The highest and best use of the proceeds would be to invest more than at least 35-40% of the proceeds in programs that specifically reduce emissions and provide other benefits in disadvantaged communities. Engage disadvantaged communities in developing investment priorities that will reduce existing air quality disparities. Community air monitoring outcomes can be used to guide investment strategies. |
| **Health and co-benefits** | Health benefits would come from the investment of proceeds. Prioritizing investments in electric trucks and buses in areas of high pollution or high population density can maximize the reductions in air pollutants. |
| **Just transition: businesses and industries, workers** | Proceeds can be invested in ways that support a just transition for workers and disadvantaged communities. Investments can also lessen the impact on businesses such as helping convenience stores transition to providing EVSE and can also help ease the transition to new fuels technologies by funding opportunities to train mechanics to service new vehicles. Participation in the regional TCI-P would maintain level playing field for NY businesses in regional economy. |
| **Other** | Cap-and-invest programs ensure emissions reductions; carbon pricing does not. As a regional program, TCI-P ensures a designated level of regional reductions, but resulting reductions might vary among the participating states. Implementation of a cap-and-invest program should not be considered to preclude other strategies to fund maintenance of current infrastructure. |

# Mitigation strategy – Various market-based/financing policies: Overview

| | | | |
|---|---|---|---|
| **Description:** | Various market-based policies will support electrification, public transportation, smart growth and other transportation goals. These policies complement the other more specified strategies, including recommendations for TCI-P participation, clean fuel standard, private financing strategies and feebates | | |
| **Action type:** | Regulatory, financing, legislative | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Low |
| **Cost and funding considerations:** | All policies are intended to be self-funding and will provide financial support for other policies and goals | | |
| **Ease of implementation:** | Various | | |
| **Example case studies:** | Oregon - VMT/MBUF pilot; London - Congestion Pricing; Seattle - Curb Pricing; Hudson Yards/#7 Line Extension - Tax Increment Financing; Demand Parking Pricing – Washington DC; California – registration fees to fund EVSE | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Individuals may object to paying for services, like parking, that were previously free or lower cost<br>2. Drivers may object to incurring fees for access to locations that were previously complimentary, especially in EJ Communities<br>3. Home rule would preclude state action without local partnership for some policies | 1. Fees can fund access to improved transit service and other alternatives to driving<br>2. Provides more livable communities<br>3. Engage with localities; provide them with portion of proceeds |



# Mitigation strategy – Various market-based/financing policies Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Congestion/Variable Pricing/Demand Parking – coordinate with municipalities; State Legislature; Federal Highway Administration | DOT, municipalities | 1-3 years | Municipalities, parking authorities, |
| Vehicle registration fees. Legislation would be required. | DMV | 1 year | Car dealers, AAA |
| Mileage-Based User Fees – evaluate pricing level to maintain investment level first with and eventually without gas tax revenues. Legislation would be required | DOT, Tax & Finance | 3-years | Fuel/charging providers, AAA, public transportation sponsors |
| Tax Increment Financing/Special Assessment Districts | Municipalities, Tax & Finance | 1-2 years | Municipalities, public transportation sponsors, developers |
| Curb Pricing | Municipalities, Tax & Finance | 1-2 years | Public transportation sponsors, developers |

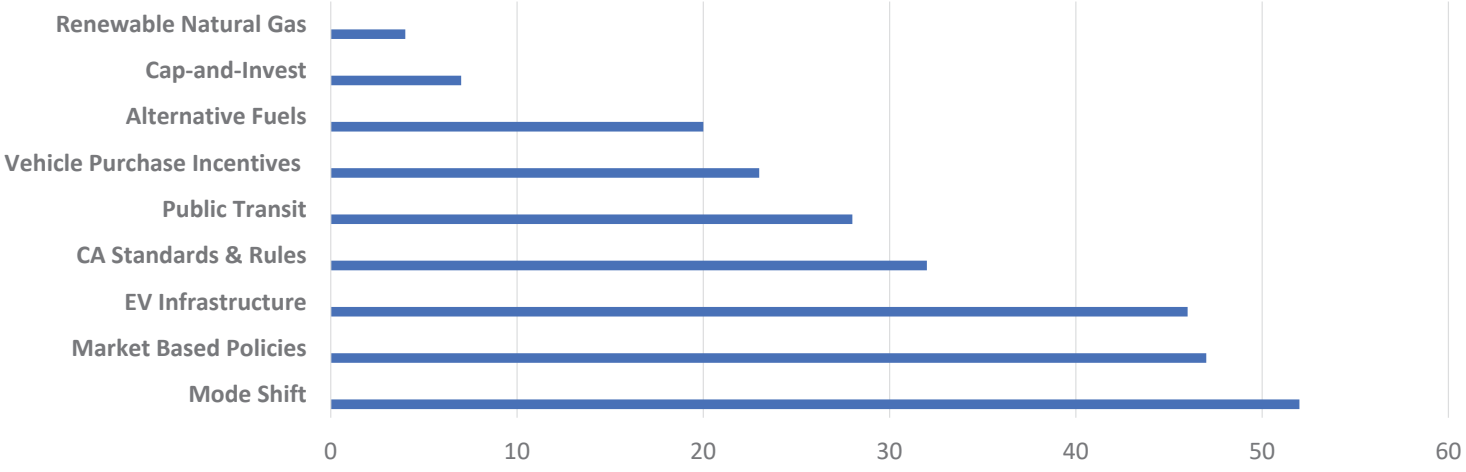
# Mitigation strategy – Various market-based/ financing policies  Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | As a direct result of these funding mechanisms, disadvantaged communities will benefit from reduced pollution in congested urban areas, increased infrastructure investment and from enhanced transit access. These funding mechanisms can raise revenue to support emission reduction activities put forward in the other Transportation Advisory Panel recommendations, which are targeted toward disadvantaged communities. |
| **Health and co-benefits** | As a direct result of these funding mechanisms, there would be a decline in peak hour pollution with resulting public health benefits. These funding mechanisms can raise revenue to support emission reduction activities put forward in the other Transportation Advisory Panel recommendations, which will result in broader health and economic benefits. |
| **Just transition: businesses and industries, workers** | Projects funded by tax increment financing will create jobs; may potentially drive-up housing costs |
| **Other** | |



# Summary of Comments Received by Transportation Advisory Panel

The Transportation Advisory Panel received comments from 69 organizations/individuals discussing the following subjects:



# Just Transition Principles Review

## Stakeholder-Engaged Transition Planning & Collaborative Planning for a Measured Transition Toward Long-Term Goals

- A diverse range of stakeholders were engaged during the recommendation development process including:
  - Two TAP Public Engagement Meetings
  - Five Expert Roundtables
  - Cross Panel coordination meetings held with other Advisory Panels
- Consumer engagement and stakeholders key to the continued development of each strategy have been identified.
- Proposals to make local planning processes more collaborative and inclusive in finding solutions that help increase low-carbon transportation options are recommended.

# Just Transition Principles Review

## Realize Vibrant, Healthy Communities Through Repair of Structural Inequities & Equitable Access to High Quality, Family-Sustaining Jobs

- Recommendations are designed to help accelerate decarbonization in and around LMI and EJ communities.
- Public Transportation increases and Smart Growth recommendations support connecting workers to employment and community sustainability.

## Climate Adaption Planning and Investment for a Resilient Future

- A focus on enhancing active mobility options, more public transportation frequency, and smart growth to provide a level of resiliency in the transportation system.

## Protection and Restoration of Natural and Working Lands Systems & Resources & Redevelopment of Industrial Communities

- Smart Growth development will help concentrate land uses and development in areas that are targeted for growth and redevelopment while preserving natural and working lands from development pressures.

# Energy Efficiency and Housing Advisory Panel

## Recommendations to the NYS Climate Action Council for Consideration in the Scoping Plan

May 3, 2021

NEW YORK STATE OF OPPORTUNITY. Climate Action Council



# Key Terms as Used in the Recommendations

**All-electric building:** No combustion equipment is used as part of the building heating, cooling, hot water, cooking, and laundry.

**Building decarbonization:** The reduction of carbon emissions (aka GHG emissions), through the conversion of existing equipment and systems powered by combustion processes, to highly efficient equipment and systems powered by emissions-free sources.

**Building electrification:** The conversion of an existing building's heating, cooling, hot water, cooking, and laundry equipment and systems powered by combustion processes, to highly efficient equipment and systems powered by electricity.

**Commercial building:** All buildings or facilities that are not included in the definition for "Residential building"

**Disadvantaged communities (DACs) (interim definition):** Properties located in census block groups that are below the HUD 50% Area Median Income threshold and within DEC PEJAs (income + race/ethnicity) or NYS Opportunity Zones.

**Electric readiness:** The installation of electrical service and panel capacity, conduit, fixtures, and outlets for a future installation of electric equipment for space heating and cooling, hot-water, cooking, and laundry.

**Electric vehicle (EV) readiness:** The installation of electrical service and panel capacity, conduit, fixtures, and outlets for a future installation of EV chargers.

**Embodied carbon**: The sum of all GHG emissions resulting from the mining, harvesting, processing, manufacturing, transportation and installation of materials and buildings.

**Energy efficiency:** Minimized consumption of energy required to perform useful work.

**Energy storage readiness:** The installation of electrical service and panel capacity, conduit, fixtures, and outlets for a future installation of electric batteries.

**HFCs or hydrofluorocarbons**: greenhouse gases, manufactured for use in refrigeration, air conditioning, foam blowing, aerosols, fire protection and solvents.

**Low- to moderate-income (LMI):** LMI households have incomes at or below 80 percent of area median income.

**Multifamily building:** A residential building with five or more dwelling units.

**NYStretch Energy Code:** A model code for voluntary adoption by local jurisdictions in New York State, to be enforced as the local Energy Conservation Construction Code, which sets energy conservation standards more stringent than the NYS Energy Conservation Construction Code.

**Resilience:** The capacity to withstand and recover from events that incur stress and damage.

**Residential building**: A building where the main or dominant use is to provide complete independent facilities for living, sleeping, eating, cooking, and sanitation including single-family and multifamily but not to include transient uses classified as R-1 in the Building Code of NYS

**Single family building:** A residential building with one to four dwelling units.

**State Energy Code:** The NYS Energy Conservation Construction Code promulgated pursuant Article 11 of the Energy Law

# Acronyms

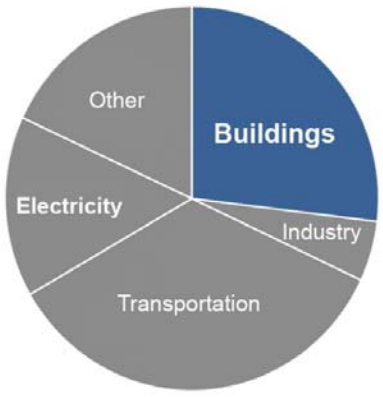
**CO2e:** Carbon Dioxide equivalent
**DAC(s):** Disadvantaged Communities
**EJ:** Environmental Justice
**EV:** Electric Vehicle
**GHG**: Greenhouse gas
**GWP**: Global Warming Potential
**HFCs:** Hydrofluorocarbons
**HVAC:** Heating, ventilation, and air conditioning
**LMI:** Low- to moderate-income
**MMt:** Million Metric Tons
**MWBE:** Minority/Women-Owned Business Enterprise
**PACE:** Property Assessed Clean Energy
**PV:** Photovoltaic
**R&D:** Research and Development
**SDVOB:** Service-Disabled Veteran Owned Business
**T&D**: Transmission and Distribution
**VRF:** Variable Refrigerant Flow
**WAP:** Weatherization Assistance Program

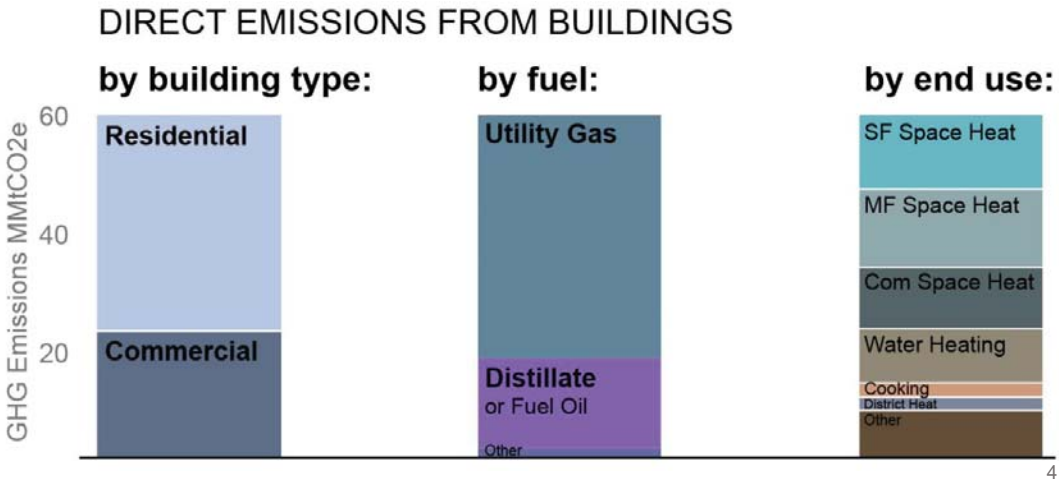
**Government agencies and authorities:**
**DEC:** Department of Environmental Conservation
**DASNY:** Dormitory Authority of the State of New York
**DFS:** Department of Financial Services
**DOH:** Department of Health
**DOS:** Department of State
**DOT:** Department of Transportation
**DOTF:** Department of Taxation and Finance
**DPS:** Department of Public Service
**HCR:** New York State Homes and Community Renewal
**HPD:** NYC Dept. of Housing Preservation and Development
**HUD:** U.S. Department of Housing and Urban Development
**NYCHA:** NYC Housing Authority
**NYPA:** New York Power Authority
**NYSERDA:** New York State Energy Research and Development Authority
**PHA:** Public Housing Authority
**PSC:** Public Service Commission
**SHPO:** State Historic Preservation Office



# Emissions from our Buildings Today

- **Onsite fossil fuel combustion is attributed as *direct* emissions** from the buildings sector. Electricity usage (indirect emissions) is accounted for in the electricity generation sector.
- Direct emissions in buildings are dominated by fossil-fuel combustion (mostly gas) for space heating and hot water – thus, **electrification is the largest driver of direct emissions reductions.**



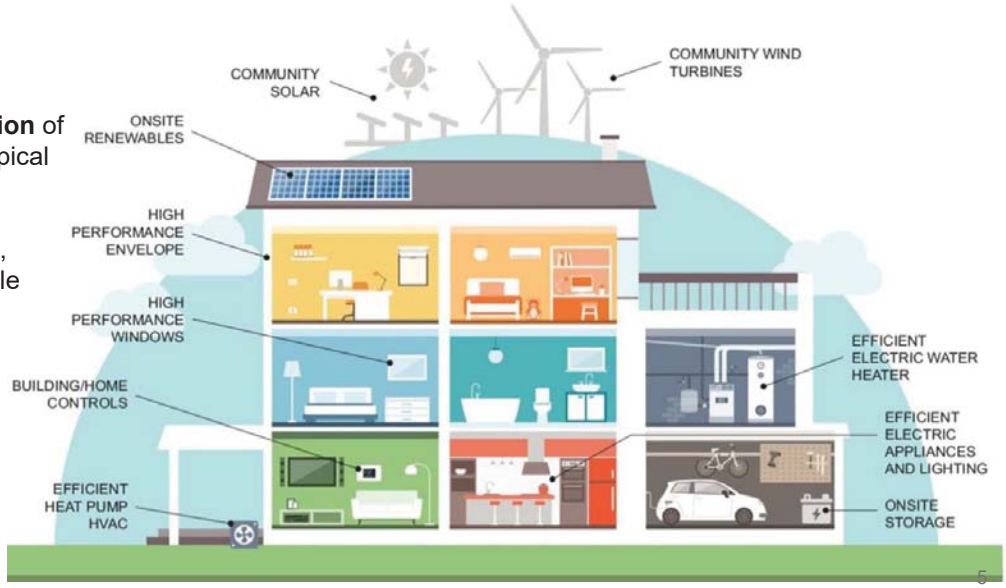
# Beneficial Building Electrification & Energy Efficiency

**Electrification** of heating and hot water systems in nearly all buildings is a key strategy for building decarbonization and depends upon **energy efficiency improvements** in all buildings and **100% zero-emissions electricity** by 2040 under the Climate Act.

### Scope of Panel

- **On-site GHG emissions from combustion** of fossil fuels for heating and hot water in typical building types:
  **Residential**
  (single family; multifamily including coops, condos and rentals; market rate; affordable including regulated and unregulated)
  **Commercial and Institutional**
  (office, retail, education, etc.)

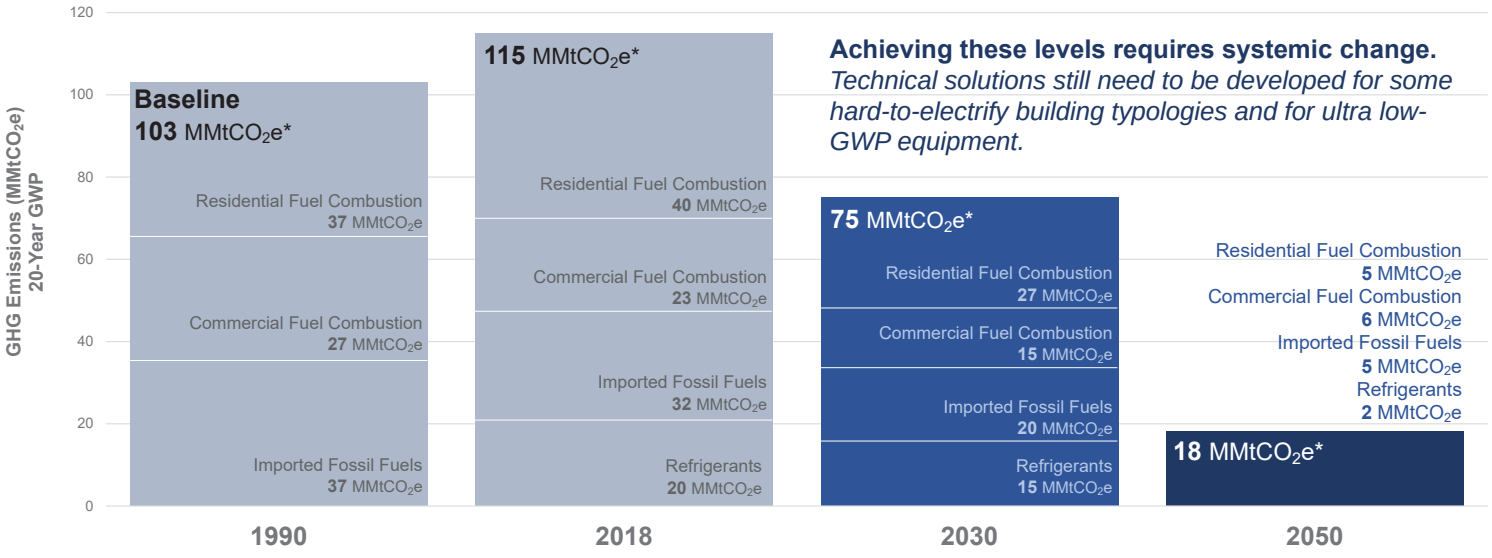
*The Panel adopted a building-level focus; further analysis is needed in campus/community thermal networks and specialized uses in industry or critical care.*






# Aggregate GHG Emissions Impact of Recommendations

## Energy Efficiency & Housing Advisory Panel




**Achieving these levels requires systemic change.**
*Technical solutions still need to be developed for some hard-to-electrify building typologies and for ultra low-GWP equipment.*

* million metric tons carbon dioxide equivalent
*Draft values subject to public review process for annual emissions accounting*

# Scale of the Solution Demands New Resources

**6.2 million buildings in New York State**

- 4.9 million single family homes
- 250,000 multifamily buildings
- 370,000 commercial and institutional buildings

**Eliminating GHG emissions from New York's building stock by 2050 will require broad, systemic changes.**

- By 2030, more than 200,000 homes *every year* will need to upgrade to all-electric and energy efficient systems
- The 370,000 office, retail, restaurant, school, and other commercial and institutional buildings in New York State will need to cut energy use in half and stop using fossil fuels for heating and hot water
- Widespread awareness in a well-informed public, with clear market signals, can change behaviors and practices, accelerate decarbonization, and lower the costs

**An equitable transformation at this scale requires new resources.**

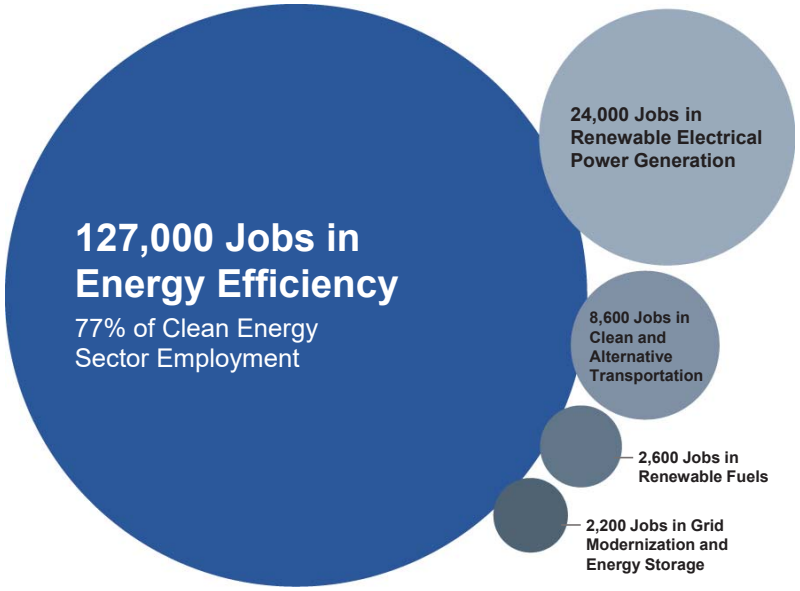
- Focusing the investment of private capital needed to construct, upgrade, and operate highly efficient buildings powered by zero-emissions electricity
- Investing public resources to support market-enabling initiatives and incentives for early adoption of technologies
- Investing public resources to fund building efficiency and electrification in LMI homes, affordable and public housing, and disadvantaged communities – while supporting energy affordability, safe and healthy housing, economic opportunities, and the repair of structural inequalities



# Building Decarbonization and Economic Development

Decarbonizing New York's building stock will deliver **significant job growth and economic opportunity**, in every region of the state.

- New York's **energy efficiency industry employs the largest share** of clean energy workers, accounting for **77% of clean energy sector employment** and **88% of industry establishments.**
- The efficiency sector continues to **add workers installing high-efficiency HVAC equipment and heat pumps**, which account for **over half of the sector's employment.**




Source: 2020 Clean Energy Industry Report

# Approach to Recommendations

## Equitably advance building electrification and energy efficiency at scale

- **Address new construction and retrofits for single family housing, multifamily housing, and commercial and institutional buildings**, with attention to:
  - **Equity and affordability**: Identify and mitigate any potential negative impacts on low- to moderate-income (LMI) households and disadvantaged communities (DACs), with special attention to affordability; preventing tenant displacement; repair of structural inequalities; and supporting compact, vibrant, and healthy communities
  - **Practicality**: Identify and mitigate implementation challenges for owners and building operators, including cost/benefits
  - **Minimizing costs:** Identify ways to make building decarbonization upgrades cheaper and cost competitive
  - **Expanding solutions**: Identify ways to bring better technologies and solutions to NYS
  - **Benefits**: Identify both energy and non-energy benefits including health, comfort, and productivity
  - **Sustainable and resilient outcomes:** Identify and avoid outcomes that lead to less sustainable development patterns and development in climate at-risk areas
- Address key enabling policies, including **access to financing and financial incentives, affordability, workforce development,** and broad **public awareness and engagement** that motivates behavioral change
- Consider implementation, with attention to equity, feasibility, commercial availability, and grid readiness
- **Lead by example** in the State's own facilities and construction activities, to reduce GHG emissions from State buildings and to accelerate market adoption of building decarbonization technologies, design approaches, and operational practices
- Recognize that this is a national and global problem. New York State is a leader but will need significant **help and partnership with the Federal government** to bring these recommendations to fruition at an economy-wide scale



# Outreach

- **Public Panel Meetings**
  - 8 public meetings, September 2020 – March 2021
- **Expert Round Tables**
  - 3 round tables in November 2020
  - Builders, installers, designers of single family/ multifamily housing; landlords, owners, agents
- **Stakeholder Survey**
  - October – December 2020
  - ~65 responses
- **Carbon Neutral Buildings Roadmap outreach process**
  - 15 stakeholder engagement sessions; notes distributed to Panel members
  - >950 stakeholder participants across sessions
- **Public Engagement Session, February 4, 2021**
  - 270 attended, ~330 including NYS agency staff
  - Written comments received through 2/18/21
  - 110 unique comments (session and email)
  - ~320 comments via two coordinated emails
- **Meetings with REBNY condo/coop managers**
  - February 2020 (x2)
- **Meeting with residential property owner associations**
  - Rent Stabilization Association (RSA), Community Housing Improvement Program (CHIP), New York State Association for Affordable Housing (NYSAFAH) in March 2021

# Consultation with other Panels

## Panel-level Coordination

- Oct. 2020 – CJWG presented at EEH Panel about DACs
- Dec. 2020
  - EEH Panel delegates attended CJWG
  - DEC/DOS/NYSERDA presentation on Resilience and Climate Adaption, with LULG reps
- Jan. 2021
  - Local Building Decarbonization Laws and Services learning session, with LULG
  - EEH Panel reps attended bioeconomy subgroup of Agriculture and Forestry
- Feb. 2021
  - 2/5 subgroup meeting with Power Gen & utilities on gas transition, rates, grid impacts of electrification
  - HFCs learning session, with Waste Panel
- March 2021
  - Engagement session with residential property owner associations, with Power Gen

## Staff-level Coordination

- Land Use and Local Government (LULG)
  - Adaptation and Resilience
  - Clean energy recommendations
- Power Generation Panel
  - LMI/DAC
  - Equitable access to solar
  - Electrification and gas system transition
- Agriculture and Forestry; Energy-Intensive and Trade-Exposed Industries
  - Embodied carbon and mass timber
- Waste
  - HFCs and embodied carbon
- Just Transition Working Group
  - Workforce development



# Mitigation Strategy Summary

| | Description | Action type | Emissions impact by 2050 | Ease of implementation | Cost* |
|---|---|---|---|---|---|
| 1 | Enact enabling legislation and adopt codes, standards, and regulations to improve energy efficiency, reduce emissions, and enhance building resilience. Adopt regulations that phase out fossil fuel use in buildings, requiring energy-efficient electric heating and cooling, electric hot water heating, and electric appliances. | Legislative, regulatory, programmatic | High | Medium/Hard | $$$ |
| 2 | Require measuring building energy usage, benchmarking energy performance, and making that information accessible via disclosure or labeling. | Legislative, regulatory, programmatic | Low (but enables other mitigation) | Easy | $ |
| 3 | Advance a managed, phased, and just transition from reliance on fossil gas and the gas distribution system to a clean energy system, including elimination of embedded subsidies for fossil gas. | Legislative, regulatory | High (overlap with #1) | Hard | $$$ |
| 4 | Advance a managed and just transition from reliance on HFC use as refrigerants and in all products used in building construction. | Legislative, regulatory | High | Hard | $$ |

**Cost estimates for mitigation strategies reflect total resource costs statewide, expressed as an equivalent annualized cost. The total resource cost approach measures costs to upgrade buildings and utility infrastructure net of energy savings across all entities (public and private sector). The categories used for **equivalent annualized total resource cost** are: $ (<$250M, resources are already on hand), $$ ($250M - $1B, requires some new resources), and $$$ (>$1B, requires high degree of new resources).*

# Mitigation Strategy – Initiative #1 Codes and Standards

## Overview

| | | | |
|---|---|---|---|
| **Description:** | **Enact enabling legislation and adopt codes, standards, and regulations to improve energy efficiency, reduce emissions, and enhance building resilience. Adopt regulations that phase out fossil fuel use in buildings, requiring energy-efficient electric heating and cooling, electric hot water heating, and electric appliances.** | | |
| **Action type:** | Legislative, regulatory, programmatic | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$$ | | |
| **Ease of implementation:** | Medium/Hard | | |
| **Example case studies:** | California, Massachusetts, Norway | | |



# Mitigation Strategy – Initiative #1 Codes and Standards

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Legal challenge (e.g., federal preemption) | 1. Legislation to enable emissions-based codes and standards that are not subject to federal preemption |
| 2. Lack of awareness/confidence in market | 2&3. Clear market signal with phased-in dates for implementation to allow market to adapt, invest and build capacity |
| 3. Limited workforce/supply chain readiness to design and install efficient, non-fossil solutions | 2. Education for consumers and market participants broadly |
| 4. Cost premium to owners and renters | 3. Workforce and supply chain development across builders, trades, professions, contractors, suppliers, retailers |
| 5. Potential negative impacts on LMI households, tenants, DACs and public housing, incl. disproportionate burden of cost premiums and on housing affordability. Specific challenges for LMI rental housing incl. the property owner's ability to finance and recoup capital costs; equitable distribution of energy costs for heating and cooling with electrification; and risk of triggering rent increases, de-regulation of housing units, gentrification | 4. Control costs by targeting natural investment points in life cycle of a building (e.g., construction, equipment replacement, sales/leasing). Upgrade equipment at its end of life, adopt capital planning for large buildings. Strategic market incentives and subsidies for LMI/DACs. Reduction in capital cost of efficient and electric building equipment/systems (via enabling investments, market scale); change in relative energy costs over time (via rate design, depreciation policies for utility assets, possible economy-wide carbon fee) |
| 6. Resource constraints prevent local governments from adequate code enforcement | 5. Provide adequate financial and technical assistance for LMI homeowners and building owners within DACs and public housing; provide for alternative compliance pathways and exemptions where there are extenuating circumstances, such as related to housing affordability; collaborate with housing advocates to identify and streamline solutions to allocate heating and cooling costs equitably across building owners and income-eligible residents; monitor for and use policy to mitigate potential risks re: affordable housing, disinvestment in low-income properties, gentrification |
| 7. Opposition from builders, current suppliers of fossil fuels | 6. Provide State funding and resources for local code enforcement (staff, training, materials), especially focused on supporting low-income New Yorkers |
| 8. Grid reliability and need for substantive upgrades to electric system to meet increase in demand as buildings electrify (T&D, system lines, and customer panel upgrades) | 7. Industry education and engagement; transition opportunities for current suppliers of fossil fuels |
| | 8. Energy efficiency and capital improvements for building resilience to grid failure (high-performance walls/roofs/windows, batteries, PV); incentive structures that encourage ground source heat pumps, which mitigate peak electric demand as buildings electrify; required grid-interactive controls on major electric equipment; investments in the electric grid to ensure reliability and resilience; also see cross cutting recommendation on resilience |

# Mitigation Strategy – Initiative #1 Codes and Standards

**The following components would require that new construction (and additions and alterations as applicable) of residential and commercial buildings are built to a highly efficient, zero emission standard and incorporate requirements for building resilience, where feasible.**

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| **As soon as possible**: Adopt **highly efficient State Energy Code for new construction** (and additions and alterations as applicable) of residential and commercial buildings. | NYSERDA, DOS | 2-4 years | DASNY, local gov'ts, builders, manufacturers, consumers |
| **Starting in 2023**: Amend the **relevant State codes for new construction** (and additions and alterations as applicable) of residential and commercial buildings to require:<br>• solar PV on feasible areas;<br>• grid-interactive electrical appliances as feasible (e.g., batteries, hot water heaters);<br>• energy storage readiness;<br>• electric readiness for space conditioning, hot water, cooking, and dryers; and<br>• EV readiness where parking is already provided. | NYSERDA, DOS | 2 years | DASNY, local governments, builders, manufacturers, consumers |
| Adopt **all-electric State codes** (prohibit gas/oil equipment for space conditioning, hot water, cooking, and appliances) for **new construction** (and additions and alterations as applicable),<br>• **2025** - single family<br>• **2030** - multifamily and commercial buildings. | NYSERDA, DOS | 2-4 years | DASNY, local governments, builders, manufacturers, consumers |
| Enabling action: Encourage local governments to adopt NYStretch Energy Code, until highly efficient, all-electric codes are adopted statewide. | NYSERDA | ongoing | DOS, DASNY, local governments |
| Enabling action: Provide State funding for local code enforcement (staff, training, materials) and State credentialing of third-party Energy Code inspectors. | DOS, NYSERDA | 6 months | Local governments |

*Note: Timeframes associated with recommended regulations will depend on the type of regulation and its governing body and legislation, State Administrative Procedure Act rulemaking requirements and timelines, and ongoing assessment of feasibility, impacts and analysis of what timeframes are needed to meet New York State's climate goals.* 15

# Mitigation Strategy – Initiative #1 Codes and Standards

**The following components would require the sale and installation of energy efficient and zero emission new equipment, when replaced at the end of useful life in residential and commercial buildings, as well as efficiency upgrades for certain large buildings.**

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| **As soon as possible:** Adopt **energy efficiency standards for appliances** that are exempt from federal preemption (e.g. computers, monitors, fluorescent and LED light bulbs, air purifiers). | NYSERDA, DOS | 12-18 months | Builders, manufacturers, retailers, consumers |
| **2030**: Require **lighting upgrades** to current Energy Code standards for existing commercial properties larger than 25,000 sq. ft. | NYSERDA, DOS | 4 years | Local governments |
| **2030**: Adopt an **energy efficiency performance standard** for existing commercial properties larger than 25,000 sq. ft. (with credit for building electrification). 2030 will begin compliance periods. Compliance standards will be informed by statewide benchmarking data. | NYSERDA, DOS | 6-7 years; after ~3 yrs. of benchmarking data is available | NYPA, DASNY, DOTF, PSC/DPS, local governments, utilities |
| Adopt **zero emission standards** that prohibit gas/oil replacements (at end of useful life) of heating and cooling and hot water equipment,<br>• **2030**: single-family<br>• **2035**: multifamily and commercial buildings. | NYSERDA, DOS, DEC | 2-4 years; promulgate standards at least 5 yrs. before they take effect | Builders, manufacturers, retailers, consumers |
| Adopt **zero emission standards** that prohibit gas appliance replacements (at end of useful life) for cooking and dryers,<br>• **2035**: single family and multifamily buildings. | NYSERDA, DOS, DEC, DOH (lead/support TBD) | | Manufacturers, retailers, consumers |
| Provide for thoughtful development of alternative compliance pathways from recommended codes and standards for extenuating circumstances (including but not limited to housing affordability-related matters, health and safety/emergency needs). This would apply to pre-existing building stock recommendations. | NYSERDA, DOS, DEC, SHPO | Concurrently with regulatory action | Builders, manufacturers, retailers, consumers |

*Note: Timeframes associated with recommended regulations will depend on the type of regulation and its governing body and legislation, State Administrative Procedure Act rulemaking requirements and timelines, and ongoing assessment of feasibility, impacts and analysis of what timeframes are needed to meet New York State's climate goals.* 16

# Mitigation Strategy – Initiative #2 Benchmarking & Disclosure

## Overview

| | | | |
|---|---|---|---|
| **Description:** | **Require measuring building energy usage, benchmarking energy performance, and making that information accessible via disclosure or labeling.** | | |
| **Action type:** | Legislative, regulatory, programmatic | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Low |
| **Cost and funding considerations:** | $ | | |
| **Ease of implementation:** | Easy/Medium | | |
| **Example case studies:** | New York City, Washington DC, Seattle, Boulder, London | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Building owners need access to consumption data statewide<br>2. Lack of awareness in market may limit the effective use of data on energy usage and performance to inform decision making<br>3. Risk of disinvestment in disadvantaged communities if disclosure/labeling makes properties less attractive to potential renters and buyers | 1. Ongoing coordination among NYS agencies and utilities to set statewide standards for the provision of energy usage data and to expand provisions in place in NYC (including automatic upload of data for benchmarking) to utilities statewide<br>2. Education for consumers, brokers and building owners on how to use the energy usage and benchmarking information<br>3. Adequate technical and financial assistance for LMI homeowners and building owners in disadvantaged communities to scope and finance energy upgrades |



# Mitigation Strategy – Initiative #2 Benchmarking & Disclosure

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| Starting in **2023** - Statewide energy **benchmarking and disclosure** program - Require owners of multifamily and commercial properties larger than 10,000 sq. ft. to annually report whole building energy and water consumption data to NYSERDA. | NYSERDA | 1-2 years | DOS, NYPA, DASNY, HCR, DOTF, PSC/DPS, utilities, local governments |
| Starting in **2025** - Require owners of all residential and commercial buildings to obtain and publicly disclose, as part of **sale or lease** listing of a building, housing unit, or commercial space, the prior-year energy consumption of the building, unit, or space (e.g., at least 12 consecutive months of energy bill data).<br>Starting in **2027** – Require owners of single-family buildings to obtain and disclose an energy performance rating (e.g., a Home Energy Rating System (HERS) index) as part of **sale listing**. | DOS, NYSERDA | 2 years | PSC/DPS, utilities, local governments |
| Starting in **2025** - Require multifamily and commercial properties larger than 25,000 sq. ft. to undertake at least once every ten years a **comprehensive building energy assessment** (audit) that:<br>• evaluates the building's systems;<br>• identifies opportunities to invest in energy efficiency upgrades; electrification or electrification-readiness for building systems; and<br>• resilience measures.<br><br>Filing an assessment report with NYS would be required on a cycle established by NYS or at the time that a building permit is needed for specified work that must conform to Code, whichever comes first. | DOS, NYSERDA | 2 years | DOS, NYPA, DASNY, HCR, DOTF, local governments |
| Policy implementation: Ensure consistency and alignment, where appropriate, across State and local government requirements (e.g., NYC local laws), incl. in reporting templates and timeframes. Use statewide benchmarking data to inform subsequent programmatic and policy design. | NYSERDA | | DOS, local governments, housing agencies |

# Mitigation Strategy – Initiative #3 Gas System Transition

## Overview

| | | | |
|---|---|---|---|
| **Description:** | **Advance a managed, phased, and just transition from reliance on fossil gas and the gas distribution system to a clean energy system, including elimination of embedded subsidies for fossil gas.** | | |
| **Action type:** | Legislative, regulatory | | |
| **GHG reduction by 2030:** | Medium (overlap with #1) | **GHG reduction by 2050:** | High (overlap with #1) |
| **Cost and funding considerations:** | $$$; long-term planning expected to mitigate the risk of stranded assets | | |
| **Ease of implementation:** | Hard | | |
| **Example case studies:** | Netherlands (revocation of obligation to serve, subsidized gas phase out). To date, no U.S. states have created formal transition plans or limited expansion of gas distribution infrastructure altogether; California, Massachusetts, and NYS (Case 20-00652) have opened PSC proceedings to investigate the role of gas distribution companies in a future clean energy system and long-term gas planning procedures. | | |



# Mitigation Strategy – Initiative #3 Gas System Transition

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. The utility has an obligation to provide gas service to buildings located within an established distance from the utility's existing facilities and as governed by NYS statute<br>2. Industry and consumer opposition (e.g., gas industry, developers/construction, manufacturers, large end-users)<br>3. If not coordinated with broader codes and standards, could drive customers to other fossil fuels<br>4. End uses with high dependence on gas (hard-to-electrify)<br>5. Costs burdens placed upon remaining gas customers, with disproportionate burden on LMI households and DACs<br>6. Maintaining reliability and safety of gas system throughout transition<br>7. Grid reliability and need for substantive upgrades to electric system to meet increase in demand as buildings electrify (T&D, system lines, and customer panel upgrades) | 1. Legislative change<br>2. Phased planning process that is inclusive of stakeholders including industry, consumer, and LMI/DAC representatives; gas workforce protections and transition plan; consumer education on benefits of the transition<br>3. Broader codes and standards, consumer education<br>4. Gas infrastructure planning effort and strategic investments in innovation can work with these sectors to develop feasible and economic decarbonization options<br>5. Comprehensive equity strategy and resources to enable LMI/DAC households to make energy efficiency upgrades and electrify affordably and expeditiously; planning and regulatory analysis of accelerated depreciation approaches<br>6. Utility planning and operational practices to meet current customer needs and maintain safe and reliable service while minimizing infrastructure investments<br>7. Phased approach to consider and mitigate/manage impacts on the electric grid. Regulators work with utilities on their long-term capital planning to help mitigate costs (e.g., utilities to account for code changes in their infrastructure planning) |

# Mitigation Strategy – Initiative #3 Gas System Transition

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| **Undertake a planning study and process** to examine the regulatory, legislative, and other policy changes needed for a managed and just transition of the gas system and infrastructure. Planning and subsequent changes would proceed in a phased manner, with attention to:<br>• safety, equity, and reliability and affordability of service;<br>• assessment of existing gas infrastructure and options for contraction;<br>• identification of end-users highly reliant on gas, technically feasible alternatives, and economic impacts;<br>• a new requirement that each utility regularly file a proposal for how it would meet the State's 2030 and 2050 GHG emissions reduction goals within its customer base, incl. annual utility projections for key metrics (e.g., emissions, fossil gas sales and number of customers by customer class);<br>• alternative models for the gas utility's long-term role, business model, ownership structure, and regulatory compact, as part of a managed transition. | PSC and DPS, in collaboration with utilities, NYSERDA | Phased (build on PSC Case 20-00652); steps in 2 years to 10+ years | Consumers, builders, local governments<br><br>LMI/DAC households, public housing authorities, EJ and affordable housing groups<br><br>Utility workers, unions, local governments |
| Develop a **comprehensive equity strategy** to incorporate the needs of LMI households and DACs in the transition, ensuring they are not left behind. This requires meaningful LMI/DAC engagement in the transition process and prioritizing technical and financial assistance to enable LMI/DAC households to make energy efficiency upgrades and electrify affordably. | PSC and DPS, in collab. with utilities, NYSERDA, DOL | Concurrent with planning process | |
| Create an **equitable transition plan for the gas industry workforce**, including protections, retraining and training that leverages transferrable skills, and job transition opportunities with attention to opportunities at dual-commodity utilities.This requires both a comprehensive system-wide equity strategy and utility-level equity strategies that include adequate accountability and oversight. | | | |
| **Minimize new investments in gas delivery infrastructure,** not otherwise needed for safety/reliability. Change utility incentives and planning to promote (non-pipes) alternatives to conventional gas infrastructure investment. Align long-term utility planning with the adoption cycle for updated building codes and standards. | PSC and DPS, utilities | Concurrent with planning process | Consumers, builders, solution providers for non-pipes alternatives |



# Mitigation Strategy – Initiative #3 Gas System Transition

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| **Stop utilities advertising fossil gas as "clean,"** "natural," "climate friendly," or in similar terms. | PSC and DPS | 6 months | Utilities |
| **Phase-out incentives and rebates for fossil gas equipment** that are offered by utilities or NYSERDA. | PSC and DPS | 1 year to adopt phased approach | Utilities, NYSERDA, consumers |
| **Undertake analysis and provide resources for building-readiness for electrification** (to address common building typologies today and over the next decade) and **undertake analysis, planning, and information sharing for electric grid-readiness for electrification** (to include sub-feeder level information for each electric distribution utility and to support planned, transparent upgrades to the grid so that building owners know when access to sufficient electrical service will be available to fully electrify their building). | PSC and DPS, NYSERDA, utilities | 1-2 years | Local governments, builders, property managers, consumers |
| Undertake analysis and **planning for decarbonization of the ConEd district steam system**. | PSC and DPS, ConEd | 2-3 years | Steam customers |
| Level the playing field for adoption of clean heating solutions by **eliminating the "100-foot rule"** which can bias customer decision-making around heating choices. (The 100-foot rule covers most or all of the cost of new gas connections for residential customers and significant costs for new non-residential firm gas customers).<br><br>**Clean heating choices should be considered policy in the public interest** to support healthy homes, with the provision of heating service to homes (rather than specifically gas or steam service) recognized in State Policy as necessary for the preservation of health and general welfare. | Legislative action, PSC and DPS | 2-3 years | Utilities, builders, consumers, local governments |
| Develop **easement rules to allow access for thermal/ground source loops** to use utility and public (e.g., municipal) rights of way on reasonable terms. | NYSERDA | 2-3 years | PSC and DPS, utilities, local governments |

# Mitigation Strategy – Initiative #4 Transition from HFCs

## Overview

| | | | |
|---|---|---|---|
| **Description:** | **Advance a managed and just transition from reliance on the use of hydrofluorocarbons (HFCs) as refrigerants and in all products used in building construction.** | | |
| **Action type:** | Legislative, regulatory | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$ | | |
| **Ease of implementation:** | Hard | | |
| **Example case studies:** | California Short-Lived Climate Pollutants Strategy; US Climate Alliance SLCP Roadmap; Washington and other state legislative actions to address building codes | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. HFC use is currently widespread in products being recommended to electrify space conditioning and in foams that provide insulation for higher efficiency buildings<br>2. Introduction of a replacement with other deleterious environmental and/or health effects<br>3. Refrigerants are global commodities; a single state is unlikely to spur manufacturers to shift to low-GWP refrigerant technologies | 1. Resource toolkits, programs and incentives that make low-global warming potential (low-GWP) refrigerant technologies and low-GWP alternatives in building/construction foams available and affordable to customers now; training installers and contractors on handling, equipment maintenance, and disposal; enforcement of HFC disposal<br>2. Research into long term health effects of exposure to new chemicals in building materials<br>3. Ongoing collaboration with US Climate Alliance ensures widespread alignment on policy and mitigates impacts to manufacturers and costs for consumers |



# Mitigation Strategy – Initiative #4 Transition from HFCs

| Components required for delivery | Implementation lead | Time to adopt regulation/action | Other key stakeholders |
|---|---|---|---|
| Update the relevant **NYS codes** to allow low-GWP refrigerants. | DOS | 3-5 years | Manufacturers and servicers |
| Require **reclamation or destruction** of refrigerants from appliances at end-of-life, with verification and reporting, and require leak detection for certain commercial refrigeration (align with Waste Panel recommendations). Provide education and training, technical assistance, and economic support (e.g., incentives to purchase leak detection and reclamation equipment, compensation for refrigerant reclamation) to aid local industry with this transition. | DEC, NYSERDA | 1-5 years | Manufacturers, servicers, contractors, property managers |
| Support **workforce training** and education for low-GWP refrigerants and technologies and for low-GWP alternatives in building/construction spray foam. | DEC, NYSERDA, SUNY | 1-3 years | Manufacturers, servicers, contractors |
| Expand the scope of the NYS **Significant New Alternatives Policy (SNAP) Rule** which prohibits certain HFCs in refrigerator/freezers, chillers, commercial refrigeration, and aerosols/foams/solvents; and lower the GWP threshold over time as low and ultra-low GWP options become available. Align NYS policy with anticipated federal (US EPA) policy measures to meet HFC reduction requirements as well as with other US Climate Alliance states, in order to send a strong market signal to manufacturers and industry while mitigating costs of the transition. | DEC | 2 years | Manufacturers, servicers, contractors |
| Support **further research** into known data gaps, including analysis of typical leak rates and charge size for VRF systems and research into long term health effects of exposure to new chemicals in building materials. | NYSERDA | 2 years | Manufacturers, designers, property owners |
| Continue to support **demonstration projects** for low-GWP refrigerants in HVAC and hot-water systems, and for refrigerant leakage detection and reduction strategies. Develop case studies in alternative refrigerants and refrigerant management, showing the safety, performance, and cost impacts. | NYSERDA | ongoing | Manufacturers, designers, and property managers |

# Enabling Strategy Summary

| | Description | Action type | Ease of implementation | Cost* |
|---|---|---|---|---|
| **Cross-cutting:** The scale of transformation will require mobilizing private capital and a significant increase in public resources. The CAC should conduct an economy-wide analysis to identify public and private resources and funding mechanisms. | | | | |
| 1 | Public Financial Incentives | Financial, regulatory, programmatic | Hard (given scale) | $$$ |
| 2 | Public and Private Low-cost Financing | Financial | Hard (given scale) | $$$ + mobilize private capital |
| 3 | Workforce | Financial, regulatory, programmatic | Medium | $$ |
| 4 | Consumer Education | Programmatic | Medium | $$ |
| 5 | Innovation | Financial, programmatic | Easy | $$ |
| 6 | Embodied Carbon | Financial, regulatory, programmatic | Easy | $ |
| Cross-cutting recommendations also address federal support, energy prices, resilience, and the importance of energy efficiency. | | | | |

**Cost estimates for enabling strategies reflect new State resources above current levels of investment, through 2030. State investments in market enabling strategies will be needed for at least the coming decade, with ongoing State resources thereafter to support LMI households and DACs. The categories used for **new State resources (through 2030)** are: $ (<$25M, resources are already on hand), $$ ($25M - $100M, requires some new resources), and $$$ (>$100M, requires high degree of new resources).*



# Cross-Cutting Recommendation: Economy-wide Analysis to Identify Resources

**Realizing transformation at this scale - and doing so in ways that advance equity - will require new resources:**

- Focusing the investment of private capital that will be needed to construct, upgrade, and operate highly efficient buildings powered by zero-emissions electricity
- Investing public resources to support market-enabling initiatives and incentives for early adoption of technologies
- Investing public resources to fund building efficiency and electrification in LMI homes, affordable and public housing, and disadvantaged communities – while supporting energy affordability, safe and healthy housing, economic opportunities, and the repair of structural inequalities

**Cross-cutting Recommendation:** Currently identified funding/financing mechanisms will not address the scale of transformation needed.

- The CAC should conduct an economy-wide analysis to identify public and private resources and funding mechanisms, including federal resources and mechanisms to mobilize private capital, at scale. These resources should holistically support the CAC's Scoping Plan including, but not limited to, all sectors, markets, and building types.
- The CAC also should form an advisory body comprised of members with relevant expertise to advance ways to engage private sector sources of capital and financial institutions (e.g., mortgage, municipal, and community development financial institutions), in support of the economy-wide analysis and on an ongoing basis.

# Enabling Initiative #1 Public Financial Incentives

## Overview

| | |
|---|---|
| **Description:** | **Provide incentives for single family, multifamily, and commercial and institutional building owners that speed uptake and help to transform the market for building efficiency, electrification, and decarbonization, with a focus on enabling uptake that benefits LMI households, affordable housing and public housing, and DACs.** |
| **Action type:** | Financial, Programmatic, Regulatory |
| **Cost and funding considerations:** | $$$<br><br>The Panel estimates:<br>• A **minimum <u>$1B annually</u> in funding is needed specifically for programs that serve LMI households, affordable and public housing, and disadvantaged communities**, on an ongoing basis.<br>• **Financial incentives to motivate early adoption in market-rate housing and commercial buildings also will be needed for at least the coming decade**, supported by public funding at levels comparable to or higher than current energy efficiency and building electrification programs.<br><br>NYS currently invests (through 2025, across programs administered by NY's Utilities, NYSERDA, HCR, and OTDA):<br>• ~ $250M annually for energy efficiency programs that specifically serve LMI households and affordable housing, as part of > $1B annually to support energy efficiency and building electrification across residential, commercial, and institutional buildings statewide.<br><br>Also see prior slide on Economy-wide Analysis to identify new resources |
| **Ease of implementation:** | Hard, given scale |
| **Example case studies:** | NY-Sun, Statewide LMI Portfolio of energy efficiency programs, NYS Clean Heat, Comfort Home Pilot |



# Enabling Initiative #1 Public Financial Incentives

## Overview

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Ensuring sufficient funding levels and broader funding sources; specifically, there is a need to expand revenue sources beyond charges on electric and gas ratepayers<br>2. Incentive programs can be complicated for consumers to navigate<br>3. Incentive programs do not always provide equitable access or funding to those most in need, and the charges to raise the revenue for such programs can be regressive<br>4. Barriers to sharing data and administrative “silos” can prevent targeting services and benefits to those households and communities with the highest energy burdens | 1. Potential for assistance from federal government, given interest in advancing the climate agenda and investing in infrastructure<br>2. In program design, emphasis on ease of access to available and relevant resources for consumers/installers, particularly for LMI households and buildings in DACs that can need resources from multiple programs<br>3. Maximize use and access to existing State programs and incentives to enhance the efficacy of energy efficiency and electrification work; align and streamline WAP, EmPower, and utility programs to optimize use of available resources; review HEAP formulas for the provision of funding for electrification and shell improvements. Create new incentive programs to support both energy and non-energy building improvements that are necessary for building decarbonization<br>4. Ongoing coordination among State agencies (NYSERDA, OTDA, NYSDOH, HCR, DPS) and the utilities, including through the State’s Low-Income Energy Task Force, to assess the feasibility of consolidating program applications for relevant energy, housing, and other assistance and for sharing data, with appropriate data-privacy practices |

# Enabling Initiative #1 Public Financial Incentives

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Identify and pursue modifications to **regulatory frameworks** for energy efficiency and building electrification programs to further align the programs with State objectives.<br>This includes, but is not limited to, consideration for and implications of accounting for full (societal) costs and benefits of energy upgrades in buildings. | DPS, PSC | 2 years | utilities, NYSERDA, DOS, clean energy industry |
| Create a program to **provide direct cash incentives for electrical service upgrades** and in-building wiring and equipment, to offset costs associated with preparing a building for electrification (similar to the EV Make-Ready Program). | DPS, PSC, utilities | 2 years | Real estate industry, local governments |
| Expand/create **new direct cash incentives for energy efficiency and electrification** in residential and commercial buildings, with priority on LMI households, affordable housing, public housing, and DAC's. Incentives that help enable uptake and transform the market broadly will be needed for at least the coming decade, with ongoing resources thereafter for LMI/DACs. | State-level entity (TBD on design) | 2 (scale up from ongoing) | NYSERDA, DPS, utilities, housing agencies/authorities, LMI/DAC households, EJ and affordable housing groups |
| Support and accelerate **efficiency, electrification, and resilience in public housing**, statewide (e.g., in NYCHA and other Public Housing Authority developments). Identify funding sources to support deeper retrofits and electrification. Support resiliency centers in public housing developments that provide safe temperatures, backup power (including solar-storage pilots), and community spaces to coordinate disaster relief. | PHAs, NYPA, NYSERDA | 2 years | PHA residents, HCR, DPS, NYC agencies (DOB, MOS, HPD),utilities, EJ and affordable housing groups |
| Create a **"Retrofit and Electrification Readiness Fund" for LMI households, affordable housing, public housing, and residential buildings in DACs** to cover costs of non-energy building improvements that are necessary to install energy measures and broadband installation costs when funding energy projects. | NYSERDA, DPS and PSC, HCR | 3-4 years | HPD, LMI/DAC households, EJ and affordable housing groups |
| **Leverage healthy homes services and funding** across housing, health, and energy improvements for low-income households to fund green and healthy housing retrofits, e.g.:<br>• Build on the NYS Healthy Homes VBP pilot and further leverage NY Medicaid's Value-Based Payment (VBP) program for Managed Care Organizations to contribute to healthy housing services and home energy efficiency improvements;<br>• Expand use and leveraging of both state and federal funding (e.g., use of WAP funds for health and safety improvements, new HUD Older Adult Home Modification Program);<br>• Engage with non-profit hospitals in community health needs assessments. | NYSERDA, DOH | 4 years (scale up from pilots) | OTDA, HCR, HPD, DPS, utilities, community-based organizations, nonprofit hospitals, healthcare professionals |



# Enabling Initiative #2 Public and Private Low-cost Financing

## Overview

| | |
|---|---|
| **Description:** | **Low-cost financing for energy efficiency, electrification, electrification readiness, solar PV, and related improvements in buildings to provide single family, multifamily, and commercial and institutional building owners with access to low-cost capital at the scale needed to pay for the building upgrades necessary for decarbonization.** |
| **Action type:** | Financial |
| **Cost and funding considerations:** | $$$ + unlock private capital |
| **Ease of implementation:** | Hard, given scale |
| **Example case studies:** | GJGNY; mobilize low-cost capital at a scale comparable to the NYS Environmental Facilities Corp (Clean Water State Revolving Fund) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Lack of awareness in market; predatory lending | 1. Provide for consumer protections in financing products |
| 2. Lender interest | 2. Lender education and outreach |
| 3. Perceptions of risk in underwriting to energy performance | 3. Sufficient resources and case studies available to lenders to provide adequate modeling for underwriters |
| 4. Complexity of developing a large-scale, financing structure with the credit-worthiness elements that institutional investors will view as AAA | 4. Models exist for bond-backed State/local revolving fund |
| 5. Current economic conditions for building owners | 5. Scale of transformation will require both unlocking private capital and raising substantial public revenue |

# Enabling Initiative #2 Public and Private Low-cost Financing

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Provide support for **lenders to underwrite to energy performance standards** and applicable regulatory requirements. | HCR, NYSERDA | Ongoing | DFS, private lenders |
| Continue to scale up **green requirements in affordable housing deals** while ensuring that sufficient resources are available to maintain, preserve and produce clean, safe and affordable housing. Streamline access to all incentives and resources for regulated affordable housing building decarbonization to go through housing agencies making projects affordable, to also make projects energy efficient, all-electric or electric-ready, and resilient. | HCR, HPD | Ongoing | NYSERDA, DPS, OTDA, NYCMOS |
| Provide **greater access to low-cost financing products** for upgrades, including for low-income homeowners and/or DACs (e.g., low-interest financing coupled with credit enhancement/insurance). | NY Green Bank/NYSERDA, HCR | 2 years | DFS, Private banks licensed by DFS; CDFIs |
| Expand the **use of performance contracting** to achieve goals for State, municipal, and K-12 school building upgrades. | Legislative action | 1-2 years | NYPA, NYSERDA, State agencies |
| Provide a **revolving loan fund for building decarbonization**: e.g., enable public mandates coupled with access to low-cost capital. | Bond-issuing government authority | 4 years | DASNY, DOS, DEC (EFC), NYPA, local gov'ts |



# Enabling Initiative #3 Workforce

## Overview

| | |
|---|---|
| **Description:** | **Support workforce education, training, job placement and development that equip the state's current and future workforce to design, install, inspect, maintain and operate healthy, comfortable, low-carbon buildings while increasing clean energy job placement for DACs and advancing industry diversity.** |
| **Action type:** | Financial, programmatic, regulatory |
| **Cost and funding considerations:** | $$; building upon NYSERDA's $100M clean energy workforce training initiative |
| **Ease of implementation:** | Easy to develop programs and robust training infrastructure; medium-effort to coordinate/deliver training and placement services at scale, and operationalize support needed for DAC access |
| **Example case studies:** | NYSERDA's clean energy workforce programs |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Insufficient skilled new entrants to meet labor demand; industry capacity limited by certain workforce gaps (e.g., drilling is a pinch point in geothermal industry capacity)<br>2. Training does not lead to job placement<br>3. DAC residents face additional barriers/challenges to securing or retaining jobs<br>4. Job losses for fossil-fuel related industries<br>5. Cost pressure of upgrades results in wage depression for certain segments (e.g., building service workers) | 1&2. Ensure training investments are driven by industry/employers' needs and demand for new workers. Offer curriculum/career guidance in K-12 and technical schools; develop/scale recruitment models. Provide training integrated with hiring support services. Incl. training/mentorship for current workers and leaders in HVAC and delivered fuel companies to transition to heat pumps.<br>3. Prioritize investment in DAC outreach, career pathways and placement support. Invest in foundational skills and wrap-around support (e.g., childcare subsidy, free MetroCard). Require employers taking public subsidies conduct periodic racial bias training.<br>4. Ensure a just transition; prioritize for retraining and job placement. Also see point 1 above.<br>5. Support retention of workers and equitable access to high-quality, family-sustaining jobs (coordinate with Just Transition Working Group). |

# Enabling Initiative #3 Workforce

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Scale up training** for incumbent and new clean energy workers and adjacent industries, through investments in training infrastructure/delivery, career pathways, on-the-job-training, industry partnerships. Support expanded or new training for:<br>• Local government workforce of code officials and building inspectors;<br>• Building operations, maintenance, and service workers;<br>• Healthy homes training, to equip energy auditors and health/social workers who make home visits to identify health and safety issues and contractors/installers to address these issues;<br>• Training/industry partnership to increase the number of qualified geothermal drillers;<br>• Training for workers in fossil fuel industries to transfer their skills to clean energy opportunities. | NYSERDA | 2020-2025 | DOL, DOS, state agencies, unions, industry/trade orgs, training orgs, local gov'ts, manufacturers, distributors, impact investors/foundations |
| **Prioritize DACs/low-income residents** and other priority populations for training and job placement by creating community-to-employment pipelines and career pathways; analyze current on-the-job training investments for their effectiveness as an employment pathway and refine as appropriate. Promote good wages, benefits, local and targeted training and hiring through Community Benefits/Workforce Agreements and On the Job Training Funding where appropriate, feasible and permitted by law. Leverage State agencies' spending and regulatory influence to advance commitments around job access and job quality for DACs. | NYSERDA, DOL | 2-3 years | ESD, community-based orgs, unions, training providers, community colleges, social service agencies, workforce one-stops, foundations |
| Increase ranks of **MWBE and SDVOB** (Service Disabled Veteran Owned Business) and cooperatives through increased access to workforce training and business development support; increase MWBE and SDVOB participation across broader array of State-funded investments and projects. | NYSERDA, DOL, ESD | 2 years | State agencies, local govts, workforce, community-based orgs, one-stops, training providers |
| Require building decarbonization **curricula and career services** in State-funded education incl. K-12, technical schools, apprenticeships, and engineering and architecture programs at public universities, and encourage this curricula at private universities. | NYSERDA, NYS Board of Regents, SUNY, CUNY | 2-4 years | DOL, unions, private colleges & univs, accrediting boards |
| Require **continuing education on building decarbonization** (e.g., energy efficiency, electrification, embodied carbon) as part of licensing for architects, engineers, trades, contractors, building ops. and maintenance, real estate professionals (inspectors, brokers, etc.). | DOS, NYSERDA, DOL, local licensing agencies | 3 years | unions, industry orgs, accrediting boards |
| Support **retention** of experienced building service workers. | NYSERDA, DOL | 2 years | Unions, Building Owners, DOS, local licensing agencies |



# Enabling Initiative #4 Public Awareness and Consumer Education

## Overview

| | |
|---|---|
| **Description:** | **Support broad public awareness and consumer education, create strategic partnerships including with trusted community leaders, and scale-up targeted outreach and decision-making support to increase market demand and accelerate the transition to low-carbon, energy-efficient, all-electric buildings.** |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | $$ |
| **Ease of implementation:** | Easy to develop content; medium effort to develop integrated strategic plan and coordinate aligned messaging and dissemination; high touch/volume, delivered through range of channels to effectively reach broad range of audiences. |
| **Example case studies:** | Clean Energy Hub model (under development) |

# Enabling Initiative #4 Public Awareness and Consumer Education

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Low awareness of Climate Act, building inefficiencies, climate solutions for buildings, and steps to take | 1. Broad-based public outreach campaign with clear customer journey to resources/programs; drive participation through retargeting and repeated exposure; create sense of shared responsibility |
| 2. Competing demands on consumers' attention | 2. Trusted, high-visibility resources/channels (e.g., local elected officials, social media influencers, sponsored content); embed messages in TV/film (e.g., home improvement or cooking shows) |
| 3. Perception of natural gas as clean, opposition campaigns from fossil fuel industry | 3. Direct utilities to sunset "clean gas" messaging; public education on the negative indoor air quality and climate impacts of combustion appliances |
| 4. Lack of familiarity with heat pumps or inaccurate perceptions | 4. Ample data/case studies/customer testimonials (e.g., Maine leading on heat pumps); engage validators; offer tours |
| 5. Partisan polarization in news/info sources | 5. Early local community engagement (regional working groups, Hubs) to build trust, drive engagement, and provide transparency; use varied channels to deliver message; engage younger generations to influence parents |
| 6. Raised awareness does not translate into action | 6. Streamlined customer access to programs (e.g., one-stop shop/Hub to help DAC customers); deliver info when customers are making energy-related decisions (e.g., during home purchase, at home improvement stores, through utility marketplaces, as part of asset management plans) |
| 7. Reluctance to electrify due to grid reliability / risk of losing heat | 7. Address grid reliability, resilience head-on as part of all messaging; showcase technical solutions and demonstrate improvements to increase public confidence |



# Enabling Initiative #4 Public Awareness and Consumer Education

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support and scale up **multilingual public and consumer education** efforts through large-scale, coordinated awareness, inspiration and education campaign; traditional and broad reaching media, digital communication, “influencer” style campaigns, user-generated campaigns, out of home displays, zines, mailers, virtual tours; resources for installers, distributors, home-visiting workforce, other supply chain actors to educate consumers, customer-facing resources and tools. | NYSERDA, utilities | 2 years | Utilities, installers, distributors, manufacturers, real estate industry, unions, trade associations, home improvement retailers. |
| Create **Strategic Partnerships** that can have Broad Impact: including utilities (promote decarbonization and sunset 'clean gas' messaging), trusted community leaders and organizations (e.g. churches), cooperative extensions, business councils, industry orgs/large corps, unions, schools/teachers, film and public venues, state and local elected officials. Build on experience from Heat Smart programs. | NYSERDA | 2-3 years | Utilities, PSC, community-based orgs, industry orgs, local coop. extensions, Heat Smart campaigns |
| Ensure messages, messengers, and media **reflect DACs** in marketing efforts and prioritize education and technical assistance for DACs. Maintain a “one-stop shop” website for clean energy, electrification, and energy efficiency programs, and establish and fund community hubs to offer education, resources, local contractors, technical assistance and program navigator support. Build on the commitment of NYSERDA and NYS Utilities to maintain the NY Energy Advisor website and coordinated marketing for a statewide portfolio of LMI programs, and on NYSERDA’s development of regional Clean Energy Hubs. | NYSERDA | 1-2 years | Utilities, community-based grassroots organizations, cooperative extensions, manufacturers, installers, state and local elected officials. |
| Publicize **best practices** for efficient building operations and recognize leaders/innovators in efficient operations for early adopters. Create an incentive program/challenge to attract others or encourage others to sign **a pledge to commit to neutrality**. | NYSERDA | 1-2 years | Industry groups, unions, local govts. |
| Provide **technical assistance and resource toolkits** for building decision-makers and residents including playbooks for low-carbon solutions in common building types, free in-home or virtual audits to homeowners, and capital planning support for large buildings. Provide info resources and tools to support tenant engagement. Demonstrate low-carbon solutions through challenges, case studies. Develop case studies showing the feasibility, performance, and costs for three paths to transition to all-electric buildings: full electrification, partial electrification, and electrification ready. | NYSERDA, utilities | 2-3 years | Building decision-makers; real estate orgs; Service providers (A&E firms, MEPs); tenant organizations; residential contractors. |

# Enabling Initiative #5 Innovation

## Overview

| | |
|---|---|
| **Description:** | **Support research and development (R&D), demonstration projects, and more companies and manufacturers operating in NYS to bring innovative solutions to the marketplace for: highly efficient, all-electric, and resilient buildings; grid-interactive buildings, with revenue opportunities; and reducing embodied carbon in buildings.** |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | $$; building upon NYSERDA's $60M annual commitment |
| **Ease of implementation:** | Easy |
| **Example case studies:** | New York Battery and Energy Storage Technology (NY-BEST), ARPA-e, California Public Interest Energy Research (PIER) project, MassCEC |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. NYS funding and the NYS market opportunity alone are not large enough to drive needed R&D.<br>2. Industry inertia and building-as-usual culture favor familiar building practices and materials.<br>3. Need to expedite solutions for certain building typologies.<br>4. Cost is the primary driver for choice of solutions and few current solutions successfully compete on current cost and value proposition<br>5. Market-driven innovation may leave behind LMI households, DACs | 1. Advocate for federal government R&D funding and work in partnership with like-minded states and entities. Concurrently increase NYS funding of R&D, which has a strong multiplier for jobs and economic development.<br>2. Leverage New York's robust innovation ecosystem; codes and standards to sunset fossil fuel use in buildings would provide strong market signal.<br>3. Develop NYS demonstrations and case studies for emerging technologies in prevalent building typologies.<br>4. Orient innovation toward cost reduction as well as additional value.<br>5. Fund innovation opportunities that target solutions for LMI/DACs and locate demonstration projects in DACs. |



# Enabling Initiative #5 Innovation

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Advocate for, and leverage, **Federal and National Laboratory resources** focused on identifying and commercializing advancements in technologies for building decarbonization and building resilience. | Chamber | ASAP | NYSERDA, SUNY |
| Scale up resources to identify and promote **tech. transfer** for innovative building decarbonization technologies and design approaches that are in use internationally and could be transferred to the NYS market, e.g., via support adapting for NYS standards, demonstrations, market research, partnering with NYS entities, and manufacturing assistance. | NYSERDA, ESD | Scale up from ongoing, over 1-2 years | manufacturers, designers, like-minded states/orgs. |
| Provide support and outreach for **MWBEs, cooperatives, and B Corps**, e.g. dedicated access to expert advisory services; internships, fellowships, and board placement in innovative companies; access to venture capital for underrepresented women and minority entrepreneurs, via New York Ventures. | NYSERDA, ESD | Scale up, over 1-2 years | |
| Continue to support R&D, demonstrations, and technology transfer/commercialization for next generation HVAC systems and building envelopes that deliver high performance, meet technical needs, and lower costs, incl. for: continued improvement in cold climate performance across a range of heat pump products/sizes; improved domestic hot water heat pump technologies; solutions for harder-to-electrify buildings; community thermal loops; advanced heat recovery and ventilation; improved thermal storage for HVAC applications; innovative materials, construction approaches, and manufacturing methods that improve building envelopes; and other technologies. | NYSERDA | Continue ongoing | Federal government, SUNY campuses and researchers, manufacturers, designers, building decision-makers, utilities, like-minded states/organizations |
| Support R&D, demonstrations, technology transfer/commercialization, and development of standards across manufacturers and equipment for **Grid-Interactive Efficient Buildings** (GEBs), to deliver energy efficiency, load flexibility, and modulation capabilities that contribute to efficient grid management and grid reliability. | NYSERDA | Scale up from ongoing, over 1-2 years | |
| Support the development of market signals incl. revenue streams **for Grid-Interactive Efficient Buildings,** via analysis of opportunities to provide grid services and electric/thermal services to neighboring buildings, assessment of market mechanisms for supporting desired policy outcomes, and pilots/demonstrations to inform rulemaking/ratemaking. | PSC/DPS, NYSERDA, utilities | Scale up, over 1-2 years | |
| Assess and then support R&D needs with respect to building resilience (with electrification and more frequent extreme weather**); flexibility and resilience** of the electrical system; and related energy and thermal storage solutions. | NYSERDA, DEC | | |

# Enabling Initiative #6 Embodied Carbon

## Overview

| | |
|---|---|
| **Description:** | **Establish procurement requirements and design specifications for State-funded projects and support education, building reuse, R&D, and in-state manufacturing of alternative products in order to lower the embodied carbon of products and materials used in the buildings sector and to create broad carbon literacy regarding the impact of materials, while increasing attention to carbon-sequestering products (e.g., cross-laminated timber, hempcrete).** |
| **Action type:** | Education, Financing, Regulatory |
| **Cost and funding considerations:** | $ |
| **Ease of implementation:** | Easy, via a diversified approach |
| **Example case studies:** | Port Authority NY/NJ calls for EPDs in some specifications; NYSERDA takes embodied carbon into account in awarding support for building construction projects; EC3 is a viable, free tool gaining traction |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Lack of awareness of embodied carbon impacts regarding products in use in building industry (designers, contractors, and manufacturers)<br>2. Industry inertia and building-as-usual culture favor familiar building practices and materials.<br>3. Inaccurate impression that reducing embodied carbon will cost more and damage economy | 1. Create method to require transparency and therefore engagement with data on embodied carbon as part of daily practice (in all state work).<br>2. Lead-by-example by requiring reduction of embodied carbon in State-funded projects. Incorporate into project calculations the value of carbon guidance issued by DEC for use by State agencies, to create awareness of the cost of GHG emissions and embodied carbon.<br>3. Harness NYS forestry economy to develop carbon negative building retrofit products in state, thus supporting carbon and economic development and DAC support goals. |



# Enabling Initiative #6 Embodied Carbon

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Drive embodied carbon reductions through procurement in State-funded projects **(leading by example**), initially by requiring Environmental Product Declarations (EPD) for structural building materials and products used in the project and promoting the use of available modeling software/design tools for embodied carbon calculations. In parallel, require that State-funded projects follow lower-carbon specifications for the most carbon intense building materials and products (e.g. concrete, foam insulations, glass, window units). Subsequently set a target embodied carbon reduction level (below the established mean carbon budget as illustrated over the previous years) for projects. | Under GreenNY, incl. DASNY, NYSERDA, DOS; explore procurement specs. under Exec.Order 4 and potential links to public bid process for construction projects | ~2 yrs. for EPD/tools; ~4-5 yrs. for carbon specs; and rigorous carbon budget reduction goals by 2030 | PA NY/NJ, DOT, DEC, OGS, NYPA, NYC DDC, builders, designers, manufactures, local gov'ts. AIA ACEC, AGC… |
| Support **R&D, demonstration projects, and technology transfer/commercialization** for enhanced low embodied carbon construction, including preference for re-use of existing buildings. | NYSERDA for products to market, DASNY and SUCF for design practices | ~2 yrs. | AIA, ACEC, AGC, like-minded states/orgs. |
| Provide assistance to expand **in-state manufacturing** for products that are lower in embodied carbon (e.g., low carbon concrete) or made of carbon sequestering materials also known as biogenic or agriculture-based materials (e.g., hempcrete and sustainable wood products). | SUNY ESF, NYS Wood Products Development Council | 2-5 years aggressive build-out | NESEA and other green building organizations, Sustainable Business Council |
| Identify and pursue financial incentives, changes to building codes, and other strategies specifically to encourage **building reuse**, beginning in urban centers where returning vacant buildings to use and maintaining the existing building facade and architectural style and can be an additional benefit to the embodied carbon reduction. | *[to be identified]* | 5 years for projects meeting certain requirements (size, cost, etc.) | Real Estate Associations, IDAs, local governments |

# Cross-Cutting Panel Recommendations

| Initiative | Panel Recommendation |
|---|---|
| **Federal Agenda** | The Panel recommends the CAC **advocate for Federal resources and policy support** in the scoping plan. Climate change is a national and global problem. New York State is a leader but will need significant assistance and partnership from the Federal government to bring these recommendations to fruition. |
| **Revenue Sources** | The Panel recommends the CAC **conduct an economy-wide analysis to identify resources** and funding mechanisms to support the final scoping plan. While the Panel identified and recommended some potential funding/financing mechanisms, these do not address the full need outlined in the recommendations. Further analysis and expert/stakeholder input is needed to identify resources for this scale of transformation. |
| **Energy Costs and Price Signals** | The Panel recommends **ongoing PSC attention to rate design and retail rate price signals for both electricity and gas**, to ensure affordability as buildings electrify and to promote demand flexibility. |
| **Adaptation and Resilience** | **Adaptation and Resilience recommendations are of material importance** as buildings electrify heating systems, and as the frequency of extreme weather events increases the probability and scale of grid outages. At the building level, the Panel recommends several changes in the State codes that support more resilient buildings and efficient, flexible technologies that can enhance grid reliability and resilience, including high-performance walls/roofs/windows to improve passive survivability, solar PV along with energy storage readiness, grid-interactive appliances, and EV readiness to position for vehicle-to-grid/vehicle-to-building applications. The Panel also supports multiple specific recommendations advanced by the cross-panel Adaptation and Resilience group, notably: (i) to develop policies and programs to reduce human risks associated with new patterns of thermal extremes (e.g., community-based cooling and warming centers, weatherization from thermal extremes, cool roofs); (ii) to ensure the reliability, resilience and safety of a decarbonized energy system (e.g., modernize the energy system, energy efficiency upgrades and capital improvements to buildings to endure grid failures and to accept power when the system is re-energized); and (iii) to strengthen meaningful community engagement and public education and build adaptive capacity (e.g., train building operations staff in disaster preparedness, provide home and small business resilience audits/refinancing). The Panel underscores the need for additional research, analysis, and policy development on this critical topic. |
| **Energy Efficiency Upgrades for Existing Homes** | Although the Panel's recommendations do not include a regulatory requirement to perform energy efficiency upgrades to existing residential buildings, the Panel **underscores the importance of insulation/weatherization and energy efficiency measures** to make homes comfortable and to reduce emissions, heating costs, and seasonal demand peaks. Either regulations and/or substantial subsidies likely will be needed in the future to effectuate this at scale. Given market challenges and costs, the Panel recommends that the first step is to require energy benchmarking and disclosure as described in Mitigation Strategy #2, which can then inform future policy deliberations and programs to assist low-income New Yorkers. In the meantime, funding for LMI weatherization/energy efficiency efforts will need to be substantially increased. |



# Additional Panel Perspectives Summary

| Initiative | Panel Recommendation |
|---|---|
| **Federal Advocacy** | Some members of the Panel recommend **specific Federal advocacy items**, including for increased federal funding for efficiency and electrification upgrades (e.g. for weatherization, HEAP, P-12 schools); attention to federal tax credits (e.g., increase the geothermal commercial tax credit to 30%, boost federal tax credits for affordable housing without reducing unit production); federal support for critical R&D investments (e.g. in ultra low-GWP equipment, long-duration storage, resilience solutions); and to expand guidelines in WAP to allow/increase funding for electrification and healthy homes. |
| **Carbon Fee** | Some members of the Panel recommend that the CAC and NYS policymakers consider an **economy-wide carbon fee**, both to level the relative cost of electricity and gas and to fund investments in building upgrades and workforce initiatives that directly benefit LMI households and disadvantaged communities. If a carbon fee is applied to electricity generation, it will be important to establish an aligned carbon fee applied to fossil fuels combusted in buildings.<br><br>Some members of the Panel support the **Climate and Community Investment Act** (introduced in the NYS Senate as S4264A) to raise and direct funding. |
| **Low-Cost Financing and Financial Incentives** | Some members of the Panel identified **additional financing and financial incentive mechanisms** for further consideration by the CAC, including: on-bill “pay as you save” financing (or inclusive financing) products for clean energy upgrades as a service to utility customers, with consumer protections; engaging mortgage lenders to require compliance with regulations and to provide lower interest rates for low-emissions buildings; exploring additional ways to expand PACE-like and municipal financing; extending State and local sales tax exemption and/or income tax credits to heat pump equipment; and creating or modifying property tax abatements to incent early adoption of deep building decarbonization. |
| **Energy Costs and Price Signals** | Some members of the Panel proposed **specific electric rate design modifications** for consideration, including time-varying rates that encourage electricity use when it is least expensive; voluntary demand-based delivery rates for residential customers that reinforce the storage capability of ground source heat pumps; seasonal rates that take advantage of NY’s current summer peak to provide lower prices for winter heating; specific rate classes for electric heating, all-electric buildings, or all-electric affordable housing; and progressive rate design to mitigate potential energy cost increases for LMI households. In addition to an analysis of natural gas distribution asset depreciation policies for ratemaking purposes, some Panel members proposed **gas rate design modifications** for consideration, including the elimination of block rate structures that provide lower volumetric rates to customers who use more natural gas. |
| **Codes & Standards** | Some members of the Panel recommend a **more accelerated schedule for adopting an all-electric State Code**, starting for single family homes in 2023 and for multifamily and commercial buildings in 2026. |

# Additional Panel Perspectives Summary (continued)

| Initiative | Panel Recommendation |
|---|---|
| **Integration Analysis** | The Panel's recommendations do not fully solve for hard-to-electrify buildings, which may require alternative solutions or transition strategies. The Panel recommends **further analysis of viable solutions for hard-to-electrify buildings**, to be undertaken by NYSERDA. Some members of the Panel further propose that the Integration Analysis process consider additional solutions that include (but are not limited to) some use of hybrid electric-fossil fuel systems as a transition strategy and some use of low-carbon fuels in buildings (e.g., high-percentage biodiesel blends in heating fuel, renewable natural gas, hydrogen, wood).<br><br>Initial analysis suggests that for the buildings sector, the package of policies advanced by this Panel are generally consistent with driving an 85% reduction of emissions by 2050 (relative to 1990 levels), but likely will fall short of driving a 40% reduction of emissions by 2030. Some members of the Panel recommend that the Integration Analysis consider the extent to which the following **additional policy options could accelerate emissions reductions over the next decade**: a more accelerated schedule for adopting an all-electric State Code; a more accelerated schedule for emissions-based standards in existing low-rise multifamily buildings or existing commercial buildings; a requirement that existing residential buildings meet an insulation/air sealing standard (for single family and low-rise multifamily) or a building performance standard (for large multifamily); more funding to drive near-term voluntary adoption of energy efficiency/weatherization; and introduction of a carbon price (in conjunction with regulatory measures) to influence energy conservation as well as capital investment decisions. For these policy options, benefits/costs and practicality of implementation would need to be assessed. |



# Benefits & Impacts **Disadvantaged Communities**

| | |
|---|---|
| Mitigation Strategy #1<br>**Codes and Standards**<br>Mitigation Strategy #4<br>**HFC Transition** | Cost premiums for installation of efficient and electric equipment/systems will need to be subsidized with adequate financial and technical assistance for LMI homeowners, public housing, and building owners within DACs;<br>Avoid potential disinvestment in low-income properties and disadvantaged communities;<br>Training, job placement and workforce development prioritized in DAC and for priority populations. |
| Mitigation Strategy #2<br>**Benchmarking & Disclosure** | Energy affordability is a challenge for many LMI households and required energy disclosure provides important information (incl. on ongoing energy costs) when buying or renting a home, informing decision-making and budgeting;<br>Energy disclosure may lead to higher prices for efficient homes and apartments, which could price out LMI households. |
| Mitigation Strategy #3<br>**Gas System Transition** | NYS faces a risk that LMI/DAC households will be among those left carrying the rate-base for gas infrastructure, creating an unfair burden;<br>Planning process needs to involve stakeholders from disadvantaged communities, to ensure policies maximize benefits and minimize unintended harm to these communities;<br>Provide dedicated resources to help LMI/DAC households and public housing make energy efficiency upgrades and electrify affordably; refine affordability policy to account for household energy burden. |

# Benefits & Impacts **Disadvantaged Communities**

| | |
|---|---|
| Enabling Initiative #1<br>**Low-cost Financing** | Lending tools to incentivize projects benefitting LMI households and/or DACs and public housing to ensure equal participation in decarbonization would provide a convenient alternative financing mechanism that could be appealing and prioritize LMI households and DACs<br>Provide protections from predatory lending<br>Do not create incentives that undermine general affordability and denser living patterns (associated with lower emissions per capita) |
| Enabling Initiative #2<br>**Financial Incentives** | Direct cash incentives to LMI households and DACs would encourage energy efficiency upgrades and early transitioning from fossil fuels<br>Early adoption by LMI and DACs would mean these populations are not left on an increasingly costly gas system<br>Do not create incentives that undermine general affordability and denser living patterns associated with lower emissions per capita |
| Enabling Initiative #3<br>**Workforce** | Training, job placement and workforce development prioritized in DACs and for priority populations.<br>Quality, good-paying jobs for DAC residents and priority populations |
| Enabling Initiative #4<br>**Consumer Education** | Inspire and increase participation in clean energy (more public subsidy going to disadv community residents)<br>Reduced energy costs/burden;<br>Low carbon upgrades improve quality/value of building stock which may further reduce healthcare costs<br>Increased local capacity to participate in and benefit from clean energy transition. |
| Enabling Initiative #5<br>**Innovation** | Innovation that drives down the installed cost of building decarbonization upgrades is particularly valuable for disadvantaged communities, which spend a disproportionate share of their income on energy and housing.<br>Affecting manufacturing can address many EJ issues where siting of dirty manufacturing is often in lower-income and black and brown communities.<br>NYSERDA's innovation program is supporting specific product development and demonstration for heat pump units that fit into affordable multifamily retrofits. |
| Enabling Initiative #6<br>**Embodied Carbon** | Any reduction in embodied carbon in building materials will, over time, benefit distressed and disadvantaged communities by greening up manufacturing, and reducing negative air/soil/water impacts. Attention should be paid to achieving cost parity for low-embodied carbon products compared to conventional. Solutions will need to address remediation of present building conditions where needed to facilitate reuse and also can return vacant buildings to use. |



# Benefits & Impacts **Health & Co-Benefits**

| | |
|---|---|
| Mitigation Strategy #1<br>**Codes and Standards** | Improved outdoor and indoor air quality resulting in better health outcomes;<br>Improved building occupant comfort and productivity;<br>Safety benefits from removing indoor combustion sources, such as reduced risk of fire and carbon monoxide poisoning; Reduced environmental damages associated with fossil fuel combustion and production, including spills and groundwater contamination |
| Mitigation Strategy #2<br>**Benchmarking & Disclosure** | Energy disclosure and market competition are likely to attract buyers/renters for efficient homes, apartments, and commercial spaces; energy-efficient properties have higher occupancy levels, rental premiums, and sale prices relative to less-efficient properties. |
| Mitigation Strategy #3<br>**Gas System Transition** | Avoiding gas infrastructure build-out and requiring new homes to be all-electric will lead to improved outdoor and indoor air quality resulting in better health outcomes;<br>Safety benefits from removing indoor combustion sources, such as reduced risk of fire and carbon monoxide poisoning; Reduced environmental damages associated with fossil gas combustion and production. |
| Mitigation Strategy #4<br>**HFC Transition** | Proper management of refrigerant-containing appliances will decrease overall pollution from disposal of this material. Adverse health effects of exposure to new chemicals need to be further understood. |

# Benefits & Impacts **Health & Co-Benefits**

| | |
|---|---|
| Enabling Initiative #1<br>**Low-cost Financing** | Electrification, efficiency, and readiness measures would improve the quality of life for people living and working in many buildings, improve air and environmental quality, and address other environmental hazards (e.g. mold/asthma triggers) |
| Enabling Initiative #2<br>**Financial Incentives** | Electrification, efficiency, and readiness measures designed and installed by a well-trained workforce would improve the quality of life for people living and working in many buildings, improve air and environmental quality, and address other environmental hazards (e.g. mold/asthma triggers, vulnerability to extreme heat/cold) |
| Enabling Initiative #3<br>**Workforce** | Cross-training of clean energy workforce on health and in-home health workforce on energy to more effectively identify and address home health hazards<br>Skilled workforce will result in healthier, more comfortable buildings for occupants |
| Enabling Initiative #4<br>**Consumer Education** | Promotes messaging that building electrification improves indoor and outdoor air quality and supports human health,<br>Highlights improved comfort; provides tenants greater control over their heat, higher cognitive functioning with better air quality<br>Highlights efficiency in new technology that delivers cooling as well as heating<br>Demonstrates need for improved resiliency |
| Enabling Initiative #5<br>**Innovation** | Cleaner air as onsite combustion in phased out<br>Innovation is expected to deliver healthy, more comfortable buildings for occupants via solutions that are technically feasible and economic for a broad range of building typologies<br>Retrofits will add value to properties |
| Enabling Initiative #6<br>**Embodied Carbon** | A transition to wood-based products, and other biogenic carbon products, can directly improve well-being of building occupants through stress reduction and connection to Nature. Additionally, wood and linoleum, for example, kill off bacteria on their surfaces significantly faster than steel or plastics (99.9% dead after 3 minutes on wood, none died on plastics). Many natural, low-embodied carbon products have significantly lower off-gassing than synthesized products such as spray foam insulation. |



# Benefits & Impacts **Just Transition: Businesses and Industries, Workers**

| | |
|---|---|
| Mitigation Strategy #1<br>**Codes and Standards** | Couple codes/standards with workforce development to grow the workforce equipped to deliver electrification and energy efficiency services and to ensure incumbent workers have paths to transition;<br>Training/upskilling of design professionals, HVAC, and construction industries;<br>New industries and jobs in the clean energy economy |
| Mitigation Strategy #2<br>**Benchmarking & Disclosure** | Better market information about building performance unlocks demand for energy-efficiency services and skilled workers such as design professionals, energy auditors and building raters, facility managers, and HVAC and construction workers (with appropriate protections against potential predatory targeting of LMI/DAC households);<br>Training/upskilling new and incumbent workers in these fields to meet demand, as well as real estate professionals. |
| Mitigation Strategy #3<br>**Gas System Transition** | Displaced gas utility workers must have a just transition path to other positions within the utility or alternate employment. Examples include utilities coupling the roll out of smart meters with job retraining for meter readers to fill other positions and agreements negotiated in the planned closure of the Diablo Canyon nuclear plant in California and of the TransAlta coal plant in Washington. |
| Mitigation Strategy #4<br>**HFC Transition** | New jobs and industries created in refrigerant service, recovery, and destruction. Training opportunities in new technologies provide access to a growing jobs field. |

# Benefits & Impacts **Just Transition: Businesses and Industries, Workers**

| | |
|---|---|
| Enabling Initiative #1<br>**Low-cost Financing**<br>Enabling Initiative #2<br>**Financial Incentives** | Through program design, the following JTWG Principles can be addressed:<br>#4: Realize vibrant, healthy communities through repair of structural inequalities<br>#8: Climate Adaption Planning and Investment for a Resilient Future<br>#10: Mutually-Affirming targets for State Industrialization and Decarbonization |
| Enabling Initiative #3<br>**Workforce** | Job growth and economic development in every part of NYS<br>Business development and growth for MWBE and cooperatives.<br>Will build local capacity to ensure stakeholder-engaged just transition planning process<br>Job losses in fossil fuel industries (fuel oil supply chain, conventional HVAC industry); mitigate through direct investment in retraining and new business development |
| Enabling Initiative #4<br>**Consumer Education** | Will ensure a stakeholder-engaged transition planning process<br>Gets in front of mandates and creates the opportunity for a timely transition away from fossil fuels<br>Builds awareness for building decarbonization |
| Enabling Initiative #5<br>**Innovation** | Clean energy industries are poised for significant growth; investment in innovation and anchoring an in-state supply chain of growing businesses and manufacturing will make it easier for the State to achieve its climate goals while also attracting new investments and jobs. |
| Enabling Initiative #6<br>**Embodied Carbon** | A just transition can be created by working toward knowledge and transparency first, allowing the market to recognize the importance of embodied carbon reductions. The cost burden for transparency can be mostly met by manufacturers, is relatively minor, and is already well underway. Connecting financial mechanisms to transparency can put the biggest effort onto the biggest projects, thereby creating a balanced approach. There is little/no effect on workers beyond education of the market, which will happen through specifications on projects. In addition, wood-based products are beneficial to New York's forestry industry. |



# Benefits & Impacts **Other**

| | |
|---|---|
| Mitigation Strategy #1<br>**Codes and Standards** | Education for consumers, trades, professions, contractors, suppliers, retailers;<br>Invest in building resilience and community-scale resilience to avoid grid failure;<br>Prioritize investments in the reliability, resilience, and affordability of the NYS electric grid |
| Mitigation Strategy #2<br>**Benchmarking & Disclosure** | Benchmarking building energy on a regular basis helps to identify energy efficiency opportunities and is correlated with reduced energy consumption by an average of 2% to 3% annually across multiple benchmarking efforts;<br>Benchmarking data provides market actors and government agencies insight into how buildings perform, enabling more informed investment decisions, lead generation, targeting of public resources, and public policy development;<br>Education for consumers around using energy data, real estate transactions, and hiring a professional energy rater/auditor also will support informed decision-making. |
| Mitigation Strategy #3<br>**Gas System Transition** | Cross-sector: Implement energy infrastructure planning, land use planning, and building codes in ways that are complementary and support larger policy goals (e.g., infrastructure, economic development). |

| | |
|---|---|
| Enabling Initiative #1<br>**Low-cost Financing** | Resiliency note: Financing could be tied to being located outside the Special Flood Hazard Area to encourage relocation. This could also leave households behind that do not or cannot relocate. |
| Enabling Initiative #2<br>**Financial Incentives** | Program design for incentive programs should be collaborative and engage a wide variety of stakeholders in order to best serve LMI households and DACs |
| Enabling Initiative #4<br>**Consumer Education** | Increased awareness and education will increase demand and adoption of new technology and practices<br>Increased demand will reduce cost and stimulate the economy<br>Builds support for decarbonizing the built environment<br>Promote workforce needs and support job growth |
| Enabling Initiative #6<br>**Embodied Carbon** | Creating market awareness of carbon in products will be the most effective strategy for activating responses in all industries. Once products have a clear role in our carbon reduction, every sector will change, from building, to transportation, to manufacturing, to food production. |

# Appendix

## Energy Efficiency and Housing Advisory Panel Members

CHAIR

**RuthAnne Visnauskas**
Commissioner
Homes & Community Renewal

**Janet Joseph**
Senior Vice President for Strategy & Market Development
NYSERDA

**Peggie Neville**
Deputy Director of Efficiency & Innovation
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**Gina Bocra**
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**Kyle Bragg**
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**Amy Sugimori**
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**Molly Dee**
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**Dan Egan**
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Vornado Realty Trust

**Bret Garwood**
Chief Executive Officer
Home Leasing, LLC

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Director of Policy and Strategy
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**Jin Jin Huang**
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Ecosave, Inc.

**Elizabeth Jacobs**
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**Jamal Lewis**
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Green & Healthy Homes Initiative

**Sadie McKeown**
EVP, Lending & Initiatives
The Community Preservation Corporation

**Bill Nowak**
Executive Director
NY Geothermal Energy Organization

**Daphany Sanchez**
Executive Director
Kinetic Communities Consulting

**Laura Vulaj**
Senior Vice President & Director of Sustainability
SL Green Realty Corp.

# Category definitions (1 of 2)

| | Low | Medium | High |
|---|---|---|---|
| **Emissions impact (1990 baseline)* – EE&H Panel adopted a 1990 baseline to benchmark to economy-wide targets** | Strategy results in <10% of the reductions needed from the sector for each target year (2030 and 2050)<br>OR<br>Less than 1.5 million metric tons (MMT) of emissions reductions in 2030 or 3 MMT 2050 | Strategy results in 10-33% of the reductions needed from the sector in at least one of the target years<br>OR<br>greater than 1.5 but less than 4 MMT of emissions reductions in 2030 or over 3 but less than 8 MMT in 2050 | Strategy results in >33% of the reductions needed from the sector in at least one of the target years<br>OR<br>over 4 MMT of emissions reductions in 2030 or over 8 MMT in 2050. |
| | **Easy** | **Medium** | **Hard** |
| **Ease of implementation** | • Strategy has been implemented many times and/or can build off an existing NYS program<br>• Proven and widely available technology<br>• Key stakeholders are strong supporters; no strong opponents | • Strategy is new to New York State but has been successfully implemented in other comparable states/countries<br>• Proven technology with known GHG impact, but still small-scale<br>• Key stakeholders are neutral, or balanced mix of supporters and opponents | • Strategy is unproven in comparable settings<br>• Early-stage technology (e.g., need for pilots to prove feasibility and significant capital to scale up)<br>• Key stakeholders oppose the strategy |

*Estimated reductions may also account for a Business-As-Usual scenario that predicts emissions growth in the sector

# Category definitions (2 of 2)

| | $ | $$ | $$$ |
|---|---|---|---|
| **Mitigation Strategy Cost – expressed for EE&H Panel as equivalent annualized cost** | • <$250M total resource cost<br>• Most resources required for successful implementation are already on hand | • $250M - $1B total resource cost<br>• Requires some new resources for successful implementation | • Over $1 Billion total resource cost<br>• Requires high degree of new resources (people, equipment, technology)<br>• Strategies with cost >$10B should indicate the range of anticipated costs |
| | **$** | **$$** | **$$$** |
| **Enabling Strategy Cost – expressed for EE&H Panel as new State resources through 2030** | • <$25M total cost<br>• Most resources required for successful implementation are already on hand | • $25M - $100M total cost<br>• Requires some new resources for successful implementation | • Over $100M total cost<br>• Requires high degree of new resources or is a demonstration project<br>• Strategies with cost >$250M should indicate the range of anticipated costs |

# Power Generation Advisory Panel Recommendations

May 3, 2021

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council

PowerGenPanel@dps.ny.gov



## Power Generation Panel Members

**Sarah Osgood,**
**Acting Chair**
Director, Policy Implementation: Department of Public Service

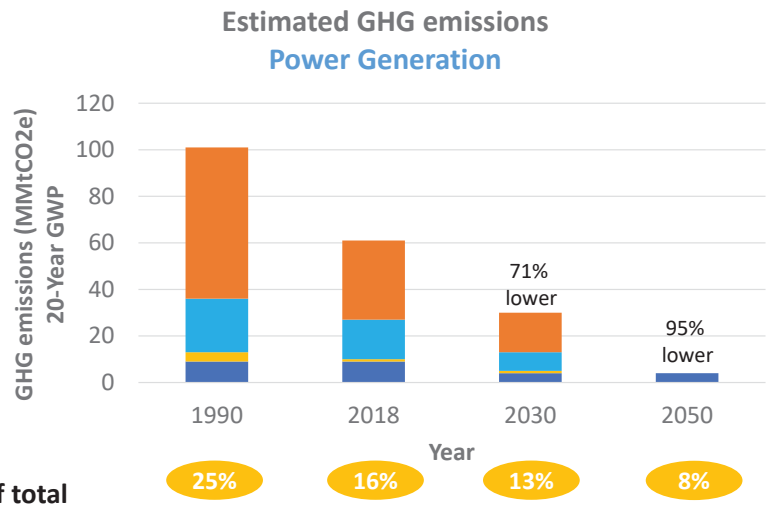
| | | | | |
|---|---|---|---|---|
| **William Acker** Executive Director: New York Battery and Energy Storage Consortium | **Cecilio Aponte** Senior Analyst, Origination: at The AES Corporation | **Elizabeth (Betta) Broad** Director: New Yorkers for Clean Power | **Rory Christian** President: Concentric Consulting, LLC | **Lisa Dix** Sr. NY Representative: Beyond Coal Campaign, Sierra Club |
| **Annel Hernandez** Associate Director: New York City Environmental Justice Alliance | **Kit Kennedy** Senior Director of Climate & Clean Energy Program: NRDC | **Shyam Mehta** Executive Director: NYSEIA | **Emilie Nelson** Executive Vice President: NYISO | **John Reese** Senior Vice President: Eastern Generation |
| **Stephan Roundtree, Jr.** Northeast Director: Vote Solar | **Jennifer Schneider** Intl. Representative & Legislative & Political Coordinator for NY: IBEW | **James Shillitto** President: Utilities Workers Union of America Local 1-2 | **Darren Suarez** Manager of Public and Government Affairs: Boralex Inc. | **Laurie Wheelock** Litigation and Policy Counsel: Public Utility Law Project |

# Description of Recommendation Types

- **Mitigation strategies:** actions that directly reduce emissions and contribute to the achievement of the greenhouse gas emission limits or carbon sequestration needed to achieve net zero, where applicable. Consider how the collective estimated emissions impact of these strategies amount to the Pathways reduction target for the panel (if applicable) and support attaining the greenhouse gas limits.
- **Enabling initiatives:** actions without direct emissions benefit that enable or magnify the mitigation strategies, enhance climate justice, or just transition
  - Examples of such initiatives include outreach, education, and increasing awareness; capacity building; workforce development; and research and development.



# Aggregate GHG emissions impact of Power Generation panel recommendations




**% of total NY emissions**

2018 emissions data are preliminary draft

**Electricity Sector**

Emissions (2018 Subtotal)

- Fuel Combustion (34mmt)
- Imported Fossil Fuels (17mmt)

Panel Goals:

- 2030: 70% RE is equivalent to 50% emission reduction from 2018 levels above
- 2050: Align with 100% Zero Emission by 2040

**Other Sectors**

- NYS Oil and Gas Methane Leakage
  - Recommendations reduce leakage 50% from 2018 levels (9mmt to 4mmt)
  - Additional actions by other Panels not included
- Electricity T&D
  - Phase-Out SF6 by 2050 (<1mmt to 0mmt)

# Power Generation Advisory Panel Considerations

## Electrifying buildings and transportation is crucial to meeting CLCPA goals.

### Principles

> Reliability
> Equity
> Affordability
> Zero-emission
> Timely

### Approach to Electrification Must…

> Minimize the system costs of electrification and balance the behind-the-meter costs with grid-side costs, with both bulk and local solutions
> Optimize the deployment and operation of resources – locationally and for flexibility – through storage, managed load, and clean dispatchable generation
> Look to utilities, DER providers, and bulk providers for this – as makes most sense and with steady and improvement and rules
> Provide for improved holistic planning of the electric system and across energy systems to accommodate significant changes in characteristics of generation and significant changes in load due to electrification
> Pay heightened attention to resilience and reliability as the energy system becomes more electric
> Support solutions in technologies, regulation, markets, and systems management and oversight



# Mitigation & Enabling Strategy Summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1 | Growth of Large-Scale Renewable Energy Generation | Procurement, Regulatory | Medium | $ |
| 2 | Clean Energy Siting & Community Acceptance | Executive, Regulatory | Medium - Hard | $$ |
| 3 | Clean Distributed Generation / Distributed Energy Resources | Procurement, Regulatory | Medium | $$ |
| 4 | Existing Storage Technology | Legislative, Regulatory, Executive | Medium | $$ |
| 5 | Demand Side | Executive, Regulatory | Medium | $ |
| 6 | Reliability for the future grid | Executive, Regulatory | Easy | $ |

# Mitigation & Enabling Strategy Summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 7 | Access and Affordability for All | Executive, Regulatory | Medium | $$ |
| 8 | Workforce Development | Executive | Easy | $$ |
| 9 | Market Solutions | Regulatory, Executive | Medium | $ |
| 10 | Technology Solutions | Research & Development | Medium | $$$ |
| 11 | Long Duration Storage Technology | Executive, Regulatory, Research & Development | Hard | $$-$$$ |
| 12 | Energy Delivery & Hosting Capacity | Executive, Regulatory | Hard | $$$ |
| 13 | Gas Infrastructure, Transmission & Methane Leakage | Executive, Regulatory | Easy - Medium | $$ |
| 14 | Retirement of Fossil Fuel-Fired Facilities | Regulatory | Hard | $ |



# Enabling initiative – Initiative #1: Growth of Large-Scale Renewable Energy Generation

| | |
|---|---|
| **Description:** | Accelerate deployment of renewable energy systems including solar, land-based wind, and offshore wind in alignment with the Clean Energy Standard. |
| **Action type:** | Procurement, Regulatory |
| **Cost and funding considerations:** | $; NYSERDA's existing Tier 1, Tier 4, and OSW programs. |
| **Ease of implementation:** | Medium (acceleration of current actions) |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Ensuring efficient processes for installing renewable generation (procurement, siting, interconnection, construction) and for constructing and upgrading the transmission and distribution networks is necessary to effectively deploy renewables within the time needed. | • The Power Generation Advisory Panel's recommendations on siting, interconnection, and energy delivery to address these barriers.<br>• NYSERDA should continue to evaluate its procurement programs for effectiveness to ensure continual, swift, progress is being made. |

# Enabling initiative – Initiative #1: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Continue to evaluate and adjust policies and procurement targets as necessary in order to achieve the CLCPA targets. | DPS/NYSERDA | Ongoing | PSC, DEC, Utilities, Renewable Energy Developers, siting communities |
| Continue to support successful programs and regulatory changes, such as Build Ready and The Accelerated Renewable Energy Growth and Community Benefit Act through funding and hiring adequate staff in the Office of Renewable Energy Siting and other relevant State Agencies (NYSERDA, DPS, DEC, etc.) | DOB | Ongoing | DPS, DEC, NYSERDA, ORES, Utilities, Renewable Energy Developers |
| Identify key transmission and distribution upgrades, improvements, and new line construction needed to deliver renewable energy from where it is built, to where it is needed. | DPS/NYSERDA | ASAP | PSC, DEC, NYISO, Utilities, Transmission Developers, renewable developers, innovation companies |
| Establish a non-binding metric/goal for the Office of Renewable Energy Siting (ORES) with respect to megawatts of renewable energy which should be permitted each year, based on what is required to reach 70% renewables by 2030. | ORES | ASAP | |



# Enabling initiative – Initiative #1: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Ensuring the delivery of community benefits from siting of renewable generation (See Community Benefits Recommendation) and closing of fossil fuel plants in disadvantaged communities will alleviate undue burdens on disadvantaged communities. In addition, electrification will cause significant load growth between now and 2040. Without sufficient buildout of large-scale renewables, continued reliance on fossil fuel-fired facilities will be needed and emissions will not decrease. |
| **Health and other co-benefits** | Aggressive deployment of renewable technologies and upgrades and construction of transmission and distribution systems will make it possible to close fossil fuel generation facilities, improving air quality and decreasing emissions. In 2016, in-state fossil fuel combustion accounted for 163.47 MMt$CO_2$e (80% of all state emissions). |
| **Just transition: businesses and industries, workers** | Increases in jobs available in renewable energy system and transmission construction, as well as operation and maintenance of these systems. |
| **Other** | |

# Enabling initiative – Initiative #2: Clean Energy Siting & Community Acceptance

| | |
|---|---|
| **Description:** | Support the development and use of information and resources for local communities to make beneficial decisions about renewable energy projects in their community. |
| **Action type:** | Executive, Regulatory |
| **Cost and funding considerations:** | $$; NYSERDA's Clean Energy Communities program could be leveraged for some activities, but the State should also seek federal funding from the administration's stimulus and infrastructure bills. Community credit subsidies. |
| **Ease of implementation:** | Medium - Hard |
| **Example case studies:** | Scenic Hudson's Roadmap to a Clean Energy Future, Long Island Solar Roadmap, Tompkins County, NYS Geographic Information System, NY Solar Map, WindExchange.Energy.gov, NYC Community Energy Planning Tool, Temiscouata and Apuiat Wind Farms, NYCHA and Brooklyn Army Terminal RFP's |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Efficient processes for installing renewable energy projects and for upgrading the local transmission and distribution networks will be necessary to effectively deploy renewables.<br>• Local community opposition for projects if benefits are not realized locally. | • Strong community communication, engagement, and public outreach will be important for these projects to be possible. |



# Enabling initiative – Initiative #2: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Clean Energy Development** | | | |
| Research and incentive viability agrivoltaics to integrate into the agricultural community and provide habitat improvement for threated and endangered species. | NYSERDA | ASAP | ORES, NYSERDA, DPS, DEC, DOS, AGM, Utilities, NYISO, Renewable Energy Developers, Transmission and Distribution System Operators, municipalities and local communities |
| Develop a Clean Energy Development Mapping tool to help municipal representatives and local communities make informed land use decisions, and communicate local wants to developers. | NYSERDA | ASAP | |
| Offer NYS support and funding for Regional Planning Associations to assist municipalities in planning for renewable energy development. | NYSERDA | ASAP | |
| Refine NYSERDA process/evaluation and incentivize for "buildable projects". | NYSERDA | ASAP | |
| Study and advise communities how to best implement options for decommissioning of community owned projects at the end of their production life. | NYSERDA | ASAP | |
| **Public Education and Outreach** | | | |
| NYS should launch a statewide public education campaign to inform New Yorkers about the climate crisis and the benefits of shifting to a clean energy economy. | NYSERDA | ASAP | |
| **Equity & Local Community Benefits** | | | |
| Ensure community benefits and avoided costs are tracked in dollars. | | | |
| Allow all NYPA customers to benefit from electric utility value stack NYS-wide. | PSC/DPS | ASAP | |
| Determine who needs benefits and then create municipal/cooperative structures in disadvantaged communities. Examine laws regarding cooperatively owned enterprises and establish consumer protections in this new market. | | ASAP | |

# Enabling initiative – Initiative #2: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Equity & Local Community Benefits (cont'd)** | | | |
| Make host community benefits more robust and targeted (ex. NYSERDA's Host Community Billing Program) | NYSERDA | ASAP | NYSERDA, DPS, DEC, DOS, Utilities, NYISO, Renewable Energy Developers, Transmission and Distribution System Operators, municipalities and local communities |
| Empower local governments to take a leadership role in educating the community in clean energy. | NYSERDA/DOS | ASAP | |
| Provide funding for non-profits and community-based organizations to do education and outreach about clean energy benefits. | NYSERDA/DPS | ASAP | |
| Expand and streamline incentives for energy efficiency, including funding for customers based on utility payment history instead of credit scores. | NYSERDA/DPS/ Utilities | ASAP | |
| Invest in local weatherization assistance and energy efficiency programs. Enable host towns to speed up rural broadband expansion. | | Ongoing | |
| Incentivize local "climate resilience hubs", a central location that has solar + storage and becomes a location the community gather during power outages. | | ASAP | |
| Improve NYC DCAS for more renewable energy projects.<br>- loan loss reserve program<br>- LMI community subscriber benefits program | NYSERDA | ASAP | |
| **Commercial Rooftop & Parking Lot Solar** | | | |
| Conduct further analysis that looks for ways to build economic/incentive structures to increase development of commercial rooftop and parking lot solar installations paired with storage. | NYSERDA | Ongoing | |



# Enabling initiative – Initiative #2: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | These will provide municipalities, local communities, and disadvantaged communities valuable information and resources to make beneficial decisions about renewable energy projects in their communities. Municipalities, local communities, and disadvantaged communities will also have more control over local land use and development. Local renewable energy projects could provide utility cost savings, local infrastructure development, and job opportunities. |
| **Health and other co-benefits** | Aggressive deployment of renewable technologies and upgrades and construction of transmission and distribution systems will make it possible to close fossil fuel generation facilities, improving air quality and decreasing emissions. |
| **Just transition: businesses and industries, workers** | Local renewable energy projects could provide utility cost savings for businesses, local infrastructure development opportunities, and job opportunities for local workers. |
| **Other** | |

# Enabling initiative – Initiative #3: Clean Distributed Generation / Distributed Energy Resources

| | |
|---|---|
| **Description:** | By generating smaller amounts of clean electricity closer to end-users, we can increase energy efficiency, reduce carbon pollution, improve grid resiliency, and potentially curtail the need for costly transmission investments. |
| **Action type:** | Procurement, Regulatory |
| **Cost and funding considerations:** | $$ |
| **Ease of implementation:** | Medium |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • An efficient process for installing DG/DERs (procurement, siting, interconnection, construction) and for constructing and upgrading the delivery system is necessary.<br>• Local community opposition for projects if benefits are not realized locally. | • Focus on "high benefit" projects and programs that serve local communities, including dual-use solar/ag, affordable multifamily housing, and landfills/brownfields, and continue to invest in energy delivery.<br>• Regional discussion forum(s) between local communities and those involved in the projects to have dialogue and understand everyone's perspective. |



# Enabling initiative – Initiative #3: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Hosting Capacity: Proactive and timely investments in local transmission and distribution infrastructure, and associated cost-sharing/allocation associated with the utilities in these upgrades. Accelerate adoption of innovative technologies and programs that increase hosting capacity such as flexible interconnection, hybrid systems and coupling with energy storage or controlled load, smart inverters, and solutions that enable maximum back feeding at substation level from distribution to transmission as part of local transmission and distribution planning process. | PSC/DPS, NYSERDA | ASAP | NYISO, NYSERDA, developers, transmission & distribution operators, communities, DEC, DOH, DOT |
| Interconnection: Address pace of processing interconnection applications and need for right-sizing human resources at utilities to mitigate delays in application processing. | | Ongoing | |
| Rate Design: Consider need for dynamic underlying electric rate structures and programs(e.g., dynamic load management) that provide appropriate price signals to customers to incentivize DER deployment and usage. | | Ongoing | |
| Compensation: Address improvements to VDER stack to more accurately reflect value provided by DERs incorporating the social cost of carbon calculation and avoided transmission costs. | | Ongoing | |

# Enabling initiative – Initiative #3: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Incentives: Target incentives to stimulate high-benefit DER projects (dual-use solar/ag, multifamily housing, heat pumps/geothermal, collective solar projects) and paired with electrification serving LMI and EJ communities. Expand NYSERDA's Solar Energy Equity Framework programs; Low Income Community Solar Concept and Adder for Inclusive Community Solar Projects. | PSC/DPS, NYSERDA | Ongoing | NYISO, developers, transmission & distribution operators, communities, DEC, DOH, DOT |
| Ground-Mounted Siting: Address resistance and concerns to siting of ground-mounted projects, particularly upstate and western NY. | NYSERDA | Ongoing | |
| Rooftop and Parking Lot Solar Permitting: Need for streamlined permitting process across authorities having jurisdiction that reduces processing times and soft costs. | DOS/NYSERDA | Ongoing | |
| Codes: Provide model zoning ordinances to municipalities for residential/commercial properties to require new construction be designed as "solar-ready". | DOS/NYSERDA | Ongoing | |
| Resources & Education: Create or expand on regional discussion forums, between NYS, local communities, and projects to connect communities with resources, information, and address local concerns. | NYSERDA | Ongoing | |
| Aggregations: Encouraging aggregations of distributed resources will provide additional value for grid management | PSC/DPS, NYSERDA | ASAP | |



# Enabling initiative – Initiative #3: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | DG/DER is a primary way (alongside energy efficiency) to meet the social equity requirements of the CLCPA. Renewable energy from DG/DERs sources can help addressing reliability needs and air quality issues from the closing of fossil fuel facilities in EJ communities. If properly developed, clean DG/DER projects can also allow communities to participate in the process, provide economic development and workforce development opportunities, and bolster resiliency. |
| **Health and other co-benefits** | Deployment of clean DG/DERs and upgrades to energy delivery systems will make it possible to close fossil fuel generation facilities, improving air quality and decreasing emissions. |
| **Just transition: businesses and industries, workers** | Development and jobs for renewable energy systems, transmission construction, and operation and maintenance of these systems. |
| **Other** | |

# Enabling initiative – Initiative #4: Existing Storage Technology

| | |
|---|---|
| **Description:** | The State developed a 3GW goal for energy storage in the 2018 energy storage roadmap based on a 50% renewable target for 2030. 70% renewables and the transition to a carbon-free grid requires higher levels of energy storage as exemplified in the recent Power Grid Study identifying a need for >15GW. |
| **Action type:** | Legislative, Regulatory, Executive |
| **Cost and funding considerations:** | $$; Potential to expand NYSERDA's existing Market Acceleration Bridge Incentive program. |
| **Ease of implementation:** | Medium (rapid deployment and scaling) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Deployment needs are greater than initially envisioned and existing program are likely insufficient to meet expanding need.<br>• Buyer-side mitigation (BSM) rules in NYISO Capacity Market<br>• NYISO and Utility interconnection study methods<br>• Limitations in the NYISO and Utility interconnection study methods | • Eliminate BSM for CLCPA resources.<br>• Future programs considered should be harmonized with BSM and how it might change in the future such that access to the capacity market for these resources is maximized.<br>• Public outreach, community engagement, and addressing host community concerns will be important for success of these projects. |



# Enabling initiative – Initiative #4: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Update State's Energy Storage Roadmap, as soon as practicable, to update and revise storage deployment goals recognizing the substantially higher requirements identified in the Power Grid Study. | NYSERDA | ASAP | DPS, developers, NYISO |
| Provide increased funding for energy storage deployment. The State should initiate a new docket that establishes new binding targets and creates a dedicated funding mechanism similar to the clean energy standard for storage as soon as practicable and no later than the end of 2022. | PSC | ASAP | DPS, NYSERDA, developers |
| Expand CES to better integrate storage. | NYSERDA | ASAP | DPS, developers, utilities |
| Incorporate energy storage into energy delivery and transmission planning | NYSERDA/DPS | ASAP | NYISO, utilities |
| Further refined modeling of the future grid is needed to evaluate the potential system reliability needs anticipated for the future grid. The modeling should identify the need for storage resources with longer durations that may develop with technology innovation, to show the true breakdown of potential storage vs. fully dispatchable generation needs. | NYSERDA | Ongoing | DPS, NYISO, utilities, developers |
| Incentives for companies that provide systems sufficiently tested for the higher safety standards required in urban environments such as NYC. | NYSERDA | ASAP | DPS, developers, utilities |
| Continued work with NYISO on market enhancements that facilitate the resource transition, support investment, minimize costs to consumers, eliminate BSM for CLCPA resources, and meet reliability. Future programs should be harmonized with BSM and how it might change in the future such that access to the capacity market for these resources is maximized | NYSERDA/DPS | Ongoing | NYISO, utilities, developers |

# Enabling initiative – Initiative #4: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Increased energy storage deployment can reduce peaker plant usage and decrease health impacts on disadvantaged communities. |
| **Health and other co-benefits** | Aggressive deployment of these technologies will it make possible to reduce peaker plant dependence and close fossil fuel generation facilities, thereby improving air quality and decreasing emissions. |
| **Just transition: businesses and industries, workers** | Growth and career paths for new workers who want to enter this new field and incumbent energy workers who are looking to transition. Development and jobs for renewable energy systems, transmission construction, and operation and maintenance of these systems. |
| **Other** | Will need large scale testing and demonstration ensure these new assets work properly on the existing grid. |



# Enabling initiative – Initiative #5: Demand Side

| | |
|---|---|
| **Description:** | Analyze and appropriately model responsive demand as part of future generation and energy supply. Consider those modeled impacts on costs and timelines of power generation by decade and incorporate into system planning. It is imperative that flexible, responsive loads are analyzed and modeled appropriately to optimize for the lowest system cost and the most expeditious deployment of both clean supply and demand solutions. |
| **Action type:** | Executive, Regulatory |
| **Cost and funding considerations:** | $; The potential costs must be thoroughly analyzed and evaluated through the lens of avoided grid upgrade costs as well as health and economic benefits, especially for disadvantaged communities. Funding sources could come from NYSERDA, expanded federal Weatherization Assistance Programs and clean energy programs. |
| **Ease of implementation:** | Medium |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Successful implementation will require a vision, commitment and directive from the state to structure a broad and long-term collective effort from all parties, adequate funding, transparency and education. | |

# Enabling initiative – Initiative #5: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Complete a study on avoiding or reducing grid upgrade costs with such things as demand response and the use of geothermal, including district thermal systems, especially downstate, with a focus on low and moderate income individuals and disadvantaged communities. | DPS, Utilities, NYSERDA | Ongoing | PSC/DPS, NYSERDA, NYISO, local governments, contractors and community-based organizations especially those that provide Weatherization Assistance Programs. |
| Identify and make available key pieces of data needed for markets to facilitate the clean energy transition is real-time marginal, average emissions, and/or zonal resource/fuel mix data, as needed from NYISO and as defined by NYC and pert. State Agencies (a number of assumptions including for imports and exports from other RTO/ISOs must be determined) to facilitate cost-effective implementation of the CLCPA, LL97, and to improve VDER values and demand response programs. | PSC/DPS, NYISO, NYSERDA | ASAP | |
| Prioritize state and federal appliance standards. Adopt State equipment standards (or advocate for the federal government to adopt standards) that require a universal, standardized communication protocol in electric and heat pump water heaters, as well as in space heating heat pumps, EVs, and in-home batteries. | NYSERDA | Ongoing | |
| Develop standards to enable “opt out” programs rather than “opt in”. Make demand flexibility programs opt-out, not opt-in as long as standards are developed to ensure that customers would reap savings on their bills and service delivery is not reduced. | PSC/DPS | Ongoing | |



# Enabling initiative – Initiative #5: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Rethink cost-benefit tests. In order to accurately assess the true value of EE and demand response while complying with the CLCPA, the PSC should reopen the generic BCA proceeding to update costs and benefits, including CLCPA compliance costs (carbon and other environmental impacts), important non-energy benefits (localized health impacts, equity, etc.), and inclusion (or lack thereof) of customer cost contributions. | PSC/DPS | ASAP | PSC/DPS, NYSERDA,DEC, NYISO, local governments, contractors and community-based organizations especially those that provide Weatherizatio n Assistance Programs. |
| Ensure that energy storage does not face double rules and unfair charges. NYS should consolidate its permitting rules for energy storage so they can be evaluated in one process. Utility commissions should reexamine their tariffs on energy storage resources and ensure they are applied fairly. | PSC/DPS | ASAP | |
| Prioritize under-resourced communities.<br>- Utilities should engage the community and partner with CBOs to learn about communities and identify needs and shared objectives.<br>- New funding should be directed toward low-income and disadvantaged communities and existing funds should be made more accessible.<br>- In planning for a sustainable future, NYS should work with communities to ensure appropriate metrics to track program success and partner with local governments to establish appropriate consumer protections. | PSC/DPS, Utilities, NYSERDA | ASAP | |

# Enabling initiative – Initiative #5: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | The concentration of the dirtiest peaking plants in zones J and K, sited in disadvantaged communities, provides an opportunity to back down that generation in the near term through efficiency and load responsiveness, while transmission and large-scale renewables get built to serve downstate. Targeting EE and DR in disadvantaged communities is an opportunity to provide these communities with ownership of clean energy solutions that will provide benefits at the household, utility, and community level. Greater investment should be paired with tracking and transparency around spending and benefits for disadvantaged communities. EE, DERs, and load flexibility are effective avenues for EJ communities to own clean energy solutions that provide benefits at the household, utility, and community levels. |
| **Health and other co-benefits** | Reducing demand through efficiency, and creating demand flexibility, especially downstate, will yield large GHG and criteria pollutant reductions/health benefits in the near term due to the current grid mix. |
| **Just transition: businesses and industries, workers** | Scaling up investments in dynamic load management and energy efficiency will create jobs in the part of the clean energy sector with the most growth potential. Energy efficiency and load management implementation will help businesses reduce energy costs.<br>There will be power sector benefits from investing in demand reduction in fossil fuels through increased building efficiency (through weatherization), to reduce gas supply pressures in winter, and avoid dual-fueled peakers switching to oil during gas peaks. |
| **Other** | |



# Enabling initiative – Initiative #6: Reliability for the future grid

| | |
|---|---|
| **Description:** | Generation resources combined with the transmission and distribution systems, control centers, and wholesale markets provide a continuously operating, reliable system to service New York's electric needs. All of these elements will need to transition and come together effectively to manage the transitioning grid to provide continuity of a reliable power system, while implementing the CLCPA. The recommendations to implement and achieve the CLCPA must support the high reliability standards in place in NY by implementing improvements and enhancements where needed and sustaining the practices that provide high quality electric service. If properly integrated the additional clean distributed generation, storage and large-scale renewables which the CLCPA will provide will help to build a more flexible and resilient grid to address and mitigate the impacts of climate change. |
| **Action type:** | Executive, Regulatory |
| **Cost and funding considerations:** | $; The costs of establishing an effective process to complete the necessary reliability reviews are minimal. Funding sources for investment include recovery through electric rates, wholesale market revenues, state and federal infrastructure funding. |
| **Ease of implementation:** | Easy – The process for ensuring reliability is well established |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Achievement of the CLCPA mandates must progress with a continued eye on reliability and as issues arise, solutions must be identified and implemented timely to ensure that both reliability needs and CLCPA mandates are met.<br>• Transmission constraints limit the flexibility of the grid and will make it more challenging to integrate new resources. Constraints between upstate and downstate (particularly zone J) is a current barrier to reliability which needs to be addressed.<br>• Solving the reliability issues will be a challenging but necessary part of a successful transition. | • Effective communication processes across the multitude of agencies and organizations that support reliability.<br>• Enhancing market rules so that all resources can participate in the market, based on their attributes, to provide the products and services needed for reliability.<br>• Increased transmission is needed in order to mitigate the scope and scale of reliability challenges; helping to address the need for peakers and lowering the downstate local capacity requirements. |

# Enabling initiative – Initiative #6: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Established biennial checkpoints should be conducted to assess the state of bulk power system reliability in consultation with the federally designated electric bulk system operator (NYISO) and the state and federally jurisdictional entity the New York State Reliability Council (NYSRC). These checkpoints will ascertain if any program adjustments are needed to ensure continued safe and adequate electric service and will be informed by the review of NY power system performance in conformance with established operations requirements and by relevant studies including the NYISO's Reliability Needs Assessment. | PSC/DPS | Ongoing | PSC, DPS, NYISO, Utilities, NYSRC, FERC, Generators, Transmission Developers, NYSERDA (Climate Assessment) |
| Power system studies and planning should consider analyses to integrate climate change impacts as needed for reliability and resiliency. Studies will need to reflect that risks and reliability challenges will change through time due to the impacts of climate change and the changes to the power system. | PSC/DPS | Ongoing | |
| To the extent any changes are proposed within the Scoping Plan that could alter the current regulatory structure and statutory approach to meeting reliability in NY, input and review must be solicited by the DPS, the NYISO, the NYSRC, and the Utilities | PSC/DPS | ASAP | |
| Actions needed to ensure reliability while working to achieve CLCPA will additionally be reflected in the State Energy Plan. | PSC/DPS/ NYSERDA | Ongoing | |
| Continued efforts to improve reliability and resiliency to extreme weather events, which will be exacerbated by climate change, should occur. This work should include continued infrastructure investment such as: storm hardening, elevating equipment and substations, and moving lines underground. Additionally, design criteria must change through time and reflect the impacts of climate change as needed. Given the impacts of storms on communities, investment in community outreach to provide effective communication and support from the time of storm preparation through restoration must be made. | Utilities | Ongoing | |
| The market products, requirements and technology standards needed to maintain reliability should be updated through time so that all resources can participate in the market, based on their attributes, to provide the products and services needed for reliability. Undue costs should not be imposed which would impair meeting CLCPA goals, including creating barriers to renewables. Reliability needs and risks will change through time and the markets should reflect these changes as well. | NYISO | Ongoing | |



# Enabling initiative – Initiative #6: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Affordability is a real concern for disadvantaged communities. However, power outages have a disproportionate impact on disadvantaged communities because they are less able to afford measures to mitigate the human safety and health risks or recover from the potential loss of property. Now and continuing into the future, disadvantaged communities should be prioritized in terms of restoration of service. |
| **Health and other co-benefits** | Prevention of the high costs and consequences of electric service interruptions in New York, including exposure to extreme cold or heat and loss of property. |
| **Just transition: businesses and industries, workers** | Prudent steps to ensure a reliable power system are necessary to support businesses, industry and workers. New York cannot afford a decrease in the reliability of the electric grid, which is already challenged under current conditions. Additionally, poor power quality can negatively impact industrial processes. The clean distributed generation investments required by the CLCPA (e.g., rooftop solar, community solar, EE/DG and storage) can also provide much needed clean generation for, reduced energy costs and investments in disadvantaged communities. |
| **Other** | |

# Enabling initiative – Initiative #7: Access and Affordability for All

| | |
|---|---|
| **Description:** | Prioritize helping low-income utility customers and disadvantaged communities, while also assuring that these communities will be able to afford and fully benefit from the State's transition to electrification |
| **Action type:** | Executive, Regulatory |
| **Cost and funding considerations:** | $$; Federal Relief funds should be first, directed to equity related costs to help with the implementation associated with these recommendations |
| **Ease of implementation:** | Medium (there are fiscal/unknown costs that must be accounted for) |
| **Example case studies:** | DPS' Low-Income Affordability Program (Case: 15-M-0565), NYC's Energy Cost Savings Program for small businesses |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Expanding the PSC's Low-Income Affordability Program could result in higher rates for non-eligible customers.<br>• The State's ability to project how much financial support will be adequate while assuring that low-income customers will not surpass the 6% energy burden during the transition to electrification.<br>• With regards to efforts to modify financial assistance programs, such as HEAP, there is a concern that tenants will be unable to achieve certain benefits associated with changes to these programs, if their landlord does not prioritize making such technology upgrades and renters usually do not have control over their fuel source.<br>• State budget pressures could make it difficult to create new positions. | • Examine and monitor whether existing utility financial assistance programs are reaching all eligible customers who need help affording their energy bills, while also modifying such programs to adequately support the electrification and energy efficiency.<br>• Complete a study on avoided grid upgrade costs with energy efficiency, demand response, and the use of geothermal downstate, with a focus on low-moderate income individuals.<br>• Re-assigning existing State staff roles and duties could ameliorate the need to hire a new position & Agency coordination. |



# Enabling initiative – Initiative #7: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Continually examine and monitor PSC's Low Income Affordability Program and ensure that all low-income utility customers are identified and utility discounts are reflective of low-income utility customers' actual income levels. | DPS | Ongoing | |
| Improved coordination of State agencies and expansion of pilots and programs to assist small businesses with the transition to electrification | NYSERDA, OTDA | Ongoing | ESD, DAM, DPS, DOH |
| Modify the Home Energy Assistance Program (HEAP) to help encourage electrification, energy efficiency, and reduce continued use of fossil fuels for both tenants and homeowners | OTDA, NYSERDA | ASAP | |
| Increase access to energy efficiency and low-income customer support programs | OTDA, NYSERDA | Ongoing | DOH, HCR |
| Consider studying alternative rate structures as a means of protecting low-income, disadvantaged communities and small businesses from large cost shifts | PSC/DPS | ASAP | |
| Study how to avoid grid upgrade costs with energy efficiency and investment in downstate NY, with a focus on geothermal and Long Island | NYSERDA/DPS | ASAP | |
| Coordination across State Agencies is essential. | OTDA | Ongoing | NYSERDA, DOH, ESD, DAM, DPS |

# Enabling initiative – Initiative #7: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| The New York State Department of Public Service should be open to alternative rate structures as a means of protecting low-income, disadvantaged communities and small businesses from large cost shifts. | DPS | Ongoing | NYSERDA |
| Appoint a lead at the New York State Department of Public Service specifically for Equity and Environmental Justice to better incorporate environmental justice and equity concerns into the Commission's decision-making process by creating a new senior position to coordinate that work. | DPS | ASAP | |
| Implement intervenor funding for nonprofits and community-based organizations ("CBOs") who work on DPS, NYSERDA, NYISO cases, matters and proceedings. Intervenor funds will help support the nonprofits and CBOs who are actively advocating on behalf of low-income individuals and disadvantaged communities, providing an important balance in such proceedings and programs. | DPS, NYSERDA | Ongoing | OTDA, DOH, HCR |
| Develop a comprehensive and publicly available accounting system to track the spending and the actual benefits of state spending pursuant to CLCPA. Definition of benefits should cover positive outcomes associated with costs and spending, and include benefits to businesses, investors, and other market actors as well as those flowing to ratepayers and disadvantaged communities. To the extent possible, accounting should distinguish between funding designed to help accrue benefit members of disadvantaged communities, and the actual benefit realized by members of these communities. | DEC, NYSERDA | ASAP | ESD, DPS, OTDA, DOH, HCR |
| Publish yearly reports on allocation of benefits, both in terms of program scale and actual implemented benefit and establish remediation plans for non-attainment of 40% minimum allocation of benefits. | DEC, NYSERDA | ASAP | ESD, DPS |

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# Enabling initiative – Initiative #7: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Provides economical support to low-income customers so they can afford the transition to electrification<br>• The benefits of energy efficiency is also a central element that when paired with direct assistance, will be tremendously helpful for low-income individuals to control their energy costs.<br>• The State's work will continue to include prioritizing building electrification with a focus on the low-income and disadvantaged communities. |
| **Health and other co-benefits** | Emissions reductions from implementation of the CLCPA will be seen on an aggregate statewide basis, but it will be important to triage implementation to assist Clean Air Act non-attainment areas and emissions Environmental Justice areas first and most deeply.<br><br>Efforts to support low-income communities so that they can afford full electrification will result in positive health benefits. |
| **Just transition: businesses and industries, workers** | If not instituted carefully, the cost of energy for businesses may become uncompetitive and prove economically difficult for high energy-using industries to afford. |
| **Other** | Access and affordability to clean energy programs, energy efficiency, and other assistance programs improves living and housing conditions. |

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# Enabling initiative – Initiative #8: Workforce Development

| | |
|---|---|
| **Description:** | Make it a priority to provide education and career opportunities for individuals with a focus on disadvantaged communities to enter the clean energy industry. Ensure a just transition for people currently employed in fossil industries so their needs are met. |
| **Action type:** | Executive |
| **Cost and funding considerations:** | • $$; HS/College technical training is approx. $6-10K/student based on past program data.<br>• Federal Relief funds should be first, directed to equity related costs.<br>• Expand the NYS Fossil Fuel Plant Closure fund and specifically target funds for worker transitions and supporting lost taxes in communities. |
| **Ease of implementation:** | Easy |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Campaigns work best when they originate in the communities themselves and interest tends to be reduced when programs try to bridge income classes.<br>• This type of recruitment and job training for private solar companies is a year-round commitment and a significant investment to get a person ready.<br>• Will need to engage with companies that may be potentially put out of business and convince them to allow their workforce to be retrained in other skills. | |



# Enabling initiative – Initiative #8: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Establish continuing education, certifications, and licensing in trades and professions for current fossil fuel workers. Work with companies to help transition their workforce to building operations and maintenance, design, construction, and real estate professionals and into clean energy jobs. Partner with NYS agencies (NYSERDA, DOL, etc.) to work with unions to ensure they are aware of project bid opportunities. | NYSERDA | ASAP | NYS Energy/Labor/ Social Service/Edu Agencies, K-12 schools, vocational/technical & higher education, education & workforce development non-profits, fossil fuel & energy companies, renewable energy companies, construction/ repair/ buildings businesses |
| Leverage RFPs from the public sector agencies for clean energy and workforce development. (ex. Solarize Brownsville) | NYSERDA | Ongoing | |
| Scale up training and workforce opportunities for new clean energy workers and in LSR siting locations with preferences in training and job placement to priority populations. Emphasize these principles within RFPs. | NYSERDA | Ongoing | |
| Create community-to-employment pipelines and career pathways and prioritize individuals in disadvantaged communities. Ensure a clear ladder/pathway to secure jobs and careers with family sustaining wages and labor unions, where possible. | NYSERDA | ASAP | |
| Scale up strategic partnerships in education/outreach efforts with an emphasis on disadvantaged communities and provide state agency coordination with various benefit programs in a "one stop shop" that prioritizes LMI communities. | NYSERDA | Ongoing | |
| Focus on businesses and job opportunities around not only installation, but also manufacturing and the entire supply chain. Engage with clean energy providers to evaluate current and future workforce needs. Align training with industry needs and potential jobs, including consideration of needs by geographical areas, to develop a successful pipeline. | NYSERDA | Ongoing | |

# Enabling initiative – Initiative #8: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Create opportunities for Minority and Women Owned businesses and in disadvantaged communities to gain a foothold in the industry and work up the value chain. Increase ranks of MWBEs, coops., employee-owned businesses, community projects through capacity building and business development support. | NYSERDA | ASAP | NYS Energy/Labor/ Social Service/Edu Agencies, K-12 schools, vocational/technical & higher education, education & workforce development non-profits, fossil fuel & energy companies, renewable energy companies, construction/ repair/ buildings businesses |
| Require labor standards such as Prevailing Wage, PLA's and use of accredited apprenticeship programs to ensure that the jobs are long lasting careers for NY residents that live in the local communities hosting renewable industries | NYSERDA | ASAP | |
| Enhance Climate and Clean Energy/decarbonization curricula in State-funded education in K-12, technical schools, BOCES programs, CUNY/SUNY, engineering and architecture programs at universities. Increase investment in STEM education curricula within K-12 student populations from disadvantaged communities to facilitate entry into targeted career pathways (eg. wind, solar, building decarbonization, etc.). Leverage BOCES, CUNY/SUNY education platforms and job placement opportunities in their programs. Ensure an 'all government approach' by obligating the state education department, SUNY, the Department of Labor, NYSERDA and other relevant agencies to help design, implement and resource the above-referenced efforts. | NYSERDA | Ongoing | |



# Enabling initiative – Initiative #8: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Open community career pathways/workforce development through education, skills and training in clean energy can provide much needed education, skills and training to communities and open career pathways. Develop business opportunities for MWBEs and community development. |
| **Health and other co-benefits** | Helping to ensure a strong and vibrant clean energy workforce will facilitate the opportunities to expand deployment of renewable energy technologies. This will help to more quickly shutdown fossil fuel generating facilities, improving air quality in communities that host these facilities. |
| **Just transition: businesses and industries, workers** | Provides businesses and workers increased transition opportunities to clean energy industries. |
| **Other** | |

# Enabling initiative – Initiative #9: Market Solutions

| | |
|---|---|
| **Description:** | Markets that incentivize resources with the desired attributes, provide optimal reliable grid management, and are sufficiently flexible to allow for technology innovation will help achieve the CLCPA objectives, while ensuring benefits for, and reducing impacts on, disadvantaged communities. |
| **Action type:** | Regulatory, Executive |
| **Cost and funding considerations:** | $ |
| **Ease of implementation:** | Medium |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Will require several forward-looking market designs and the implementation of each design must be structured in a way that sends the correct price signal at the appropriate time | • Coordination across DPS, NYSERDA, the NYISO, and utilities. |



# Enabling initiative – Initiative #9: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Expand wholesale market eligibility participation rules for new policy resources.** The NYISO is in the process of implementing the first part of a Hybrid Storage Model, where hybrid resources will be allowed to participate as two separate resources located at the same site. The current expectation is for a second potentially more versatile "Aggregated" model market design in 2021. The NYISO is also working on a Distributed Energy Resources (DER) Participation Model. The NYISO is working toward but has not yet implemented a full wholesale DER market design. The NYISO should make changes consistent with FERC Order 2222 requirements. | NYISO | Ongoing | PSC, NYSERDA, Utilities, Suppliers |
| **Continue assessing opportunities to improve accuracy and granularity of wholesale market energy price signals, including shortage pricing, congestion relief, and peak/off-peak pricing.** Inclusion, and valuation, of ancillary market services will need to be evaluated in the context of integrating increasing quantities of renewable resources and other products. | NYISO | Ongoing | |
| **Adapt current ancillary service market designs and look to add products that are needed to incent flexibility as needed to efficiently integrate renewables.** The NYISO supports markets for energy, ancillary services, and capacity. The fundamental relationship among these markets will likely need to evolve. For example, more revenue will likely shift to ancillary service markets over time as system needs are reevaluated in the context of integrating increasing quantities of renewable resources. Be proactive in developing new products needed, however they should be structured properly to only reflect current system needs to not cause unnecessary costs. A balancing act is needed between developing the products and services of the future while not implementing changes before they are needed. | NYISO | Ongoing | |

# Enabling initiative – Initiative #9: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Expand Demand-Side Opportunities and Opportunities for Flexible Resources.** It is anticipated that demand response resources will play a more critical reliability role in the future as the grid becomes more electrified and the load shape shifts. Demand Response can also supply some amount of needed system flexibility without emitting carbon which is consistent with the 2040 CLCPA policy objective. There should be a holistic evaluation of both wholesale and retail demand response programs to identify gaps and opportunities for new programs or program changes to meet the needs of a changing grid. As the grid evolves with State policy, it will become more important that incentives are adequate for the participation of flexible resources in the real-time (RT) energy market. An efficient RT market can create opportunities for resources to compete and meet rapidly changing system needs. The NYISO is evaluating prospective changes to the energy market in the context of its Grid in Transition project. | NYISO/DPS | Ongoing | NYSERDA, Utilities |
| **Improve access for Distributed Resources and continue improvements to cost causation retail rate price signals.** Continue to promote and improve VDER- Rate Design. Continued innovation in DSM and DER programs, with a focus on expanding utility customer enrollment and performance. Continue to promote and improve Standby rates. Increase deployment and efficient use of Distributed Energy Resources (DER) - Continue design and implementation of Distributed System Platforms (DSP) and markets for DER products and services. | DPS | Ongoing | NYSERDA, Utilities, Suppliers |



# Enabling initiative – Initiative #9: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Determine most effective approach to Incorporate Environmental Values in Market Pricing and/or in Policy and Investment Benefit Cost Analysis.** Consider Improvements to current State Programs to incent CLCPA resources through mechanisms such as Renewable Energy Certificates, Offshore Wind Renewable Energy Certificates, and storage solicitations. Consider Changes and/or Augmentation to RGGI program to more fully reflect the cost and impact of emissions as represented in NY policy. Consider if (Electric Only) Carbon Pricing in the Wholesale Markets will help achieve the CLCPA mandates, including a more rapid increase in renewable and storage build out and a transition of the fossil fleet. If Carbon Pricing is not adopted, consider alternate mechanisms to fully enable Wholesale Markets to support the grid transition. Consider if an Economy-wide Carbon charge will help achieve the CLCPA mandates. Consider a Clean Dispatch Credit for emission-free, fully dispatchable assets that dispatch during peak load times. | DPS | Ongoing | NYSERDA, DEC, Utilities, Suppliers, NYISO |
| **Examine all Resource Adequacy options and continue to improve resource adequacy contribution compensation.** Consider alternative market structures of procuring Resource Adequacy. New York should ensure that BSM will not be applied to CLCPA resources and should advocate at FERC for alternatives to BSM that maximize access to the capacity market for public policy resources. New York and the NYISO should investigate how best to include all resources in the capacity markets, with the goal of reflecting energy efficiency and dynamic smart loads in resource adequacy. Continue to evaluate the capacity market value of all resource types so that resources are paid for capacity consistent with the value they provide to the grid. Allow fair access to the capacity market for energy limited resources and accurately reflect the value of such resources especially as the need for grid flexibility grows over time. | DPS | Ongoing | NYISO, NYSERDA, Utilities, Suppliers |
| **Enhance/augment the availability of public information to assist developers in making informed project development decisions.** | NYISO/DPS | Ongoing | NYSERDA, Renewable developers |

# Enabling initiative – Initiative #9: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Proactive Advocacy.** New York State should fund expansion of the existing office and team within Department of Public Service (DPS) that systematically focuses on proactive advocacy at NYISO and FERC to provide the necessary resources to DPS to ensure that wholesale markets and planning processes align with CLCPA goals and support environmental justice concerns, while maintaining reliability. The expanded office should focus on improved coordination with other essential State agencies including NYSERDA and DEC. The office should also monitor the developments of FERC's soon to be created Office of Public Participation and work with both that office and its Environmental Justice senior advisor to assist and support increased participation by low-income New Yorkers at FERC. | DPS | ASAP | NYSERDA, DEC, Utilities, Suppliers, NYISO, FERC |
| **Earnings Adjustment Mechanisms.** The PSC should initiate a generic proceeding for Earnings Adjustment Mechanisms (EAMs) to review and evaluate how existing EAMs are working, lay the groundwork and create consistency across the utilities where it makes sense to do so, and consider additional EAMs related to the decarbonization and social equity goals of the CLCPA and the process to do so. This review should be done on a periodic basis, and EAMs should be adjusted as necessary to encourage the needed outcomes. | PSC | ASAP | DPS, NYSERDA, Utilities, Suppliers |



# Enabling initiative – Initiative #9: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Effective and flexible markets help to lower costs for consumers, including those in disadvantaged communities. |
| **Health and other co-benefits** | Effective and flexible markets enables clean technologies to come forward and displace undue burdens from fossil fuel generation on environmental justice communities. |
| **Just transition: businesses and industries, workers** | The transition away from fossil plants which will impact workers of those facilities and host communities. Complementary just transition and equity policies are needed to both transition current fossil workers to these new opportunities and ensure that workers from disadvantaged communities will benefit from new opportunities. |
| **Other** | |

# Enabling initiative – Initiative #10: Technology Solutions

| | |
|---|---|
| **Description:** | Increase research, development, and appropriately-scaled demonstration and deployment of emissions-free technology needed to reach our goals. |
| **Action type:** | Research & Development |
| **Cost and funding considerations:** | $$$; Continued and increased support of NYSERDA's existing programs. |
| **Ease of implementation:** | Medium (accelerating and expanding existing processes) |
| **Example case studies:** | NYSERDA's Innovation Team |

| **Risks / Barriers to success** | **Possible mitigants** |
|---|---|
| • Significant scaling of current efforts:<br>  • Coordination of multiple entities to scale current innovation efforts.<br>  • Increasing funding and staffing of the needed programs.<br>  • Rapidly developing technologies today to be deployed at scale by 2040.<br>• Current studies have identified that even after full deployment of available clean energy technologies, there is a remaining need for 15-25 GW in 2040 to meet demand and maintain reliability, although that gap may change over time.<br>• Whether the answer is new long duration battery technology, RNG, advanced green hydrogen, nuclear, overbuilding of renewable technologies or other new technologies that may emerge due to R&D efforts over the next two decades, the costs are likely to be high and aggressive action and smart planning will be challenging to make these fundamental shifts in our energy systems in two decades. And yet the health, societal, and economic benefits of the transition are also immense, and the cost of inaction or insufficient action are tremendous and would far outweigh the costs of action. | • Federal policy and action<br>• NYSERDA acting as a "hub" for research and development to ensure a coordinated and efficient effort.<br>• Increased funding and staffing of relevant programs needed |



# Enabling initiative – Initiative #10: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| **Achievement of 70 by 30: Focus on Aggressively Deploying Currently-Available Solutions** | | | |
| Focus on energy delivery, energy efficiency, the economics of long duration and seasonal storage, siting, and identifying technology gaps. | NYSERDA | Ongoing | NYISO, DPS, Utilities, developers. |
| Aggressive deployment of current renewable energy and storage technologies. | NYSERDA | Ongoing | DPS, DEC, NYISO, Utilities, siting communities |
| Continued build out of transmission and transmission upgrades | DPS | Ongoing | Utilities, Transmission developers, Utilities, DEC, siting communities |
| Supporting utility-scale demonstration projects of new technologies, including storage and transmission and distribution. | Utilities | Ongoing | Developers/researchers, Utilities, DPS, NYISO |

# Enabling initiative – Initiative #10: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Achievement of 100 by 40: Focus on Identifying and Developing Needed Solutions for Dispatchable Technologies** | | | |
| **Identify, explore, evaluate, and develop dispatchable technologies and solutions as they emerge. Focus on solutions we know are desirable.** | NYSERDA | Ongoing | Developers/Researchers |
| Detailed, holistic, modeling within a zero-emissions world. Modeling should include holistic integration of load, generation, and energy delivery, and be flexible in the solutions chosen. While modeling is being completed, the State should move forward with known needs. | NYSERDA | Ongoing | NYSERDA, DPS, NYISO |
| Support NYSERDA in its innovation efforts. NYSERDA should act as a hub for technological innovation and convene stakeholders and conduct strategic research on untapped renewables and storage projects. NYSERDA should develop of consortium of NYISO, utilities, developers, and solution providers to bring technologies to large-scale deployment faster and more cost-effectively. | NYSERDA | Ongoing | Developers/researchers, Utilities, DPS, NYISO |
| Supporting utility-scale demonstration projects of new technologies, including storage and transmission and distribution. | Utilities | Ongoing | Developers/researchers, Utilities, DPS, NYISO |



# Enabling initiative – Initiative #10: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| During planning, emissions-free resources (e.g., storage, energy efficiency, renewable energy) should be prioritized where feasible when considering end-uses, technology limitations, impacts, and costs. However, should a substitute for natural gas still be needed, advanced green hydrogen and possibly RNG could fill this gap in order to maintain reliability, if scalability, feasibility, and environmental impact and air quality issues can be addressed. | NYSERDA | Ongoing | PSC/DPS, DEC, NYISO, Utilities, Power Plant Owners/ Operators, Researchers & Developers |
| DPS and NY DEC should begin a process and rulemaking to define "emissions free" compliant with the CLCPA for advanced fuels | DEC/DPS | ASAP | |
| Further analysis, technical development, and research is needed in order to determine the feasibility, climate impact, and health impacts of advanced fuels prior to infrastructure investment:<br>• Determine the lifecycle GHG accounting framework of RNG and advanced green hydrogen. Priority utilization should be provided for feedstocks with the lowest GHG emissions, with strong preference given to zero- or negative-emissions sources.<br>• The potential air quality and health impacts of producing and using these fuels and best practices/end-uses to minimize these impacts.<br>• The safety of advanced green hydrogen, storage, and pipeline operation.<br>• Technological innovation, development, and scaled-deployment is needed in order to prove the effectiveness and economics of the technologies. | NYSERDA | Ongoing | |

# Enabling initiative – Initiative #10: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| The contribution of nuclear power to the 2040 resource mix and any additional policy actions needed should be evaluated prior to the cessation of the Zero Emissions Credit (ZEC) Program in 2029.<br>• Analysis should occur prior to the ending of the ZEC program in 2029 to determine whether subsidizing any of the State's remaining nuclear reactors will be necessary for meeting the 2040 emissions mandate and/or whether more cost effective and environmentally-friendly alternatives are available . The analysis should consider the inflexible baseload attributes of nuclear plants as well as reliability, cost, health, safety, community impact and environmental concerns of nuclear power generation. | PSC/DPS | 2029, and in alignment with NRC re-licensing | Customers, hosting communities, environmental groups, EJ, labor, NYSERDA, DEC, nuclear generating facilities, NYISO |
| o Should public policy mechanisms be proposed for the continuation of nuclear power generation, effective mechanisms for input and comments by stakeholders and the public should be implemented (specifically customer, environmental, environmental justice, labor, local and indigenous communities). | PSC/DPS | 2029, and in alignment with NRC re-licensing | |



# Enabling initiative – Initiative #10: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Consideration of the impacts of new technologies on environmental justice communities in relation to air quality and overall health effects. |
| **Health and other co-benefits** | Aggressive deployment of current renewable energy technologies and development of new technologies well help to more quickly shutdown fossil fuel generating facilities, improving air quality in these communities. |
| **Just transition: businesses and industries, workers** | With the right policies in place, new businesses and industries will grow in New York State centered around clean energy technologies (energy efficiency, solar, wind and offshore wind and battery storage) and the supply chain for these technologies. Becoming a "hub" for clean energy technology development will attract clean energy research and development companies to New York. |
| **Other** | Care must be taken to ensure that new technology deployment is collaborative and complimentary to other grid investments such that the lowest overall cost is incurred to achieve the CLCPA goals. |

# Enabling initiative – Initiative #11: Long-Duration Storage Technology

| | |
|---|---|
| **Description:** | Achieving the CLCPA's high renewable energy, zero emission electricity system will require substantial amount of energy storage operating over various timescales—spanning from minutes to hours, days, weeks and even longer—to maintain grid flexibility, reliability, and resiliency. |
| **Action type:** | Executive, Regulatory, Research & Development |
| **Cost and funding considerations:** | $$-$$$ |
| **Ease of implementation:** | Hard (predicting, modeling, and developing of new technologies) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • The specific technologies, products, and use/business cases for long-duration storage are still being developed<br>• Scaling new technologies so they will be commercially viable in the grid<br>• Large scale testing and demonstration needed to ensure assets work properly on the existing grid | • Further R&D and the establishment of a Center of Excellence to accelerate the deployment of long-duration storage<br>• Change formula for funding Centers of Excellence and demonstration projects |



# Enabling initiative – Initiative #11: Components of the strategy, Benefits and impacts

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Focus State programs and funding on research and demonstration projects for the development of large scale and longer duration storage | NYSERDA/DPS | Testing and commercial deployment by 2030 | NYISO, utilities, developers |
| Develop and expand a Storage Center of Excellence so that new technologies can be matured and deployed on the grid for large scale testing | NYSERDA | ASAP | DPS, utilities, developers |
| Attract and engage relevant parties in collaborative efforts to address the challenges unique to long-duration storage | NYSERDA | Ongoing | DPS, utilities, developers, NYISO, ESD |

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Development and deployment of long duration storage would significantly impact our ability to reach the 2040 goal, and would allow high-emitting fossil fuel generation facilities to no longer be needed for reliability. As these facilities are often located in disadvantaged communities, it would alleviate environmental burdens in these communities. |
| **Health and other co-benefits** | Further reduce peaker plant dependence decreases emissions and improves air quality. |
| **Just transition: businesses and industries, workers** | NYS has the opportunity to be a leader in the "grid of the future", be the hub of a new clean energy field, and ensure these investments lead to new workforce development and job growth. |

# Enabling initiative – Initiative #12: Energy Delivery & Hosting Capacity

| | |
|---|---|
| **Description:** | Pursue planning and implementation processes to facilitate necessary energy delivery options for the renewable energy buildout. |
| **Action type:** | Executive, Regulatory |
| **Cost and funding considerations:** | $$$; There are existing mechanisms for state and FERC rate recovery. The State should also seek federal funding from the administration's stimulus and infrastructure bills. |
| **Ease of implementation:** | Hard – Building or upgrading energy delivery system infrastructure will be difficult. It will require thorough planning and technology advancements. |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Complex upgrades to the energy delivery system will be required.<br>• Some upgrades may be costly.<br>• Host community opposition if engagement and public outreach are not done properly. | • Strong community communication, engagement, and public outreach will be important for these projects and upgrades to be possible. |



# Enabling initiative – Initiative #12: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Expand Electricity Transmission and Distribution Systems to Support Energy Delivery** | | | NYSERDA, DPS, DEC, Utilities, NYISO, Transmission and Distribution System Operators, municipalities and local communities where projects are sited and where energy is delivered. |
| Continue with strategic long-term transmission and distribution investments by NYPA and utilities for expedited projects needed in the short term (within ~5 years), by utilities for local transmission and distribution investments within a utility's footprint, and declare public policy needs in the current NYISO PPTN process through FERC Order 1000. | PSC/NYPA | Ongoing | |
| Focus on increasing hosting capacity with a holistic/top-down approach and to accelerate adoption, while being mindful of the tradeoffs between siting resources in high-cost areas and investments in T&D infrastructure to reach the most equitable cost option. | PSC/DPS | ASAP | |
| Create a database to track penetration and identify where there may be headroom for Renewable Energy Zones. Recommend process to 1) establish Renewable Energy Zones, 2) determine quantity of renewable energy targeted within each zone, and 3) develop a plan for each REZ to build sufficient transmission to ensure energy delivery within and out of the zone. | DPS/NYSERDA | ASAP | |
| **Offshore Wind (OSW)** | | | |
| Conduct further planning and pursue system upgrades on Long Island and in NYC to facilitate 9,000 MW of OSW. | DPS/NYSERDA | Ongoing | |
| Promote multiport infrastructure investment to support and facilitate the growth of the offshore wind industry in NY. Future offshore wind solicitations should continue to include a multi-port strategy and requirement for offshore wind generators to partner with any of the 11 prequalified NY ports to stage, construct, manufacture key components, or coordinate operations and maintenance activities. | NYSERDA | Ongoing | |

# Enabling initiative – Initiative #12: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Advanced Grid Technologies & Future Studies for Planning Processes** | | | NYSERDA, DPS, DEC, Utilities, NYISO, Transmission and Distribution System Operators, municipalities and local communities where projects are sited and where energy is delivered. |
| Building on the Power Grid Study, continue R&D and rapid deployment of advanced grid technology to:<br>a) alleviate transmission system bottlenecks to allow for better deliverability of renewable energy throughout the State;<br>b) unbottle constrained resources to allow more hydro and/or wind imports and the ability to reduce system congestion;<br>c) optimize the utilization of existing transmission capacity and right of ways;<br>d) increase circuit load factor through dynamic ratings;<br>e) encourage utilities to accelerate investments in their local systems that will facilitate renewables development and enhancing the electrification of transportation, but also grow safety and resiliency. | DPS/NYSERDA | ASAP | |



# Enabling initiative – Initiative #12: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| **Advanced Grid Technologies & Future Studies for Planning Processes (continued)** | | | NYSERDA, DPS, DEC, Utilities, NYISO, Transmission and Distribution System Operators, municipalities and local communities where projects are sited and where energy is delivered. |
| Examine and, if needed, modify planning processes (timeframe of processes, forward looking, technology deployment alignment, address defaulting to regulated solutions) to encourage the incorporation of advanced technologies | DPS/NYSERDA | ASAP | |
| Conduct a study that looks more closely at short- and long-duration storage, clean dispatchable energy, and T&D investments to get a more precise view of the long-term needs of the grid; further informing public policy decisions and market design | DPS/NYSERDA | ASAP | |
| Develop and publish LT&D system information in time to support renewable developer decision making timelines. | PSC/Utilities | ASAP | |
| **Interconnection** | | | |
| Explore additional areas of openness and engagement with the NYISO and other stakeholders to improve the interconnection/Class Year process. | PSC/DPS | ASAP | |
| NYS can be more involved with stakeholders in planning optimal locations for clean energy projects, either through community energy studies, stakeholders' processes, or other connections, while serving as a resource for technical information and a bridge to communicate with the NYISO. | DPS/NYSERDA | Ongoing | |
| Further engagement, outreach, education, and support for local municipalities, communities and residents to improve acceptance of energy delivery projects. | DPS/NYSERDA | Ongoing | |

# Enabling initiative – Initiative #12: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Rapid improvements and upgrades to the energy delivery system will allow more renewable energy into the system reducing the need for fossil fuel generational facilities. Closing fossil fuel generation facilities in disadvantaged communities will improve air quality. |
| **Health and other co-benefits** | Aggressive upgrades and construction of transmission and distribution systems will make it possible to close fossil fuel generation facilities, improving air quality and decreasing emissions. |
| **Just transition: businesses and industries, workers** | Renewable energy developers will be able to site and construct projects more easily and quickly, bringing more projects to NYS and increasing renewable energy development activity. |
| **Other** | |



# Mitigation strategy – Initiative #13: Gas Infrastructure, Transmission & Methane Leakage

| | | | |
|---|---|---|---|
| **Description:** | This recommendation intends to address methane leakage and the infrastructure related to fossil natural gas, though it also applies to any potential future gas technologies. This recommendation aligns with what was proposed by the Energy Efficiency & Housing Panel, but includes a broader scope beyond that of the end-use gas distribution sector. Transition away from gas with a managed, phased, and just transition from natural gas and decommission natural gas infrastructure to the maximum extent possible and as quickly as possible. | | |
| **Action type:** | Executive, Regulatory | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$ | | |
| **Ease of implementation:** | Easy - Medium | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Natural gas infrastructure is an extensive statewide network, much of it underground and within buildings. Leakage detection and repair (LDAR), as well as decommissioning may be challenging in populous areas.<br>• As New York transitions away from natural gas, it will need to ensure proper system maintenance and investment, and chart a path to avoid stranded assets.<br>• The Federal Energy Regulatory Commission oversees interstate natural gas transmission and plays a significant role in approving natural gas infrastructure, which presents additional regulatory considerations for this category of facilities. | • Improved planning, including inventorying infrastructure components and characterizing emissions to allow for prioritization of LDAR.<br>• Coordination with local regional and federal entities.<br>• Advances in LDAR technology. |

# Mitigation strategy – Initiative #13: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Undertake a detailed economic analysis to determine the most equitable and cost-effective strategy for transitioning off of gas, maintaining public safety and customer reliability, and decommissioning gas systems/infrastructure. A strategic approach to decommissioning the distribution system should be considered while considering both end-use customers and growth in the power generation sector with electrification. This analysis should be completed in parallel with decommissioning power plants and the NYISO Reliability Needs Assessment. | DPS | ASAP | DPS, NYSERDA, DEC, Utilities, natural gas producers, infrastructure owners, local municipalities |
| Initiate a proceeding to establish emission reductions targets for transmission and gas utilities, allocating specific targets (short, medium and long term) to establish the trajectory for the gas utility sector to achieve the 2050 emissions reductions targets. | DPS/DEC | Ongoing | |
| Implement Legislative changes to the provisions of the public service law and transportation corporations law so as not to promote gas system expansion by creating a customer right to gas service and requiring that existing customers subsidize gas system extensions to new customers as they are currently written. | DPS | ASAP | |
| Deny additional gas infrastructure permits to avoid creating additional stranded assets and exacerbating GHG emissions. Furthermore, NYS should advocate to FERC for denial of gas infrastructure projects that will exacerbate GHG emissions. These actions should be taken to the extent consistent with reliability. | DPS/DEC | ASAP | |



# Mitigation strategy – Initiative #13: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support the current DEC effort to promulgate regulations to decrease methane emissions from gas infrastructure, including upstream emissions, and in coordination with the PSC, mandate specific emission reduction targets (including interim targets) for transmission, storage and gas distribution utilities upstream of the meter. These targets are necessary to guide utility gas system planning. | DEC | Ongoing | DPS, NYSERDA, DEC, Utilities, natural gas producers, infrastructure owners, local municipalities |
| Support future efforts from DEC to further control, reduce, and eliminate methane emissions from gas infrastructure. This may include: Implementation of the usage of leak detection and repair enhanced technology, developing an inventory of all infrastructure and sources of methane emissions potentially subject to State regulation, and operation and maintenance requirements resulting in reduced methane emissions | DPS/DEC | ASAP | |
| Continued research and development of leakage detection technologies, including continuous monitoring technologies and survey (aerial or land) for the production, transmission and storage of natural gas. | DPS | Ongoing | |
| Develop a program to accurately characterize gas infrastructure components through information requests better estimate emissions and improve inventory reporting. | DEC | ASAP | |

# Mitigation strategy – Initiative #13: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Develop an integrated plan and coordinate efforts with utilities, gas producers, infrastructure owners, and local municipalities to decommission infrastructure by implementing non-pipes alternatives (NPAs) and detect and repair leaks in remaining gas infrastructure while maintaining affordable, safe and reliable service. | DPS | ASAP | DPS, NYSERDA, DEC, Utilities, natural gas producers, infrastructure owners, local municipalities |
| Identify funding sources and appropriately fund efforts to locate and cap abandoned wells. | DEC | ASAP | |
| Develop an online registry for submission of data to organize the data and information in a manner that informs and directs infrastructure decommissioning. The CLCPA [75-0105(4)] states that the DEC shall consider a registry but does not direct the DEC to create one. The online registry should have a transparent planning and reporting process, include emissions from the gas industry (from wells to end of distribution network pipes/burner tips) and sources of "fugitive" methane from other methane sources such as landfills, wastewater treatment etc. The information collected shall track and collect data needed for interim targets. The registry shall Account for, report, and track environmental attributes of any advanced fuel project or fugitive methane avoidance project that assures no double counting of reductions or environmental benefits. The CAC should determine the best and highest environmental attributes. | DEC | ASAP | |



# Mitigation strategy – Initiative #13: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | In addition to being a greenhouse gas (GHG), methane is a precursor to ozone which impacts disadvantaged communities disproportionately. Reducing methane emissions from natural gas infrastructure improves local air quality, especially in neighborhoods that have significant and/or older infrastructure.<br>Rebuilding gas infrastructure will increase the likelihood of stranded assets, increase rate pressures, and exacerbate equity impacts, especially for LMI customers, as customers transition off of the gas system. |
| **Health and other co-benefits** | • 2017 (20 yr GWP) emissions from the oil and natural gas sector was 8,950,000 MTCO2e.<br>• LDAR at wells, compressors and storage sources may reduce GHG emissions by 375,000 MTCO2e.<br>• Additional reductions can be realized with further requirements, including capping abandoned wells, regulation of operation and maintenance and other activities.<br>• Methane is a precursor to ozone which impacts disadvantaged communities disproportionately, the reduction of methane has the potential to also reduce ozone. |
| **Just transition: businesses and industries, workers** | As the natural gas system transitions, job availability and roles within the sector may change to: Shuttering of natural gas power plants; Decommissioning of the system; Leakage detection and repair services; and Need to understand and operate a changing system (different infrastructure needs, footprint, or equipment, and different gas compositions). |
| **Other** | |

# Enabling initiative – Initiative #14: Retirement of Fossil Fuel-Fired Facilities

| | |
|---|---|
| **Description:** | Develop a plan and implement regulations to phase out fossil fuel-fired baseload and peaking generation resources as quickly as practicable while retaining system reliability by prioritizing efforts to lower emissions of co-pollutants in disadvantaged and environmental justice communities. Leverage existing technology, innovative zero-emissions technology where feasible, transmission and distribution investment, targeted energy efficiency and demand response, market design, and policy or regulatory mechanisms. |
| **Action type:** | Regulatory |
| **Cost and funding considerations:** | $; Renewable and storage resources can compete to displace fossil-fuel fired plant capacity payments. Potential revenue from regulatory compliance should be considered in all cost assessments. |
| **Ease of implementation:** | Hard – Retiring all fossil sources on the system will be difficult, requiring thorough and innovative planning, as well as technology advancements. |
| **Example case studies:** | DEC "Peaker Rule," 6 NYCRR Subpart 227-3 |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Effective deployment of renewables, flexible generation or storage, and distributed resources, as well as energy efficiency and demand response solutions that can reliably replace existing fossil resources will be critical.<br>• Transmission and distribution upgrades are needed to complement the zero emissions resource build out, in order to ensure energy delivery. | • The recommendations from the Power Generation Advisory Panel focus on enabling strategies to assist in the transition away from fossil fuels. These include strategies to more rapidly deploy renewable technologies, including flexible resources, addressing barriers to renewables deployment, transmission and distribution upgrades, developing and deploying technology innovations, encouraging effective market structures, and ensuring a just and equitable transition. |



# Enabling initiative – Initiative #14: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other Key Stakeholders |
|---|---|---|---|
| **Non-Consensus Recommendation with Majority Support: Temporary Moratorium on New or Repowered Fossil Fuel-Fired Facilities until the Full Recommendation is Adopted** | | | |
| Moratorium on New Fossil Generation: A moratorium will be placed on the permitting, licensing, siting and construction of any new (including repowered, partially repowered) fossil fuel electric generating facility until, as described in the consensus recommendation, (a) the final CAC recommendations are adopted by the state; and (b) NYSDEC has completed its Assessment and Determination of Emissions reduction targets and finalized Emissions Reductions regulations setting ratcheted down emission limits and targets to zero by 2040; and (c) the New York State Planning board and the PSC have finalized the electric sector gas planning process in order to support and ensure the achievement of the emissions reductions targets and compliance with the promulgated emissions reduction regulations by DEC unless a system reliability need is certified as described in the paragraph below.<br>System Reliability: No new, repowered or partially repowered fossil fuel generation facility would be allowed unless (a) NYISO and the local transmission owner certify the existence of a reliability need that cannot otherwise be addressed through a local or bulk transmission system upgrade and that can only be addressed by the fossil generator; (b) the PSC determines based on demonstration from the local transmission distribution company, the utility, and NYISO that no combination of transmission, energy storage, emissions free electric generation, demand response and energy efficiency can address the reliability need within the relevant time frame; (c) if repowering, the fossil fuel generation facility would result in "a significant reduction in criteria and hazardous air pollution from a representative baseline 12 month period within the prior 24 months, as determined by DEC; (d) NYSDEC conducts a thorough equity analysis as mandated under the CLCPA and as required by NYSDEC Commissioner Policy 29; (e) all projects will be subject to Article 10; and (f) the license and permits or renewed permits for any such facility shall be terminated by 2040. | CAC | ASAP | |

# Enabling initiative – Initiative #14: Components of the strategy

| Components required for delivery | Implement-ation lead | Time to implement | Other Key Stakeholders |
|---|---|---|---|
| **Non-Consensus Recommendation with Majority Support: Temporary Moratorium on New or Repowered Fossil Fuel-Fired Facilities until the Full Recommendation is Adopted (cont'd)** | | | |
| New Fossil Generation Through 2040: After the promulgation of the regulations and processes described above and fully detailed in the consensus recommendations below, new, repowered or partially repowered fossil fuel generation facilities may only be licensed or permitted if they comply with these regulations, processes and plans and if their licenses, permits and any permit renewals will terminate by 2040. In its permitting decisions and in the development of the regulations noted above, DEC is required under the CLCPA to "prioritize reductions of greenhouse gas emissions and co-pollutants in disadvantaged communities" and to ensure that a project "shall not disproportionately burden disadvantaged communities." | CAC | ASAP | |

| Alternative Viewpoint on Non-Consensus Recommendation |
|---|
| The CLCPA requires state agencies to integrate consistency with the CLCPA into their decision-making. In order to achieve the 2030 mandate it is necessary to substantially build out NY's infrastructure; including renewable and storage resources, along with transmission and distribution to support energy delivery. This work, combined with the comprehensive planning and regulatory process to determine how to phase down fossil reliably in a fact based manner by 2040, is what is needed to achieve the CLCPA goals. |



# Enabling Initiative – Initiative #14 Retirement of Fossil Fuel-Fired Facilities

*Principles for Retiring, Repowering and New Fossil Fuel-Fired Facilities*

> Fossil-fuel fired facilities should not be permitted to operate after 2040.

> Reducing greenhouse gas emissions and co-pollutants in disadvantaged communities is a priority, and we must ensure an equitable and affordable transition.

> The State must move quickly and take strong action both to invest in renewable electricity, storage, energy efficiency, and transmission and distribution to phase out fossil fuel generation, all while maintaining reliability.

- Electrification of buildings of transportation are critical to achievement of the CLCPA and will increase load on the electric grid.
- Continued provision of safe and adequate electrical service is required as alternative solutions are implemented.
- Not all solutions are yet known, and the transition requires innovative and holistic planning.

> Public and stakeholder input must be considered in any such planning.

> State agency decision-making and approvals must consider consistency with GHG emissions limits.

# Enabling initiative – Initiative #14: Retirement of Fossil Fuel-Fired Facilities

> **There are 3 main components to the Fossil Fuel Generation Recommendation:**

1. A planning process to determine emissions reduction targets to reach zero emissions by 2040.

2. Promulgation of emissions regulations by DEC in order to reach the 2040 goal.
   - *Similar to the "Peaker Rule" (DEC 6 NYCRR Subpart 227-3), any closures designated by the emissions regulations of fossil fuel generation facilities would prompt a reliability needs analysis and identification of alternatives.*

3. An iterative planning process that builds on #1 in which the progress, the reduction targets, the regulations, and the other mechanisms being utilized are evaluated and revised as necessary in order to reach the 2040 goal.

The above components shall be enacted as soon as possible by the relevant State Agencies.



# Enabling initiative – Initiative #14: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other Key Stakeholders |
|---|---|---|---|
| **A planning process to determine emissions reduction targets to reach zero emissions by 2040** | | | |
| Determine the potential for greenhouse gas emission and co-pollutant reductions from fossil fuel generation by 2030 and set a corresponding timeline for emissions reduction targets. The timeline from present to 2030 for possible emission reductions shall be determined in conjunction with the renewable energy procurement and interconnection schedule and shall represent a continual decline in emissions from present to 2040 while ensuring reliability. The process shall include effective mechanisms for input and comments by stakeholders (including but not limited to: generators, utilities, and environmental, environmental justice, public health, labor, and electricity consumer advocates and organizations, as well as local communities) and the public. | New York State Energy Planning Board | As soon as possible, but no later than 2023 | NYSERDA, PSC, DEC |
| When setting emission reduction targets, consideration should be given to the location and emissions profile from fossil generating units across the state , as well as relevant planning studies from involved organizations (e.g., the Power Grid Study, NYISO reliability analyses, etc.) in order to inform decisions to address these emissions in the most efficient and effective manner possible. | New York State Energy Planning Board | As soon as possible, but no later than 2023 | NYSERDA, PSC, DEC |
| Disadvantaged communities shall be considered when determining the emissions reduction targets, as required by the CLCPA. | New York State Energy Planning Board | As soon as possible, but no later than 2023 | NYSERDA, PSC, DEC |

# Enabling initiative – Initiative #14: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other Key Stakeholders |
|---|---|---|---|
| **Promulgation of emissions regulations by DEC in order to reach the 2040 goal** | | | |
| Following the above analysis, DEC shall examine all potential regulatory options, including new regulations and/or permit requirements or amendment of current regulations and/or permitting requirements, to determine the most efficient, effective and enforceable format to achieve the determined emissions reduction targets and the CLCPA goals. Evaluation of emissions, benefits, reliability needs, cost, and available replacements and solutions (and their subsequent impacts) must be executed. Specific focus should also be given to reducing emissions and co-pollutants in disadvantaged and environmental justice communities. The process shall include effective mechanisms for input and comments from stakeholders prior to formal proposal under SAPA, similar to the process used in promulgating the DEC "Peaker Rule," 6 NYCRR Subpart 227-3. Once completed DEC shall follow SAPA in promulgating the identified regulation(s). The effectiveness of the regulations shall be evaluated every two years. This evaluation should coincide with the resource planning review. | DEC | As soon as possible, but no later than 2024 | NYSERDA, PSC, NYSEPB |
| Coordination of closures and the necessary reliability assessments should take place between State Agencies (e.g., DEC, PSC, NYSERDA) and other key stakeholders (e.g., the NYISO, utilities and fossil fuel facility owners and operators), similar to the process used in promulgating the DEC "Peaker Rule," 6 NYCRR Subpart 227-3. | DEC | As soon as possible, but no later than 2024 | NYSERDA, PSC, NYSEPB, NYISO, Utilities |



# Enabling initiative – Initiative #14: Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other Key Stakeholders |
|---|---|---|---|
| **An iterative planning process in which the progress, the reduction targets, the regulations, and the other mechanisms being utilized are evaluated and revised as necessary in order to reach the 2040 goal.** | | | |
| The New York State Energy Planning Board shall commence an iterative planning process in order to support and ensure the continued achievement of the emissions reduction targets and compliance with promulgated regulations including identification of alternatives and barriers to those alternatives, and analysis or additional mechanisms needed. | New York State Energy Planning Board | Performed every two yea rs and timed to serve as a critical input into future Clean Energy Standard, Stat e Energy Plan and/or Climate Action Council updates. | NYSERDA, DEC, PSC, NYISO, Utilities |
| Examine options to reduce or eliminate emissions from fossil fuel-fired generation facilities, including behind-the-meter fossil resources as expeditiously as practicable but not later than 2040, identifying the nature, feasibility, cost and avoided costs, risks and risk mitigants, and impacts on emissions and health as well as reliability. | | | |
| Outline the impacts on communities and workers of such options and the ability to repurpose these facilities to take advantage of their location and infrastructure to ensure reliability while meeting of the CLCPA goals. | | | |
| Examine and prioritize options to reduce greenhouse gas emissions and co-pollutants in disadvantaged communities. | | | |
| Investigate and implement market mechanisms to assist in the removal of fossil fuel-fired generating facilities from the system, including but not limited to the opportunity for carbon pricing, Clean Dispatch Credits, and valuing of environmental attributes. | | | |

# Retirement of Fossil Fuel-Fired Facilities

> Only after alternative solutions (or combination thereof) such as storage (of any duration), zero-emissions resources, transmission upgrades or construction, energy efficiency, or demand response, are fully analyzed and determined to not be able to solve the identified grid reliability need, shall fossil fuel-fired generation facilities be considered in order to meet DEC emissions reduction regulations.

> **Fossil fuel-fired generation facilities shall only be considered if:**

- The NYISO and local transmission operators confirm that the fossil fuel-fired facility is required to maintain bulk or non-bulk power system reliability and that need cannot be reasonably met with any zero-emissions alternatives or combination of zero-emissions alternatives (above).
- A fossil fuel-fired generation facility results in:
  - A fossil fuel-fired generation or low carbon facility provides needed electric system qualities necessary for the reliable operation of the electric system that the alternatives cannot provide.
  - A greater integration of zero-emissions resources
  - A reduction of fossil fuel-fired generation capacity while decreasing greenhouse gas emissions and co-pollutants
  - A significant reduction of greenhouse gases and co-pollutants (reduction requirements to be defined by DEC regulations and analysis)
- A fossil fuel-fired generation facility addresses a specific environmental justice concern (as required by the CLCPA)
- Public and stakeholder input must be incorporated into the decision-making process (as required by Article 10)

> **For all scenarios, a thorough analysis of equity considerations, as required by the CLCPA, is completed by the relevant State Agency.**



# Enabling initiative – Initiative #14: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Closure of high-emitting fossil units should be prioritized in environmental justice communities through measures such as energy efficiency, battery storage, renewables deployment, and necessary transmission and distribution upgrades. As fossil generation facilities close, the impact of the lost tax revenue must also be examined within these communities and a transition must be identified. |
| **Health and other co-benefits** | Phasing out fossil fuel-fired generating facilities, especially the largest emitters, will decrease emissions and improve air quality, particularly in the communities where fossil fuel generation is located. In 2016, in-state fossil fuel combustion accounted for 27.72 MMtCO2e (14% of all state emissions). |
| **Just transition: businesses and industries, workers** | The closure of fossil units will impact workers. Training and support in the transition to new jobs will be important (see Workforce Development recommendation for additional information). |
| **Other** | |

# Appendix



# Category definitions (1 of 2)

| | Low | Medium | High |
|---|---|---|---|
| **Emissions impact (2018 baseline)** | Strategy results in <10% of the reductions needed from the sector for each target year (2030 and 2050)<br>OR<br>Less than 1.5 million metric tons (MMT) of emissions reductions in 2030 or 3 MMT 2050. | Strategy results in 10-33% of the reductions needed from the sector in at least one of the target years<br>OR<br>greater than 1.5 but less than 4 MMT of emissions reductions in 2030 or over 3 but less than 8 MMT in 2050. | Strategy results in >33% of the reductions needed from the sector in at least one of the target years<br>OR<br>over 4 MMT of emissions reductions in 2030 or over 8 MMT in 2050. |
| | **Easy** | **Medium** | **Hard** |
| **Ease of implementation** | • Strategy has been implemented many times and/or can build off an existing NYS program<br>• Proven and widely available technology<br>• Key stakeholders are strong supporters; no strong opponents | • Strategy is new to New York State but has been successfully implemented in other comparable states/countries<br>• Proven technology with known GHG impact, but still small-scale<br>• Key stakeholders are neutral, or balanced mix of supporters and opponents | • Strategy is unproven in comparable settings<br>• Early-stage technology (e.g., need for pilots to prove feasibility and significant capital to scale up)<br>• Key stakeholders oppose the strategy |

# Category definitions (2 of 2)

| | $ | $$ | $$$ |
|---|---|---|---|
| **Mitigation Strategy Cost** | • <$250M total resource cost<br>• Most resources required for successful implementation are already on hand | • $250M - $1B total resource cost<br>• Requires some new resources for successful implementation | • Over $1 Billion total resource cost<br>• Requires high degree of new resources (people, equipment, technology)<br>• Strategies with cost >$10B should indicate the range of anticipated costs |
| **Enabling Strategy Cost** | • <$25M total cost<br>• Most resources required for successful implementation are already on hand | • $25M - $100M total cost<br>• Requires some new resources for successful implementation | • Over $100M total cost<br>• Requires high degree of new resources or is a demonstration project<br>• Strategies with cost >$250M should indicate the range of anticipated costs |



# Energy-Intensive and Trade-Exposed Industries Advisory Panel

## Recommended Strategies

April 5, 2021

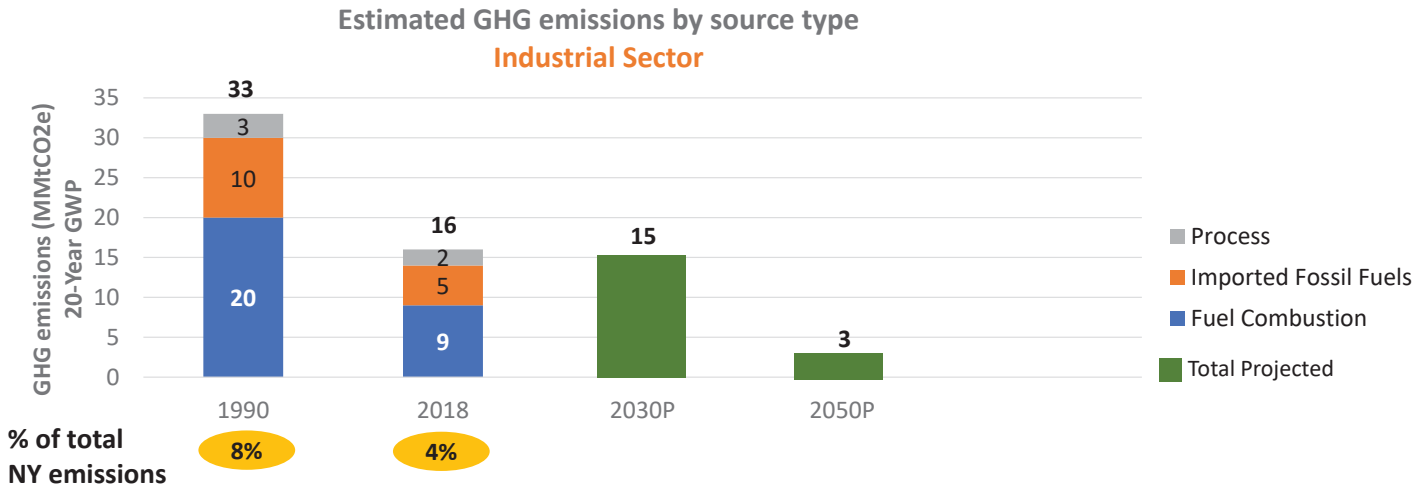
NEW YORK STATE OF OPPORTUNITY. Climate Action Council

# Public and Stakeholder Input Process

- All EITE Advisory Panel meetings have been open for viewing by the public; all meeting presentations and notes have been posted to climate.ny.gov.
- December – input from Climate Action Council, Climate Justice Working Group
- January – input from public in virtual forum (verbal and written)
- Ongoing – written comments accepted at:
  - E-mail (preferred): climate@esd.ny.gov
  - Letter:
    - EITE Advisory Panel
    - c/o Empire State Development
    - 633 Third Avenue
    - New York, NY 10017
- February – input from EITE advisory panel on draft strategies
- March – finalized EITE advisory panel strategies for Climate Action Council



# Industrial sector GHG emission estimates with EITE panel strategies




Source: Draft DEC/NYSERDA analysis subject to public review, 2018 emissions data are preliminary draft
Notes: Excludes indirect emissions from electricity consumption and product use emissions; "Imported Fossil Fuels" includes estimates of upstream GHG emissions associated with fuel combustion; "Fuel Combustion" GHG emissions include combustion of all fuel types at industrial facilities; "Process" GHG emissions include all non-combustion emissions related to industrial production; 2030P and 2050P values shown are based on E3 Pathways report under pre-CLCPA accounting and should be considered illustrative only.

# EITE considerations for Industrial emission mitigation strategies

- Industrial sectors within EITE panel scope (Manufacturing, Mining) total a small share (~4%) of State emissions
- "Heterogeneous" nature may result in higher cost per tons of emissions reduced.
- "EITE" industries are likely to represent a high share of Industry sector emissions; non-incentive-oriented approaches may cause leakage.
- Emissions will decline with decarbonization of Power Generation sector; near-term opportunities likely focused on energy efficiency, while most deep decarbonization (carbon capture, low-carbon fuels, etc.) is est. to occur further into the future as new technologies scale, mature and become more viable.

# EITE Strategies

**Mitigation strategies**: Directly reduce emissions and contribute to the achievement of the GHG emission limits or carbon seq. needed to achieve net zero, where applicable:

1. Provide financial incentives and technical assistance for the decarbonization of EITE sectors
2. Create procurement incentives for business to capitalize on low-carbon economic opportunities

**Enabling initiatives:** No direct emissions benefit, but enable or magnify the mitigation strategies, enhance climate justice, or just transition. (*Examples: outreach, education, and awareness; capacity building; workforce development; and research and development.)*

3. Identify and support technological innovation to enable deep industrial decarbonization
4. Workforce development training to support Energy-Intensive and Trade Exposed (EITE) industries
5. Increase the available data on industrial GHG emissions to help prioritize efforts and monitor progress
6. Provide economic incentives to grow the green economy

# Mitigation strategy – Initiative #1: Financial and Technical Assistance

| | | | |
|---|---|---|---|
| **Description:** | Provide technical assistance to help identify economically viable decarbonization projects and provide comprehensive energy management planning. Provide financial assistance for decarbonization projects and leverage low-cost hydropower to support industry. | | |
| **Action type:** | Engineering support and financial incentives | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | Costs to support industry can be through utility collections of a System Benefits Charge, agency funding or federal grants and support. | | |
| **Ease of implementation:** | Easy | | |
| **Example case studies:** | NYSERDA's Clean Energy Fund, NYPA's Low-Cost Power Program, Investor-Owned Utility Energy Efficiency Programs. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Industries' internal competition for resources may prohibit investment in implementation of GHG reduction strategies | Provide clear market signals of long-term resource commitments and benefits to industry |



# Mitigation strategy – Initiative #1: Financial and Technical Assistance

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| NYSERDA financial and technical initiatives<br>• Approval of continuation of Clean Energy Fund<br>• Market Engagement and Outreach | NYSERDA | Ongoing | DPS, NYSERDA, NYPA Utilities, Regional Economic Development Councils |
| Utility Energy Efficiency Programs | Utilities | Ongoing | DPS, NYSERDA, NYPA |
| Low-cost Hydro Power Programs | NYPA | Ongoing | DPS, Utilities |

# Mitigation strategy – Initiative #1: Financial and Technical Assistance

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Industrial facilities implementing GHG emission reduction projects or receiving low-cost hydro power may be located within a disadvantaged community. |
| **Health and co-benefits** | Significant health benefits are expected from lowering GHG emission reductions at energy intensive industrial facilities in which some facilities are in heavily populated areas. |
| **Just transition: businesses and industries, workers** | Over 127,000 clean energy jobs exist in energy efficiency in New York and as increased investments in GHG emission reduction projects occur opportunities exist for job growth in the sector.*<br><br>*2020 New York Clean Energy Industry Report, p. 37. |
| **Other** | |



# Mitigation strategy – Initiative #2: Low-Carbon Procurement Policies

| | | | |
|---|---|---|---|
| **Description:** | Develop preferential procurement standards for low-carbon building materials and remove impediments to the State's purchase of low-carbon materials. Low-carbon materials will be required to reduce emissions in the built environment. Providing a value proposition for manufacturers to produce low-carbon products will help reduce process related emissions. | | |
| **Action type:** | Legislative/Regulatory | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | Low-carbon products available in the near have comparable cost characteristics to legacy materials. Long-term costs can be controlled by capping preferential standards (e.g. maximum % discount on bid price when proposal contains low-carbon products) | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | Buy Clean California; EU 2014 Public Procurement Directives | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Availability of different types of low-carbon products<br>• Life Cycle Analyses (LCAs) of products require standardized accounting frameworks to ensure accurate accounting of emission reduction. | • RD&D funding for product development<br>• Work with federal government as well as other states and municipalities on LCA best practices to ensure that compliance is favorable to business interests. |

# EITE - Mitigation strategy – Initiative #2: Low-Carbon Procurement Policies

| **Colmponents required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Develop a list of the most carbon intense building materials and products (e.g. concrete, steel, glass, etc.) eligible for incentives or preferential treatment in procurement. | GreenNY , NYSERDA, DEC | <1 year | NYSERDA, DASNY, OGS, NYSERDA, DEC, DOT, PANYNJ |
| Determine a standard for assessing the Global Warming Potential (GWP) of products | GreenNY, NYSERDA, DEC | 1-2 years | NYSERDA, DASNY, OGS, NYSERDA, DEC, DOT, PANYNJ, Other States, Federal gov. |
| Implement project scoring criteria that provide advantages to projects/bids utilizing products that meet or exceed GWP targets | Multiple | 2+ years | Builders/architects/ manufacturers |
| Continuous monitoring and updating of standards | GreenNY, NYSERDA, DEC | Ongoing | NYSERDA, DASNY, OGS, NYSERDA, DEC, DOT, PANYNJ, Other States, Federal gov |



# Mitigation strategy – Initiative #2: Low-Carbon Procurement Policies

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | The production methods utilized to manufacture low-carbon products often reduce other harmful co-pollutants relative to the production of the legacy products being replaced. As a result, production of low-carbon products may have beneficial local health impacts in disadvantaged communities where industrial facilities are often located. |
| **Health and co-benefits** | See above. |
| **Just transition: businesses and industries, workers** | Development of low-carbon products and associated markets will offer new business opportunities, including to NYS-certified M/WBE and SDVOBs. Technologies that will enable large scale production of low-carbon goods will be developed by startups and other new business ventures that will spur job growth and new innovative industries in NY State. |
| **Other** | |

# Enabling initiative – Initiative #3: Research Development & Demonstration (RD&D)

| | |
|---|---|
| **Description:** | Develop a comprehensive Innovation Roadmap to determine priorities for deep decarbonization RD&D investment. Meeting the CLCPA goals for industry is not technically and/or economically feasible with currently available technologies alone. This research effort should analyze the social, financial, and technological characteristics of solutions that will enable industry to meet CLCPA goals. The research should consider the intersection of the industrial/manufacturing, agriculture, transportation, and power generation sectors when determining investment priorities. |
| **Action type:** | Research initiative |
| **Cost and funding considerations:** | • Funding required for initial roadmap analysis with additional funding for further research and early-stage pilots to be determined pending the outcome of analysis.<br>• Potential to leverage federal spending in these areas given developments with the new administration |
| **Ease of implementation:** | Easy |
| **Example case studies:** | *Electrifying U.S. Industry* (Renewable Thermal Collective); *Getting to Neutral* (Lawrence Livermore National Lab); *Low-Carbon Heat Solutions for Heavy Industry* (Columbia University) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Research scope will need to be tightly defined to ensure meaningful recommendations can be ascertained | • Form collaborative stakeholder group to provide input on research scope |



# Enabling initiative – Initiative #3: Research Development & Demonstration

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to support)* |
|---|---|---|---|
| Development of research scope of work | NYSERDA | < 1 year | |
| Release of a solicitation to conduct the research and analysis | NYSERDA | 1-2 years | |
| Provide funding for additional research and pilot/demonstration projects | NYSERDA | Ongoing | ESD, NYPA, DEC |

# Enabling initiative – Initiative #3: Research Development & Demonstration

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Research must take into account environmental justice concerns when making recommendations for areas of action and investment. |
| **Health and co-benefits** | Research must take into account public health concerns when making recommendations for areas of action and investment. |
| **Just transition: businesses and industries, workers** | A robust RD&D program will attract private investment, highly skilled personnel resources, and new businesses to NY state. |
| **Other** | |



# Enabling initiative – Initiative #4: Workforce Development

| | |
|---|---|
| **Description:** | Provide workforce development training on existing and new innovative emission reduction technologies |
| **Action type:** | Regulatory (Clean Energy Fund)-- NYS Labor |
| **Cost and funding considerations:** | Costs for training are mitigated by expanding job opportunities for clean energy workforce in addition to cost savings at facilities as GHG strategies are implemented. |
| **Ease of implementation:** | Easy |
| **Example case studies:** | NYSERDA Workforce Development Programs , NYS Dept of Labor Programs |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Training programs not aligned with business needs<br>• Risk aversion for businesses to invest in training<br>• Long lead time to find skilled workers | • Develop and or expand training to meet the needs and capacity<br>• Offset cost of training |

# Enabling initiative – Initiative #4: Workforce Development

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities supporting)* |
|---|---|---|---|
| **NYSERDA will partner with training organizations and businesses to expand training capacity in NY and update training content to prepare workers for jobs with clean energy technologies.**<br>• Issue Competitive Solicitations<br>• Develop strategic partnerships with industry organizations<br>• Support training activities that will include job preparation and job placement initiatives<br>• Support business-facing intermediaries such as community-based organizations | NYSERDA | Ongoing | NYSDOL, ESD, Utilities |



# Enabling initiative – Initiative #4: Workforce Development

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Many industrial facilities are in or near disadvantaged communities, efforts will encourage participation by and job placement for disadvantaged workers. |
| **Health and local air quality** | Significant health benefits are expected from lowering GHG emission reductions at energy intensive industrial facilities, some of which are in heavily populated areas. |
| **Just transition: businesses and industries, workers** | Opportunities exist for worker training, especially within disadvantaged communities, including partnering with unions, engineering companies, energy efficiency service providers. |
| **Other** | |

# Enabling initiative – Initiative #5: GHG Reporting

| | |
|---|---|
| **Description:** | Expand the universe of facilities that are required to report on their GHG emissions. |
| **Action type:** | Regulatory |
| **Cost and funding considerations:** | Reporting facilities would be the bearer of cost. DEC would be the bearer of cost for data collection and review. |
| **Ease of implementation:** | Medium – regulation adoption takes 12-24 months typically, but process is well established. |
| **Example case studies:** | Existing regulations (6 NYCRR Part 202-2) that require GHG reporting for major sources of criteria pollutants. |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| - Establishing a GHG emissions threshold at which reporting will be required. There will likely be disagreement between state and regulated community as to what the threshold should be.<br>- Concern about placing additional regulatory requirements on facilities already highly regulated by DEC. | - Evaluate whether to align this requirement with reporting already done to meet EPA GHG Reporting Program.<br>- To the extent possible the new regulatory requirement should make clear that EITE industries already reporting GHG emissions to DEC would not be required to also report under any new reporting requirement. |



# Enabling initiative – Initiative #5: GHG Reporting

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to support)* |
|---|---|---|---|
| Develop Rule Initiation Memorandum (RIM) | DEC | 1 month | N/A |
| Initial draft of GHG reporting regulation | DEC | 4 months | N/A |
| Public outreach to get input on initial draft regulation | DEC | 4 months | Regulated facilities, business council, industrial sector organizations, environmental advocacy organizations. |
| Finalize draft regulation | DEC | 3 months | N/A |
| Public notice of draft regulation | DEC | 1 – 2 months | As above |
| Prepare response to comments and finalize regulation | DEC | 3 months | N/A |
| Adopt regulation | DEC | 1 month | N/A |

# Enabling initiative – Initiative #5: GHG Reporting

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Having a more complete picture of GHG emitting facilities will allow a more focused effort to reduce GHG emissions as much as possible. Since most often GHG emissions are the result of fuel combustion any reduction in fuel combustion will also result in lower emissions of criteria and hazardous air pollutants, which tend to be elevated in Disadvantaged Communities. |
| **Health and local air quality** | As described the initiative has the potential to result in lower criteria pollutant emissions. Reductions in criteria pollutant emissions have long been known to be beneficial to the health of individuals. |
| **Just transition: businesses and industries, workers** | Collecting emissions data from a larger universe of industrial facilities will enable a more complete picture of greenhouse gas emissions, allowing the State to better track its emission reduction progress, identify the potential for additional reductions in the EITE sectors and prioritize emission reduction efforts. |
| **Other** | |



# Enabling initiative – Initiative #6: Economic incentives

| | |
|---|---|
| **Description:** | Leverage the State's climate policies to develop an in-state supply chain of green economy companies by engaging in business development discussions and offering loans, grants, tax credits, and other economic incentives. |
| **Action type:** | Economic Incentives |
| **Cost and funding considerations:** | Costs are offset by attracting additional spending, which produces State and local tax revenues; State programs already in existence: Excelsior Jobs Program, NY Ventures, NYSERDA, etc. |
| **Ease of implementation:** | Easy / Operational |
| **Example case studies:** | In April 2020, New York State created special "Green Economy Tax Credits" as economic incentives under the Excelsior Jobs Program, which have helped to attract several projects, including:<br>• Li-cycle: Will recycle lithium-ion batteries, resulting in 100 jobs. NYS committed $5 million.<br>• Plug Power: Will produce hydrogen fuel cell stacks and electrolyzers, resulting in 377 jobs. NYS committed $13 million in tax credits. |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Many green industries will require additional conditions to grow in NYS; greater market demand, workforce and suppliers.<br>• Many jurisdictions are competing for green economy jobs. | • To be effective, economic incentives may need to be supported by workforce planning and other efforts to stimulate demand (e.g., clean energy and low-carbon procurements). |

# Enabling initiative – Initiative #6: Economic incentives

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities supporting)* |
|---|---|---|---|
| • **Offer economic incentives to secure green economy attraction and expansion projects, including**:<br>o Engagement with green economy businesses to identify potential in-state economic opportunities;<br>o Engagement with awardees and suppliers of State green procurements (e.g., offshore wind energy and port investment solicitation) and contests (e.g., 76 West clean energy business plan competition) to discuss potential in-state economic opportunities;<br>o Coordinating with State partners to identify all relevant incentives (ESD, NYSERDA, NYPA, etc.)<br>o Offering and administering economic incentives where necessary. | ESD | Ongoing | NYSERDA, NYPA |
| • **Implement complementary initiatives to grow workforce, supplier base and market demand.** | Various | Ongoing | NYSERDA, NYPA, SUNY |



# Enabling initiative – Initiative #6: Economic incentives

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | • Green economy projects may occur within disadvantaged communities. Project location decisions are typically business-driven, not State-driven. |
| **Health and local air quality** | • Certain green economy projects, while bringing local jobs and investment, may also bring air quality or other environmental impacts, which would be need to be reviewed under State law. |
| **Just transition: businesses and industries, workers** | • Certain former power plant facilities may be available to be repurposed for green economic development projects – e.g., offshore wind projects that leverage fossil fuel electric generation facilities as interconnection points – potentially offsetting economic losses from decarbonization.<br>• Green economy companies may provide supplier opportunities to EITE businesses, and vice versa. |
| **Other** | • Green economy industries are poised for significant growth, and anchoring an in-state supply chain of growing green businesses will both make it easier for the State to achieve its climate goals while also attracting new investments and jobs. |

# Summary:
- Mitigation Strategies
- Enabling Initiatives

| Initiative # | Description | Action type | Emissions Impact | Ease of Implementation | Cost |
|---|---|---|---|---|---|
| 1. Mitigation Strategy | Provide financial incentives and technical assistance for the decarbonization of EITE sectors | Financial and technical assistance | High | Easy | $$$ |
| 2. Mitigation Strategy | Create procurement incentives for business to capitalize on low-carbon economy opportunities | Low-carbon procurement policies | Low | Medium | $$ |
| 3. Enabling Initiative | Identify and support technological innovation to enable deep industrial decarbonization | Research, Dev. & Demonstration | N/A | Medium/Hard | $$ |
| 4. Enabling Initiative | Workforce development training to support Energy-Intensive and Trade-Exposed (EITE) industries | Workforce development | N/A | Easy | $$ |
| 5. Enabling Initiative | Increase the available data on industrial GHG emissions to help prioritize efforts and monitor progress | Reporting requirement | N/A | Medium | $ |
| 6. Enabling Initiative | Provide economic incentives to grow the green economy | Economic incentives | N/A | Easy | $ |



# Agriculture and Forestry Advisory Panel

## Emissions Reduction and Carbon Sequestration Recommendations

April 5, 2021

NEW YORK STATE OF OPPORTUNITY. Climate Action Council

# Contents





# Detailed Contents

# Acronyms

AEM: Agricultural Environmental Management

AgNPS: Agricultural Non-point Source Pollution

BIPOC: Black Indigenous People of Color

CALS: Cornell College of Agriculture and Life Sciences

CCA: Certified Crop Advisors

CCE: Cornell Cooperative Extension

CNCPS: Cornell Net Carbohydrate and Protein System

CRF: Climate Resilient Farming

EJ: Environmental Justice

ENGO: Environmental Non-Governmental Organization

ESFPA: Empire State Forest Products Association

NASS: National Agricultural Statistics Service (USDA)

NRCS: National Resources Conservation Service (USDA)

NYGB: New York Green Bank

NYSSWCC: New York Soil and Water Conservation Committee

PES: Payment for Ecosystem Services

REDCs: Regional Economic Development Councils

SAF: Society of American Foresters

SUNYESF: State University of New York College of Environmental Science and Forestry

SWCD: Soil and Water Conservation District

TNC: The Nature Conservancy

USDA: United States Department of Agriculture

WI-DNR: Wisconsin Department of Natural Resources

WPDC: Wood Products Development Council

# NYS Agencies and Authorities

AGM: Department of Agriculture and Markets

DEC: Department of Environmental Conservation

DASNY: Dormitory Authority of the State of New York

DOH: Department of Health

DOS: Department of State

DOT: Department of Transportation

DOTF: Department of Taxation and Finance

DPS: Department of Public Service

ESD: Empire State Development

HCR: Homes and Community Renewal

NYPA: New York Power Authority

NYSERDA: New York State Energy Research and Development Authority

OGS: Office of General Services

PANYNJ: Port Authority of New York and New Jersey

PSC: Public Service Commission

SWCC: NYS Soil and Water Conservation Committee

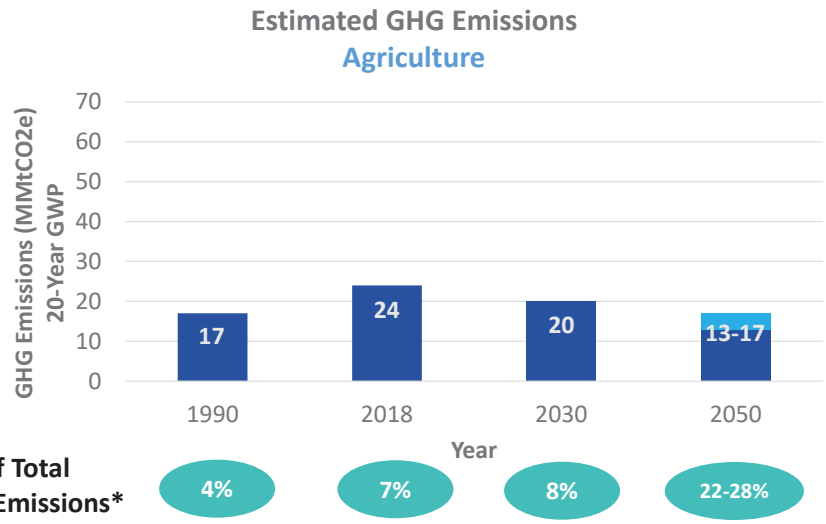


# Description of Recommendation Types

**From the Recommendations Guidance document**

- **Mitigation strategies:** actions that directly reduce emissions and contribute to the achievement of the greenhouse gas emission limits or carbon sequestration needed to achieve net zero, where applicable. Consider how the collective estimated emissions impact of these strategies amount to the Pathways reduction target for the panel (if applicable) and support attaining the greenhouse gas limits.
- **Enabling initiatives:** actions without direct emissions benefit that enable or magnify the mitigation strategies, enhance climate justice, or just transition
  - Examples of such initiatives include outreach, education, and increasing awareness; capacity building; workforce development; and research and development.
  - While enabling initiatives do not need to be tied to specific mitigation strategies, an enabling initiative should be tied to specific mitigation strategies wherever possible.
- **Adaptation and resilience strategies**: actions to help adapt to the effects of climate change and increase resilience to climate hazards
- Not all panels will have all of these types of recommendations
- While advisory panels should try to answer each question in the companion guidance document when filling in the recommendations template, there may be cases where not all questions are relevant or answerable. In such cases, it is fine to leave questions unanswered.

# Aggregate GHG Emissions impact of Agriculture and Forestry panel recommendations



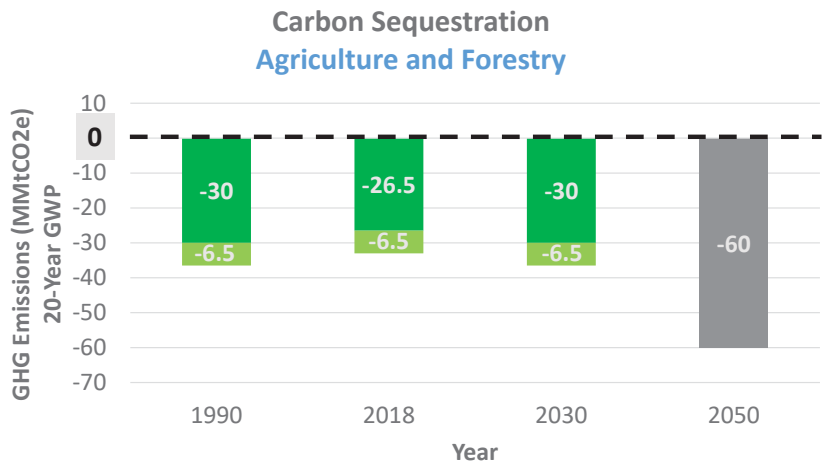

*Not including carbon sequestration.
2018 emissions data are preliminary draft

**Scope (2018 Subtotal DRAFT):**
- Agricultural Emissions: Livestock and Fertilizer (24 MMt)

**Emission Reduction Goals**
- 2030: Reduce 15% from current levels
- 2050:
  - Reduce 30% (return to 1990 levels)
  - Reduce 45% (additional ambition)

**Additional Goals**
- Avoid leakage by maintaining and enhancing agriculture in NYS
- Increase carbon sequestration on agricultural lands (next slide)

# Carbon Sequestration impact of Agriculture and Forestry panel recommendations




**Scope (2018 Subtotal DRAFT):**
- Forestry and Agroforestry Sequestration (-26.5MMt)
- Cropland, Grassland, Urban Trees, Harvested Wood Products Sequestration (-6.5MMt)

**Carbon Sequestration Goals**
- 2030: No Net Loss Forests (= 1990 levels)
- 2050: Achieve full Net Zero Goal <u>across all sectors in NYS</u> by enhancing carbon sequestration in Agriculture and Forestry

# Mitigation strategy summary – Agriculture

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1A | Soil Health Management Practices (also referred to as Regenerative Agricultural Practices) | Executive/ Financial/ Legislative | Low – 2030 Medium - 2050 | Easy-Hard | $$ |
| 2A | Nutrient Management | Executive/ Financial/ Legislative | Low-Medium – 2030 Medium-High- 2050 | Easy-Medium | $ |
| 3A | Alternative Manure Management | Executive/ Financial/ Legislative | Medium - 2030 High – 2050 | Easy - Medium | $$ |
| 4A | Precision Feed, Forage and Herd Management | Executive/ Financial/ Legislative | Medium – 2030 Medium – High - 2050 | Easy | $ |
| 5A | Agroforestry | Executive/ Financial/ Legislative | Low-2030 Medium - 2050 | Easy-Medium | $$ |



# Mitigation strategy – Initiative 1A Soil Health: Overview

| | | | |
|---|---|---|---|
| **Description:** | Reduce net GHG emissions and increase carbon sequestration/storage and other environmental benefits through adoption of soil health management practices (e.g., cover/double crops, reduced tillage, perennial crop systems. Also referred to as Regenerative Agricultural Practices). | | |
| **Action type:** | Agricultural Emission Reduction/Sequestration (Executive, Legislative, Financial) | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $$, funding from Environmental Protection Fund (EPF) through Climate Resilient Farming (CRF), Agricultural Environmental Management (AEM) Base Program, Agricultural Non Point Source Abatement and Control (AgNPS) Program (water quality), and other state and federal programs, seek new and enhanced funding sources, including private investments as many soil health practices have the potential to generate cost savings, improve yields and quality, and diversify farm products. | | |
| **Ease of implementation:** | Easy, infrastructure and cost-share funding programs exist to support soil health including the implementation of regenerative farming practice systems; Medium, develop soil health standard to help further adoption of BMPs, develop an annual acre goal for the most common practices (cover and double crops/reduced tillage); Hard, quantification and verification tools. | | |
| **Example case studies:** | Carbon Farm Study, Healthy Soils NY, Soil Health Characterization Report, Whole Farm Nutrient Mass Balance (Cornell Spear Program), US Climate Alliance Toolkit, Carbon Reduction Potential Evaluation (CaRPE) Report | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Upfront costs to adoption<br>• Uncertainty in potential mitigation and impermanence of increasing soil carbon – Difficult to verify<br>• Proving additionality<br>• Equipment affordability and access<br>• Planting windows – highly dependent on weather conditions throughout growing season<br>• Need for continued research, field trials, and pilot projects for data collection and monitoring<br>• (Im)Balance of imports/exports of carbon (soil health) and nutrients at the farm, landscape, and regional scales<br>• Practice adoption on rented/leased land | • Increase CRF and AgNPS funding, increase payment rates and access to cost-share programs, increase technical assistance,<br>• Increase adoption of soil health practices; Support cover & double-crop practices, encourage coupling of practices (e.g., no-till & cover cropping together)<br>• Make efforts under Healthy Soils NY visible to farmers and public<br>• Advance quantification and measurement and reporting tools<br>• Advance research in perennial grain production<br>• Convert annual cropland to perennial hayland/pasture where appropriate (e.g., steep slopes, highly erodible lands, etc.)<br>• Expand on-farm planning to include site specific, explicit carbon sequestration goals<br>• Establishing a Payment for Ecosystem Services (PES) mechanism to assist in incentivizing long-term adoption<br>• Outreach to landowners to incentivize adoption of practices on rented lands |

## Mitigation strategy – Initiative 1A Soil Health: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Increase financial support for currently available and implemented practices - Expand funding for NYS CRF, AEM Base, AgNPS; increase payment rates, increase access, build equity into programs, increase technical assistance, encourage adoption of a system of practices, develop soil health standard, establish annual goal for common practices. Increase awareness and support for urban soils and agriculture. | NYSAGM, NYSSWCC, SWCDs | 6-12 months | USDA, Cornell, CCE Farmers |
| Quantification and measurement - Develop tools for verification of benefits, invest in remote sensing to quantify adoption of practices. | NYSAGM, NYSSWCC, Cornell | 1-2 years | SWCDs, USDA, NYSERDA, Farmers, ESF, TNC |
| Establish and maintain a comprehensive research, development, and demonstration strategy for monitoring and verification of soil health that address additionality and permanence to support State climate goals and enable Federal and private funding of GHG mitigation practices. | NYSAGM, NYSSWCC, Cornell | 2-4 years | SWCDs, USDA, NYSERDA, Farmers, ESF, TNC |
| Support perennials - Convert annual cropland to perennial hayland/pasture and where appropriate (e.g., steep slopes, highly erodible lands, etc.). | NYSAGM, NYSSWCC, SWCDs | 6-12 months | CCE, Farmers, USDA |
| Establish and maintain a comprehensive research strategy in soil health to bring new practices and approaches (e.g., enhanced rock weathering, biochar) that increase sequestration rates, productivity, other environmental benefits, and scale for adoption. | NYSAGM, Cornell, SUNYs, USDA | 2-4 years | NYSSWCC, SWCDs, Farmers, Other Colleges and Universities |
| Support continued development and implementation of precision/digital agricultural tools and sustainable intensification, which is the sustainable increase in yields on current cropland to reduce stress on marginal cropland to support this mitigation strategy. | NYSAGM, NYSSWCC, Cornell, CCE, SWCDs | 3-5 years | Farmers, NYSERDA, USDA |

## Mitigation strategy – Initiative 1A Soil Health: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| AEM Planning – Conduct comprehensive on-farm planning to include carbon sequestration goals, GHG emission, nutrient management, and soil health. | NYSAGM, NYSSWCC, SWCDs | continuous | Farmers, CCE, Cornell, USDA |
| Make efforts visible to farmers and public through outreach campaign making information more available, expand regenerative agricultural practices in marketing programs (e.g., NY Grown & Certified), improve information provided to public to help customers understand practices involved in products they purchase. | NYSAGM, CCE | 1-2 years | NYSSWCC, SWCDs, Farmers |
| Expand education and outreach to include all farmers and to support practice adoption and encourage coupling of practices into systems for maximum benefit. Emphasize agricultural and soil health instruction in schools to connect students with farms and farmers and knowledge of ecological benefit of healthy soils. | NYSAGM, NYSSWCC, Cornell, SWCDs, CCE | continuous | USDA, NYSERDA, Farmers, ESF |
| Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices. | NYSAGM, NYSSWCC, SWCDs | continuous | Farmers, CCE, Cornell, USDA, Land Trusts, Non-Profits |

# Mitigation strategy – Initiative 1A Soil Health: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Identify practice systems that can generate revenue and/or added value to the farm, identify variety of public and private funding sources. | NYSAGM, NYSSWCC, Cornell, CCE, SWCDs | 6-12 months | Farmers, NYSERDA, USDA |
| Peer to peer networking to elevate long-term adoption of SH practices (local farmer SH discussion groups). Seek feedback from groups/communities not currently engaged in practices and programs (e.g., holding focus groups or surveys, addressing urban soils and urban agricultural operations). Improving access reflects the need to ensure that all farmers can take part in these practices and programs. | NYSAGM, NYSSWCC, SWCDs, Cornell, CCE | 6-12 months | Farmers, USDA, NYS Farm Bureau, NYFVI, Other farm organizations |
| Increase adoption on rented and leased land. Seek feedback regarding support needed for farmers not currently engaged in practices and programs. Engage, educate, and incentivize landowners to increase adoption of practices on land they rent to farmers. | NYSAGM, NYSSWCC, SWCDs, Cornell, CCE | 6-12 months | Farmers, USDA, NYS Farm Bureau, NYFVI, American Farmland Trust, Other farm organizations |
| Establish a Payment for Ecosystem Services (PES) mechanism to provide a new structure for establishing and maintaining practice systems, to incentivize carbon sequestration, carbon storage, GHG reduction, and other environmental benefits. | NYSAGM, NYSSWCC, SWCDs | 1-2 years | Farmers, USDA, Cornell, CCE |

# Mitigation strategy – Initiative 1A Soil Health: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing research, planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.<br><br>Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. Additional focus will be on connecting availability of fresh, local food to disadvantaged communities through programs like NY Fresh Connect, farm to school programs, and others. Emphasize agricultural and soil health instruction in schools to connect students with farms and farmers and knowledge of ecological benefit of healthy soils. |
| **Health and co-benefits** | Increased soil health; increased farm viability; adaptation and resilience to extreme weather (increased water retention during drought and erosion prevention during extreme precipitation), potential profitability of harvesting a double-crop, and improved water quality due to nutrient and sediment retention. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to encourage and incentivize soil health management practices. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |

## Mitigation strategy – Initiative 2A Nutrient Management: Overview

| | | | |
|---|---|---|---|
| **Description:** | Nutrient Management - Reduce nitrous oxide (N2O) emissions while achieving desired crop yield and quality through continued and expanded nutrient management planning and implementation on crop fields, hay fields, pastures, orchards, vineyards, and other agricultural lands receiving nutrients. | | |
| **Action type:** | Agricultural Emission Reduction (N2O) (Executive, Financial, Legislative) | | |
| **GHG reduction by 2030:** | Low-medium (based on fertilizer N and manure use efficiency) | **GHG reduction by 2050:** | Medium-high (based on fertilizer N and manure use efficiency) |
| **Cost and funding considerations:** | $, funding from EPF through Climate Resilient Farming, AEM Base Program, AgNPS Program (water quality), other state and federal programs, and private sector investment where practices provide a reasonable return. | | |
| **Ease of implementation:** | Easy for implementation of nutrient management. Medium for more advanced as well as future approaches. | | |
| **Example case studies:** | Carbon Farming Report; N Fertilizer Mgt (Info Sheet #5);. Whole Farm Nutrient Mass Balance (Cornell Spear Program), US Climate Alliance Toolkit, CaRPE Report | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • New processes, technologies, costs, and returns to evaluate<br>• Demands sustained, adaptive management by farmers and crop advisors for most benefit<br>• Learning curve by farmers, crop advisors, and fertilizer industry<br>• Gaps in applied research as well as field monitoring technology<br>• Weather variability changes N efficiency performance<br>• Lack of necessary equipment | • On-farm research partnerships to continue to identify efficient, site specific management strategies (N eff. with crop yield and quality)<br>• More public and private sector investment<br>• More public and private sector planning capacity<br>• Fertilizer industry-led priorities focused on 4Rs of nutrient mgt<br>• Improved methods of monitoring performance via crop yield measurement and N use efficiency<br>• Peer-to-peer crop yield and N efficiency contests<br>• Crop insurance options |

## Mitigation strategy – Initiative 2A Nutrient Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Technical Assistance - Increase cost-share support for technical assistance (planning) and soil health/nutrient management practice implementation through AEM Programs, such as the Climate Resilient Farming Program. Seek feedback from groups not currently engaged in practices and programs to remove obstacles (e.g., holding focus groups or surveys). | NYSAGM, NYSSWCC, SWCDs | 6-12 months | CCE, CCAs, Cornell, USDA, Fertilizer Industry, Farmers |
| Increase Financial Support - Expand cost-share eligibility in AEM Programs, such as the Climate Resilient Farming Program, for equipment needed by farms to implement more advanced soil health and nutrient management practices. Build equity into programs | NYSAGM, NYSSWCC, SWCDs | 6-12 months | CCE, CCAs, Cornell, USDA, Fertilizer Industry, Farmers |
| Evaluation – Further use of improved methods of monitoring performance via crop yield measurement, N use efficiency, and Whole Farm Nutrient Mass Balances (NMB for farm-wide N management). Document benefits of NM to farmers, policymakers, and public. | Cornell, CCE, CCAs, Fertilizer Industry, Farmers | Continuous | NYSAGM, NYSSWCC, SWCDs |
| Collaboration with industry led Nutrient Management Initiatives/services. N efficiency x yield crop contests for peer-to-peer competition and informational opportunities. | Fertilizer Industry, CCA, Farmers, Cornell | Continuous | CCE, Cornell, USDA, NYSAGM, NYSSWCC, SWCDs |

# Mitigation strategy – Initiative 2A Nutrient Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand capacity of custom farming service providers to aid on farm implementation of nutrient management practices. | NYSAGM, NYSSWCC, SWCDs | 6-12 months | CCE, CCAs, Cornell, USDA, NYSDEC, Fertilizer Industry, Farmers |
| Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices. | NYSAGM, NYSSWCC, SWCDs | Continuous | Farmers, CCE, Cornell, USDA, Land Trusts, Non-profits |
| Implement long-term funding support for nutrient management applied research and outreach (management approaches, technology, new inputs with lower GHG inputs, etc.). | Cornell, CCE, CCAs, Fertilizer Industry, Farmers | Continuous | NYSAGM, NYSSWCC, SWCDs |
| Increase outreach to all farmers, that's consistent with the research and technical standards used in NY, and make steps taken by farmers more visible to consumers. | Fertilizer Industry, CCAs, Farmers, CCE, Cornell, USDA, NYSAGM, NYSSWCC, SWCDs | 6-12 months | |
| Continue and enhance training for planners and farmers. | NYSAGM, NYSSWCC, SWCDs, Cornell, CCE | Continuous | USDA, Farmers, CCAs |

# Mitigation strategy – Initiative 2A Nutrient Management: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.<br><br>Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. Nutrient management improves downstream community water resources, including disadvantaged communities. |
| **Health and co-benefits** | Nutrient management improvements have the potential to elevate local food production and resiliency, improve water quality, air quality, economic development and jobs. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |

# Mitigation strategy – Initiative 3A Alternative Manure Management: Overview

| | | | |
|---|---|---|---|
| **Description:** | Alternative Manure Management - Reduce methane emissions by implementing practice systems specifically planned and designed for each farm, such as cover and flare systems, anaerobic digester systems, and other/innovative systems that collect, capture and combust methane from manure storages or prevent methane production from manure storage. | | |
| **Action type:** | Agricultural Emission Reduction / (Executive, Financial, Legislative) | | |
| **GHG reduction by 2030:** | Medium – High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$, funding from EPF through AEM Base, CRF, and AgNPS Program (water quality), Federal funds, private investment where practices provide a sufficient return, NYSERDA (related to energy generation) | | |
| **Ease of implementation:** | Easy for systems with a track record of use in NYS and medium for more advance manure management systems. | | |
| **Example case studies:** | Climate Resilient Farming Program; Carbon Farming Report; Manure Storage GHG Mitigation (Info Sheets #2 and #3); Cornell PRO-DAIRY Environmental Systems (research and on-farm case studies); NYSERDA Programs/projects. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • New processes, technologies, costs, and returns to evaluate<br>• Storage retrofit and bedding challenges<br>• Operation and maintenance necessary for optimal methane capture and combustion<br>• Methane loss risk relative to ambient manure storage baseline<br>• Gaps in applied research as well as in-field leak monitoring processes<br>• Potential nutrient imbalances with increase in imported organic waste processing<br>• Quantifying and verifying outcomes | • AEM Planning – develop specific mitigation strategies for each farm<br>• Performance based funding; building performance measures into access to public funds; include GHG monitoring into implementation of new GHG mitigation practices<br>• Increase adoption of cover and flare systems for existing manure storages. Track performance of GHG reductions of completed projects<br>• More public and private sector investment<br>• More private sector engineering, technology, operation, and verification support.<br>• Mitigation services for other sectors (e.g., food waste, energy)<br>• Dairy farmer-led industry priorities toward net zero GHG<br>• University and on-farm research partnerships to continue to identify effective, value-generating manure management systems for a range farm management scenarios |

## Mitigation strategy – Initiative 3A Alternative Manure Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand funding for NYS Climate Resilient Farming Program & AgNPS. Increase payment rates, access, technical assistance, and eligible manure management practice systems, build equity into programs. | NYSAGM, NYSSWCC, SWCDs | Ongoing | CCE, PEs, Cornell, NYSERDA, USDA, Farmers, Lenders |
| Expand funding for advancement of energy production, methane mitigation, including measurement and abatement of methane leakage, and future innovations based upon the recommendations from the biomass action plan. | NYSERDA | 5 Years | NYSAGM, Farmers, PEs, Cornell, NYS DEC |
| Expand Public/Private Partnerships - Align manure management systems designed for energy production, organic waste management, and methane mitigation with markets (existing or future; LCFS; industry net zero initiatives; etc.) and private sector investment. | Industry, NYSAGM, PEs, Cornell, CCE, NYSERDA, USDA, Farmers, Lenders | 5 Years | NYSSWCC, SWCDs |
| Increase technical assistance and engineering capacity for feasibility assessment, planning, design, operation, maintenance, and monitoring of systems. | Industry, PEs, Cornell, CCE, NYSERDA, USDA, NYSAGM, NYSSWCC, SWCDs | 5 Years | Farmers, NYSDEC, Lenders |
| Refine policies to encourage new manure storages funded through the state programs to incorporate methane mitigation strategies including retrofit capacity. | NYSAGM, NYSSWCC, SWCDs | 6-12 months | CCE, PEs, Cornell, NYSERDA, USDA, Farmers |
| Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices. | NYSAGM, NYSSWCC, SWCDs | Continuous | Farmers, CCE, Cornell, USDA |

## Mitigation strategy – Initiative 3A Alternative Manure Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Pursue further methane leakage research and monitoring to guide systems and management to minimize losses and optimize GHG reduction benefit. | NYSAGM, NYSERDA | Ongoing | CCE, PEs, Cornell, USDA, Farmers |
| Through training, expand capacity of technical service providers and farm staff to design, build, operate, and maintain alternative manure management systems. | NYSAGM, Cornell, PEs, SWCDs | 1-2 years | CCE, NYSERDA, USDA, Farmers, NYS Farm Bureau, Other farm organizations |
| Implement long-term funding support for alternative manure management applied research and outreach, including processes for realizing additional value from manure and analyses for strategic development/siting of methane mitigating manure and organic waste management systems. | NYSAGM, NYSERDA, Cornell, NYSDEC | 6-12 months | SWCDs, CCE Farmers, Pes |
| Develop a NYS-funded loan guarantee program to stimulate investment in alternative manure management systems. | NYSAGM, NYSERDA, Cornell, Lenders | 1-2 years | NYSSWCC, SWCDs |
| Develop NYS-bulk buying programs to reduce core material and equipment costs (covers, flares, separators, standardized controls, other components, etc.). Similar to solar industry and energy efficient heating programs. | NYSAGM, NYSERDA, Industry | 2-4 years | Farmers, NYSDEC, Lenders |
| Improve connections/markets between farms with alternative manure management systems and other businesses able to supply organic co-products or use products generated by such on-farm systems (e.g., electricity, heat, gas, organic soil amendments). | NYSAGM, NYSERDA, NYSDEC | 1-2 years | CCE, PEs, Cornell, USDA, Farmers |

## Mitigation strategy – Initiative 3A Alternative Manure Management: Benefits

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.<br><br>Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. |
| **Health and co-benefits** | Manure management improvements for methane mitigation have the potential to elevate local food production and resiliency, water quality, and air quality, economic development, energy, higher use of organic waste, and jobs by reducing the negative impacts of climate change from short-lived climate pollutants. NYSDEC regulates emissions from engines and flares associated with alternative manure management systems. Flares associated with ambient temperature covered manure storages are exempt from registration and permitting, because emissions, such as hydrogen sulfide, sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter, and volatile organic compounds, are below regulatory thresholds. Engines and flares associated with anaerobic digester systems process gases in higher concentrations, so such emissions are regulated via registration or permit for monitoring and compliance with State and federal air quality standards. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |

# Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Overview

| | | | |
|---|---|---|---|
| **Description:** | Precision Feed, Forage and Herd Management – Reduce methane and nitrous oxide emissions while achieving desired ruminant growth and lactation goals. Strategy acknowledges that additional methane emission reduction may be realized from feed additives developed in the future. | | |
| **Action type:** | Agricultural Emission Reduction (methane and nitrous oxide) / (Executive, Financial, Legislative) | | |
| **GHG reduction by 2030:** | Medium (based on feed and forage mgt. only; higher potential with future feed additives) | **GHG reduction by 2050:** | Medium (based on feed and forage mgt. only; higher potential with future feed additives) |
| **Cost and funding considerations:** | $, funding from EPF through AEM Base, CRF, and AgNPS Program (water quality), Federal Programs, private investment where practices provide a sufficient return. | | |
| **Ease of implementation:** | Easy for implementation of precision feed and forage management with continued and enhanced training delivered to farms/industry. | | |
| **Example case studies:** | Carbon Farming Report; Dairy Manure Mgt and GHG Opportunities (Info Sheet #2); Cornell Net Carbohydrate and Protein System (CNCPS) research and extension; Precision Feed Management projects in NYC Watershed. | | |

| **Risks / Barriers to success** | **Possible mitigants** |
|---|---|
| • New processes, technologies, costs, and returns to evaluate<br>• Demands sustained, adaptive management by farmers and advisors for most benefit<br>• Learning curve by farmers, advisors, and feed industry<br>• Gaps in applied research<br>• Weather and market disruptions can influence performance (low quality forage) | • University and on-farm research partnerships to continue to identify efficient, site specific management and herd strategies<br>• More public and private sector investment<br>• More public and private sector planning capacity<br>• Dairy farmer-led industry priorities toward net zero GHG.<br>• Improved methods of monitoring performance throughout forage and feeding systems on farms |

# Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand outreach and education of precision feed and forage management to more ruminant livestock farmers, nutritionists, and feed industry professionals. | Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, CCAs, SWCDs, NRCS | Ongoing | Milk Cooperatives and Processors |
| Expand access to precision feed and forage management monitoring (e.g., for feeding, production, intake) and decision tools (e.g., CNCPS) applicable to a range of farm conditions and management. Increase on-farm use of methane module within CNCPS and develop statewide benchmarks to gauge improvement overtime. | Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, CCAs, SWCDs, NRCS | Ongoing | Milk Cooperatives and Processors |
| Expand capacity of SWCDs and partners to aid on farm implementation of precision feed and forage management practices. | NYSAGM, NYSSWCC, SWCDs | continuous | Farmers, CCE, Cornell, USDA |

# Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Implement long-term funding support for precision feed and forage management applied research and outreach (including basic and applied research for methane mitigating feed additives). | NYSAGM, NYSSWCC, Cornell, SWCDs | 2 Years and Continuous | Milk Cooperatives and Processors |
| Explore establishment of a co-product market (e.g., food "wastes" supplied from food processors, retailers, or institutions) for best uses (including as livestock feed). | Food Processors, Food Retailers, Food Institutions, NYSDEC | 2 Years | Cornell, CCE, Farmers, Independent Nutritionists, Feed Industry Nutritionists, NYSAGM |
| Develop a science-based strategy focused on improving herd management decision making which positively impacts cow efficiency to reduce GHG emissions while optimizing milk yield and return on investment. Provide technical assistance for implementation. | NYSAGM, Cornell CALS, PRO DAIRY | 1-2 Years | Dairy farmers, NYSDEC, CCE, SWCDs, Farm organizations |



# Mitigation strategy – Initiative 4A Precision Feed, Forage and Herd Management: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.<br><br>Improvements in food production capacity, resiliency and diversity have a positive effect on communities. |
| **Health and co-benefits** | Precision feed and forage management improvements have the potential to elevate local food production. Feed and forage management can result in higher production, quality, and returns on investment, enhancing profitability and farm resiliency. Additional co-benefits include water quality improvements, air quality, economic development and jobs by reducing the negative impacts of climate change from short-lived climate pollutants. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |

# Mitigation strategy – Initiative 5A Agroforestry: Overview

| | | | |
|---|---|---|---|
| **Description:** | Agroforestry - Adding trees into areas of agricultural production to reliably increase carbon sequestration and other environmental benefits. | | |
| **Action type:** | Agricultural Emission Reduction/Sequestration (Legislative, Executive, Financial) | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Low - Medium |
| **Cost and funding considerations:** | $, funding from EPF through Climate Resilient Farming and AgNPS Program (water quality); Watershed-wide funding opportunities; Federal Funding, USDA Programs, (CSP, CRP, EQIP), private investment where practices provide a sufficient return. | | |
| **Ease of implementation:** | Easy for implementation of buffers; Medium for silvopasturing and alleycropping; Medium for ensuring survivability of tree plantings | | |
| **Example case studies:** | Buffers: AgNPS, USC Buffer Pilot, Watershed Groups; Silvopasture: CRF Program, CCE field research, Cornell Forest Connect; Plantation Silvopasture, Woodland Silvopasture ) Angus Glen Farms, Schuyler County. | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Upfront costs to adoption<br>• Land access and transfer<br>• Workforce gaps<br>• Gaps in research, field trials, pilot projects, and market analyses in agroforestry systems<br>• Long-term management and maintenance<br>• Tree species selection and survivability | • Increase adoption of agroforestry practices; support (research (applied R&D & case studies of economics of practices), education, & technical asst) for farms diversifying operations (e.g., nut/orchard/maple/Christmas tree). that have revenue potential for farms<br>• Set goals for acres of practices implemented (based on ~3M acres available land) # acres technically available & # acres feasible for implementation<br>• **Buffers**: increasing incentives for implementation through existing programs; developing new incentive structures for buffers (PES), elevating workforce to plan, design, implement and establish buffers<br>• **Silvopasture**: expand the Climate Resilient Farming Program to include a track for agroforestry/silvopasture; expand education and technical assistance; expand programs that plan, design and implement intensively managed rotational grazing systems<br>• **Alleycropping**: conduct field trials and pilot projects, expand education and technical assistance |

# Mitigation strategy – Initiative 5A Agroforestry: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Expand NYS Climate Resilient Farming Program to include agroforestry track. Set acreage targets for priority practices. | NYSAGM, NYSSWCC, SWCDs | 6-12 months | Cornell, CCE, USDA, Farmers |
| Continue emphasis on forested buffers through AgNPS and Source Water Buffer Program, USDA CRP/CREP. | NYSAGM, NYSSWCC, SWCDs, Land Trusts | 6-12 months | USDA, Farmers, Watershed Coalitions, municipalities |
| Expand Trees for Tributaries Program, Non-Ag NPS, DEC Division of Fish and Wildlife Programs. | NYSDEC, NYSAGM, NYSSWCC | 1-2 years | SWCDs, CCE, Farmers, Watershed Coalitions |
| Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products. | NYSAGM, CCE, Cornell | continuous | American Farmland Trust, Land Trusts, CCE, SWCDs, Farmers, Landowners, Farm Bureau, Financial lenders, Watershed Coalitions |
| Alleycropping: conduct field trials and pilot projects, expand education and technical assistance. | NYSAGM, NYSSWCC, Cornell, CCE, SWCDs | 2-4 years | Farmers, Farm Bureau, Other farm orgs. |
| Silvopasture: expand programs that plan, design, and implement intensively managed rotational grazing systems with a focus on proper site and species selection for adding trees. | NYSAGM, NYSSWCC, SWCDs, CCE | 2-4 years | Farmers, NYSDEC, TNC, USDA |

## Mitigation strategy – Initiative 5A Agroforestry: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Establish a Payment for Ecosystem Services (PES) mechanism to provide a new structure for establishing and maintaining practice systems, to incentivize carbon sequestration, carbon storage, GHG reduction, and other environmental benefits. | NYSAGM, NYSSWCC, SWCDs | 1-2 years | Farmers, USDA, Cornell, CCE |
| Farmland access: Assist farmers in securing long term leasing and farm transfer to beginning farmers – long term leases required for long term perennial systems. | NYSAGM, NYSSWCC, American Farmland Trust, Land Trusts | continuous | Cornell, CCE, Financial Lenders |
| Conduct outreach to financial lenders/insurance providers | NYSAGM, CCE, Cornell | continuous | Financial Lenders, American Farmland Trust, Land Trusts, SWCDs, Farmers, Landowners, NYFB |
| Collaboration with federal partners to better align federal and state policy priorities | NYSAGM, NYSSWCC, Cornell, CCE, SWCDs | 2-4 years | Farmers, Farm Bureau |
| Expand capacity of SWCDs and partners to aid on farm implementation of GHG reduction and sequestration management practices. | NYSAGM, NYSSWCC, SWCDs | continuous | Farmers, CCE, Cornell, USDA |



## Mitigation strategy – Initiative 5A Agroforestry: Benefits and Impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. The strategy will also prioritize disadvantaged communities by placing emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Components of the strategies include: considering a higher percentage of cost share funding for state programs designed to assist historically underserved farmers and/or creating program targets for funding for such farmers, in implementing GHG reductions strategies; collecting data on the number of farms in disadvantaged communities, the demographics of farmers in the state, and the experiences of minority farmers to allow greater access to programs and technical assistance.<br><br>Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. |
| **Health and co-benefits** | Agroforestry practice systems have the potential to elevate local food production, diversify farm incomes and increase farm profitability. Systems also provide resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, market diversification, economic development and jobs. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction, improved access for historically underserved including, BIPOC and beginning farmers. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and on-farm job creation. |
| **Other** | Woody perennial buffers are small reliable practices that have a high value of carbon sequestration per acre. Silvopasture and alleycropping have the potential to increase income streams for farms, providing an economic return on investment. |

# Enabling (or Support) Strategy Summary – Agriculture

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1A | AEM Planning for Climate Mitigation/Adaptation, aka "Carbon Farm Planning" | Planning (Exec/Financial) | Medium | $ |
| 2A | Establish a program for long-term, annual monitoring and benchmarking of GHG mitigation, carbon sequestration, and adaptation performance across applicable areas of management on farms in NYS. Information products provide useful, farm-level data for confidential benchmarking by farmers as well as publicly available data through farm case studies (with farmer agreement) and aggregated datasets to support future policy, research, and implementation. | Monitoring (Executive/ Financial/ Legislative) | Medium | $$ |
| | | | | |



# Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka "Carbon Farm Planning": Overview

| | |
|---|---|
| **Description:** | AEM Planning for Climate Change Mitigation/Adaptation |
| **Action type:** | Planning/Evaluation/Estimating Impact (Executive/financial) |
| **Cost and funding considerations:** | $; funding that supports AEM planning; expansion of models, planning framework, education and training of SWCDs and AEM planning workforce, pilot plans on various sizes and types of farms, potential for farmers to develop their own plans (also with training, minimum required standards, and at certain scales) |
| **Ease of implementation:** | Easy for overview planning; moderate for comprehensive planning, including forest management, energy consumption, feed management, etc. |
| **Example case studies:** | COMET Planner, COMET Farm, Forestry Management, NYSERDA Ensave Agricultural Energy Audits, CNCPS and Precision Feed and Forage Management Guidelines, CNMP Guidelines, USDA-NRCS Carbon Planning Guidance, other existing tools/guidelines |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Funding for planning template<br>• Maintaining strong emphasis on water quality and soil health planning, while planning for GHG and adaption<br>• Workforce demands and gaps<br>• Challenges with farmer interest or incentives for these planning efforts<br>• Coarse models and quantification methodology<br>• Challenges with matching scales and levels of planning rigor with various levels of yet defined goals/outcomes | • Increase state and federal funding<br>• Assemble technical advisory committee to develop planning protocols appropriate to scale(s) and accuracy(s) of existing models and methods, farmer interests/goals, and mitigation/adaptation goals<br>• Develop protocols proportional to scale and accuracy of existing tools<br>• Add GHG mitigation and climate adaptation to existing plans for water quality/soil health<br>• Train additional SWCDs and AEM Planners for intentional climate mitigation/adaptation planning and implementation<br>• Depending on applicability and scale, develop tools and train farmers to develop their own plans<br>• Inform and educate farmers on climate impact and mitigation opportunity, match incentives to plans<br>• Invest in model evaluation and development and quantification methods |

# Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka "Carbon Farm Planning": Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Form technical advisory panel. | NYSAGM, NYSSWCC | 6-12 months | Cornell, SWCDs, Farmers, USDA, CCE, NYSDEC |
| Technical advisory panel to define different levels of planning goals and outcomes (e.g., overview, whole farm scale; detailed management area scale; to inform directionally correct change; to inform change leading to quantifiable or even marketable outcomes; what information are farmers most interested in). | NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs | 1-2 years | Other entities with mitigation/adaptation tools and methods |
| Technical advisory panel to develop planning protocols (including methods, preferred models, and recommended planner skills) for the levels defined, above. Iterative process, as some planning levels may not be supported by existing methods and models. Process will identify gaps for future development. Strive for compatibility among State and federal programs. Design methods for collection and aggregation of outcomes from planned and implemented practice systems (e.g., estimates for GHGs, sequestration, metrics for adaptation). | NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs | 1-2 years | Other entities with mitigation/adaptation tools and methods |

# Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation: aka "Carbon Farm Planning": Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| On-farm piloting of those planning protocols deemed currently feasible by the panel (supported through AEM Base Program among Districts and farmers). | NYSAGM, NYSSWCC, SWCDs, Farmers | 1-2 years | Cornell, NRCS, CCE, NYSDEC |
| Technical advisory panel reviews pilots and refines planning protocols. | NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs | 2-3 years | Other entities with mitigation/adaptation tools and methods |
| Training of feasible planning protocols to public- and private-sector Ag service providers. | NYSAGM, NYSSWCC, Cornell, SWCDs, NRCS | 2-3 years | |
| Communication of AEM Planning for Climate Mitigation/Adaptation with farmers (case studies, learning from pilot farmers, training on farmer developed planning protocols/tools, etc.). | NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NGOs | 2-3 years | |
| Inclusion of planning protocols in AEM Base Program and perhaps federal programs for full use with farmers. Priority practice systems from plans lead to implementation via direct investment by farmers, other private investors, and/or lenders, as well as State and federal cost-share programs and incentives. | NYSAGM, NYSSWCC, SWCDs, NRCS, Farmers, NYS DEC | Continuous | Cornell, CCE, NGOs |
| Technical advisory panel uses new science and feedback from on-farm use to adapt, advance, train, and implement new planning protocols over time. | NYSAGM, NYSSWCC, Cornell, SWCDs, Farmers, NRCS, CCE, NYSDEC, NGOs | Continuous | Other entities with mitigation/adaptation tools and methods |

# Enabling initiative – Initiative 1A: AEM Planning for Climate Mitigation/Adaptation, aka "Carbon Farm Planning: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services and financial assistance improves access to programs and effective practices for all farmers. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. |
| **Health and other co-benefits** | AEM Planning for Climate Mitigation/Adaptation has the potential to elevate local food production and resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, economic development and jobs. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy will include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |



## Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Overview

| | |
|---|---|
| **Description:** | A new program for long-term, annual monitoring and benchmarking of GHG mitigation, carbon sequestration, and adaptation performance across applicable areas of management on farms in NYS. Information products provide useful, farm-level data for confidential benchmarking by farmers as well as publicly available data through farm case studies (with farmer agreement) and aggregated datasets to support future policy, research, and implementation. |
| **Action type:** | Program establishment and development (Executive/Financial/Legislative) |
| **Cost and funding considerations:** | $$; Necessary annual costs likely to include staff and program overhead; incentives for farmer participation; costs of data products (e.g., remotely sensed data); cost for contractors where specialty services in information management, on-farm analyses, or applied research are necessary; and web service and IT expenses. |
| **Ease of implementation:** | Medium; requires development of methods for efficient and meaningful monitoring, benchmarking (including establishing feasible performance goals), aggregated summarization, and delivery (communication at various scales). Expectation that methods will adapt with future knowledge and technology. |
| **Example case studies:** | Whole Farm Nutrient Balance (Cornell Spear Program); Dairy Farm Business Summary (Cornell PRO-DAIRY and Farm Credit East); Precision Feed Management Benchmarking (Cornell and CCE); Ag Census and Annual Surveys (NASS); Soil Health Case Studies (American Farmland Trust); NYS and EPA GHG inventories. |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • New program development (ramp-up expenses: time, funding, defining best initial direction/methods, sample sizes, and scales for various areas of farm management)<br>• Trust and participation among Ag-sector participants<br>• Potential sampling bias stemming from subpopulation of participating farms | • Experienced advisory committee to shape the program based on comprehensive knowledge of existing approaches, NYS agriculture, and CLCPA<br>• Incentives for farm participation (useful for farm performance; pathway to other markets or programs; funding for participation; marketing benefit for farm; others)<br>• Private sector partnership (e.g., dairy processors or co-ops) where goals align among programs |

## Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Establish funding line for a CLCPA agricultural benchmarking and monitoring program. | NYSAGM, NYSDEC | 1 year | Cornell, NYSSWCC, Farmers, CCE, Farm Credit East, SWCDs, CCAs, NASS, food processors and co-ops |
| Co-develop methods for program (program staff and advisory committee). | NYSAGM, NYSSWCC Cornell, NYSDEC | 1-2 years | ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops |
| Introduce program with farmers and farm advisors (field). | NYSAGM, NYSSWCC, Cornell | 2-3 years | ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops |
| Initiate program with farmers. | NYSAGM, NYSSWCC, Cornell | 2-3 years | ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops |
| Deliver data summaries for confidential farm-scale use and aggregated summaries for public use. | NYSAGM, NYSSWCC, Cornell | 2-3 years | ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops |
| Repeat method annually. | NYSAGM, NYSSWCC, Cornell | Continuous | ESF, Farmers, SWCDs, CCE, Farm Credit East, CCAs, NASS, TNC, American Farmland Trust, food processors and co-ops |



## Enabling initiative – Initiative 2A: Benchmarking and Monitoring: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | This enabling initiative will increase access to methods/programs that help farmers generate their own farm-scale information for decision making, with an emphasis on assisting historically disadvantaged farmers, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. |
| **Health and other co-benefits** | Improved farm-level data and broader-scaled, aggregated information about farm management have the potential to elevate local food production and resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, habitat, scenic vistas/tourism, economic development and jobs. |
| **Just transition: businesses and industries, workers** | Inter-generational family transfer provides opportunities to incentivize changes in farm management for GHG emission reduction. Emphasis will be on improved access to technical and financial support for historically underserved and beginning farmers. This strategy could include youth engagement, internships, educational opportunities, public and private sector job creation through increased technical assistance and implementation (e.g., climate conservation corps, tree corps), and potentially on-farm job creation. |
| **Other** | |

# Mitigation Strategy Summary – Avoided Conversions

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Keep Forests as Forests: Maintain and enhance the state's carbon sequestration potential through avoided forest conversion | Legislative (Budget, Programmatic); Regulatory | High | Easy for land acquisition. Difficult for new tax incentives and regulatory changes | $$$ |



# Mitigation strategy – Initiative # 1: Avoided Forest Conversion: Overview

| | | | |
|---|---|---|---|
| **Description:** | Keep Forests as Forests: Maintain and enhance the state's carbon sequestration potential through avoided forest conversion | | |
| **Action type:** | Legislative (Budget, Programmatic); Regulatory | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$$: Land acquisition funding, tax incentives, staffing needed to implement land acquisition goals, administer tax incentive, implement regulations and provide technical assistance | | |
| **Ease of implementation:** | Easy for land acquisition. Difficult for new tax incentive and regulatory changes | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Dependent on passage of Legislation<br>• Cost to taxpayers for acquisition and tax incentives<br>• Landowner interest to participate varies<br>• Nearly 700,000 forest landowners<br>• Large number of municipalities/home rule<br>• Potential tax base impact to municipalities<br>• Sprawl needs to be managed effectively | • State reimbursement of municipalities must be sufficient to address tax shift caused by Forest Tax Law<br>• Prioritize conservation easements as appropriate, and provide resources for adequate long-term stewardship<br>• Invest in partner capacity<br>• Bolster local forest economies<br>• Restore state open space conservation funding to historic levels (2008 Environmental Protection Fund included $60 million), environmental bond act<br>• Reinvigorate NYS Open Space planning process with emphasis on conservation as a climate strategy<br>• Increasing focus of state economic development incentives to reduce sprawl and spur climate smart investments in community development |

# Mitigation strategy – Initiative #1: Avoided Forest Conversion Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Land Acquisition (fee and conservation easement) by state, municipalities, land trusts | DEC | 10 years | Municipalities, land trusts, communities, OPRHP, SUNY ESF |
| Statutory change to Real Property Tax Law amending current 480a and creating tracks including forest carbon management. Address deficiencies in current 480a to make program more attractive to private forest landowners, easier to administer, lower acre threshold, and further sustainability goals. (see Forest Management recommendations for further details) | DEC | 3 years | DTF, DEC, Municipalities, Legislature, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF |
| Keep Forests as Forests Law – Require mitigation of forest carbon loss due to conversion for development. | DEC | 3 years | Municipalities, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF |
| Forest Carbon Markets | TBD | 5 years | Municipalities, NYFOA, ESFPA, SAF, land trusts and NGOs, SUNY ESF |
| *Note: LULG is leading on local land use recommendations.* | | | |



# Mitigation strategy – Initiative #1: Avoided Forest Conversion Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Continued sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest. | DEC, AGM | Ongoing | CAFRI, SAF, NYFOA, ESFPA, SUNY ESF |
| Enhance local capacity for land conservation – Statewide authorization of Community Preservation Act (incl working lands), Conservation Partnership Program, etc. | DEC, AGM, municipalities | Ongoing | Land trusts, NGOs, SWCDs |
| Strengthen Right to Practice Forestry Law | DEC | 1 year | Municipalities, DOS, ESFPA, NYFOA |
| Outreach and technical assistance to landowners on forest management, estate planning/intergenerational transfer, outreach to public on importance and contribution of working forestlands | DEC | Ongoing | SUNY ESF, Cornell, CCE, AGM, land trusts and NGOs, SWCDs |
| Research agenda to support avoided conversion – quantification for No Net Loss, prioritize conservation activities, monitoring to quantify policy impacts | DEC | 1 year, ongoing | SUNY ESF, Cornell, AGM, land trusts and NGOs |
| State legislation to secure local government ability to maintain roads as minimum maintenance roads to reduce development pressure | Municipalities, DOT | 1 year | Municipalities, landowners, DOS |

# Mitigation strategy – Initiative #1: Avoided Forest Conversion
# Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Include measures to increase access to land, resources, education, training, and incentives for BIPOC.<br>Include indigenous consultation and deeper community engagement<br>Payment of taxes on state-owned lands varies |
| **Health and co-benefits** | Air and water quality. Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Reduce emissions from vehicle use from prevented sprawl development. Wildlife habitat, outdoor recreation, flood mitigation |
| **Just transition: businesses and industries, workers** | Include provision for alternative locations of housing and business development |
| **Other** | Allows lower and middle income landowners to keep their lands and manage them more sustainability. Harvested wood product markets support this strategy and are discussed in the Advance Markets for Sustainably Harvested Long-Lived Wood Products and Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products strategies. This strategy will be supported by the LULG Advisory Panel's recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning.<br>Inter-agency collaboration is occurring to advance renewable energy development in a way that avoids, minimizes and mitigates impact to prime agricultural soils, and forest carbon stocks and ecosystems. |

# Enabling strategy summary – Avoided Conversions

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1 | Avoided agricultural land conversion - Maintain and protect the states' potential for carbon sequestration on agricultural lands through avoided farmland conversion | Legislative (Budget, Technical/ Programmatic) | Easy | $$ |
| 2 | Bolstering Local Agricultural Economies | Legislative (Budget, Technical/ Programmatic) | Easy | $-$$ |
| 3 | Enhance local government planning for land conservation | Legislative, Technical Assistance | Easy | $ |

# Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Overview

| | |
|---|---|
| **Description:** | Maintain and protect the states' potential for carbon sequestration on agricultural lands through avoided farmland conversion; enhance farm viability, increase food security, and implement smart growth to reduce future GHG emissions from Vehicle Miles Traveled. |
| **Action type:** | Legislative (Budget, Technical/ Programmatic) |
| **Cost and funding considerations:** | $$: Environmental Protection Fund, staffing needed to implement farmland protection goals and provide technical assistance |
| **Ease of implementation:** | Easy for land acquisition. |
| **Example case studies:** | US Climate Alliance Toolkit, Carbon Farm Study |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Cost to taxpayers for acquisition of conservation easements and tax incentives<br>• Landowner interest in selling their land or CE<br>• Number of municipalities/home rule<br>• Data for land conversion and quantification of GHG reduction<br>• Land access and intergenerational transfer | • Incentives for intergenerational transfer and farmland access<br>• Incentives for intergenerational family transfer and support for farm succession.<br>• Support for farmland protection and improved access for historically underserved including, BIPOC and beginning farmers<br>• Youth engagement, internships and educational opportunities<br>• Leasing state land to new farmers, prioritizing beginning, socially disadvantaged, limited resources and women farmers<br>• Providing tax incentives for farmers to lease or sell land to qualified farmers, with a higher tax incentive for lease or sale to beginning, socially disadvantaged, limited resource and women farmers |



# Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Increase funding for Farmland Protection programs to plan for agriculture and purchase Development Rights (through conservation easements) by state, municipalities, and land trusts. | AGM | 10 years | Farmers, Municipalities, land trusts, SWCDs |
| Farmland access: Assist farmers in securing long-term leasing and farm transfer to historically underserved including, BIPOC, beginning farmers, socially disadvantaged, limited resources, and women farmers. Support youth engagement, internships and educational opportunities. | AGM | Ongoing | Farmers, Municipalities, land trusts, SWCDs |
| Continue and strengthen agricultural assessment and agricultural districts programs | AGM | 1 year | Farmers, Municipalities, land trusts, SWCDs |
| Enhance local capacity for land conservation – Statewide authorization of Community Preservation Act (incl working lands), Conservation Partnership Program, transfer of development rights, etc. | DEC, AGM, municipalities | Ongoing | Farmers, land trusts, SWCDs |
| Support and enhance farmland access and succession programs | AGM | Ongoing | Farmers, Municipalities, land trusts, SWCDs |

# Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Make connections between existing programs (e.g., AEM, CRF, AgNPS) to increase co-benefits. Target protected farmland for agricultural BMPs that reduce GHG emissions and sequester carbon like soil health management practice systems. | AGM, DEC, NRCS, FSA | Ongoing | Farmers, Municipalities, land trusts, SWCDs |
| Develop new data sets to support avoided conversion. Develop monitoring and quantification methodology to measure impacts of avoided conversion. | AGM, Cornell | 1 year, ongoing | Cornell, SWCDs, Municipalities, farm owners, NRCS |
| Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products. | AGM, CCE, Cornell, SWCDs | Ongoing | American Farmland Trust, Land Trusts, Farmers, NRCS, Landowners, Farm Bureau, Financial Institutions |
| State legislation to secure local government ability to maintain roads as minimum maintenance roads to reduce development pressure | Municipalities, DOT | 1 year | Municipalities, DOS, landowners |

# Enabling strategy – Initiative #1: Avoided Agricultural Land Conversion: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increasing planning, technical services, and financial assistance improves access to programs and effective practices for all farmers. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Include indigenous consultation and deeper community engagement. Utilize existing programs that provide economic support to farms, like farmers markets or the Fresh Connect Checks Program, to connect vulnerable populations to healthy local food. |
| **Health and co-benefits** | Agricultural land protection captures carbon in the land base and prevents future emissions from vehicle use from prevented sprawl development. Protecting farmland has the potential to maintain or improve local food production, community resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, wildlife habitat, economic development and employment. All of these may have associated health benefits. |
| **Just transition: businesses and industries, workers** | Include provision for alternative locations of housing and business development (infill)<br>Improve the resiliency of communities by improving food security<br>Inter-generational family transfer, improved access for BIPOC and beginning farmers, youth engagement, internships and educational opportunities, public and private sector job creation, on-farm job creation. |
| **Other** | Reducing emissions from prevented sprawl development will only be achieved through strategic farmland protection, coupled with planning and smart growth.<br>This strategy will be supported by the LULG Advisory Panel's recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning.<br>Inter-agency collaboration is occurring to advance renewable energy development in a way that avoids, minimizes and mitigates impact to prime agricultural soils. |

# Enabling initiative – Initiative #2: Bolstering Local Agricultural Economies: Overview

| | |
|---|---|
| **Description:** | Support emission reductions by enhancing existing programs, and promoting the expansion of those programs, that encourage farm viability and resilient communities through the production and consumption of local food |
| **Action type:** | Legislative (Budget, Technical/Programmatic) |
| **Cost and funding considerations:** | $-$$: Funding needed to support programmatic needs and staffing |
| **Ease of implementation:** | Easy; supporting existing initiatives |
| **Example case studies:** | There is a lot of research on impacts of food miles, institutional purchasing of local products, community agriculture, etc. |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| - Cost of expanding programs<br>- Interest in participation from farms and communities | - Promote expansion of farmers markets and incentive programs for disadvantaged communities such as seniors, veterans and SNAP recipients within these markets through programs like the Fresh Connect Checks Program and Farmers Market Nutrition Program<br>- Improve implementation of the 2013 Food Metrics Law to enhance state procurement of local foods<br>- Enhance urban food production and greening efforts through programs such as the Community Gardens Program<br>- Connect institutions, like schools, universities, food banks, hospitals and prisons, who procure large volumes of food from out of state to local buying opportunities through initiatives like Farm-to-School and Nourish NY |

# Enabling initiative – Initiative 2: Bolstering Local Agricultural Economies: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand existing programs in the state that support local procurement of NYS agricultural products (e.g., Fresh Connect Checks Program, Farmers Market Nutrition Program, Farm-to-School, Nourish NY). | AGM; OGS; ESD | 0-3 years depending on resources | Institutions, NGOs, SWCDs |
| Engage with communities and producers to advertise these opportunities | AGM- Council on Hunger and Food Policy; ESD | 0-3 years depending on resources | Municipalities, NGOs, Agricultural Associations , SWCDs |
| Expand education and technical assistance for beginning farmers and generational transfer. Assist farmers with business planning and modeling. Expand supply chain development for new products. | NYSAGM, CCE, Cornell | Continual | American Farmland Trust, SWCDs, Farmers, Landowners, Farm Bureau, Financial lenders |

# Enabling initiative – Initiative #2: Bolstering Local Agricultural Economies: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Provide additional resources to existing programs that connect vulnerable populations, such as SNAP recipients and underserved communities of color, to healthy local food. Emphasis on access to conservation technical assistance and funding programs to historically underserved and disadvantaged community members, e.g., BIPOC, women, LGBTQIA+, low income, veteran, or beginning farmers. Improvements in food production capacity, resiliency and diversity have a positive effect on disadvantaged communities. |
| **Health and other co-benefits** | Increase the availability of local nutritious food to mitigate and prevent chronic disease. Potential to elevate local food production, diversify farm incomes and increase farm profitability. Systems also provide community resiliency, water quality, air quality, storm/flood mitigation, public infrastructure protection, drought resiliency, wildlife habitat, scenic vistas/tourism, market diversification, economic development and employment. All of these may have associated health benefits. |
| **Just transition: businesses and industries, workers** | Improve the resiliency of communities by improving food security<br>Support economic viability of farms to maintain agricultural careers |
| **Other** | |

2

# Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Overview

| | |
|---|---|
| **Description:** | Encourage and provide guidance for the inclusion of farmland and forestland protection in municipal comprehensive plans. Require inclusion of farmland and forestland protection in state funded municipal comprehensive plans. Encourage and fund development of Natural Resource Inventories. |
| **Action type:** | Legislative, Technical Assistance |
| **Cost and funding considerations:** | $ - Technical assistance staff, grants, support for Environmental Management Committees and Conservation Advisory Councils. |
| **Ease of implementation:** | Easy – enhance existing programs |
| **Example case studies:** | Smart Growth program, Hudson River Estuary Program (HREP) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Home rule<br>Resources needed for planning | Replication of HREP style support across state<br>Support planning through Smart Growth and other programs |

# Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Develop guidance for the inclusion of farmland and forestland protection in municipal comprehensive plans. Require inclusion of farmland and forestland protection in state funded municipal comprehensive plans. Fund development of Natural Resource Inventories. | DOS, DEC, AGM | 3 years | Municipalities, muni cipal associations, NGOs, SWCDs, SUNY ESF |
| Technical Assistance to implement guidance effectively, including strategies and best practices for land conservation, and identifying priority areas for conservation. Encourage development of Natural Resource Inventories. | DOS, DEC, AGM | Ongoing | municipalities, municipal associations, NGOs, SWCDs, ESFPA, NYFOA, SUNY ESF |
| | | | |



# Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Create resources to support local and regional smart growth planning and decision-making (e.g., maps to identify suitable reforestation locations, highest value cropland, idle lands for farming, etc.) | DOS, DEC, AGM | Ongoing | municipalities, municipal associations, NGOs, SWCDs, SUNY ESF |
| Conduct quantitative survey of land resources across the state and identification of critical barriers including options of using idle and underutilized lands. | DOS, DEC, AGM | Ongoing | municipalities, municipal associations, NGOs, SWCDs, SUNY ESF |
| | | | |

# Enabling initiative – Initiative #3: Enhance local government planning for land conservation: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Include recreational access as a component of forest planning. Include farm and forest land access for disadvantaged communities including BIPOC. Include indigenous consultation and deeper community engagement. Food security enhanced by keeping land in farming in communities. |
| **Health and other co-benefits** | Air and water quality. Maintain food and crop production in NYS communities, maintain carbon sequestration of farm and forest land in NYS. Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Wildlife habitat, outdoor recreation, flood mitigation. Avoided vehicle emissions from avoided development. Increase the availability of local nutritious food to mitigate and prevent chronic disease. |
| **Just transition: businesses and industries, workers** | Include provision for alternative locations of housing and business development (infill)<br>Improve the resiliency of communities by improving food security |
| **Other** | This strategy will be supported by the LULG Advisory Panel's recommendation on facilitating and supporting collaborative county-wide and regional smart growth comprehensive planning. |



# Mitigation strategy summary – Forest Management

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Maintain and increase carbon sequestration in NYS forests by securing forest regeneration, improving forest health and productivity, and restoring degraded forests through the widespread adoption of improved, sustainable forest management practices | Statutory, Incentives | High.<br>3.3-11.0 million metric tons of CO2 e per year | Medium | $$-SSS |
| 2 | Increase forested acres through afforestation and reforestation efforts to establish climate adapted and resilient forests. There are potentially 1.7 million acres of marginal lands available for establishing forests. | Statutory, Incentives | High<br>5-12 million metric tons CO2 e per year | Medium | $$$ |
| 3 | Increase and maintain tree cover in urban and developed areas to reduce energy use and corresponding GHG emissions through the shading and cooling effect of trees. Increase carbon sequestration through tree establishment and extending the average life of urban trees through improved maintenance. | Statutory, Incentives | Medium | Medium | $$ |

# Mitigation strategy – Initiative #1:
## Improved, Sustainable Forest Management: Overview

| | | | |
|---|---|---|---|
| **Description:** | Maintain and increase carbon sequestration in NYS forests by securing forest regeneration, improving forest health and productivity, and restoring degraded forests through the widespread adoption of improved, sustainable forest management. | | |
| **Action type:** | Legislative (RPTL 480a), Regulation, Incentive | | |
| **GHG reduction by 2030:** | Carbon sequestration-High. | **GHG reduction by 2050:** | Carbon sequestration-High |
| **Cost and funding considerations:** | $$-$$$. Substantial investment in NYS forests and forest sector over current levels. Overall cost will depend on state reimbursement levels to local municipalities under current and new tax abatement programs. Increase in funding to cost share and grant programs for private landowners, current and future forest health mitigation efforts and increases in funding to improve forest management on state and municipal lands. Increase agencies staffing levels to deliver and manage programs. Goal of 5 million acres under professional management by 2030 through these proposals | | |
| **Ease of implementation:** | Medium. Mechanisms, practices and programs for improved forest management exist. Mitigation costs per acre can be high due to invasive species and regeneration issues. Strategy needs to be delivered on a such a scale to improve millions of acres of existing forest to have a significant carbon impact | | |
| **Example case studies:** | Vermont Current Use Program, Family Forest Carbon Program, FLEP and EQIP, Working Woodlands | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • High cost to private landowners in time and money<br>• High cost to local municipalities and state budget<br>• Immense, scale of effort to reach 13.6 million acres of privately owned forest<br>• Low landowner interest or skepticism in government programs<br>• Workforce gaps in private and public sectors<br>• The unpredictability of current and future forest health threats<br>• Lack of landowner knowledge of public and private forestry programs | • Diverse, private wood markets<br>• Simplifying programs and removing administrative barriers for landowners<br>• Private industry/public partnership for funding grants/cost sharing projects<br>• State reimbursement to local governments must be sufficient for tax incentives to work<br>• Building forest resiliency measures into all efforts and programs<br>• Creative Financing through NY Green Bank or creation of Forest Carbon Bank<br>• Widespread landowner outreach |



# Mitigation strategy – Initiative #1:
## Improved, Sustainable Forest Management: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Create a new RPTL 480b real property tax incentive to allow private forest landowners to manage for multiple benefits (e.g., wildlife habitat) and, if desired, conserve their forests in natural conditions to participate in tax programs. Tax benefit to landowners increases as the years of commitment increase, recognizing the accumulated sequestration benefits over time. 25-acre eligibility. A carbon forest management plan written by a carbon certified forester is required if harvesting. Initial benefit starts at a lower level than 480a and 480c. Up to 100% reimbursement to local municipalities. | DEC | 3 years | Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF |
| Create a real property tax incentive, RPTL 480c to provide forest landowners a tax incentive to undertake practices that increase carbon stocks while addressing need for additionality. A carbon forest management plan written by a carbon certified forester is required if harvesting. 25-acre eligibility. Practice and/or forest carbon inventory based. Tax benefit to landowners increases as the years of commitment increase, recognizing the accumulated sequestration benefits over time. Up to 100% reimbursement to local municipalities | DEC | 3 years | Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF |
| Amend 480a statute and regulations to induce greater landowner participation and integrate stronger sustainability provisions (e.g., forest regeneration). The primary goal remains to encourage sustainable timber management. Tax abatement benefit for landowners remains unchanged. Up to 100% reimbursement to local municipalities. | DEC | 3 years | Legislature, NYFOA, ESFPA, SAF, NGO's, Landowners, NYS Tax and Finance, Local municipalities, SUNY ESF |

# Mitigation strategy – Initiative #1: Improved, Sustainable Forest Management: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Enhance agency and partner capacity to deliver free forest carbon and forestry technical assistance and education programs (e.g., Forest Stewardship Program, AEM, PRISM, Master Forest Owners, etc.) to forest landowners. Improve agency and partner coordination in delivery and reporting of forestry services to maximize efficiency | DEC/CCE/SWCD/NGO's/ SUNY ESF | 1 Year | SWCD NYFOA, ESFPA, SAF, NGO's, CCE, Landowners, USDA |
| Expand funding for cost share programs, such as Regenerate NY and AEM to assist forest landowners in widespread implementation of project-based practices to protect and increase carbon stocks on private forestland. Projects would focus on forest regeneration, restoring degraded forests and installation of best management practices for forest carbon. | DEC/CCE/SWCD/AGM/ NGO | 1 year | Legislature, SWCD NYFOA, ESFPA, SAF, NGO's, Landowners, USDA |
| Establish caches across the state to allow operators to borrow forestry and logging equipment and devices on a short-term basis needed for implementing best management practices during logging operations. | DEC, SWCD, NGO, Wood Products Development Council | 1-2 Years | SWCD, Industry, NGO's |
| Provide funding for low interest loans or grants for upgrading to new logging or manufacturing equipment to facilitate, increased utilization, improved forest management or best management practices (e.g. lower site impacts). Example: Machine tracks for wheeled harvesters to lower soil impacts. | Wood Products Development Council, NGO's | 1 year | Legislature, SWCD NYFOA, ESFPA, SAF, NGO's |

# Mitigation strategy – Initiative #1: Improved, Sustainable Forestry: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Increase prevention of invasive forest pests and diseases entering New York and the U.S (e.g. SMART trade). Work with federal and state partners to strengthen regulations, inspection and enforcement of wood packaging material and live plant imports. Improve surveillance for forest health and disease | DEC | 1-2 years | USDA-APHIS, AGM, ESFPA, SAF, |
| Reduce the loss of forest carbon due to acute forest health issues on private and public forest. Facilitate an increase in capacity for rapid response teams for forest pest and disease outbreaks (e.g., ALB) or invasive vegetation issues that negatively impact forest carbon (e.g. forest regeneration).. Priority would be on intervening where rapid, extensive loss of forest carbon sequestration capacity could occur. | DEC | 1 year | Legislature, SWCD NYFOA, ESFPA, SAF, NGO's |
| Create a NY Forest Carbon Bank. A carbon bank would allow New York State to finance Greenhouse Gas (GHG) reduction and carbon sequestration activities by NYS farm forests and forest landowners by allowing entities to buy tons of carbon from forest landowners generated through improved land management practices that increase carbon sequestration. | DEC, NYSERDA | 1-2 years | Legislature, SWCD NYFOA, ESFPA, SAF, NGO's/SUNY ESF |

# Mitigation strategy – Initiative #1: Improved, Sustainable Forestry: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Strategy will benefit rural economically disadvantaged communities, including those in EJ areas, by improving the forest-based economy and increasing job opportunities. Allows lower to middle income landowners to hold on to their lands, maintain open space, keep forest as forest, and sustainably manage their lands. |
| **Health and co-benefits** | Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Co-benefits to this strategy include avoided forest conversion, supporting forest and forestry sector jobs in rural communities, improved forest ecosystem resiliency and soil health, improved forest productivity, enhancing wildlife habitat, protecting water quality, maintaining rural character and providing public recreational opportunities. |
| **Just transition: businesses and industries, workers** | Mitigation strategy would expand the opportunities available to forestry-based businesses in rural areas of New York; by increasing the demand for forestry services including natural resources professionals, certified herbicide applicators, forestry equipment operators, and mill operators. Ancillary benefits of forest recreation and forest-based recreation businesses. |
| **Other** | Sustainability measures already in place or being developed through this strategy are integral to many of the proposed Bioeconomy recommendations. |



# Mitigation strategy – Initiative #2: Afforestation/Reforestation: Overview

| | | | |
|---|---|---|---|
| **Description:** | Increase forested acres through afforestation and reforestation efforts to establish climate adapted and resilient forests. There are potentially 1.7 million acres of marginal lands available for establishing forests. | | |
| **Action type:** | Regulation (DEC, AGM), Incentive (DEC, AGM) | | |
| **GHG reduction by 2030:** | Carbon Sequestration-High | **GHG reduction by 2050:** | Carbon Sequestration-High |
| **Cost and funding considerations:** | $$$. Upgrading state tree nursery capacity. Costs of labor, trees, tree protection and long-term maintenance. Specialized tree planting equipment will be needed. Increased staffing and volunteers. | | |
| **Ease of implementation:** | Hard. Need to identify priority acres where afforestation and reforestation are likely to succeed. Seek out opportunities for enhancing natural afforestation success. Long term maintenance on private lands is needed for long term survivorship of established forests | | |
| **Example case studies:** | CCC efforts in the 1930's and 40's planted around 300,000 acres in NYS | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • High Cost<br>• Challenge of establishing resilient forests<br>• Many competing land uses for marginal lands (agriculture, development)<br>• Very labor intensive to establish forests either by planting or natural means<br>• Workforce gaps in private and public sectors<br>• Current nursery capacity needs to increased<br>• Deer herbivory is costly to control and increases tree mortality<br>• Seed and seedling availability (lag time for nursery stock)<br>• Term of enrollment must be sufficient to deliver benefit | • Private industry/public partnership for funding projects<br>• State of the Art Marketing Campaign<br>• Reforestation resources and services covered for landowners; landowners provide land<br>• Corp or internships, technology to reduce labor costs<br>• Federal Assistance<br>• Investments in nursery capacity and seeding technology<br>• Statewide deer management and local controls (e.g., hunting, culling, fencing)<br>• Increased investment in PRISMs, tree-smart trade, and other related strategies |

# Mitigation strategy – Initiative #2: Afforestation/Reforestation: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to be engaged)* |
|---|---|---|---|
| Establish NY Tree Corp (or Climate Corp) to provide direct tree establishment and maintenance services to public and private landowners. Regionally based Tree Corp would be provided with staff and equipment to establish and maintain seedlings at no or low cost. | SWCD/DEC/AGM | 3 years | Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's, landowners, USDA |
| Expand cost share funding for existing tree establishment and maintenance programs such as Regenerate NY and AEM programs. These existing programs can help move reforestation/afforestation efforts forward while larger efforts, such as the NY Tree Corp become established. | DEC/SWCD/AGM | 1-2 years | Legislature, SWCD, USDA NYFOA, ESFPA, SAF, NGO's |
| Increase state tree nursery capacity to support large scale afforestation and reforestation efforts. Upgrade to expand tree species offerings to meet adaptation and resiliency challenges. Enhance seed collection and storage efforts, seedling production, workforce development, pre- and post-planting practices. | DEC | 3 Years | Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's, landowners |
| Develop an opportunity assessment to identify areas where afforestation and reforestation are likely to succeed. Seek out opportunities for enhancing natural afforestation success, which could be more economical | DEC/SWCD/AGM/SUNY ESF/ | 3 years | Legislature, NYFOA,SWCD, ESFPA, SAF, TNC, NGO's |
| Expand or create new, free tree seedling programs such as Buffer in a Bag programs to assist landowner with smaller project areas. Explore partnerships with local governments and regional organizations to scale up programs. | DEC/SWCD | 2 years | Legislature, NYFOA, ESFPA, SAF, NGO's |

# Mitigation strategy – Initiative #2: Afforestation/Reforestation: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to be engaged)* |
|---|---|---|---|
| Work with public and private partners on reforestation efforts in ROW areas of the state. Focus on tree and shrub species compatible with power transmission and distribution right of way's, roadside areas, pipelines, railroads, etc. Public outreach for right tree, right place is needed. | DEC, NYPA | 1-2 years | NYPA, DOT, Municipalities, ISA (UAA), Industry |
| Tree Planting Equipment Loan Program to allow landowners and operators access to specialized equipment for small- and large-scale tree planting projects. | SWCD/DEC | 1-2 years | Legislature, SWCD, NYFOA, ESFPA, SAF, NGO's |
| Enhance agency and partner capacity to deliver technical assistance and education programs to landowners. Assist with planting plans, site and species selection. Promote tree planting programs. Increase partner cooperation to meet requests, ensure minimal overlap of services, capture accomplishments and coordinate efforts. | DEC/CCE/SWCD/AGM/ NGO | 1 year | Legislature, NYFOA, ESFPA, SAF, NGO's |
| Investment in seeding and seeding technology to fill in smaller forest gaps where needed. Drone, robotic technology to distribute seeds in areas regeneration needs to be supplemented after a treatment. | DEC | 1-2 years | Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's |

# Mitigation strategy – Initiative #2: Afforestation/Reforestation: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Strategy will benefit rural, economically disadvantaged communities, including those in EJ areas, by improving the forest-based economy and increasing job opportunities. Provides valuable job experience and training in tree planting and forestry sector through volunteer opportunities, internship and full and part time jobs in rural areas |
| **Health and co-benefits** | Numerous studies in the U.S. and around the world are exploring the health benefits of spending time outside in nature, green spaces, and, specifically, forests. Co-benefits to this strategy include avoided agricultural conversion, supporting forest and forestry sector jobs in rural communities, improved forest ecosystem resiliency and soil health, improved forest productivity, enhancing wildlife habitat, protecting water quality, and maintaining rural character. |
| **Just transition: businesses and industries, workers** | Mitigation strategy would expand the opportunities available to forestry-based businesses in rural areas of New York; by increasing the demand for forestry services including natural resources professionals as well as certified herbicide applicators, tree planters and forestry equipment operators. Increased job opportunities from expanded public and private nursery capacity. |
| **Other** | |



# Mitigation strategy – Initiative #3: Urban Forestry: Overview

| | | | |
|---|---|---|---|
| **Description:** | Increase and maintain tree cover in urban and developed areas to reduce energy use and corresponding GHG emissions through the shading and cooling effect of trees. Increase carbon sequestration through tree establishment and extending the life of urban trees through improved maintenance. | | |
| **Action type:** | Emission Reduction and Carbon Sequestration | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $$. Increasing grant funding to communities and expanding to individual landowners. Higher cost of establishing urban trees vs. planting trees in fields. Increased staffing resources for program delivery. | | |
| **Ease of implementation:** | Medium. Sustained tree maintenance after establishment in harsher environments. Most urban and community trees are privately owned | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Requires staff to manage additional workload<br>• Sufficient availability of trained individuals to preform tree work Sufficient availability of resources/ equipment to preform tree work.<br>• Availability of suitable growing stock to plant<br>• Ensuring survival of trees planted.<br>• Most urban and community trees are privately owned | • Utilizing third party project/ grant managers (not for profits) to handle multiple projects on a regional level<br>• Work with professional organizations (ISA, TCIA, for profit training groups) to develop training programs that can be rolled out statewide<br>• Develop guidance and work with other agencies/ municipalities to establish shared resources such as equipment caches |

# Mitigation strategy – Initiative #3:
## Urban Forestry: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Increase funding levels of Urban and Community Forestry Grants to assist local municipalities in the management of the urban forest which includes planning, planting and maintenance of trees, Provide funding opportunities for private individuals to establish and maintain privately owned trees. | DEC | 1-2 years | Local communities, arborists |
| Develop guidance and provide support to local communities to establish or expand youth and young adult conservation corps that employ and train disadvantaged youth and provide a source of skilled labor for increasing, maintaining and improving the management of the urban forest | DEC, SWCD, | 1-2 years | NY Society of Arboriculture, local governments, non-profit organizations |
| Develop an opportunity assessment to focus tree establishment and maintenance efforts within urban areas and communities where the most climate, societal, and public health benefits are likely to be achieved. | SUNY ESF, SWCD, DEC, CCE | 1-2 years | Legislature, NYFOA,SWCD, ESFPA, SAF, NGO's |
| Develop guidance and provide support and funding to local communities for planning and implementing planting and maintenance projects that help communities adapt to climate change. This may include sharing resources (equipment, staff, bulk ordering, etc.). This will help communities maintain critical ecosystem services like flood mitigation, clean air, clean water, reduced sediment and nutrient runoff, reduced energy use, shade and improved human health | DEC, Cornell CALS/SUNY ESF | 1 year | DOS, ESD, nonprofit organizations, local governments, USDA |

# Mitigation strategy – Initiative #3:
## Urban Forestry: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Urban communities in EJ areas will benefit from increased tree canopy and open spaces through increased public health benefits, property values, reduced energy costs, and recreational opportunities. A community engaged in urban forestry activities improves the overall quality of life. |
| **Health and co-benefits** | Numerous studies in the U.S. and around the world have shown and continue to explore the mental, physical and societal health benefits of spending time outside in nature, green spaces, and —specifically— forests. Significant co-benefits to this strategy include urban forests more resilient to the negative impacts of climate change; Overall improved public health, mitigation of heat island effects, and providing public recreational opportunities |
| **Just transition: businesses and industries, workers** | Provides increased volunteer and job opportunities to local communities. Services for arborists, tree service and utility line workers could increase based on increased tree maintenance activities. This strategy will create more livable communities throughout New York. |
| **Other** | |

# Enabling strategy summary – Forest Management

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1. | Expand funding for peer reviewed climate, forest carbon and applied forest management research | Scientific Research | Medium | $-$$ |
| 2. | Develop and support workforce development and training programs for forest sector workers to enable an increase demand in forestry services to be met. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level. | Training, Implementation | Medium | $ |
| 3. | Facilitate the development of a forest-based culture and economy through state-of-the-art outreach, education and marketing techniques to inform the public and policy makers about forest and forest carbon issues | Outreach and Education | Hard | $-SS |



# Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Overview

| | |
|---|---|
| **Description:** | Expand funding for peer reviewed climate, forest carbon, and applied forest management research |
| **Action type:** | Research |
| **Cost and funding considerations:** | $-$$. Provide funding for researchers, facilities, assistants and equipment needed to sustain a robust forest carbon research effort over time. |
| **Ease of implementation:** | Medium. Sustaining funding over time and during difficult economic times. |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Sustaining funding for long term forest research<br>2. Biased research to further a particular agenda<br>3. Public and policy-makers education in forestry and climate issues | 1. Identifying long term public and private funding sources, such as forest industry, private foundations, and state budget<br>2. Published peer reviewed research as a measure of success<br>3. Creating new ways to disseminate or demonstrate results |

# Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Support research needs of improved forestry management mitigation strategies. Focus on peer reviewed forestry and forest carbon research in New York State Forests, such as improving forest resilience and vigor, regeneration and forest soil carbon. | Cornell CALS/SUNY ESF, DEC | 1-2 years | AGM. CCE, WPDC NYFOA, ESFPA, SAF, USDA, TNC/ENGOs |
| Develop a suite of forestry practices designed to improve forest carbon sequestration in New York forests. Practices would be deployed across state funded forestry programs to achieve consistency. | Cornell CALS/SUNY ESF, DEC | 1-2 years | CCE,NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOs |
| Develop efficient, cost effective monitoring and verification systems for accurately measuring forest carbon to evaluate practices and programs over time. | Cornell CALS/SUNY ESF, DEC | 1-2 years | CCE,NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOs |
| Research using science-based decision systems that enables the leveraging of climate change investments to make more efficient and cost-effective decisions on forest-based climate change initiatives. | Cornell CALS/SUNY ESF, DEC | 1-2 years | CCE,NYFOA, ESFPA, SAF, USDA, WPDC, TNC/ENGOs |



# Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Research on the most cost-effective methods of using trees and short rotation woody corps (e.g., shrub willow, miscanthus) to sequester carbon on marginal lands. | Cornell CALS/SUNY ESF, DEC, AGM | 1-2 years | CCE,NYFOA, ESFPA, SAF, USDA, SWCD, TNC/ENGOs |
| Increase urban forestry and forest carbon research to maximize the carbon and other benefits of establishing and maintaining urban forests. Focus on | Cornell CALS/SUNY ESF, DEC | 1-2 years | CCE,NYFOA, ESFPA, SAF, USDA, TNC/ENGOs |
| Fund research into long term new and emerging Natural and Working Lands solutions to meet our 2050 goals. | Cornell CALS/SUNY ESF, DEC, AGM | 1-2 years | CCE, NYFOA, ESFPA, SAF, USDA, TNC/ENGOs |
| Increase research into emerging forest products and forest product markets as it relates to bioeconomy and harvested wood product initiatives | Cornell CALS/SUNY ESF, DEC, WPDC | 1-2 years | CCE, NYFOA, ESFPA, TNC/ENGOs |

# Enabling initiative – Initiative #1: Climate and Forest Carbon Research: Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Provide research employment and volunteer opportunities for students from disadvantaged communities. Demonstration sites or projects could be in EJ areas for urban forestry projects. |
| **Health and other co-benefits** | Improving sustainable forestry practices lead to healthier, more productive forests. Research universities and institutions are local economic engines that support the local communities they are located in. They also often include educational programing and events for the general public. |
| **Just transition: businesses and industries, workers** | May provide increased job opportunities based on the new products or methods developed through research efforts. Forest sector workers may find new types of positions. |
| **Other** | |



# Enabling initiative – Initiative #2: Workforce Development: Overview

| | |
|---|---|
| **Description:** | Develop and support workforce development and training programs for forest sector workers meet an increase demand in forestry services. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level. |
| **Action type:** | Training and Education |
| **Cost and funding considerations:** | $. Private/Public funding partnership opportunity. Increase funding to Wood Products Development Council, forestry colleges, BOCES. Some federal funding may be available. |
| **Ease of implementation:** | Medium. Existing programs are in place that could be scaled up and expanded. Some additional areas of need may need to be identified. |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Liability insurance at facilities<br>2. Lower paying, more dangerous jobs<br>3. Cost of training and education to the worker, student or employer<br>4. Long term success of moving trainees/students into careers | 1.Using state, federal or PPP funding to cover training and education costs to eliminate barriers for employers and individuals<br>2. Improve on safety training within programs<br>3. Provide state support to bolster programs<br>4. Evaluate how many student/trainees go into and remain in forestry careers |

# Enabling initiative – Initiative #2: Workforce Development: Components

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to be engaged)* |
|---|---|---|---|
| Improve Cooperating Consulting Forest Policy, CP-36: Require continuing education in forest carbon or forest carbon management. Improve the rigor and accountability of the program | DEC | 1 Year | SAF, NYFOA, ACF, SUNY ESF |
| Provide funding for climate change, forest carbon management, and silvicultural training for forestry and natural resources professionals in the public and private sector. | DEC | Ongoing | SWCD, SAF, ESFPA, CCE, SUNY ESF |
| Forest Carbon Certification Program: Qualified participants would receive a certification credential that allows them to work under state funding forestry and forest carbon programs. | DEC | 1 Year | SAF, ACF, ESFPA, SUNY ESF |
| Lower the initial fee or provide cost share dollars for forestry workers to obtain their NYS Pesticide Applicator's license | DEC or WPDC | 1-2 years | CCE, SAF, ACF, ESFPA |
| Support and bolster existing state, NGO, or industry urban forestry and utility forestry training programs. Integrate forest carbon and forest carbon management into programs | DEC | 1-2 years | ISA, Releaf, SUNY ESF, Public Utilities, Industry |
| Provide support for existing training apprenticeship programs for careers in forestry and forest product across the entire supply chain from the woods to the mill. Incorporate forest carbon and forest carbon management into training programs and forestry curriculums at the high school (e.g., BOCES) and college level. | Wood Products Development Council | 1 Year | Paul Smiths College, SUNY ESF, BOCES, Workforce Development Institute (WDI) |
| Bolster state support for Trained Logger Certification to develop and implement new training modules around improved forestry practices including forest carbon best management practices (BMP's) designed to increase carbon sequestration(e.g. reduced soil carbon loss through improved harvesting techniques). | DEC | 1-2 years | TLC, ESFPA, SUNY ESF |

# Enabling initiative – Initiative #2: Workforce Development: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Increased job opportunities in rural economically disadvantaged communities. Initiative supports local workers and economy to remain in local communities and NY state by providing the skills necessary to succeed. Keeps local forest industry and manufacturing knowledge intact to position itself to take advantage of new, emerging markets. |
| **Health and other co-benefits** | Initiative increases logger safety through training and through increased availability of newer, safer, modern equipment. A better trained forest sector workforce will improve implementation of forestry and climate strategies. Co benefit also include improved water quality, forest productivity and increased public confidence in foresters and loggers. |
| **Just transition: businesses and industries, workers** | Maintaining employment in natural resource sectors and related industries. Prevents displacement of workers and industries. |
| **Other** | |

# Enabling initiative – Enabling initiative – Initiative #3: Outreach and Education: Overview

| | |
|---|---|
| **Description:** | Facilitate the development of a forest-based culture and economy through state-of-the-art outreach, education and marketing techniques to inform the public and policy makers about forest and forest carbon issues |
| **Action type:** | Education and Implementation |
| **Cost and funding considerations:** | $ - $$. The cost of sustained state-of-the-art marketing campaigns, social and traditional media, training, and increase in trained outreach staff. |
| **Ease of implementation:** | Medium. Behavior change takes time and requires research-based strategies. Behavior change strategies have been successfully implemented for an array of campaigns |
| **Example case studies:** | Wisconsin DNR, TELE |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1.Technical concepts and language<br>2.Misinformation and opposing public perceptions<br>3.Potential increased costs to consumers associated with bioeconomy products<br>4. Proper technical guidance on tree establishment/maintenance for municipalities, tree company's, utilities and general public | 1.Stewardship and Cooperating Forester Outreach Training<br>2.Happy Little Tree Marketing Campaign<br>3.Bio-Economy Promotion<br>4. Increase urban forestry outreach efforts |



# Enabling initiative – Initiative #3: Outreach and Education: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to be engaged)* |
|---|---|---|---|
| Stewardship and Cooperating Forester Outreach Training: Provide public and private foresters with training, technical assistance, and resources on landowner engagement and climate change. | Cornell CALS/SUNY ESF, DEC | 1 year | SWCD, NYFOA, ESFPA, MFO/CCE, TNC/ENGOs |
| Bio-Economy Promotion: Engage social media influencers and wood product manufactures to promote NYS wood products as trendy, local, and sustainable. This includes supporting and promoting traditional wood products, emerging markets and urban wood utilization | Wood Products Development Council, SUNY ESF | 2 years | DEC, AGM, ESFPA |
| Build public acceptance for forest management and increase the adoption of climate focused private forest management. Communicate clear and simple messages that connect forestry and management to the things people value (clean air, water, recreation, etc.).(e.g Happy Little Trees Marketing Campaign) | Cornell CALS/SUNY ESF, DEC | 2 years | MFO/CCE, NYFOA, TNC ENGOs |
| City and Municipality Engagement: Provide outreach messaging toolkits to urban foresters, city planners, and local officials. Toolkits will focus on the climate and other co-benefits of urban forests, private forest management, and local wood products. | DEC | 1 year | Municipalities, SUNY ESF |

# Enabling initiative – Initiative #3: Outreach and Education: Components of the strategy

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Bolster urban forestry and natural resource education and outreach, especially in underserved communities. Residents in underserved communities are often skeptical of government led improvement projects. Identify and work with local partners. | DEC | 1-2 Years | Local government, no nprofit organizations, SUNY ESF |
| Increase the promotion of urban forestry and tree care through TreeLine USA for utilities, TreeCity USA for communities and Tree Campus for college campuses. Support increased ReLeaf efforts in communities across the state. | DEC | 1-2 Years | ReLeaf, Arbor Day Foundation, Municipalities, Private and Public Universities, Public Utilities, Industry, SUNY ESF |



# Enabling initiative – Initiative #3: Outreach and Education: Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Promotion of a bio-based, forest economy is likely to indirectly support the economic wellbeing of rural New Yorkers and may provide opportunities to low-income communities in those areas. |
| **Health and other co-benefits** | There is research to suggest that the use of wood products in the built environment has benefits for human health. One such study can be found here. |
| **Just transition: businesses and industries, workers** | Training foresters in better communication practices is likely to enhance the skillsets of natural resource professionals. Outreach tools for municipalities and natural resource professionals will serve to enhance landowner engagement and can indirectly expand opportunities for the forest industry. |
| **Other** | Planned communication strategies for natural resource professionals is likely to improve outcomes for private landowners. Private landowners will benefit from a better trained workforce and a suite of outreach tools that provide them with a better understanding of the benefits and risks of forest management. |

# Enabling strategy summary - Bioeconomy

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| 1 | Expand Markets for Sustainably Harvested Durable Wood Products | Market development, Research | Medium | $$ |
| 2 | Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products | Research and Planning | Medium | $ |
| 3 | Increasing market access for NY low-carbon products | Market development; Research | Hard | $$ |
| 4 | Financial and Technical Assistance for Low-Carbon Product Development | Technical support, financial incentives | Easy/Medium | $$ |
| 5 | Bio-based Products Research Development & Demonstration Overview | Research initiative, pilots | Medium | $ |
| 6 | Net Negative Carbon Dioxide Removal | Research and policy development | Hard | $$ |

To learn more about the concept of a bioeconomy please see this document by SUNY ESF



## Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

| | |
|---|---|
| **Description:** | Advance the use of high value timber for long lasting products while advancing forest health and forest carbon sequestration. Displace GHG-intensive building materials (steel, concrete) with durable wood products (carbon sequestered in cross-laminate timber, hard wood floors) that reduces the net building and infrastructure GHG and provide long duration carbon storage |
| **Action type:** | Market development, Research |
| **Cost and funding considerations:** | $$ ($25M - $100M) |
| **Ease of implementation:** | Medium; |
| **Example case studies:** | other states like Maine and Oregon have embraced mass timber, Canada too |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Current building codes limit the area (square footage), height, and number of floors that be built with mass timber<br>• Cost of construction compared to other methods<br>• No plants currently operate in NYS, meaning construction material would need to arrive ready to use, or a plant would need to be established to process materials<br>• Limited softwood supply for mass timber in NYS means raw material would likely need to be imported<br>• Lifecycle benefits uncertainty for some use cases<br>• Architects and builders do not have as much experience with mass timber and other low carbon bio-based building products | • Accelerate the code revision cycle and adopt the 2021 International Building Code<br>• Incentivize the use of mass timber construction which has long duration carbon sequestration benefits and provides a substitute for high carbon materials (e.g., concrete)<br>• Expand the current efforts of SUNY ESF, to have mass timber dormitories on SUNY campuses<br>• Use mass timber construction in the new DEC Environmental Stewardship building at the Great NYS Fair<br>• Sponsor pilot construction and retrofit efforts to educate builders alongside lifecycle analysis and economic quantification to more clearly demonstrate benefits |

# Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Advance building code changes to adopt the International Code Council 2021 International Building Code | DOS, NYC DOB, | 2-3 years | NYSERDA, USGBC, SUNY ESF |
| Enhance NYS supply chain for harvested wood products; fund innovation to develop mass timber applications using northern hardwoods | SUNY ESF/Cornell CALS, NYSERDA, | 5-10 years | ESFPA,WPDC, DEC; ESD, AGM |
| Revise state procurement specifications that limit the eligibility of wood products that meet the technical performance standards | GreenNY, OGS, DEC, DASNY | 2-3 years | SUNY, DOCC, OMH, HCR, NYSERDA, SUNY ESF, WPDC |
| Remove barriers and create incentives for using wood for infrastructure applications, including bridges, sound barriers, transportation hubs, utility poles, marine and foundation pilings, retaining walls, docks, and piers | DOT, PANYNJ, DEC, EFC | 5-10 years | ASCE, AIA, SUNY ESF, RIT P2I |



# Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Outreach and education to construction industry and public on mass timber construction and harvested wood products (fire safety, high-rise applications)<br>Promoting carbon sequestering materials that are substitutes for energy efficiency materials that are fossil fuel based (e.g., hemp insulation replacing foams; research potential on uses for residues from hemp product creation) | SUNY ESF<br>Cornell CALS | 1 year | Industry partners, AIA, USGBC, DEC, USCA, ESFPA, WPDC, AGM, HCR, DASNY, RIT P2I |
| Set standards and specifications for a minimum portion of harvested wood products, such as mass timber or wood flooring, in new construction in certain state funded/supported buildings and infrastructure projects when NY supply chain can cost effectively meet the demand | GreenNY, OGS,DEC, DASNY, | 3-5 years | DEC, HCR, SUNY, DOCCs, |
| Support R&D, demonstration, and technology transfer of wood utilization and wood innovations to scale the use and climate benefits of wood in the built environment | SUNY ESF/Cornell CALS, NYSERDA, AGM, DEC | 1-5 years | ESFPA, WPDC, Industry Partners, USCA |

## Enabling initiative – Expand Markets for Sustainably Harvested Durable Wood Products

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Promote the value of building with wood in affordable housing to save time and money, provide safe and healthy housing, stimulate jobs, reduce embodied carbon emissions, and enhance carbon storage. The use of clean, low carbon products that have low off-gassing and toxicity will be another benefit to disadvantaged communities |
| **Health and co-benefits** | Sustainable harvest practices and improved utilization of high grade wood provides an economic driver for conservation of natural and working lands, particularly when customers want verified low carbon products. Ecosystem conservation will also translate to benefits for human health, water quality and air quality. Improve quality of living for tenants and others which impacts physical and mental health. Bio-based products will also often have a safer profile when installed and from cradle to end of life. Bio-based products also have end-of-life opportunities, in a circular economy landfill wastes are reduced. Modular application of mass timber drives cost efficiencies for construction projects by shortening the urban installation time which also reduces site emissions/nuisances |
| **Just transition: businesses and industries, workers** | New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than $13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly $10 billion of economic activity. Generates manufacturing and construction jobs. Creates new market for existing secondary wood products industries such as flooring, millwork and molding for interior design. mass timber has the potential to be designed and manufactured in modular capacity in rural locations, creating rural jobs with safer and more efficient conditions |
| **Other** | Supports sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest. COVID-19 pandemic has driven many wood prices high due to increased demand, need to evaluate near term effect on costs/ timeframe of implementing this strategy |

6

## Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

| | |
|---|---|
| **Description:** | This plan will identify feedstock volumes and production methods that utilize NYS biomass resources in a sustainable, sequestration maximizing manner to create replacements for hard to decarbonize fuels while considering other uses for these feedstocks (see recommendation on low-carbon product development). Fuel derived from biomass will likely have a limited but strategic role in New York's 2030 and 2050 needs |
| **Action type:** | Research and Plan development |
| **Cost and funding considerations:** | $, <$2M total cost |
| **Ease of implementation:** | Medium. A comprehensive plan is a significant undertaking with many elements that would require coordination and may be challenging. |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Competition for finite land area to grow a variety of products (food, feed, fiber, fuel)<br>• The benefits, environmental and social impacts, and limitations are highly dependent on the specific combination of the source of energy, management, logistics, spatial and temporal scales, conversion technologies, co-products, end-use efficiency, environmental and social externalities, and the baseline to which an energy pathway is compared<br>• Reduced carbon availability for recycling into soils, impacts and nutrient management<br>• Requires comprehensive look at role of other biofuels as well as other uses for the biomass inputs | • Focus on wastes and residues as feedstocks, anticipated 2050 fuels needed should frame 2030 feedstock development and associated infrastructure.<br>• Apply criteria to assess the energy, environmental, and social benefits, impacts, and limitations of all energy pathways (e.g., biomass, solar, wind, fossil etc.) and to select pathways with highest and best use of our limited natural resources with low risks of undesirable environmental and social impacts<br>• Incentivize carbon storage in soil through amendments like biochar<br>• Focus on closed-loop processes where possible and in-state feedstock development to meet in-state demand.<br>• Matching the conversion technology to the fuel source and to the products needed (i.e., jet fuel, chemicals, etc) is essential to achieve the maximum economic returns and long-term performance from a bioenergy system. |

## Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Establish rigorous energy, greenhouse gas, and environmental sustainability guidelines and metrics | DEC, NYSERDA, AGM | 2-3 years | SUNY, TNC/ENGOs, SUNY ESF/Cornell CALS, USEPA, RIT P2I |
| Identify bioenergy pathways with high lifecycle energy efficiency and high emissions reductions (from land-harvest, conversion, and delivery to the end user) that replace fossil fuels and complement next generation energy delivery systems | NYSERDA, SUNY ESF/Cornell CALS | 2-3 years | SUNY, USDOE, national labs (ARGONNE), toxicology experts/risk assessment |
| Identify 2050 hard to decarbonize fuel needs (e.g., high quality distillate jet fuels) and incentivize appropriate bioenergy development (feedstock supply chain, conversion systems, and end use markets) to meet these needs. | SUNY ESF/Cornell CALS, NYSERDA/DPS | 2-3 years | Utilities, USDOE, Industry, PANYNJ, CAAFI |



## Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Prioritize use of feedstocks that are residues from existing agricultural, forest, and waste systems. (through preferential pricing in product development proposal) | NYSERDA, DEC, SUNY ESF, Cornell CALS | 2-3 years | CCE, SWCD, ESFPA, WPDC, AGM, NYCDEP, RIT P2I, (other waste stakeholders) |
| Activate former agricultural and underused lands (including former industrial lands) for more productive uses, one of which could be purpose-grown biomass | AGM, DEC | 3-5 years | SUNY ESF/Cornell CALS, CCE, SWCD, Forest Connect, TNC/ENGOs, Hunting stakeholders (deer management) |
| Develop energy systems that can best support a net-zero carbon economy in NY. NYSERDA and the Green Bank to develop programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products | NYSERDA, DPS | Ongoing | Utilities, CAAFI, USDA, USDOE, Industry, SUNY ESF/Cornell CALS |

# Enabling initiative – Sustainable biomass feedstock action plan for 2050 hard-to-decarbonize products

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Interim fuels and infrastructure systems ensure near-term affordable energy alternatives to traditional fossil fuel systems (e.g., boilers) or promote affordable bio-electricity further encouraging the transition to electrification in both rural and urban areas |
| **Health and co-benefits** | Increases forest area under active professional management, increases forest management for maximum sequestration. Keeps our forests as forests, avoids conversion of forests to other land uses, and enables private forest owners to invest in management that not only maintains but scales carbon sequestration, clean water and wildlife habitat. Combustion of biomass could lead to increased air emissions and impacts to public health; any consideration of combustion must address this issue |
| **Just transition: businesses and industries, workers** | Develops markets for low grade wood products, increasing value to rural industries. Create new opportunities in rural areas (e.g., agricultural/forestry jobs, biomaterial processing jobs, and infrastructure development and maintenance). New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than $13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly $10 billion of economic activity. Strengthen our existing bioeconomy for the future and to ensure a supply chain of feedstock and, workers and innovation to unleash new biobased products. |
| **Other** | Supports sustainable management of NYS forests and ag lands which maintains or increases carbon stocks, while producing an annual sustained yield of bio-based feedstocks. |

# Enabling initiative – Increasing market access for NY low-carbon products

| | |
|---|---|
| **Description:** | Enhancing carbon sequestration, greenhouse gas mitigation, and economic development opportunities by reducing barriers and creating competitive advantage for NY produced low carbon products |
| **Action type:** | Market development; Research & Development |
| **Cost and funding considerations:** | $$ ($25M - $100M) Low carbon products available in the near-term have comparable cost characteristics to fossil fuel based products after accounting for positive externalities but lack production capacity in Northeast U.S. Public-private partnerships would support initial technology deployment. |
| **Ease of implementation:** | Hard for implementation due to policy novelty and lack of NYS-specific carbon intensity calculations for many fossil fuel based products. Moderate for post-implementation under model in which producers of fossil fuel based and bio-based products provide lifecycle data that are reviewed and certified by DEC. |
| **Example case studies:** | USDA Biopreferred® program; Dutch Ministry of Infrastructure and the Environment tenders |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Measurement and verification of carbon content is complex and if not done properly can erode market confidence<br>• Lifecycle data availability for covered fossil fuel based products<br>• Deployment of low carbon substitutes to fossil fuel based products<br>• Interim maintenance of existing low carbon supply chains<br>• Permitting timeframes and lack of technology awareness | • Look to leverage existing certification standards<br>• Confidential producer analysis of covered fossil fuel based products<br>• Combine with low carbon preferential procurement policies<br>• Base product coverage on TRL of low carbon substitutes<br>• Leverage in-state academic/industry expertise on low carbon products & conduct needed research to increase certainty in verification, leading to low carbon product standards |

# Enabling initiative – Increasing market access for NY low-carbon products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Begin tracking and reporting on this market to spot emerging trends, innovative applications, external market opportunities, growth opportunities to guide the development | ESD, NYSERDA | 1 year | Business Council, AGM, REDCs, trade groups |
| Spur innovation through lead by example in low carbon procurement requirements for state government (e.g. bio-based products, low carbon concrete) | GreenNY, OGS, DEC, DASNY | 2-3 years | SUNY, DEC, NYSERDA, PANYNJ |
| Commence a technology readiness level analysis of low carbon substitutes for fossil fuel based products and fuels; Identify the high value products from bio-based processing of New York grown feedstocks and invest in production facilities | NYSERDA, SUNY ESF | 1-3 years | DEC, ESD, Industry, SUNY, OEMs, |
| Strategic use of incentives to drive scale-up of high-demand products when the low carbon alternative is not yet cost competitive with the fossil fuel based option | NYSERDA, AGM, DEC | 3-5 years | Industry, DEC, NYSERDA, ESD |

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# Enabling initiative – Increasing market access for NY low-carbon products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Develop standards and guidelines for defining a low carbon product, including ensuring sustainable feedstock production (biomass action plan) | GreenNY, DEC, NYSERDA, AGM | 2 years | Industry, SUNY, |
| Expand access to low interest loans or grants for existing NYS businesses to develop new low carbon products lines by educating local banks on emerging bio-technologies and offering NYGB loan guarantees | DFS, NYGB, ESD | 2-3 years | NYFB, technology incubators, IDAs, SUNY, Small Business Administration, USDA Rural development, financing partners, Urban Green Council |
| Create a low-carbon products portal to facilitate connecting NYS producers to corporations and other buyers that have made GHG emission reduction commitments, expand the NY Grown program to cover more products and adding a low-carbon aspect to this program | AGM, RIT P2I | 2 years | Industry, Urban Green Council, SUNY ESF/Cornell CALS, NYSERDA, trade groups, producers, SWCD |

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# Enabling initiative – Increasing market access for NY low-carbon products

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand production of high-value agroforestry products that contribute to maintaining healthy forests (sap/syrup production, nuts, mushroom cultivation, and ginseng production) | AGM | 2 years | SWCD, NYFB, CCE |
| Enhance the public's understanding of the bioeconomy and its role in implementing the CLCPA | AGM, SUNY ESF | Ongoing | NYSAF, social scientists, industry, REDCs |
| Develop low carbon fuel strategies for hard to electrify applications | DEC, NYSERDA | 2 years | Industry, Utilities, Aviation stakeholders |
| Consumer and business-to-business education on bio-based products and low carbon products, build buyer confidence | RIT P2I (?) | 1 year | trade groups, OEMs |

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# Enabling initiative – Increasing market access for NY low-carbon products

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Transitioning industrial emitters located primarily in disadvantaged communities to low carbon fuels could decrease co-pollutant emissions (Knothe, Yin et al., Yang et al.) |
| **Health and other co-benefits** | In the transition to electrification and for applications that are difficult to electrify, low carbon fuels can have reduced co-pollutant emissions as compared to fossil fuel emissions at industrial emitters, leading to health benefits. Many low carbon product feedstocks (e.g., willow) provide ecosystems and bioremediation services during growth. |
| **Just transition: businesses and industries, workers** | 20,000 new jobs are potentially expected in the low carbon products sector in NYS. Low carbon processing is an enabling technology for the broader transition to a decarbonized economy. Significant opportunities exist for worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Investment in market development would provide the market certainty needed to deploy a thriving low carbon processing sector within NYS while minimizing opportunities for carbon leakage. |
| **Other** | The amount of material going to landfill will decrease. Building materials that sequester carbon will have additional market value; this may help drive down the costs of sequestration policies. There will be less uncertainty in the long-term market for initial producers of low carbon products. |

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# Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

| | |
|---|---|
| **Description:** | Provide financial and technical assistance to grow a bioprocessing industry in New York that utilizes low-grade wood and other biomass residuals to create bio-based substitutes for fossil fuel based products |
| **Action type:** | Engineering support, supply chain development, financial incentives, legislative action |
| **Cost and funding considerations:** | $$ ($25M - $100M) Costs to support existing supply chains can be through public-private partnerships, agency funding, and/or federal grants and support. |
| **Ease of implementation:** | Easy due to current availability of both decarbonization technology and existing supply chains. Work with SUNY campuses and industry to identify qualifying near-term decarbonization investments. |
| **Example case studies:** | EPA Green Suppliers Network; Södra pulp mill biomethanol production facility |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Owners of existing supply chains lack capital/margins to make near-term decarbonization capacity investments<br>2. Owners of existing supply chains lack technical expertise to make near-term decarbonization capacity upgrades<br>3. Rural labor is limited, competitive for workers could hurt existing businesses<br>4. Incentives to attract new businesses could put existing businesses at a competitive disadvantage | 1. Provision of financial incentives to qualifying near-term decarbonization capacity investments<br>2. Provision of regulatory and technical support to qualifying near-term decarbonization investments.<br>3. Policies need to focus on attracting new workers into rural areas to meet labor needs<br>4. Policies should also encompass new product offerings or diversification of existing businesses |

## Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Development of criteria for qualifying near-term bioprocessing capacity investments. | NYSERDA, industry leaders | 6-12 months | DEC, ESD, SUNY ESF, SWCD |
| Financial and technical initiatives to identify and promote the high value outputs from New York bioprocessing inputs | NYSERDA, DTF, ESD | Ongoing | DEC, REDCs, legislature |
| Define sustainable feedstock production for bio-based processing to determine feedstock volume and practices that maximize sequestration, part of biomass action plan | NYSERDA, DEC, AGM, SUNY ESF, Cornell CALS | 2 years | SWCD |
| Create an economic development initiative focused on attracting bioprocessing/bio-based product businesses to NYS | ESD | 2 years | SUNY ESF, REDCs, IDAs, industry leaders, SWCD |
| Preferential pricing for in-state low grade feedstocks that maximize carbon sequestration (organic waste streams, wood residues, marginal land) | DEC, AGM | 2-3 years | Legislature, local governments, SWCD |
| NYSERDA and the Green Bank to develop programs that leverage private capital to invest in conversion technology for bio-based feedstock into bio-based products | NYSERDA, NYGB | Ongoing | ESD, IDAs |

# Enabling initiative – Financial and Technical Assistance for Low-Carbon Product Development

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Potential for reinvigoration of idled rural production sites such as sawmills, create projects at existing NYS infrastructure that is able to support future deep decarbonization projects following the deployment of next-generation technology. Bioprocessing facilities should not be sited in disadvantaged communities unless the community is seeking the project |
| **Health and co-benefits** | Substantial health benefits are expected from reduced fossil fuel combustion emissions by emitters that interact with existing supply chains. Bio-based products will also often have a safer profile when installed and from cradle to end of life. Bio-based products also have end-of-life opportunities, in a circular economy landfill wastes are reduced |
| **Just transition: businesses and industries, workers** | New York's forests and wood products industries are currently directly responsible for nearly 40,000 well-paying jobs and more than $13 billion of economic output and are indirectly responsible for another 53,000 jobs and nearly $10 billion of economic activity. Significant opportunities exist for worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Near-term decarbonization of existing supply chains is an enabling technology for the broader transition to a decarbonized economy via the maintenance of those supply chains. Supply chain retention is an important factor in carbon leakage prevention. |
| **Other** | Reduced landfilling, increased value proposition for building materials via carbon sequestration potential, reduced uncertainty in long-term market for initial producers of low carbon products, correction of market failure caused by lack of externality internalization. Supports sustainable management of NYS forests which maintains or increases forest carbon stocks, while producing an annual sustained yield of bio-based feedstocks from the forest. |

# Enabling initiative – Bio-based Products Research Development & Demonstration Overview

| | |
|---|---|
| **Description:** | Develop a demonstration and pilot project portfolio to drive investment in the areas of biobased low-carbon fuels, products, and related sequestration that considers intersection of industrial/manufacturing, agriculture, transportation, and power generation sectors. Fund Innovation challenges and select projects that can scale beyond business as usual |
| **Action type:** | Research initiative, Project demonstration/pilot |
| **Cost and funding considerations:** | $, $1 million required for initial roadmap analysis with additional funding research and early-stage pilots to be determined pending the outcome of the analysis. |
| **Ease of implementation:** | Medium |
| **Example case studies:** | CA Energy Commission Autothermal Pyrolysis Demonstration; Cornell University's Leland Pyrolysis Kiln Demonstration |
| | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. A poorly defined scope for RD&D could direct limited funds towards low performing technologies creating a lost opportunity for innovation.<br>2. Decarbonization efficiency will need to be quantified via a metric such as carbon abatement cost to enable comparison of low carbon pathways with net sequestration pathways. | 1. Utilize expert elicitation to determine appropriate research scope.<br>2. Utilize in-state expertise on lifecycle assessment and techno-economic analysis to establish best practices on decarbonization efficiency quantification. |

# Enabling initiative – Bio-based Products Research Development & Demonstration Overview

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Development of research agenda scope | NYSERDA, SUNY ESF/Cornell CALS | <1 year | DEC, SUNY |
| Develop solicitation to perform research and identify promising pilot/demonstration projects | NYSERDA | 1-2 years | NYCDOB, DEC, AGM, SWCD, ESD, National labs, |
| Fund research and pilot/demonstration projects | NYSERDA | Ongoing | ESD, NYPA, DEC, USDA, USDOE, private investors, philanthropy |



# Enabling initiative – Bio-based Products Research Development & Demonstration Overview

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Research must take account of potential impacts to economic development, ecosystem services, and human health in disadvantaged communities in which pilot projects would be located. |
| **Health and other co-benefits** | Research must quantify criteria pollutant emissions, ecosystem services, and bioremediation potential of deep decarbonization and net sequestration pathways analyzed under roadmap. This will enable pathways that contribute to improvements in these areas to be considered for pilot funding. |
| **Just transition: businesses and industries, workers** | The roadmap will identify the economic growth potential of the pathways considered in the form of market size, jobs growth across the supply chain, and workforce development requirements/opportunities. |
| **Other** | |

# Enabling initiative – Net Negative Carbon Dioxide Removal (CDR)

| | |
|---|---|
| **Description:** | Advance deployment of natural CDR pathways that serve to create a negative emissions profile for bioeconomy products and other economic sectors. (long duration carbon storage beyond net zero) |
| **Action type:** | Research and policy development |
| **Cost and funding considerations:** | $$ ($25M - $100M), Currently available CDR technologies require financial incentive in range of DEC's value of carbon to be economically feasible. Many CDR strategies provide co-benefits (e.g., ecosystem remediation) that offset costs elsewhere. |
| **Ease of implementation:** | Medium, many applications are in the RD&D stage, near-commercial applications seek market value for the negative emissions values, research is needed to expand future pathways. Moderate for post-implementation as best practices are deployed. |
| **Example case studies:** | CA Energy Commission Autothermal Pyrolysis Demonstration; Cornell University's Leland Pyrolysis Kiln Demonstration; U.S. 45Q tax credit, enhanced weathering, enhanced photosynthesis |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1. Verification and confidence in CDR technologies whose results go beyond net zero and achieve enduring negative GHG emissions<br>2. Deployment of CDR projects, costs, land-use trade-offs<br>3. Many emerging technologies will need to advance to commercialization | 1. Regular CDR certification and monitoring<br>2. Provide long-term incentive value<br>3. Invest in research to establish standards for lifecycle benefits to prioritize investments in the most impactful strategies |

# Enabling initiative – Net negative Carbon Dioxide Removal (CDR)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** *(Entities that need to be engaged)* |
|---|---|---|---|
| Set clear goals and standards regarding the need for net negative removal, evaluate solutions viable today and monitor solutions that could be viable in the future | NYSERDA, DEC | 2 years | Legislature, Cornell CALS, SUNY ESF |
| Identification of verifiable and maintainable CDR technologies and pathways | NYSERDA, SUNY ESF | 2-3 years | DEC, industry partners, IBI, National labs (LLNL, Argonne) |
| Develop RD&D agenda and priorities, Initial work to focus on nature-based CDR pathways while examining the role of technology-based pathways in the future | NYSERDA, DEC, SUNY ESF, Cornell CALS | 1 year | SUNY, AGM |
| Fund demonstration projects | NYSERDA | 3-5 years | ESD, NYPA, DEC, USDA, USDOE, private investors, philanthropies |

# Enabling initiative – Net negative Carbon Dioxide Removal (CDR)

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Many CDR technologies provide associated positive externalities (e.g., ecosystem services, improved air quality, reduced agricultural pollution) and would benefit communities that have disproportionately experienced harm from negative externalities of current energy mix. |
| **Health and co-benefits** | Many CDR feedstocks (e.g., agricultural waste, dedicated energy crops) provide ecosystem and bioremediation services during growth. CDR technology biochar shows promise for urban organics management, or as a replacement for fly ash in concrete. Net negative CDR can provide permanent storage of atmospheric carbon |
| **Just transition: businesses and industries, workers** | Significant opportunities exist for CDR project worker training, especially within disadvantaged and rural communities, including partnering with local labor unions and community colleges. Many CDR pathways are enabling technologies for the broader transition to a decarbonized economy. |
| **Other** | Correction of market failure caused by lack of externality internalization. |

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# Carbon Farm Study

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|---|---|
| **Jurisdiction:** | *Cornell University, NYS Department of Agriculture and Markets* |
| **Context:** | *New York Agriculture and Climate Change: Key Opportunities for Mitigation, Resilience, and Adaptation completed in 2020, ranks the most promising GHG mitigating strategies for agriculture in NYS based on co-benefits, measurability, achievability, ease of implementation, and time scale per the Carbon Farming Act (A3281). Note, this study also provides many additional case-studies and references critical to the development of Agriculture and Forestry Advisory Panel recommendations.* |
| **Description of action(s):** | *Five practices were selected for priority implementation because they are the most cos-effective and permanent opportunities using currently available technologies and realistic verification methods. Analysis offered provided baseline for the mitigation strategies for meeting the agricultural goals under the Agriculture and Forestry Advisory Panel of the CAC.* |
| **Type of action(s):** | *Research paper; Voluntary incentive-based opportunities* |
| **Impact:** | *14 mmt of GHG reduction opportunities available through alternative manure management, precision feed, forage, and herd management, soil health, crop fertilizer nutrient management, agroforestry practices, and afforestation of idle or underutilized agricultural land. Co-benefits that may apply to practices include soil health, community relations, adaptation to climate change, profitability, air quality, water quality, biodiversity, and energy production potential.* |
| **Cost and bearer of cost:** | *Environmental Protection Fund (EPF) Climate Resilient Farming SFY 2017-2018 budget* |
| **Ease of implementation:** | *Moderate; this is current research for NY agriculture is guiding the development of recommendations from the Agriculture and Forestry Advisory Panel* |

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# US Climate Alliance (USCA) Toolkit

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|---|---|
| **Jurisdiction:** | *US Climate Alliance (USCA), American Farmland Trust (AFT), Coalition on Agricultural Greenhouse Gases (C-AGG)* |
| **Context:** | *The agriculture policy toolkit released in August 2020, provides USCA states a reference for climate and ag policy in the US developed in support of Natural and Working Lands (NWL) initiatives. It focuses on programs and policies driving adoption of agriculture pathways that reduce GHG emissions and increase carbon sequestration.* |
| **Description of action(s):** | Agriculture can be a solution to climate change and sharing highlights and recommendations of state agricultural policies and programs with climate benefits including case studies of effective and innovative state polices and programs. |
| **Type of action(s):** | Case Study and Toolkit; Voluntary incentive-based opportunities |
| **Impact:** | *Agriculture plays an important role in the economies of USCA states. Climate change negatively affects agriculture overall and agriculture is a net emitter of greenhouse gases. Agriculture can be an important climate mitigation solution.* |
| **Cost and bearer of cost:** | Varied examples of public and private funding |
| **Ease of implementation:** | Moderate; Lessons learned from several policies and programs highlighted can be integrated into recommendations being put forward. |

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# Cornell Characterization of Soil Health in NYS

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|---|---|
| **Jurisdiction:** | *Cornell College of Agriculture and Life Sciences (CALS), Cornell Soil Health Laboratory, NY Soil Health Working Group* |
| **Context:** | *Soil health concepts, practices, and testing have generated a growing awareness of soil's central role and highlights that sustainable soil management requires an understanding of biological, physical, and chemical processes and that management can significantly degrade or improve the quality of the soil. The NYS Soil health dataset was compiled from 1,456 soil samples collected from 2014 to 2018.* |
| **Description of action(s):** | Soil health in New York is affected by both soil type and cropping system differences that relate to carbon cycling and soil disturbances. Metrics for quality standards and goals are common for many natural resources (air, water, etc.) soil health goals can help farmers calibrate their management and target policy efforts. |
| **Type of action(s):** | Soil health standards for improved soil health and carbon sequestration |
| **Impact:** | *Building soil organic carbon offers an opportunity for carbon storage for negative emissions on-farm. Carbon sequestration and soil health improvements are aligned for a win-win of on-farm and statewide GHG reduction goals.* |
| **Cost and bearer of cost:** | Soil health testing is paid for by the farm and can be supported by state cost-share programs. |
| **Ease of implementation:** | Easy; this is current research for NY soil health that can be used to develop a soil health standard for NYS. |

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# Payment for Ecosystem Services for Vermont

| | |
|---|---|
| **Jurisdiction:** | *University of Vermont, State of Vermont* |
| **Context:** | *Payment for Ecosystem Services (PES) when aligned with water quality goals has the potential to protect water quality while aiding the struggling agricultural economy. University of Vermont Gund Institute's white paper issued September 2019 highlights that to support economic viability for farmers with a PES program that is voluntary, flexible, and equitable will incentivize innovative and sustainable agricultural land management that provides multiple ecosystem services (for nutrient and/or GHG reductions).* |
| **Description of action(s):** | Voluntary financial incentive program compensating farmers for performance gains that provide multiple ecosystem services. |
| **Type of action(s):** | *Research paper on voluntary incentive-based program to increase efforts to reduce phosphorus entering Lake Champlain in order to meet the Total Maximum Daily Load (TMDL) set by the state.* |
| **Impact:** | *A PES program that is performance-based would quantify ecosystem service provisioning from farms and reward farmers for their measured contributions to public goods. Programs that incentivize performance reward farmers based on quantifiable outcome but have historically been too expensive and burdensome to monitor and verify. Advances in measurement and modeling tools have created an opportunity for performance-based payment programs.* |
| **Cost and bearer of cost:** | Setting the right rates enables the desired level of farmer participation and ecosystem service outcomes. The rate per unit will have to be calculated. Public and private funding sources. |
| **Ease of implementation:** | Moderate; examples of program logistics exist but the rate per unit offered and quantification verification may take time to research and set standards for. |

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# WAC Nutrient Management Credit Program

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|---|---|
| **Jurisdiction:** | *NYC Watershed, Watershed Agricultural Council (WAC) , NYC Department of Environmental Protection (NYC DEP)* |
| **Context:** | *The Watershed Agricultural Council (WAC) created the Nutrient Management Credit Program (NMC) in early 2000's to provide financial incentive to offset some of the added costs associated with properly implementing a farms Nutrient Management Plan. Program participants receive $10/acre plus an animal unit rate for following and monitoring their Nutrient Management Plan.* |
| **Description of action(s):** | Voluntary financial incentive program including technical assistance provided to participating farms |
| **Type of action(s):** | *Voluntary incentive-based program; created as part of NYC watershed filtration avoidance plan* |
| **Impact:** | *140 farms participate reducing phosphorus in the watershed. On average each farm participating receives $3,900 credit towards eligible expenses relating to nutrient management. The reduction of phosphorus has improved water quality in the NYC watershed and has aided in meeting the filtration avoidance plan. Technical assistance necessary for plan implementation supports jobs for agricultural planning and on-farm management. This model could be implemented to track and incentivize GHG emissions reductions on-farm as well as other types of Ecosystem Services.* |
| **Cost and bearer of cost:** | Costs are covered through NYC DEP. Annual cost of program in 2020 was ~$560,000. |
| **Ease of implementation:** | Moderate technical assistance is important for accurate planning and implementation and oversight of record keeping. |

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# Silvopasture Examples in New York

| | |
|---|---|
| **Jurisdiction:** | Cornell University, Cornell Cooperative Extension (CCE) of Schuyler County and the SCNY Ag Team, Case study location: Angus Glen Farms, LLC Watkins Glen, NY |
| **Context:** | Silvopasture is a land management system that sustainably integrates trees, livestock and forage. When properly implemented, silvopasture may increase carbon sequestration through increasing the number and growth rate of trees, increasing the longevity of trees, growing trees for long-lived products, increasing soil carbon, and reducing the clearing of forest for pasture. Case studies of Angus Glen Farms from 2015 to date provide examples of woodlot Silvopasture and plantation Silvopasture management. |
| **Description of action(s):** | Silvopasture is utilized in most other regions of the world but has not been widely adopted in the Northeast. Although successful examples of silvopasture exist in NY, increased awareness and support would improve the rate and scale of adoption. |
| **Type of action(s):** | Land use and land management |
| **Impact:** | Estimated potential in NYS: 2 million acres – defined as development of silvopastures on existing woodlands that can be profitably and sustainably managed. This acreage would increase significantly if new and expanded grazing operations create opportunities to feasibly incorporate small and fragmented parcels that may not be profitable in isolation. Additional benefits include enhanced food security, local jobs and rural economic development. |
| **Cost and bearer of cost:** | Net Present Value (NPV, 5% discount rate) of silvopasture is $1,200/acre vs. $600 for timber only vs. $60 for hay only. Additional benefits not factored in to the NPV calculation include increased animal performance, reduced vegetation (invasive species) management costs, and a locally-grown source of grass-fed meat and fence posts (reduced transportation costs). |
| **Ease of implementation:** | Moderate; technical assistance and outreach is important for implementation. |

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# Silvopasture Examples in New York

# NRCS Carbon Planning Guidance

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|---|---|
| **Jurisdiction:** | *USDA Natural Resource Conservation Service (NRCS)* |
| **Context:** | *A carbon plan is a whole-farm conservation plan that when implemented will enhance soil health, increase carbon sequestration, and reduce GHG emissions. Planning guidance from NRCS from 2018 provide a pathway for developing carbon plans.* |
| **Description of action(s):** | *The planner and farmer develop a plan to identify carbon sequestration and GHG mitigation potential.* |
| **Type of action(s):** | Voluntary plan to address on-farm resource concerns with a focus on opportunities for carbon sequestration and GHG reduction. |
| **Impact:** | *Site-specific conservation practice systems implemented with known and/or quantifiable greenhouse gas benefit.* |
| **Cost and bearer of cost:** | Cost-share assistance is needed and technical assistance for plan development. Public and private funding could be used. |
| **Ease of implementation:** | Moderate; planning templates and tools need to be customized to New York. Planning infrastructure exists and a Carbon Planning element can be added. |



# Cornell Nutrient Management Spear Program Whole Farm Nutrient Mass Balance Assessment

| | |
|---|---|
| **Jurisdiction:** | *Cornell College of Agriculture and Life Sciences (CALS), Nutrient Management Spear Program* http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/MassBalances.html |
| **Context:** | *Farm Nutrient Mass Balances (NMB) help farmers and their advisors find ways to increase nutrient use efficiency on farms and, thereby, decrease nutrient imports and reduce loadings to watersheds. Balances provide a useful and achievable metric for assessing nutrient loadings and potential losses on farms, include N20, as losses could be significantly reduced if fewer nutrients were imported onto the farm in the first place. [from http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/MassBalances.html].* |
| **Description of action(s):** | *The NMB of a farm is the difference between the amounts of nitrogen (N), phosphorus (P), and potassium (K) imported as feed, fertilizer, animals, and bedding, and nutrients exported via milk, animals, crops, and manure. With the development of feasible farm nutrient mass balance guidelines, farmers and advisors are better able to identify farm-specific opportunities to reduce nutrient loadings. This collaborative approach among farmers and advisors providing confidential, farm-specific summaries for benchmarking by farmers and anonymized statewide summaries offers an example for the benchmarking and monitoring enabling initiative prioritized in the Panel recommendations.* |
| **Type of action(s):** | *Extension program; Voluntary, incentive-based opportunities.* |
| **Impact:** | *Work with hundreds of farms in NYS has shown reductions of between 29%-41% in nitrogen balances over the last decade (https://doi.org/10.3168/jds.2015-9776).* |
| **Cost and bearer of cost:** | *Long-term funding for NMB program staff; for field staff from Cornell Cooperative Extension, Soil and Water Conservation Districts, and AEM Planners; and as incentives for farmer participants.* |
| **Ease of implementation:** | Moderate; MNB work has been underway for over two decades, but more funding, technical assistance and outreach is important for expanded implementation. |

# USDA BioPreferred procurement program

| | |
|---|---|
| **Jurisdiction:** | *U.S. Department of Agriculture, United States* |
| **Context:** | *Created in 2002 and expanded in 2018 by Congress, the BioPreferred Program's purpose is to increase the purchased of biobased products. It uses a mandatory purchasing requirement for federal agencies/contractors and a voluntary labeling initiative for qualifying products. The Program was created to support U.S. energy security but has since been expanded to also support U.S. environmental security.* |
| **Description of action(s):** | Mandatory government procurement program. |
| **Type of action(s):** | *Created by legislative act and implemented by executive branch.* |
| **Impact:** | *Covers 139 categories (e.g., cleaners, carpet, lubricants, paint, etc.) of biobased products that displace fossil products. Estimated to support 4.2 million domestic jobs (direct, indirect, and induced) and contribute $393 billion to U.S. economy ($127 billion direct sales and $266 billion spillover sales). Jobs growth has been concentrated in rural/lower-income areas. Covered biobased products are estimated to displace 300 million gallons of annual U.S. petroleum consumption, which is equivalent to removing 200,000 cars from the roads.* |
| **Cost and bearer of cost:** | Costs are borne by federal government agencies. |
| **Ease of implementation:** | Moderate to implement (need to establish biobased product criteria) and easy to maintain. |

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# Dutch Ministry of Infrastructure and the Environment (RWS) tenders

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|---|---|
| **Jurisdiction:** | *Rijkswaterstaat (Dutch Ministry of Infrastructure and the Environment), Netherlands* |
| **Context:** | *Created by the Netherlands House of Commons, the RWS tenders purpose is to encourage the minimization of environmental impacts related to infrastructure building. It required that green criteria be included in all RWS tenders by 2015.* |
| **Description of action(s):** | RWS tenders require two sustainability criteria, one on energy savings, efficient use of materials, and use of renewable energy; and a second on the environmental impacts of the use of materials specified in a contract. |
| **Type of action(s):** | *Created by legislative act and implemented by the executive branch.* |
| **Impact:** | *Incentivizes bidders that can prove via life cycle assessment ("CO2 performance ladder") that their operations lead to significant CO2 operations. Utilizes sustainable construction logistics and "Social Return on Investment" to quantify full impacts across the supply chain. Employs DuboCalc software to calculate the full environmental effects of a material, building, or method as an environmental cost indicator that utilizes life cycle environmental impacts in 11 areas.* |
| **Cost and bearer of cost:** | Costs are borne by national government agencies. |
| **Ease of implementation:** | Moderate to implement (need to establish sustainability criteria and calculators) and easy to maintain. |

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# EPA Green Suppliers Network

| | |
|---|---|
| **Jurisdiction:** | *Washington D.C.; U.S. federal government* |
| **Context:** | *Created by U.S. EPA in collaboration with U.S. Department of Commerce National Institute of Standards and Technology's Manufacturing Partnership in order to help small-, medium-, and large-sized manufacturers stay competitive and profitable while reducing their impact on the environment.* |
| **Description of action(s):** | The U.S. EPA's Green Suppliers Network works with manufacturers to engage their suppliers in low-cost technical reviews to identify strategies for improving process lines, using materials more efficiently, and reducing waste. Technical assistance is provided on the measurement and improvement of energy efficiency and GHG emissions across the supply chain. |
| **Type of action(s):** | *Executive* |
| **Impact:** | *Participating manufacturers and their suppliers have been able to quantify the environmental impacts of their supply chains and improve their profitability while minimizing energy losses, pollution, and GHG emissions. Participants further report improvements to their sustainability commitments, risk mitigation efforts, and ability to meet customer demand for greener products.* |
| **Cost and bearer of cost:** | Cost not available; cost of technical assistance borne by EPA; cost of implementing improvements borne by participating manufacturers and their suppliers. |
| **Ease of implementation:** | Moderate due to need to establish network, although implementation ease has increased as major retailers have adopted their own supply chain sustainability metrics. |

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# Södra pulp mill biomethanol production facility

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|---|---|
| **Jurisdiction:** | *Project Location: Mönsterås, Sweden; Entity: Södra pulp mill* |
| **Context:** | *Announced in 2017 and operational in 2020. Biomethanol production facility constructed on-site at existing pulp mill to increase energy efficiency and contribute to circular economy. Biomethanol is sold to Danish biodiesel producer Emmelev A/S as input that displaces natural gas consumption. Resulting biodiesel is incentivized as part of Denmark's transportation decarbonization targets.* |
| **Description of action(s):** | Installation of biomethanol production capacity that utilizes forestry waste generated at an existing pulp mill. |
| **Type of action(s):** | *Commercial low-carbon product investment in response to national decarbonization policy and the European Union's Renewable Energy Directive 2.* |
| **Impact:** | *The use of biomethanol to produce biodiesel results in a biodiesel that is 100% renewable and achieves a lower carbon intensity than biodiesel that does not utilize biomethanol as an input. Increases the economic sustainability of Sweden's existing low-carbon feedstock supply chain and creates additional jobs at an existing pulp mill. Produces 5,000 tons of biomethanol annually.* |
| **Cost and bearer of cost:** | Cost not available; cost borne by Södra pulp mill. |
| **Ease of implementation:** | Moderate due to novelty of biomethanol production capacity integrated with existing low-carbon feedstock supply chain. |

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# Cornell University's Leland Pyrolysis Kiln Demonstration

| | |
|---|---|
| **Jurisdiction:** | *Project Location: Ithaca, NY; Entity: Cornell University* |
| **Context:** | *Began operations in 2018 for the purpose of converting waste and sustainable biomass to biochar (sequestered CO2). Funded through a philanthropic gift to Cornell's Atkinson Center for a Sustainable Future. Designed to achieve commercially representative operations of biogenic carbon sequestration in NYS.* |
| **Description of action(s):** | Construction and operation of pyrolysis kiln that processes 50 kg/hr of organic feedstock at temperatures of up to 600°C. The kiln yields 15-20 kg/hr biochar and is capable of utilizing a wide range of feedstocks, including ag waste, woody biomass, animal waste (manure, poultry litter), etc. |
| **Type of action(s):** | *R&D* |
| **Impact:** | *Biochar produced by the kiln achieves stable sequestration of the feedstock's biogenic carbon content, resulting in a net-negative GHG emissions pathway. The use of high temperatures neutralizes any pathogens contained in the feedstock (e.g., dairy manure). In addition to carbon sequestration, biochar has been found to increase crop yields, reduce nutrient run-off, and achieve other ecosystem services/bioremediation benefits in some applications.* |
| **Cost and bearer of cost:** | Funded through a $5 million gift from philanthropist Yossie Hollander. |
| **Ease of implementation:** | Easy due to availability of equipment for demonstration-scale facility. |

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# Cornell University's Leland Pyrolysis Kiln Demonstration


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# California Energy Commission Autothermal Pyrolysis Demonstration

| | |
|---|---|
| **Jurisdiction:** | *Project Location: El Dorado Hills, CA; Government: State of California* |
| **Context:** | *In 2017, the California Energy Commission (CEC) solicited proposals for projects to demonstrate production of bio-oil that was suitable for upgrading to fungible low carbon fuels. The project team of Lawrence Livermore National Laboratory (LLNL), Iowa State University (ISU), Frontline Bioenergy (FBE), and Sierra Pacific Industries (SPI) received an award.* |
| **Description of action(s):** | *The project team is designing, constructing, and fabricating a modular, autothermal pyrolysis system to convert 50-ton-per-day of wood waste into bio-oil suitable for upgrading into low carbon "drop-in" hydrocarbon transportation fuel. Deliverables of the project include 50,000 gallons of bio-oil, technical demonstration of the hydroprocessing of the bio-oil into transportation fuel, and an economic and life cycle analysis of the overall process.* |
| **Type of action(s):** | *R&D* |
| **Impact:** | *The project supports California goals of reducing greenhouse gas emissions; expanding the supply of alternative fuels; and expanding the capacity of forests to remove $CO_2$ from the atmosphere.* |
| **Cost and bearer of cost:** | *Total project cost: $7.397 million. Bearer of cost: CEC ($5.7 million); FBE ($0.72 million); ISU ($0.305 million); LLNL ($0.291 million); SPI ($0.38 million).* |
| **Ease of implementation:** | *Easy due to leveraging of existing technological pathways and use of modular equipment.* |



# California Energy Commission Autothermal Pyrolysis Demonstration

# Waste Advisory Panel

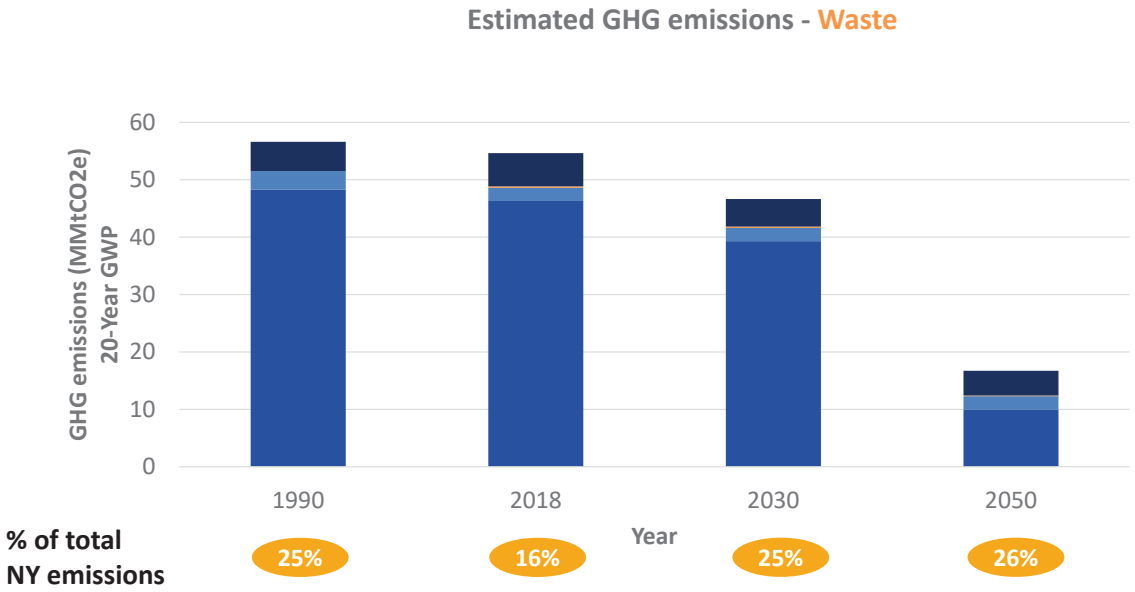
## Recommendations

April 5, 2021

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council



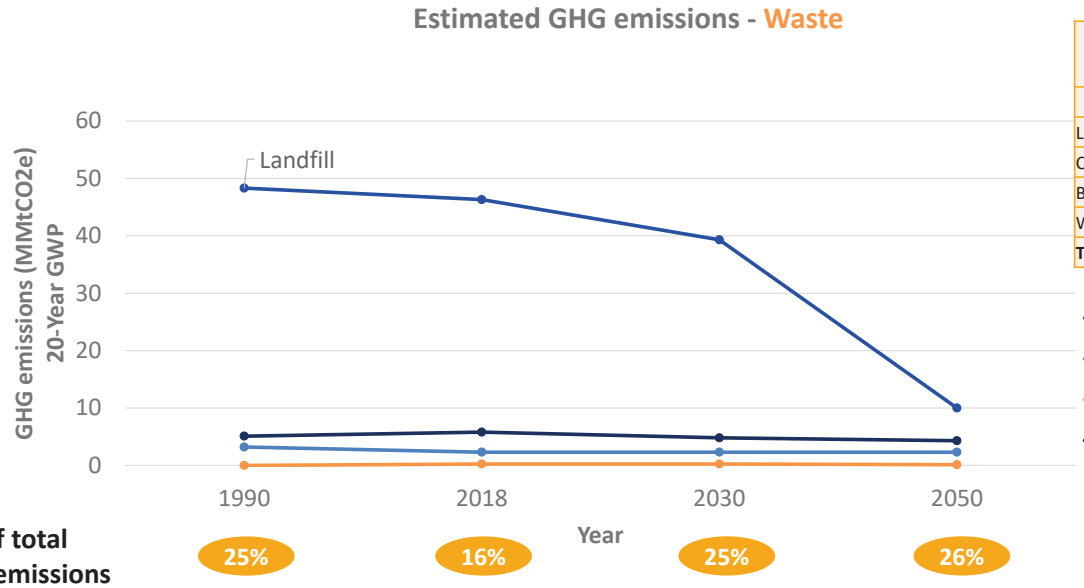
## Aggregate GHG emissions impact of Waste panel recommendations




**Reductions require aggressive initiatives to divert organics from landfills and reduce methane leaks.**

2018 emissions data are preliminary draft

# Aggregate GHG emissions impact of Waste panel recommendations




| Total reductions in GHG emissions from 1990 | | |
|---|---|---|
| | 2030 | 2050 |
| Landfill | 18.6% | 79.3% |
| Combustion | 28.1% | 28.1% |
| Biological | (increase) | (increase) |
| Wastewater | 5.9% | 15.7% |
| **Total all sectors** | 17.6% | 70.5% |

**% of total NY emissions**

25% 16% 25% 26%

2018 emissions data are preliminary draft

# Actions needed to achieve GHG emissions reductions

> Landfills
  - Achieving the aggressive goals of *Beyond Waste*, the New York State Solid Waste Management Plan (e.g., 90% paper recycling and 65% food waste diversion by 2030)
  - Delay in achieving GHG emissions reductions due to typical slow rate of degradation of waste placed in landfills

> Combustion
  - No reduction projected from 2018-2050 because existing combustor facilities will be needed to handle MSW remaining after reduction, reuse, and recycling strategies

> Biological (composting, regional anaerobic digesters)
  - 50% of current leaks eliminated by 2030; 75% by 2050

> Wastewater
  - 50% of current anaerobic digester leaks eliminated by 2030; 75% by 2050
  - 1/3 of fugitive emissions from WRRFs eliminated by 2030; 2/3 by 2050
  - 1% increase in municipal sewer system utilization (conversion from septic) by 2030; 2% by 2050

# Mitigation strategy summary

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 1 | Reduce methane and carbon dioxide emissions by reducing the combustion and landfilling of organics and other methane/GHG producing wastes. | Legislative; Regulatory; Financial | High | Easy | $$ |
| 2 | Reduce methane and carbon dioxide emissions from waste disposal facilities by enacting broad Extended Producer Responsibility (EPR)/Product Stewardship requirements to cover the recycling of packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, and other methane generating wastes. | Legislative | High | Easy to Medium | $$ |
| 3 | Identify and reduce fugitive emissions of methane from landfills and anaerobic digesters through baseline measurement, increased monitoring, and engineering and regulatory programs to reduce leaks. | Regulatory | High | Easy to Medium | $ |



# Mitigation strategy summary

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 4 | Reduce methane and carbon dioxide emissions from landfills and combustors by supporting domestic recycling facilities and markets for recovered resources, including compost, digestate, and recycled aggregate/building deconstruction materials. | Legislative; Financial | Medium | Easy to Medium | $ - $$ |
| 5 | Recognizing that some waste generation is unavoidable, determine limited and strategic best uses for energy produced from biogas/RNG derived from organic waste. Assess use in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries and hard to electrify users. Utilize market value of the energy to support organics diversion and waste reduction initiatives. Align energy price analysis with funding needs for build-out of organics recycling infrastructure. | Legislative; Financial | Medium to High | Medium | $$ |

# Mitigation strategy summary

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| 6 | Reduce methane and carbon dioxide emissions from waste disposal facilities by supporting robust waste reduction, reuse, and recycling initiatives. | Legislative; Financial | Medium | Easy | $ |
| 7 | Transform Wastewater Treatment Plants from waste disposal priority to Water Resource Recovery Facilities (WRRFs) that emphasize capture of beneficial products. | Financial | High | Medium | $$ |
| 8 | Measure and reduce fugitive emissions from WRRFs, septic and sewer systems. Where density and local conditions allow, eliminate septic tanks and convert to municipal sewer system collections or advanced onsite treatments. | Legislative; Regulatory; Financial | High | Easy to Medium | $$ |
| 9 | Reduce GHG emissions associated with end-of-life management of appliances that contain High-Global Warming Potential refrigerants. Benefits are highest in the near-term while these refrigerants are still in widespread usage. | Legislative; Regulatory | Medium to High | Easy | $ |



# Mitigation strategy – Initiative #1: Organic Waste Reduction and Recycling

| | | | |
|---|---|---|---|
| **Description:** | Reduce methane and carbon dioxide emissions by reducing the combustion and landfilling of organics and other methane/GHG producing wastes. | | |
| **Action type:** | Legislative; Regulatory; Financial | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$; Cost are associated with the development of infrastructure for additional food donation, increased food scraps recycling, and organics handling. However, costs are shifted from waste disposal. | | |
| **Ease of implementation:** | Easy; The technologies exist, the challenges are financial (e.g., investment & end markets), behavioral, and logistical (e.g., siting, etc.). | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • The relatively low cost of landfilling make alternatives less attractive<br>• Capacity and economically viable markets must exist for compost, biogas, digestate, and other organics products.<br>• Requires significant and broad-based behavior change.<br>• May create impacts in transportation and handling.<br>• Presence of co-pollutants including emerging contaminants. | • As more organics recycling facilities and collection systems are established the cost should become more competitive.<br>• Successful food scraps recycling systems already exist and can be replicated.<br>• Low carbon approaches to collection and transportation.<br>• Reliable end markets / market outlets.<br>• Tip fee surcharge important to establishing funding sources. |

# Mitigation strategy – Organic Waste Reduction and Recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Expand and Amend existing Food Donation and Food Scraps Recycling Law to include smaller food scraps generators, eliminate or increase mileage limit for organics recycling facilities and eliminate the financial hardship exemption. | Legislative | 1-2 years increase requirements of existing law | DEC, food generators, DOH, DAM, donation organizations, SWMFs |
| Phase in organics source separation requirements and eventual ban on the combustion and landfilling of food scraps, food processing wastes, and other high-strength and organic wastes. | DEC | 5-10 years phase in source separation and full ban | " |
| Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects. | Legislative | 1-2 years | DEC, solid waste management facilities (SWMFs), municipalities |
| Provide financial assistance for emergency food relief organizations and organics recycling facility infrastructure. Encourage partnerships between retailers and donation organizations for food and other household products. | DEC | 1 year | SWMFs, food recovery organizations |



# Mitigation strategy – Organic Waste Reduction and Recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Financial assistance to expand food scraps drop-off and local-scale processing opportunities (e.g., farmers markets, community gardens, transfer facilities, etc.).<br>Financial assistance for local, non-profit, and small-scale organics collection and processing systems. | DEC; DAM | 1-2 years | Municipalities, small-scale solid waste management facilities (SWMFs) and transporters, farmers |
| Financial assistance, education, and outreach to schools for food waste reduction, food donation, and on-site food scraps recycling programs. | DEC; NYSED | 2-3 years | NYSED, municipalities, schools |
| Provide incentive for public-private partnership for organics recycling facility development. | DEC; ESD | 2-3 years | Municipalities, SWMFs |
| Encourage co-location of solid waste infrastructure investments and operation by simplifying regulatory requirements and incorporate into local planning. | DEC; Legislative | 1-3 years | SWMFs |

# Mitigation strategy – Organic Waste Reduction and Recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Require local solid waste management planning units to emphasize food scraps recovery programs. | DEC | 1 year | Municipalities, local solid waste planning units |
| Food waste reduction education and outreach to businesses and residents. Evaluate and define food labelling and portion practices (including "best by dates", meal planning, etc.) to reduce waste. Implement "best by" food label standardization. | Legislative; DEC | 1-2 years | Residents, businesses, solid waste management facilities, retailers, manufacturers |
| Support reducing food waste in stores via enhanced demand planning systems (digital), minimized in-store inventory, dynamic pricing near expiry, and reduced portion size of food sales. Program to be coupled with education materials in stores and GHG smart shopping tips. | DEC | 1-3 years | Retail, groceries, digital inventory apps |



# Mitigation strategy – Organic Waste Reduction and Recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Evaluate the co-location of food donation and compost sites for streamlined waste diversion. Support installation of renewable energy projects (solar, wind, battery) to power refrigeration at donation sites for produce and perishable goods. | Legislative | 1-5 years | Food donation organizations, businesses, municipalities |
| Expand successful models for organics collection programs inclusive of multi-family buildings and public housing (e.g., NYCHA, etc.). | DEC; housing authorities | 1-3 years | Municipalities |
| Fund digital platforms for donation logistics and operation including efficient transportation route planning, food safety monitoring, reusable storage solutions where feasible, etc. | Legislative | 1-5 years | Food donation organizations, businesses, municipalities |

# Mitigation strategy – Organic Waste Reduction and Recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Require thoughtful food waste reduction and education strategies in school meals. Consider GHG impacts in purchasing of products selected for consumption. Enhance compost and waste diversion education standards in schools for early habit adoption. | Legislative; NYSED | 1-5 years | Municipalities, schools |
| Support technology-enabled waste tracking in restaurants. | DEC | 1-3 years | DEC, restaurants |
| Land use and procurement for non-profit, small-scale composters: Require that composting is explicitly allowed, and encouraged, on municipal park lands. | Legislative; DEC | 1-3 years | Parks |
| Increase the ability to distribute organic amendments locally: Establish local compost receiving partners with food growers, street tree, stormwater resiliency projects, individuals, etc. | DEC | 1-3 years | Municipalities, solid waste management facilities |



# Mitigation strategy – Organic Waste Reduction and Recycling

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Solid waste combustion and landfill facilities may be located in EJ and disadvantaged communities. Food waste in these facilities leads to odors that significantly impact quality of life for those communities and potential health impacts. Removing food waste will reduce truck traffic to the landfill and odors. |
| **Health and co-benefits** | Odors from landfills and transfer facilities have an impact on neighboring communities, and exposure to odors could result in health impacts. Reducing these odors will improve air quality and may reduce health impacts in these communities. |
| **Just transition: businesses and industries, workers** | Increasing food donation will assist those in need and increasing food waste recycling will increase job opportunities, including local jobs for recycling facilities located close to the source. |
| **Other** | The technologies are readily available if the requirements, financing, and end markets are available. |

# Mitigation strategy – Initiative #2: Extended Producer Responsibility/Product Stewardship

| | | | |
|---|---|---|---|
| **Description:** | Reduce methane and carbon dioxide emissions from waste disposal facilities by enacting broad Extended Producer Responsibility (EPR)/Product Stewardship requirements to cover the recycling of packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, and other methane generating wastes. | | |
| **Action type:** | Legislative | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$; Funding will be provided by the product manufacturers. | | |
| **Ease of implementation:** | Easy to Medium | | |
| **Example case studies:** | Successful current beverage container, electronic waste, thermostat, and battery programs in New York State. | | |

| **Risks / Barriers to success** | **Possible mitigants** |
|---|---|
| • May require the development of infrastructure to collect and recycle.<br>• Manufacturers are located across the globe.<br>• Certain industries may oppose taking responsibility or will cite successful recycling models already in place (e.g., paper and packaging manufacturers). | • Successful programs in New York State and elsewhere already exist using this model. |



# Mitigation strategy – Extended Producer Responsibility/Product Stewardship

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Legislation to create a framework for extended producer responsibility/product stewardship, or individual legislation targeting products with the greatest greenhouse gas impact (e.g., packaging and printed paper, carpet, tires, textiles, solar panels, wind turbines, all batteries, appliances (especially those containing refrigerants), mattresses, etc.) | Legislative | 1-5 years | DEC, product manufacturers |

# Mitigation strategy – Extended Producer Responsibility/Product Stewardship

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Reduction in landfilling will also reduce the need for transfer facilities and will reduce truck traffic that can impact EJ and disadvantaged communities. These facilities can significantly impact quality of life for those communities and potential health impacts. |
| **Health and co-benefits** | Reduction in truck traffic and transfer facilities can reduce emissions and will improve air quality in these communities.<br>Reduction in illegal dumping by providing convenient methods of recycling. |
| **Just transition: businesses and industries, workers** | Requiring manufacturers to establish collection systems for recycling will lead to local jobs associated with those collection systems. |
| **Other** | Requiring manufacturers to take responsibility for materials management leads to product designs that have less waste at the end of their useful life.<br>Solar panels and large-scale batteries are more of a concern for end-of-life management of renewable energy technologies that are expected to grow exponentially under the CLCPA. Currently no widely available options exist for end-of-life management of these items. |



# Mitigation strategy – Initiative #3: Reduce fugitive emissions

| | | | |
|---|---|---|---|
| **Description:** | Identify and reduce fugitive emissions of methane from landfills and anaerobic digesters through baseline measurement, increased monitoring, and engineering and regulatory programs to reduce leaks. | | |
| **Action type:** | Regulatory | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $ | | |
| **Ease of implementation:** | Easy to Medium | | |
| **Example case studies:** | California Methane Study (“Super-Emitter Study”) | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Current monitoring of fugitive emissions from landfills and ADs are not robust and full emissions data are lacking.<br>• Fugitive emission levels likely vary significantly among individual facilities (e.g., California Super-Emitter Study). | • Monitoring technologies continue to improve.<br>• Total number of landfill facilities anticipated to drop over time as facilities close or are repurposed for organics processing.<br>• Existing financial limitations of the facilities and municipalities. |

# Mitigation strategy – Reduce fugitive emissions

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Incorporate improved monitoring technologies (e.g., drones) into facility operations and existing monitoring programs. | DEC | 1-5 years | Solid waste management facilities |
| Implement best practices for further emissions reduction.<br>• Landfill examples: enhanced landfill covers to increase oxidation of methane, specialty landfill gas collectors for difficult to access areas, dewatering to increase collection.<br>• AD examples: improve maintenance on methane collection systems. | DEC | 1-5 years | Solid waste management facilities |
| DEC regulation changes for landfills to require installation of landfill gas collection systems sooner after waste placement; expansion of monitoring requirements for fugitive emissions beyond existing criteria. | DEC | 1-3 years | Solid waste management facilities |



# Mitigation strategy – Reduce fugitive emissions

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Landfills may be located in EJ and disadvantaged communities. Increased methane collection rates reduce the potential for odors or impacts from emissions. |
| **Health and co-benefits** | Emissions lead to odors and potential health impacts which have a significant impact on neighboring communities. Reducing these leaks will improve air quality and may reduce health impacts in these communities. |
| **Just transition: businesses and industries, workers** | Projects produce energy, jobs, co-located facilities, and opportunities for partnerships with industries needing energy and/or heat. |
| **Other** | Fugitive emissions data will focus regulatory and industry resources at the specific facilities or areas where the greatest improvements can be made. |

# Mitigation strategy – Initiative #4: Recycling markets

| | | | |
|---|---|---|---|
| **Description:** | Reduce methane and carbon dioxide emissions from landfills and combustors by supporting domestic recycling facilities and markets for recovered resources, including compost, digestate, and recycled aggregate/building deconstruction materials. | | |
| **Action type:** | Legislative; Regulatory; Financial | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $ - $$ | | |
| **Ease of implementation:** | Easy to Medium | | |
| **Example case studies:** | Onondaga Resource Recovery Agency's solid waste management facilities have public-private partnerships; existing OGS green procurement rules; ESD has previously assisted with funding recycling markets (e.g., glass, tires, etc.) | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Commodities markets are global and subject to severe capacity and price fluctuations.<br>• Markets may exist but the price paid is not enough to sustain the cost of material collection and processing. | • Growth in domestic markets will reduce volatility in market pricing.<br>• Domestic market pricing can be increased by subsidies, source separation requirements and other means. |



# Mitigation strategy – Recycling markets

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects. | Legislative | 1-2 years | DEC, solid waste management facilities, municipalities |
| Financial assistance to develop recycling markets. | Legislative | 1-4 years | DEC, solid waste management facilities, municipalities |
| Financial assistance to research and increase the capture and use of building deconstruction materials and recovered aggregate for a variety of applications. Change government requirements (e.g., procurement standards, bid specifications, etc.) to include recycled or reused deconstruction materials. | DEC | 1-4 years | DOT, solid waste management facilities, municipalities |

# Mitigation strategy – Recycling markets

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Provide incentive for public-private partnership for recycling facility development. | DEC | 2-3 years | DEC, municipalities, solid waste management facilities |
| Legislation to require a minimum level of recycled content in certain products and packaging to support end markets. | Legislative | 2-5 years | DEC, product manufacturers |
| Legislation and green procurement programs to require the use of recyclables (compost, construction aggregate, etc.) by State and local entities and those contracting with the government. | OGS; DEC | 1-3 years | State agencies |



# Mitigation strategy – Recycling markets

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Developing local markets supports the businesses that provide job opportunities and reduce pollution in disadvantaged communities (see other recommendations). |
| **Health and co-benefits** | Building local markets for materials reduces long distance truck traffic and associated health effects. |
| **Just transition: businesses and industries, workers** | Market development is critical to support the potential jobs in recycling and composting and will help support a just transition. |
| **Other** | |

# Mitigation strategy – Initiative #5: Biogas Use

| | | | |
|---|---|---|---|
| **Description:** | Recognizing that some waste generation is unavoidable, determine limited and strategic best uses for energy produced from biogas/RNG derived from organic waste. Assess use in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries and hard to electrify users.<br>Utilize market value of the energy to support organics diversion and waste reduction initiatives. Align energy price analysis with funding needs for build-out of organics recycling infrastructure. | | |
| **Action type:** | Legislative; Financial | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$; Stable, enhanced energy revenue will attract investment to aggressively manage methane in existing disposal facilities and existing and new organics recycling facilities. | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | CA Biomat (Bioenergy Feed-in Tariff Program – SB1122) | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Redirection of organics in MSW stream to new and existing digesters and compost facilities will require quantification of feedstock and facility capacity and locations.<br>• Ability to attract enough fuel approximate to facilities/guarantee fuel availability.<br>• Perception that new transmission infrastructure will be needed for biogas use. | • Alternative revenues at organics recycling facilities will allow lower tip fees to attract NY organics at competitive levels.<br>• Identify solutions to collection/feedstock/capacity issues and establish template for accelerated construction of organics recycling facilities 2030-2050.<br>• No significant new transmission infrastructure would be allowed to support additional biogas. |



# Mitigation strategy – Biogas Use

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Identify energy pricing model and conduct market-based study for waste-generated biogas. Provide funding mechanism to support organics recycling infrastructure. | NYSERDA; PSC; Utilities | 2-5 years | Solid waste management facilities, utilities, municipalities, business community |
| Evaluate strategic and local uses of generated fuels, electricity, or other energy produced from biogas/RNG for essential needs during transition to electrification and other low-emissions energy sources. Stress fuel uses in the waste transportation sector, electric co-location or cogeneration opportunities for energy/heat intensive industries, and hard to electrify users. Example: resilient microgrid capacity. | NYSERDA; PSC; Utilities | 2-5 years | Solid waste management facilities, utilities, municipalities, business community |

# Mitigation strategy – Biogas Use

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Reduction and control of methane and other gases by the creation of new organics recycling infrastructure will reduce the potential impact on disadvantaged communities where disposal facilities are located. |
| **Health and co-benefits** | Specific infrastructure improvements will also provide enforceable emission controls of other pollutants to improve local air quality. |
| **Just transition: businesses and industries, workers** | Jobs will follow the construction and operation of new facilities. Organics management has potential to develop into a national industry of its own. |
| **Other** | Organics recycling facilities need a revenue source other than gate fees. |



# Mitigation strategy – Initiative #6: Waste reduction, reuse, and recycling

| | | | |
|---|---|---|---|
| **Description:** | Reduce methane and carbon dioxide emissions from waste disposal facilities by supporting robust waste reduction, reuse, and recycling initiatives. | | |
| **Action type:** | Legislative; Financial | | |
| **GHG reduction by 2030:** | Medium | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $; The cost is very low compared to other solid waste initiatives. Reuse centers also assist those in need as a low or no cost source for household goods, etc. Repair cafes assist people in maintaining their household goods. | | |
| **Ease of implementation:** | Easy | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Having sufficient funding to establish and operate.<br>• A Business Plan and administrator for a broader statewide networking/franchising system is challenging. | • A consistent and sufficient funding source will lead to greater success.<br>• Energized grass roots volunteer, non-profit, and faith-based organizations already exist to implement. |

# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Require a surcharge (fee per ton) on all waste landfilled or combusted in New York State and all waste generated in New York State being sent for landfilling or combustion out-of-state to provide financial support for reduction, reuse, and recycling projects. | Legislative | 1-2 years | DEC, solid waste management facilities, municipalities |
| Financial assistance to support waste reduction and reuse education and program implementation. | DEC | 1-3 years | Municipalities, schools |
| Financial support for local reuse centers, materials exchanges/sharing hubs, certain repair shops, and innovative businesses incorporating recovered or waste reducing materials and technologies. (There is a big need to move beyond volunteer-run only operations.) | DEC | 1-3 years | Municipalities, non-profit charities |
| Legislation to require "By Request Only" policies for single-use (e.g., cutlery, straws, etc.) products at businesses. | Legislative; DEC | 1-2 years | Municipalities, businesses |



# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Support innovative zero-waste product development and business projects. | Legislative | 1-3 years | Businesses |
| Require textile origination/conditions of manufacture labeling and reduced sales of textiles; reduce import of GHG intensive and polluting textiles into NYS; optimize and reduce retail stocking; consumer-facing labeling on clothes and in stores; standardize eco-friendly clothing certification based on GHGs and pollutants. | DEC | 2-5 years | Clothing retailers/industry |
| Support and expand successful recyclables collection programs inclusive of multi-family buildings and public housing (e.g., NYCHA, etc.). Use best available save as you throw programs, with consumer education in buildings. | DEC; housing authorities | 1-3 years | Municipalities |

# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Require reusable/refillable options for consumer goods in retail stores. Support the reduction and eventual elimination of single-use packaged items for use in stores. Implement deposit container programs where feasible.<br>Require the sale of reusable diapers and feminine hygiene products in stores that choose to sell their disposable counterparts. Expand this to all personal care products, including toothpaste, soap, shampoo, etc. | Legislative | 5 years | Businesses |
| Support digital demand software/technologies to monitor and reduce over-production across all sectors with comprehensive, measurable, and equitable regulation and inspection, inclusive of food, livestock & pets, home goods, hygiene and health products, restaurant goods, textiles, and all other consumer goods. | Legislative | 1-4 years | Retailers, Manufacturers |



# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Fund infrastructure development (i.e., eco-hubs) to increase access to reuse and recycling opportunities for multi-family housing and campuses (e.g., NYCHA, business parks, etc.). Facilities consist of Reverse Vending Machines (RVM), inclusive of MGP, e-waste, textile, organics, reuse programs, and non-traditional recyclable items. | DEC; ESD; HCR | 3-5 years | NYCHA, housing authorities, municipalities |
| Implement new and expand existing statewide campaigns for reduction, reuse, and recycling (e.g., tv, hulu, spotify, radio and podcasts, billboards, subways, social media, other forms of media). | DEC | 2-3 years | NYSAR3, media companies, SUNY ESF |
| Support peer-to-peer education and outreach campaigns in underperforming and BIPOC communities around reduction, reuse, and recycling. | DEC | 1-3 years | EJ communities, municipalities, schools |

# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Support coordination between local and regional municipalities to enhance regional recycling initiatives. Provide funding to hire local enforcement officers for municipal recycling programs. Encourage cross-jurisdiction and multi-planning unit collaboration on these efforts (e.g., Hudson Valley Regional Council Materials Management Committee). | Legislative; DEC | 1-3 years | Municipalities, planning units |
| Require government procurement standards for low GHG-emitting products (e.g., textiles, paper, packaged products, etc.). | OGS; DEC | 1-3 years | State agencies |
| Evaluate the feasibility of requiring universal restaurant reusables (unbranded) which can be used across establishments, with a deposit for use and drop off locations. | DEC | 1-3 years | Restaurants |



# Mitigation strategy – Waste reduction, reuse, and recycling

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Support workforce development, job training and trades skills in repair, refurbishment, remanufacturing, recycling, and innovative materials reuse. (Example case study: NY Youth Works @ DOL) | ESD; NYSERDA; DOL | 1-3 years | DEC, businesses, non-profit charities, municipalities |
| Evaluate the feasibility of requiring reusable shipping containers and padding to replace packaging material from online retailers. | Legislative | 1-3 years | DEC, online retailers |

# Mitigation strategy – Waste reduction, reuse, and recycling

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Education on waste reduction can have a positive financial impact on EJ and disadvantages communities. Local reuse centers can be a source for free or low-cost household items. Repair cafes help individuals keep their household items working, reducing the need to purchase new appliances, etc. Reuse centers and sharing platforms offer free or low-cost household items to those who cannot afford to buy new or have the space to own. Reduces waste, builds equity, and reduces the need to buy new. |
| **Health and co-benefits** | Less materials produced leads to less pollution and waste from product manufacturing. |
| **Just transition: businesses and industries, workers** | Job training workshops and education will benefit people looking for work in disadvantaged communities. Repair shops can be a source of local employment. Funding/moving away from volunteer-run organizations and employing people to run reuse centers, etc. will improve local employment. |
| **Other** | Many examples of successful programs exist. |



# Mitigation strategy – Initiative #7: WRRF Conversion

| | | | |
|---|---|---|---|
| **Description:** | Transform Wastewater Treatment Plants from waste disposal priority to Water Resource Recovery Facilities (WRRFs) that emphasize capture of beneficial products | | |
| **Action type:** | Financial | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$; WRRFs are a key component of the circular economy and present tremendous opportunities for reducing GHG emissions; however, their funding is tied to water and sewer rates, is generally constrained, and is largely dedicated to water quality projects. Additional funding streams will be necessary to unlock the GHG reduction potential of wastewater and its associated infrastructure. | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Difficult to self-fund projects due to water quality priorities and water/sewer rate affordability considerations.<br>• Capital investments needed to maintain state-of-good-repair in addition to new resource recovery approaches.<br>• Market conditions and regulations favor landfilling biosolids/digestate over beneficial reuse.<br>• Evaluate extent and impact of co-pollutants such as emerging contaminants. | • Bioproducts resulting from resource recovery can be valuable if markets are aligned with GHG reduction priorities.<br>• Incentivizing biogas production and utilization can offset costly infrastructure upgrades.<br>• Current infrastructure has existing capacity to digest difficult-to-compost organics.<br>• Many municipalities are working towards this goal and would benefit from additional State-level support. |

# Mitigation strategy – WRRF Conversion

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| **Support beneficial use of biosolids**: Current market conditions often result in municipalities landfilling treated biosolids, losing the finite resources to landfills. Rising landfilling prices may push some municipalities to beneficially reuse naturally, but others that have agreements with local landfills and will require additional incentives to transition to beneficial reuse. Emerging technologies may make nitrogen, phosphorus and other nutrient separation and recovery economically feasible. | Local utilities; Municipalities | 2-10 years | DEC; landowners and farmers; agriculture sector |
| **Support beneficial use of renewable biogas,** recognizing that water treatment process waste generation is unavoidable**:** Existing treatment plants have high thermal demands to operate digesters used to stabilize sludge. Boilers and engines on site are often able to replace natural gas with a WRRF's own digester gas. Some facilities may be well situated to provide local communities and co-located facilities with limited but strategic quantities of RNG. | Local utilities; Municipalities | 2-10 years | DEC; engineering consultants; energy utilities |



# Mitigation strategy – WRRF Conversion

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| **Operate co-digestion programs with existing capacity:** Anaerobic digesters with existing capacity should accept difficult-to-compost organics such as post-consumer food waste and FOG (Fats, Oils and Grease). Diverting additional organic wastes to WRRFs will require increased pre-processing and depackaging capacity throughout the state – either on- or off-site. Thickening improvements at WRRFs are low-capital investments that can increase capacity to operate co-digestion programs. | Local utilities | 2 – 10 years | Local organics processors, haulers and microhaulers, DEC, waste preprocessing facilities |

# Mitigation strategy – WRRF Conversion

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Reduced volume of biosolids sent to landfills will reduce methane, odors (particularly a concern where landfills that serve NY communities abut EJ communities); beneficial use of biogas can help grid-constrained areas by reducing utility demand or by exporting power or RNG, as well as sending RNG to difficult-to-electrify local buildings or businesses. This transformation will require investments in infrastructure that will be difficult to self-fund because of concerns with keeping water and sewer rates affordable. |
| **Health and co-benefits** | Beneficial reuse of biosolids has potential to offset synthetic, GHG intensive fertilizers, re-green space (tree plantings), and restore disturbed land. |
| **Just transition: businesses and industries, workers** | WRRFs will function as job creation hubs in the circular economy. Capturing non-renewable resources contained in wastewater (e.g., nitrogen, phosphorous) from treatment processes will require workforce training and permanent job creation. This will range from technical positions at the facility to distributed roles in communities to manage the resource streams made available. |
| **Other** | Nutrient recovery has the potential to offset large quantities of fossil fuel consumption if it replaces fertilizers containing atmospheric nitrogen (an energy intensive process) that takes place outside of NYS and is therefore not contained in the state inventory but contributes to climate change. |

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# Mitigation strategy – Initiative #8: Fugitive emissions from WRRFs

| | | | |
|---|---|---|---|
| **Description:** | Measure and reduce fugitive emissions from WRRFs, septic and sewer systems. Where density and local conditions allow, eliminate septic tanks and convert to municipal sewer system collections or advanced onsite treatments. | | |
| **Action type:** | Legislative; Regulatory; Financial | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | High |
| **Cost and funding considerations:** | $$. Larger municipal utilities may be able to absorb some costs, but medium and smaller municipalities do not have the funding to accomplish without state funding. Sewering costs will vary based on availability of a local WRRF and local soil conditions, among other factors. Funding will be critical to address wastewater GHG emissions; DEC regulations may need to be revised to require monitoring and remediation. | | |
| **Ease of implementation:** | Easy to Medium, depending on emission source, funding available and monitoring capabilities. | | |
| **Example case studies:** | | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Monitoring of emissions can be difficult without proper equipment and training.<br>• Difficult to quantify and address sewer emissions.<br>• Nitrous oxide emissions profile of WRRFs is significant but poorly quantified.<br>• Sewer conversions require proximity to a WRRF, and requires responsible entity, referendum, debt obligation, and high up front costs.<br>• Private Property / Easement Access | • Some larger municipalities are already implementing these techniques and can provide guidance to others.<br>• Abating methane fugitive emissions is primarily a financial issue not a technical feasibility issue.<br>• Some communities have high septic costs because of soil conditions and may be willing to transition.<br>• State funding could be repurposed to support this water quality and methane emission reduction improvements such as sewering. |

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# Mitigation strategy – Fugitive emissions from WRRFs

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| **Capture and beneficially reuse fugitive biogas**: Repair and consistently operate WRRF flares, boilers, engines, or other equipment on-site in order to prevent fugitive methane emissions. Evaluate captured biogas potential to identify strategic beneficial uses before flaring excess capacity. | Local utilities; Municipalities | 6 months – 10 years | DEC, NYSERDA, EFC |
| **Rulemaking and monitoring:** Wastewater infrastructure was not always designed to mitigate GHG emissions and may require additional emissions monitoring rulemaking and oversight to implement. financial and procurement assistance to wastewater system operators is needed as well as job training to help stakeholders meet new air emission standards. | DEC; EFC; NYSERDA | 1 – 2 years | Municipalities, local utilities |



# Mitigation strategy – Fugitive emissions from WRRFs

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| **Perform emissions monitoring and updated at WRRFs and septic systems.** | DEC | 6 months – 5 years | Local municipalities |
| **Ensure proper maintenance of septic systems at the municipal level**. Municipalities could establish a funding mechanism (paid for by homeowners) to allow contractual services for routine maintenance on septic systems (potentially legislation). | Municipalities | 3 – 5 years | Home-owners, Septic system maintenance companies |
| **Repurpose septic sewer assistance programs:** Existing programs could be extended to include sewer hookups to defray high up-front costs of sewering. | EFC | 1-5 years | NYSCDBG, NYSDOH, NYSDEC, NYSEFC, USDA-RD |

# Mitigation strategy – Fugitive emissions from WRRFs

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Wastewater treatment plants are sometimes located in EJ and disadvantaged communities. Energy self-sufficiency at WRRFs can allow utilities to distribute finite renewable energy resources to other community needs. |
| **Health and co-benefits** | Emissions from wastewater treatment plants lead to odors and potential health impacts which have a significant impact on neighboring communities. Reducing these leaks will improve air quality in these communities. Proper maintenance of septic systems and septic conversions will improve surface and ground water quality. |
| **Just transition: businesses and industries, workers** | Local engineering, construction, and operation employment will be positively impacted by improving operations at these treatment facilities. These treatment plants are located throughout New York State, in large and small communities, providing widespread local employment opportunities. |
| **Other** | Reducing leaks will increase the amount of methane that is captured and can be used to generate renewable energy for use at the treatment plant and locally. |



# Mitigation strategy – Initiative #9: Refrigerant Diversion

| | | | |
|---|---|---|---|
| **Description:** | Reduce GHG emissions associated with end-of-life management of appliances that contain High-Global Warming Potential refrigerants. Benefits are highest in the near-term while these refrigerants are still in widespread usage. | | |
| **Action type:** | Legislative; Regulatory | | |
| **GHG reduction by 2030:** | High | **GHG reduction by 2050:** | Medium |
| **Cost and funding considerations:** | $ | | |
| **Ease of implementation:** | Easy | | |
| **Example case studies:** | EIA 100 Billion Ton Climate Problem (UK), EPA Part 608 implementation | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Wide range of manufacturers, products, and types of use of refrigerants.<br>• Enforcement challenging due to the large number of end-of-life facilities.<br>• Current lack of disposal data on these appliances. | • Many alternative refrigerants are being produced, but end-of-life management of existing appliances still remains important. |

# Mitigation strategy – Refrigerant Diversion

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** (*Entities that need to be engaged)* |
|---|---|---|---|
| Require reclamation or destruction of refrigerants from appliances at end of life and institute requirements for verification and reporting. | DEC | 1-5 years | Appliance manufacturers and producers, solid waste management facilities, auto repair |
| Imposing a ban on sale of virgin high-global warming potential (GWP) refrigerants for servicing with an exception for reclaimed refrigerants. | DEC | 1-5 years | Appliance manufacturers and servicers |
| Extended Producer Responsibility program (see Initiative #2) | Legislative | 1-5 years | |
| Create registry and reporting requirements (to track sales, stockpiles, and leaks) for large refrigeration and HVAC systems and refrigerant wholesalers and distributors. | Legislative; DEC | 1-5 years | Appliance manufacturers and servicers, users such as supermarkets |



# Mitigation strategy – Refrigerant Diversion

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | HVAC and refrigeration equipment is important for human safety and resilience to climate change. Those who are most vulnerable may also be most affected transformations in this industry, including short-term price impacts driven by state and federal policy. Addressing leakage and disposal could mitigate costs. |
| **Health and co-benefits** | Proper management of refrigerant-containing appliances will decrease overall pollution from disposal of this material. |
| **Just transition: businesses and industries, workers** | Could lead to additional jobs related to service, recovery, and destruction of refrigerants from end-of-life appliances. |
| **Other** | These management techniques should be coupled with continued alternative refrigerant (replacement) research and production. |

# Enabling strategy summary

| Description | Action type | Ease of implementation | Cost |
|---|---|---|---|
| Continue to research and obtain more accurate data on climate impacts from solid waste | Financial | Easy | $ |
| Green, equitable jobs and workforce development. Institute coordination around workforce recruitment and employment frameworks. Develop strategies that result in a living wage green-collar labor system for residents and communities that are economically disadvantaged. Sustainable funding for environmental justice, resident-led initiatives with proven, shovel-ready (local and regional) solutions that reduce and divert recyclables and organics with a focus on multi-family buildings, disadvantaged, BIPOC, and underperforming communities. | Financial | Easy | $ |

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# Enabling initiative: Research

| | |
|---|---|
| **Description:** | Continue to research and obtain more accurate data on climate impacts from solid waste |
| **Action type:** | Financial |
| **Cost and funding considerations:** | $; Costs associated with contracts with academic and consulting entities to perform research/pilot studies |
| **Ease of implementation:** | Easy |
| **Example case studies:** | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Obtaining and contracting in a timely manner<br>• Applying research to existing mitigation strategies<br>• Obtaining research results in time to implement to meet State climate goals<br>• Limitations in available expertise in areas needed | • Contracting procedures already well understood<br>• Some research already occurring on these topics<br>• Timing to complete research should not be extensive |

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# Enabling initiative: Research

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Better understanding of potential co-pollutants from solid waste management and recycling facilities, including emerging contaminants. | DEC | 1-3 years | Solid waste management facilities (SWMFs), academics, consultants |
| Development of lifecycle analysis model and solid waste management decision making tool. | DEC | 1-3 years | SWMFs, academics, consultants |
| Research end of life management for difficult to manage materials (e.g., refrigerants, green energy infrastructure like solar panels, etc.). | DEC | 1-3 years | NYSERDA, SWMFs, academics, consultants |
| Comprehensive landfill gas and water resource recovery facility emissions research study to evaluate emissions monitoring techniques, quantify fugitive emissions, and to evaluate most appropriate uses for the gas during transition to statewide electrification. | DEC | 1-3 years | Landfills, academics, consultants, utilities |
| Market study of quantity and characteristics of organics (food waste, biosolids, other high strength waste) produced in state as well as possible end uses (agriculture, mine reclamation, roadside soil amendments and erosion control, etc.) | DEC | 1-3 years | DAM, DOT, academics, consultants, SWMFs |



# Enabling initiative: Research

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Better research on co-pollutants and other impacts from solid waste management facilities (SWMFs) that may be located in EJ communities and means to potentially mitigate issues affecting these communities. |
| **Health and other co-benefits** | Research on co-pollutants can help inform ways to eliminate health issues related to water and air pollution.<br>Market research and development will assist SWMFs in effectively distributing product. |
| **Just transition: businesses and industries, workers** | Research projects lead to additional employment in engineering consultant firms and academic institutions. |
| **Other** | Emerging waste streams from clean energy efforts have not been previously studied or handled. Further research will help inform end-of-life management for these new wastes. |

# Enabling initiative: Green jobs

| | |
|---|---|
| **Description:** | Green, equitable jobs and workforce development. Institute coordination around workforce recruitment and employment frameworks. Develop strategies that result in a living wage green-collar labor system for residents and communities that are economically disadvantaged. Sustainable funding for environmental justice, resident-led initiatives with proven, shovel-ready (local and regional) solutions that reduce and divert recyclables and organics with a focus on multi-family buildings, disadvantaged, BIPOC, and underperforming communities. |
| **Action type:** | Financial |
| **Cost and funding considerations:** | $ |
| **Ease of implementation:** | Medium |
| **Example case studies:** | Inner City Green Team (NYC) |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| | • See above recommendation about public/private funding mechanism for green jobs in waste<br>• Thoughtfully easing restrictions for entrepreneurs in city and state agencies |



# Enabling initiative: Green jobs

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders (***Entities that need to be engaged)* |
|---|---|---|---|
| Institute a job program aimed at recruiting recycling and sustainability champions and residents from multi-family buildings, disadvantaged communities, BIPOC, and underperforming communities. | DOL; Municipalities | 1-3 years | Municipalities, workforce |
| Strengthen partnerships with local workforce development and staffing programs. | DOL; DSNY; NYCHA; upstate municipalities | 1-3 years | Municipalities, workforce |
| Ensure funding consistent for program success. | DOL | 1-3 years | Municipalities, workforce |
| | | | |
| | | | |

# Enabling initiative: Green jobs

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Reduces economic disadvantages faced by such communities through creation of empowering workforce and job program co-led by people in community. |
| **Health and other co-benefits** | Creates heightened sense of community and solid waste management awareness. |
| **Just transition: businesses and industries, workers** | Strengthen partnerships with identified workforce development and staffing programs, which aims to attain job skills and better prepare working age residents for jobs that will increase earning and employment outcomes.<br>Creates the model for economic opportunity and sustainable green-collar jobs with a living wage that improves quality of life. |
| **Other** | Empowers residents to take green action, and increase pride where they live. |



# Additional panel perspectives summary

| Initiative | Summary of views |
|---|---|
| 1; 7 | Route at least 90% of organic waste to composting sites and facilities within 1-5 miles in cities, and 10 miles in less dense areas; Limited support for food waste routed as co-digestate to existing wastewater treatment facilities, up to 10% of organic waste stream, for local clean energy. |
| 5 | Encourage increased methane collection from landfills through an off-take or procurement program that compensates generators for reducing methane by combustion. |
| 5 | Off-take or procurement program for each kilo-watt hour (kWh) generated or thousand cubic feet (MCF) of pipeline gas produced; minimum price paid for compost products used in publicly funded projects. |
| N/A | Decommission NYS incinerators and end contracts out of state by 2030. Do not permit any subsidies, nor permit new incinerators, or incineration/burning by other names (inc. pyrolysis, gasification). |
| N/A | Establish polluter funded union jobs for cleanup and monitoring of natural and built environment (waterways and oceans, sewage, soils, air) to help all communities meet at least minimum legal environmental standards by 2035. Inclusive of but not limited to: fossil fuel companies, incinerators, plastic producers, single-use product producers, etc. |

# Additional panel perspectives summary (cont.)

| Initiative | Summary of views |
|---|---|
| N/A | Improve the Management of Combined Sewer Overflows (CSOs) to prevent continued contamination during rain and storm events with comprehensive green and grey infrastructure. The NYS Department of Environmental Conservation (DEC) should require stronger application of green infrastructure strategies and nature-based solutions to increase the CSO capture rate. DEC should also better monitor compliance and require green infrastructure intervention in Municipal Separate Storm Sewer System (MS4) and direct drainage areas to decrease risk of pollutants reaching our waterways. Public investments in addressing CSOs should be coupled with strong maintenance strategies that support the local workforce goals, as well as public input and community awareness. Additionally, a strong CSO policy should incorporate resilient safe disposal and control of floatable and settleable trash and debris, alongside an improved street disposal and recycling plan. |



# Land Use and Local Government Advisory Panel

## Recommended Strategies

May 3, 2021

NEW YORK STATE OF OPPORTUNITY. Climate Action Council

# Panel Members

**Sarah Crowell, Chair**
Director, Office of Planning, Devt, & Community Infrastructure: DOS

**Mark Lowery**
Assistant Director, Office of Climate Change: DEC

**Supported by a Multi-Agency Staff Working Group**

**Jessica Bacher**
Managing Director: Pace University School of Law Land Use Law Center

**Jayme Breschard-Thomann**
Senior Project Manager: Bergmann PC

**Kevin Law**
Former President & CEO: Long Island Association

**Katie Malinowski**
Executive Director: NYS Tug Hill Commission

**Ed Marx**
Former Commissioner of Planning: Tompkins County

**Kathy Moser**
Senior Vice President: Open Space Institute

**Priya Mulgaonkar**
Project Manager: Hester Street Collaborative; formerly NYCEJA

**Gita Nandan**
Board Chair: RETI (Resilience, Education, Training and Innovation) Center

**Juan Camilo Osorio**
Assistant Professor: Pratt Institute School of Architecture

**Eric Walker**
Climate and Clean Energy Strategist

# Local and Regional Governance in NYS

> New York's local governments wield significant influence through their legal authorities, relationship with their community members, and oversight of their own municipal assets and facilities. Municipalities of New York include:
  - **62 Cities**
  - **932 Towns**
  - **Over 551 Villages**
  - **~ 7,000 Special Districts**

> Local governments are critical partners to the State in providing the right planning, regulatory, financial and information-driven environment for these changes

> Regional and county-level organizations such as County IDAs, MPOs, and Regional Planning Boards and Regional Economic Development Councils do important land use planning that guides, frames, and informs local zoning
  - **62 Counties**
  - **14 Metropolitan Planning Organizations**
  - **9 Regional Planning Boards**
  - **10 Regional Economic Development Councils**


**Regional Planning Boards**

# Land Use and Local Government Goals

Local government provides the scaffolding/framework to facilitate the recommendations of many other panels. The LULGAP approached their recommendations with the following goals in mind:

- Support local and regional initiatives to **promote efficient land use/smart growth**
- **Maximize carbon sequestration potential** of both developed and undeveloped lands
- **Build capacity at the regional level** and streamline/enhance support to municipalities
- **Increase energy efficiency** in new development and promote energy efficiency retrofits
- **Accelerate responsible development and adoption of clean energy sources**
- **Reduce emissions** associated with municipal operations, buildings, facilities, and fleets
- **Commitments to environmental justice, disadvantaged communities, and a just transition**

# Recommendation Development Process

## Land Use and Local Government Advisory Panel

Process

### Themes and Priorities

Identification and consolidation of themes and priorities for each subgroup.

### Strategy Development

Translating themes into simple and actionable strategies for further review. Simple feasibility assessment, evaluation and feedback, and cross-panel communication.

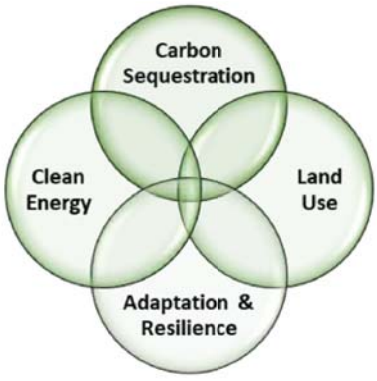
### Recommendation Development

Translating Strategies into achievable recommendations for detailed review. Detailed feasibility and mitigation assessment, research, and cross-panel review.

### Recommendation Feedback and Integration Analysis

Recommendations undergo further review and evaluation by LULGAP, receive cross-panel feedback and are readied for integration analysis by the CAC.

**Subgroups**



# Public and Stakeholder Input Process

**Panel Meetings:** The Land Use and Local Government Advisory Panel has held eight full Panel meetings that were open to the public; all meeting presentations and notes have been posted to climate.ny.gov.

**Local Government Officials Roundtable:** Local government input was received during two roundtable discussions (December 2020 and March 2021) and six small-group conversations with representatives from municipalities from across the state (November 2020). Over 30 local officials participated – distribution is illustrated on the following slide.

**Stakeholder Survey:** A survey was created by the panel, shared with panel member networks and other local government groups. The survey was open from December 1, 2020 to January 4, 2021 and 38 responses were received

**Public Input:** Input from the public received during a virtual forum in December 2020, during advisory panel meetings through the "chat" function, and by email to a dedicated email account (LULG@dos.ny.gov)

**Climate Action Council Engagement:** Input from the CAC received in November 2020.

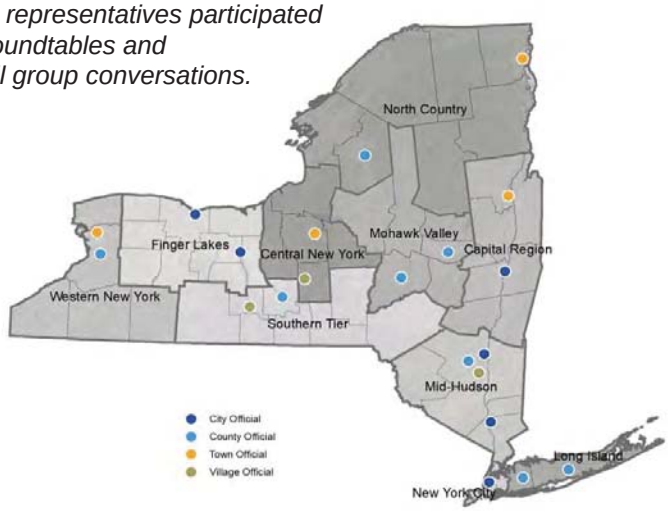
**Cross Panel Coordination:** Regular collaboration with Transportation, Ag & Forestry, Energy Efficiency & Housing, Power Generation and Waste Advisory Panels, as well as the Climate Justice and Just Transition Working Groups.



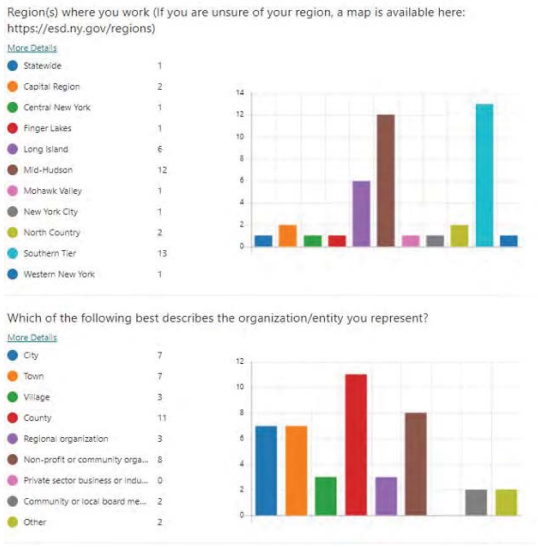
# Local Engagement

**Local Government Officials Representation**

*Over 30 representatives participated in two roundtables and six small group conversations.*




**Stakeholder Survey Representation**



# Glossary

**Blue Carbon:** carbon captured by ocean and coastal ecosystems.

**Brownfield Opportunity Area:** a planning and development program that transforms brownfields from liabilities to community assets that generate and support new businesses, jobs, and revenues for local economies, as well as providing new housing, commercial activity and public amenities.

**Community Choice Aggregation:** Community Choice Aggregation (CCA) allows local governments to choose where the energy comes from for their community. CCA is a municipal energy procurement model that replaces the utility as the default supplier of electricity for virtually all homes and small businesses within the jurisdiction.

**Community Distributed Generation (CDG):** Community distributed generation (CDG) allows an electrical production facility up to 5kW, such as a solar farm project, to share benefits through a subscription with residential and business participants who otherwise are not able to participate in solar benefits.

**NY Stretch Energy Code:** NYStretch Energy Code was developed by NYSERDA as a statewide model code for New York jurisdictions to use to meet their energy and climate goals by accelerating the savings obtained through their local building energy codes.

**ICLEI:** Local Governments for Sustainability (or simply ICLEI) is an international non-governmental organization that promotes sustainable development.

**Property Assessed Clean Energy (PACE) financing:** A program adopted by an eligible local government that allows property owners to pay back the cost of clean energy upgrades to their commercial or non-profit property over time and is secured through a benefit assessment lien on the improved property.

**Smart Growth:** sustainable, equitable planning and development that integrates the 3 Es—Equity, Economy and Environment. Smart Growth is based on several community design principles, including compact, mixed-use, mixed-income development in municipal centers; walkable, bikable and transit-accessible streetscapes; a variety of housing types, sizes and prices; safe, accessible public places; and strategically preserved open space and natural resources for outdoor recreation, healthy ecosystem and water functions and working lands, such as farms and forests.

**Transit Oriented Development:** smart growth development that is concentrated within a half-mile radius of rail or bus transit.

# Land Use

NEW YORK STATE OF OPPORTUNITY. Climate Action Council

# Land Use - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| LU-1 | Guide future growth, redevelopment, and conservation at the multi-municipal scale through regional planning. Facilitate and support collaborative multi-municipal smart growth comprehensive planning at the county and regional scales to inform and guide land use decisions, including designation of priority development areas and priority conservation areas | Programmatic and legislative | Medium | $$ |



# Land Use - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| LU-2 | Empower Local Government to Achieve Smart Growth Planning and Development. Provide direct planning and zoning assistance to local communities. Promote municipal implementation of mitigation strategies through enhanced technical assistance, increased support for local adoption of zoning and land use regulations consistent with smart growth principles, and local policies that support sustainable, equitable development and the accelerated expansion of local clean energy through a streamlined “Plan-to-Zone” initiative | Programmatic and technical assistance | Easy | $$ |

# Land Use - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| LU-3 | Enhance Resources to Enable Equitable Smart Growth. Provide local government with the necessary tools and resources to guide, enable and inform the process of achieving equitable smart growth projects such as TOD, mixed-income/affordable housing, downtown, village and hamlet centers, and infill development. | Programmatic and regulatory | Hard | $ |
| LU-4 | Align state funding priorities. Prioritize smart growth, equity, and sustainability in all relevant state funding, including new infrastructure spending | Programmatic and regulatory | Medium | $ |
| LU-5 | Accelerate Transit Oriented Development. Accelerate mixed-use, mixed-income transit-oriented development around key transit hubs served by rail and bus. | Programmatic/ Legislative | Medium | $$ |



# Enabling strategy - LU-1: Guide Future Growth Overview

| | |
|---|---|
| **Description:** | **Guide future growth, redevelopment, and conservation at the regional scale through regional planning.** Facilitate and support collaborative smart growth comprehensive planning at the county and regional scales to inform and guide land use decisions, including designation of priority development areas and priority conservation areas |
| **Action type:** | Programmatic and legislative |
| **Cost and funding considerations:** | $$ - requires some new resources for successful implementation, State and local funds and sources. |
| **Ease of implementation:** | Easy – Builds on/expands existing county and regional planning efforts |
| **Example case studies:** | Tompkins County; Genesee County; Cleaner Greener Regional Sustainability Plans |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Long-term viability and stability of programs and funding sources are necessary for continued progress. In addition, existing power for comprehensive planning and zoning rests overwhelmingly with cities, towns, and villages individually. While the General Municipal Law provides for a role for counties in certain instances, the application is quite limited. | Require that counties and regional planning councils consult with municipalities, and allow larger municipalities to handle on their own, in consultation with counties. Ensure that regular funding is available to counties and regional entities to undertake planning in cooperation with municipalities. |

# Enabling strategy – LU-1: Guide Future Growth
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Align State funding selection criteria with the priorities and principles contained in the Cleaner, Greener Communities Regional Sustainability Plans, to the extent practicable | DOS, NYSERDA | 2 years | REDCs, DOS, multiple state agencies |
| Identify opportunities to increase coordination with REDCs and alignment of REDC Regional Strategic Plans with sustainability/smart growth/equity principles | REDCs | ongoing | ESD, DOS, NYSERDA other state agencies |
| Expand DOS Countywide Resiliency Planning grants to incentivize county-wide smart growth comprehensive plans that adhere to clear State goals and outcomes. Include health impact assessments where feasible and relevant, particularly in disadvantaged communities that have experienced health disparities | DOS | 2 years | Regional entities and local governments |



# Enabling strategy – LU-1: Guide Future Growth
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Develop criteria and incentives for regional entities and counties to identify priority development areas (including areas appropriate for clean energy siting) and priority conservation areas in consultation with local jurisdictions and communities. **Priority Development Areas** may include Brownfield Opportunity Areas, downtowns, central businesses districts, municipal centers, hamlets, former industrial districts, infill projects in developed areas, obsolete fossil fuel-based power plants, re-development/adaptive re-use of existing buildings, TOD/Equitable TOD, disadvantaged communities (as defined by the Climate Justice Working Group), dead/dying malls and vacant property clusters designated by land banks, among others; **Priority Conservation Areas** may include wetlands, riparian areas, forests, agricultural lands and other natural areas and working lands that preserve and restore vital habitats, landscape connectivity, biodiversity, natural water movement, local food security and passive recreation, among others. | DOS, DEC | 2 years | Multiple state agencies, regional entities, counties, municipalities, CBOs |

# Enabling strategy – LU-1: Guide Future Growth
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Extend eligibility for smart growth-related planning and implementation grants to regional planning councils and, where appropriate, qualified community-based organizations. | DOS/DEC | 2 years | |
| Evaluate opportunities through the use and potential expansion of General Municipal Law Section 239 County Review to further empower counties to implement shared regional smart growth priorities throughout metropolitan and micropolitan statistical areas in municipal planning, zoning and subdivision proposals | DOS | 1-3 years | Counties and local governments |
| Work with the Industrial Development Agencies in each region to proliferate tax incentive policies in their Uniform Tax Exemption policies to incentivize infill and downtown redevelopment | DOS | 5-10 years | IDAs |



# Enabling strategy – LU-1: Guide Future Growth
# Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding access to public transportation through Transit-Oriented Development (TOD) will have positive impacts for lower-income households and disadvantaged communities by addressing the spatial mismatches<br>• **Establish brownfields/BOAs and disadvantaged communities (as defined by the CJWG and CAC) as Priority Growth Areas** to bring planning/zoning resources and smart, sustainable, equitable projects to these communities.<br>• **Emphasize mixed-income/affordable housing in the smart growth formula** to de-concentrate poverty and address displacement and gentrification.<br>• **Smart Growth planning may also open the door to shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which build community wealth, increase homeownership, address displacement/gentrification and reduce the concentration of poverty in disadvantaged communities. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution, particularly in disadvantaged communities and communities of color. Co-benefits include, but are not limited to:<br>• **Greater physical activity**, which improves physical well-being and reduces chronic disease<br>• **More opportunities for social interaction for** improved mental health<br>• **Enhanced access to health care** facilities that have become more dispersed and distributed<br>• **Access to services** through walkable, bikeable and transit-friendly infrastructure<br>• **Greater access and proximity to fresh, nutritious food**, local food production and distribution<br>• **Accessible to transit** and other public transportation options. |
| **Just transition: businesses and industries, workers** | Smart Growth has generated economic development, business attraction and job creation benefits to communities throughout the State. Additionally, smart growth land use patterns attend to the spatial mismatch between jobs and housing, particularly for lower-income households who spend a disproportionate amount of their time and income commuting. "Locations with housing and transportation options, a mix of uses close together, and a high quality of life can improve environmental outcomes while providing economic advantages for businesses…" *- Smart Growth and Economic Success: The Business Case, EPA Office of Sustainable Communities, 2013* |

# Enabling strategy – LU-2: Empower Local Government to Achieve Smart Growth - Overview

| | |
|---|---|
| **Description:** | **Empower Local Government to Achieve Smart Growth Planning and Development.** Provide direct planning and zoning assistance to local communities. Promote municipal implementation of mitigation strategies through enhanced technical assistance, increased support for local adoption of zoning and land use regulation consistent with smart growth principles and local policies that support sustainable, equitable development and the accelerated expansion of local clean energy through a streamlined "Plan-to-Zone" initiative |
| **Action type:** | Existing program expansion and investment, new technical assistance tools, state and local policy changes |
| **Cost and funding considerations** | $$- Some resources for successful implementation already exist; new state and local government funds will be needed for some components. |
| **Ease of implementation:** | Easy – strategy can build off existing New York State programs |
| **Example case studies:** | Tug Hill Commission's Mini-Comp Plan Program, Allegany County's Comp Planning School, Tompkins Co. CNY Regional Planning and Development Board's Vision, Tug Hill Commission's Mini-Comp Plan Program, University of Buffalo's Regional Institute's One Region Forward Initiative |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Some may interpret "expedited" or "streamlined" planning/zoning as a curtailment of public input and engagement. Basic or mini/bare-bones comp plans may be viewed as not detailed or thorough enough. | Require that funded comp plans contain robust public input and engagement and meet the threshold legal standard for a comp plan that can be used as the basis for subsequent zoning and other land use ordinances. |



# Enabling strategy – LU-2: Empower Local Government to Achieve Smart Growth - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Create or expand smart growth grant programs to assist municipalities in the efficient development of comprehensive plans, district/corridor plans and zoning ordinances, including form-based codes, that adhere to clear State goals and outcomes; include priority considerations for disadvantaged and rural communities with less capacity/staff. | DOS | < 1 year – current pilot program | Regional entities and local governments |
| Define base criteria for comprehensive plans, including extensive community outreach and engagement, that would comport with case law; ensure that plans adhere to clear State goals and outcomes. | DOS | 2 years | Partnering state agency legal staff |
| Provide centralized necessary baseline data for municipalities to access and use in developing plans, including data on affordability, poverty and public health. | DOS | 2-3 years | Partnering state agencies |

# Enabling strategy – LU-2: Empower Local Government to Achieve Smart Growth - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Develop model local laws to assist municipalities of various sizes and capacities to implement smart growth plans and zoning ordinances, including model inclusionary zoning ordinances to address gentrification, displacement the concentration of poverty. | DOS/DEC | 2-3 years | Local governments, academia, and partnering state agency legal staff |
| Expand the roles and responsibilities of DOS Smart Growth planning, NYSERDA Clean Energy Communities (CEC) Regional Coordinators and DEC Climate Leadership Regional Coordinators to provide smart growth planning and zoning technical assistance and capacity-building to municipalities, which would include the integration of land use, transportation and housing planning and projects. | DOS/NYSERDA/DEC | 1-2 years | Regional entities and local governments |
| Support community-based planning to inform redevelopment of obsolete power plant sites and brownfields, particularly through NYSERDA's Power Plant Re-use initiative, in furtherance of the principles developed by the CLCPA Just Transition Working Group. | NYSERDA/DOS | 1-2 years | Municipalities |



# Enabling initiative – LU-2: Empower Local Government to Achieve Smart Growth Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Explore opportunities to address displacement, gentrification, the concentration of poverty, segregation, and inequitable access to opportunity by providing assistance and resources for community land trusts, land banks, inclusive zoning that promotes mixed-income, affordable, rental and supportive housing and shared/community-centered ownership models. | DOS and other state agencies | < 1 year | HCR, ESD and other state agencies, Universities, NGOs and local governments |

# Enabling strategy – LU-2: Empower Local Government to Achieve Smart Growth - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Provide grant funding to support community-based organizations to develop local land use plans for disadvantaged communities that can inform and guide development to reduce emissions, adapt to climate change, and achieve a just transition. Examples of such plans include UPROSE's Green Resilient Industrial District (GRID), El Puente's Green Light District, THE POINT CDC's South Bronx Community Resiliency Agenda, and PUSH Buffalo's PUSH GREEN / PUSH BLUE | DOS | 1 year | Community-based not-for-profits |
| Evaluate options such as financial and technical incentives to support development of GEISs for local smart growth overlay zoning (preferably in priority development areas such as TODs), including early and comprehensive community engagement. Consider a State established revolving grant fund to support the GEISs, with a pay-back by the developer if they develop projects consistent with the zoning. | DOS | 1-3 years | DEC/Regional Entities/Local Gov'ts/Private Developers/IDAs/Environmental Justice Community |



# Enabling initiative – LU-2: Empower Local Government to Achieve Smart Growth Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding access to public transportation through Transit-Oriented Development (TOD) will have positive impacts for lower-income households and disadvantaged communities by addressing the spatial mismatches between lower-income households and the jobs they commute to.<br>• **Establish brownfields/BOAs and disadvantaged communities (as defined by the CJWG and CAC) as Priority Growth Areas** to bring planning/zoning resources and smart, sustainable, equitable projects to these communities.<br>• **Emphasize mixed-income/affordable housing in the smart growth formula** to de-concentrate poverty and address displacement and gentrification.<br>• **Smart Growth planning may also open the door to shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which build community wealth, increase homeownership, address displacement/gentrification and reduce the concentration of poverty in disadvantaged communities.<br>• **New shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which build community wealth, increase homeownership, address displacement/gentrification and reduce the concentration of poverty in disadvantaged communities. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution, particularly in disadvantaged communities and communities of color. Co-benefits include, but are not limited to:<br>• **Greater physical activity**, which improves physical well-being and reduces chronic disease<br>• **More opportunities for social interaction** for improved mental health<br>• **Enhanced access to health care** facilities that have become more dispersed and distributed<br>• **Access to services** through walkable, bikeable and transit-friendly infrastructure<br>• **Greater access and proximity to fresh, nutritious food**, local food production and distribution<br>• **Accessible to transit** and other public transportation options. |
| **Just transition: businesses and industries, workers** | Smart Growth has generated economic development, business attraction and job creation benefits to communities throughout the State. Additionally, smart growth land use patterns attend to the spatial mismatch between jobs and housing, particularly for lower-income households who spend a disproportionate amount of their time and income commuting. "Locations with housing and transportation options, a mix of uses close together, and a high quality of life can improve environmental outcomes while providing economic advantages for businesses…" - *Smart Growth and Economic Success: The Business Case, EPA Office of Sustainable Communities, 2013* |

# Enabling strategy – LU-3: Enable Equitable Smart Growth Projects - Overview

| | |
|---|---|
| **Description:** | **Enhance Resources to Enable Equitable Smart Growth Projects**<br>Provide local government with the necessary tools and resources to guide, enable and inform the process of achieving equitable smart growth projects such as TOD, mixed-income/affordable housing, downtown, village and hamlet centers, and infill development. |
| **Action type:** | Programmatic and regulatory |
| **Cost and funding considerations:** | $ - total cost and most resources for successful implementation are already on hand. State and local government funds and public, private, and other sources |
| **Ease of implementation:** | Medium |
| **Example case studies:** | New Rochelle Downtown Overlay Zone, Westbury TOD Zone, Cambridge MA Affordable Housing Overlay |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Must address concerns, particularly in distressed, disadvantaged communities, that expediting a development process will deny or decrease opportunities for community input. | Require extensive and early public outreach, education and engagement, possibly through a pre-filing "uber-scoping" requirement as a pre-condition to funding or permitting; develop training materials—including graphics, scenario analyses, maps and other visuals—to assist developers in effective outreach and engagement. |

# Enabling strategy – LU-3: Enable Equitable Smart Growth Projects - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Develop a Sustainable Development/Climate Act Resource Guidebook to serve as a resource to assist regional entities, counties, municipalities, developers in navigating, accessing and integrating of state programs relative to sustainable community development and clean energy development. Improve accessibility and ease coordination across programs. | DOS | 1-2 years | Granting state agencies |
| Provide model outreach materials and other tools and guidance to support pre-development community outreach, engagement and education for smart growth projects in order to generate support, awareness and buy-in prior to a developer filing the project with a municipal board. Coordinate with community-based organizations, local government officials, universities and others, as needed. | DEC/DOS/DOT | 2-3 years | Regional Entities/Local Gov'ts/Private Developers/IDAs/CBOs/Universities/Environmental Justice Community/Affected State Agencies |

# Enabling strategy – LU-3: Enable Equitable Smart Growth Projects - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Include all state funding programs in the annual Consolidated Funding Application to the extent practicable and provide a centralized source of information on all state funding opportunities for municipalities and not-for-profits. | ESD/affected agencies | 1 year | Municipalities, not-for-profits |
| Investigate creating an expedited local review of supportive housing or affordable housing where at least 20% is affordable at 80% AMI or below. | HCR, OTDA, DOS | 1-3 years | Local governments |
| Build on existing state data portals such as NYSERDA's Climate Science Clearinghouse and DOS's GIS Gateway, and DEC EJ mapping to provide a centralized, user-friendly digital repository of data resources useful to regional/county/local planners in the development of smart growth land use plans, zoning codes and projects—including data on affordability and other equity matters, disadvantaged communities, climate change projections and cumulative health impacts. This should be framed as a one-stop-shop to consolidate data and planning tools related to climate change mitigation and adaptation, disaster risk reduction, and regional and local land use planning and clean energy siting. | DOS/NYSERDA | 2-3 years | Other state agencies, regional entities and local governments |



# Enabling strategy – LU-3: Enable Equitable Smart Growth Projects - Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Provide model zoning and site plan review ordinances that accommodate a variety of densities and uses for localities as a baseline. Such an ordinance should also make available siting for supportive housing, group homes, homeless shelters, multi-family housing, accessory dwelling units, and other affordable housing. | DOS, HCR, OTDA | 1-2 years | Local governments |

# Enabling strategy – LU-3:Enable Equitable Smart Growth Projects – Benefits and Impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding access to public transportation through Transit-Oriented Development (TOD) will have positive impacts for lower-income households and disadvantaged communities by addressing the spatial mismatches<br>• **Establish brownfields/BOAs and disadvantaged communities (as defined by the CJWG and CAC) as Priority Growth Areas** to bring planning/zoning resources and smart, sustainable, equitable projects to these communities.<br>• **Emphasize mixed-income/affordable housing in the smart growth formula** to de-concentrate poverty and address displacement and gentrification.<br>• **Smart Growth planning may also open the door to shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which build community wealth, increase homeownership, address displacement/gentrification and reduce the concentration of poverty in disadvantaged communities. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution, particularly in disadvantaged communities and communities of color. Co-benefits include, but are not limited to:<br>• **Greater physical activity**, which improves physical well-being and reduces chronic disease<br>• **More opportunities for social interaction** for improved mental health<br>• **Enhanced access to health care** facilities that have become more dispersed and distributed.<br>• **Access to services** through walkable, bikeable and transit-friendly infrastructure<br>• **Greater access and proximity to fresh, nutritious food**, local food production and distribution<br>• **Accessible to transit** and other public transportation options. |
| **Just transition: businesses and industries, workers** | Smart Growth has generated economic development, business attraction and job creation benefits to communities throughout the State. Additionally, smart growth land use patterns attend to the spatial mismatch between jobs and housing, particularly for lower-income households who spend a disproportionate amount of their time and income commuting. "Locations with housing and transportation options, a mix of uses close together, and a high quality of life can improve environmental outcomes while providing economic advantages for businesses…" - *Smart Growth and Economic Success: The Business Case, EPA Office of Sustainable Communities, 2013* |

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# Enabling strategy – LU-4: State Priorities Overview

| | |
|---|---|
| **Description:** | **Align State Funding Priorities**<br>Prioritize smart growth, equity, and sustainability in all relevant state funding, including new infrastructure spending |
| **Action type:** | Programmatic and regulatory |
| **Cost and funding considerations** | $ - Some additional resources needed, but primarily recommends enhanced prioritization of existing funds. |
| **Ease of implementation:** | Medium - Strategy expands and strengthens existing state programs |
| **Example case studies:** | Genesee County's Smart Growth Plan/Ordinance; New York State Smart Growth Infrastructure Policy Act |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Could be viewed as Must address concerns, both in well-resourced and distressed, disadvantaged communities, that expediting a development process could potentially decrease opportunities for community input. | Public education for greater understanding of need to target spending; support for local and regional planning that is consistent with smart growth principles. |

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# Enabling strategy – LU-4: State Priorities
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Review and refine the 11 Smart Growth criteria in the State Smart Growth Infrastructure Policy Act to more accurately identify new smart growth-and sprawl-inducing infrastructure projects and to align those criteria more directly with the CLCPA, including an emphasis on equity and affordability. Include definitions of priority development areas and priority conservation areas. Extend applicability of the Act to all state agencies and authorities and all relevant state programs, including planning and design grants (not just infrastructure). | Legislature/DOS | < 1 year | DOT and affected state agencies |
| Incentivize Smart Growth-inducing infrastructure by providing priority funding for infrastructure projects that score above a certain threshold in Smart Growth review, particularly those in Priority Development Areas; include definitions of Priority Development Areas and Priority Conservation Areas in the State Infrastructure Act. | Granting State Agencies | 1-2 years | |
| Assess as-of-right funding programs to ensure alignment with new objectives to prioritize smart growth and restrict expansion of sprawl inducing infrastructure and develop updated Smart Growth threshold criteria to be considered for use in scoring State infrastructure grant proposals. | DOS/DOT | 1-3 years | Affected State Agencies |



# Enabling strategy – LU-4: State Priorities
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Provide regular funding for RESTORE NY and DEC's Environmental Restoration Program to ensure dependable availability of support for the restoration of distressed, vacant, abandoned, contaminated and/or brownfield areas | ESD/DEC/DOS | 1 year | Municipalities |
| Expand and enforce the "priority and preference" provision in the BOA statute to include other relevant grants beyond those already identified in statute. | DOS/DEC | 2 years | Regional entities and local governments |

# Enabling strategy – LU-4: State Priorities Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding access to public transportation through Transit-Oriented Development (TOD) will have positive impacts for lower-income households and disadvantaged communities by addressing the spatial mismatches<br>• **Establish brownfields/BOAs and disadvantaged communities (as defined by the CJWG and CAC) as Priority Growth Areas** to bring planning/zoning resources and smart, sustainable, equitable projects to these communities.<br>• **Emphasize mixed-income/affordable housing in the smart growth formula** to de-concentrate poverty and address displacement and gentrification.<br>• **Smart Growth planning may also open the door to shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which build community wealth, increase homeownership, address displacement/gentrification and reduce the concentration of poverty in disadvantaged communities. |
| **Health and other co-benefits** | Any reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution, particularly in disadvantaged communities and communities of color. Co-benefits include, but are not limited to:<br>• **Greater physical activity**, which improves physical well-being and reduces chronic disease<br>• **More opportunities for social interaction** for improved mental health outcomes<br>• **Enhanced access to health care** facilities that have become more dispersed and distributed.<br>• **Access to services** through walkable, bikeable and transit-friendly infrastructure<br>• **Greater access and proximity to fresh, nutritious food**, local food production and distribution<br>• **Accessible to transit** and other public transportation options. |
| **Just transition: businesses and industries, workers** | Smart Growth has generated economic development, business attraction and job creation benefits to communities throughout the State. Additionally, smart growth land use patterns attend to the spatial mismatch between jobs and housing, particularly for lower-income households who spend a disproportionate amount of their time and income commuting. "Locations with housing and transportation options, a mix of uses close together, and a high quality of life can improve environmental outcomes while providing economic advantages for businesses…" *- Smart Growth and Economic Success: The Business Case, EPA Office of Sustainable Communities, 2013* |



# Enabling strategy – LU-5: TOD Overview

| | |
|---|---|
| **Description:** | **Facilitate and Accelerate Equitable Transit Oriented Development (TOD).**<br>Accelerate mixed-use, mixed-income transit-oriented development around key transit hubs served by rail and bus. |
| **Action type:** | Programmatic/Legislative |
| **Cost and funding considerations:** | $$- funding from existing and new grants and tax credits; cost of structure parking more expensive |
| **Ease of implementation:** | Easy |
| **Example case studies:** | New Rochelle, Westbury, Wyandanch |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| Rural communities may feel left out of the equation, given that some don't have population densities to support TOD. Housing in TODs is often expensive and could contribute to displacement/gentrification. In addition, existing authority for comprehensive planning and zoning rests overwhelmingly with cities, towns, and villages individually. While the General Municipal Law provides for a role for counties in certain instances, the application is quite limited. | Upstate transit agencies and communities coordinate to accommodate rural transit needs. Ensure that housing affordability is included in planning, incentives and other support for TOD. |

# Enabling strategy – LU-5: TOD
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Support municipal equitable TOD plans and zoning, including form-based codes, through a grant program and guidance and technical assistance (including model local laws); promote equity tools and models, such as community land trusts, land banks, inclusionary zoning and shared/community-centered ownership and equity models, to address displacement, gentrification and the concentration of poverty; and require communities with commuter rail stations to have an adopted TOD plan that meets state criteria in order to be eligible for supportive state TOD resources, with due consideration for smaller rail stations that may not have a full TOD or TOD plan. | DOS/DOT | 1 year | Municipal/regional planners, transit entities |
| Amend the State Smart Growth Public Infrastructure Policy Act to more effectively direct state resources to projects that advance TOD; add a definition of, and criteria for, TOD that includes rail and bus and the particular transit needs of rural areas; extend applicability of the Act to all state agencies and authorities and all relevant state programs, including planning and design grants (not just infrastructure). | Legislature/DOS | 1 year | Affected agencies |
| Explore enhanced subsidies for TOD projects, especially those that include a meaningful threshold level of affordable housing and incorporate tools and measures such as community land trusts, land banks, inclusionary zoning and shared/community-centered ownership models—include the TOD State Housing Goal in HCR's 9% Low-Income Housing Tax Credit program in all relevant state solicitations; consider other opportunities for tax credits for projects in TOD areas that are consistent with an adopted TOD plans and meet state criteria for equity and affordability, such as an additional "bump up" of Brownfield Cleanup Program tax credits in designated BOAs that are also TODs. | DOS/HCR | 1 year | Municipalities/affected agencies |

# Enabling strategy – LU-5: TOD
# Components of the strategy

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Fund and support GEISs to streamline the review process in TODs; create a revolving fund for municipalities to undertake GEISs for TOD zoning and projects—if a developer agrees to build according to the TOD zoning and accepts certain community benefits components, such as affordable housing, green infrastructure, green building or public spaces, the developer will pay back into the fund a portion of the cost of the GEIS; consider using TIFs for this purpose. | DOS | 1 year | Municipal planners/ transit entities |
| Explore opportunities to support and incentivize lower municipal parking minimums and/or parking maximums in consideration of decreased household need, given proximity and accessible of transit. | DOS | 2 years | Municipalities, MPOs, affected agencies |
| Facilitate appropriate structured parking to support a desired TOD density—explore opportunities to defray the cost of structured parking in conjunction with TOD development, such as state funding, low-cost financing, and tax credits; develop best practices for design and construction of structured parking that integrates ground-level retail and that is may be retrofitted for other uses should the demand for parking decline in the future. | Transit authorities/state agencies | 1 year | Municipalities |
| Encourage municipalities to notify the relevant transit entity of planning, zoning and projects that will impact transit ridership and parking needs to allow transit agencies an early opportunity to offer input on such potential impacts. | DOS/DOT/DEC/ESD | 1 year | MPOs, Municipalities/ transit entities |

# Enabling strategy – LU-5: TOD
# Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Expanding access to public transportation through Transit-Oriented Development (TOD) will have positive impacts for lower-income households and disadvantaged communities by addressing the spatial mismatches between jobs and housing, which often forces lower-income households to spend more time and income on transportation and commuting. Equitable TOD presents an ideal opportunity for affordable, mixed-income housing. Other benefits include:<br>• **The emphasis on mixed-income/affordable housing helps** de-concentrate poverty and avoid or reduce displacement and gentrification.<br>• **Smart Growth development such as TOD may also open the door to shared equity/ownership opportunities**—e.g., community land trusts, deed-restricted ownership, owner-/community-operated businesses—which builds community wealth, increases homeownership, addresses displacement/gentrification and reduce the concentration of poverty in disadvantaged communities. |
| **Health and other co-benefits** | TOD is the most energy-efficient form of smart growth in terms of VMT reductions and increased transit use. The reduction in VMT/transportation-based GHG emissions will improve air quality and help reduce the incidence of disease caused or exacerbated by air pollution, particularly in disadvantaged communities and communities of color. Co-benefits include, but are not limited to:<br>• **Greater physical activity** through walkable, bikeable streetscapes and reduced automobile use, which improves physical well-being and reduces chronic disease .<br>• **More opportunities for social interaction** for improved mental health<br>• **Enhanced access to community health care** facilities that have become more dispersed and distributed.<br>• **Access to services** through walkable, bikeable and transit-friendly infrastructure<br>• **Greater access and proximity to fresh, nutritious, local food**, which addresses food deserts, particularly in lower-income neighborhoods.<br>• **Accessibility to transit** and other public transportation options.<br>• **Reduced urban heat island effect**, which disproportionately impacts disadvantaged communities. |
| **Just transition: businesses and industries, workers** | TOD has generated economic development, business attraction and job creation benefits to communities throughout the State; greater access to transit will help address the effects of job shifts to a clean energy economy, if planned smartly with job opportunities in mind. As discussed above, for example, TOD addresses the spatial mismatch between jobs and housing, particularly for lower-income households who spend a disproportionate amount of their time and income commuting. "Locations with housing and transportation options, a mix of uses close together, and a high quality of life can improve environmental outcomes while providing economic advantages for businesses…" *- Smart Growth and Economic Success: The Business Case, EPA Office of Sustainable Communities, 2013* |

# Clean Energy

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council

# Clean Energy - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| CE-1 | Develop a statewide dashboard of community greenhouse gas emissions inventories to promote local climate action planning, monitor equity considerations, measure progress, and ensure data consistency at the county/municipality level. | Programmatic | Medium | Low |
| CE-2 | Encourage local governments to demonstrate leadership in energy efficiency by developing model above-minimum energy conservation construction policies or adopting the NY Stretch Energy Code and promoting its adoption, enhanced code enforcement including streamlined permitting, third party inspections, and shared enforcement, and Property Assessed Clean Energy (PACE) financing. | Programmatic | Easy | Low |

# Clean Energy - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| CE-3 | Establish statewide policies that require consistent advancement on building decarbonization by adopting a highly efficient State Energy Code aligned with CLCPA goals as soon as possible, establishing energy benchmarking and performance standards for buildings, and creating innovative public benefit financing mechanisms. | Legislative | Hard | Medium |
| CE-4 | Facilitate clean energy siting through planning support and the development and promotion of model local laws, streamlined permitting, and local development regulations that clearly identify appropriate as-of-right installation opportunities for different clean energy technology types, and clear requirements and reasonable processes for installations that are not as-of-right. | Programmatic | Medium | Medium |

# Clean Energy - Enabling strategy summary

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| CE-5 | Connect homes, businesses, and community institutions with clean energy products, services, and job opportunities through Community Choice Aggregation programs, microgrids, district systems, workforce development initiatives, and community-scale campaigns to encourage adoption of new, innovative technologies to generate value and savings for consumers in an equitable manner. | Programmatic | Medium | Low |
| CE-6 | Continue and expand state program opportunities, incentives, technical assistance, and centralized procurement services to motivate local governments and related public entities to improve assets they control with high-impact actions such as LED lighting, energy efficiency upgrades, heat pump projects, methane recovery for energy production from wastewater treatment and landfills, solar on municipal premises, and municipal and school district fleet electrification. | Programmatic | Medium | Medium |

# Enabling strategy – CE-1: Community Dashboard Overview

| | |
|---|---|
| **Description:** | Develop a statewide dashboard of community greenhouse gas emissions inventories to promote local climate action planning, monitor equity considerations, measure progress, and ensure data consistency at the county/municipality level. |
| **Action type:** | Programmatic; Regulatory |
| **Cost and funding considerations:** | Low |
| **Ease of implementation:** | Medium |
| **Example case studies:** | Utility Energy Registry (UER); NREL State and Local Planning for Energy (SLOPE) Platform; ICLEI Clear Path |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Not all required data (i.e. fuel oil, gasoline, and diesel consumption, as well as vehicle miles travelled (VMT) and fuel mix) is currently reported at the county, city, town, and village level.<br>• Dashboard must be easy to use and provide good, actionable information that local government officials, municipal staff, and community stakeholders can use to inform decision-making at the local level. | • Establish aggregated data reporting requirements for suppliers of fuels in a similar way to how the NYS Public Service Commission (PSC) requires electricity and natural gas consumption data reported by utilities (see PSC "Order Adopting the Utility Energy Registry" in CASE 17-M-0315 issued April 20, 2018).<br>• Include data on energy production and clean energy actions.<br>• Explore methods for estimating GHG of transportation at the county, city, town, and village level. |

# Enabling strategy – CE-1: Community Dashboard Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Track progress toward meeting clean energy goals at the community level, including in disadvantaged communities.<br>• Assist in targeting state resources to achieve benefits in disadvantaged communities. |
| **Health and other co-benefits** | • Dashboard provides data that can help manage local sources of air pollution. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |
| **Other** | |

# Enabling strategy –CE-1: Community Dashboard Components for delivery

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Establish a Community GHG Working Group consisting of state agencies, academic institutions, consultants, and regional and municipal officials. Activities of the group include the following:<br>• Review existing guidance including ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (ICLEI Community Protocol) to identify methods.<br>• Work with state agencies, MPOs, utilities, and other stakeholders to identify and secure New York-specific data needed to complete the emission inventories.<br>• Develop standard GHG inventory reporting formats for regional and local community inventories. | NYSERDA | 2 years | MPOs, utilities academic institutions, consultants, state agencies, and regional and municipal officials. |
| Launch and maintain the dashboard, ensuring it is accessible to all communities | NYSERDA | 1 year | Community stakeholders |

# Enabling strategy – CE-2: Local Policies Overview

| | |
|---|---|
| **Description:** | Encourage local governments to demonstrate leadership in energy efficiency by developing model above-minimum energy conservation construction policies or adopting the NY Stretch Energy Code and promoting its adoption, enhanced code enforcement including streamlined permitting, third party inspections, and shared enforcement, and Property Assessed Clean Energy (PACE) financing. |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | Low |
| **Ease of implementation:** | Easy |
| **Example case studies:** | Clean Energy Communities; Climate Smart Communities; NYStretch Energy Code |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Many local governments, especially small, resource-constrained communities, struggle with tight budgets and limited staff capacity which limits their ability to take local climate actions. | • State programs like Clean Energy Communities and Climate Smart Communities that offer clear guidance, grants, technical assistance, and recognition can motivate communities to take local climate action and demonstrate climate leadership with a focus on equity. |

# Enabling strategy –CE-2: Local Policies Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Programs designed to encourage local climate action should include rules that focus the benefits of clean energy investments in disadvantaged communities. |
| **Health and other co-benefits** | • Local climate actions often reduce local sources of air pollution including combustion fuels used for heating and transportation. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |

# Enabling strategy – CE-2: Local Policies
# Components for delivery

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** | **Time to implement** | **Other key stakeholders** |
|---|---|---|---|
| Utilize the Clean Energy Communities and Climate Smart Communities programs to encourage local climate action | NYSERDA; DEC | 2 years | Counties, Cities, Towns, and Villages |
| Continue and expand NYPA Clean Energy Services to reach more communities | NYPA | 2 years | Counties, Cities, Towns, and Villages |
| Expand the Regional Coordinator Network to enhance and strengthen assistance to local governments and related entities across a range of climate actions and increase support to small, resource-constrained, and underserved communities. | NYSERDA; DEC | 2 years | Regional Planning Boards |

# Enabling strategy – CE-3: Statewide Policies
# Overview

| | |
|---|---|
| **Description:** | Establish statewide policies that require consistent advancement on building decarbonization by adopting a highly efficient State Energy Code aligned with CLCPA goals as soon as possible, establishing energy benchmarking and performance standards for buildings, and creating innovative public benefit financing mechanisms. |
| **Action type:** | Legislation |
| **Cost and funding considerations:** | Medium |
| **Ease of implementation:** | Hard |
| **Example case studies:** | New Efficiency: New York report; NYC Local Law 97 |

| **Risks / Barriers to success** | **Possible mitigants** |
|---|---|
| • Local governments often have limited capacity to adopt and enforce regulations and are often leery of taking on initiatives that may place them at what they perceive to be a competitive disadvantage to other communities in their region. | • Rather than a patchwork of different rules and opportunities in different communities, adopt statewide policies that apply evenly across the board. |

# Enabling strategy – CE-3: Statewide Policies
# Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Regulations may be applied to focus the benefits of clean energy investments in disadvantaged communities. |
| **Health and other co-benefits** | • Regulations are designed to reduce local sources of air pollution including combustion fuels used for heating and transportation. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |
| **Other** | |

# Enabling strategy –CE-3: Statewide Policies
# Components for delivery

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** | **Time to implement** | **Other key stakeholders** |
|---|---|---|---|
| Establish energy benchmarking and performance standards for buildings through state legislation | Legislature | 2 years | AG |
| Establish targets for the Energy Code to align with CLCPA goals. | Legislature | 2 years | |
| Revise the Energy Law relating to the Energy Code to extend the consideration of a 10-year cost effectiveness period to allow for assessment over a longer time horizon, potentially the equipment lifecycle or be based on secondary or societal effects, such as reductions in carbon emissions. | Legislature | 2 years | |
| Provide funding for administrative costs of code updates incurred by local governments and state agencies, including enforcement, purchase of codes books, guidance documents, and training for stakeholders. | DOS, NYSERDA | 2 years | |
| Consider programs to offer municipal based financing for required decarbonization building improvements based on clean water financing model. | tbd | 5 years | |

# Enabling strategy – CE-4: Planning Support Overview

| | |
|---|---|
| **Description:** | Facilitate and promote deployment of clean energy to expand equitable access, maximize local economic benefit and resiliency, and minimize environmental impacts through planning support, provision model local laws, streamlined permitting, and local development regulations that clearly identify appropriate as-of-right installation opportunities for different clean energy technology types, and clear requirements and reasonable processes for installations that are not as-of-right. |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | Medium |
| **Ease of implementation:** | Medium |
| **Example case studies:** | Clean Energy Communities; SolSmart; Scenic Hudson's Solar Mapping Tool |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Local governments often have limited capacity to anticipate and plan for solar and energy storage development in their communities | • State programs like Clean Energy Communities and Climate Smart Communities that offer clear guidance, grants, technical assistance, and recognition can motivate communities to adopt appropriate siting policies at the local level. |

# Enabling strategy –CE-4: Planning Support Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Regulations may be applied to focus the benefits of clean energy investments in disadvantaged communities. |
| **Health and other co-benefits** | • Regulations are designed to reduce local sources of air pollution including combustion fuels used for heating and transportation. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |

# Enabling strategy – CE-4: Planning Support Components for delivery

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Develop and promote model local laws and development regulations. | NYSERDA | <1 year | Community Stakeholders, Solar Industry |
| Promote adoption of the NYS Solar Permit and other local actions to streamline the permitting process for clean energy technologies including energy storage at a variety of scales. | NYSERDA | <1 year | Code Enforcement Officers |
| Develop tools and resources including mapping to help municipalities undertake a comprehensive evaluation of the potential for clean energy development in their communities and plan pro-actively for deployment that maximizes local benefit and minimizes impact on lands with high-quality soils and other competing uses. | NYSERDA | 2 years | Community Stakeholders, Agriculture and Forestry; Solar Industry; Utilities |
| Provide technical and financial support to help local governments plan for and review solar projects. | NYSERDA | 2 years | Regional Planning Boards |

# Enabling strategy – CE-5: Community Initiatives Overview

| | |
|---|---|
| **Description:** | Connect homes, businesses, and community institutions with clean energy products, services, and job opportunities through Community Choice Aggregation programs, microgrids, district systems, workforce development initiatives, and community-scale campaigns to encourage adoption of new, innovative technologies to generate value and savings for consumers in an equitable manner. |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | Low |
| **Ease of implementation:** | Medium |
| **Example case studies:** | Sustainable Westchester; Solarize; Heatsmart Tompkins |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Local governments often have limited capacity to adopt and implement complex clean energy policies.<br>• Job training in the clean energy field does not always lead to job placement. | • State programs like Clean Energy Communities and Climate Smart Communities that offer clear guidance, grants, technical assistance, and recognition can motivate communities to adopt appropriate siting policies at the local level.<br>• Workforce Development programs that focus on job placement. |

# Enabling strategy – CE-5: Community Initiatives Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Potential to reduce the energy burden in disadvantaged communities by reducing household energy costs.<br>• Help create jobs and drive investment in disadvantaged communities. |
| **Health and other co-benefits** | • Reduce local sources of air pollution including combustion fuels used for heating and transportation. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |

# Enabling strategy – CE-5: Community Initiatives Components for delivery

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Continue to encourage development of Community Choices Aggregation (CCA) programs where communities choose 100% renewable energy as the default supply, and where participants are automatically enrolled in Community Distributed Generation (CDG). | NYSERDA | 1 year | Community Stakeholders; CCA Administrators; ESCOs |
| Enable county governments to authorize and form CCA programs with local opt-out. | DPS | 1 year | Local Governments; Community Stakeholders |
| Promote community-scale campaigns to encourage adoption of new, innovative technologies to generate value and savings for consumers. | NYSERDA | 1 year | Community Stakeholders |
| Expand workforce development programs focused on training and job placement in clean energy and emerging technologies. | NYSERDA | 2 years | Unions; Clean Energy Industries |
| Enable the development of microgrids (municipal, schools and private) and district clean energy systems. | NYSERDA | 10 years | Utilities; Campuses |

# Enabling strategy – CE-6: Local Assets Overview

| | |
|---|---|
| **Description:** | Continue and expand state program opportunities, incentives, technical assistance, and centralized procurement services to motivate local governments and related public entities to improve assets they control with high-impact actions such as LED lighting, energy efficiency upgrades, heat pump projects, methane recovery for energy production from wastewater treatment and landfills, solar on municipal premises, and municipal and school district fleet electrification. |
| **Action type:** | Programmatic |
| **Cost and funding considerations:** | Medium |
| **Ease of implementation:** | Medium |
| **Example case studies:** | NYPA Clean Energy Solutions; Clean Energy Communities; Climate Smart Communities |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| • Local governments often have limited financial resources and capacity to make improvements with the greatest potential impact.<br>• Local government and related public entities could achieve greater savings if they worked through shared services models. | • State programs that offer clear guidance, grants, technical assistance, and recognition can motivate local governments and related public entities to improve the assets they control.<br>• Create opportunities for communities like inter-municipal conference calls, planning institutes, work groups, or aggregations to provide a framework for communities to complete high-impact actions in mutually supportive cohorts. |

# Enabling strategy – CE-6: Local Assets Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | • Program can be designed to prioritize the improvement of energy consuming assets located in disadvantaged communities |
| **Health and other co-benefits** | • Projects may reduce local sources of air pollution including combustion fuels used for heating and transportation. |
| **Just transition: businesses and industries, workers** | • Clean energy investments can create jobs and attract businesses establishments while saving energy and money that can be reinvested locally. There are an estimated 164,000 clean energy jobs across New York State including energy efficiency, renewable energy, grid modernization and storage, renewable fuels, and alternative transportation. These jobs are in installation, maintenance and repair, sales and distribution, manufacturing, and professional services. |
| **Other** | |

# Enabling strategy – CE-6: Local Assets
## Components for delivery

| Components required for delivery | Implementation lead | Time to implement | Other key stakeholders |
|---|---|---|---|
| Provide technical support to help local governments and related public entities develop and implement clean energy projects. | NYSERDA | 1 year | Community Stakeholders |
| Evaluate options to reduce interconnection costs for municipal-owned priority sites. | NYSERDA | 2 years | Solar Industry |
| Prioritize funding for projects that recover methane from wastewater treatment and landfills for energy production. | NYSERDA | 5 years | Community Stakeholders |
| Develop tools and resources to help municipalities procure energy and enable direct purchases of energy by municipalities from the wholesale market. | NYSERDA; DPS | 2 years | |
| Support electrification of municipal and school district fleets while increasing fleet-wide fuel economy. | NYSERDA; DEC | 10 years | School Districts |
| Encourage local governments to track and report the energy use of municipal buildings and facilities (benchmarking). | NYSERDA | 2 years | |
| Increase waste reduction and recycling rates in municipal operations and in the community. | DEC | 10 years | Counties |

# Carbon Sequestration

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# Carbon Sequestration - Mitigation strategy summary

| Initiative # | Description | Action type | Emissions impact | Ease of implementation | Cost |
|---|---|---|---|---|---|
| CS-1 | **FRESHWATER WETLANDS**<br>Maintain and enhance the carbon sequestration potential of freshwater, non-tidal wetlands in New York State through protection, restoration, and monitoring. | Legislative and regulatory | Low | Medium | $-$$ |
| CS-2 | **BLUE CARBON**<br>Maintain and enhance the carbon sequestration potential of "blue carbon" in New York State, including coastal and estuarine tidal wetlands, submerged aquatic vegetation, and other coastal habitats, through protection, restoration, and monitoring. | Legislative and regulatory | Low | Medium | $-$$ |

# Mitigation strategy – CS-1: Freshwater Wetlands Overview

| | | | |
|---|---|---|---|
| **Description:** | Maintain and enhance the carbon sequestration potential of freshwater, non-tidal wetlands in New York State through protection, restoration, and monitoring. | | |
| **Action type:** | Legislative and regulatory | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Low |
| **Cost and funding considerations:** | $-$$: agency staff, land acquisition, grants needed | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | See *State Wetland Protection: Status, Trends & Model Approaches* (Environmental Law Institute [ELI]); Pennsylvania's Wetlands Net Gain Strategy; NYC DEP's Land Acquisition Program | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1.) potential opposition to increased regulation<br>2.) municipal resistance to land protection<br>3.) insufficient funding and staff<br>4.) competing interests (e.g., agriculture, renewable energy)<br>5.) policy differences in permitting agencies<br>6.) variable landowner interest in selling or easements | 1.) stakeholder engagement, outreach, education<br>2.) reimbursement programs for lost municipal tax revenue<br>3.) new funding (e.g., environmental bond act) and partnerships<br>4.) prioritize and increase funding for NYS Open Space Plan acquisitions that support climate strategies<br>5.) cross-agency and cross-industry communication, coordination |

# Mitigation strategy – CS-1: Freshwater Wetlands Components of the strategy (p. 1 of 2)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Improve and expand regulation of all freshwater, non-tidal wetlands and adjacent areas by fundamentally changing New York's statutory system for regulating these wetlands, including shifting wetland maps from regulatory to informational, and establishing jurisdictional boundaries through field delineation. Further improve implementation of the regulatory program by updating state regulations and developing internal and external guidance. | Legislature, DEC | 5 years | DOS, APA |
| Ensure regulatory oversight for wetlands and waterbodies that were removed from federal protection under the 2020 promulgated "Navigable Waters Protection Rule." In addition, explore expanded use of Unusual Local Importance designation to restore oversight to a portion of the wetlands that lost protections under the Rule. | Legislature, DEC | 3 to 5 years | DOS, ORES, DPS, OAG |

# Mitigation strategy – CS-1: Freshwater Wetlands Components of the strategy (p. 2 of 2)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Develop regional permits (or specific Nationwide Permit 54 regional conditions) with Army Corps of Engineers (ACOE) to incentivize use of natural and nature-based features to enhance resilience and ecosystem benefits. | DOS, DEC, DOT | Unknown (depends in part on ACOE willingness) | ACOE |
| Increase NYS and other investment in the protection, restoration, and monitoring of freshwater, non-tidal wetlands and adjacent areas, including riparian areas, to maximize carbon sequestration potential (e.g., Environmental Bond Act and Environmental Protection Fund; grants programs like DEC Water Quality Improvement Program and NYS Conservation Partnership Program). | Legislature, DEC, DOS | 10 years | OPRHP, conservation NGOs, counties, municipalities, land trusts, SWCDs |

# Mitigation strategy – CS-1: Freshwater Wetlands Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Improving wetland function provides natural areas for enjoyment, recreation, and education; helps to mitigate flooding risk by moderating storm water; and contributes to clean water through natural filtration. Need to assess potential negative impact of green gentrification. |
| **Health and co-benefits** | Healthy wetlands provide services that benefit people: flood mitigation, recreation (e.g., fishing, hunting, wildlife viewing), carbon sequestration, clean water. Exposure to nature provides physical and mental health benefits. Biodiversity is supported and contributes to mosquito control in healthy wetlands. |
| **Just transition: businesses and industries, workers** | Benefits include flood mitigation, reduced flood risk to communities and public infrastructure, improved guidance for regulatory compliance. Impacts include regulatory restrictions in wetlands and adjacent areas. |
| **Other** | Healthy, resilient fish and wildlife resources; open space for all New Yorkers; increased recreational opportunities in urban and suburban areas. |

# Mitigation strategy – CS-2: Blue Carbon Overview

| | | | |
|---|---|---|---|
| **Description:** | Maintain and enhance the carbon sequestration potential of "blue carbon" in New York State, including coastal and estuarine tidal wetlands, submerged aquatic vegetation, and other coastal habitats, through protection, restoration, and monitoring. | | |
| **Action type:** | Legislative and regulatory | | |
| **GHG reduction by 2030:** | Low | **GHG reduction by 2050:** | Low |
| **Cost and funding considerations:** | $-$$: agency staff, land acquisition, grants needed | | |
| **Ease of implementation:** | Medium | | |
| **Example case studies:** | See *Where the Wetlands Are—And Where They Are Going: Legal and Policy Tools for Facilitating Coastal Ecosystem Migration in Response to Sea Level Rise* and *State Wetland Protection: Status, Trends & Model Approaches* (ELI) | | |

| Risks / Barriers to success | Possible mitigants |
|---|---|
| 1.) potential opposition to increased regulation<br>2.) municipal resistance to land protection<br>3.) insufficient funding and staff<br>4.) competing interests (e.g., waterfront development)<br>5.) policy differences in permitting agencies<br>6.) variable landowner interest in selling or easements | 1.) stakeholder engagement, outreach, education<br>2.) reimbursement programs for lost municipal tax revenue<br>3.) new funding (e.g., environmental bond act) and partnerships<br>4.) prioritize and increase funding for NYS Open Space Plan acquisitions that support climate strategies<br>5.) cross-agency and cross-industry communication, coordination |

# Mitigation strategy – CS-2: Blue Carbon
## Components of the strategy (p. 1 of 2)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Improve and expand regulation of all tidal wetlands and adjacent areas, coastal habitats, and Coastal Erosion Hazard Areas that meet regulatory criteria. Further improve implementation of the regulatory program by developing internal and external guidance, and changes in law and regulation (e.g., review NYCRR Part 661 to consider measures for preventing conversion). | Legislature, DEC | 5 years | DOS, APA |
| Develop regional permits (or specific Nationwide Permit 54 regional conditions) with Army Corps of Engineers (ACOE) to incentivize use of natural and nature-based features to enhance resilience and ecosystem benefits. | DOS, DEC, DOT | Unknown (depends in part on ACOE willingness) | ACOE |

# Mitigation strategy – CS-2: Blue Carbon
## Components of the strategy (p. 2 of 2)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Increase NYS and other investment in the protection, restoration, and monitoring of tidal wetlands and coastal habitats, including migration pathways and submerged aquatic vegetation (SAV), to maximize carbon sequestration potential (e.g., Environmental Bond Act and Environmental Protection Fund; grants programs like NYS Conservation Partnership Program). | Legislature, DEC, DOS | 10 years | OPRHP, conservation NGOs, counties, municipalities, land trusts, SWCDs |

# Mitigation strategy – CS-2: Blue Carbon
## Benefits and impacts

| Anticipated Benefits and Impacts | |
|---|---|
| **Disadvantaged communities** | Resilient coastal areas have greater protection against property damage in EJ communities from flooding and storm surge. Increased protection of waterfront areas to allow for tidal wetland migration provides public open space and enhanced access to recreation like fishing and wildlife viewing. Need to assess potential negative impact of green gentrification. |
| **Health and co-benefits** | Healthy wetlands and coastal habitats provide services that benefit people: flood mitigation, recreation (e.g., fishing, boating, wildlife viewing), carbon sequestration, clean water. Exposure to nature provides physical and mental health benefits. Biodiversity is supported. |
| **Just transition: businesses and industries, workers** | Benefits include flood mitigation, reduced flood risk to communities and public infrastructure, improved guidance for regulatory compliance. Impacts include regulatory restrictions along shorelines and coastal habitats. |
| **Other** | Healthy, resilient fish and wildlife resources; open space for all New Yorkers; increased recreational opportunities in urban and suburban areas. |

# Enabling strategy summary:
## Mapping, Research, Planning, and Assistance

| Initiative # | Description | Action type | Ease of implementation | Cost |
|---|---|---|---|---|
| CS-3 | Maintain and enhance the carbon sequestration potential of natural areas in New York State, including wetlands, coastal habitats, forests, and grasslands through improved mapping (both regulatory and non-regulatory), research, conservation planning guidance, stewardship, and assistance for local governments and landowners. | Mapping, analysis, research, technical assistance, funding | Easy | $ |

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Overview

| | |
|---|---|
| **Description:** | Maintain and enhance the carbon sequestration potential of natural areas in New York State, including wetlands, coastal habitats, forests, and grasslands through improved mapping (both regulatory and non-regulatory), research, conservation planning guidance, stewardship, and assistance for local governments and landowners. |
| **Action type:** | Mapping, analysis, research, technical assistance, funding |
| **Cost and funding considerations:** | $: staff to provide technical assistance and training; funding for small grants, research, mapping, analysis, development of implementation material and tools, stewardship initiatives |
| **Ease of implementation:** | Easy |
| **Example case studies:** | *Hudson River Estuary Wildlife and Habitat Conservation Framework*; OSI Climate Resilient Landscape Initiative; NYS Matrix Forests and Linkages; Tompkins County Unique Natural Areas, Conservation Plan and Strategy; LiDAR Enhanced Wetlands Mapping in New York City Watershed; Land Cover Mapping and Modeling Initiatives in Chesapeake Bay Watershed and Delaware River Basin, Object-based Wetland Mapping Approach for Pennsylvania; Hudson River Estuary Program's Conservation and Land Use Team; GulfCorps; Planting Westchester |

| **Risks / Barriers to success** | **Possible mitigants** |
|---|---|
| 1.) resistance to mapping of resources for conservation or protection<br>2.) insufficient uptake and application of planning tools and approaches<br>3.) variable interests and goals of decision-makers (e.g., landowners, municipalities) | 1.) new funding (e.g., environmental bond act) and partnerships<br>2.) education and outreach<br>3.) training and technical assistance for key decision-makers and stakeholders |

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Components of the strategy (p. 1 of 4)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Apply the best available technology to **update maps** of wetlands (regulated and unregulated; tidal and non-tidal); shallow water habitats; Significant Coastal Habitats; Coastal Erosion Hazard Areas; and priority forests and natural areas. Ensure all maps and inventories are accurate and publicly available, and schedule recurring updates using the best available technology. Replace Article 24 wetland maps with updated informational Article 24 wetland maps. | DEC | 5 years | OPRHP, DOS, conservation NGOs, SWCDs, research partners, other state agencies |
| Develop **statewide conservation framework** that incorporates current, accurate spatial data on critical ecosystems (terrestrial and aquatic), including priority ecosystem complexes and future needs that address climate adaptation needs (e.g., landscape connectivity, wetland migration pathways, source water areas); and provides basis for prioritizing state funding, tax relief, land acquisition, and technical assistance programs to conserve priority natural areas and promote smart growth. Make publicly accessible and provide outreach and assistance to ensure appropriate and effective use of framework. | DEC | 5 years | OPRHP, DOS, conservation NGOs (e.g., OSI), SWCDs, research partners, regional planning commissions, land trusts |

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Components of the strategy (p. 2 of 4)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Assist county and local governments to create **land-use policies, land conservation programs, and smart growth strategies** that prioritize and protect wetlands, forests, grasslands, stream buffers, and other natural areas (e.g., statewide authorization of Community Preservation Act [CPA]; training and support on use of CRRA model local laws, comprehensive planning language, zoning, and other conservation planning approaches; funding for CACs and EMCs; etc.) * | DOS, DEC, Legislature (CPA) | 2-10 years | Regional and county planning commissions, counties, municipalities, conservation NGOs, SWCDs |
| Enhance and create **landowner incentives and other techniques** to conserve and restore tidal and non-tidal wetlands, forests, grasslands, and natural areas and utilize living shoreline and nature-based solutions (e.g., tax abatement programs; tax incentives; land conservation programs; payment for ecosystem services). * | Legislature | 5 years | DOS, DEC, counties, municipalities, land trusts, landowners, conservation NGOs |
| Provide or support technical guidance and incentive programs, based on latest scientific understanding, to **forest landowners** including land trusts and municipalities, to increase carbon sequestration through management and stewardship .* | DEC | 3 years | Research partners, land trusts, conservation NGOs, Extension, SWCDs |

***Note: Agriculture and Forestry is leading on forest carbon recommendations.***

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Components of the strategy (p. 3 of 4)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Fund **research, analysis, and monitoring** to determine carbon storage and sequestration potential of tidal and non-tidal wetlands, SAV, forests, and other priority natural areas, to increase understanding of mitigation opportunities and to establish siting protocols and priorities for conservation and restoration. | DEC, DOS | 5-10 years | research partners |
| Develop **cost-benefit analysis tools** that incorporate the value of carbon for use in planning, environmental assessment, and permitting of conservation and restoration projects. | DEC | 1 year | DOS, research partners |
| Initiate **climate resilient demonstration projects** by working with existing wetland protection, restoration, or NNBF projects to add additional components for maximizing climate resilience and carbon sequestration capacity, developing quantification models and best practices, and monitoring effectiveness. | DEC, DOS | 1 year | counties, municipalities |

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Components of the strategy (p. 4 of 4)

| **Components required for delivery** *(Brief description of action required)* | **Implementation lead** *(Entity responsible for completing)* | **Time to implement** *(Time required to implement)* | **Other key stakeholders** **(***Entities that need to be engaged)* |
|---|---|---|---|
| Create a **conservation and restoration service corps program** (for early and experienced professionals) and a **youth climate conservation corps** (for unemployed young people ages 18-25) that focuses on ecosystem stewardship, management, and restoration activities to maximize carbon sequestration in natural and developed areas (e.g., tree plantings in lower-income, suburban neighborhoods; wetland restoration; native grassland establishment in municipal parks). (Added benefit to support just transition and "green job" career training.) | DEC, OPRHP | 5 years | Many possibilities, e.g., DOS, NOAA, Student Conservation Association, proposed Civilian Climate Corps, AmeriCorps, existing conservation corps programs, counties, municipalities, conservation NGOs, SWCDs |

# Enabling strategy – CS-3: Mapping, Research, Planning, and Assistance - Benefits and impacts

| **Anticipated Benefits and Impacts** | |
|---|---|
| **Disadvantaged communities** | Expanding and improving natural areas provides recreational opportunity; storm water management and reduced flood risk; clean air and water. Technical and funding assistance can enable greater participation in local land use by disadvantaged communities. Need to assess potential negative impact of green gentrification. |
| **Health and other co-benefits** | Healthy ecosystems provide services that benefit people: flood mitigation, recreation (e.g., hiking, camping, fishing, hunting, wildlife viewing), carbon sequestration, clean water and air, and mental and physical health benefits. Biodiversity improves resilience to disturbance and can moderate disease and pests like mosquitos and ticks. |
| **Just transition: businesses and industries, workers** | Benefits include mitigation of floods and associated property damage; reduced flood risk to communities and public infrastructure; green job career training; improved understanding, guidance, and tools for decision-making; tax incentives for nature-friendly practices. |
| **Other** | Healthy, resilient fish, wildlife, and habitat; open space for all New Yorkers; increased recreational opportunities in urban and suburban areas; up-to-date decision-making tools accessible to all. |

# Appendix: Case Studies

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## Priority Development Area Plans

| | |
|---|---|
| **Jurisdiction:** | *Genesee County/Tompkins County* |
| **Context:** | *Genesee county sought to preserve its agricultural land and rural character, while also redeveloping and revitalizing in municipal centers and attracting businesses.* |
| **Description of action(s):** | *Genesee County designates Smart Growth "Development Areas"—including hamlets, villages, urban centers, industrial centers—and allows water infrastructure extensions only to development in those areas; Tompkins County designated Development and Conservation Focus Areas to inform local land use planning and zoning* |
| **Type of action(s):** | *Executive (Genesee/Tompkins County Planning Departments)/Legislative (Tompkins County Legislature)* |
| **Impact:** | *Focusing development in walkable, bikable, transit-friendly municipal centers and preserving open space reduces GHG emissions and air pollution from VMT; helps attract businesses and jobs; and sequesters carbon.* |
| **Cost and bearer of cost:** | *County; cost of plans and implementation unknown* |
| **Ease of implementation:** | *Medium* |

# Priority Conservation Area Plans

| | |
|---|---|
| **Jurisdiction:** | *Municipal/Multi-Municipal; State—Hudson River Estuary Program (HREP).* |
| **Context:** | *Municipalities, with support from HREP, sought to direct growth to municipal centers/downtowns and protect priority conservation/biodiversity areas in planning and zoning.* |
| **Description of action(s):** | ***Red Hook Centers & Greenspaces Plan.*** *The Town incorporated designated centers (development areas) and greenspaces (conservation areas) into its comp plan and zoning ordinance.*<br>***HREP Pilot Multi-Municipal Conservation Planning Project.*** *HREP helped 3 municipalities—Red Hook (Town/Village) and Tivoli—to apply a Cornell habitat connectivity model to municipal planning. The oilot project resulted in a framework of conservation opportunities and strategies to incorporate the connectivity model into planning, and resulted in the addition of designated priority habitat linkages into the communities' Community Preservation Plan.*<br>***Town of Wawarsing.*** *Town used biological data on conservation to inform designation of Critical Environmental Areas under SEQRA.* |
| **Type of action(s):** | *Executive* |
| **Impact:** | *Conservation areas help direct growth into municipal centers, which reduces VMT and contributes to climate adaptation.* |
| **Cost and bearer of cost:** | *State/Municipal* |
| **Ease of implementation:** | Medium |

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# Centralized Baseline Planning and Zoning Database

| | |
|---|---|
| **Jurisdiction:** | *Region—Boston Metro Area Planning Council; State—CT* |
| **Context:** | *Both initiatives seek to provide baseline data to municipalities to assist in their development of comp plans, zoning ordinances and other land use policies, particularly for municipalities that may not have the staff or capacity to hire consultants to gather/access these data.* |
| **Description of action(s):** | • ***Boston Metropolitan Area Planning Council (MAPC) Open Data Zoning Atlas:*** *https://zoningatlas.mapc.org/ Centralized database for municipalities*<br>• ***CT Desegregate Connecticut Zoning Database:*** *www.desegregatect.org/atlas Centralized database for municipalities, focusing on equity issues, including equitable TOD.* |
| **Type of action(s):** | *Organization* |
| **Impact:** | *The databases help municipalities plan for smart, sustainable, equitable development, which reduces VMT, supports public health and promotes equity.* |
| **Cost and bearer of cost:** | Sponsoring organization/cost unknown |
| **Ease of implementation:** | Hard |

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# Expedited Comp Plans with Region-/County-Based Technical Support

| | |
|---|---|
| **Jurisdiction:** | *Regional—NYS Commission; County—Alleghany County* |
| **Context:** | *Tug Hill and Alleghany county seek to proliferate the number of comp plans by providing technical support and capacity-building, rather than one-off grants and efforts.* |
| **Description of action(s):** | ***Tug Hill Mini-Comp Plan program**—Commission uses circuit riders and existing regional plans and data to inform, jump-start and expedite the development of short municipal comp plans, which can then lead to zoning.*<br>***Allegany County's Comprehensive Planning School**—with a NYSERDA Cleaner, Greener grant, the county developed and delivered a "Comprehensive Planning School" to four municipalities and then helped them develop and pass individual municipal comp plans.* |
| **Type of action(s):** | *Executive (Tug Hill—agency-based; Alleghany—county-based)* |
| **Impact:** | *[Please include the resultant GHG emissions impact, economic impact (e.g. jobs, economic growth), local pollution and health impact, impact on disadvantaged communities, and other impacts as relevant]* |
| **Cost and bearer of cost:** | Agency/cost unknown |
| **Ease of implementation:** | Easy |

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# TOD Support and Incentives

| | |
|---|---|
| **Jurisdiction:** | *Municipal* |
| **Context:** | *Municipalities were seeking to expedite, support and incentivize smart growth/TOD.* |
| **Description of action(s):** | • ***New Rochelle Downtown/TOD Overlay Zone**—City created several overlay zones covering 279 acres of downtown land that include smart growth design elements as a form-based code—projects that comport with this overlay zoning can receive incentives, such as height/density bonuses; a revolving fund supports GEISs consistent with the zoning, costs to be paid back to the fund by the developer if the project is built; a step-by-step guide was created to help developers to build according to the code.*<br>• ***Westbury TOD Zone:** The Village re-zoned 52 acres of prime land around the Westbury LIRR station, with density bonus incentives for workforce, veterans and senior housing and an expedited review process by the Village Board (re-zoning funded by the DRI).* |
| **Type of action(s):** | *Executive* |
| **Impact:** | *TOD was recognized as the most energy-efficient form of development in the 2015 State Energy Plan; TOD significantly reduces VMT and offers the greatest opportunities for mixed-income/mixed-use, walkable, bikable and transit-friendly development.* |
| **Cost and bearer of cost:** | Municipality/cost unknown |
| **Ease of implementation:** | Easy |

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# IDA Smart Growth Tax Incentives

| | |
|---|---|
| **Jurisdiction:** | *Municipal/IDA* |
| **Context:** | *IDAs include tax incentives for downtown redevelopment projects in their Unified Tax Exemption Policy.* |
| **Description of action(s):** | *Erie County IDA—extended tax incentives to vacant/abandoned properties in downtowns.*<br>*Tompkins IDA—Created the City of Ithaca Community Investment Incentive Tax Abatement program to further incentivize the redevelopment of the city's downtown, increase density and housing availability and affordability promote redevelopment of vacant/abandoned buildings.* |
| **Type of action(s):** | *Regulatory/Executive* |
| **Impact:** | *Downtown redevelopment reduces VMT, promotes outdoor activity and offers opportunities for affordable, mixed-use/mixed-income development.* |
| **Cost and bearer of cost:** | Municipalities/IDAs (through tax abatements) |
| **Ease of implementation:** | Easy |



# Gentrification/Displacement Protections and Community Wealth-Building

| | |
|---|---|
| **Jurisdiction:** | *State/Municipal* |
| **Context:** | *Gentrification and displacement are risks that must be addressed within the planning and development process, in partnership with grass-roots entities that are well-versed in the impacts and solutions.* |
| **Description of action(s):** | ***Albany County Land Bank/Community Land Trust Partnership**—land banks redevelop vacant properties and community land trusts build long-term affordability into their ownership model by owning the underlying land; these two entities partnered to reinforce one another's work and create more opportunities for long-term, successive affordability, while allowing for managed equity creation.*<br>***Kearney Realty Artist/Affordable Housing Mixed-Income Projects**—the developer maximizes public programs, including the DRI, in order to continue as property managers to achieve equity—design is high quality and woven into the surrounding community; projects sponsor/support artists, arts and cultural events; properties are strategically located in transitional neighborhoods in order to de-concentrate poverty, create a mix of incomes and ultimately reduce gentrification.* |
| **Type of action(s):** | *Executive* |
| **Impact:** | *These entities reduce and avoid displacement and gentrification, increase homeownership for lower-income households, create community wealth through both home-ownership and business-ownership and reduce the concentration of poverty in disadvantaged communities.* |
| **Cost and bearer of cost:** | *Municipalities/IDAs (through tax abatements)* |
| **Ease of implementation:** | *Easy* |

# Appendix B: CJWG Feedback on Advisory Panel Recommendations

## Climate Justice Working Group

### Recommendations to the NYS Climate Action Council for Consideration in the Scoping Plan

June 28, 2021

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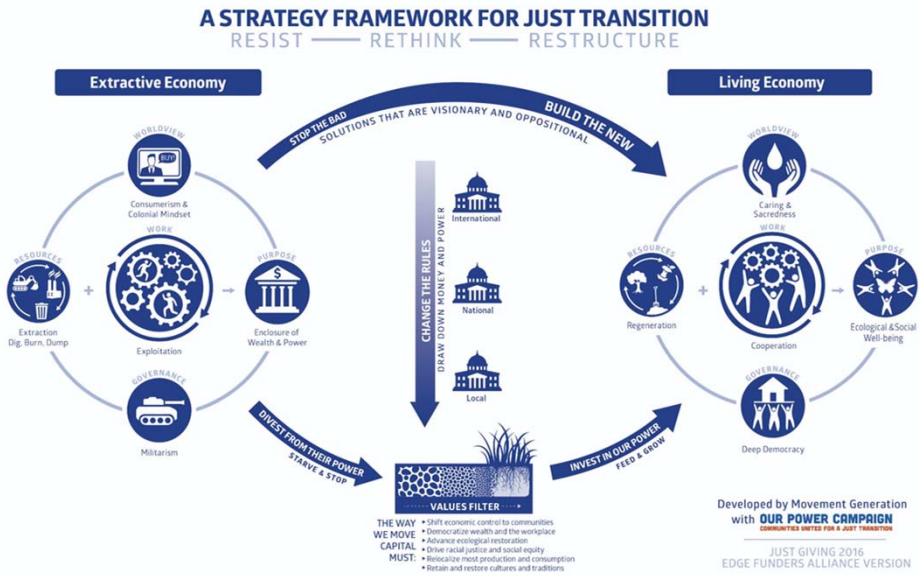
## Our Justice Lens and the Principles We Stand By




2

2

## Observations and General Impressions - Mainly on Transportation Advisory Panel Recs

- **Recognize that goals/benchmarks/accountability is essential**
  - The recommendations need clear guidance on how benefits/investments will be defined, measured, tracked, and shared over the long term
  - Scoping plan must ensure data is available to accurately measure the success of implementing the CLCPA
- **Better scrutinize every action for justice**
  - Some of the recommendations presented false market based solutions
- **Provide greater clarity, reasoning, and purpose**
  - Some goals such as the doubling of muni-sponsored public transportation appear arbitrary without an analysis on the basis of the target
  - Policies with significant implications like a feebate deserve more than a 'handwave'. ***It sounds like 'free money'. How does it actually work in practice?***
  - Provide explanation of how the social cost of carbon was incorporated
  - Edit jargon to plain speak, and remove vague, squishy language and strive to provide key details


- **Increase ambition**
  - Fill in the gap of connectivity between regions of the state that rely on public transportation by prioritizing high speed rail and long range bus service
  - Refine TOD Strategy to elevate its estimated GHG reduction impact by 2050 from medium to high by placing the most emphasis on VMT reduction
  - Deemphasize vehicle electrification as the topmost solution as it fails to address SOV associated issues. This hinders our ability to address the root cause of runaway transportation emissions, and its related link to systemic issues such as racism and poverty





## Dangers of a market based approach to climate justice

**Transportation Climate Initiative (TCI) Flaws**

- Best available evidence shows cap and trade systems do not eliminate air pollution hotspots, and often exacerbate them
- Like RGGI, funds generated by TCI are vulnerable to budgetary raids by the Executive and Legislature
- Reforms to cap and trade are unlikely to remedy pollution disparities given the program's inability to surgically reduce mobile source emissions which are more complex to regulate than stationary sources
- The inherent design flaws of cap and trade result in environmental racism
- The inadequate involvement of EJ groups in the policy process reflects a profound failure of democracy, and bolsters the case for abandoning sector specific carbon pricing policies for a comprehensive carbon fee like that in the CCIA


**Denial of Home Occupant Justice**

- Protect LMI renters by amending the provision on new market rate housing within TODs that is currently limited to home ownership to include renting and rent to own options

**Clean Fuels Standard Concerns**

- Allowing high carbon fuel producers to meet their credit obligations by paying clean producers for their energy is a weak way to enforce the standard - as it lets them offset instead of eliminate their emissions - which by itself won't guarantee that emission reductions and investments in overburdened communities occur at the necessary speed and scale required by the CLCPA
- Clean air necessitates an 'electrify everything' approach.
  - Allowing vehicles to combust lower carbon liquid fuels that still emit criteria pollutants won't eliminate air pollution hotspots

# Recommended Additional Actions

**Electrify Everything that Moves**

- Adopt ZEV for medium and heavy duty vehicles and carve out explicit targets for trucks and bus conversion that prioritize diesel emission reduction in air pollution overburdened communities
- Mandate rapid phase in of the conversion of the state's fleet to ZEVs

Rapidly expand policies to encourage uptake of EVs – like incentives and enhancement/expansion of charging infrastructure

**Hone in on Equitable VMT Reduction**

- Establish a New York State-supported Equitable (Fair & Affordable) Transit-Oriented Development (E-TOD) effort via the Regional Economic Development Councils or through a New York Statewide E-TOD Program.
- Include at least 20% affordable housing minimum for all new TOD
- Amend Municipal Home Rule Law to explicitly allow fees on new development to offset public transportation service costs
- Require at least 50% of transportation sector climate monies to be spent on non-car programs

**Extra Support 4 Communities Facing Barriers**

- *Within the Consolidated Funding Application (CFA) of the Regional Economic Development Councils,* mandate prospective developers and employers to identify how their prospective projects (and related NYS funding requests) consider public transportation options for low-income workers.
- Incentivize hiring of disadvantaged workers in transit manufacturing by enabling companies to get a credit for setting aside a certain proportion of their workforce for hiring them

5

5

# EE & Housing Advisory Panel

***Concerns & Suggestions***

- Recognize that when DACs benefit, we all benefit and advance justice
  - We should be aggressively pursuing established State goals
    - However, New York State's own energy affordability goal of 6% or less of household income was not even acknowledged

- Emphasize Just Transition to a greater effect
  - Regulatory action and investments in efficient appliances and clean heating/cooling/cooking must be front loaded in DACs or poor and working class households will be left behind
    - Sunset dates for combustion appliances and systems are inadequate without added goals to benefit DAC, such as:
      - Investments from proposed electrification and retrofit readiness fund
      - Mandate utility planning for fossil fuel divestments and just transition investments
        - Target workforce training and job creation
        - Reduce cost burdens with adequate rate design in LMI households and historically redlined areas
    - Prioritize consumer financing options made available by CDFIs and credit unions as part of the Community Reinvestment Act regulatory compact

- Consumer protection needs are generally inadequate, therefore update the recommendations to include:
  - Utility customer bill of rights
    - Including a safety net style guarantee of renewable energy to every household
  - Public education measures to counter power of IOUs and alleviate the opaqueness of the energy system
  - Clawback provisions to defend against rate increases, gentrification, and displacement are needed as part of public subsidies to private landlords
  - Energy benchmarking/disclosure requirements that protect and empower tenants with information about the energy use intensity and affordability of their housing stock

6

6

## Energy Efficiency & Housing Advisory Panel

***Undertake the following additional actions***

- Create standards for upgrading existing buildings
  - Include proper cost projection and place based strategies for buildings in need of substantial repair or remediation
- Bolster local supply chains and create jobs
  - Outline plan for preservation, diversification, and growth of local supply chains and material and appliance distributors serving DACs

- Heed the special needs of and jurisdictional issues of the State's public housing stock in particular NYCHA and housing in NYC
- Tweak PSC policies to encourage EE and additional funding as part of the rate base for EE

- Calculate costs and benefits holistically
  - Consider the health impacts associated with poor indoor air quality and insufficient thermal comfort
  - Incorporate the cumulative cost burden related to housing, energy, transportation, and healthcare

7

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## Climate Justice Working Group

# Input to the NYS Climate Action Council on Power Generation Panel Recommendations

July 22, 2021

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council

8

## Overall Impressions:

**Makes real progress in several key areas** ***and yet….***

- Expansion of workforce development
- Affordability
- Community solar access
- Rapid expansion of renewable energy
- Phase out of existing fossil fuel plants

- The door to false solutions is still open
- There isn't enough emphasis on public power/energy democracy & consideration that LMI program size needs to be commensurate with need
- Cumulative impacts are not considered in the recs

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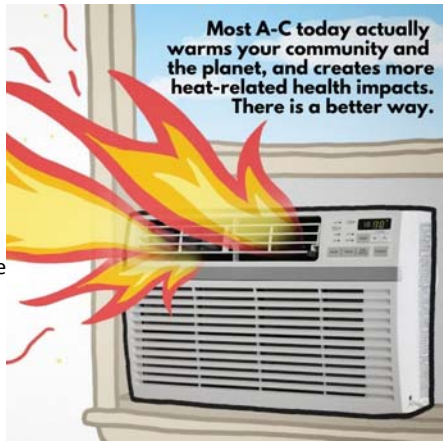
### Access and Affordability for All

•Reduce the overwhelming share of household income that POC and low-income communities spend on electric power (over 6% for many)
•Prioritize modifications to NYS Home Energy Assistance Program, including:
- Re-orient grants to only support installation of green technology
- Help eligible households pay their bills over the hot summer months, in addition to the cost of a new AC unit

•Remove silos that agencies work in so households are aware of all programs they're eligible for. Currently, unless one agency communicates with all others, customers can be on their own to learn about programs they're eligible for like EmPower
•Direct DPS to study and consider alternative rate structures that are more progressive and to support green energy.
•PG panel guidance on 40% investment recommendation requires further input from CJWG:
- Interagency definition of public investments is needed
- We agree with the inclusion of transparency, accounting, and remediation efforts in the event of a failure to meet targets

•Expand existing pre-development programs for energy projects which are owned by municipalities, Indigenous tribes, CBO's, and NGOs
•Hire more EJ teams within agencies: for example, appoint an EJ lead at DPS
•Provide **SIGNIFICANT** incentives for LMI households to upgrade their appliances




**Specialists in energy equity, energy justice, energy democracy and/or environmental/climate justice need to be intentionally hired!**

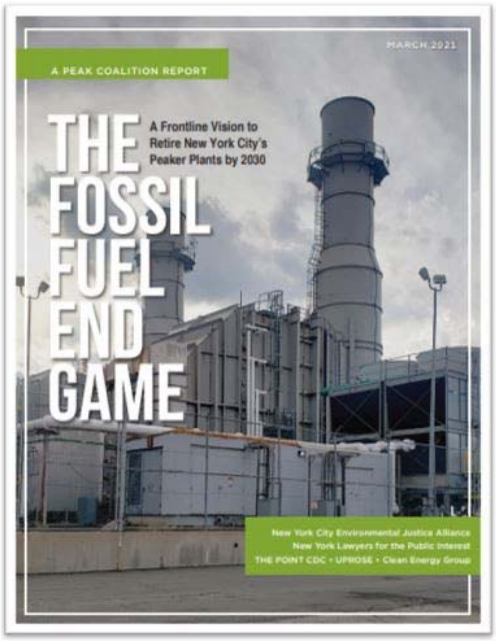
10

### Retirement of fossil fuel-fired facilities

•We support the rec. to rapidly launch an assessment and planning process to effectively and equitably reach zero emissions from power generation by 2040
•Process for the promulgation of DEC led GHG regulations for 2040 must be clear, and the end date enforceable.
•Also, make the planning process iterative so all of the utilized regulations and mechanisms are evaluated and revised as needed every 2 years in order to reach the 2040 goal
•Place moratorium on new fossil fuel plants

- This is critical until final CAC recommendations are adopted. No new fossil fired facilities should be permitted under the moratorium absent a valid, demonstrable system reliability need that can't be reasonably met by non-polluting power.

•Address current and prospective emissions from crypto-currency mining operations to prevent the facilities from exploiting a loophole in PSC oversight to repower fossil generating facilities behind the meter. Place a moratorium on these operations until the conclusion of a full generic EIS to determine whether these operations can be mitigated to comply with the CLCPA




11

### Distributed Generation/Distributed Energy Resources

***We support these***, and urge the prioritization of the following recommendations:

- Compensation – Address improvements to VDER stack to more accurately reflect value provided by DERs, incorporating DEC's SCC calculation and avoided transmission costs. Introduce an EJ/DAC adder to value stack.
- Target incentives to stimulate high value DER projects (like dual use solar/ag, multifamily housing, heat pumps/geothermal, etc. and pair them with LMI and EJ electrification goals. Expand NYSERDA's Solar Energy Equity Framework.
- Create dynamic rate structures and programs that provide appropriate price signals and stimulate DER usage
- Ensure a process is in place that assures LMI community solar savings don't in any way prevent access to other LMI energy savings programs like NY's Heating Assistance Program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**Reliability for the Future Grid**

- Make NYISO more transparent – with more checkpoints and opportunities for public input and critiques. NYISO's needs assessment must be better disseminated and shared with local energy advocates
- Sync CLCPA Scoping Plan and mandates to the State Energy Plan
- ***We support*** the PG panel rec to improve reliability and resilience to climate impacts, via continued infrastructure investment (prioritize these projects in historically overburdened POC communities where access to basic amenities are less) with design criteria that can be adopted to reflect evolving climate impacts
- Invest in community outreach to provide effective communication and support for communities impacted by extreme weather events
- Address the impact of extreme heat beyond overcapacity to the grid, like increased water demand for cooling of power plant systems and sagging power lines that elevate fire risk from tree strikes


- *Storm hardening infrastructure investments must be FIRST implemented in historically burdened/black & brown communities, since they have less access to cooling for summer storms, heating for winter storms, transportation, or savings*

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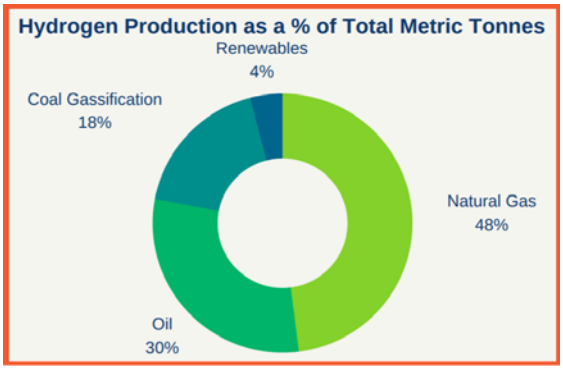
**Technology Solutions (only support the real ones in order to achieve justice!)**

**•We are concerned about the promotion of false solutions and believe that:**

- The 70% clean energy by 2030 target should be achieved with existing technologies
- And the 100% by 2040 target should be achieved by focusing on developing needed solutions for dispatchable technologies
  - Certain demonstration projects distract from clear renewable energy goals – **the PG panel recommendation focused on lifecycle air quality and health impacts of unproven technologies should be pursued as a priority.**

•Fossil fuel industry supported technology fixes are based on false premises and are legally questionable under the CLCPA and often don't reduce the pollution burden in EJ communities as noted in the NY Renews False Solutions Report.

- **Fuels that are false solutions** emit as much as or more carbon than fossil fuels, create local air pollution from combustion, are not economically viable, divert land from food production and carbon sequestration, and deplete fresh water supplies.




The recommendations concerning nuclear energy must be strengthened:


-Conduct lifecycle analysis of the environmental, health, safety, emissions, and EJ impacts of this fuel
-Proactively plan for the scheduled shut down of the four reactors in upstate NY. The next two retirements will occur in 2029 unless the State shells out billions in subsidies. This includes planning for a Just Transition for impacted workers and communities.
-Account for the inflexibility of nuclear power generation as grid needs evolve when more renewable energy comes online
-The Onondaga Nation should be consulted on the nuclear waste storage and transport impacting their traditional lands.

- Hydrogen may have a valuable role to play in the deep decarbonization of heavy transport and industrial processes, but runaway plans for its extensive use in the power sector raise grave concerns. It has a significant water footprint and its combustion in power plants produces nitrogen oxide emissions up to six times greater than methane. NYPA already embarking on a hydrogen combustion demonstration project despite these concerns is a red flag

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## Workforce Development

***We support*** the recommendations to provide education and career opportunities in clean energy for DACs and fossil fuel sector employees
*•DACs, workers, MWBEs need state agencies involved* in any aspect of large- or small-scale clean energy projects to fully leverage their capacity to lock in enforceable commitments around access to quality jobs and ensure public investments in workforce development generate the desired ROI

•Fully leverage tools like community workforce agreements, community benefit agreements, first source hiring, and project labor agreements to increase access to construction and permanent jobs for DAC members; Develop agreements in partnership with frontline communities, industry, and organized labor
•Further emphasize green worker-owned cooperatives that can be hired for public & private projects and economic ownership of local clean energy projects to prevent displacement during 'revitalization' projects

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## Energy Delivery & Hosting Capacity

***We support*** this series of recommendations as they're key to building out renewables. **Some concrete actions we'd add:**

•Pro-actively identify key transmission and distribution upgrades, improvements, and new line construction needed to deliver renewable energy across the state and maximize the retirement of fossil fired resources
•Approach interconnection with an intelligent, justice oriented lens:

- Adopt PSC regulations to allow for advanced metering to enable cost effective and time efficient solar interconnection options
- Work with CBO's to tailor regulatory changes in favor of community led clean energy projects and ensure they are sufficiently resourced to engage
- Subsidize community led solar projects for customer side upgrades and equipment and exempt them from all utility side interconnection costs
- Subsidize offshore wind interconnection upgrades, as placing the cost burden entirely on the industry may delay CLCPA mandated deployment targets
- Study grid vulnerabilities in DACs and prioritize improvements in those areas


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## Growth of Large-Scale Renewable Energy Generation, Siting, and Community Acceptance

**We suggest the following actions:**

•Balance approach of large-scale renewables with significant investment and technical support for DACs to develop behind the meter microgrids
•Launch statewide public education campaign to inform New Yorkers about the climate crisis and benefits of shifting to a clean economy.

•***We support*** the recommendations to:

- Incentivize local climate resilience HUBs
- Fund non-profits and CBOs to conduct community outreach
- Expand and streamline customer incentives for EE, including funding for customers based on utility payment history instead of credit scores
- Ensure community benefits and avoided costs are tracked in dollar amounts, and the value of the cumulative health benefits of clean power is quantified

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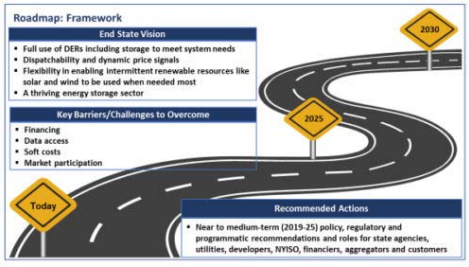
## Existing Storage Technology

***We support:***

- Updating the State's energy storage roadmap, as soon as practicable, to update and revise storage deployment goals recognizing the substantially higher requirements identified in the power grid study of 15GW by 2030

a) The recommendation to provide increased funding for energy storage deployment

b) The recommendation to initiate a new docket, ideally before year end 2021, that establishes new mandated yearly energy storage targets increasing to an overall statewide storage target of 15GW by 2030, and mandates funding and financing mechanisms similar to the clean energy standard for storage.




**Storage to protect DACs where the resilience need is much higher should be prioritized!**

18

## Phase Out Natural Gas

**Gas Infrastructure, Transmission, & Methane Leakage**

**•The transition away from gas infrastructure is a strong recommendation by the PG panel!** It should include a detailed analysis on the cost effective and equitable strategy necessary for this transition to be just.
•The recommended proceeding on GHG reductions for gas utilities concerning transmission and allocation of timelines should prioritize progress in areas in EJ communities where co-pollutants pose a high cumulative burden
•Scrutinize the legitimacy of the concern that phasing out gas infrastructure poses grid reliability risks, as the notion unnecessarily conflicts with achieving crucial short term, foundational emission reductions. Continuing to build out infrastructure on the unfounded premise of reliability makes zero technical and economic sense. It's not necessary and becomes a stranded asset. We must **Ask who pays for this and benefits from it?**
•Clarify what the recommendation on supporting DEC efforts means- If this refers to existing processes, that should be explicit, and expressed as a recommendation
•The Abandoned Wells approach should be more thoughtful.

- Public funds should be used as a last resort to cap wells as it drains resources from investments that could made in transitioning DACs to clean energy
- Consider ways the oil and gas industry can 'adopt a well' in their service territory or otherwise contribute to reducing emissions from the sources.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# Climate Justice Working Group

## Input to the NYS Climate Action Council on Land Use and Local Government and Agriculture & Forestry Panel Recommendations

**September 13, 2021**

NEW YORK STATE OF OPPORTUNITY. | Climate Action Council

20

Overall Impression of Land Use and Local Government Recs – We support with small room for improvements

## Adaption & Resilience

- Creation of State Resilience Officer position should incorporate Just Transitions principles and be a DAC supported appointment
- Provide clarity on the positioning of the Adaptation & Resilience Sub-Cabinet position
- Resilient infrastructure fund needs to prioritize frontline communities
- Pro-actively mitigate adverse impacts in DACS from proposed:
  - Insurance premium surcharges
  - Strategies to address underinsurance
  - Managed retreats and buyouts of properties
- Make online tools that support vulnerability assessments available in multiple languages

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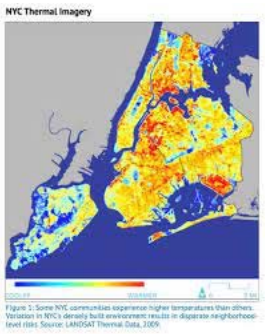
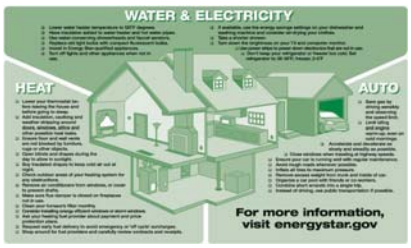
Adaptation & Resilience continued..

- Maintain ongoing analysis of health implications of new climate projections on heat increases
- Incorporate air quality into heat warning systems
- Update DOS Costal Management Program to require diesel emission reductions from land and water based vehicles




- Enhance and leverage the NYS WAP to better protect inhabitants from extreme weather

- Directly fund efforts to build and maintain nature based infrastructure and natural areas
- Along with including EV charging as part of resilience plans, add an overall response that prepares communities for evacuation needs, and values solar + storage and V2G benefits

22

## Make 'Smart Growth' truly intelligent and equitable!

- Adopt flexible definition of smart growth to include various mixed used developments
- Acknowledge difference in rural, urban, and suburban areas
- Make concentrated effort to avoid burdening DACs in the prioritization of conservation areas and degrowth of high climate risk and ecologically sensitive areas

- Meaningfully engage communities in the planning and implementation of projects. Consider creating a 'Climate Justice through Community Planning and Action' grant program to fund local capacity building in DACs for project planning and review processes

23

## Smart Growth continued…

- Ensure there is an 'E' before T-O-D to avoid gentrification/ displacement!
- Prioritize investments in high density, transit underserved and high pollution burden areas

- Promote open spaces and recreation, not just TOD in new commercial/residential development

Let's avoid this! >>>>

- Establish a clear definition of GEIS to ensure it doesn't obliviate municipal land review requirements
- Reform REDCS to include diverse DAC representation
- Adopt explicit land use strategies to reduce GHGs and co-pollutants in DACs

24

## Clean Energy – *By and large, we support the recommendations in this section. It's important to note that:*

- Technical support to local governments would allow these often understaffed entities to take better advantage of opportunities
- Projects that recover methane from wastewater treatment facilities should be onsite only and not be used to justify pipeline expansion
- Develop a statewide dashboard of community greenhouse gas emissions inventories

- We are enthusiastic about plans to decrease waste and increase recycling and electrify municipal and school district fleet but encourage the State to be thoughtful in how DAC's are defined to qualify for TVIP funds to ensure equitable participation


- NYPA should play a larger role in working with municipalities to support renewables deployment
- On Community Choice Aggregation explicit focus must be on removing barriers to entry and safeguards for households in DACs

City of Rochester, NY
rochester
community power

25

## Carbon Sequestration through conservation

DAC benefits must be prioritized in investments to restore and protect aquatic habitats, including in the Environmental Bond Act and Environmental Protection Fund, DEC Water Quality Improvement Program and NYS Conservation Partnership

Avoided land conversion is crucial for carbon sequestration, VMT reduction, enhanced farms, and food security

26

## Overall Impression of Ag & Forestry panel recommendations:

*Unfortunately, they are insufficient to the task:*

- A 30% GHG reduction target is inadequate when the CLCPA requires elimination of all anthropogenic emissions (except from livestock sources)
- Doesn't totally address systemic racism
- Still enables harmful, large scale farm operations
- Relies on false solutions like biogas and biomass
- Maintains use of fracked gas in fertilizers
- Fails to spur robust organic farming
- Too many voluntary incentives and not enough mandatory actions

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## Take a holistic approach that not only reduces GHGs, but improves crop yields and protects drinking water!

### We can do it! Examples:

A recent Genesee Valley of NY study proved the numerous benefits of better soil management and use of strip-till, cover crops, and nutrient management

- Grants offered by the Watershed Agricultural Council and NYC enhance drinking water and climate mitigation and resilience!
- The NYS Legislature just enacted the Soil Health and Climate Resiliency Act (S4722A/A5386A). The CAC must see to it that NYS vigorously implements it!

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## CAC should incorporate climate justice principles to ensure that:

- BIPOC farmers are able to participate throughout the process including design and implementation
- Policies designed to lower GHGs don't increase - and in fact decrease - the use of harmful toxic pesticides
- Disproportionate barriers for small to mid-size farms and for social disadvantaged farmers aren't created

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## A 30% net GHG cut from present day levels by 2050 is inadequate. CAC should pursue more ambition and steps like:

- Adopt the climate goals set in the federal Agriculture Resilience Act – which requires cutting GHGs in half from 2010 levels by 2030 and to net zero by 2040
- Reform method of distributing State funds to NY farms to make it equitable, rather than disproportionately benefiting GHG intensive operations like large scale dairy farms

- Make the Transition Just for workers! – Include safeguards to enable equitable workforce training and compensation

- Impose a fee on fertilizers that funds a transition to organic farming. This would meaningfully reduce GHGs and protect precious public waterways and private water wells from runoff

30

## CAC should adopt real and not false farm energy solutions:

- Do not utilize biomass
  - Like biofuels, burning trees isn't a smart solution

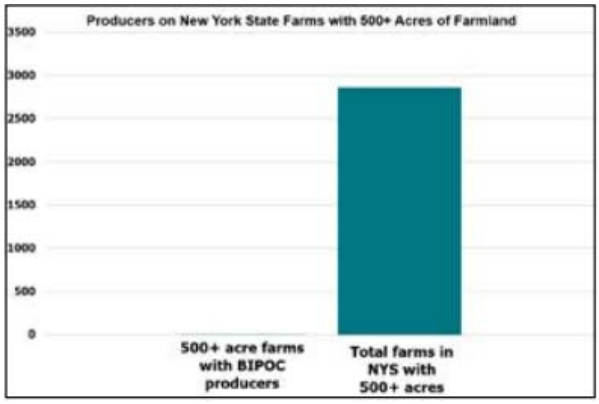
- Create a pathway for 100% zero emissions farm vehicles and equipment

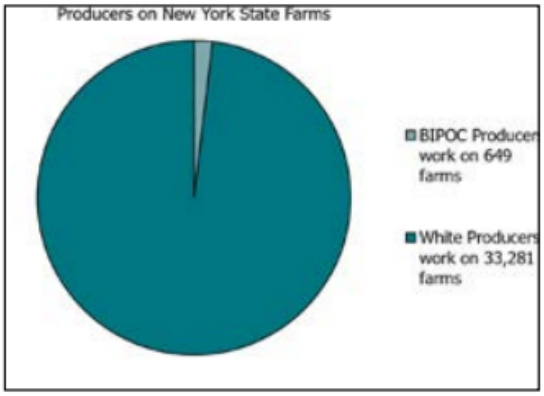
- Do not support the installation of biodigesters at CAFO's – these are inherently unsustainable!

- Fund transformative practices upstream of manure storage and towards practices that smaller producers can adopt

31

## Uproot systemic racism in NYS farming!




Graph Sources: Diversity and Racial Equity Working Group Report, NYAGM

- Meaningfully involve BIPOC farmers in the creation of incentive programs – consider setting up an Advisory Board that would make recommendations on program design
- Offer incentives in the form of grants instead of loans and eliminate the match requirements for grants
- Support community gardens and protect them from development
- Provide land to BIPOC farmers and farmer workers that have been historically excluded from farming opportunities

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# Climate Justice Working Group Feedback

## Waste and Energy-Intensive & Trade-Exposed Industries Advisory Panels

## Just Transition Working Group

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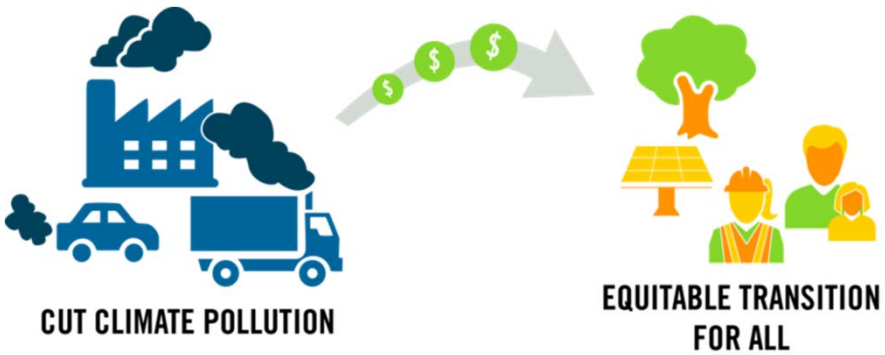
## CJWG perspectives on Just Transition, EITE, and Waste




October 1, 2021

NEW YORK STATE OF OPPORTUNITY. Climate Action Council

34

# Just Transition


➢ Clarify definition of 'low carbon energy' manufacturing
- Require a 'best in class' framework when public subsidies are allocated to manufacturers to encourage high road performers

➢ The Enabling Initiatives are generally strong and commendable
- Add a Workforce Assessment Plan to ensure impacted workers can contribute to the process of protecting workers and include retirement planning, allowing aging fossil workers a dignified retirement

35

# Just Transition

- Consider Community Benefits Agreements between manufacturers, union groups, and impacted communities
  - Make these legally binding
- Minimize disruptions in the transition of the existing workforce by including plans to reuse shuttered dirty power plants for clean energy and sustainable manufacturing
- Focus on eliminating implicit bias in searching/hiring for workers

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# EITE

We support the emphasis on:

- Green job creation for members of DACs
- Data collection and reporting requirements to paint an accurate picture of how industrial facilities impact DACs
- State procurement of low-carbon materials

***But**, we* suggest:

- Making climate and EJ the explicit objective, as opposed to business development
- Strongly emphasizing demand-side changes to reduce materials waste
- Prioritizing electrification for industrial heat whenever feasible
- Ensure the BIPOC are included in the process of creating workforce development programs, to ensure that their unique perspectives are represented

37

# Justly reduce EITE industry footprints

➔ Carbon capture and storage is not a clean resource

➔ 'Green H2' can be a suitable alternative fuel in high heat industrial processes but DEC should be ready to use its power under Section 7 of the CLCPA to prohibit actions that add to pollution burdens in DACs, i.e. avoid harmful emission releases from combustion, such as NOx

➔ Offset projects should deliver meaningful local environmental benefits that negate the source impacts

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# Waste

- Industry flexed significant power over panel recommendations:
  - Ideas pertaining to rethinking and redesigning waste systems were omitted, like:
    - Barring incineration
    - Taxing overproduction of food
    - Mandating sustainable shipping/packaging and pet litter bags
    - Creating polluter funded union jobs for cleanup of waterways, oceans, sewage, soils, air
  - The overall lack of emphasis on waste reduction and local scale diversion practices was staggering

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# Waste

- DEC overemphasized incremental, underwhelming actions like creating landfill and biogas markets (despite their questionable air and climate benefits) and recycling as opposed to reducing/rethinking
- Industry influence perpetuated practices, like the lack of regulations on waste trucking and the overproduction of materials
- The process by which the panel recommendations were finalized lacked opaqueness
- As revealed by the integration analysis, greater ambition in reducing emissions from waste is necessary

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# Appendix C: JTWG Recommendations to the Council on Measures to Minimize the Carbon Leakage Risk and Minimize Anti-Competitiveness Impacts of Potential Carbon Policies and Energy Sector Mandates

In its transition to a net zero GHG emission economy, the State must also consider the issue of GHG emissions "leakage." Under the Climate Act, leakage is defined as, "A reduction in emissions of greenhouse gases in the state that is offset by an increase in emissions of greenhouse gases outside of the state." The concept of leakage is important given the fact that climate change is a global problem, whereas the State's policy authority is confined to activities within its borders.

New policies that increase the cost of energy, reduce the reliability of energy, or increase the cost of emitting GHGs could cause businesses to shift their production outside of New York, or avoid the State altogether, and instead invest in out-of-state locations with lower energy and/or GHG emission costs.

The problems caused by leakage are twofold. First, the state experiences a loss of jobs, investment, and tax revenues (economic leakage). Second, when businesses leave or avoid the state to operate in jurisdictions with less stringent clean energy or GHG emission policies, the likely end result would be an increase of emissions over the level that would have been allowed had the business remained in New York, thereby actually worsening global emissions.[1] In sum, mitigating leakage risk is of interest to the State for both climate and economic reasons, which is further demonstrated by the Climate Act requirements related to mitigating anti-competitive impacts and for the emission reduction regulations ultimately adopted by DEC to incorporate measures to minimize emissions leakage.[2]

In general, industries most at risk of leakage include those that consume the most energy (and emit the most greenhouse gases) and are most vulnerable to trade, often referred to as "energy-intensive and trade-exposed" (EITE) industries. The draft Scoping Plan does not define a formal list of industries that should

[1] The inverse of this scenario is also true – it would be possible for New York State to increase its own industrial emissions on an absolute basis, while actually lowering global emissions by creating an environment in which more emission-intensive production activities are shifted to New York and undertaken in a lower-emitting production environment. For example, New York State could displace the production of older, emissions-intensive steel overseas with the in-state production of less emissions-intensive, electric arc furnace-produced steel that is made with clean energy.

[2] See Environmental Conservation Law 75-0103(8)(d) and (f); 75-0109(3)(e).

be considered EITE as it relates to State policies, but, in New York, some EITE industries are likely to be in manufacturing-related industries that produce goods like cement, glass, primary metals, gases, and semiconductors.

As the State implements the Scoping Plan, it will need to carefully monitor the potential for unintended emission and economic leakage. The following represents a more detailed analysis related to the risk of leakage and potential measures to mitigate the risk of leakage.

## Measures to Mitigate the Risk of Leakage in EITE Industries

Under the Climate Act, State agencies will be required to promulgate rules and regulations to ensure compliance with the statewide emissions reduction limits. To mitigate the risk of economic and emissions leakage, governments that implement large-scale industrial emission-reduction regimes tend to design such systems with special accommodations for EITE industries. For example, jurisdictions that otherwise assign a price per ton of carbon-dioxide equivalent emitted (e.g., a cap-and-trade system) might provide special emission allowances to EITE emitters (State of California, Western Climate Alliance) while other systems may compensate certain industries for some of the cost of their carbon liability (Australia).[3]

In cases where the primary risk of leakage is not an emissions price but the cost of energy, similarly, policies can also be designed to reduce the cost of energy for EITE industries, such as through discounted electricity rates.[4] Within New York, certain industries are similarly supported with low-cost hydropower or power proceed allocations from NYPA, or with discount programs offered by utilities who are seeking to add more price-sensitive industrial energy consumers to their portfolios.

This draft Scoping Plan includes both of those potential sources of leakage. To the extent that the strategies in this Plan will lead to increased energy costs, this draft Plan identifies mitigation strategies that would proactively reduce the risk of leakage in EITE industries by relying on incentive-oriented approaches such as financial and technical assistance programs and low-carbon procurement incentives, as described in more detail in the Industry chapter.

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[3] While border adjustments (fees on imports and rebates to exports that are meant to create a level playing field when regulations vary across jurisdictions) are theoretically an option, they are generally considered to face significant legal and technical challenges under international trade laws. California 2010 Cap-and-Trade regulation, Appendix K at 33.

[4] Minnesota provides special discounted EITE electric rates but not in the context of an emissions reduction or control policy. The rates are available to certain industrial companies that are "uniquely exposed to global competitive pressures." *Minnesota Power makes competitive rate filing to help protect jobs in NE Minnesota*, Minnesota Power Press Release, June 30, 2016.

As explained in the Statewide and Cross-Sector Policies section of the draft Scoping Plan, implementation of an economy-wide carbon tax or cap-and-invest program would reduce emissions and provide funding to support other programs. If industrial sources are included, mechanisms should be identified to mitigate the risk of leakage from such policy. First, New York could participate in a regional program that provides a common carbon price across the region. New York already participates in the Regional Greenhouse Gas Initiative (RGGI) and it could decide to participate in another regional program as part of a multi-sector or economywide strategy. Second, the policy could be designed to exempt facilities in EITE industries (in the case of a carbon tax) or provide free allowances to such facilities in any cap-and-invest program. The free allocation could be output-based and be based on benchmarking of more efficient, lower emission sources in the industry.

In the future, as DEC or other state agencies promulgate rules and regulations to achieve the statewide emissions reduction limits, the State should consider the strategies discussed in the Just Transition chapter, to mitigate the risk of leakage in EITE industries posed by any emission mandates that may threaten significant emissions leakage in industry.

## Analysis to Identify Energy-Intensive Industries and Related Trades

This analysis is being provided per the Climate Act, which requires that the JTWG, among its other responsibilities, "identify energy-intensive industries and related trades…"[5] The report was prepared by staff to the JTWG in consultation with the EITE Industries Advisory Panel.

The analysis herein relies on a combination of publicly available Federal and State data sources to assess the energy intensity, emissions intensity, and trade intensity of all U.S. industries in the Manufacturing and Mining, Quarrying, and Oil and Gas Extraction sectors, as well as the New York State employment and occupational characteristics of the most intensive sectors.

A primary objective of this analysis was to determine which industries and occupations in New York State may be most energy-intensive and trade-exposed, as a proxy for assessing which industries may be least and most at risk of emissions leakage in association with any future energy or GHG emission mandates.

[5] ECL § 75-0103.

The draft Scoping Plan does not define a formal list of industries that should be considered EITE as it relates to State policies, but this report does present information on the most energy-, emissions- and trade-intensive U.S. industries, as well as the presence of those industries in New York. This report also includes suggested considerations in the event that the State does elect to adopt an EITE definition in the future.

## Background on Emissions Leakage

In the context of the Scoping Plan, new policies that increase the cost of energy, reduce the reliability of energy, or increase the cost of emitting GHGs could cause businesses that consume a lot of energy and/or emit a lot of GHG emissions to shift their production outside of New York, or avoid the State altogether, and instead invest in out-of-state locations with lower energy and/or GHG emission costs.

As an example, consider a scenario in which the State adopted new energy sector mandates that increased the total cost of energy by 20%. If a steel producer is currently spending 10% of its total costs on energy, it would now experience a 2% increase in its total costs. Because steel is generally sold as a global commodity with limited profit margins, the state's steel industry would be limited in its ability to raise its prices (without being displaced by competitors' cheaper substitutes) and, as a result, would experience a commensurate loss in profitability associated with its cost increases. With the in-state manufacturer unable or less able to profitably make steel in the state and sell it at globally competitive prices, the industry may shift more of its production to other jurisdictions with lower energy and/or GHG emission compliance costs where it could more profitably make steel.

## Background on Energy Intensive and Trade Exposed (EITE) Industries

This section explains the meaning of EITE industries in greater detail.

1. Energy-Intensive Industries

Energy-intensive industries consume a high amount of energy (such as electricity and combustion fuels) as a share of their economic output. In general, energy intensity is measured by comparing an industry's energy expenditures as a percentage of its revenues. When the cost of energy increases, energy-intensive sectors will experience the greatest relative cost increases – for example, if the cost of electricity increases by 10%, an industry for which electricity is 10% of its costs of production will see its total costs increase by 1%, whereas an industry for which electricity is 1% of the cost of production would see its total costs increase by only 0.1%.

2. Emissions-Intensive Industries

Emissions-intensive industries are those that emit a high amount of GHG emissions relative to the value of their economic output. Industries may produce GHG emissions either directly - such as from the on-site combustion of fossil fuels or from on-site chemical reactions that occur within industrial processes - or indirectly, such as by consuming electricity that was produced by the combustion of fossil fuels offsite. When climate policies are enacted that increase the price of GHG emissions, emissions-intensive industries generally will bear the greatest relative cost increases as a share of their total costs of operation, as with energy-intensive industries.[3]

3. Trade-Exposed Industries

Trade-exposed (or trade-intensive) industries are producers in highly competitive markets where customers are sensitive to prices. Trade exposure is often measured by the extent to which products are bought and sold across jurisdictional boundaries (e.g., agricultural commodities), as opposed to more captive industries (e.g., hospitals). Trade-exposed industries have limited ability to charge higher prices because their customers have access to numerous competitive substitutes and will tend to shift their purchases to the lowest-cost producers.

4. "EITE Industries"

EITE industries are those that are both "EI" (energy and/or emissions-intensive) and "TE" (trade-exposed), or those most impacted by increases to the costs of energy or emissions, as well as those least able to pass along any such increased costs to their consumers through higher prices. As a result, EITE industries are generally considered to be those most at risk of leakage.

The risk of leakage for non-EITE industries is much lower. Industries that are "trade-exposed" will still be minimally at risk of leakage from increased energy costs if they spend only a small percentage of their total revenues on energy. Similarly, industries that are energy- or emission-intensive but not trade-exposed will generally be less impacted by increased costs if they can pass the added costs along to consumers in the form of price increases, thereby minimizing the impact on profit. For example, a local hospital is unlikely to spend much of its expenses on energy – as a result, energy price increases will, relative to its budget, have a much less significant impact on its finances. Additionally, a local hospital is also much more able to pass along such costs to its consumers – in an emergency, an ambulance passenger is unlikely to ask its driver to cross state lines to visit a hospital with lower energy bills.

In assessing the scale of leakage risk to New York, several findings are worth noting. First, studies suggest that, where governments undertake stringent emission reduction schemes without taking measures to mitigate leakage, the risk for economic leakage is significant. However, studies also suggest that, in practice, realized leakage is much lower when such governments adopt leakage mitigation measures.[6]

## Methods Used to Identify Energy-Intensive Industries in New York State

This section of the report is a summary of the methods used to identify energy-intensive, emissions-intensive and trade-intensive industries and related trades in New York State. Methods used were based on a Staff review of five jurisdictions' approaches and methodologies to calculating energy intensity and related measures (California, Canada, European Union, United States and Australia). A clear focus was placed on the Californian[7] and United States' American Clean Energy and Security Act (ACES)[8] methodologies as being the most applicable for New York State, and the methodology described herein was based primarily on the ACES method with New York State-specific adjustments. Calculations were performed by Staff based in part on data compiled by The Cadmus Group LLC.

1. Classification of Industries

In assembling a taxonomy of industries to assess for EITE characteristics, staff relied on the 2017 list of industries included in the North American Industry Classification System (NAICS), which is published by the U.S. Census Bureau at http://census.gov/naics.

NAICS is a detailed industry classification system that includes numerical codes, written descriptions and lists of sample activities for over 1,000 different industries across North America. It was first developed between the United States, Canada, and Mexico so the three countries could directly compare industrial production statistics, and has been used by the U.S. Census Bureau since 1997. Due to the significant availability of statistics for each NAICS industry, the system is frequently and widely used to classify and analyze industries by government authorities, policymakers and researchers.

Staff selected NAICS for classifying industries for several reasons, including:

[6] Aldy (2017).

[7] See: California Air Resources Board, Leakage Analysis: 2010 Regulation, Appendix K to the Initial Statement of Reasons.

[8] For additional details, see *The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries: An Interagency Report Responding to a Request from Senators Bayh, Specter, Stabenow, McCaskill, and Brown*, December 2, 2009.

- Due to the widespread use of NAICS for compiling other statistics, NAICS is the only industrial classification system for which the necessary data is available to assess industry-by-industry activities such as energy consumption, emissions, and trade relative to their economic activity is available;
- Many businesses and industries are already familiar with their own NAICS code due to being required to list it on tax filings and related documents, which will make it easier for businesses to understand their industry's intensities based on their NAICS code;
- NAICS was also used for EITE analysis by the U.S., California, and Canada, allowing New York State to more easily compare its results against those of other jurisdictions; and
- Relying on NAICS as a classification system will allow the State to measure industries in other ways, such as their number of jobs and firms, where they are located, and so on.

Specifically, Staff examined the intensities of all industries with NAICS codes falling within the Manufacturing (31- to 33-) or Mining, Quarrying, and Oil and Gas Extraction (23-) sectors.

## 2. Identification of Measures for Assessment

Based on a review of other jurisdictions' precedent EITE industry definitions and available data, staff developed working definitions of each metric.

### *A. Energy Intensity*

Energy intensity was defined as the ratio of an industry's energy consumption relative to its size, or economic activity. The numerator contains the proxy for the amount of energy used, and the denominator contains the proxy for amount of economic activity. The result of this ratio represents, in general, how much an industry spends on energy as a percentage of its total revenues. The formula for assessing energy intensity was established as follows:

$$\% \text{ Energy Intensity} = \frac{\$ \text{ Electricity Expenditures} + \$ \text{ Fuel Expenditures}}{\$ \text{ Value of Shipments, Sales or Revenues}}$$

### *B. GHG Emissions Intensity*

GHG emissions intensity was defined as the ratio of an industry's GHG emissions produced relative to its size, or economic activity. The numerator contains the proxy for the amount or cost of emissions, and the denominator contains the proxy for amount of economic activity. Emissions is the sum of GHG emissions from direct on-site fuel combustion, direct non-combustion industrial processes, and indirect emissions

from the use of electricity. The formula for assessing GHG emissions intensity was established as follows:

$$\% \text{ GHG Emissions Intensity} = \frac{\text{Emissions (tCO2e)} \times \$ \text{ Value of Carbon}}{\$ \text{ Value of Shipments, Sales or Revenues}}$$

*C. Trade Intensity / Trade Exposure*

Trade intensity, or trade exposure, was defined as the ratio of an industry's cross-border trade activity relative to its total market size, or domestic production plus imports. The numerator contains the proxy for the measurement of trade, and the denominator contains the proxy for total market size. The working formula for assessing trade exposure was established as follows:

$$\% \text{ Trade Intensity} = \frac{\$ \text{ Imports} + \$ \text{ Exports}}{\$ \text{ Value of Shipments, Sales or Revenues} + \$ \text{ Imports}}$$

3. Methods of Calculation for Intensities by Industry

To collect the necessary data and calculate each industry's intensities, staff followed the procedures outlined below.

*A. Calculation of Energy Intensity*

Staff used the Annual Survey of Manufacturers and the U.S. Economic Census reports, employing the most appropriate NAICS codes as unique identifiers, to calculate the energy intensity of Manufacturing and Mining, Quarrying, and Oil and Gas Extraction sectors in the United States. Using the sum of dollars spent on electricity and fuel divided by the total value of shipments, for each of these sectors, Staff calculated the energy intensity of each industry as dollars spent over value of shipments.

*B. Calculation of Emissions Intensity*

Staff calculated emissions intensity based on the sum of each industry's direct combustion emissions, indirect electricity emissions, and direct non-combustion process emissions. Estimates for each emissions type was calculated as follows:

- Direct combustion emissions*:* Using primarily the fuel consumption data found in the 2018 EIA Manufacturers Energy Consumption Survey (MECS) report, Staff calculated the emissions from direct combustion for each industry in Manufacturing and Mining at the six-digit NAICS code level. Where NAICS codes at the six-digit level were not available from the EIA MECS report,

Staff followed the alternative methods employed under the ACES approach as outlined by the U.S. EPA.[9]

- Indirect electricity emissions: Using primarily the electricity consumption data found in the EIA MECS report, Staff calculated the emissions from indirect electricity use for each Manufacturing and Mining, Quarrying, and Oil and Gas Extraction industry. Where NAICS codes at the six-digit level were not available in this report, Staff followed the alternative methods employed under the ACES approach as outlined by the U.S. EPA.[10]
- Non-combustion process emissions: Staff reviewed the EPA GHG Inventory Team's methodology for calculating emissions from direct industrial processes. Based on this review, Staff employed two methods for calculating direct emissions from industrial processes for each industry, using available data in the following order of priority:
    - Method 1: Takes the total value of shipments to estimate production weight and applies process emission factors to the estimated weight. The process emission factors are dependent upon production weight, which is estimated at the 6-digit NAICs level by dividing the total expenditures by a 2018 price per unit.
    - Method 2: Where Method 1 was insufficient, the total process emissions from the 2009 ACES report were divided by the then dollar value of shipments, and the same factor was applied to the 2018 dollar value of shipments.

Finally, Staff calculated emissions intensity for each industry by summing together all three emission estimates and multiplying it by the New York State Value of Carbon ($125), then dividing the product by the industry's value of shipments.

### *C. Calculation of Trade Intensity*

Staff compiled data on international trade for each industry at the six-digit NAICS level. Trade intensity was calculated as the sum of imports and exports divided by the sum of value of shipments and imports for each industry.

### *D. Addressing Data Gaps*

[9] U.S. Environmental Protection Agency Office of Air & Radiation. *Estimation of Eligible Sectors and Emissions under H.R. 2454*, February 23, 2010.

[10] *Ibid.*

Where information was not available at the six-digit NAICS level, Staff sought to estimate the most accurate intensity possible by, first, seeing if such data was available under an alternative data source,[11] and/or, second, by identifying the highest digit NAICS code-level for which all data was available, and then subtracting out any known lower-digit levels to produce the most accurate estimate possible for each six-digit NAICS industry.[12]

## Methods Used to Identify Related Trades in New York State

Related trades were identified based on the simple compilation of data, with minor exceptions.

1. Method to Identify New York State Jobs, Establishments and Worker Wages

The number of New York State jobs, establishments, and quarterly worker wages for each six-digit NAICS industry was estimated based on one of two methods, in order of priority, based on data availability:

- Method 1: Relies on the total number of jobs in New York State for each six-digit NAICS industry as per the Quarterly Census of Employment and Wages (QCEW), Q3, 2020, as per the New York State Department of Labor.
- Method 2: Where QCEW data was not able to be employed due to data confidentiality and suppression issues, for such industries, Staff relied on data estimates from a third party provider, EMSI, and used the most recent data available at each six-digit NAICS industry, Q2, 2020.

To calculate Annualized Average Worker Wages, an industry's total wages for the quarter were annualized by multiplying them by four, and were then divided by the number of total New York State jobs for that industry.

2. Method to Identify the Top NYS Occupations or Related Trades

Based on the aforementioned analyses, Staff identified the top New York State occupations across the following categories of U.S. industries:

[11] For example, where data for a manufacturing industry was unavailable under the Annual Survey of Manufacturers, Staff generally reviewed the Economic Census to determine if data existed at the six-digit level.

[12] By way of example, if two 6-digit codes lacked adequate data for an intensity calculation at the U.S. Industry level, Staff would then review whether data existed at the 5-digit code level. If data was still suppressed or unavailable, Staff would calculate intensity at the 4-digit code level. In some cases, certain 6-digit code data was available, while other 6-digit codes under the same 4-digit code were unavailable; in these cases, Staff would begin with the 4-digit code totals and then subtract out the known 6-digit code totals, to produce a more accurate imputed estimate of the intensity of any missing 6-digit code(s).

- All Manufacturing industries;
- All Mining and Natural Resource Industries;
- Top 30 Energy Intensive Industries
- Top 30 Emissions-Intensive Industries
- Top 30 Trade-Intensive Industries

The source for identifying the occupational data was the New York State Department of Labor Occupational Employment Statistics (OES) survey, 2016-2019.

## Results of Energy, Emissions, and Trade Intensity Analysis

The exhibits attached to this appendix summarize the results of the Staff's identification of energy-intensive industries and related trades, as well as the identification of emissions-intensive and trade-intensive industries. Below are some key highlights:

- ***Manufacturing and Mining sector businesses span the state:*** businesses in these sectors are located nearly everywhere except for natural preserves such as the Adirondacks (Figure C-1).
- ***Most potential EITE sector jobs are in the Manufacturing sector:*** Overall, New York State has approximately 440,000 jobs in Manufacturing occupations, but only about 8,000 jobs in Mining and related sector occupations (Tables C-2 and C-3). Together, both sectors represent only about 9% of the State's roughly 8 million total private sector jobs in the state.
- ***A small number of U.S. industries exhibit the greatest energy intensities:*** Out of the 388 industries analyzed in the Manufacturing and Mining, Quarrying, and Oil and Gas Extraction sectors, only 41 industries had energy intensity over 5%, and only 10 of the 388 industries had energy intensity above 10%.
- ***Most NYS jobs are not in the most leakage-prone industries:*** While Manufacturing and Mining and Natural Resource occupations together represent nearly 450,000 jobs, only about 9,000 of these jobs are in occupations within the top 30 most energy-intensive and emission-intensive industries, suggesting that a small share of the overall sector is likely to be at the highest risk of leakage (Figure C-5). Additionally, 364,000 of the 404,000 sector jobs (90%) have energy-intensity of less than 2.5 percent, and 18 of the top 20 largest NYS Manufacturing and Mining sector industries have energy intensity of less than 2%.

- ***The largest NYS industries that may be most prone to leakage appear to be in primary metals, chemicals, cement, glass, paper and semiconductor industries:*** In examining Manufacturing and Mining, Quarrying, and Oil and Gas Extraction industries with at least 450 jobs and 2.5% energy intensity (an arbitrary threshold, see Figure C-13), the largest industry is Semiconductor and Related Device Manufacturing (7,200 jobs, 3.6% energy intensity), followed by Paper (Except Newsprint) Mills (3,800 jobs, 6% energy intensity). However, the most energy-intensive industries with at least 450 jobs appear to be Alumina Refining and Primary Aluminum Production (500 jobs, 16.9% energy intensity), Industrial Gases Manufacturing (1,300 jobs, 15.4% energy intensity) and Cement Production (500 jobs, 14.8% energy intensity).

## Considerations for a Definition of EITE Industries in New York State

As described earlier, governments that enact significant emission reduction policies have historically identified EITE industries and sought to take specific measures intended to reduce the risk of emissions and economic leakage. However, the Scoping Plan does not contain provisions for a carbon tax or industry-specific allowance price that might present a much greater risk of leakage to EITE industries and thus require more dramatic special accommodations. Nonetheless, in the future, where State energy sector or emission mandates threaten significant emissions leakage in industry, the State may wish to finalize an approach for which industries and business operating locations will be designated as EITE, as well as what benefits will be conferred for an industry's EITE status. This section outlines additional considerations for such a definition.

### *A. Considering the Benefits of an Industry Receiving an EITE Classification*

At least as important as finalizing an approach to classify EITE industries will be determining what accommodation or benefit an EITE status would confer. Here, any benefits assigned to EITE industries should be carefully targeted to ameliorate the specific leakage risk that would otherwise be created. For example, if the primary leakage risk stems from increased electricity prices, the State should identify ways to lower electricity costs for EITE industries. Similarly, if a leakage risk stems from a limited emission allowance, then the State should consider differentiated allowances for EITE industries.

### *B. Considering Criteria to Use when Qualifying "EITE" Status*

While energy and emissions intensity historically have been closely aligned, energy intensity becomes a less accurate indicator of GHG emission intensity as the electric system becomes cleaner and energy users employ new and innovative ways to use energy more efficiently. To this end, the State should consider using the measures of energy intensity and trade exposure to qualify as EITE when acting to mitigate the

risk of leakage due to any energy cost increases, and emissions intensity and trade exposure to qualify as EITE when acting to mitigate the risk of leakage due to emission compliance cost increases. Alternatively, if the State imposes measures based on the carbon content or an industry's products or some other regime, then the approach for identifying EITE industries may need to be adapted or modified as well, such as by measuring carbon intensity.

To this end, it is worth observing that different jurisdictions achieved markedly different results in identifying EITE industries under their systems, as shown below.[13]

| Characteristic under EITE Definition | U.S. (ACES) | California | Canada |
|---|---|---|---|
| EITE Qualification Criteria* | a) >5% Energy or Emissions Intensity; and >15% Trade-Exposed; OR<br><br>b) >20% Energy or Emissions Intensity | High Risk of Leakage = Emissions >1,000 tCO2e per $USD million of value added; and Trade Exposure >19% | Medium or High Risk of Leakage =<br>a) ≥1% Emissions Intensity; and ≥10% Trade-Exposed; OR<br>b) ≥3% Emissions Intensity; OR<br>C) >80% Trade Exposed |
| EITE Industries | 35 | 61 | 109 |

### *C. Assessing the Risk of Leakage Due to Intrastate Trade Exposure*

New York – as with all U.S. states – must be concerned not only with international trade exposure, as contemplated by the U.S., EU, Australian, and Canadian definitions, but also with interstate trade exposure to leakage. The barriers to moving across state lines are much lower than those involved with moving across international borders. The California Cap-and-Trade program accounts for domestic competition by setting the thresholds for classifying sectors as emissions intensive somewhat lower than what would be used in a national program. Similarly, New York State should consider whether any industries that appear less trade-intensive based on international commerce may still be "TE" as it relates to the risk of interstate leakage.

### *D. Selecting EITE Measures for which Data is Available*

In finalizing the measures to be used when assessing whether an industry will qualify as EITE, as well as how frequently EITE status is re-assessed, data availability should be taken into account. As described

[13] American Clean Energy and Security Act of 2009, H.R. 2545 ("ACES"); State of California 2010 Cap-and-Trade regulation, Appendix K; Government of Canada Voluntary Participation Policy for Output-Based Pricing System (2018). In addition to the general criteria set forth herein, a number of approaches to identifying industries at risk of leakage also contain provisions for more detailed eligibility considerations to be applied on a case-by-case basis. *See, e.g.*, ACES (characterizing industries that exceed the standard thresholds as only "presumptively eligible").

previously, even when relying on a widely used industry classification system and national-level data sources, staff still was required to identify methodological remedies to address data gaps. To this end, any EITE definition should either rely on existing and available data or else provide for the collection of the new data required to support its implementation. For example, because the State of California already had a robust state-level industry GHG emission reporting system, it was able to calculate its in-state emissions intensity with a much higher degree of fidelity. The industry GHG emissions reporting system noted in the Industry Chapter of Section IV would be an example of an improved GHG emissions reporting system.

### *E. Assessing Industries in Other Sectors for EITE Status*

The working approach to identifying EITE industries used in this report was limited to an analysis of the Manufacturing and Mining, Quarrying, and Oil and Gas Extraction sectors. However, other sectors may also be vulnerable to business leakage. New York State may wish to expand its analysis to other sectors and industries to discern whether other industries may also be vulnerable to leakage due to a combination of energy and/or emissions intensity and trade exposure, such as certain greenhouse-based agriculture operations or data centers. Additionally, if the State imposes any industry-specific emission reduction or energy policies in other areas, such as trade-exposed aspects of the Transportation sector, then that sector may also merit additional analysis.

### *F. Assigning EITE Status to Specific Economic Activities within an Industry*

In some cases, it is possible that the State may wish to go even further than the approximately 1,000 industries included in the NAICS system and make EITE determinations at an even more granular level of detail. As an example, as it relates to steel production, California's cap-and-trade system exempted only facilities using an electric arc furnace, but not facilities using older and more emissions-intensive production methods. In addition, it is possible that the State might identify economic activities carried out by businesses that are EITE in the context of broader industries for which the aggregate of activities are not, on average, EITE.

### *G. Assigning Differentiated Benefits Based Relative Intensity/Exposure*

Rather than applying a binary designation of a sector as EITE or non-EITE, the State may wish to further classify sectors based on tiers. For example, assigning certain benefits to only those industries that are High Emissions Intensity and High Trade Exposure, even if a High Emissions Intensity and Moderate Trade Exposure industry would ordinarily be thought of as "EITE." If an EITE definition was

promulgated for use by other state agencies, when designing programs for EITEs, each agency could exercise discretion in identifying the tiers appropriate for different benefits.

### *H. Aligning State Efforts with Federal Policy*

Due to the failure of ACES to pass the U.S. Senate, currently, staff did not identify any active Federal designations of EITE industries. However, in the event that the U.S. Government implements stringent emissions or energy policies in the future, or policies designed to mitigate leakage risk among EITE industries, then such policy changes could require changes to any State EITE definitions or benefits in force.

### *I. Developing Procedures for Verification of EITE Status*

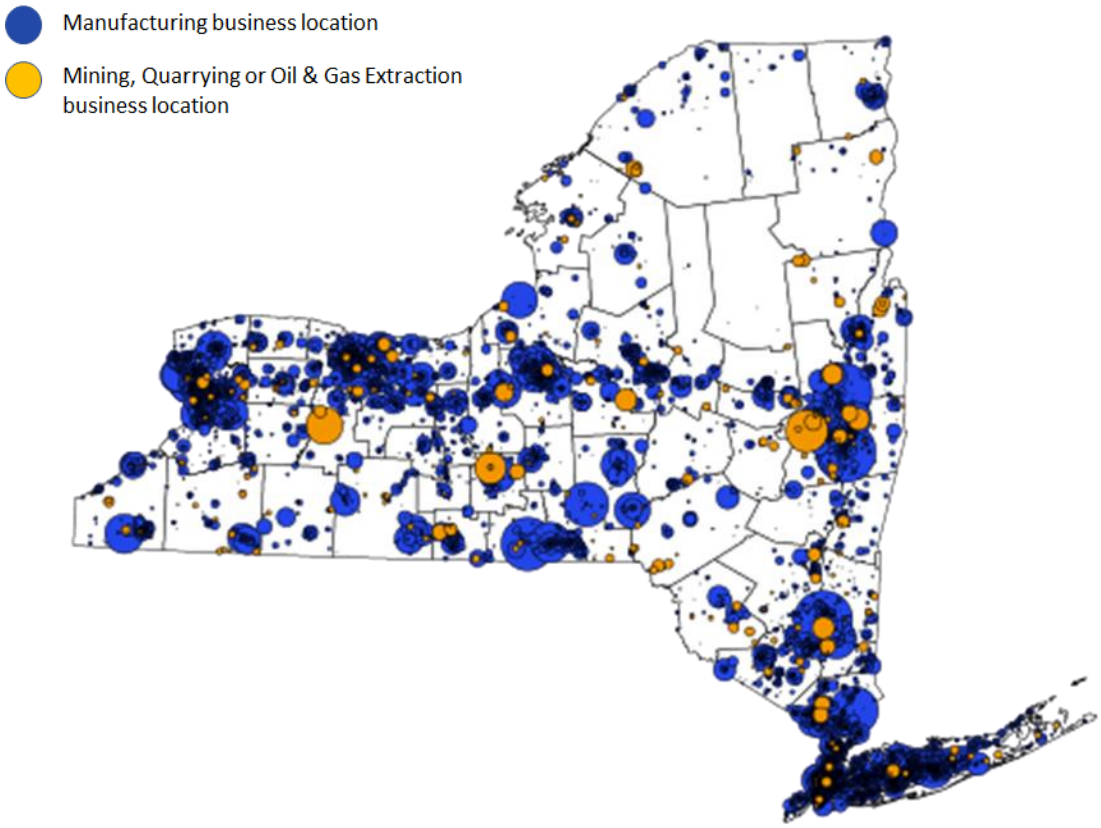
Government authorities have previously used NAICS codes to confer status or eligibility under certain programs or initiatives. For example, in 2020, as part of the Paycheck Protection Program, NAICS codes were used to determine the size thresholds for a business to be considered an eligible borrower. Similarly, as part of the State's COVID-19 New York Forward reopening strategy in 2020, NAICS industries were used to describe when different business locations could reopen. However, in cases where a business might conduct activities described under multiple NAICS industries and where the stakes of one's NAICS industry designation are high, there is an inherent incentive for a business to represent its operations as falling into the most favorable NAICS industry. To this end, any State entity using the NAICS EITE designations will – as it would need to for any eligibility system the State might employ – develop a system for verifying that a business or its operation location truly due fall into the identified EITE industry and thus merit the associated benefits.

### *J. Assigning EITE Status based on Appeal Procedures*

It is impossible to capture the unique nature of every business in one industry category, and many businesses may operate economic activities that fall into multiple NAICS industry definitions. Here, the State may wish to develop appeal procedures such that a business whose industry is not listed as EITE may still yet qualify as EITE at one or more operating location that is determined to present a leakage risk to certain policies.

# Appendix C Exhibits

Figure C-1. Manufacturing and Mining Industries in New York State




**Source:** New York State Department of Labor

Table C-1. Top New York State Occupations with Manufacturing Sector

| SOC Code | Occupational Title | Employment | % Of Sector Employment |
|---|---|---|---|
| - | *Total all occupations* | *440,547* | *100.00%* |
| 51-2090 | Miscellaneous Assemblers and Fabricators | 29,125 | 6.61% |
| 51-1011 | First-Line Supervisors of Production and Operating Workers | 17,531 | 3.98% |
| 51-9111 | Packaging and Filling Machine Operators and Tenders | 14,744 | 3.35% |
| 51-9061 | Inspectors, Testers, Sorters, Samplers, and Weighers | 13,825 | 3.14% |
| 51-2028 | Electrical, electronic, and electromechanical assemblers, except coil winders, tapers, and finishers | 11,969 | 2.72% |
| 51-4041 | Machinists | 11,875 | 2.70% |
| 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 9,992 | 2.27% |
| 11-1021 | General and Operations Managers | 9,782 | 2.22% |
| 41-4012 | Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products | 9,038 | 2.05% |
| 17-2112 | Industrial Engineers | 8,685 | 1.97% |
| 15-1256 | Software Developers and Software Quality Assurance Analysts and Testers | 7,546 | 1.71% |
| 51-4121 | Welders, Cutters, Solderers, and Brazers | 7,337 | 1.67% |
| 51-6031 | Sewing Machine Operators | 7,116 | 1.62% |
| 51-5112 | Printing Press Operators | 6,904 | 1.57% |
| 43-5071 | Shipping, Receiving, and Inventory Clerks | 6,746 | 1.53% |
| 43-9061 | Office Clerks, General | 6,462 | 1.47% |
| 51-3092 | Food Batchmakers | 6,265 | 1.42% |
| 43-4051 | Customer Service Representatives | 6,258 | 1.42% |
| 49-9041 | Industrial Machinery Mechanics | 5,996 | 1.36% |
| 53-7064 | Packers and Packagers, Hand | 5,670 | 1.29% |
| 49-9071 | Maintenance and Repair Workers, General | 5,236 | 1.19% |
| 43-5061 | Production, Planning, and Expediting Clerks | 5,137 | 1.17% |
| 51-9023 | Mixing and Blending Machine Setters, Operators, and Tenders | 4,910 | 1.11% |
| 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 4,881 | 1.11% |
| 17-2141 | Mechanical Engineers | 4,770 | 1.08% |
| 53-7051 | Industrial Truck and Tractor Operators | 4,765 | 1.08% |
| 51-3011 | Bakers | 4,753 | 1.08% |
| 51-4031 | Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic | 4,487 | 1.02% |

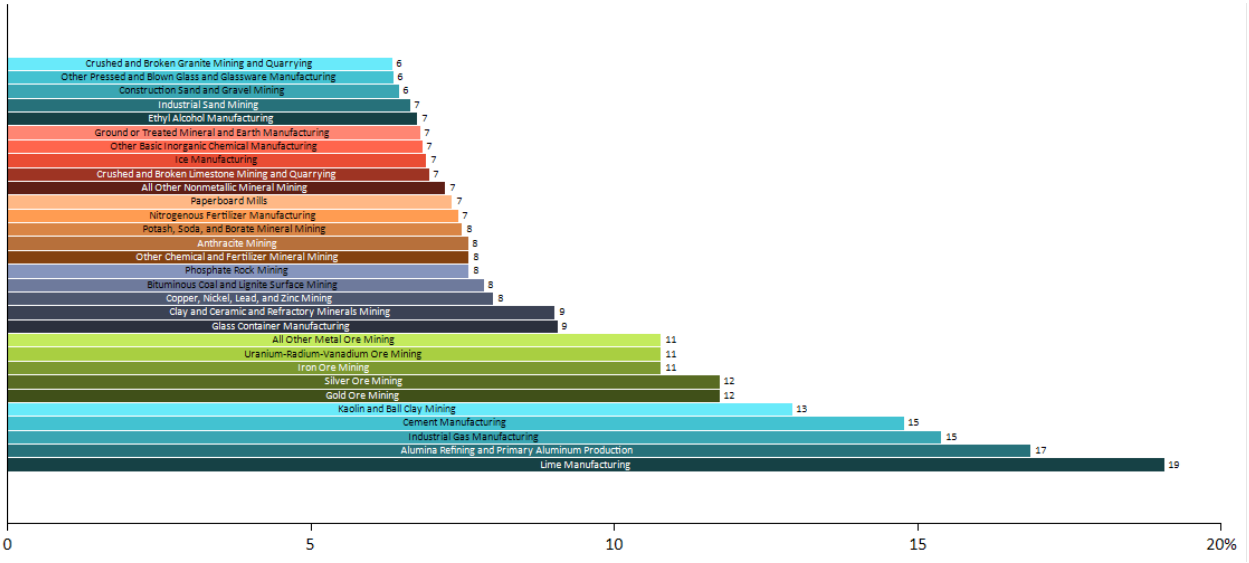
**Source:** New York State Department of Labor, Occupational Employment Statistics (OES) survey, 2016-2019.

Table C-2. Top New York State Occupations within Mining and Natural Resources Sector

| SOC Code | Occupational Title | Employment | % Of Sector Employment |
|---|---|---|---|
| - | *Total all occupations* | *8,222* | *100.00%* |
| 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 714 | 8.68% |
| 39-2021 | Animal Caretakers | 712 | 8.66% |
| 47-2073 | Operating Engineers and Other Construction Equipment Operators | 520 | 6.33% |
| 47-5022 | Excavating and Loading Machine and Dragline Operators, Surface Mining | 391 | 4.75% |
| 47-2061 | Construction Laborers | 390 | 4.74% |
| 45-4022 | Logging Equipment Operators | 355 | 4.32% |
| 53-7064 | Packers and Packagers, Hand | 327 | 3.97% |
| 45-2093 | Farmworkers, Farm, Ranch, and Aquacultural Animals | 233 | 2.84% |
| 11-1021 | General and Operations Managers | 233 | 2.84% |
| 51-9111 | Packaging and Filling Machine Operators and Tenders | 227 | 2.76% |
| 43-9061 | Office Clerks, General | 213 | 2.60% |
| 49-3042 | Mobile Heavy Equipment Mechanics, Except Engines | 177 | 2.16% |
| 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 167 | 2.03% |
| 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 154 | 1.87% |
| 45-2092 | Farmworkers and Laborers, Crop, Nursery, and Greenhouse | 141 | 1.71% |
| 39-2011 | Animal Trainers | 135 | 1.64% |
| 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 132 | 1.60% |
| 47-5097 | Earth Drillers, Except Oil and Gas; and Explosives Workers, Ordnance Handling Experts, and Blasters | 122 | 1.49% |
| 51-9021 | Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders | 120 | 1.46% |
| 49-9041 | Industrial Machinery Mechanics | 114 | 1.38% |
| 49-9071 | Maintenance and Repair Workers, General | 96 | 1.16% |
| 25-3021 | Self-Enrichment Teachers | 95 | 1.15% |
| 47-5051 | Rock Splitters, Quarry | 89 | 1.08% |
| 51-9032 | Cutting and Slicing Machine Setters, Operators, and Tenders | 89 | 1.08% |
| 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 87 | 1.06% |
| 45-2021 | Animal Breeders | 83 | 1.00% |

**Source:** New York State Department of Labor, Occupational Employment Statistics (OES) survey, 2016-2019.
Note: Includes occupations associated with Natural Resources that were not included in EITE analysis.

Figure C-2. Energy Intensity by U.S. Industry – Top 30 (2018)



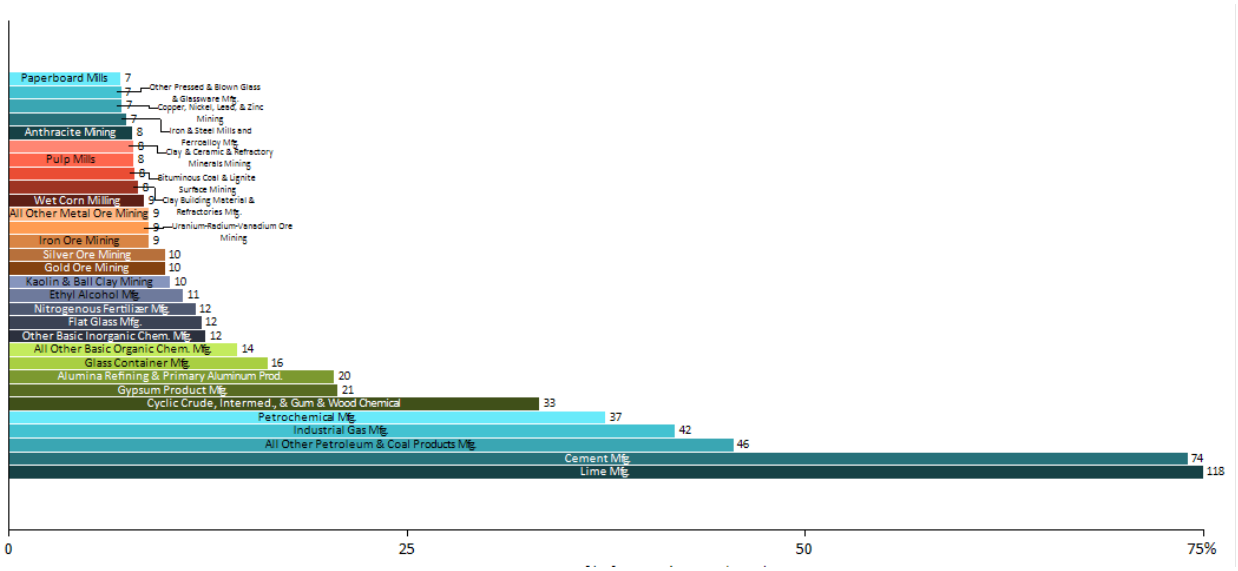

**Source:** Business Impacts Subgroup Staff Working Group Analysis.
Note: Energy intensity is defined as the sum of fuel and electricity expenditures by each industry divided by its value of shipments.

Table C-3. Top New York State Occupations within Top 30 U.S. Industries by Energy Intensity

| Occupational Title | Employment | % of Industry Employment |
|---|---|---|
| Total all occupations | 9,391 | 100.00% |
| Heavy and Tractor-Trailer Truck Drivers | 586 | 6.24% |
| Chemical Equipment Operators and Tenders | 444 | 4.73% |
| Industrial Machinery Mechanics | 415 | 4.42% |
| Operating Engineers and Other Construction Equipment Operators | 407 | 4.34% |
| Excavating and Loading Machine and Dragline Operators, Surface Mining | 342 | 3.64% |
| Construction Laborers | 323 | 3.44% |
| Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders | 304 | 3.24% |
| Packaging and Filling Machine Operators and Tenders | 267 | 2.84% |
| Inspectors, Testers, Sorters, Samplers, and Weighers | 266 | 2.83% |
| First-Line Supervisors of Production and Operating Workers | 262 | 2.79% |
| Miscellaneous Assemblers and Fabricators | 239 | 2.54% |
| Laborers and Freight, Stock, and Material Movers, Hand | 225 | 2.40% |
| Maintenance and Repair Workers, General | 224 | 2.39% |
| Industrial Engineers | 186 | 1.98% |
| Packers and Packagers, Hand | 176 | 1.88% |
| Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products | 170 | 1.81% |
| Mobile Heavy Equipment Mechanics, Except Engines | 161 | 1.72% |
| General and Operations Managers | 148 | 1.58% |
| First-Line Supervisors of Construction Trades and Extraction Workers | 116 | 1.24% |
| Paper Goods Machine Setters, Operators, and Tenders | 116 | 1.24% |
| Industrial Truck and Tractor Operators | 113 | 1.20% |
| Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders | 113 | 1.20% |
| Electricians | 107 | 1.14% |
| Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 104 | 1.11% |
| Light Truck Drivers | 103 | 1.10% |
| Mixing and Blending Machine Setters, Operators, and Tenders | 99 | 1.05% |
| Bookkeeping, Accounting, and Auditing Clerks | 97 | 1.04% |
| Office Clerks, General | 97 | 1.03% |
| Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic | * | * |

**Source:** New York State Department of Labor, Occupational Employment Statistics (OES) survey, 2016-2019.
Note: *Indicates data is not releasable under DOL confidentiality protocols.

Figure C-3. GHG Emissions Intensity by U.S. Industry – Top 30 (2018)

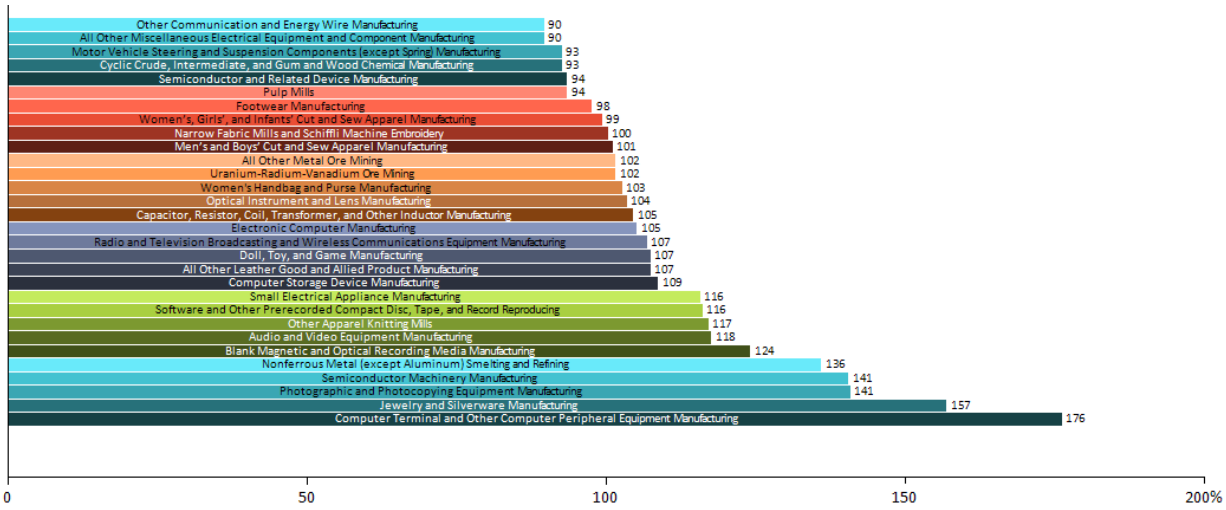



**Source:** Business Impacts Subgroup Staff Working Group Analysis.
Notes: 1. Emission intensity is defined for each industry as: i) the product of: a) the sum of direct fuel, direct non-combustion process and indirect electricity emissions; and b) the NYS value of carbon $125; ii) divided by its value of shipments. 2. X-axis has been capped at 75% to enhance visibility of industries relative to extreme value of Lime Manufacturing.

Table C-4. Top New York State Occupations within Top 30 U.S. Industries by GHG Emissions Intensity

| SOC Code | Occupational Title | Employment | % Of Industry Employment |
|---|---|---|---|
| - | Total all occupations | 8,756 | 100.00% |
| 51-9011 | Chemical Equipment Operators and Tenders | 685 | 7.82% |
| 49-9041 | Industrial Machinery Mechanics | 554 | 6.32% |
| 51-2090 | Miscellaneous Assemblers and Fabricators | 431 | 4.92% |
| 51-1011 | First-Line Supervisors of Production and Operating Workers | 420 | 4.79% |
| 51-9061 | Inspectors, Testers, Sorters, Samplers, and Weighers | 298 | 3.41% |
| 17-2112 | Industrial Engineers | 278 | 3.18% |
| 49-9071 | Maintenance and Repair Workers, General | 273 | 3.12% |
| 47-2111 | Electricians | 264 | 3.01% |
| 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 256 | 2.93% |
| 51-9051 | Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders | 212 | 2.43% |
| 41-4012 | Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products | 208 | 2.37% |
| 53-7064 | Packers and Packagers, Hand | 196 | 2.24% |
| 51-9111 | Packaging and Filling Machine Operators and Tenders | 196 | 2.23% |
| 51-9041 | Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders | 182 | 2.08% |
| 43-5071 | Shipping, Receiving, and Inventory Clerks | 146 | 1.67% |
| 53-7051 | Industrial Truck and Tractor Operators | 141 | 1.61% |
| 11-1021 | General and Operations Managers | 139 | 1.59% |
| 11-3051 | Industrial Production Managers | 127 | 1.45% |
| 51-4041 | Machinists | 122 | 1.39% |
| 51-8091 | Chemical Plant and System Operators | 120 | 1.37% |
| 51-9196 | Paper Goods Machine Setters, Operators, and Tenders | 116 | 1.33% |
| 51-9195 | Molders, Shapers, and Casters, Except Metal and Plastic | 104 | 1.19% |
| 43-5061 | Production, Planning, and Expediting Clerks | 101 | 1.16% |
| 51-9124 | Coating, Painting, and Spraying Machine Setters, Operators, and Tenders | 94 | 1.07% |
| 51-4021 | Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic | * | * |
| 51-4051 | Metal-Refining Furnace Operators and Tenders | * | * |

Figure C-4. Trade Intensity by U.S. Industry – Top 30 (2018)




**Source:** Business Impacts Subgroup Staff Working Group Analysis
Note: Trade intensity is defined as each industry's sum of imports and exports divided by the sum of its value of shipments and imports.

Table C-5. Top New York State Occupations within Top 30 U.S. Industries by Trade Intensity

| SOC Code | Occupational Title | Employment | % Of Industry Employment |
|---|---|---|---|
| - | Total all occupations | 45,817 | 100.00% |
| 15-1256 | Software Developers and Software Quality Assurance Analysts and Testers | 3,747 | 8.18% |
| 51-2028 | Electrical, electronic, and electromechanical assemblers, except coil winders, tapers, and finishers | 2,543 | 5.55% |
| 51-6031 | Sewing Machine Operators | 2,138 | 4.67% |
| 17-2112 | Industrial Engineers | 1,759 | 3.84% |
| 51-9071 | Jewelers and Precious Stone and Metal Workers | 1,724 | 3.76% |
| 17-2071 | Electrical Engineers | 1,498 | 3.27% |
| 11-1021 | General and Operations Managers | 1,149 | 2.51% |
| 51-1011 | First-Line Supervisors of Production and Operating Workers | 1,089 | 2.38% |
| 17-2141 | Mechanical Engineers | 1,066 | 2.33% |
| 17-3023 | Electrical and Electronic Engineering Technologists and Technicians | 1,009 | 2.20% |
| 51-9061 | Inspectors, Testers, Sorters, Samplers, and Weighers | 983 | 2.14% |
| 41-4012 | Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products | 907 | 1.98% |
| 43-4051 | Customer Service Representatives | 860 | 1.88% |
| 51-2090 | Miscellaneous Assemblers and Fabricators | 857 | 1.87% |
| 15-1211 | Computer Systems Analysts | 775 | 1.69% |
| 13-1020 | Buyers and Purchasing Agents | 714 | 1.56% |
| 17-3026 | Industrial Engineering Technologists and Technicians | 704 | 1.54% |
| 43-5071 | Shipping, Receiving, and Inventory Clerks | 619 | 1.35% |
| 43-9061 | Office Clerks, General | 586 | 1.28% |
| 15-1232 | Computer User Support Specialists | 584 | 1.28% |
| 11-9041 | Architectural and Engineering Managers | 560 | 1.22% |
| 13-1161 | Market Research Analysts and Marketing Specialists | 554 | 1.21% |
| 13-2011 | Accountants and Auditors | 530 | 1.16% |
| 11-3021 | Computer and Information Systems Managers | 529 | 1.15% |
| 51-9083 | Ophthalmic Laboratory Technicians | 519 | 1.13% |
| 43-5061 | Production, Planning, and Expediting Clerks | 501 | 1.09% |
| 17-2072 | Electronics Engineers, Except Computer | 488 | 1.07% |
| 27-1022 | Fashion Designers | 482 | 1.05% |
| 17-2199 | Engineers, All Other | 470 | 1.03% |
| 13-1198 | Project Management Specialists and Business Operations Specialists, All Other | 467 | 1.02% |
| 51-9141 | Semiconductor Processing Technicians | * | * |
| 13-1111 | Management Analysts | * | * |
| 51-2031 | Engine and Other Machine Assemblers | * | * |

**Source:** New York State Department of Labor, Occupational Employment Statistics (OES) survey, 2016-2019.
Note: *Indicates data is not releasable under DOL confidentiality protocols.

Figure C-5. Energy vs. Trade Intensity - U.S. Manufacturing and Mining Industries (2018)

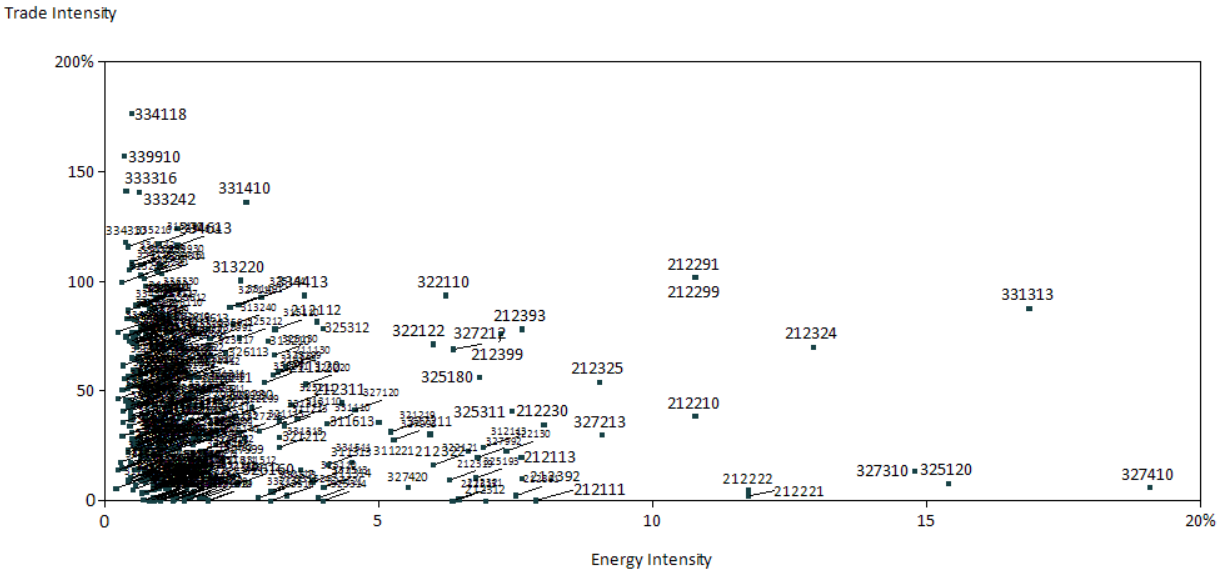



Figure C-6. Energy vs. Trade Intensity - Energy vs. Trade Intensity by NYS Employment: Manufacturing and Mining

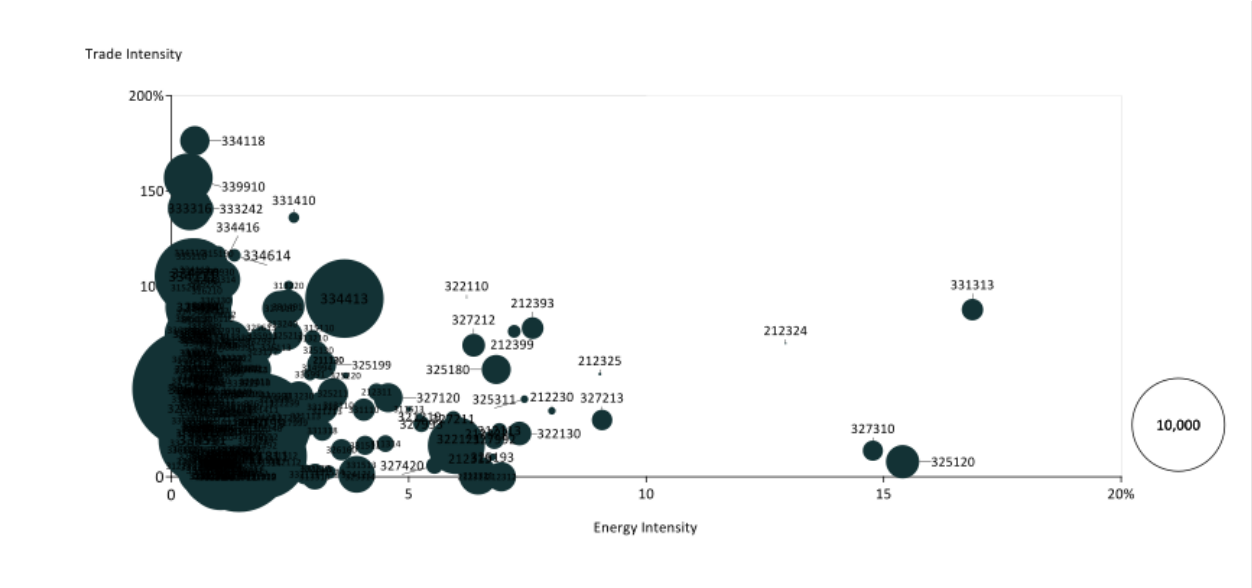


Figure C-7. Energy vs. Trade Intensity - Top 20 Manufacturing Industries by NYS Jobs

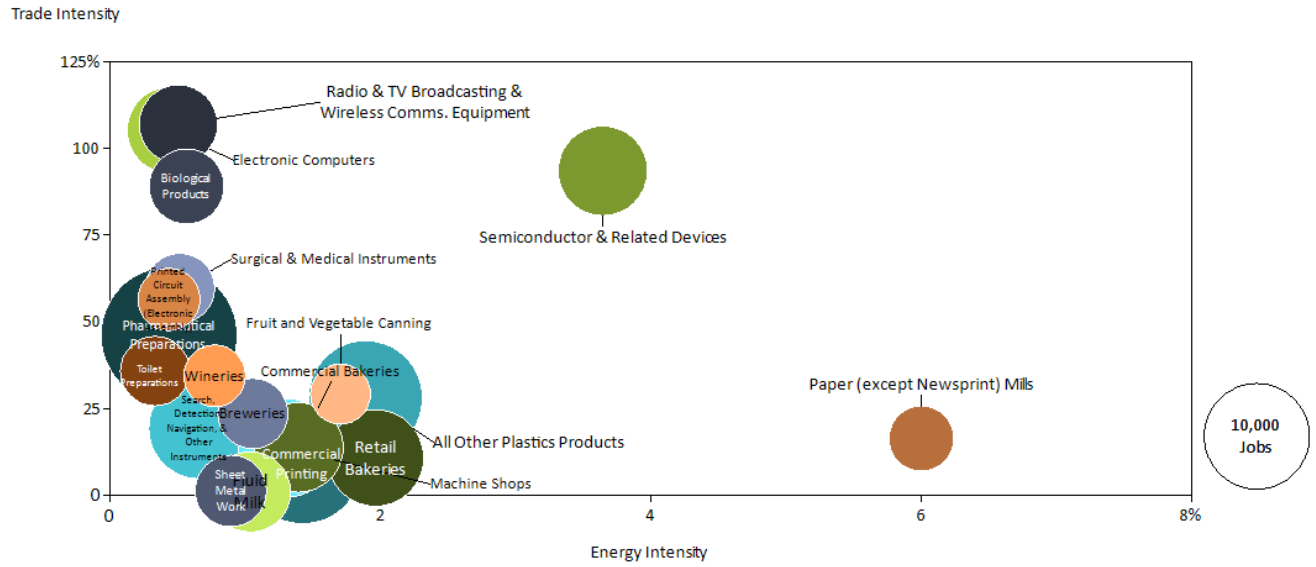



Figure C-8. Energy vs. Trade Intensity - NYS Industries >2.5% Energy Intensity, >450 Jobs

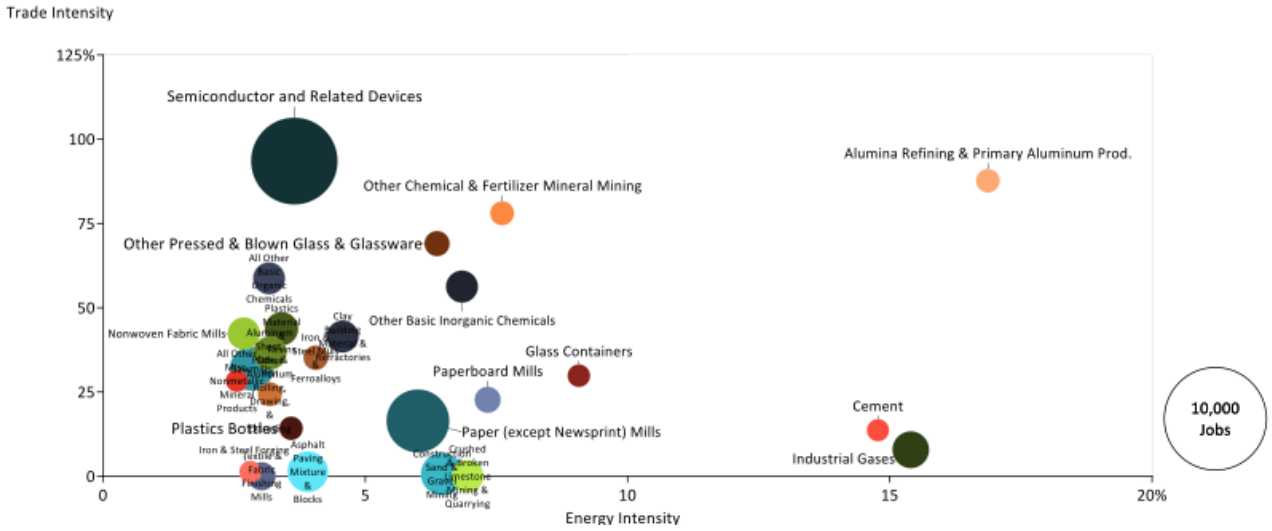


Table C-6. Complete EITE Analysis Results by U.S. Industry (Sorted by Total NYS Jobs)

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Pharmaceutical Preparation Manufacturing | 325412 | 183 | 16,708 | $74,924 | 0.4% | 0.3% | 46.1% |
| Commercial Printing (except Screen and Books) | 323111 | 1,161 | 12,907 | $56,017 | 1.4% | 0.7% | 9.2% |
| All Other Plastics Product Manufacturing | 326199 | 228 | 11,655 | $57,719 | 1.9% | 0.8% | 28.1% |
| Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing | 334511 | 55 | 9,107 | $102,375 | 0.7% | 0.3% | 19.4% |
| Machine Shops | 332710 | 677 | 8,623 | $55,709 | 1.3% | 0.6% | 13.7% |
| Retail Bakeries | 311811 | 950 | 8,347 | $31,816 | 2.0% | 1.2% | 10.8% |
| Commercial Bakeries | 311812 | 279 | 7,198 | $46,891 | 1.4% | 0.8% | 13.9% |
| Semiconductor and Related Device Manufacturing | 334413 | 77 | 7,175 | $110,012 | 3.6% | 1.7% | 93.5% |
| Electronic Computer Manufacturing | 334111 | 30 | 6,689 | $161,928 | 0.4% | 0.2% | 105.2% |
| Fluid Milk Manufacturing | 311511 | 55 | 5,774 | $71,310 | 1.0% | 0.6% | 1.0% |
| Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing | 334220 | 64 | 5,519 | $85,192 | 0.5% | 0.2% | 106.9% |
| Biological Product (except Diagnostic) Manufacturing | 325414 | 12 | 5,052 | $101,381 | 0.6% | 0.3% | 89.0% |
| Sheet Metal Work Manufacturing | 332322 | 230 | 4,587 | $61,053 | 0.9% | 0.4% | 1.3% |
| Breweries | 312120 | 273 | 4,419 | $50,775 | 1.1% | 0.6% | 23.6% |
| Surgical and Medical Instrument Manufacturing | 339112 | 83 | 4,335 | $68,635 | 0.5% | 0.2% | 59.7% |
| Toilet Preparation Manufacturing | 325620 | 96 | 4,321 | $74,886 | 0.3% | 0.2% | 35.8% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Paper (except Newsprint) Mills | 322121 | 36 | 3,789 | $70,370 | 6.0% | 6.8% | 16.4% |
| Printed Circuit Assembly (Electronic Assembly) Manufacturing | 334418 | 45 | 3,473 | $67,904 | 0.4% | 0.2% | 56.5% |
| Wineries | 312130 | 245 | 3,422 | $33,732 | 0.8% | 0.4% | 34.5% |
| Fruit and Vegetable Canning | 311421 | 72 | 3,243 | $58,705 | 1.7% | 1.1% | 29.2% |
| Precision Turned Product Manufacturing | 332721 | 90 | 3,216 | $52,045 | 1.5% | 0.6% | 0.0% |
| Cheese Manufacturing | 311513 | 42 | 3,184 | $54,501 | 0.9% | 0.5% | 5.6% |
| Sign Manufacturing | 339950 | 373 | 3,181 | $57,848 | 0.7% | 0.4% | 3.5% |
| Corrugated and Solid Fiber Box Manufacturing | 322211 | 57 | 3,032 | $64,656 | 1.1% | 0.6% | 5.7% |
| Other Aircraft Parts and Auxiliary Equipment Manufacturing | 336413 | 51 | 2,984 | $70,994 | 0.4% | 0.2% | 45.1% |
| Relay and Industrial Control Manufacturing | 335314 | 47 | 2,973 | $84,816 | 0.4% | 0.2% | 75.0% |
| Women's, Girls', and Infants' Cut and Sew Apparel Manufacturing | 315240 | 277 | 2,824 | $71,166 | 0.3% | 0.2% | 99.3% |
| Ready-Mix Concrete Manufacturing | 327320 | 165 | 2,792 | $71,945 | 1.2% | 0.9% | 0.0% |
| Jewelry and Silverware Manufacturing | 339910 | 447 | 2,783 | $72,497 | 0.4% | 0.2% | 156.9% |
| Cut and Sew Apparel Contractors | 315210 | 409 | 2,741 | $43,418 | 0.8% | 0.5% | 0.0% |
| All Other Miscellaneous General Purpose Machinery Manufacturing | 333999 | 61 | 2,672 | $98,534 | 0.7% | 0.3% | 79.2% |
| Other Measuring and Controlling Device Manufacturing | 334519 | 60 | 2,623 | $82,255 | 0.5% | 0.2% | 72.6% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Surgical Appliance and Supplies Manufacturing | 339113 | 155 | 2,617 | $60,824 | 0.4% | 0.2% | 55.5% |
| Ornamental and Architectural Metal Work Manufacturing | 332323 | 254 | 2,556 | $66,988 | 0.7% | 0.4% | 11.3% |
| Dental Laboratories | 339116 | 356 | 2,475 | $55,879 | 0.6% | 0.3% | 24.0% |
| Other Motor Vehicle Parts Manufacturing | 336390 | 39 | 2,460 | $62,324 | 0.7% | 0.3% | 51.3% |
| Railroad Rolling Stock Manufacturing | 336510 | 26 | 2,459 | $73,312 | 0.7% | 0.4% | 30.5% |
| Fabricated Structural Metal Manufacturing | 332312 | 112 | 2,456 | $67,661 | 0.7% | 0.4% | 13.1% |
| All Other Miscellaneous Manufacturing | 339999 | 184 | 2,373 | $59,644 | 0.5% | 0.3% | 56.5% |
| Wood Kitchen Cabinet and Countertop Manufacturing | 337110 | 372 | 2,330 | $50,678 | 1.1% | 0.6% | 11.2% |
| Metal Window and Door Manufacturing | 332321 | 80 | 2,301 | $63,771 | 0.8% | 0.4% | 10.4% |
| Photographic and Photocopying Equipment Manufacturing | 333316 | 39 | 2,263 | $98,262 | 0.4% | 0.2% | 140.9% |
| Other Industrial Machinery Manufacturing | 333249 | 71 | 2,204 | $78,313 | 0.7% | 0.3% | 51.3% |
| Frozen Specialty Food Manufacturing | 311412 | 40 | 2,173 | $54,712 | 1.3% | 0.6% | 1.9% |
| Fluid Power Valve and Hose Fitting Manufacturing | 332912 | 17 | 2,160 | $69,815 | 0.8% | 0.3% | 33.5% |
| All Other Miscellaneous Electrical Equipment and Component Manufacturing | 335999 | 55 | 2,141 | $181,320 | 0.6% | 0.3% | 89.7% |
| Instruments and Related Products Manufacturing for Measuring, | 334513 | 73 | 2,093 | $66,563 | 0.4% | 0.2% | 86.6% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Displaying, and Controlling Industrial Process Variables | | | | | | | |
| Meat Processed from Carcasses | 311612 | 73 | 2,046 | $53,841 | 1.0% | 0.5% | 0.2% |
| Electronic Connector Manufacturing | 334417 | 18 | 2,036 | $87,237 | 0.7% | 0.3% | 62.5% |
| Copper Rolling, Drawing, Extruding, and Alloying | 331420 | 22 | 1,968 | $64,743 | 1.0% | 0.5% | 24.8% |
| Ophthalmic Goods Manufacturing | 339115 | 37 | 1,959 | $65,823 | 0.8% | 0.3% | 74.8% |
| Paper Bag and Coated and Treated Paper Manufacturing | 322220 | 53 | 1,903 | $59,326 | 1.3% | 0.7% | 33.5% |
| Power Boiler and Heat Exchanger Manufacturing | 332410 | 27 | 1,870 | $69,088 | 0.7% | 0.4% | 38.6% |
| Glass Product Manufacturing Made of Purchased Glass | 327215 | 71 | 1,865 | $58,963 | 2.4% | 1.4% | 31.0% |
| All Other Miscellaneous Fabricated Metal Product Manufacturing | 332999 | 83 | 1,853 | $61,276 | 1.2% | 0.6% | 71.6% |
| Photographic Film, Paper, Plate, and Chemical Manufacturing | 325992 | 19 | 1,844 | $79,117 | 1.4% | 2.2% | 44.0% |
| Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing | 334416 | 37 | 1,837 | $55,141 | 1.0% | 0.4% | 104.6% |
| Sawmills | 321113 | 105 | 1,831 | $49,599 | 2.8% | 1.5% | 31.9% |
| Commercial Screen Printing | 323113 | 261 | 1,823 | $36,743 | 1.0% | 0.5% | 39.4% |
| Other Communications Equipment Manufacturing | 334290 | 44 | 1,823 | $97,669 | 0.3% | 0.2% | 40.7% |
| Optical Instrument and Lens Manufacturing | 333314 | 48 | 1,815 | $68,306 | 1.0% | 0.5% | 103.5% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Perishable Prepared Food Manufacturing | 311991 | 70 | 1,808 | $43,873 | 0.9% | 0.5% | 1.2% |
| Other Electronic Component Manufacturing | 334419 | 65 | 1,804 | $63,957 | 0.7% | 0.3% | 53.7% |
| Nonupholstered Wood Household Furniture Manufacturing | 337122 | 199 | 1,797 | $49,796 | 1.2% | 0.6% | 60.4% |
| Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals | 334515 | 62 | 1,792 | $83,607 | 0.4% | 0.2% | 83.0% |
| Air and Gas Compressor Manufacturing | 333912 | 9 | 1,778 | $81,029 | 0.5% | 0.2% | 73.6% |
| Electroplating, Plating, Polishing, Anodizing, and Coloring | 332813 | 83 | 1,768 | $57,299 | 3.6% | 1.9% | N/A |
| Current-Carrying Wiring Device Manufacturing | 335931 | 20 | 1,744 | $82,514 | 0.6% | 0.3% | 88.9% |
| Motor Vehicle Electrical and Electronic Equipment Manufacturing | 336320 | 33 | 1,729 | $53,160 | 0.6% | 0.3% | 64.2% |
| Turbine and Turbine Generator Set Units Manufacturing | 333611 | 24 | 1,716 | $113,403 | 0.7% | 0.4% | 76.0% |
| Construction Sand and Gravel Mining | 212321 | 140 | 1,710 | $70,132 | 6.5% | 5.4% | 0.7% |
| Motor Vehicle Transmission and Power Train Parts Manufacturing | 336350 | 22 | 1,683 | N/A | 0.8% | 0.4% | 25.3% |
| All Other Miscellaneous Food Manufacturing | 311999 | 42 | 1,643 | $63,493 | 1.2% | 0.7% | 54.2% |
| Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing | 333924 | 12 | 1,641 | N/A | 0.5% | 0.2% | 52.6% |
| Confectionery Manufacturing | 311352 | 77 | 1,607 | $42,854 | 0.9% | 0.5% | 27.6% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| from Purchased Chocolate | | | | | | | |
| Asphalt Paving Mixture and Block Manufacturing | 324121 | 90 | 1,582 | $86,785 | 3.9% | 4.2% | 1.3% |
| Folding Paperboard Box Manufacturing | 322212 | 20 | 1,576 | $61,916 | 1.1% | 0.5% | 7.8% |
| Irradiation Apparatus Manufacturing | 334517 | 15 | 1,572 | $100,820 | 0.6% | 0.3% | 70.1% |
| Motor Vehicle Metal Stamping | 336370 | 6 | 1,568 | N/A | 1.0% | 0.4% | 5.6% |
| Soft Drink Manufacturing | 312111 | 32 | 1,558 | $69,592 | 1.1% | 0.6% | 10.2% |
| Metal Crown, Closure, and Other Metal Stamping (except Automotive) | 332119 | 52 | 1,546 | $59,419 | 1.4% | 0.6% | 9.9% |
| Custom Architectural Woodwork and Millwork Manufacturing | 337212 | 138 | 1,534 | $59,924 | 0.9% | 0.5% | 0.3% |
| Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers | 332812 | 103 | 1,489 | $55,909 | 2.2% | 1.2% | N/A |
| Other Engine Equipment Manufacturing | 333618 | 3 | 1,466 | N/A | 0.5% | 0.3% | 64.7% |
| Electromedical and Electrotherapeutic Apparatus Manufacturing | 334510 | 51 | 1,465 | $83,624 | 0.3% | 0.2% | 50.3% |
| Cut Stone and Stone Product Manufacturing | 327991 | 158 | 1,455 | $51,776 | 1.1% | 0.6% | 43.7% |
| Pottery, Ceramics, and Plumbing Fixture Manufacturing | 327110 | 36 | 1,445 | $60,586 | 2.3% | 1.3% | 88.3% |
| Wood Container and Pallet Manufacturing | 321920 | 93 | 1,414 | $43,024 | 1.4% | 0.8% | 8.5% |
| Tire Manufacturing (except Retreading) | 326211 | 1 | 1,407 | N/A | 1.7% | 0.9% | 56.3% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Machine Tool Manufacturing | 333517 | 60 | 1,405 | $59,959 | 0.6% | 0.3% | 75.6% |
| Cookie and Cracker Manufacturing | 311821 | 50 | 1,390 | $42,737 | 1.0% | 0.5% | 6.5% |
| Plastics Bag and Pouch Manufacturing | 326111 | 27 | 1,386 | $60,759 | 1.7% | 0.7% | 28.4% |
| Special Die and Tool, Die Set, Jig, and Fixture Manufacturing | 333514 | 98 | 1,375 | $53,694 | 1.3% | 0.6% | 13.6% |
| Gasket, Packing, and Sealing Device Manufacturing | 339991 | 25 | 1,374 | $60,486 | 1.5% | 0.7% | 67.9% |
| Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding | 331491 | 17 | 1,347 | $62,715 | 2.4% | 1.3% | 89.2% |
| Other Concrete Product Manufacturing | 327390 | 72 | 1,311 | $57,310 | 1.0% | 0.6% | 9.3% |
| Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing | 336330 | 6 | 1,307 | N/A | 0.9% | 0.4% | 92.6% |
| Industrial Gas Manufacturing | 325120 | 16 | 1,293 | $113,689 | 15.4% | 41.8% | 7.9% |
| Ice Cream and Frozen Dessert Manufacturing | 311520 | 45 | 1,276 | $52,234 | 1.2% | 0.5% | 3.9% |
| Other Snack Food Manufacturing | 311919 | 20 | 1,253 | $47,283 | 0.8% | 0.5% | 3.8% |
| Musical Instrument Manufacturing | 339992 | 41 | 1,248 | $58,510 | 1.2% | 0.6% | 61.2% |
| Polystyrene Foam Product Manufacturing | 326140 | 16 | 1,245 | $57,720 | 2.0% | 1.1% | 25.4% |
| Textile Bag and Canvas Mills | 314910 | 96 | 1,179 | $44,756 | 0.9% | 0.4% | 44.2% |
| Motor Vehicle Gasoline Engine and Engine Parts Manufacturing | 336310 | 27 | 1,161 | $62,849 | 0.8% | 0.3% | 49.4% |
| Analytical Laboratory | 334516 | 37 | 1,150 | $66,321 | 0.6% | 0.4% | 58.3% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Instrument Manufacturing | | | | | | | |
| Fluid Power Pump and Motor Manufacturing | 333996 | 8 | 1,106 | $86,086 | 0.7% | 0.3% | 78.6% |
| Plastics Material and Resin Manufacturing | 325211 | 22 | 1,079 | $104,750 | 3.4% | 3.8% | 43.8% |
| Men's and Boys' Cut and Sew Apparel Manufacturing | 315220 | 75 | 1,072 | $55,935 | 0.7% | 0.4% | 101.1% |
| Aluminum Sheet, Plate, and Foil Manufacturing | 331315 | 5 | 1,070 | N/A | 3.2% | 1.4% | 36.6% |
| Showcase, Partition, Shelving, and Locker Manufacturing | 337215 | 79 | 1,038 | $58,897 | 1.1% | 0.6% | 55.4% |
| Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing | 335122 | 37 | 1,031 | $61,558 | 0.5% | 0.3% | 37.1% |
| Other Millwork (including Flooring) | 321918 | 104 | 1,018 | $54,312 | 1.7% | 0.9% | 18.5% |
| Measuring, Dispensing, and Other Pumping Equipment Manufacturing | 333914 | 29 | 1,010 | $81,657 | 0.6% | 0.3% | 52.2% |
| Other Commercial and Service Industry Machinery Manufacturing | 333318 | 59 | 1,009 | $60,852 | 0.5% | 0.2% | 27.9% |
| Computer Terminal and Other Computer Peripheral Equipment Manufacturing | 334118 | 31 | 1,009 | $111,482 | 0.5% | 0.2% | 176.3% |
| Nonwoven Fabric Mills | 313230 | 14 | 1,001 | $49,197 | 2.7% | 1.2% | 42.4% |
| Crushed and Broken Limestone Mining and Quarrying | 212312 | 43 | 998 | $73,800 | 7.0% | 6.0% | 0.0% |
| Sanitary Paper Product Manufacturing | 322291 | 7 | 994 | $65,177 | 1.4% | 0.7% | 28.3% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Other Basic Inorganic Chemical Manufacturing | 325180 | 25 | 989 | $88,270 | 6.8% | 12.4% | 56.3% |
| Clay Building Material and Refractories Manufacturing | 327120 | 28 | 989 | $68,715 | 4.6% | 8.1% | 41.5% |
| All Other Basic Organic Chemical Manufacturing | 325199 | 26 | 984 | $85,319 | 3.2% | 14.4% | 58.7% |
| Motor Vehicle Body Manufacturing | 336211 | 23 | 950 | $47,574 | 0.6% | 0.3% | 71.4% |
| Metal Can Manufacturing | 332431 | 9 | 945 | $82,487 | 1.6% | 0.7% | 3.4% |
| Wood Office Furniture Manufacturing | 337211 | 35 | 928 | $51,827 | 1.1% | 0.5% | 30.8% |
| Polish and Other Sanitation Good Manufacturing | 325612 | 25 | 927 | $52,214 | 1.0% | 0.5% | 23.4% |
| Poultry Processing | 311615 | 34 | 910 | $40,314 | 1.0% | 0.5% | 7.4% |
| Plate Work Manufacturing | 332313 | 51 | 895 | $70,099 | 1.3% | 0.6% | 0.3% |
| Packaging Machinery Manufacturing | 333993 | 32 | 890 | $71,065 | 0.4% | 0.2% | 42.9% |
| Aircraft Engine and Engine Parts Manufacturing | 336412 | 20 | 890 | $71,816 | 0.5% | 0.3% | 44.1% |
| Metal Kitchen Cookware, Utensil, Cutlery, and Flatware (except Precious) Manufacturing | 332215 | 16 | 884 | $54,007 | 1.1% | 0.7% | 69.0% |
| Synthetic Rubber Manufacturing | 325212 | 2 | 877 | N/A | 2.5% | 4.4% | 74.2% |
| Ball and Roller Bearing Manufacturing | 332991 | 11 | 877 | $65,165 | 1.9% | 0.9% | 71.2% |
| Sporting and Athletic Goods Manufacturing | 339920 | 49 | 875 | $57,631 | 1.1% | 0.6% | 58.4% |
| Dog and Cat Food Manufacturing | 311111 | 15 | 845 | $74,880 | 0.9% | 0.5% | 9.7% |
| All Other Miscellaneous | 314999 | 98 | 842 | $52,837 | 1.0% | 0.5% | 55.2% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Textile Product Mills | | | | | | | |
| Elevator and Moving Stairway Manufacturing | 333921 | 24 | 830 | $69,160 | 0.6% | 0.3% | 27.3% |
| Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing | 333415 | 32 | 809 | $62,344 | 0.5% | 0.2% | 38.9% |
| Unlaminated Plastics Profile Shape Manufacturing | 326121 | 16 | 795 | $69,889 | 1.4% | 0.6% | 13.4% |
| Heating Equipment (except Warm Air Furnaces) Manufacturing | 333414 | 18 | 773 | $66,643 | 1.0% | 0.5% | 36.1% |
| Textile and Fabric Finishing Mills | 313310 | 88 | 765 | $72,454 | 3.0% | 1.7% | 0.0% |
| Other Animal Food Manufacturing | 311119 | 44 | 760 | $62,638 | 1.2% | 0.6% | 7.0% |
| Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum) | 331492 | 12 | 757 | $65,677 | 1.9% | 1.1% | 16.5% |
| Office Supplies (except Paper) Manufacturing | 339940 | 32 | 757 | $56,092 | 0.7% | 0.4% | 53.8% |
| Metal Tank (Heavy Gauge) Manufacturing | 332420 | 23 | 755 | $79,550 | 1.0% | 0.5% | 26.0% |
| Ship Building and Repairing | 336611 | 16 | 752 | $99,052 | 0.7% | 0.3% | 8.5% |
| Frozen Cakes, Pies, and Other Pastries Manufacturing | 311813 | 16 | 745 | $42,234 | 1.3% | 0.7% | 13.9% |
| Audio and Video Equipment Manufacturing | 334310 | 47 | 741 | $90,804 | 0.4% | 0.2% | 117.6% |
| Plastics Packaging Film and Sheet (including Laminated) Manufacturing | 326112 | 16 | 733 | $55,478 | 1.9% | 0.8% | 38.5% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Spice and Extract Manufacturing | 311942 | 24 | 726 | $72,442 | 0.5% | 0.3% | 14.1% |
| Distilleries | 312140 | 72 | 725 | $45,383 | 0.5% | 0.3% | 45.3% |
| Flour Milling | 311211 | 10 | 724 | $87,128 | 1.7% | 0.7% | 14.1% |
| Small Arms, Ordnance, and Ordnance Accessories Manufacturing | 332994 | 13 | 714 | $74,659 | 1.2% | 0.6% | 42.7% |
| Nonchocolate Confectionery Manufacturing | 311340 | 28 | 704 | $37,675 | 1.4% | 0.7% | 23.9% |
| Industrial Valve Manufacturing | 332911 | 18 | 701 | $80,837 | 0.8% | 0.4% | 87.5% |
| Industrial Mold Manufacturing | 333511 | 49 | 701 | $53,128 | 1.8% | 0.8% | 43.3% |
| Flavoring Syrup and Concentrate Manufacturing | 311930 | 15 | 698 | $60,882 | 0.4% | 0.2% | 22.1% |
| All Other Rubber Product Manufacturing | 326299 | 24 | 684 | $52,142 | 1.6% | 0.8% | 43.5% |
| Apparel Accessories and Other Apparel Manufacturing | 315990 | 63 | 678 | $40,427 | 0.7% | 0.4% | 89.3% |
| Curtain and Linen Mills | 314120 | 84 | 676 | $47,167 | 0.6% | 0.3% | 82.4% |
| Semiconductor Machinery Manufacturing | 333242 | 14 | 676 | $132,775 | 0.6% | 0.2% | 140.6% |
| Other Paperboard Container Manufacturing | 322219 | 12 | 675 | $61,004 | 1.4% | 0.6% | 9.8% |
| Dry, Condensed, and Evaporated Dairy Product Manufacturing | 311514 | 9 | 671 | $61,728 | 1.0% | 0.6% | 25.6% |
| Wood Window and Door Manufacturing | 321911 | 40 | 668 | $55,371 | 1.1% | 0.6% | 6.6% |
| Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing | 333413 | 27 | 664 | $53,509 | 0.8% | 0.4% | 52.5% |
| Paperboard Mills | 322130 | 5 | 658 | $86,912 | 7.3% | 7.0% | 22.7% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Residential Electric Lighting Fixture Manufacturing | 335121 | 49 | 658 | $61,416 | 0.6% | 0.4% | 63.6% |
| Rolling Mill and Other Metalworking Machinery Manufacturing | 333519 | 15 | 653 | $67,207 | 0.7% | 0.4% | 24.4% |
| Abrasive Product Manufacturing | 327910 | 27 | 646 | $61,901 | 1.8% | 0.9% | 49.4% |
| In-Vitro Diagnostic Substance Manufacturing | 325413 | 10 | 643 | $63,167 | 0.5% | 0.2% | 72.0% |
| Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing | 336419 | 2 | 637 | N/A | 0.4% | 0.2% | 50.9% |
| Stationery Product Manufacturing | 322230 | 26 | 635 | $56,598 | 1.0% | 0.4% | 7.4% |
| Hardware Manufacturing | 332510 | 31 | 629 | $61,550 | 0.8% | 0.4% | 66.9% |
| Mattress Manufacturing | 337910 | 18 | 623 | $55,909 | 0.3% | 0.1% | 17.7% |
| Truss Manufacturing | 321214 | 19 | 622 | $50,084 | 0.7% | 0.4% | 0.3% |
| Dry Pasta, Dough, and Flour Mixes Manufacturing from Purchased Flour | 311824 | 44 | 618 | $42,773 | 1.1% | 0.5% | 12.3% |
| All Other Miscellaneous Chemical Product and Preparation Manufacturing | 325998 | 44 | 618 | $72,684 | 1.4% | 0.8% | 37.8% |
| Other Pressed and Blown Glass and Glassware Manufacturing | 327212 | 22 | 610 | $63,074 | 6.4% | 7.1% | 69.0% |
| All Other Miscellaneous Wood Product Manufacturing | 321999 | 64 | 608 | $46,343 | 2.2% | 1.1% | 40.7% |
| Rolled Steel Shape Manufacturing | 331221 | 11 | 608 | $86,285 | 1.5% | 0.8% | 5.8% |
| Blind and Shade Manufacturing | 337920 | 35 | 601 | $62,676 | 0.5% | 0.2% | 43.3% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Paint and Coating Manufacturing | 325510 | 29 | 597 | $76,027 | 0.6% | 0.3% | 14.3% |
| Bolt, Nut, Screw, Rivet, and Washer Manufacturing | 332722 | 27 | 592 | $60,770 | 1.4% | 0.6% | 62.2% |
| Fluid Power Cylinder and Actuator Manufacturing | 333995 | 8 | 587 | $67,729 | 0.7% | 0.3% | 37.4% |
| Iron and Steel Mills and Ferroalloy Manufacturing | 331110 | 23 | 584 | $61,070 | 4.1% | 7.4% | 35.2% |
| Cutting Tool and Machine Tool Accessory Manufacturing | 333515 | 31 | 574 | $71,674 | 1.5% | 0.6% | 49.0% |
| Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing | 333612 | 16 | 571 | $59,482 | 1.0% | 0.5% | 85.1% |
| Other Cut and Sew Apparel Manufacturing | 315280 | 61 | 564 | $52,391 | 0.5% | 0.2% | 71.6% |
| Other Aluminum Rolling, Drawing, and Extruding | 331318 | 5 | 561 | N/A | 3.2% | 0.6% | 24.3% |
| Other Chemical and Fertilizer Mineral Mining | 212393 | 5 | 555 | $65,835 | 7.6% | 5.7% | 78.0% |
| Switchgear and Switchboard Apparatus Manufacturing | 335313 | 29 | 552 | $78,696 | 0.4% | 0.2% | 74.7% |
| Plastics Pipe and Pipe Fitting Manufacturing | 326122 | 8 | 543 | $125,389 | 1.9% | 0.8% | 20.9% |
| Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing | 333112 | 10 | 543 | N/A | 0.5% | 0.2% | 31.1% |
| Alumina Refining and Primary Aluminum Production | 331313 | 8 | 542 | $82,567 | 16.9% | 20.4% | 87.7% |
| Plastics Bottle Manufacturing | 326160 | 14 | 533 | $48,580 | 3.6% | 1.4% | 14.2% |
| Prefabricated Metal Building and | 332311 | 15 | 527 | $68,079 | 0.5% | 0.3% | 5.1% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Component Manufacturing | | | | | | | |
| Coffee and Tea Manufacturing | 311920 | 44 | 524 | $57,060 | 0.5% | 0.3% | 25.3% |
| Saw Blade and Handtool Manufacturing | 332216 | 28 | 520 | $54,195 | 1.3% | 0.6% | 62.4% |
| Motor and Generator Manufacturing | 335312 | 18 | 503 | $66,687 | 0.5% | 0.2% | 82.8% |
| Other Metal Container Manufacturing | 332439 | 17 | 495 | $53,534 | 1.4% | 0.8% | 44.9% |
| Glass Container Manufacturing | 327213 | 7 | 493 | $80,197 | 9.1% | 16.3% | 29.8% |
| Motor Vehicle Brake System Manufacturing | 336340 | 3 | 489 | N/A | 0.9% | 0.4% | 50.4% |
| Fiber Optic Cable Manufacturing | 335921 | 10 | 481 | $46,421 | 0.6% | 0.3% | 56.8% |
| Concrete Block and Brick Manufacturing | 327331 | 30 | 480 | $69,237 | 1.5% | 0.9% | 1.9% |
| All Other Miscellaneous Nonmetallic Mineral Product Manufacturing | 327999 | 20 | 479 | $82,729 | 2.6% | 1.5% | 28.3% |
| Cement Manufacturing | 327310 | 24 | 477 | $77,325 | 14.8% | 74.0% | 13.7% |
| Urethane and Other Foam Product (except Polystyrene) Manufacturing | 326150 | 18 | 476 | $60,042 | 1.0% | 0.5% | 25.4% |
| Frozen Fruit, Juice, and Vegetable Manufacturing | 311411 | 10 | 474 | $57,251 | 1.9% | 1.1% | 35.1% |
| Dental Equipment and Supplies Manufacturing | 339114 | 32 | 470 | $69,072 | 0.4% | 0.2% | 45.7% |
| Iron and Steel Forging | 332111 | 16 | 467 | $60,840 | 2.8% | 1.5% | 1.3% |
| Heavy Duty Truck Manufacturing | 336120 | 4 | 465 | N/A | 0.2% | 0.1% | 46.5% |
| Farm Machinery and Equipment Manufacturing | 333111 | 13 | 452 | $56,910 | 0.6% | 0.3% | 44.7% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Support Activities for Printing | 323120 | 68 | 448 | $52,361 | 1.2% | 0.5% | 4.3% |
| Ground or Treated Mineral and Earth Manufacturing | 327992 | 4 | 448 | $56,291 | 6.8% | 3.8% | 19.7% |
| Other Communication and Energy Wire Manufacturing | 335929 | 9 | 445 | $56,386 | 0.8% | 0.3% | 89.7% |
| Industrial Process Furnace and Oven Manufacturing | 333994 | 12 | 442 | $82,342 | 0.8% | 0.4% | 48.3% |
| Telephone Apparatus Manufacturing | 334210 | 14 | 436 | $68,810 | 0.6% | 0.3% | 44.6% |
| Metal Household Furniture Manufacturing | 337124 | 33 | 434 | $53,675 | 0.9% | 0.5% | 69.9% |
| Iron Foundries | 331511 | 10 | 432 | $59,770 | 4.1% | 3.8% | 16.5% |
| Roasted Nuts and Peanut Butter Manufacturing | 311911 | 18 | 431 | $45,122 | 0.8% | 0.4% | 9.7% |
| Other Fabricated Wire Product Manufacturing | 332618 | 25 | 427 | $48,401 | 1.1% | 0.6% | 42.6% |
| Power, Distribution, and Specialty Transformer Manufacturing | 335311 | 13 | 424 | $60,336 | 1.0% | 0.5% | 37.8% |
| Oil and Gas Field Machinery and Equipment Manufacturing | 333132 | 3 | 414 | N/A | 0.7% | 0.3% | 22.1% |
| Prefabricated Wood Building Manufacturing | 321992 | 26 | 412 | $46,356 | 0.9% | 0.5% | 4.9% |
| Primary Battery Manufacturing | 335912 | 4 | 409 | $71,173 | 1.6% | 0.7% | 57.0% |
| Bottled Water Manufacturing | 312112 | 19 | 402 | $55,974 | 2.4% | 1.1% | 7.6% |
| Fabric Coating Mills | 313320 | 12 | 401 | $68,336 | 1.4% | 0.8% | 73.0% |
| All Other Converted Paper Product Manufacturing | 322299 | 21 | 399 | $42,793 | 2.4% | 1.2% | 38.7% |
| Leather and Hide Tanning and Finishing | 316110 | 26 | 395 | $42,661 | 1.0% | 0.5% | 83.0% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Pesticide and Other Agricultural Chemical Manufacturing | 325320 | 10 | 389 | $65,451 | 0.9% | 0.5% | 33.0% |
| Books Printing | 323117 | 21 | 386 | $56,214 | 1.9% | 0.8% | 65.8% |
| Office Furniture (except Wood) Manufacturing | 337214 | 11 | 382 | $76,159 | 0.7% | 0.3% | 9.6% |
| All Other Leather Good and Allied Product Manufacturing | 316998 | 26 | 378 | $48,752 | 0.7% | 0.3% | 107.5% |
| Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing | 311941 | 32 | 369 | $74,211 | 0.8% | 0.4% | 18.7% |
| Specialty Canning | 311422 | 5 | 364 | N/A | 0.9% | 0.6% | 6.6% |
| Overhead Traveling Crane, Hoist, and Monorail System Manufacturing | 333923 | 11 | 359 | $63,196 | 0.4% | 0.2% | 23.4% |
| Broom, Brush, and Mop Manufacturing | 339994 | 17 | 359 | $51,465 | 0.8% | 0.3% | 48.7% |
| Medicinal and Botanical Manufacturing | 325411 | 25 | 356 | $70,107 | 0.6% | 0.3% | 59.0% |
| Aircraft Manufacturing | 336411 | 11 | 353 | N/A | 0.4% | 0.1% | 8.3% |
| Spring Manufacturing | 332613 | 12 | 342 | $61,793 | 1.4% | 0.7% | 34.0% |
| Soap and Other Detergent Manufacturing | 325611 | 34 | 339 | $80,656 | 0.5% | 0.2% | 10.4% |
| Metal Heat Treating | 332811 | 15 | 337 | $90,504 | 5.4% | 6.1% | N/A |
| Dimension Stone Mining and Quarrying | 212311 | 31 | 333 | $49,466 | 4.3% | 4.1% | 44.6% |
| Mechanical Power Transmission Equipment Manufacturing | 333613 | 11 | 333 | $60,959 | 1.1% | 0.5% | 60.0% |
| Other Crushed and Broken Stone Mining and Quarrying | 212319 | 14 | 330 | $88,216 | 6.3% | 5.2% | 9.5% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Synthetic Dye and Pigment Manufacturing | 325130 | 8 | 329 | $77,392 | 3.1% | 1.8% | 66.4% |
| Gypsum Product Manufacturing | 327420 | 17 | 326 | $77,586 | 5.5% | 20.7% | 5.9% |
| Institutional Furniture Manufacturing | 337127 | 25 | 318 | $49,402 | 0.9% | 0.4% | 86.8% |
| Tobacco Manufacturing | 312230 | 25 | 315 | $54,494 | 0.2% | 0.1% | 5.7% |
| Mineral Wool Manufacturing | 327993 | 6 | 309 | $69,564 | 5.3% | 6.5% | 27.7% |
| Conveyor and Conveying Equipment Manufacturing | 333922 | 19 | 302 | $73,652 | 0.6% | 0.3% | 28.0% |
| Broadwoven Fabric Mills | 313210 | 24 | 300 | $53,215 | 3.0% | 1.3% | 72.8% |
| Construction Machinery Manufacturing | 333120 | 16 | 300 | $54,897 | 0.6% | 0.3% | 65.6% |
| Upholstered Household Furniture Manufacturing | 337121 | 29 | 294 | $56,167 | 0.5% | 0.2% | 34.0% |
| Animal (except Poultry) Slaughtering | 311611 | 28 | 288 | $32,176 | 0.6% | 0.3% | 25.4% |
| Flat Glass Manufacturing | 327211 | 8 | 284 | $65,242 | 5.9% | 12.1% | 30.4% |
| Cane Sugar Manufacturing | 311314 | 1 | 282 | N/A | 4.5% | 3.4% | 17.4% |
| Adhesive Manufacturing | 325520 | 18 | 274 | $64,249 | 1.0% | 0.5% | 20.7% |
| Power-Driven Handtool Manufacturing | 333991 | 5 | 272 | $60,526 | 0.6% | 0.3% | 76.4% |
| Seafood Product Preparation and Packaging | 311710 | 16 | 267 | $70,958 | 1.6% | 1.1% | 21.5% |
| Ice Manufacturing | 312113 | 15 | 261 | $45,880 | 6.9% | 3.4% | 24.3% |
| Iron and Steel Pipe and Tube Manufacturing from Purchased Steel | 331210 | 9 | 258 | $50,811 | 1.9% | 0.9% | 0.2% |
| Other Apparel Knitting Mills | 315190 | 33 | 255 | $59,866 | 1.0% | 0.5% | 117.2% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Printing Machinery and Equipment Manufacturing | 333244 | 19 | 253 | $56,119 | 1.1% | 0.5% | 68.7% |
| Secondary Smelting and Alloying of Aluminum | 331314 | 6 | 250 | $59,155 | 2.0% | 3.2% | 7.4% |
| Electric Lamp Bulb and Part Manufacturing | 335110 | 3 | 247 | N/A | 1.1% | 0.7% | 56.7% |
| Steel Investment Foundries | 331512 | 4 | 244 | $55,614 | 2.3% | 1.1% | 11.2% |
| Fertilizer (Mixing Only) Manufacturing | 325314 | 16 | 243 | $59,912 | 4.0% | 2.5% | 0.0% |
| Food Product Machinery Manufacturing | 333241 | 20 | 243 | $66,851 | 0.5% | 0.3% | 38.1% |
| Petroleum Lubricating Oil and Grease Manufacturing | 324191 | 13 | 236 | $57,022 | 0.7% | 1.3% | 0.2% |
| Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing | 326113 | 9 | 235 | $60,384 | 2.2% | 1.0% | 67.8% |
| Support Activities for Oil and Gas Operations | 213112 | 40 | 234 | $75,559 | 3.3% | 2.8% | N/A |
| Fabricated Pipe and Pipe Fitting Manufacturing | 332996 | 20 | 234 | $118,875 | 0.9% | 0.5% | 0.0% |
| Artificial and Synthetic Fibers and Filaments Manufacturing | 325220 | 2 | 233 | N/A | 3.7% | 6.3% | 53.1% |
| Chocolate and Confectionery Manufacturing from Cacao Beans | 311351 | 19 | 224 | $34,758 | 1.0% | 0.5% | 0.0% |
| Noncurrent-Carrying Wiring Device Manufacturing | 335932 | 7 | 220 | $59,648 | 1.0% | 0.5% | 12.4% |
| Cut Stock, Resawing Lumber, and Planing | 321912 | 8 | 215 | $47,049 | 1.9% | 1.0% | 0.0% |
| Doll, Toy, and Game Manufacturing | 339930 | 36 | 214 | $54,237 | 1.0% | 0.5% | 107.4% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Small Electrical Appliance Manufacturing | 335210 | 8 | 210 | $51,450 | 0.4% | 0.2% | 115.7% |
| Aluminum Foundries (except Die-Casting) | 331524 | 14 | 206 | $45,496 | 3.3% | 4.0% | 2.4% |
| Manufactured Home (Mobile Home) Manufacturing | 321991 | 3 | 194 | N/A | 0.6% | 0.4% | 7.2% |
| Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use | 334512 | 11 | 194 | $58,034 | 0.5% | 0.3% | 42.5% |
| All Other Nonmetallic Mineral Mining | 212399 | 7 | 193 | $62,196 | 7.2% | 5.9% | 76.3% |
| Software and Other Prerecorded Compact Disc, Tape, and Record Reproducing | 334614 | 55 | 189 | $128,366 | 1.3% | 0.6% | 116.2% |
| Bare Printed Circuit Board Manufacturing | 334412 | 19 | 188 | $63,513 | 1.7% | 0.8% | 56.2% |
| Fats and Oils Refining and Blending | 311225 | 4 | 187 | N/A | 0.7% | 0.4% | 11.9% |
| Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing | 326130 | 10 | 185 | $57,605 | 1.6% | 0.8% | 25.4% |
| Sawmill, Woodworking, and Paper Machinery Manufacturing | 333243 | 21 | 185 | $50,809 | 0.8% | 0.4% | 62.0% |
| Carbon and Graphite Product Manufacturing | 335991 | 6 | 185 | $56,850 | 2.9% | 1.5% | 53.8% |
| Rope, Cordage, Twine, Tire Cord, and Tire Fabric Mills | 314994 | 4 | 179 | $47,812 | 3.1% | 1.3% | 57.2% |
| Printing Ink Manufacturing | 325910 | 16 | 168 | $67,509 | 0.9% | 0.4% | 73.9% |
| Welding and Soldering | 333992 | 6 | 159 | $72,429 | 0.8% | 0.4% | 40.4% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Equipment Manufacturing | | | | | | | |
| Plumbing Fixture Fitting and Trim Manufacturing | 332913 | 4 | 156 | $73,467 | 0.3% | 0.2% | 29.5% |
| Hardwood Veneer and Plywood Manufacturing | 321211 | 2 | 154 | N/A | 1.8% | 0.8% | 50.1% |
| Other Metal Valve and Pipe Fitting Manufacturing | 332919 | 7 | 150 | $71,208 | 1.1% | 0.5% | 76.5% |
| Totalizing Fluid Meter and Counting Device Manufacturing | 334514 | 9 | 147 | $66,717 | 0.5% | 0.2% | 41.1% |
| Boat Building | 336612 | 18 | 146 | $51,638 | 0.7% | 0.3% | 20.3% |
| Concrete Pipe Manufacturing | 327332 | 4 | 141 | $90,962 | 1.3% | 0.7% | 1.3% |
| Footwear Manufacturing | 316210 | 16 | 139 | $40,115 | 0.7% | 0.3% | 97.7% |
| Nonferrous Metal (except Aluminum) Smelting and Refining | 331410 | 11 | 134 | $70,349 | 2.6% | 4.0% | 136.0% |
| Rubber and Plastics Hoses and Belting Manufacturing | 326220 | 6 | 130 | $68,659 | 1.4% | 0.7% | 70.3% |
| Drilling Oil and Gas Wells | 213111 | 22 | 125 | $54,244 | 1.7% | 1.6% | N/A |
| Computer Storage Device Manufacturing | 334112 | 10 | 118 | $81,042 | 0.5% | 0.2% | 108.7% |
| Narrow Fabric Mills and Schiffli Machine Embroidery | 313220 | 11 | 111 | $57,173 | 2.5% | 1.5% | 100.3% |
| Nonferrous Metal Die-Casting Foundries | 331523 | 10 | 109 | $68,085 | 3.1% | 3.2% | 4.0% |
| Other Lighting Equipment Manufacturing | 335129 | 14 | 108 | $65,265 | 0.5% | 0.2% | 76.4% |
| Custom Compounding of Purchased Resins | 325991 | 6 | 104 | $44,440 | 1.6% | 0.7% | 28.6% |
| Motorcycle, Bicycle, and Parts Manufacturing | 336991 | 15 | 101 | $48,508 | 0.3% | 0.2% | 61.6% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Dried and Dehydrated Food Manufacturing | 311423 | 9 | 100 | $50,658 | 1.8% | 1.2% | 19.8% |
| Nonferrous Forging | 332112 | 2 | 99 | N/A | 2.0% | 1.0% | 8.5% |
| Natural Gas Extraction | 211130 | 13 | 97 | $97,586 | 3.3% | 2.8% | 61.3% |
| Other Nonferrous Metal Foundries (except Die-Casting) | 331529 | 7 | 92 | $55,722 | 1.9% | 0.9% | 0.1% |
| Rubber Product Manufacturing for Mechanical Use | 326291 | 5 | 86 | $55,474 | 1.6% | 0.7% | 1.5% |
| Powder Metallurgy Part Manufacturing | 332117 | 4 | 86 | $74,342 | 3.0% | 1.5% | 4.5% |
| Scale and Balance Manufacturing | 333997 | 4 | 86 | $58,576 | 0.5% | 0.2% | 65.0% |
| Tire Retreading | 326212 | 7 | 77 | $50,695 | 1.7% | 0.9% | 1.7% |
| All Other Petroleum and Coal Products Manufacturing | 324199 | 2 | 75 | N/A | 1.8% | 45.5% | 1.4% |
| Nitrogenous Fertilizer Manufacturing | 325311 | 4 | 69 | $86,785 | 7.4% | 11.8% | 40.7% |
| Ethyl Alcohol Manufacturing | 325193 | 1 | 66 | N/A | 6.8% | 11.0% | 10.3% |
| Travel Trailer and Camper Manufacturing | 336214 | 6 | 64 | $36,860 | 0.3% | 0.2% | 14.5% |
| Women's Handbag and Purse Manufacturing | 316992 | 16 | 63 | $42,789 | 0.7% | 0.3% | 102.7% |
| Fastener, Button, Needle, and Pin Manufacturing | 339993 | 9 | 63 | $51,539 | 2.2% | 1.1% | 42.5% |
| Custom Roll Forming | 332114 | 4 | 59 | N/A | 1.6% | 0.8% | 4.5% |
| Tortilla Manufacturing | 311830 | 7 | 58 | $37,262 | 1.6% | 0.9% | 10.8% |
| Reconstituted Wood Product Manufacturing | 321219 | 4 | 58 | $60,377 | 5.2% | 4.1% | 31.5% |
| Knit Fabric Mills | 313240 | 9 | 57 | $42,733 | 2.3% | 1.3% | 80.3% |
| Plastics Plumbing Fixture Manufacturing | 326191 | 3 | 55 | N/A | 1.0% | 0.5% | 7.2% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Household Furniture (except Wood and Metal) Manufacturing | 337125 | 9 | 53 | $45,754 | 0.9% | 0.4% | 70.8% |
| Copper, Nickel, Lead, and Zinc Mining | 212230 | 2 | 50 | N/A | 8.0% | 7.1% | 34.6% |
| Storage Battery Manufacturing | 335911 | 5 | 42 | $83,673 | 1.9% | 1.2% | 73.9% |
| Carpet and Rug Mills | 314110 | 5 | 40 | $111,737 | 1.4% | 0.7% | 33.1% |
| All Other Transportation Equipment Manufacturing | 336999 | 8 | 40 | $48,481 | 0.5% | 0.2% | 25.2% |
| Wood Preservation | 321114 | 6 | 39 | $57,306 | 0.9% | 0.6% | 7.2% |
| Crude Petroleum Extraction | 211120 | 11 | 37 | $50,164 | 3.3% | 2.8% | 61.3% |
| Asphalt Shingle and Coating Materials Manufacturing | 324122 | 3 | 36 | N/A | 1.2% | 1.8% | 6.2% |
| Rendering and Meat Byproduct Processing | 311613 | 5 | 34 | $57,958 | 5.0% | 3.6% | 35.6% |
| Mining Machinery and Equipment Manufacturing | 333131 | 2 | 33 | N/A | 1.5% | 0.7% | 57.1% |
| Motor Vehicle Seating and Interior Trim Manufacturing | 336360 | 4 | 31 | N/A | 0.5% | 0.2% | 26.2% |
| Support Activities for Nonmetallic Minerals (except Fuels) Mining | 213115 | 3 | 31 | $79,479 | 3.3% | 2.8% | N/A |
| Engineered Wood Member (except Truss) Manufacturing | 321213 | 1 | 30 | N/A | 2.0% | 1.0% | 31.4% |
| Steel Wire Drawing | 331222 | 3 | 28 | $44,814 | 1.9% | 0.9% | 30.4% |
| Steel Foundries (except Investment) | 331513 | 4 | 25 | $47,763 | 4.0% | 2.0% | 6.2% |
| Breakfast Cereal Manufacturing | 311230 | 6 | 23 | $42,753 | 1.4% | 0.8% | 11.6% |
| Petroleum Refineries | 324110 | 4 | 23 | N/A | 1.3% | 1.4% | 24.2% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Fiber, Yarn, and Thread Mills | 313110 | 5 | 22 | $20,444 | 3.5% | 1.4% | 37.5% |
| Creamery Butter Manufacturing | 311512 | 3 | 21 | $28,029 | 1.0% | 0.6% | 6.8% |
| Surface Active Agent Manufacturing | 325613 | 5 | 21 | $52,317 | 1.9% | 1.4% | 78.3% |
| Burial Casket Manufacturing | 339995 | 1 | 17 | N/A | 1.8% | 0.8% | 22.7% |
| Explosives Manufacturing | 325920 | 4 | 15 | $78,937 | 1.6% | 0.9% | 36.5% |
| Ammunition (except Small Arms) Manufacturing | 332993 | 1 | 15 | N/A | 1.5% | 0.8% | 35.5% |
| Industrial Sand Mining | 212322 | 3 | 13 | $68,645 | 6.6% | 5.6% | 22.6% |
| Support Activities for Metal Mining | 213114 | 4 | 12 | N/A | 3.3% | 2.8% | N/A |
| Hosiery and Sock Mills | 315110 | 4 | 12 | $47,745 | 3.1% | 1.4% | 78.1% |
| Major Household Appliance Manufacturing | 335220 | 2 | 12 | N/A | 0.5% | 0.3% | 55.7% |
| Light Truck and Utility Vehicle Manufacturing | 336112 | 2 | 11 | N/A | 0.2% | 0.1% | 14.1% |
| Soybean and Other Oilseed Processing | 311224 | 4 | 9 | $47,128 | 1.2% | 0.8% | 33.1% |
| Crushed and Broken Granite Mining and Quarrying | 212313 | 1 | 5 | N/A | 6.4% | 5.4% | 0.0% |
| Kaolin and Ball Clay Mining | 212324 | 1 | 5 | N/A | 12.9% | 10.2% | 70.0% |
| Clay and Ceramic and Refractory Minerals Mining | 212325 | 1 | 5 | N/A | 9.0% | 7.8% | 53.9% |
| Malt Manufacturing | 311213 | 2 | 5 | N/A | 3.3% | 2.1% | 34.3% |
| Pulp Mills | 322110 | 2 | 5 | N/A | 6.2% | 7.8% | 93.6% |
| Automobile Manufacturing | 336111 | 3 | 5 | N/A | 0.2% | 0.1% | 76.9% |
| Bituminous Coal and Lignite Surface Mining | 212111 | 0 | 0 | $0 | 7.9% | 7.9% | 0.2% |
| Bituminous Coal Underground Mining | 212112 | 0 | 0 | $0 | 3.9% | 2.2% | 81.5% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Anthracite Mining | 212113 | 0 | 0 | $0 | 7.6% | 7.8% | 19.9% |
| Iron Ore Mining | 212210 | 0 | 0 | $0 | 10.8% | 8.8% | 38.5% |
| Gold Ore Mining | 212221 | 0 | 0 | $0 | 11.7% | 9.8% | 2.2% |
| Silver Ore Mining | 212222 | 0 | 0 | $0 | 11.7% | 9.8% | 4.6% |
| Uranium-Radium-Vanadium Ore Mining | 212291 | 0 | 0 | $0 | 10.8% | 8.8% | 101.6% |
| All Other Metal Ore Mining | 212299 | 0 | 0 | $0 | 10.8% | 8.8% | 101.6% |
| Potash, Soda, and Borate Mineral Mining | 212391 | 0 | 0 | $0 | 7.5% | 6.8% | 2.4% |
| Phosphate Rock Mining | 212392 | 0 | 0 | $0 | 7.6% | 5.7% | 10.0% |
| Support Activities for Coal Mining | 213113 | 0 | 0 | N/A | 3.3% | 2.8% | N/A |
| Rice Milling | 311212 | 0 | 0 | $0 | 1.6% | 0.8% | 48.2% |
| Wet Corn Milling | 311221 | 0 | 0 | $0 | 5.3% | 8.5% | 27.7% |
| Beet Sugar Manufacturing | 311313 | 0 | 0 | $0 | 4.5% | 3.4% | 17.4% |
| Softwood Veneer and Plywood Manufacturing | 321212 | 0 | 0 | $0 | 3.2% | 1.7% | 28.7% |
| Newsprint Mills | 322122 | 0 | 0 | $0 | 6.0% | 0.6% | 71.3% |
| Petrochemical Manufacturing | 325110 | 0 | 0 | $0 | 3.8% | 37.5% | 8.7% |
| Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing | 325194 | 0 | 0 | $0 | 2.9% | 33.4% | 92.7% |
| Phosphatic Fertilizer Manufacturing | 325312 | 0 | 0 | $0 | 4.0% | 1.5% | 78.3% |
| Lime Manufacturing | 327410 | 0 | 0 | $0 | 19.1% | 118.2% | 6.0% |
| Small Arms Ammunition Manufacturing | 332992 | 0 | 0 | $0 | 1.2% | 0.6% | 23.5% |
| Blank Magnetic and Optical Recording Media Manufacturing | 334613 | 0 | 0 | $0 | 1.3% | 0.6% | 124.2% |
| Truck Trailer Manufacturing | 336212 | 0 | 0 | $0 | 0.5% | 0.2% | 28.5% |
| Motor Home Manufacturing | 336213 | 0 | 0 | $0 | 0.3% | 0.2% | 15.1% |

| U.S. Industry | | NYS Payrolled Locations | NYS Jobs | Ave. Worker Wages (Annualized) | Energy Intensity | | Trade Intensity |
|---|---|---|---|---|---|---|---|
| Guided Missile and Space Vehicle Manufacturing | 336414 | 0 | 0 | $0 | 0.4% | 0.2% | 9.6% |
| Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing | 336415 | 0 | 0 | $0 | 0.5% | 0.3% | 17.5% |
| Military Armored Vehicle, Tank, and Tank Component Manufacturing | 336992 | 0 | 0 | $0 | 0.5% | 0.3% | 27.8% |

# Sources and Assumptions to Identify Industry Intensities and Related Trades

## A. Data Sources

- Value of Shipments, Electricity and Fuel Expenditures:
  - U.S. Annual Survey of Manufacturers (2018);
  - U.S. Economic Census: Mining (2017)
- Imports and Exports:
  - U.S. International Trade Commission (2018)
- Electricity and Fuel Consumption:
  - U.S. EIA Manufacturing Energy Consumption Survey (2018)
  - U.S. Annual Survey of Manufacturers (2018)
  - U.S. Economic Census (2017)
- Process Emissions:
  - **Emissions factors:**
    - IPCC Emissions Factors Database
    - U.S. EPA Office of Air & Radiation, *Estimation of Eligible Sectors and Emissions under H.R. 2454* (2010)
  - **Global Warming Potential source:**
    - Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment (AR5) 20-year figures
  - **Pricing**
    - International Monetary Fund Commodity Pricing
    - United States Geological Survey
- Employment, Establishments and Worker Wages
  - New York State Department of Labor, Quarterly Census of Employment and Wages (QCEW), Q3 2020
  - EMSI Data Run 2021.1, QCEW Data 2020 Q2 (most recent)

- Occupations
    - New York State Department of Labor Occupational Employment Statistics (OES) survey, 2016-2019.

## B. Other Inputs:

- Value of Carbon:
    - NYS DEC Value of Carbon Guidance: $125 (2020)
- GHG Emission Factors
    - A combination of U.S.-level and NYS-specific factors were applied to estimate electricity, fuel combustion emissions and non-combustion process emissions across industries.

## C. Key Limitations:

- Industry data was available at the U.S.-level only
- Industry data was available for Manufacturing, Mining sectors only
- Certain data was unavailable at 6-digit NAICS industry and has been estimated based on 4-digit or 5-digit NAICS-level.
- Trade data was available at the international trade-level only
- Electricity and fuel combustion GHG emissions were based on estimates of the amounts of electricity and fuel consumed.
- Process GHG emissions were estimated only for a subset of industries likely to have significant process emissions based on estimated production volumes.
- The NYS value of carbon was used to quantify GHG emissions intensity due to the lack of an applicable emission price.

# Appendix D: Power Generation Sites Identified by the JTWG

Across jurisdictions, one common and prominent dimension of the vision for a just and equitable transition relates to the evolution of the power generation sector and the uncertain outcomes facing conventional power plants (primarily: fossil fuel) and their workers and host communities. This trend is certainly true for New York State, where numerous communities currently play host to conventional generation facilities of many sizes and setups (details below).

## New York State Power Generation Fleet Background

### *New York State generation fleet basics*

- 38,497 MW installed summer capacity
    - 26,371 MW fossil fuel-based generation
- Approx. 500 discrete generation *facilities* serving bulk power system, ~150 of which are emitting resources
- 53% of generation *units* older than 1980
    - Common thresholds for capacity "nearing retirement:":
      gas turbines older than 47 years old (1973); steam turbines older than 62 years old (1958)
        - Gas Turbines – 76 out of 106 units (72%)
        - Steam Turbines – 11 out of 46 units (24%), +12 in next decade
- 84% of transmission facilities older than 1980 (by mileage)

*(Sources: 2020 NYISO Gold Book; 2020 NYISO Power Trends)*

### *Gas Turbines & Steam Turbines "Nearing Retirement" (Fossil Fuel resources)*

- NYISO, 2018 Power Trends Report – growing amount of gas- and steam-turbine capacity reaching age threshold
    - In 2018, 866 MW of steam-turbine generating capacity in New York State was 62.5 years or older — an age at which, nationally, 95% of such capacity has ceased operations.
    - For gas turbines, 2,356 MW of capacity in New York State was 46 years or older. Nationally, 95% of capacity using this technology has deactivated by this age.

- By 2028, more than 8,300 MW of gas-turbine and steam-turbine based capacity in New York will reach an age beyond which 95% of these types of capacity have deactivated.

- But: 35% of New York's current generating capacity has been added since 2000

*"While there have been significant additions to New York's generating capacity since 2000, power plants age like all physical infrastructure. The need to maintain, upgrade, or replace aging generation infrastructure requires attention."*

On the road to achieving the power sector goals within the Climate Act – namely, to achieve 70% renewable electricity by 2030, and 100% zero-emission electricity by 2040 – the existing power sector will undergo significant evolutions and transformations. And indeed, these impacts were contemplated by the Climate Act as something New York would have to proactively plan around: specifically, the Climate Act tasked the Just Transition Working Group with two discrete deliverables, which the Group considered with the leadership of a Subgroup formed specifically to tackle these power plant topics.

The two power plant tasks contained in the Climate Act include: 1) identifying generation facilities that "may be closed as a result of a transition to a clean energy sector;" and 2) identifying issues and opportunities presented by the reuse of those sites. As the text of the Climate Act reads:

> *"The Just Transition Working Group shall…identify sites of electric generating facilities that may be closed as a result of a transition to a clean energy sector and the issues and opportunities presented by reuse of those sites;"*[1]

The Working Group, with the help of the Power Plants Subgroup, set about to tackle these two tasks with a robust, data-driven approach rooted in real-world case-studies and the 'facts on the ground' as much as possible, while acknowledging that future scenarios would not be known and fixed.

## Identifying Generation Facilities That May be Closed

The objective of this exercise, which was referred to in shorthand as the "power plant inventory," was to compile key information about the existing New York State generation fleet, so as to be useful to a range of stakeholders. Further, the aim of the inventory was to help inform the Working Group and Council's collective understanding of the issues and opportunities that surround power plant site reuse, putting them in more tangible/concrete terms. Finally, and importantly, the inventory was envisioned as a resource to

[1] Chapter 106 of the Laws of 2019.

assist in ongoing and future planning efforts at the local and state level, and potentially to position the state well for any future federal resources. Early in 2021, the new federal Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization was formed and held its initial meetings, as originally outlined by President Biden's January 27 executive order on tackling the climate crisis. The Working Group focus is on identifying and delivering federal resources to revitalize the local economics of coal, oil and gas, and power plant communities, ensuring benefits and protections for workers in these communities. So, through this inventorying exercise, New York may be able to position itself effectively to participate in and benefit from those efforts moving forward.

Overall, the approach to the inventory embraced the view that compiling insights into the location and timing of potential plant closures would be critical for informing specific, coordinated, and locally grounded planning, which – if done proactively – can substantially improve transition outcomes. The inventory was developed, however, with a number of important caveats and bounding statements that should be kept in mind when reviewing it:

- First, the inventory is informational only, rather than predictive or decisional. So, it does not opine on the State or Working Group's view of which plants *will* close, the cause(s) of any future closures, or the specific timing/order of any future closures. This reflects the reality that the Just Transition Working Group is not a decision-making body, and therefore is not developing an inventory that would be binding in any way.
- Second, and importantly, the inventory aims to focus on objective plant metrics and data-points most salient in future transitions: in particular, the criteria used to focus the research effort included plant age, capacity factor, fuel type, and known environmental/emission compliance plans. Recognizing that many of these data points will change in the future, it's also important to observe that the inventory will provide just a snapshot in time.
- Next, when it comes to plants' future plans in the real world, planning decisions will be the result of multiple considerations, including commercial, operational, regulatory, and market factors, among others. This inventory is not intended to predetermine any future decisions.
- In addition, plant deactivations go through a very prescriptive process through the NY-ISO. As a result, the inclusion of a plant on the inventory does not suggest that deactivation planning or other NY-ISO processes are imminent or should be initiated.

- And last but not least, a reminder that the inventory is all in the context of the major guiding Climate Act requirements for the electric sector: 70% renewable electricity by 2030, and 100% zero-emission electricity by 2040.

With these parameters in mind, the Working Group considered a universe of facilities summarized here, broken out into private facilities owned by independent power producers and investor-owned utilities; and public facilities such as those owned by or serving NYPA, LIPA, and municipal utilities. On the private side, there were 32 facilities that were identified, representing roughly 16,000 MW of capacity – but inclusive of several GW of previous/known retirements, plus additional capacity that is already planned to be out of service pursuant to the DEC NOx emissions regulations. Based on the research the group conducted, these facilities currently contribute about $140m per year in property taxes to local jurisdictions, a figure that does not include broader local economic impacts.

On the public side, a similar story emerged, with about 29 facilities that were identified, representing just 6,500 MW of capacity – and again, also inclusive of capacity that will be out of service later this decade under the DEC NOx regulations. These plants do represent considerable local property tax payments of about $180m per year, largely attributable to some of the ongoing discussions on Long Island.

With respect to jobs and employment figures, partial data was found to be available, representing roughly 2,100 jobs. Employment figures contributed via subgroup members (including labor unions representing certain power plant workers) and agencies total approximately 1,520 workers across 22 plants (out of 61 facilities on the inventory). In addition, *Quarterly Census of Employment and Wages* data, via the NYS Department of Labor (NYSDOL), provided the ability to look at de-identified/ aggregated employment numbers for other plants on the inventory (confidentiality rules prevent data from being shared at a firm- or employee-specific level). The QCEW data identified approximately 586 additional employees at another 20 facilities on the inventory; and data was unavailable or unable to verify for a small number of remaining facilities on our inventory. So, combined, these data inputs suggest that the facilities on our inventory correspond to at least approximately 2,100 jobs, with additional jobs expected for plants where data is not available.

To put these figures in context, the overall statewide generation fleet includes 38,000+ MW of total capacity, of which 26,000+ MW are fossil based resources – with a count of roughly 150 individual emitting facilities. And as shown in the appendix to NYSERDA's Clean Energy Industry Report, there were roughly 24,000 employed in New York's traditional power generation sector *overall*, which includes

direct plant workers but also the full supply chain of firms engaged in facility construction, turbine and other generation equipment manufacturing, operations and maintenance, and wholesale parts distribution.

In terms of sources and research, the team working on the Inventory endeavored to make use of publicly available data sources wherever possible. The primary source for much of the power generation data is the NYISO's Gold Book (2019 and 2020 versions primarily). Other research of publicly available online resources helped fill in other data categories. And, for some categories, some information assembled may not be readily available online, including some jobs figures contributed by members of the Power Plant Subgroup, as well as some grid infrastructure data that some of the state agency teams helped provide. A full list of sources and links is found in the version of the inventory published here.[2]

## Identifying Issues and Opportunities Presented by Reuse of Power Plant Sites

For the second power plant related task contained in the Climate Act, the Just Transition Working Group developed a list of the most prominent and impactful issues and opportunities presented by the reuse of power plant sites into new, alternative applications.[3] Through all the research conducted and the discussions held with the Working Group and Subgroup, it was clear that power plant reuse is an area where there are both challenges as well as promises of opportunity moving forward. And again, like elsewhere across the country and world, transitions related to power plants are a critical element of how a just transition will unfold in New York, so it is important to understand these issues and opportunities and their nuances.

Table D-1 provides an overview of the issues and opportunities that were identified. Further descriptions of each category follow.

Table D-1. Overview of Issues and Opportunities

| Issues Presented By Power Plant Site Reuse | Opportunities Presented by Power Plant Site Reuse |
|---|---|
| Displaced workforce, and local economic impacts | Repurposing with onsite clean energy resources |
| Reduced local property tax revenues (County, Municipality, School District) | Interconnection points and infrastructure for offsite renewables |

[2] Accessed at https://climate.ny.gov/-/media/Migrated/CLCPA/Files/JTWG-Power-Plant-Inventory.ashx.

[3] Based on the word 'Reuse' in the Act, the Group focused its efforts under this task on reuse activities that could be explored on sites after the plant in question was fully retired and deactivated. The Group did not consider future scenarios that would potentially see the plant maintaining its operations but also adding new uses/activities on the site.

| Issues Presented By Power Plant Site Reuse | Opportunities Presented by Power Plant Site Reuse |
|---|---|
| Parcel ownership, transfer, and associated factors | Commercial redevelopment – residential, commercial, mixed-use, etc. |
| Local planning capacity and community engagement | Port/marine infrastructure |
| Impacts caused by a dormant site being left unattended/unmanaged | Industrial reuse, Information Technology/data centers, manufacturing |
| Environmental remediation | Green-space, park infrastructure – including for climate resilience |
| Reliability impacts (current reliability role/contribution) | Diversify/extend property tax revenues |
| Stranded assets and infrastructure impacts | |

## *Issues Presented by Power Plant Site Reuse*

Displaced workforce, and local economic impacts

Issue: Workers at fossil fuel facilities face considerable uncertainty and apprehension related to the future of their workplace and livelihood. Supporting and providing resources to displaced workers is therefore a critical element of New York's just transition, with a need for regular and informative communications. The existing power plant workforce is a true jewel of New York State and represents an asset for the future of the energy system, with the workforce being highly skilled and trainable for future applications. One dimension of this issue was an prediction that it may prove difficult for site reuse/redevelopment to provide same-site job opportunities for workers previously employed in power plant operations, aside from certain opportunities in remediation, security, and others.

To address this issue, the Working Group identified a strong need for more advanced outreach and support to employees – *well prior* to a plant's closure where known, in addition to the "rapid response" workforce support resources that are deployed in the months immediately preceding closure of major employment facilities. The Working Group recommended that the focus of advanced workforce support be on where the impacts/concerns will be most acute – for example, for the mid-career worker with a young family and mortgage, too far from retirement age. A variety of specific activities may be worth undertaking to inform workforce resources and planning, including a state-led survey of workers' current status, skillsets, plans for retirement, interests in clean energy and other new fields (which the Working Group was supportive of). This follows the recognition that the traditional power generation workforce is not a single monolith, and there will be a variability in desires and needs accordingly.

Over the near- and long-term, there was a strong desire expressed to find job placement and training opportunities for these workers *within* New York State as a first preference – targeting skills-alignment in

both energy and non-energy roles. The Working Group identified acute needs both for retraining of workers *and retention of workers*, to ensure that plants are sufficiently staffed through the remainder of their operational lives. Finally, this issue brings with it substantial *indirect* economic impacts in/around plant communities stemming from the loss of direct employment, which should be considered as well.

Reduced local property tax revenues (County, Municipality, School District)

Issue: local revenue impacts. Host communities have for many decades planned their local budgets understanding these facilities are locally sited, and may in fact be the single largest revenue source in a locality. Further local economies are also partly organized around the operation of these facilities, which also can impact the tax base. New York has its own unique experience in these matters, including perhaps most notably surrounding the Indian Point Closure Task Force, and in many cases surrounding facilities serving the Long Island Power Authority.

The State established the Electric Generation Facility Cessation Mitigation Program, which is administered by Empire State Development. This fund was established to help with the transitions that host communities will need to make, as power plants come off line and off the local tax rolls, and as alternate revenue resource can be brought to bear. Originally supported through appropriations through the state budget, the Public Service Commission acted in 2021 to provide a stable mechanism for this fund, over the next 10 years, which is intended to support communities impacted by aging power plant closures. Because the support under the Mitigation program lasts only for a period of years, under a long-term view of budgeting and economic development, proactive efforts will need to be taken, both local and state, to account for and hopefully overcome future tax revenue losses.

Parcel ownership, transfer, and associated factors

Issue: challenges related to parcel ownership and transfer, which many intuitively grasp is closely linked to any future plans for site reuse. This set of issues is likely to be site-specific, but there will likely be scenarios both where existing plant owners are directly interested in redeveloping/repurposing their site over time, especially related to future energy uses at the site; and where that interest from existing owners does not exist, there may be steps taken to transfer parcel ownership and/or subdivide the site to allow for timely redevelopment by other interested parties.

There are also impacts related to parcel zoning status here, which may confine future reuse opportunities. In some cases, power plants may predate the adoption of local zoning maps and ordinances, meaning that their parcels may be subject to legacy zoning designations resulting from the power plant itself, rather

than more up-to-date local plans related to the site. It is also worth noting is the importance of willing cooperation of adjacent land owners for certain reuse opportunities, such as large-scale renewable energy, as one example of an application requiring more physical space.

## Local planning capacity and community engagement

Issue: that undertaking a site reuse effort can be a major endeavor from a local planning perspective, being both time and resource intensive as well as requiring certain expertise. But despite this, advance planning can help communities respond to and prepare for power plant closures, so it is critical work.

In the wake of COVID-19, local planning resources and in-house expertise may be constrained and/or misaligned with the needs related to navigating power plant site reuse. That's one reason why NYSERDA developed and advanced the $5m technical assistance program to equip localities with additional resources to undertake site reuse plans. A critical element of this local planning process is ensuring local community voices are heard and can contribute to planning efforts. This is true as a matter of principle based on the Just Transition principles the group advanced, and more concretely is necessary to ensure that any plans for reuse are designed and shaped with local community benefits in mind. In many cases, site reuse can allow communities to seize the opportunity to repair historical impacts borne locally. That reparative lens can help communities strike an appropriate balance between potentially competing considerations and preferences.

## Impacts caused by a dormant site being left unattended/unmanaged

Issue: impacts caused by sites lying dormant for extended periods of time following closure and deactivation. The desire to avoid this type of outcome or minimize the time of dormancy may drive localities to pursue site reuse expeditiously. The set of impacts here are varied, ranging from fiscal impacts, aesthetic/eyesore concerns, public health and safety considerations, environmental factors, and abutting parcel concerns, among others. One key element is adequate communication to members of the surrounding community as to the likely duration of any site dormancy. Finally, while this category of issues is not unique to power plants among other industrial sites, it is likely to be acute for power plants in many respects given the nature of the infrastructure on those sites.

## Environmental remediation

Issue: environmental remediation needs that may be required as a step prior to any site reuse. These efforts may entail activities such as asbestos abatement, waste removal, other environmental remediation and restoration, including during and after the demolition or deconstruction of any power plant structures

and associated infrastructure, such as for fuel delivery and storage. This issue is highly site specific, and the extent of remediation measures required will vary widely by site and by plant type, including at one end of the spectrum the extensive decommissioning work required for a nuclear facility such as Indian Point. Identifying funding to support remediation activities will be a material factor in reuse, and may require a mix of public and private programs and sources, including federal and state brownfield-related opportunities. Some categories of remediation work, such as asbestos, may also have a nexus with health and benefits support for plant workers.

Reliability impacts (current reliability role/contribution)

Issue: reliability, which includes: 1) any current reliability role/contribution from an existing plant, 2) any impacts that may arise due to retirement, and 3) any future contribution of energy infrastructure at the site. States across the U.S. have observed all too recently and poignantly the paramount importance of system reliability, especially during periods of prolonged need during extreme weather conditions. Thankfully, New York benefits from specific investments, policies, requirements, and planning processes to ensure that we are taking reliability as seriously as possible, including via the resource diversity and grid investments we have achieved to date and are further expanding. At the NYISO, detailed and prescriptive processes govern the safe retirement of facilities serving the bulk power system, with studies to determine whether a reliability need would result from the deactivation of the facility in question, along with ongoing, recurring analyses of system reliability over short- and long-term planning horizons.

Specifically, NYISO market participants must provide the NYISO with a minimum of 365 days prior notice before a large generator may be Retired or enter into a Mothball Outage. NYISO's review of generator deactivation is part of the Short Term Assessment of Reliability (STAR), which is performed on a quarterly basis in coordination with Responsible Transmission Owners. The ISO conducts the necessary reliability studies to review the impact on the reliability of the Bulk Power Transmission Facilities (BPTFs) that would result from the Generator being unavailable.

As one notable example where a reliability impact was not found, NYISO issued a report in December 2017 on system reliability impacts of Indian Point closure dates in 2020 and 2021, concluding that the plant could close on schedule without negatively impacting reliability. Wherever the opposite may be true, however, plans and schedules for retirement and repurposing could be disrupted/modified, if a reliability need cannot be otherwise resolved. Especially in New York City, there is a dynamic wherein the transmission and distribution grid has been built up based specifically on the locations of existing

plants – which has created a need to solve for things like load pockets and transmission security constraints with solutions located at or providing power to those existing plant location areas.

Stranded assets and infrastructure impacts

Issue: the category of stranded assets and infrastructure impacts. The topic of stranded power plant assets is discussed a lot in the national context when it comes to just transition planning, but that is most salient in vertically integrated utility markets, where ratepayers may be directly on the hook for outstanding/stranded costs for any power plants that close earlier than planned. Since New York has a restructured, competitive power generation market, this issue of stranded ratepayer assets should largely be mitigated. But it may be true that site reuse could contend with lingering assets from a non-ratepayer/private financing perspective, and there may be some instances where other infrastructure serving a plant, such as fuel transportation and storage, may be rendered obsolete/stranded should their use no longer be needed. These could include assets owned by public utilities (electric, gas, water, etc.) and which may have additional impacts at the time of plant closure.

Another important infrastructure impact relates to asset separation: specifically, to separate and disentangle switchyard and substation equipment that will remain owned and operated by the transmission owner after the plant's closure. These separation upgrades will bring benefits but can come with meaningful costs, as was reported on such investments made by National Grid surrounding the Huntley plant in recent years (post-closure). Broader infrastructure impacts certainly have to be considered too, not least of which include a potentially wide range of climate vulnerability impacts. Reuse may require the climate-proofing of future site uses, expecting increasingly common and damaging extreme events, especially in locations that may be located on the waterfront and/or most susceptible for climate impacts.

## *Opportunities Presented by Power Plant Site Reuse*

Repurposing with onsite clean energy resources

Opportunity: Repurposing power plant sites with onsite clean energy resources is a natural top candidate for reuse. Options include solar, wind, energy storage, EV charging, zero-carbon fuel production, and more. While development may pose more challenges than typical/greenfield sites, the Working Group expected there to be opportunities for both private renewable development and development via public programs such as Build Ready (NYSERDA). Onsite clean energy facilities will benefit from the use of significant grid infrastructure and interconnection capacity as power plant CRIS rights expire/are transferred. While facilities may not be able to replace power plant capacity 1-for-1 in all cases, onsite

clean energy resources present opportunity to materially reduce the pollution burden on local communities – a contributor to asthma, other respiratory illness, heart disease, and other health outcomes. Geographically targeted demand-side resources (energy efficiency, demand response, active demand management/load flexibility, grid-interactive buildings) are also an important tool as part of a holistic plant-replacement approach.

Because, as discussed above, the transmission and distribution networks have in many cases been built up based specifically on the locations of existing plants, onsite resources (and injections of power) at the location of plants will be especially beneficial to the grid. For day-to-day peak reliability applications, energy storage technologies present strong potential as a means of replacing peaking units with short runtimes with 4-hour and 8-hour lithium-ion storage technologies. Advances will be needed in emerging long duration energy storage applications to address more extended and seasonal peak needs in the future, including during extreme weather conditions. In either case, storage may be most conducive to sites with limited geographical footprint, especially at plants in urban locations.

### Interconnection points and infrastructure for offsite renewables

Opportunity: Sites also present significant opportunities to serve as transmission interconnection points for offsite renewable resources, such as offshore wind and upstate renewables. As with onsite resources, this model for reuse would make use of grid interconnection capacity and infrastructure availability, as well as space for new grid infrastructure like HVDC converter stations. Interconnection of offsite resources can be implemented as an independent solution, or as a purposeful complement to onsite clean energy infrastructure (e.g., to pair with energy storage). Prominent opportunities exist for this model to emerge, most notably via NYSERDA's Offshore Wind RFPs and Tier 4 RFP, and at/via facilities owned/leased by NYPA and LIPA. Notably, proposed offshore wind connections already contemplate connections proximate to existing generation facilities: Empire Wind 1 at Gowanus; Sunrise Wind at Holbrook; Empire Wind 2 at Barrett; Beacon Wind at Astoria. Furthermore, multiple prospective Tier 4 projects announced feature connections at Zone J power plant sites [UPDATE]. This reuse opportunity may also be compatible with a variety of other potential uses depending on physical footprint of the interconnection/grid equipment necessary, additional available space onsite

### Commercial redevelopment – residential, commercial, mixed-use, etc.

Opportunity: a range of commercial redevelopment uses – residential, commercial, office-space, mixed-use, etc. – may also present themselves as options at power plant sites. Such developments may support construction jobs, but not all may support long-term onsite job creation. Despite potential demolition and

remediation needs, commercial developers may find value in site characteristics (location, waterfront access, etc.) as well as in the ability to repurpose visually striking elements of the plant structures (e.g., smokestacks). Variation in real estate property value across regions of the state is also likely to direct this interest. Depending on site characteristics, redevelopment could bring commerce and vibrance to areas that may not previously have significant housing population and commercial activity nearby. In environmental justice areas and disadvantaged communities, however, caution needs to be exercised to ensure redevelopment centers around benefitting local communities and does not unfold in a way that promotes or induces displacement of local residents.

### Port/marine infrastructure

Opportunity: Many plants situated on the waterfront may be valuable as opportunities to pursue port/marine transport infrastructure uses, especially for plants whose water-access is also connected to rail, highway, and other transportation modes. Power plant sites on the waterfront may have unique access to deep-water ports in particular, which would allow for uses that protect/preserve the working waterfront, with activities such as offshore wind staging, assembly, and manufacturing. Rebuilding the capacity for maritime dependent uses – both commercial and recreational – may be well-received as a way to continue the history/tradition of waterfront work and access in certain areas. Waterfront access may have the additional attribute of supporting intermodal marine transit, whether for routine use (e.g., ferry services) or as an asset to address climate vulnerability (e.g., storm infrastructure for response and evacuation).

### Industrial reuse, Information Technology/data centers, manufacturing

Opportunity: Industrial reuse for a range of manufacturing and other energy intensive applications, such as information technology/data centers. Like many energy infrastructure applications, heavier energy-consumptive reuse opportunities may also benefit from significant grid capacity available at power plant sites. These more industrial applications may include information technology/data centers, general manufacturing, green manufacturing, greenhouses & agriculture, and others. Certain use-cases may also benefit from water-access for cooling processes (e.g., data centers). Many information technology and manufacturing reuse opportunities promise potential for job creation, local investment, and property tax contributions. Green manufacturing (e.g., electric vehicle supply chain/componentry) in particular has natural synergies with Climate Act goals for decarbonization and economic development. There is a recognition of certain use-cases being explored while existing power plants remain operational, rather than repurposing them; this “opportunity” does not extend to such applications, and close attention is needed to ensure industrial applications are energy efficient and powered by clean energy so as to further Climate Act achievement and economic development goals.

Green-space, park infrastructure – including for climate resilience

Opportunity: Power plant sites may also provide creative opportunities for publicly accessible green-space and parks infrastructure – especially for waterfront locations. This includes adaptive forms of reuse providing climate resilience and related ecological services, e.g., leveraging designs and measures to reduce and absorb flood surges and alleviate heat island effect, among other nature-based adaptation solutions. The ability (or lack thereof) to benefit financially from reuse exclusively reserved to these green space opportunities may not make them the first preference of existing property owners, but they could add value and appeal as a partial reuse alongside other forms of compatible development and reuse. And, public entities could play a more central role where opportunities exist to conserve land and create publicly beneficial green-space – acknowledging that doing so may not by itself support long-term job creation. Reuse could also be directed to actively complement and combine with adjacent/nearby park infrastructure that may exist along waterfronts.

Diversify/extend property tax revenues

Opportunity: an overarching opportunity spanning many of these reuse forms is to provide localities with the added benefit of finding uses to diversify and extend property tax revenues from sites after the end of a plant's useful life. A host community's planning for the long-term of life after the plant should be reflected in the use or uses pursued, with a preference in some cases for multi-stream property tax revenues. Local, regional, and state economic development efforts should leverage the site, employee skillsets, and community attributes to guide economic development strategy, once again in a manner seeking multiple, diversified tax revenue-positive enterprises. Municipalities and property owners will likely pursue a variety of tactics to market and promote interest in redeveloping a power plant site for new uses, and digital and social media may provide new opportunities to attract positive attention to the opportunities for site reuse and provide new opportunities for members of the community to weigh in with input.

# Appendix E: JTWG Recommendations to the Council on Issues and Opportunities Related to the EITE Entities

## Business Impacts: Opportunities and Challenges Facing New York State Industry

New York State's transition to a net zero emission economy will present both opportunities and challenges for its industries and workers. A just transition must lean into these opportunities and address these challenges, and this section of the Scoping Plan is intended to identify strategies for addressing both positive and negative impacts.

The issues and strategies contained in this section are preliminary and broadly crafted for the whole of industry based on a general understanding of what a transition to a clean energy economy could mean. Specific impacts will vary by industry sector and subsector, and, given the global nature of commerce, international and national-level policy should continue to be monitored for its implications to New York State.

### *Opportunities for New York State Industries and Workers*

In transitioning to a net zero emission economy, New York State is destined to experience a profound level of financial investment in the clean energy sector, and a substantial amount of these investments and jobs will flow to existing New York State businesses and residents. Further, the health benefits of the Scoping plan can make New York State a cleaner, more environmentally sustainable, and more desirable location for attracting and retaining talent. Building on these benefits, the following strategies are intended to help New York State access these opportunities.

1. Establish New York State as the Green Economy Leader

As an early mover on climate change, New York State has the opportunity become a regional and national hub for green economy innovation, business formation and job creation. The State should prioritize in-state economic benefits from its transition to a net zero emission economy by continuing initiatives like the NYSEDA Carbon2Value initiative, which includes a cohort of 10 startup companies working to scale Carbontech solutions, and the State's nation-leading, multi-billion-dollar renewable energy solicitations. Between 2015 and 2019, total clean energy jobs in New York State grew from about 141,000 to 164,000,[1]

[1] See: https://www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report.

and the ongoing transition will continue to create significant economic opportunities for both new and existing businesses.

2. Build and Foster Strategic Industry Partnerships

As a means to help ensure that businesses and workers have the awareness and ability to reduce their GHG emission impact and act on green economic opportunities, the State should foster partnerships between new green economy businesses and existing firms and workers that could contribute to an in-state green economy supply chain. Existing examples of partnership initiatives include the New York Battery and Energy Storage Technology (NY-BEST™) Consortium, NYSTAR-funded technology commercialization centers, the EPA ENERGY STAR program for industrial facilities, and the new SUNY Offshore Wind Training Institute. Future State-supported partnerships could include other research and development consortia, industry associations and working groups, and partnerships with educational institutions.

3. Promote New York State Low Carbon Products and Services

By supporting the distinguishing, development and adoption of low-carbon goods and services made within the state, New York State can foster an in-state supply chain of green economy businesses who can help the State meet its climate goals, maximize the share of economic benefits from the State's clean energy investments that accrue to in-state businesses and workers, and enhance the early competitive advantage of this in-state supply chain for the long-term. Existing examples of such initiatives include California's Buy Clean Act and the EPA ENERGY STAR program for energy-efficient products. Future State initiatives should include a state-focused program to identify and promote best practices and industrial leadership in emissions reduction and low carbon products, the development of preferential procurement standards for low-carbon building and other materials, and coordination with other states and at a national level to develop mutual mechanisms to support growing markets for low carbon products, such as a database of common standards and environmental product declarations.[2]

## *Challenges for New York State Industries and Workers*

The State's transition to a net zero emission economy will also present challenges and, in certain cases, require dramatic changes to existing industries. Over time, industries that currently account for significant levels of GHG emissions are likely to be required to improve their energy efficiency, transition to cleaner energy sources, adopt less GHG emission-intensive industrial processes, and employ other creative measures to capture and sequester carbon. This economywide transition to a net zero economy has the

[2] For a related strategy to prioritize low-carbon products in government procurements, see the Industry Chapter of Section IV.

potential to cause anti-competitive impacts to in-state firms who compete against firms located outside of New York State. To address these challenges, the following strategies include measures to level the playing field.

1. Mitigate Energy Costs Increases

To ensure the ongoing competitiveness of the state as a home for energy-intensive economic activities, New York State should avoid severe and sustained industrial energy price increases. For businesses in energy-intensive industries that trade across the State's boundaries, increases to the price of energy may result in industrial disinvestment and, over time, the loss of economic activity to jurisdictions with cheaper electricity and/or fuel. Existing examples of policies and programs to offset energy costs for price-sensitive industries include NYPA's low-cost hydropower and power proceeds programs, utility-provided discount programs, and, outside of New York State, programs such as the cheap power provided by Washington State's Grand Coulee Dam and the State of Minnesota's energy discount program for certain energy-intensive and trade-exposed industries.

2. Ensure Energy Reliability

To maintain the uninterrupted ability of energy-intensive industries to operate, the State should provide a stable energy system to power industrial operations. In certain industries, such as semiconductor manufacturing, even brief losses of power can result in the immediate spoilage of large quantities of high-cost products, resulting in both revenue losses and delays in fulfilling customer orders. Ensuring a reliable energy supply is a challenge for all sectors of the economy, and additional planning on this challenge can be found in Section IV of the Scoping Plan in the Electricity Chapter. Existing initiatives relevant to ensuring reliable access to energy include NYSERDA technical assistance programs and NYPA energy services. Future initiatives may need to support industrial users' ability to secure reliable and back-up power by supporting the use of more resilient microgrids and installing on-site, renewable energy and/or storage.

3. Mitigate Anti-Competitive Impacts

To avoid disadvantaging the in-state firms and workers most vulnerable to GHG emission and energy sector mandates, the State should adopt mitigation strategies for industry that rely on incentive-oriented approaches such as financial and technical assistance programs and low-carbon procurement incentives, as described in the Industry chapter of Section IV of this Scoping Plan. Similarly, as is described in the next section, the State should avoid placing unattainable compliance burdens on the industrial sector in ways that simply drive emissions – and their economic activities – to a less climate-friendly jurisdiction.

# Appendix F: Environmental and Health Data for Quantifying Health Benefits of Climate Policy

It is important for New York to continue to maintain and improve understanding of the health impacts of decisions related to energy and climate policy and other uses. One tool that can be used to estimate potential population health benefits of broad policy scenarios is quantitative health impact assessment.[1] These assessments generally require relevant health outcome data, environmental data and forecasted changes in those parameters, and estimates of the statistical relationship between the environmental parameters and the health outcomes, to estimate health co-benefit measures such as avoided cases of disease or premature death, years of increased life expectancy, and others.

## Health Status of New Yorkers for Selected Health Outcomes Particularly Relevant for Climate Policy

A number of health conditions are likely to be positively impacted by climate policies resulting from the Climate Act. Asthma and cardiovascular disease are two conditions associated with exposure to ambient air pollutants that are anticipated to decrease with future climate policies. The following summarizes current burden for these two health conditions and provides examples of the types of climate policies that could lead to co-benefits in the form of reduced burden.

Cardiovascular disease is the leading cause of death nationally and in New York, with almost 44,000 New Yorkers dying of cardiovascular disease in 2018.[2] Research studies have shown an association between exposure to air pollutants such as particulate matter, $NO_X$, $SO_2$, carbon monoxide, and ozone, and

[1] WHO. Evaluation and Use of Epidemiological Evidence for Environmental Health Risk Assessment: WHO Guideline Document. 2000.
U.S. Environmental Protection Agency. Air Quality Criteria for Ozone and Related Photochemical Oxidant. 2006.
U.S. Environmental Protection Agency. EPA/600/R-08/07: Integrated Science Assessment for Oxides of Nitrogen – Health Criteria. 2008.
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Arrow, Kenneth. Is there a Role for Benefit-Cost Analysis in Environmental, Health and Safety Regulation? Science. 1996. 272:221-222.

[2] DOH. Vital Statistics of New York State: 2018 Tables. https://apps.health.ny.gov/public/tabvis/PHIG_Public/lcd/reports/#state

increased hospitalization rates and mortality from cardiovascular disease.[3] In addition, lack of physical activity can increase the risk for obesity and diabetes, which increase the risk for cardiovascular disease. Thus, climate policies that reduce pollutant exposure and facilitate healthy behaviors (such as Smart Growth principles that encourage physical activity) could help to reduce cardiovascular outcomes.

Asthma is a major health problem nationally and in New York. Recent Centers for Disease Control and Prevention data shows that asthma prevalence in New York was 9.3% among adults and 8.1% among children (0-17 years) in 2019 (approximately 1.4 million adults and 315,000 children).[4] Across the state, there were more than 170,000 emergency department visits and over 34,000 hospitalizations per year due to asthma during 2014. Asthma hospitalization rates in New York are higher than national rates for all age groups. The total cost of asthma hospitalizations for 2011 was approximately $660 million, a 61% increase since 2002. Asthma is a multifactorial disease that has many contributing causes. This includes four components of air pollution, ozone, $SO_2$, $NO_X$, and particulate matter, that are known to exacerbate asthma and to cause eye and respiratory tract irritation, cough, shortness of breath, reduced lung function,[5] and mortality.[6] Based on recent data (2015-2019), there are approximately 2,000 emergency department visits annually for "heat stress" with about a tenth of those requiring hospitalization. There are about 2,900 emergency department visits each year for "cold stress" with 1,300 requiring hospitalization annually, for the same time period.

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[3] Brook, Robert. Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science for the American Health Association. Circulation: Journal of the American Health Association. 109:2655-2671. 2004.
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World Health Organization. Regional Office for Europe. (2018). Environmental noise guidelines for the European Region. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/279952

[4] Most Recent Asthma State or Territory Data https://www.cdc.gov/asthma/most_recent_data_states.htm

[5] U.S. Environmental Protection Agency. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2019). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-19/188, 2019.
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Gauderman, W. James. Association between Air Pollution and Lung Function Growth in Southern California. American Journal of Respiratory Critical Care Medicine. 2000. 162(4Pt1):1383-1390.

[6] Laden, F, Schwartz, J, Speizer, FE, Dockery, DW. 2005. Reduction in Fine Particulate Air Pollution and Mortality Extended Follow-up of the Harvard Six Cities Study. Am. J. Resp. And Critical Care Med. https://doi.org/10.1164/rccm.200503-443OC
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## Health Outcome Data

Health outcome data are counts and rates of health-related events in a population, for example, deaths due to cardiovascular disease, hospitalizations for asthma, new diagnoses of cancer, or births of premature infants. DOH collects information on many health outcomes on an ongoing basis and maintains a variety of databases. The DOH Statewide Planning and Research Cooperative System data and Vital Statistics databases are two commonly used data source for evaluating health outcomes. The Statewide Planning and Research Cooperative System is a comprehensive all payer database that currently collects information on each hospital inpatient stay and outpatient (ambulatory surgery, emergency department, and outpatient services) visit; and each ambulatory surgery and outpatient services visit to a hospital extension clinic and diagnostic and treatment center licensed to provide ambulatory surgery services.[7] The DOH maintains a Vital Statistics registry of all births and deaths that have occurred in New York outside of New York City. Through a cooperative agreement, the DOH receives data on births and deaths recorded in New York City from the New York City Department of Health and Mental Hygiene and on live births and deaths recorded outside of New York to residents of New York from other states and Canada[8] Access to individual-level Statewide Planning and Research Cooperative System or Vital Statistics data requires application and approval by data stewards.

The DOH also provides access to deidentified data that could provide inputs to quantitative health impact assessment. The DOH's Prevention Agenda highlights many health conditions, including asthma and cardiovascular disease, that impact the health of New York residents, and maintains a list of available data sources on the DOH Prevention Agenda website.[9] Many datasets are also available through Health Data NY, which provides access to health data in a variety of formats, supported by comprehensive metadata. The Environmental Public Health Tracking program displays county-level maps, charts, and tables for select environmental health, hazard and exposure indicators and learn more about environmental health topics and is also working to develop sub-county indicators where appropriate.[10]

[7] Statewide Planning and Research Cooperative System (ny.gov) https://www.health.ny.gov/statistics/sparcs/

[8] Vital Statistics of New York State (ny.gov) https://www.health.ny.gov/statistics/vital_statistics/

[9] Data Sources for Prevention Agenda 2019-2024 Community Assessment, Planning and Implementation (ny.gov) https://health.ny.gov/prevention/prevention_agenda/2013-2017/sources.htm

[10] Environmental Public Health Tracking https://health.ny.gov/environmental/public_health_tracking/

## Air Quality

Recent scientific studies of long-term air quality trends in New York City demonstrate that enactment of local and regional clean air regulations, as well as economic influences on fuel usage (such as natural gas out-competing coal costs), significantly reduce ambient levels of particulate matter, bringing the region into compliance with particulate matter NAAQS.[11] Air quality is evaluated through the state's ambient air quality network that measures levels of $SO_2$, nitric oxide, nitrogen dioxide, ozone, carbon monoxide, lead, particulate matter, and total hydrocarbons. Currently, the state operates 54 monitoring sites for the measurement of criteria and non-criteria pollutants, most of which are located in populated areas. The data available through ambient air quality monitoring can be useful for quantitative health impacts assessment work.

### *Criteria Pollutants*

NAAQS criteria pollutant standards are set at levels to protect public health and welfare with an adequate margin of safety. Currently, the state complies with the requirements of, or is "designated attainment for," the NAAQS for carbon monoxide, lead, nitrogen dioxide, particulate matter, and fine particulate matter. For $SO_2$, all counties in New York have been designated "unclassifiable/attainment" with the exception of a small portion of St. Lawrence County which has been designated as nonattainment.[12] Nine counties, in which 65% of the state's population reside, are currently not in attainment for the 2015 ozone standard.

### *Non-Criteria Pollutants*

Non-criteria pollutants that are emitted from fuel combustion include VOCs, semi-VOCs, metals, and others. VOCs like octane, benzene and others are produced as evaporative emissions from carbon-based fuel and as emissions from incomplete combustion of fuel. VOCs are important precursor compounds for ozone, which is formed in the atmosphere by reaction with $NO_X$ in the presence of heat and sunlight. The identity of individual VOCs emitted vary with fuel type, combustor type, and operating conditions.

Of the VOCs emitted, benzene is one of the most significant in terms of environment degradation and public health. In 2017, approximately 89,214 pounds of benzene were released from sources in New York. Forty percent of the benzene emissions in the state for 2017 can be attributed to the transportation

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[11] Blanchard *et al*. (2020) Accessed at https://www.tandfonline.com/doi/full/10.1080/10962247.2021.1914773?scroll=top&needAccess=true&. Pitiranggon *et al*. 2021. Accessed at https://www.sciencedirect.com/science/article/pii/S135223102100056X.

[12] U.S. EPA, "Sulfur Dioxide (2010) Designated Areas by State/County/Area," Accessed at https://www3.epa.gov/airquality/greenbook/tbcty.html.

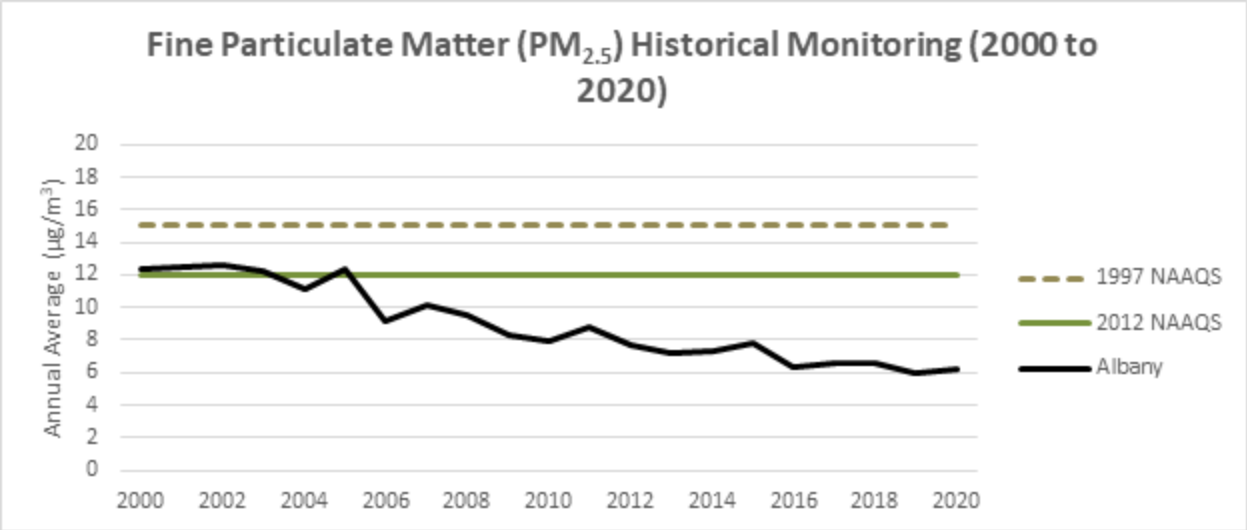
sector, and most of the remainder is attributable to other uses of petroleum. As illustrated in Table F-1, benzene concentrations across the state have decreased significantly over the last decade due in part to programs and regulations directed at reducing transportation source pollution, including the adoption of reformulated gasoline programs and improvements in vehicle emissions technology; the statewide adoption of the California Low Emission Vehicle program; and emission reductions from oil refineries and other stationary sources under the federal and state air pollution control programs. Although tremendous reductions of benzene have taken place, Figure F-1 illustrates that all locations in the state, even the most rural, are above the state's benzene annual guideline concentration of 0.13 µg/m3 set at a one-in-one-million cancer risk.

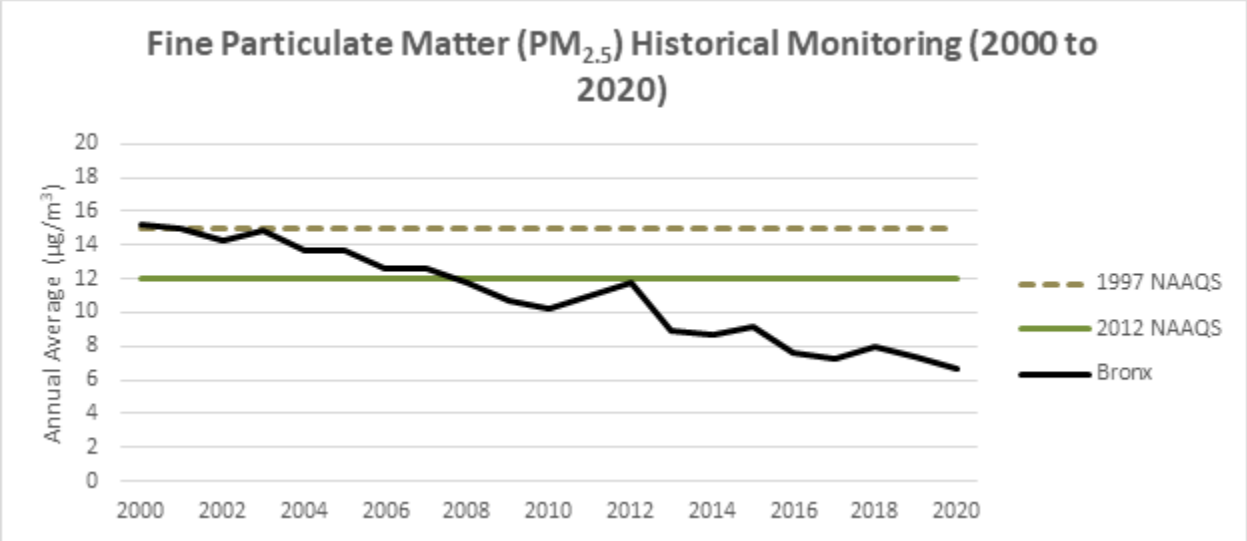
Table F-1. National Ambient Air Quality Standards

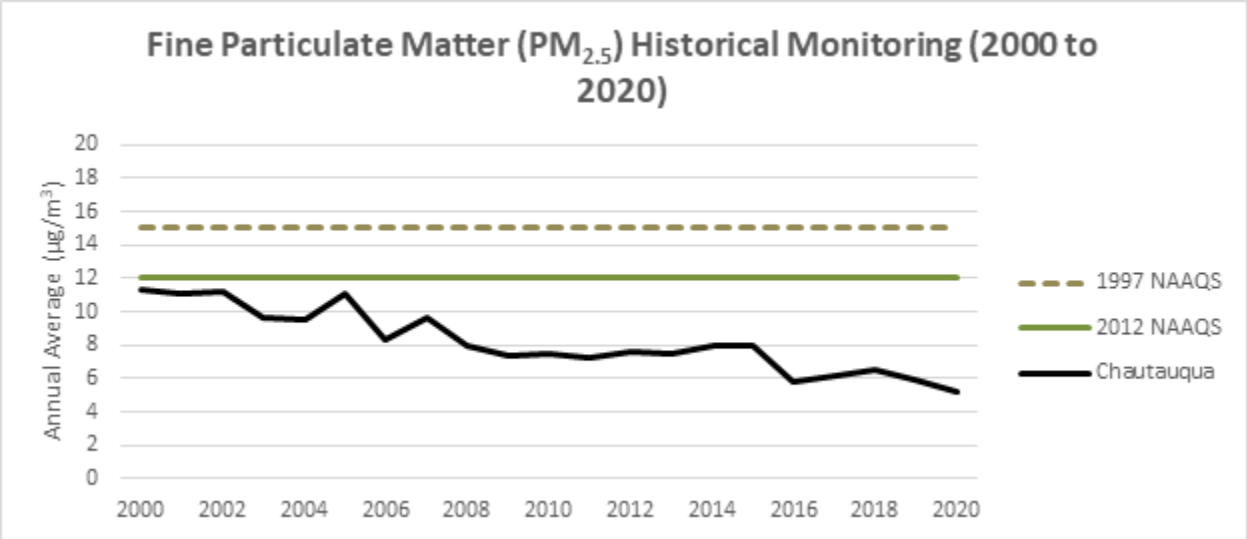
| Pollutant | Level | Averaging Time |
|---|---|---|
| CO | 9 ppm (10 mg/$m^3$) | 8-hour 1971 std |
| | 35 ppm (40 mg/$m^3$) | 1-hour 1971 std |
| Lead | 0.15 ug/$m^3$ | Rolling 3 month Average, 2008 std |
| $NO_2$ | 100 ppb (188 ug/$m^3$) | 1-hour 98th percentile, 2010 std |
| | 53 ppb (100 ug/$m^3$) | Annual, 1971 std |
| $PM_{10}$ | 150 ug/$m^3$ | 24-hour[5] |
| $PM_{2.5}$ | 35 ug/$m^3$ | 24-hour, 2006 std |
| | 12 ug/$m^3$ | Annual, 2012 std |
| $O_3$ | 0.070 ppm | 8-hour 2015 std |
| | 0.075 ppm | 8-hour 2008 std |
| $SO_2$ | 0.075 ppm (196 ug/$m^3$) | 1-hour 99th percentile, 2010 std |

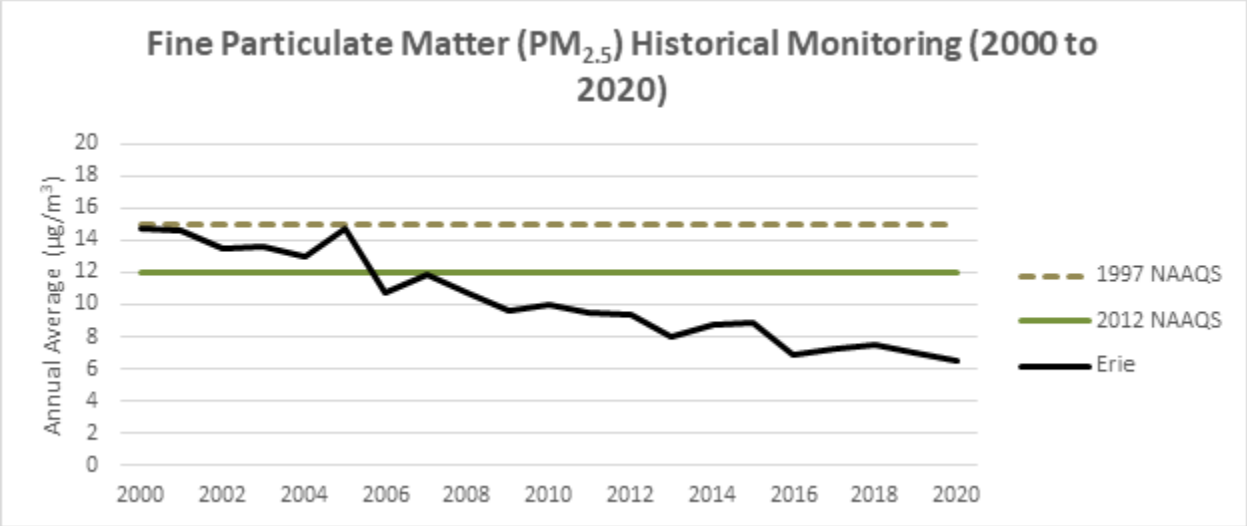
*Source: U.S. Environmental Protection Agency. National Ambient Air Quality Standards. https://www.epa.gov/criteria-air-pollutants/naaqs-table Accessed online, August 26, 2021.*

Figure F-1. Fine Particulate Matter Historical Monitoring (2000–2020)




Fine Particulate Matter ($PM_{2.5}$) Historical Monitoring (2000 to 2020)
Annual Average (µg/m³)
20
18
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
1997 NAAQS
2012 NAAQS
Chautauqua


Fine Particulate Matter ($PM_{2.5}$) Historical Monitoring (2000 to 2020)
Annual Average (µg/m³)
20
18
16
14
12
10
8
6
4
2
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
1997 NAAQS
2012 NAAQS
Erie

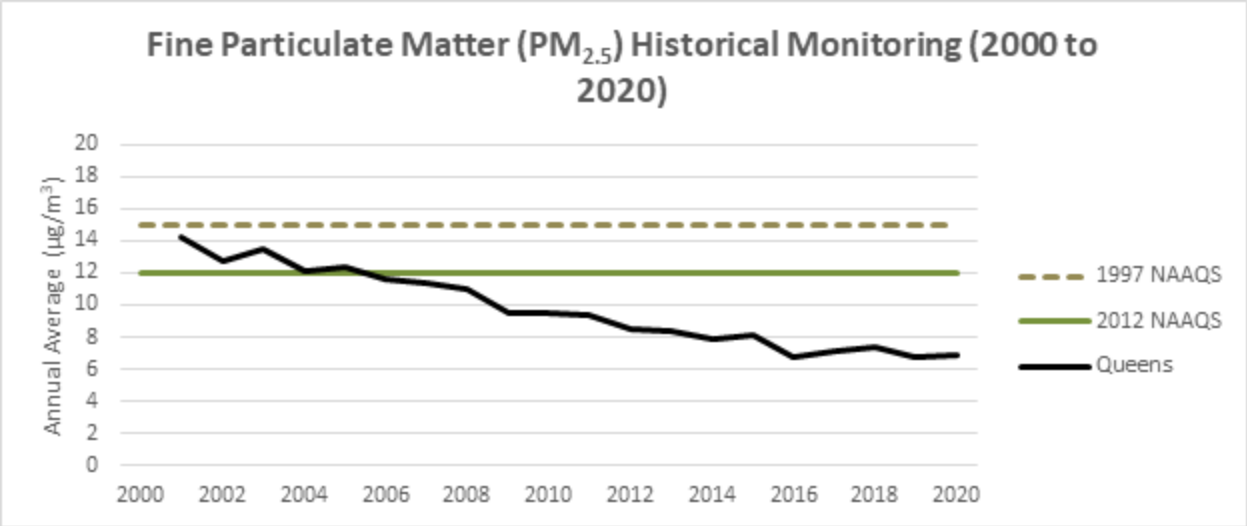
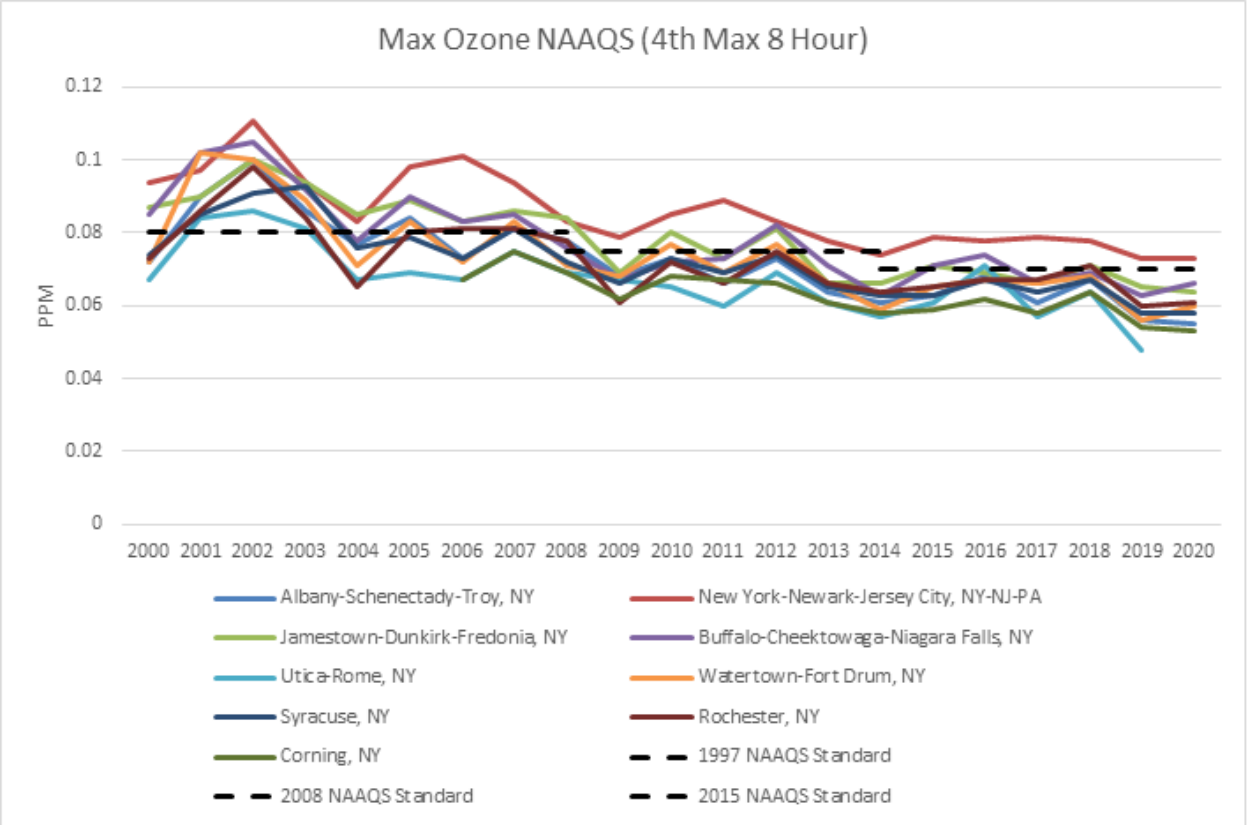



Figure F-2. Ozone Historical Monitoring (2000-2020)




*Note: The design value monitor for the NY-NJ-CT nonattainment area is in CT and currently has a design value of 0.082 parts per million.*

Figure F-3. Total Benzene Emissions in New York (2017)

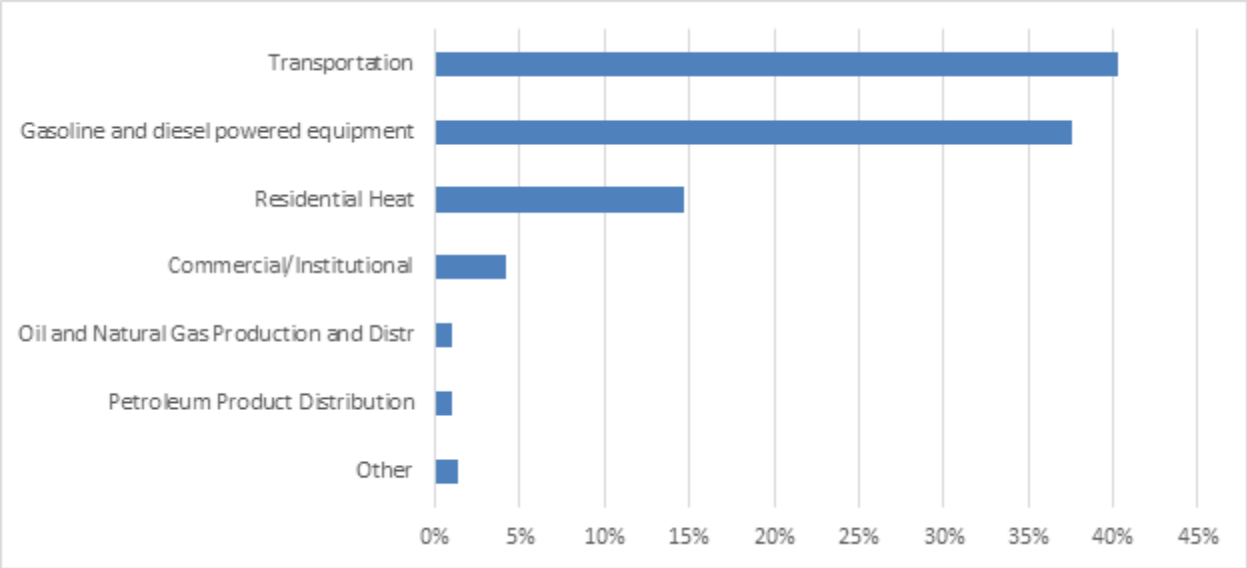
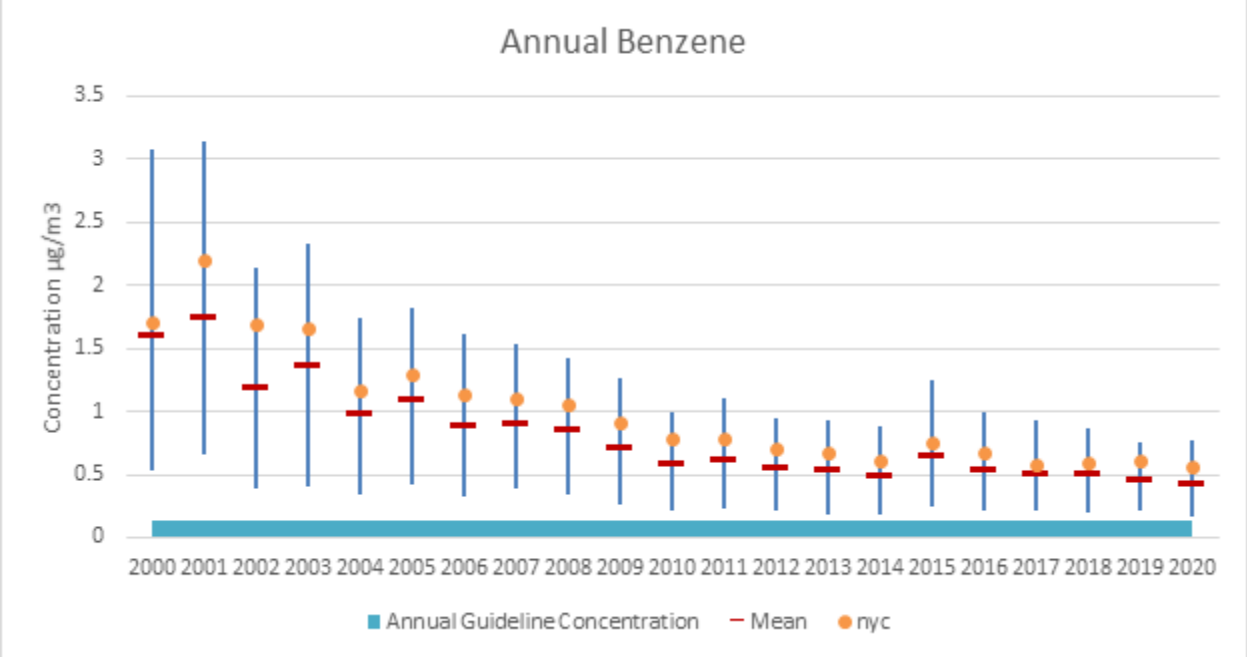



Figure F-4. Benzene Ambient Air Concentration in New York (2000-2020)



# Appendix G: Integration Analysis Technical Supplement

## New York State Climate Action Council

## Draft Scoping Plan

## Integration Analysis Technical Supplement

Prepared for:


New York State Energy Research & Development Authority (NYSERDA)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**Abt Associates**

December 2021

# Abstract

This technical supplement summarizes, reports, and documents the findings, results, and methodology of the Integration Analysis developed to support the Climate Action Council in its development of the Draft Scoping Plan pursuant to the Climate Act. The Integration Analysis evaluates strategies to achieve the Greenhouse Gas (GHG) mitigation aims of the Climate Act and assesses the resulting benefits and costs. Benefits of avoided GHG are assessed based on Value of Carbon Guidance developed by the New York State Department of Environmental Conservation (DEC) pursuant to the Climate Act. Additional public health benefits were assessed, as well as societal costs.

The technical supplement is organized as follows:

Section I. Techno-Economic Analysis
Section II. Health Co-Benefits Analysis

Additional data are available for download at https://climate.ny.gov/:

Annex 1. Techno-Economic Analysis Inputs and Assumptions
Annex 2. Techno-Economic Analysis Key Drivers and Outputs
Annex 3. Health Co-Benefits Analysis Supplemental Data

Section I. Techno-Economic Analysis defines the Integration Analysis scenarios, GHG mitigation pathways, and strategies across sectors. This section describes the physical basis for decarbonization and assesses societal benefits and costs. Section II. Health Co-Benefits Analysis describes the methods and results of the public health benefits analysis of the Integration Analysis scenarios. Annexes 1-3 compile a range of supplemental data.

# Acknowledgments

We would like to acknowledge the foundational contributions provided by the Climate Act Advisory Panel and Working Group members, as well as critical support provided by the members of the State staff working groups.

In addition, the New York State Energy Research and Development Authority is grateful for the technical review and valuable insights provided by the members of the Technical Advisory Group.

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Finally, The New York State Energy Research and Development Authority is grateful for the valuable technical contributions, guidance, review, and insights to the health analyses provided by the Technical Interagency Coordination Advisory Group members:

Division of Environmental Health Assessment, New York State Department of Health

Division of Air Resources, New York State Department of Environmental Conservation

Sarah Johnson, New York City Department of Health and Mental Hygiene

# Section I. Techno-Economic Analysis

This section describes the methods and results of the techno-economic analyses undertaken for New York's Pathways Integration Analysis. Supplemental data can be found in the annexes to this document.

## Contents

# List of Figures

# List of Tables

# Acronyms and Abbreviations

| | |
|---|---|
| AEO | Annual Energy Outlook |
| AR4 | Fourth Assessment Report |
| AR5 | Fifth Assessment Report |
| ASHP | Air source heat pump |
| Btu | British thermal unit |
| CCS | Carbon capture and storage |
| $CH_4$ | Methane |
| CJWG | Climate Justice Working Group |
| Climate Act | Climate Leadership and Community Protection Act |
| CNG | Compressed natural gas |
| $CO_2$ | Carbon dioxide |
| $CO_2e$ | Carbon dioxide equivalent |
| COBRA | CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool |
| DEC | New York State Department of Environmental Conservation |
| DOE | Department of Energy |
| DOT | New York State Department of Transportation |
| EIA | Energy Information Administration |
| FHWA | Federal Highway Administration |
| g | Gram |
| GHG | Greenhouse gas |
| GSHP | Ground source heat pump |
| GSP | Gross state product |
| GW | Gigawatt |
| GWh | Gigawatt-hour |
| IPCC | Intergovernmental Panel on Climate Change |
| MMBtu | Million British thermal units |
| MMT | Million metric ton |
| MW | Megawatt |
| MWh | Megawatt-hour |
| NET | Negative emissions technologies |
| NPV | Net present value |
| NYC | New York City |
| NYISO | New York Independent System Operator |
| NYS | New York State |
| NYSERDA | New York State Energy Research & Development Authority |
| SEDS | State Energy Data System |
| TBtu | Trillion British thermal units |
| ZEV | Zero emission vehicle |
| VMT | Vehicle miles traveled |

## Summary

The initial results of the Draft Scoping Plan integration analysis show that achieving the emissions reductions limits in the Climate Leadership and Community Protection Act (Climate Act) will require aggressive action across all sectors of New York's economy, but that the achievement of these targets is technically feasible and would have societal net benefits when accounting for avoided GHG emissions and the health benefits of reduced fuel combustion.

**Figure 1. Gross Greenhouse Gas Emissions by Scenario**

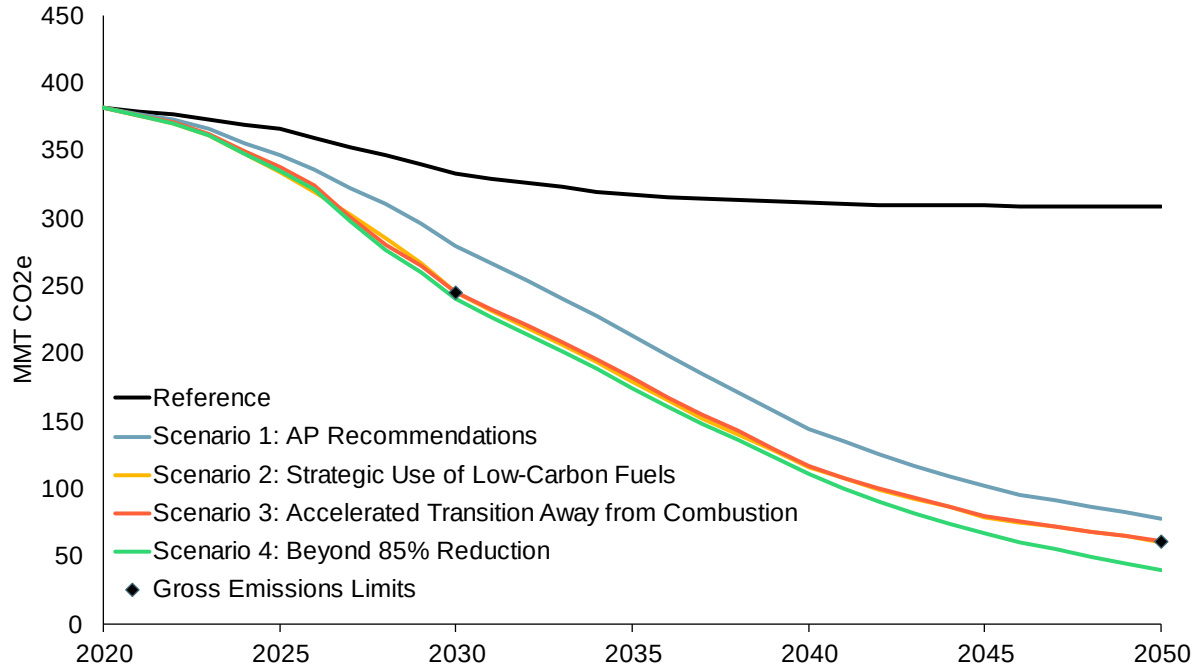
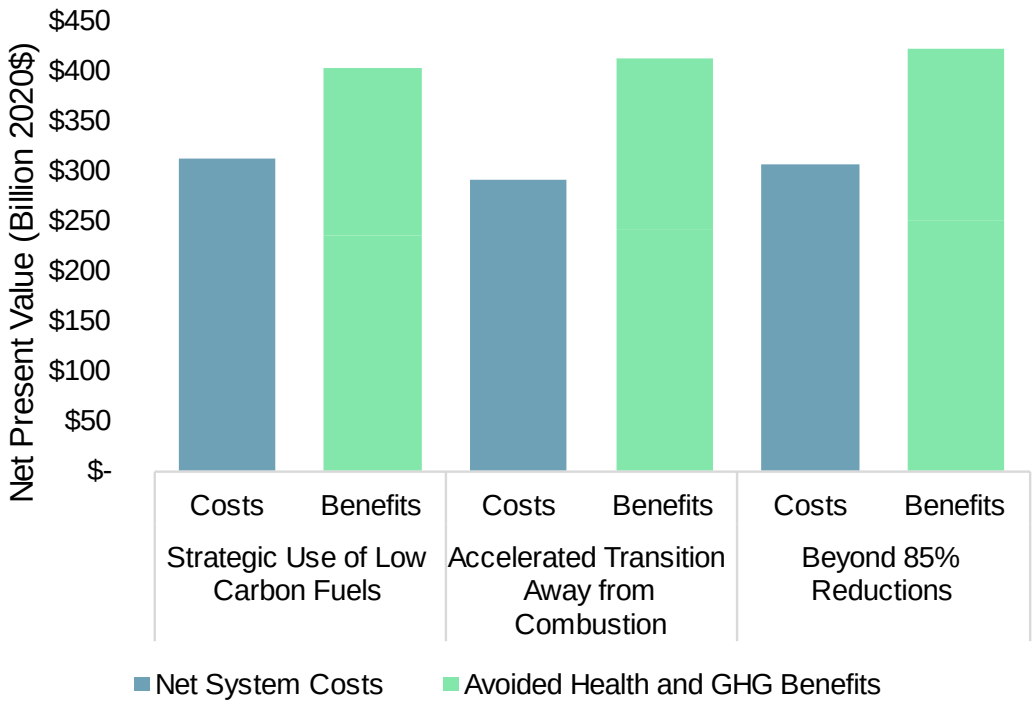



Figure 1 above shows gross GHG emissions over time in New York for the five core scenarios modeled in the integration analysis. While emissions are projected to slightly decline in the Reference case (which demonstrates how existing policies and programs have decoupled GHG emissions from economic growth in New York), significant additional reductions would be achieved by implementing the recommendations of the Climate Action Council Advisory Panels (Scenario 1: AP Recommendations). However, further action is still needed to achieve the Climate Act gross emissions limits, and three additional scenarios were modeled that demonstrate various technical pathways to achieving these targets. Many of the strategies needed to achieve significant emissions reductions are common to all scenarios (e.g., aggressive energy efficiency, building and transportation electrification, decarbonized electricity), but there remains some optionality in terms of the exact level of ambition and timing that is explored by these scenarios.

**Figure 2. Net Present Value of Benefits and Costs by Scenario (2020-2050)**




Although the investments required to achieve Climate Act emissions limits are significant, they are small relative to the size of New York's economy (annual costs for Scenarios 2 through 4 are equivalent to roughly 1% of gross state product in 2050) and are outweighed by the net benefits of avoided GHG emissions, public health improvements, and reduced fuel combustion (Figure 2). Furthermore, the level of investment needed results in an increase in system spend of just 10% relative to the Reference Case. Because significant infrastructure investment will be needed to maintain business as usual infrastructure within the state irrespective of further climate policy, redirecting investment away from status quo energy expenditures and toward decarbonization is key to realizing the aims of the Climate Act. While there is significant uncertainty to any projection of energy demands, energy infrastructure turnover, and greenhouse gas emissions that extends three decades into the future, this integration analysis finds that achieving New York's aggressive emissions targets is technically achievable, and that the costs of inaction exceed the costs of mitigation across all scenarios and sensitivities.

**Key findings from the Integration Analysis:**

- **Achieving deep decarbonization is feasible by mid-century**. Achievement of emissions reductions to meet state law requires action in all sectors, especially considering New York State's novel emissions accounting. Every sector will see high levels of transformation over the next decade and beyond, requiring critical investments in New York's economy
- **Together, the benefits of avoiding economic impacts of damages caused by climate change and the improvements in public health total $400 – 420 billion**. Realizing these benefits will require an incremental investment over the 30-year transition of approximately 10 percent in additional spending, or $290 - $310 billion, in addition to redirecting the approximately $2.7 trillion in expected system spending under the reference case towards New York's low carbon future.
- **Energy efficiency and end-use electrification will be essential parts of any Pathway that hits NYS Emissions Limits**. Approximately 1 to 2 million efficient homes are electrified with heat pumps by 2030 across compliant scenarios. Approximately 3 million zero-emission vehicles (predominantly battery electric) are sold by 2030.
- **Consumer decision-making plays a large role, especially important for the purchase of new passenger vehicles and heating systems for homes and businesses through the next decade.** In all scenarios modeled, zero emission vehicles and heat pumps become the majority of new purchases by the late 2020s, and fossil-emitting cars and appliances are no longer sold after 2035.
- **New York will need to substantially reduce vehicle miles traveled while increasing transportation access**. This should include expansion of transit service structured around community needs, smart growth inclusive of equitable transit-oriented development, and transportation demand management.
- **Wind, water, and sunlight power most of New York's economy in 2050 in all Pathways**. Even with aggressively managed load, electric consumption doubles and peak nearly doubles by 2050, and NYS becomes a winter peaking system by 2035. Offshore wind on the order of 20 GW, solar on the order of 60 GW, and 4- and 8-hour battery storage on the order of 20 GW by 2050. Firm, zero-emission resources, such as green hydrogen or long-duration storage, will play an important role to ensure a reliable electricity system beyond 2040.
- **Low-carbon fuels such as bioenergy or hydrogen may play a critical role in helping to decarbonize sectors that are challenging to electrify.** By 2030, scenarios include initial market adoption of green hydrogen in the following applications: medium and heavy-duty vehicles, and high-temperature industrial. Additional promising end-use applications include district heating and non-road transportation such as aviation and rail.

- **Large-scale carbon sequestration opportunities include lands and forests and negative emissions technologies.** Protecting and growing New York's forests is required for carbon neutrality. Negative emissions technologies (e.g., direct air capture of $CO_2$) may be required if the State cannot exceed 85% direct emissions reductions. Strategic land-use planning will be essential to balance natural carbon sequestration, agriculture activities, new renewables development, and smart urban planning.
- **Necessary methane emissions mitigation in waste and agriculture will require transformative solutions.** Diversion of organic waste, capture of fugitive methane emissions are key in the waste sector. Alternative manure management and animal feeding practices will be critical in reducing methane emissions in agriculture.
- **Continued research, development, and demonstration is key to advancing a full portfolio of options.** Additional innovation will be required in areas such as carbon sequestration solutions, long-duration storage, flexible electric loads, low-GWP refrigerants, and animal feeding.
- **Although benefits and costs are in the same range across mitigation scenarios, risk levels differ by scenario**. Although all scenarios involve a high degree of transformation across strategies and sectors, very high levels of transformation increase risk of delivering GHG emission reductions. Types of risk include reliance on technologies in early stages of *development* which require substantial innovation (e.g., negative emission technologies, carbon capture and storage, advanced low-carbon fuels), reliance on widespread adoption of technologies that are in the early stages of *deployment* (e.g., zero-emission vehicles, heat pumps), and reliance on strategies that require the highest levels of transformation of social institutions and business models (e.g., land use patterns, mobility practices, waste management).

# Chapter 1. Introduction

As part of the draft Scoping Plan development, NYSERDA commissioned Energy and Environmental Economics, Inc. (E3)[1] to model technical pathways for New York to achieve the ambitious climate targets set in the Climate Act and evaluate the implications of these pathways on energy demand, GHG emissions, and benefits and costs to New York's economy. This work is referred to as the "Integration Analysis." This technical supplement provides additional detail on the modeling performed as part of the Integration Analysis. The Analytic Approach chapter provides a high-level overview of the modeling framework used for this analysis; the Results chapter provides both detailed economy-wide and sector-specific model outputs for multiple scenarios; and the Key Findings chapter summarizes the highest profile findings of the study. Finally, the Methods and Data chapter provides greater detail on the modeling methodology, input data and data sources, and scenario assumptions that were used to develop the technical pathways. The model inputs and assumptions are compiled in greater detail in Annex 1, and the key drivers of GHG emission reductions, benefits, and costs, as well as key outputs are compiled in detail in Annex 2.

# Chapter 2. Analytic Approach

The objective of the Integration Analysis is to develop GHG mitigation scenarios for this draft Scoping Plan that incorporate the information utilized by the Council in developing this draft Plan, including Advisory Panel and Working Group recommendations and input, capture and account for how strategies interact across sectors, and evaluate benefits and costs of a suite of strategies. The Integration Analysis is built within the New York Pathways model,[2] which is a multi-model framework that includes a representation of all categories of GHG emissions in New York and takes as inputs relevant complementary analyses, including the 2021 New York Power Grid Study[3], building and transportation roadmaps, oil and gas system analysis, and refrigerant management analysis.[4] A diagram of this multi-model framework is presented in Figure 3.

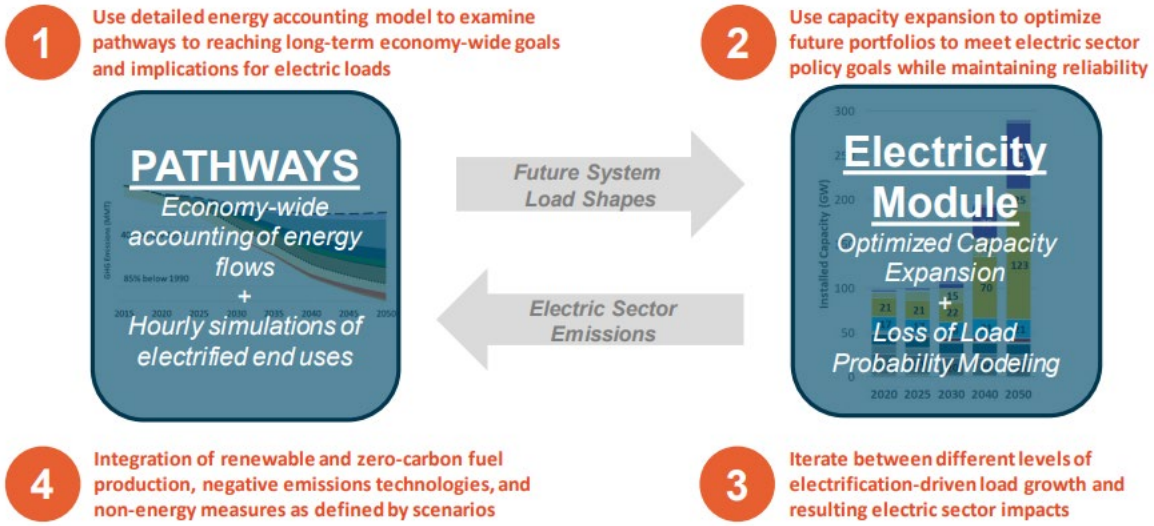
[1] For more about E3, see: www.ethree.com.

[2] The New York Pathways model was developed by E3. More detail on the NY Pathways model can be found in Chapter 5.

[3] https://www.nyserda.ny.gov/About/Publications/New-York-Power-Grid-Study, accessed January 2021

[4] NYSERDA conducts research and analysis to support the development and improvement of the statewide Greenhouse Gas Emissions Report, statewide planning and policy development, implementation of the Climate Leadership and Community Protection Act, and greenhouse gas emissions mitigation. Relevant studies produced with this research and analysis can be found here: https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions

**Figure 3. Economy-wide energy model linked to electricity module**




Chapter 3. For this draft Plan, the Council is including multiple modeled scenarios and seeks public feedback on the mix of strategies and level of ambition of these strategies to achieve the emissions limits. Detailed information on the proposed strategies to realize the levels of transformation included in the Integration Analysis scenarios can be found in the Sector Strategies sections of the sector chapters of this draft Plan.[5]

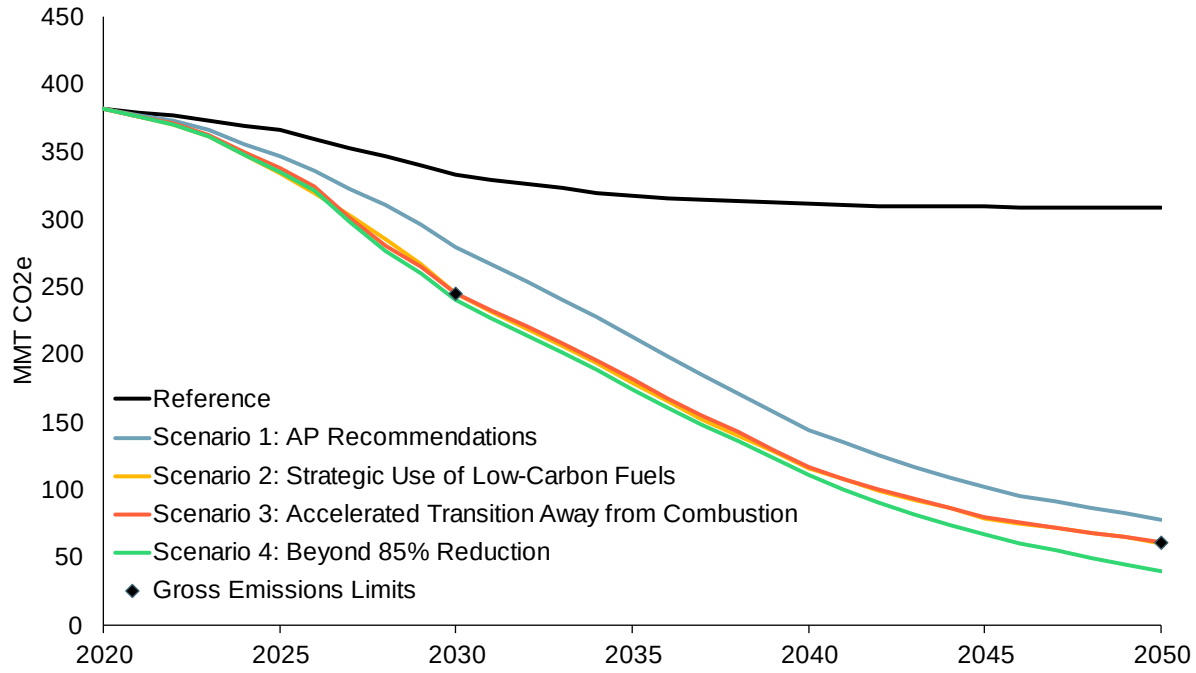
## 2.1 Scenario Design

The initial runs of the Integration Analysis evaluated a future that represents business-as-usual inclusive of implemented policies (Reference Case) and a representation of a future based on the recommendations from the Council's Advisory Panels (Scenario 1). Analytical results indicated that the Advisory Panel recommendations alone were not sufficient to achieve the Climate Act emissions limits (Figure 4). These results were presented to the Council in July 2021 and initiated a scenario design planning exercise by the Council, facilitated by the analytical team and informed by feedback from the Climate Justice Working Group (CJWG) on the advisory panel recommendations, to develop scenarios with additional emissions reductions. This exercise resulted in three additional scenarios designed to meet or exceed GHG limits

[5] See https://climate.ny.gov/

and achieve carbon neutrality (Scenarios 2 through 4). Scenarios 2, 3, and 4 all carry forward foundational themes based on findings from Advisory Panels and supporting analysis but represent different approaches based upon Council feedback and CJWG input. For more detailed scenario parameters, see Chapter 5.3. Results of Scenarios 2, 3, and 4 were presented to the Council in October - December 2021. The Council will continue deliberations on these scenarios, informed by public comment on this draft, as they work to develop the final Scoping Plan.

**Figure 4. Gross Greenhouse Gas Emissions by Mitigation Scenario**




6

- **Scenario 1: Advisory Panel Recommendations**: Representation of the Advisory Panel recommendations,[7] which provide a foundation for all scenarios through rapid electrification of buildings and transportation, decarbonization of the power sector, and ambitious reductions in non-

[6] The Reference Case is used for evaluating incremental societal costs and benefits of GHG emissions mitigation. The Reference Case includes a business as usual forecast plus implemented policies, including but not limited to federal appliance standards, energy efficiency achieved by funded programs (Housing and Community Renewal, New York Power Authority, Department of Public Service, Long Island Power Authority, NYSERDA Clean Energy Fund), funded building electrification, national Corporate Average Fuel Economy standards, a statewide Zero-emission vehicle mandate, and a statewide Clean Energy Standard including technology carveouts. For more details see Chapter 5.3.

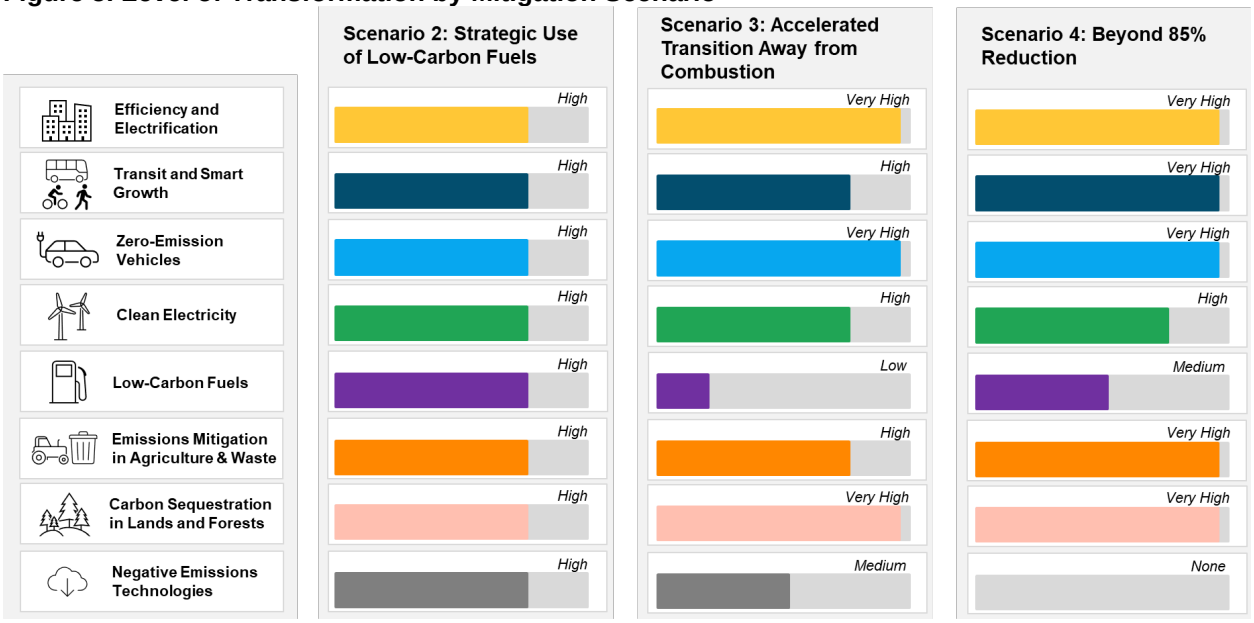
[7] More information on the relationship between the Advisory Panel recommendations and the Integration Analysis assumptions can be found in Annex 2.

combustion emissions; however, scenario modeling shows that additional effort is needed to meet Climate Act emissions limits.

- **Scenario 2: Strategic Use of Low-Carbon Fuels:** Includes the use of bioenergy derived from biogenic waste, agriculture and forest residues, and limited purpose grown biomass, as well as a critical role for green hydrogen for difficult-to-electrify applications. This scenario includes a role for negative emissions technologies to reach carbon neutrality.
- **Scenario 3: Accelerated Transition Away from Combustion:** Very limited role for bioenergy and hydrogen combustion and accelerated electrification of buildings and transportation. This scenario includes a role for negative emissions technologies to reach carbon neutrality.
- **Scenario 4: Beyond 85% Reduction:** Accelerated electrification and targeted use of low-carbon fuels. This scenario includes additional reductions in vehicle miles traveled (VMT) and innovation in methane abatement. This scenario reduces gross GHG emissions beyond the 2050 limit and avoids the need for negative emission technologies.

Figure 5 highlights the key differences in assumptions across the three scenarios that meet or achieve New York's GHG emissions limits and achieve carbon neutrality by 2050. All scenarios share common foundational themes of decarbonization, including a zero-emission power sector by 2040, enhancement and expansion of transit, rapid and widespread efficiency and electrification, electric end-use load flexibility, and methane mitigation in agriculture and waste.

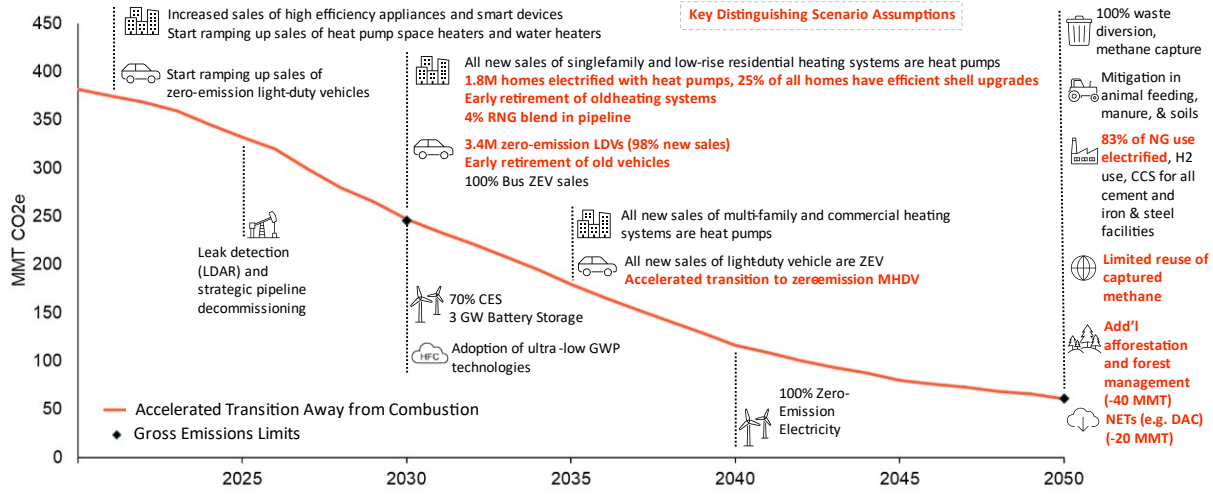
**Figure 5. Level of Transformation by Mitigation Scenario**



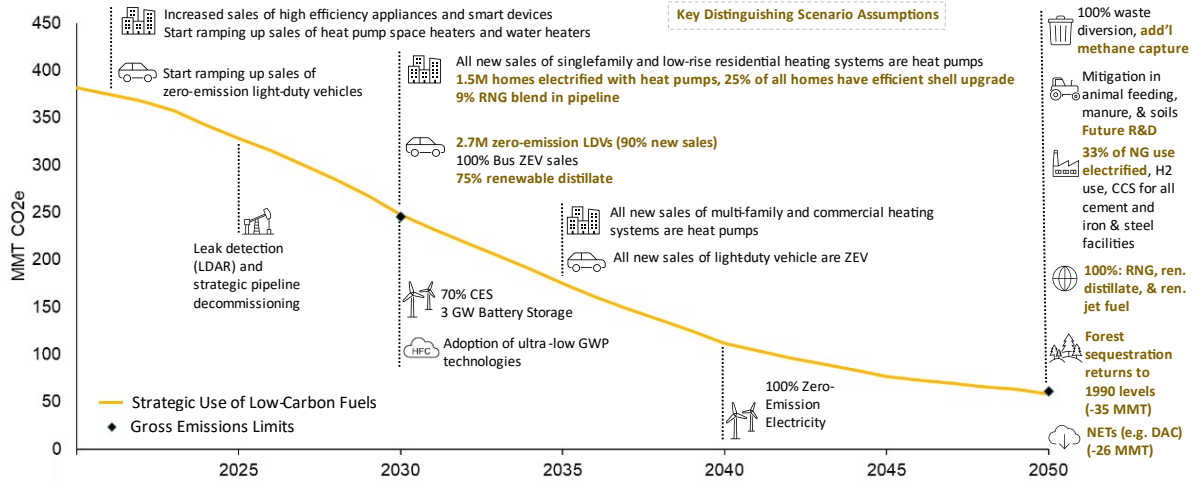

More detailed scenario assumptions are available in Chapter 3 and in Annex 2

Transformative levels of effort are required across all sectors, and scenarios include high levels of electrification including Scenario 2, which also incorporates strategic use of low-carbon fuels. Scenario 3 pushes harder on accelerated electrification to meet the emission limits using a very low-bioenergy and low-combustion mix of strategies. Scenario 4 pushes beyond 85% direct reductions in 2050 by including use of some low-carbon fuels, examining very high VMT reductions, and assuming high (but also highly uncertain) levels of innovation in the waste and agriculture sectors. Scenario 4 is the only evaluated scenario that achieves carbon neutrality without the use of negative emissions technologies like direct air capture of $CO_2$, which is also subject to high uncertainty, but is required in Scenarios 2 and 3 to address the gap between remaining gross emissions in 2050 and the ambitious assumed projections of natural sequestration. Additional documentation of scenario assumptions can be found in Chapter 3 and 5.3 but key assumptions for Scenarios 2, 3, and 4 are shown in Figure 6, Figure 7, and Figure 8. The Council expressly seeks feedback on the components of these scenarios of which detailed information can be found in the sector strategies portions of the sectoral chapters in this draft Plan.

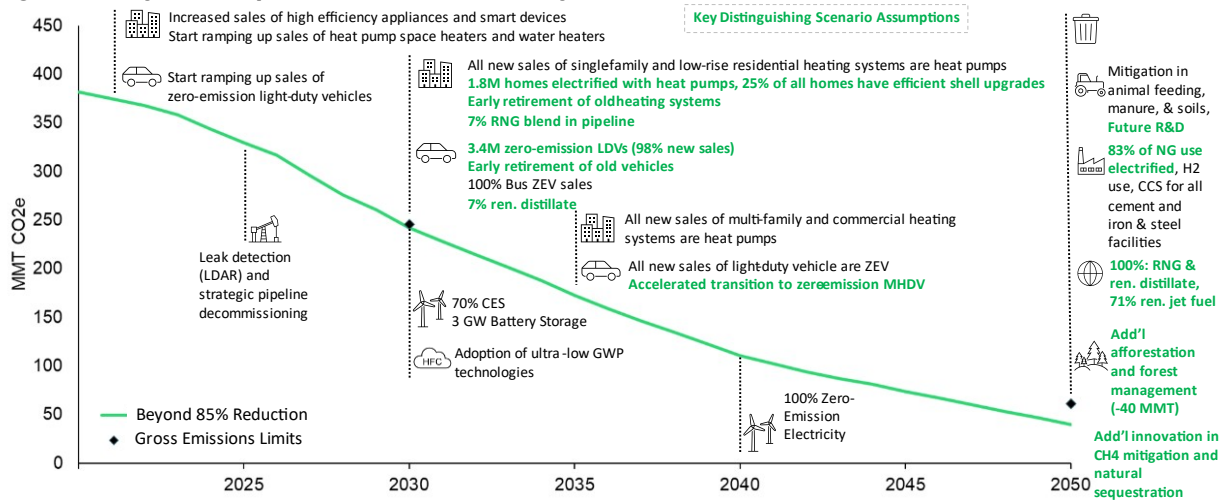
**Figure 6. Key Assumptions in Scenario 2: Strategic Use of Low-Carbon Fuels**



## Figure 7. Key Assumptions in Scenario 3: Accelerated Transition Away from Combustion




## Figure 8. Key Assumptions in Scenario 4: Beyond 85% Reduction



# Chapter 3. Results

## 3.1 Underlying Pillars of Decarbonization

New York's transition to net-zero emissions by 2050 in Scenarios 2 through 4 can be observed through key sustainability metrics that account for the expected changes in New York's population and economy over this period. Even in the Reference scenario, final energy demand and GHG emissions are expected to decline even as population and gross state product (GSP) grow at 0.2%/year and 1.9%/year. However, as shown in Figure 10 and Figure 11, the transformational mitigation measures implemented in Scenarios 2 through 4 lead to final energy intensity and GHG emissions intensity declining much sooner and much farther than in the Reference Case.

**Figure 9. Statewide Population and Gross State Product (GSP) Forecasts**

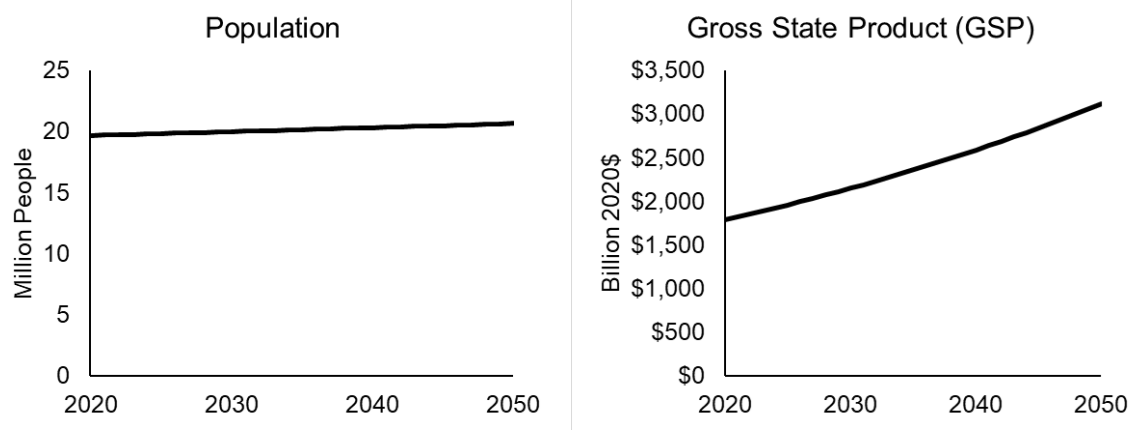



**Figure 10. GHG Intensity per Capita and per unit of GSP by Scenario in New York**

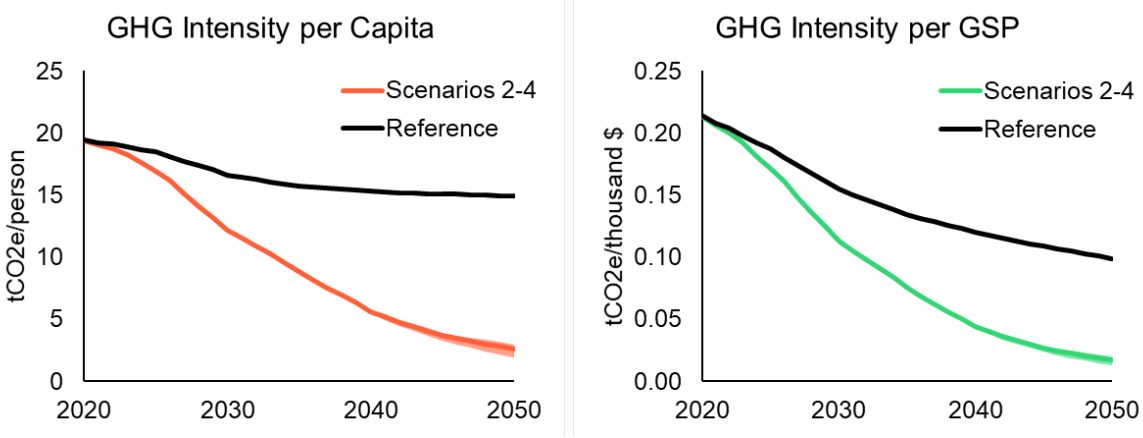
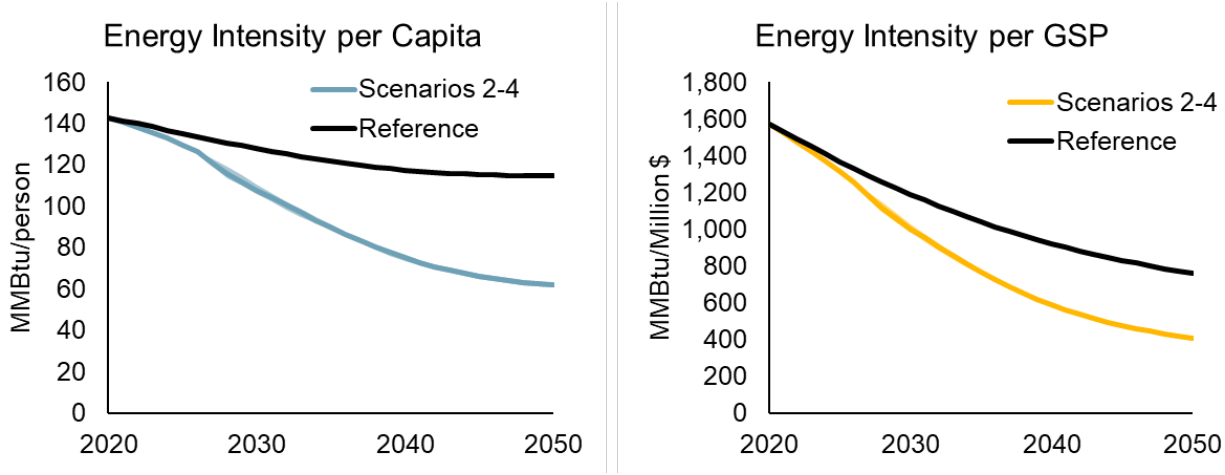


**Figure 11. Energy Use Intensity per Capita and per unit of GSP by Scenario in New York**




## 3.2 Economy-Wide Results

### *Greenhouse Gas Emissions*

Greenhouse gas emissions decline gradually in the Reference Case and decline dramatically in all other scenarios. Scenarios 2 through 4 all meet or exceed Climate Act GHG emission limits and achieve carbon neutrality by 2050 (Figure 12, Table 1, Figure 13, Figure 14)[8]. Annual GHG emissions data at the subsector level for all scenarios are reported in Annex 2.

[8] Detailed results can be found in Annex 2

**Figure 12. GHG Emissions by Mitigation Scenario**

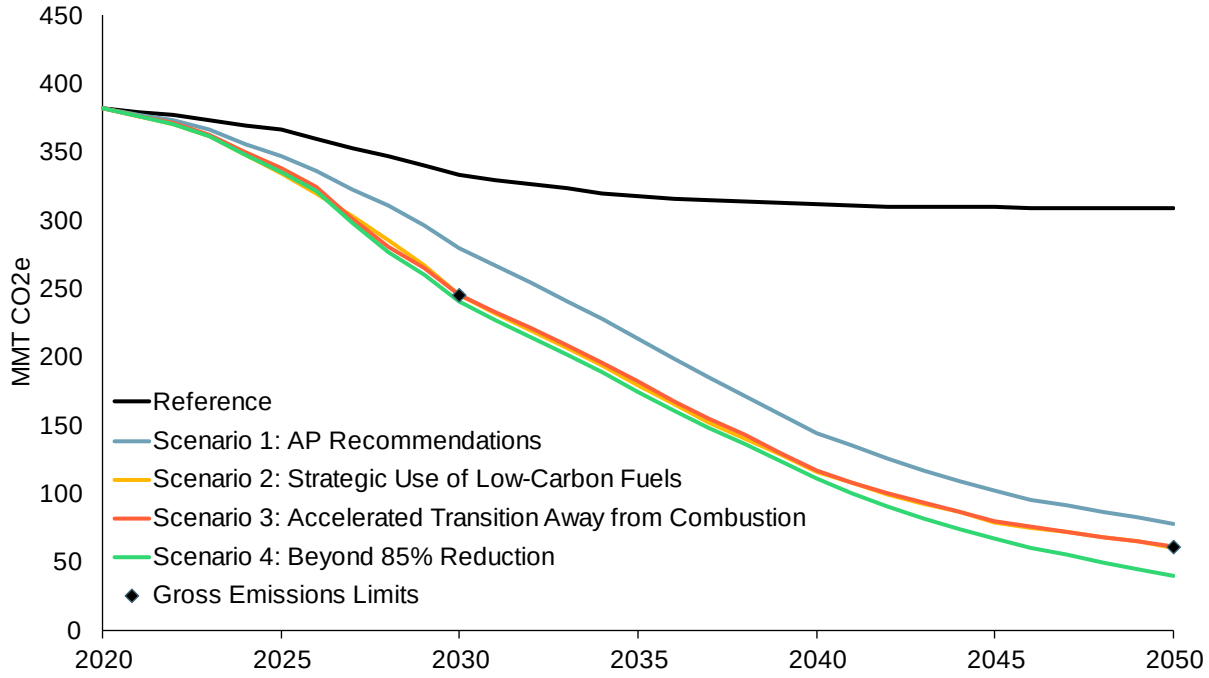



**Table 1. GHG Emissions and Percent Reductions by Scenario**

| Scenario | 2030 | 2050 |
|---|---|---|
| | MMT $CO_2E$ | MMT $CO_2e$ |
| Reference Case | 332 | 311 |
| Scenario 1: AP Recommendations | 276 | 72 |
| Scenario 2: Strategic Use of Low-Carbon Fuels | 246 | 61 |
| Scenario 3: Accelerated Transition Away from Combustion | 246 | 61 |
| Scenario 4: Beyond 85% Reductions | 242 | 40 |
| *Climate Act Gross Emissions Limits* | *246* | *61* |

**Figure 13. 2030 GHG Emissions by Scenario**

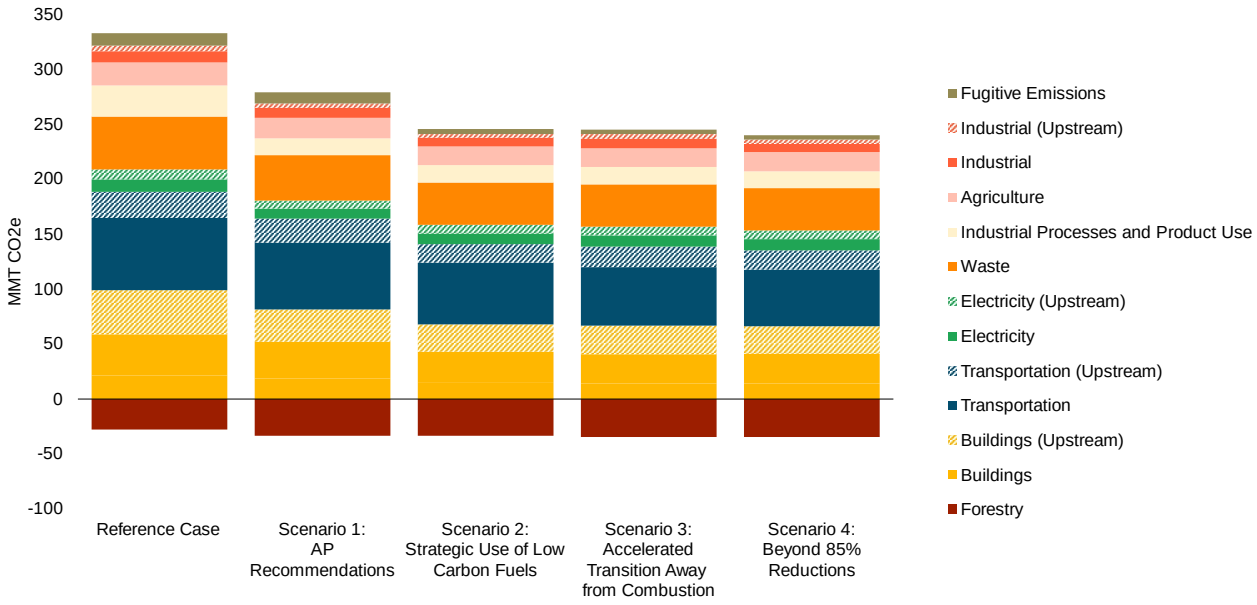
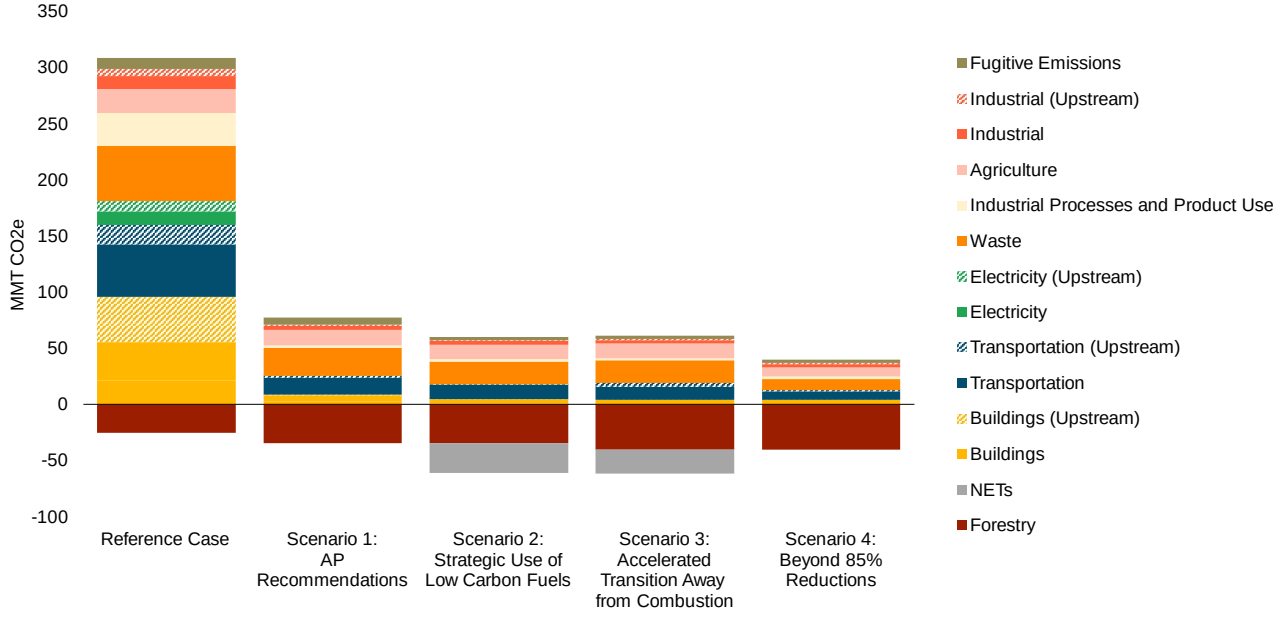



**Figure 14. 2050 GHG Emissions by Scenario**

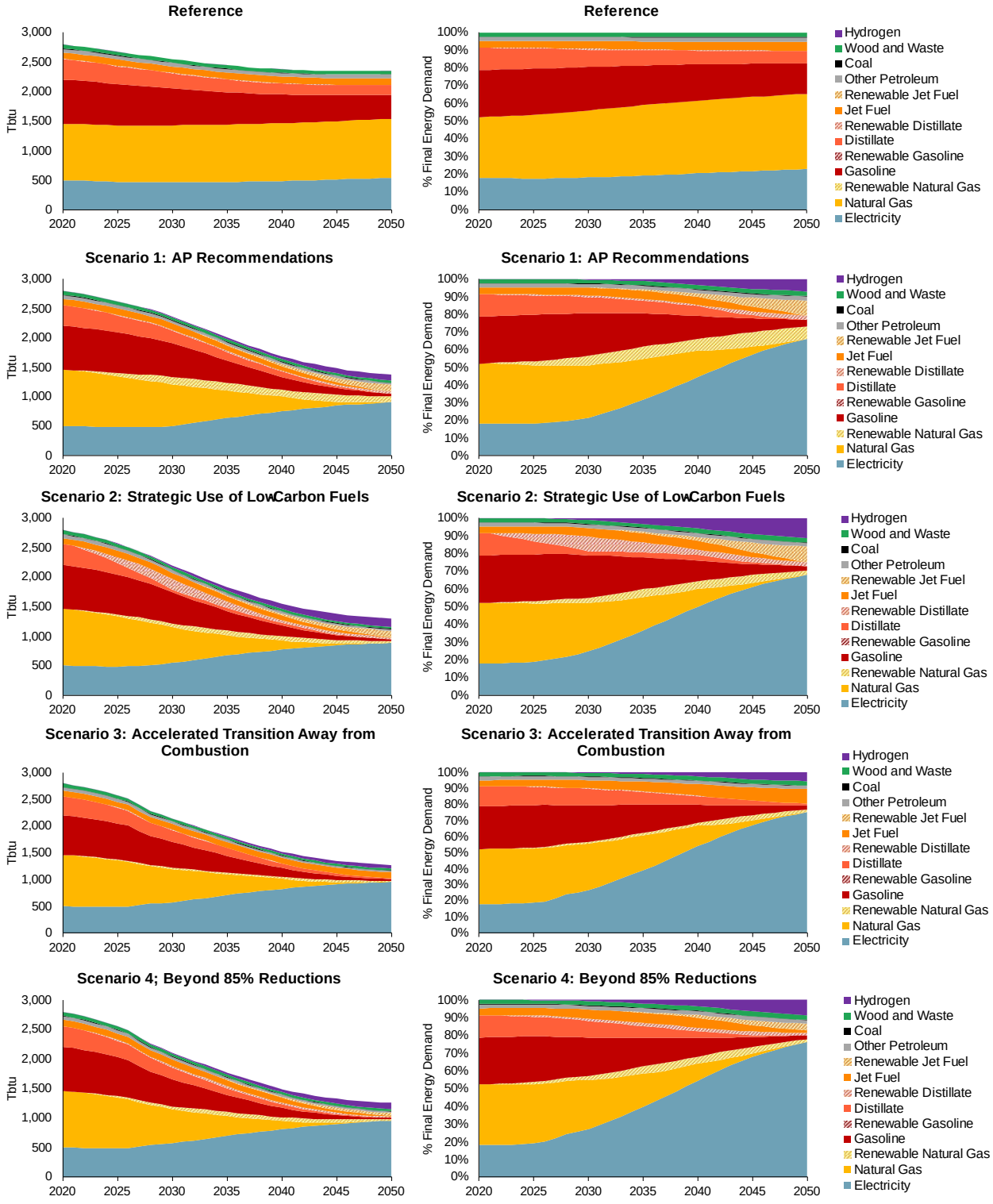


### *Final Energy Demand*

Across Scenarios 2 through 4 there is a nearly 50% decline in total final energy demand by 2050 relative to today due to efficiency and electrification measures.[9] The electricity share of final energy demand grows from less than 20% today to 68%-75% by 2050. Low-carbon fuels have a targeted role that varies by scenario, with biofuels accounting for 2-14% of final energy demand and green hydrogen accounting for 5-11% of final energy demand by 2050. After electricity and green hydrogen, jet fuel has the largest share of remaining final energy demand across scenarios in 2050. Annual final energy demand by fuel type and sector for all scenarios is reported in Annex 2.

[9] Note that while liquid and gaseous fuel use declines dramatically over the study period, reductions in wood combustion are more modest at around 40%.

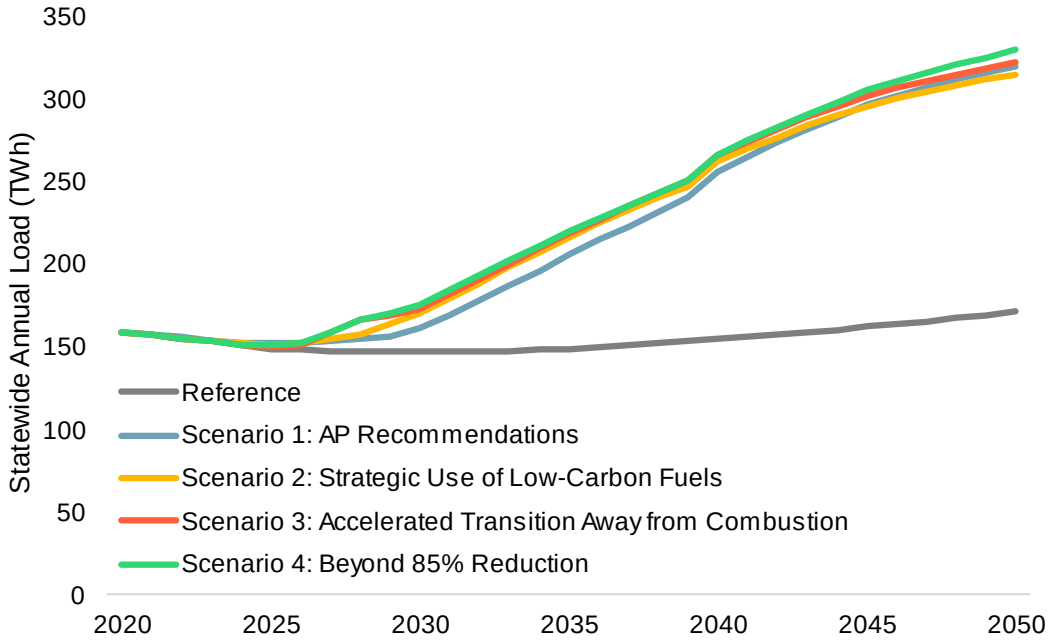
**Figure 15. Final Energy by Fuel by Scenario: Absolute (left) and % Share (right)[10]**



### *Electricity Demand*

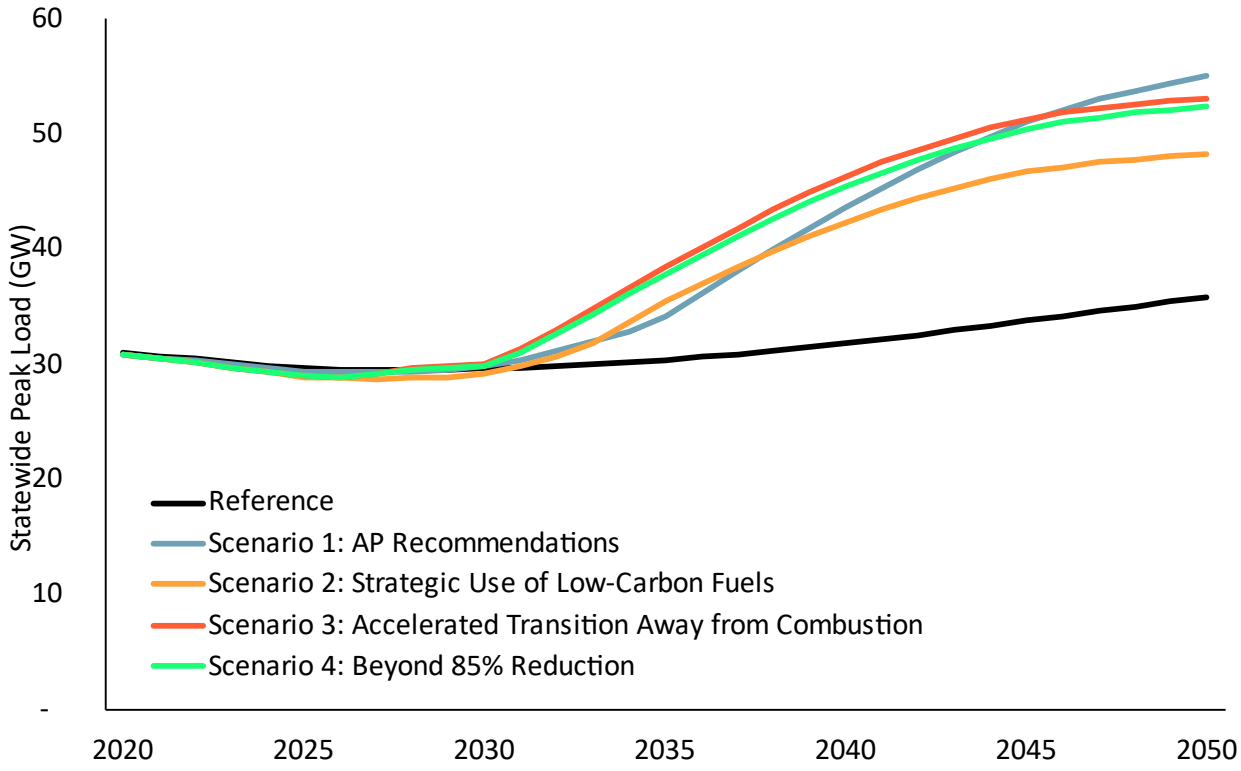
Across all pathways, clean electricity is a central pillar of New York's strategies to meet the Climate Act targets, with electricity meeting the majority of energy demand (68-76 percent) in the New York State economy by 2050. Driven by the electrification of end-uses where fossil fuels are consumed today, electricity demand is projected to double – with peak loads also nearly doubling – by 2050, even with aggressively managed loads. As building heating needs are electrified, both the magnitude and timing of electricity loads will change rapidly, and New York will transition to a winter-peaking system by 2035. The impacts of electrification-driven changes in loads on system reliability needs are described in more detail in Chapter 5. Additional electricity demand will also result from the build-out of electrolyzers necessary to supply the state with green hydrogen.

**Figure 16. Statewide Annual Electric Load[11]**




[11] This chart includes electrolysis loads to produce hydrogen, assuming that 50% of New York's hydrogen demand is produced in-state. This chart includes line losses and represents total electricity demand at the generator level. The values in this chart do not account for behind-the-meter solar resources, which are included as a source of electricity supply in this modeling.

**Figure 17. Statewide Peak Load Growth[12]**



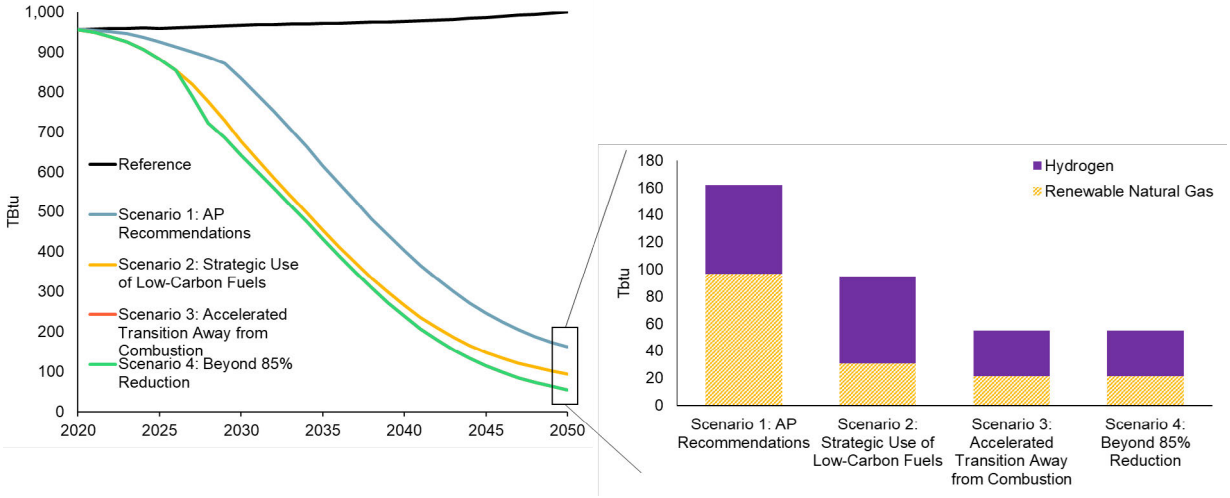

### *Gas Demand*

As New York's economy becomes more efficient and electrified, end-use gas demand declines significantly, with reductions ranging from 83-95%[13] by 2050. The small amount of remaining gas demand is entirely met with renewable natural gas and green hydrogen across all scenarios by 2050.

[12] Figure 17 represents the median (1-in-2) coincident peak for the New York Control Area. The sum of non-coincident local peaks (occurring during different hours) may be higher. The median peak was determined by assessing hourly loads over 40 years (1979-2018) of weather data.

[13] Mitigation scenarios that achieve Climate Act emissions requirements by 2050 (Scenario 2, Scenario 3, Scenario 4) achieve 90-95% reductions in end-use gas demand by 2050

**Figure 18. Annual End-Use Gas Demand by Scenario (left) and 2050 End-Use Gas Demand by Fuel (right)[14]**

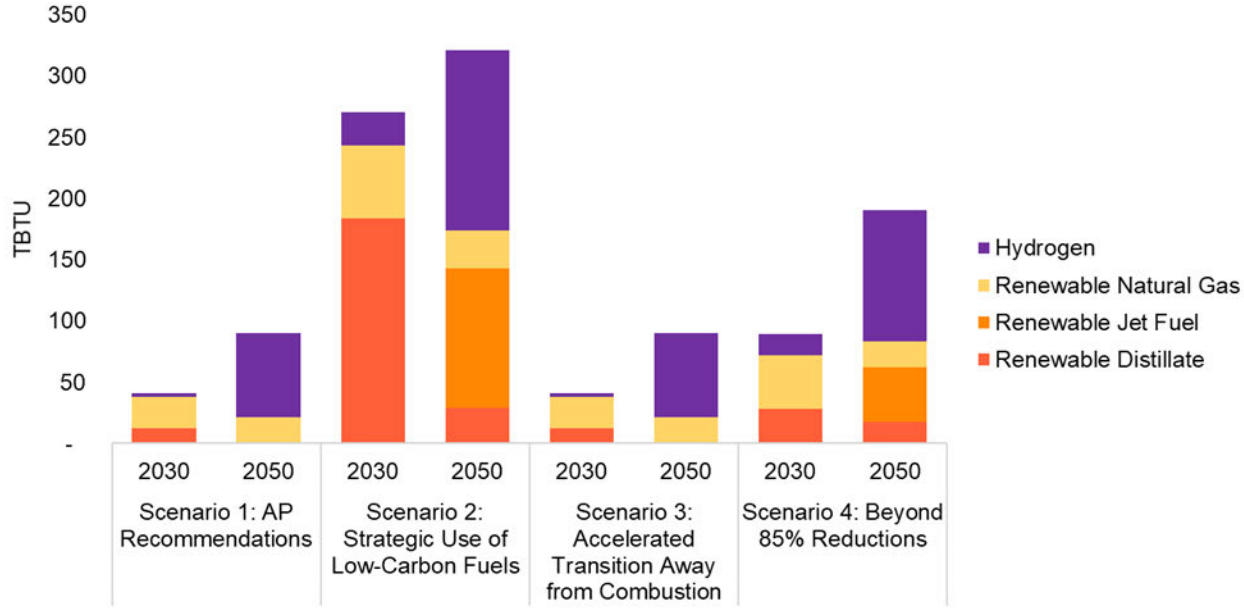



## *Low-Carbon Fuels*

All mitigation scenarios utilize a range of low-carbon fuels: renewable natural gas (RNG), renewable distillate, renewable jet fuel, and green hydrogen. The range of total demand for low-carbon fuels is approximately 50-250 TBtu in 2030 and approximately 100-300 in 2050 (Figure 19); while the Reference Case includes the use of biofuels such as wood, ethanol, and biodiesel it does not include any use of advanced low-carbon fuels such as renewable fuels or hydrogen.

[14] Includes gas demand in buildings industry, and transportation. Excludes gas burned in electric generating units and hydrogen for fuel cell vehicles

**Figure 19. Bioenergy and Green Hydrogen Utilization[15]**




Advanced biofuels are used as a drop-in replacement for existing fossil fuel demands, with allocation of feedstocks to final biofuels determined by production cost, projected fossil fuel demands, fossil fuel prices and emissions abatement potential. As a result, the allocation optimization prioritizes the production of renewable natural gas and renewable distillate first, with remaining feedstocks allocated to renewable jet fuel. Biofuel feedstock supply was sourced from the 2016 US Department of Energy (USDOE) Billion Ton Report[16], NYSERDA Potential Studies[17] [18], and input from Advisory Panel discussions with academic partners. Scenario 2 included a regional supply of wastes, residues, and purpose grown biomass (Figure 20), while Scenario 3 included only targeted in-state methane abatement (e.g. landfills), and Scenario 4 assumed an in-state supply of wastes and residues.

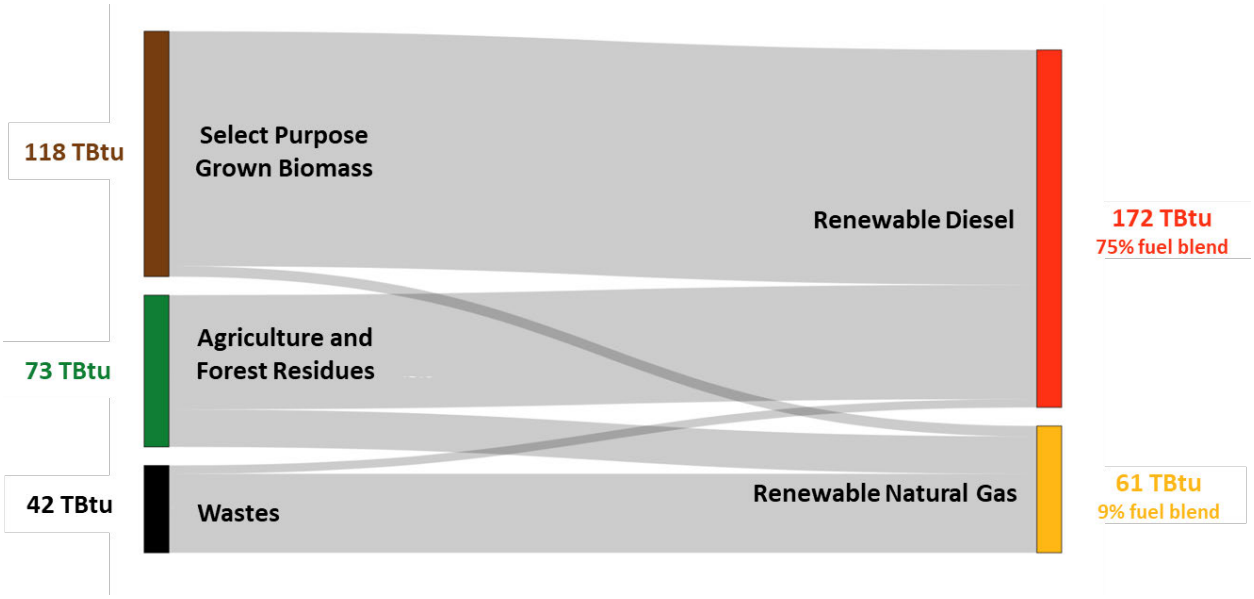
[15] Includes hydrogen demand for transportation and industry but not electricity generation. Wood continues to be used across all scenarios (~30 TBtu in 2050)

[16] https://www.energy.gov/eere/bioenergy/2016-billion-ton-report, accessed February 2021

[17] https://www.nyserda.ny.gov/about/publications/ea-reports-and-studies/eere-potential-studies, accessed February 2021

[18] https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions, accessed December 2021

**Figure 20. Bioenergy by Feedstock and Final Fuel in 2030, Scenario 2: Strategic Use of Low-Carbon Fuels**




## *Attribution Analysis*

The relative impacts of different emissions mitigation measures were explored through an attribution analysis. The attribution or "wedge" analysis models the emissions reductions that result from the implementation of specific measures, providing an understanding of the relative impact of each measure, or group of measures, on emissions. It also provides another view of key differences between scenarios.

The wedge analysis was performed by modeling sensitivity scenarios to determine the incremental emissions reduction from each set of measures. Individual wedges correspond to the emissions reduction achieved by a set of measures. Each wedge layers additional mitigation measures on top of those included in previous wedges, building to a complete view of the GHG reductions achieved in each scenario. Many measures are interactive, and so the order in which wedges are implemented impacts the emissions reductions attributed to each measure. Table 2 provides a description of the measures included in each wedge.

**Table 2. Description of Measures Included in Attribution ("Wedge") Analysis**

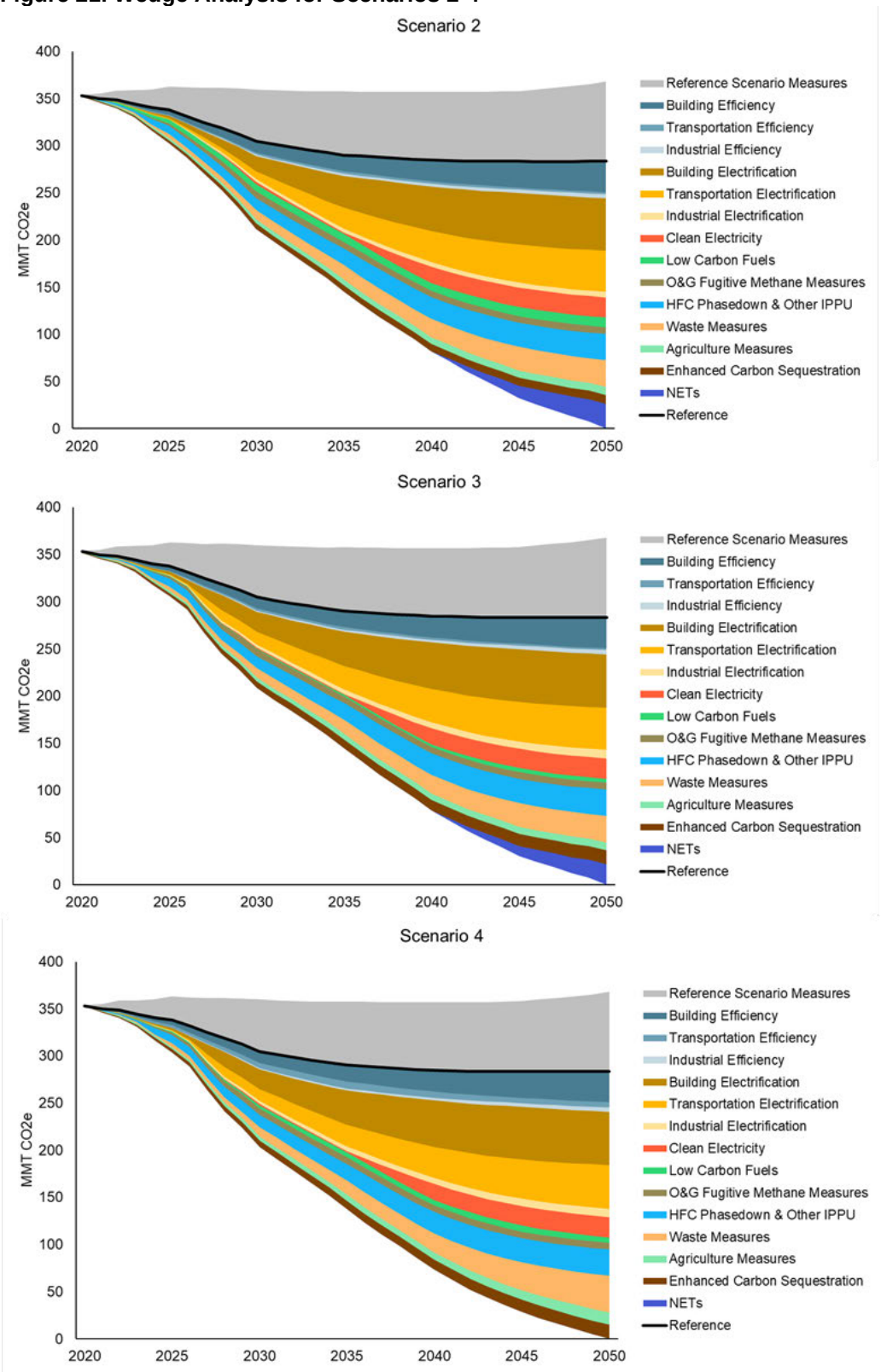
| Wedge | Description |
|---|---|
| Building Efficiency | Includes all incremental efficiency measures in the scenarios beyond New Efficiency NY policies, including efficient appliances and improved building shells. |
| Transportation Efficiency | Includes all VMT reductions relative to the Reference Case. |
| Industrial Efficiency | Includes incremental manufacturing efficiency measures beyond those identified in the 2014 NYSERDA Energy Efficiency and Renewable Energy Potential Study. |
| Building Electrification | Includes the impacts of electrifying building end uses that have existing fossil fuel use, such as space heating, water heating, cooking, and clothes drying. |
| Transportation Electrification | Includes emissions reductions from deployment of ZEVs*, as well as non-road electrification (such as rail). |
| Industrial Electrification | Includes reductions due to electrification of industrial natural gas and petroleum fuels use. |
| Clean Electricity | Includes reductions from 100x40 policy relative to 70x30, along with associated resource-specific carve-outs for offshore wind, battery storage. |
| Low Carbon Fuels | Includes reductions due to the replacement of remaining fossil fuel demand (after efficiency and electrification measures) with renewable liquid and gaseous fuels. |
| Oil & Gas Fugitive Methane | Includes reductions in fugitive methane emissions from in-state gas facilities and equipment. |
| HFC Phasedown | Includes reductions in HFCs and other IPPUs. |
| Waste | Includes reductions in methane emissions from landfills and wastewater treatment plants. |
| Agricultural Measures | Includes all reductions in agriculture emissions, such as from animals and soils. |
| Enhanced Carbon Sequestration | Includes all reductions from increased carbon sequestration in lands and forests, relative to those included in the Reference Case. |
| Negative Emissions Technologies (NETs) | Includes all reductions from NETs (modeled as direct air capture [DAC]) |

**Hydrogen fuel cell vehicles included with ZEVs in Transportation Electrification wedge as policies driving ZEV adoption would lead to the same direct emissions reductions regardless of ZEV technology and to make a distinction between hydrogen use for fuel cell vehicles, where the motor is ultimately powered by electricity, and hydrogen combustion used as a direct replacement for natural gas*

Figure 21 shows the results of the attribution analysis. Wedges are layered from top to bottom, so the first set of measures considered are the efficiency measures, and the last measures are carbon sequestration and negative emission technologies. In all scenarios, the largest reductions are achieved through building and transportation electrification. Because of the extremely clean power sector in New York, even in the Reference Case, electrification of fossil fuel consuming devices has a large GHG reduction benefit, both due to increased efficiency of electric devices and due to a fuel switch from fossil combustion to relatively clean electric generation. Even in Scenario 2, the reductions achieved by low carbon fuels are relatively small, due to the treatment of low-carbon fuels in the Climate Act gross emissions accounting framework. In Scenario 3, the electrification wedges are significantly larger in the 2025-2030 period than

in Scenario 2, which reflects the early retirement of fossil fuel consuming devices that enables greater reductions before 2030. In Scenario 3, the increased reductions from carbon sequestration allow for a reduction in required NETs to reach net zero emissions in 2050. In Scenario 4, incremental emissions reductions due to hydrogen aviation, smart growth, and intra-state rail increase the size of the electrification and efficiency wedges, while additional agriculture and waste mitigation increase the size of the agriculture and waste wedges; both of these combined result in enough emissions reductions to eliminate the need for NETs to achieve net-zero emissions by 2050. Annual emissions reductions by individual wedge for Scenarios 2-4 are reported in Annex 2.

**Figure 21. Wedge Analysis for Scenarios 2-4**



## 3.3 Sectoral Results

### *Buildings*

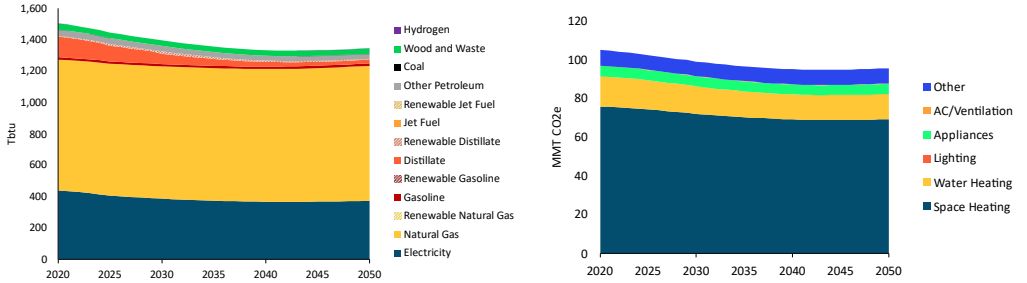
Direct emissions in the buildings sector are dominated by emissions from space and water heaters (note that indirect emissions associated with electricity generated to power electric appliances are captured under electricity generation). Although population and households are expected to grow in New York, all scenarios see a significant decline in building sector emissions through energy efficiency, rapid electrification, and improved building shells.[19]

To achieve the reductions in energy use and emissions shown in Figure 22, rapid adoption of new technologies will be required. In all scenarios, electric heat pump space heating technology systems become the majority of new purchases by the late 2020s and no fossil-emitting appliances are sold after 2035. As a result, the electricity share of final energy demand increases from 30% in 2020 to 89%-92% by 2050 across Scenarios 2-4. Base year equipment characteristics and device populations are available in Annex 1, while annual sales and stocks of devices are reported in Figure 23 and Figure 24 below as well as in Annex 2 along with annual sectoral energy demand and GHG emissions.

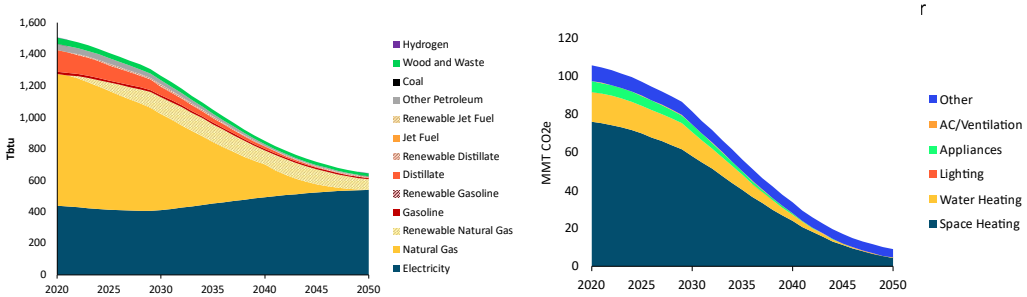
[19] Adoption of energy efficiency measures, efficient building shell measures, and heat pump systems affects all existing fuels used for primary heating in buildings (e.g., natural gas, petroleum fuels, and wood)

**Figure 22. Buildings Final Energy Demand by Fuel (left) and Emissions by Subsector (right)**

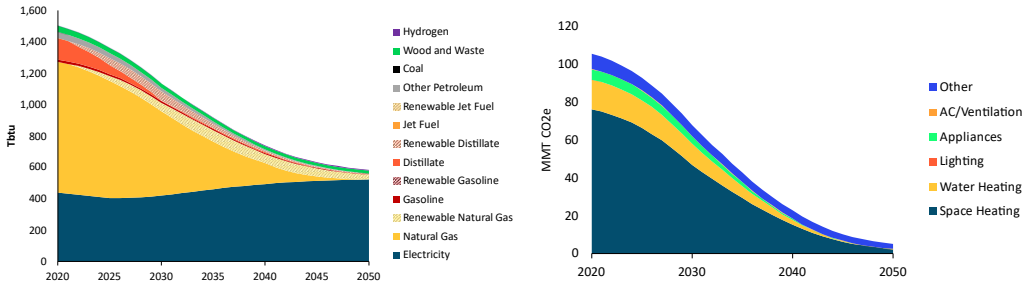
Reference



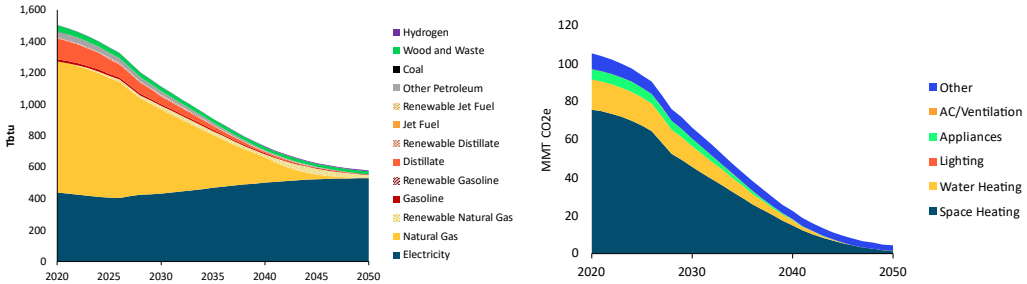

Scenario 1



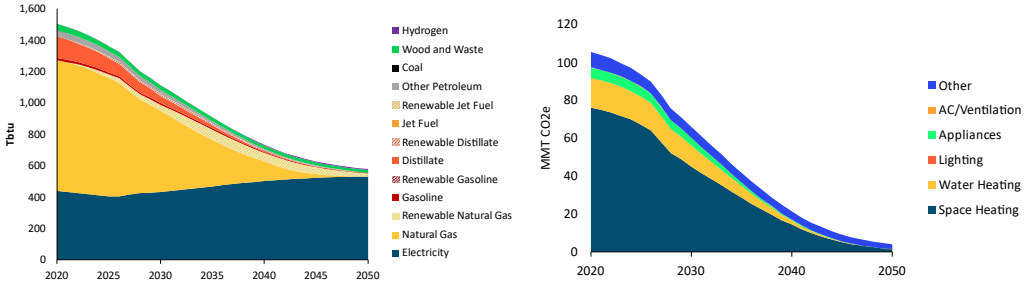

Scenario 2




Scenario 3




Scenario 4



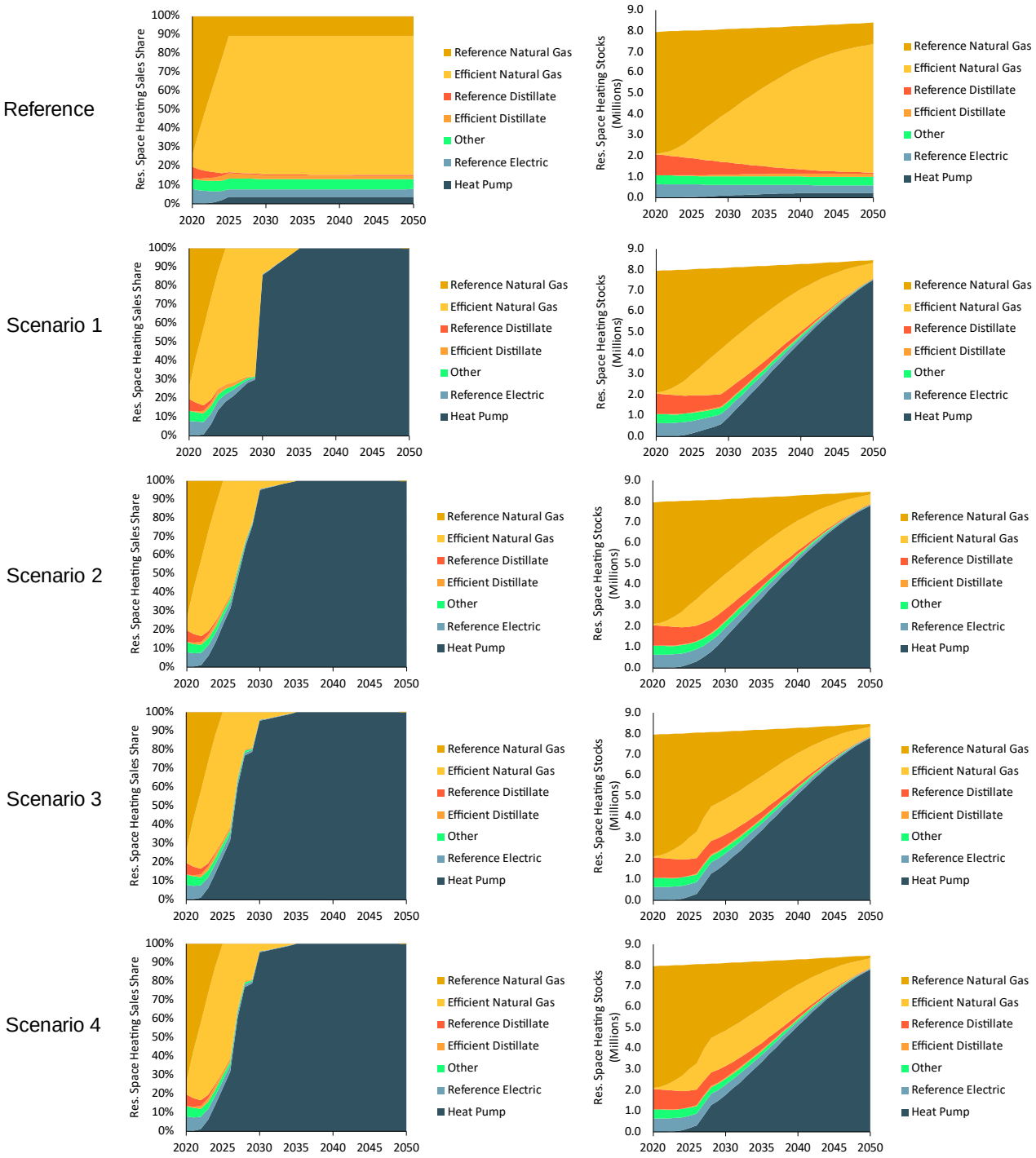
In all scenarios electric heat pump space heating technologies are predominantly cold climate air source heat pumps (ASHPs) with electric backup and a significant role for ground source heat pumps (GSHPs); ASHPs are significantly more efficient than electric resistance heaters during most heating load conditions but lose efficiency during the coldest hours of the year and require some backup heat source. ASHPs with electric backup use electric resistance as the backup heat source, resulting in increased electric system peak impacts (but generally lower than purely resistance heaters alone), whereas ASHPs with fuel backup use combustion or thermal heat sources to provide backup heat while ground source heat pumps operate with little to no performance degradation in cold conditions (Table 3). To represent a lower range of electric peak system impacts, Scenario 2 includes a small share of ASHPs with fuel backup. Scenarios 3 and 4 also include a role for early retirements of least efficient and most polluting space heaters. We also include a ground source / district heating loop sensitivity, which is described in more detail in Chapter 3.5.

**Table 3. Residential Single Family Heat Pump Annual and Peak Coefficient of Performance (COP)[20]**

| Technology | Annual COP | Peak COP |
|---|---|---|
| Air Source Heat Pump with Electric Resistance Backup | 2.41 | 1.6 |
| Air Source Heat Pump with Fuel Backup | 2.65 | n/a |
| Ground Source Heat Pump | 3.44 | 3.44 |
| Ground Source / District Loop Heat Pump Deployment Sensitivity | 3.44 [rising to 4.5 by 2030] | 3.44 [rising to 4.5 by 2030] |

[20] COP varies slightly for multi-family and commercial heating technologies, but peak to average COP relationship is consistent to the residential single family shown here

**Figure 23. New Sales Share (left) and Total Stocks (right) of Residential Space Heating Systems[21]**

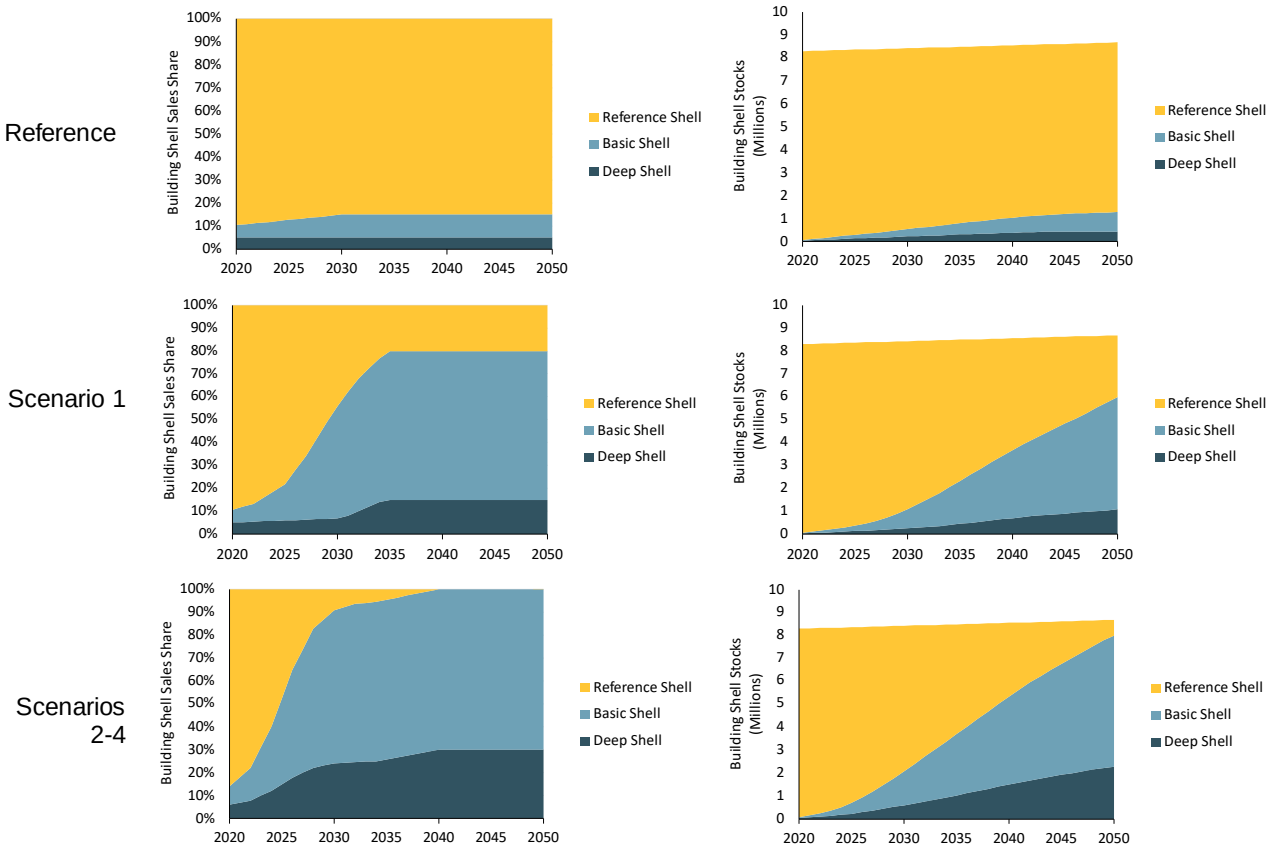



[21] Scenario 4 adoption is the same as Scenario 3

Building shell improvements (such as improved insulation, window treatments, or deep home retrofits) are modeled as reducing service demand for HVAC devices. Improvements to buildings incur costs but improve home and office comfort in addition to reducing energy bills. Two bundles of building shell improvements have been included: a basic shell upgrade and a deep shell upgrade. Basic and deep shell upgrades include a variety of measures focused on reducing energy use and increasing occupant comfort; these measures include, for example, varying levels of roof and wall insulation improvements, window treatments such as double or triple paned windows and infiltration improvements. Space heating demands are reduced by 27-44% with the basic shell package and 57-90% with the deep shell package, depending on building type. Air conditioning demands are reduced 14-27% with the basic shell package and 9-57% with the deep shell package. The total impact of building shell improvements on total HVAC service demand in buildings is a function of the market penetration of each package and distribution of building types. Building shell improvements include both retrofits and new construction, although all new construction in residential and commercial is assumed to be code-compliant and therefore has lower HVAC service demands relative to the existing building stock.[22]

[22] E3 calculated the stock rollover of building shells with a 20-year lifetime to reflect improvements in new construction and opportunities for home retrofits.

**Figure 24. New Sales Share (left) and Total Stocks (right) of Residential Building Shell**




Hydrofluorocarbon (HFCs) use has grown from near zero in 1990 to over 20 MMT $CO_2e$ in 2020, driven by the use of HFCs to replace other refrigerants (CFCs/HCFCs) over that time period. HFCs are a potent greenhouse gas but a critical part of the building electrification transition in New York. All scenarios include maximum adoption of ultra-low-GWP technologies for building, transportation, and industrial HVAC and refrigeration systems with maximum possible service reclaim at product end of life (90% recover rates).[23]

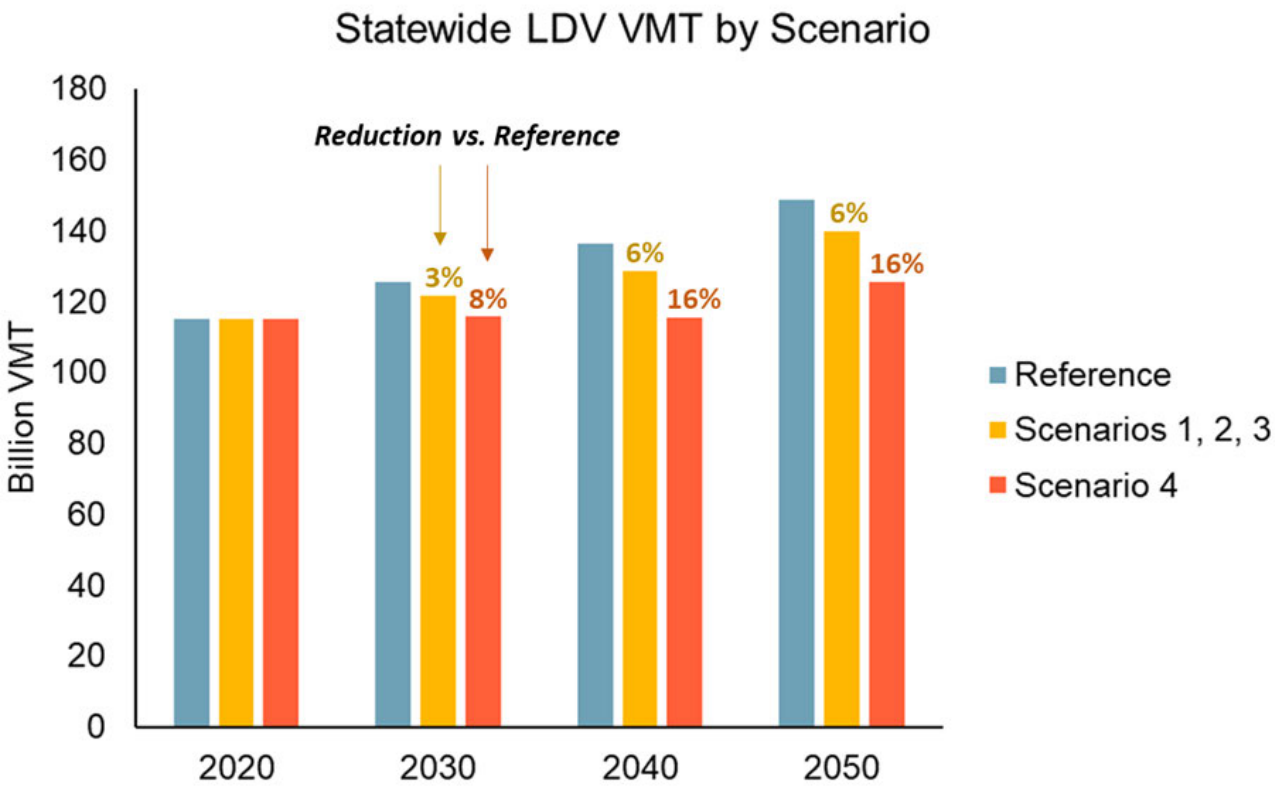
## *Transportation*

Vehicle ownership and VMT are expected to grow in all scenarios, with the highest growth occurring in the Reference Case. As shown in Figure 25 below, growth in LDV VMT in the Reference scenario, and corresponding increase in energy demand and emissions attributed to transportation, are mitigated

[23] Note that the greenhouse gas emissions associated with refrigerants are captured in the Industrial Product and Product Use (IPPU) sector, but the analysis captures interaction effects with adoption of heat pump space heating systems and adoption of refrigerant products.

somewhat by VMT-reduction measures in all mitigation scenarios. All mitigation scenarios include a key role for VMT reduction using smart growth, expanded public transit, telework and demand management programs. In addition, all scenarios include key role for zero-emission vehicle adoption, electrification of non-road sectors, and targeted low-carbon fuel use. These actions collectively reduce total final energy consumption and GHG emissions within the transportation sector (Figure 26).

**Figure 25. Statewide LDV Vehicle Miles Traveled (VMT) by Scenario**




All scenarios include a core focus on VMT-reduction due to transit, transportation demand management (TDM), telework, mixed-use development, and complete streets policies. Scenario 4 includes greater ambition in these categories, such as by including congestion pricing and other TDM policies in New York City leveraging data from the 2021 Pathways to Carbon-Neutral NYC report (Carbon Neutral NYC)[24], additional ambition in transportation-oriented development where public transit and other low or zero-carbon transportation modes like biking and walking are highly accessible, as well as strategic

[24] https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf, accessed May 2021

investments in regional rail to increase ridership and reduce statewide VMT. For more details on VMT Reductions, see Table 9 and Table 10 in Chapter 5.

To decarbonize the remaining transportation energy services demand, zero-emissions vehicles have a central role in all scenarios, with a rapid increase in customer adoption of battery electric and hydrogen fuel cell vehicles. As shown in Figure 26, the electricity share of final energy demand increases from approximately 1% in 2020 to 51%-60% by 2050 for Scenarios 2-4. Across all scenarios, sales of internal combustion engine vehicles are phased out by 2035 for light-duty vehicles and by 2045 for medium and heavy-duty vehicles. Scenario 2 includes significant vehicle electrification and a greater focus on low-carbon fuels, in particular advanced renewable diesel and renewable jet kerosene that are utilized to decarbonize trucking and aviation, respectively. Scenario 3 includes accelerated vehicle electrification relative to Scenario 2 with some early retirements of the oldest vehicles on the road. This greater pace of electrification goes in hand with greater pace of charging infrastructure investments needed to ensure New Yorkers can charge vehicles at home, at work, and using public charging points as needed. Scenario 4 includes a greater level of vehicle electrification consistent with Scenario 3, and goes further in tackling non-road emissions by including an innovation perspective on the use of electric and hydrogen aviation; Scenario 4 leverages analysis from the Transportation Roadmap which suggests feasibility of including a small role for electric aviation in decarbonizing short distance flights by 2050, and hydrogen aviation to decarbonize medium distance flights; together, hydrogen and electric aviation displace 47% of remaining aviation fuel demand in Scenario 4. Detailed annual final energy demand and GHG emissions for all scenarios are reported in Annex 2, while base year vehicle characteristics and vehicle populations are detailed in Annex 1,

**Figure 26. Transportation Final Energy Demand by Fuel (left) and Emissions by Subsector (right)**

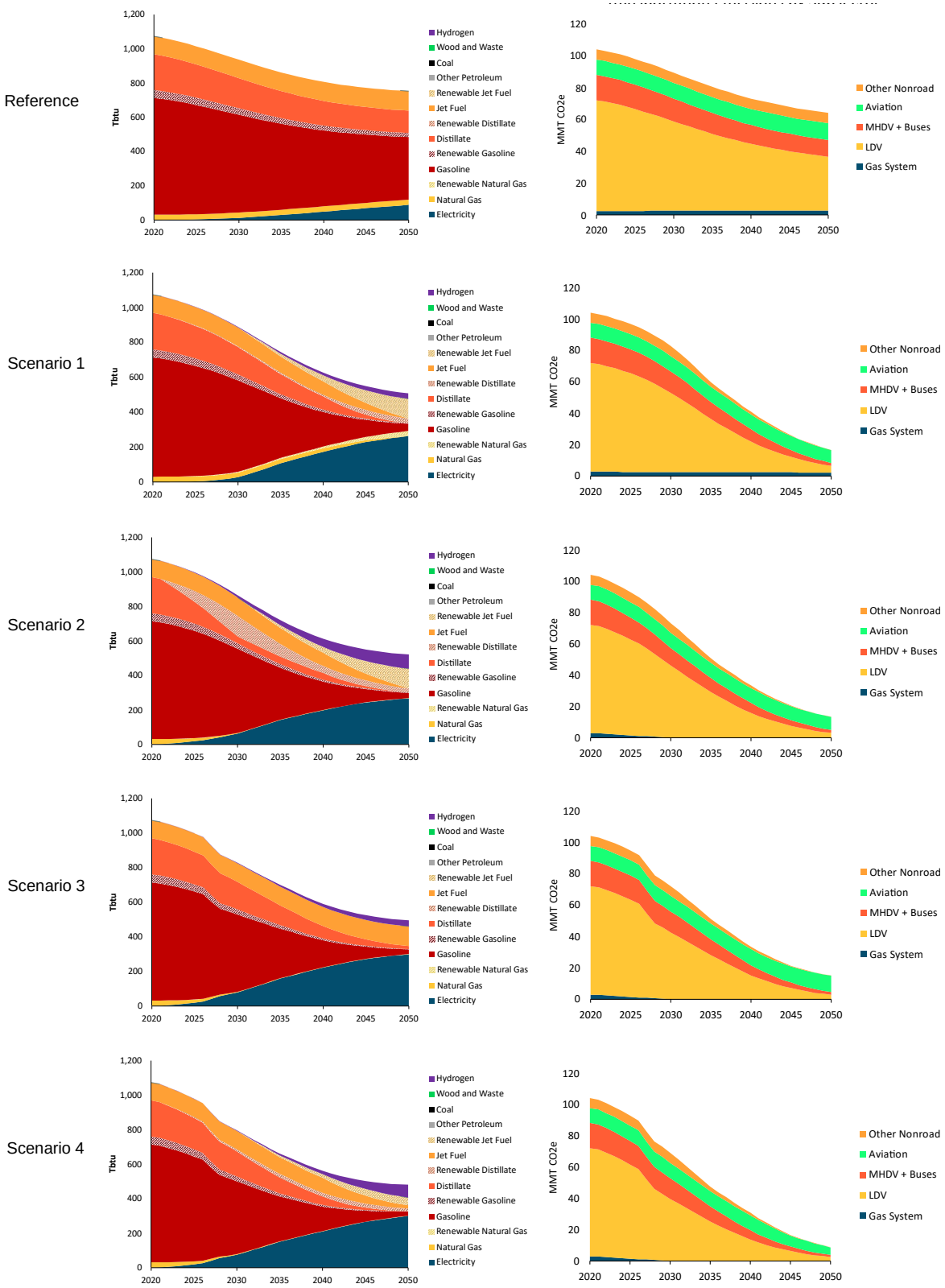
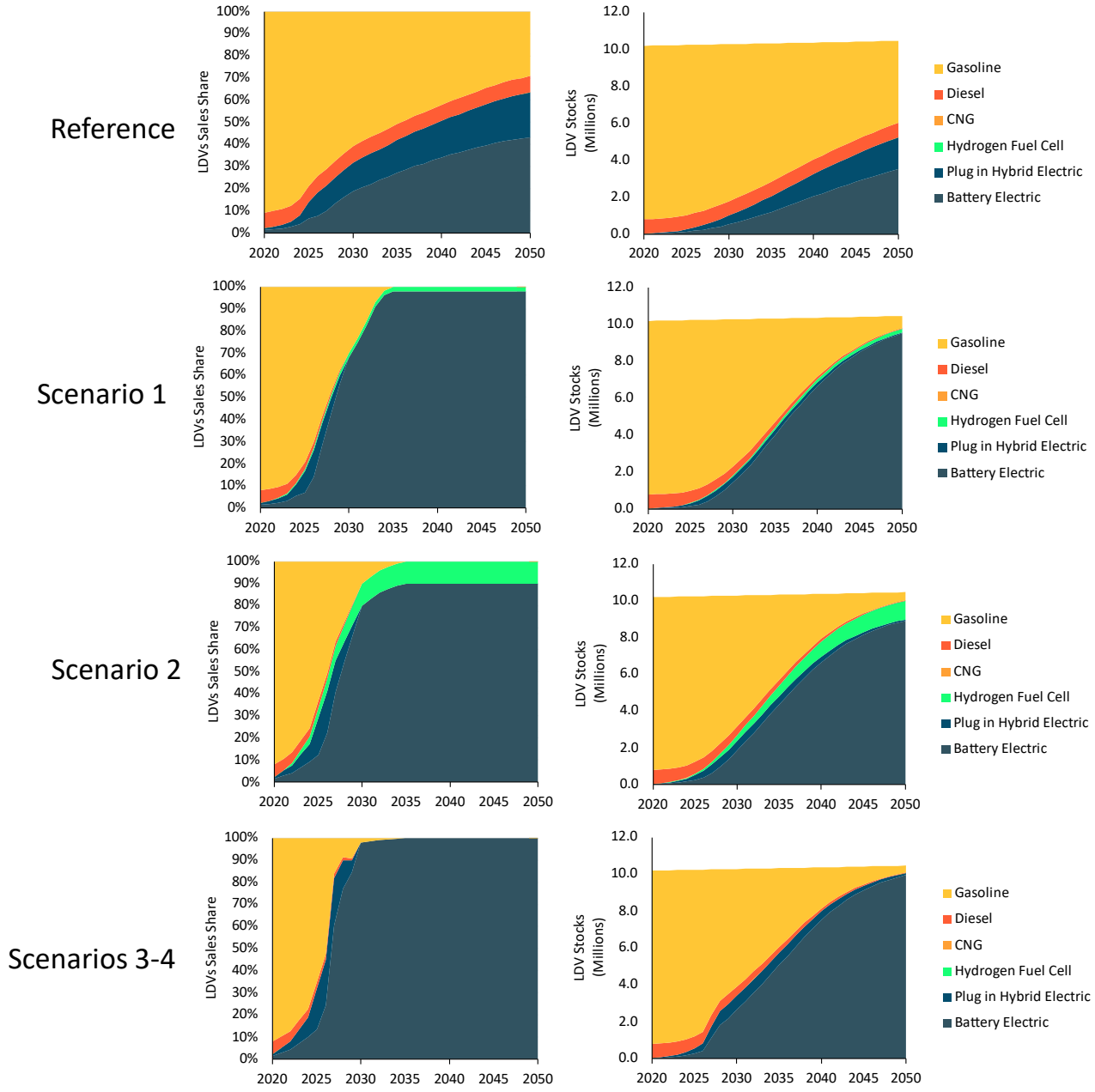
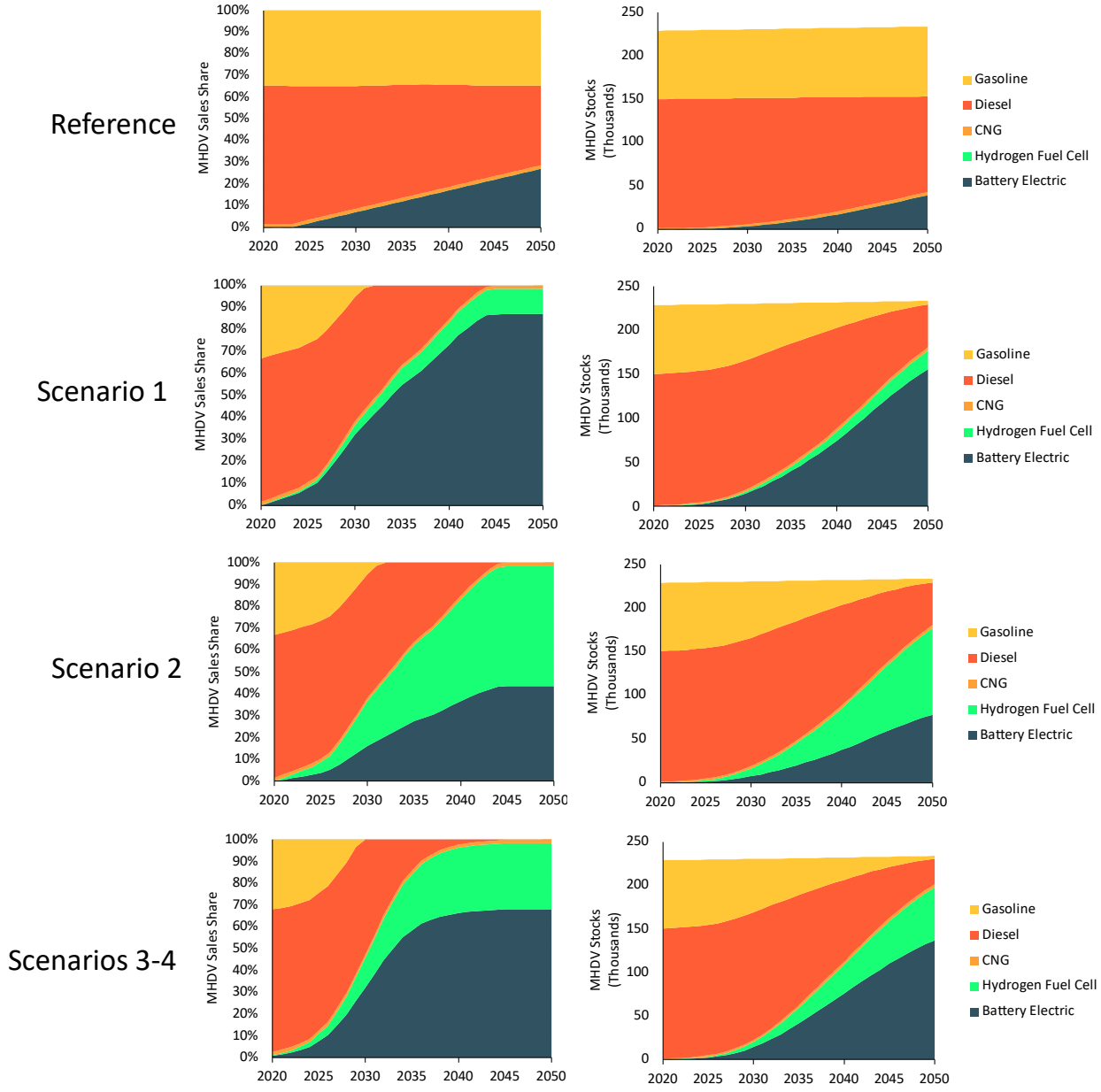


**Figure 27. New Sales Share (left) and Total Stocks (right) of Light-Duty Vehicles[25]**




[25] Scenario 4 adoption is the same as Scenario 3

**Figure 28. New Sales Share (left) and Total Stocks (right) of Medium- and Heavy-Duty Vehicles**




## *Electricity*

For electricity to become the main source of final energy for New York's carbon-neutral economy, the state must tackle a two-pronged challenge over the coming decades: (1) generation and transmission and distribution capacity must dramatically expand to reliably serve increased demand from electrification; and (2) the current mix of generating resources must transition to a carbon-free system, primarily powered by wind, water, and sunlight.

### *Energy Efficiency and Managed Electrification*

Energy efficiency and managed electrification strategies will be critical to the achievement of New York's goals. In each of the pathways modeled, New York makes significant investments in energy efficiency and pursues aggressive strategies to offset the impacts of electrification and mitigate the "peak heat" challenge.[26]

Strategies to manage the impacts of electrification can be broken into three broad categories: Managed Infrastructure, Managed Usage, and Dynamic Usage. Each strategy can play a critical role in successfully limiting growth in system peak loads.

Under the Managed Infrastructure category, all scenarios include significant investments in building shell and a diverse mix of heat pump technologies that mitigate the impacts of electrified heating. Building shell improvements play a critical role in reducing building heating needs and thus reducing the amount of electricity required to power heat pumps. The adoption of efficient heat pump technologies, such as ground-source heat pumps, as well as installation of heat pumps with fuel backup, further reduce the amount of electricity needed on the coldest days of the year, relative to air-source heat pumps with electric resistance backup. In the Transportation sector, all scenarios implicitly include the development of workplace charging infrastructure that is critical to reducing the peak impacts of electric vehicle charging. If drivers are able to plug in their vehicles while at work, then they may not need to charge for as long (or at all) when they get home each evening.

The Managed Usage category represents relatively "low-hanging fruit" to shift customer demand away from times of system peak. This analysis focused on opportunities in the Transportation sector, and all scenarios include moderate shifting of electric vehicle charging loads towards day-time and overnight charging, under an implicit assumption that there is both workplace charging infrastructure and time-of-use incentives in place.

Without investments in infrastructure and implementation of rate designs to manage the impacts of electrification, load growth and peak impacts would be substantially higher, which would in turn increase the amount of new electricity infrastructure, and associated costs, that would be required to reliably meet demand with zero-carbon generation. Analysis performed for the 2021 Carbon Neutral Buildings

[26] Peak heat refers to increases in winter peak electricity demand as a result of the electrification of building heating needs.

Roadmap found that managed infrastructure in buildings could reduce overall system peaks by up to 34%.[27]

Dynamic Usage represents more aggressive and innovative load management, in which customer demand interacts with signals from grid operators and dynamically responds to changing prices and system conditions. This type of highly flexible customer load can be particularly valuable in a highly renewable system in which static time-of-use rates may no longer accurately reflect real-time grid conditions (e.g., grid operators may want customers to shift loads to mid-day during sunny days but to evenings or mornings during windy, cloudy days). This analysis conservatively uses a central assumption that a portion of electric vehicle loads (25% of LDV loads) become capable of real-time grid interactivity, but that other end uses in buildings do not.

In this analysis, all scenarios include achievement of Managed Infrastructure and Managed Usage; sensitivity analysis was performed to explore the impacts of varying levels of Dynamic Usage. The results of the sensitivity analysis is detailed in Section 3.5.

### *Carbon-Free Electric Supply*

To meet rapidly growing electricity demand while decarbonizing electricity supply, New York must significantly expand its generation and transmission infrastructure. Coupled with New York's existing clean firm resources, all pathways require major investments in wind, solar, and battery storage, which serve as the foundational resources to achieve New York's 70x30 and 100x40 goals.

To achieve 70% renewable electricity by 2030, New York must continue to increase its Clean Energy Standard procurements for large-scale renewables, part of which involves scaling up Offshore Wind procurements on the path to the 9 GW target by 2035. Although partially offset by investments in the New Efficiency: New York program, the large increases in electricity demand by 2030 and beyond will place additional pressure on the amount of new renewable resources needed to meet and maintain the 70% target over time. Behind-the-meter solar resources play a critical role in meeting the 70x30 targets,

[27] *See* New York Carbon Neutral Buildings Roadmap, Chapter 5, https://www.nyserda.ny.gov/All-Programs/Programs/Carbon-Neutral-Buildings, accessed October 2021.

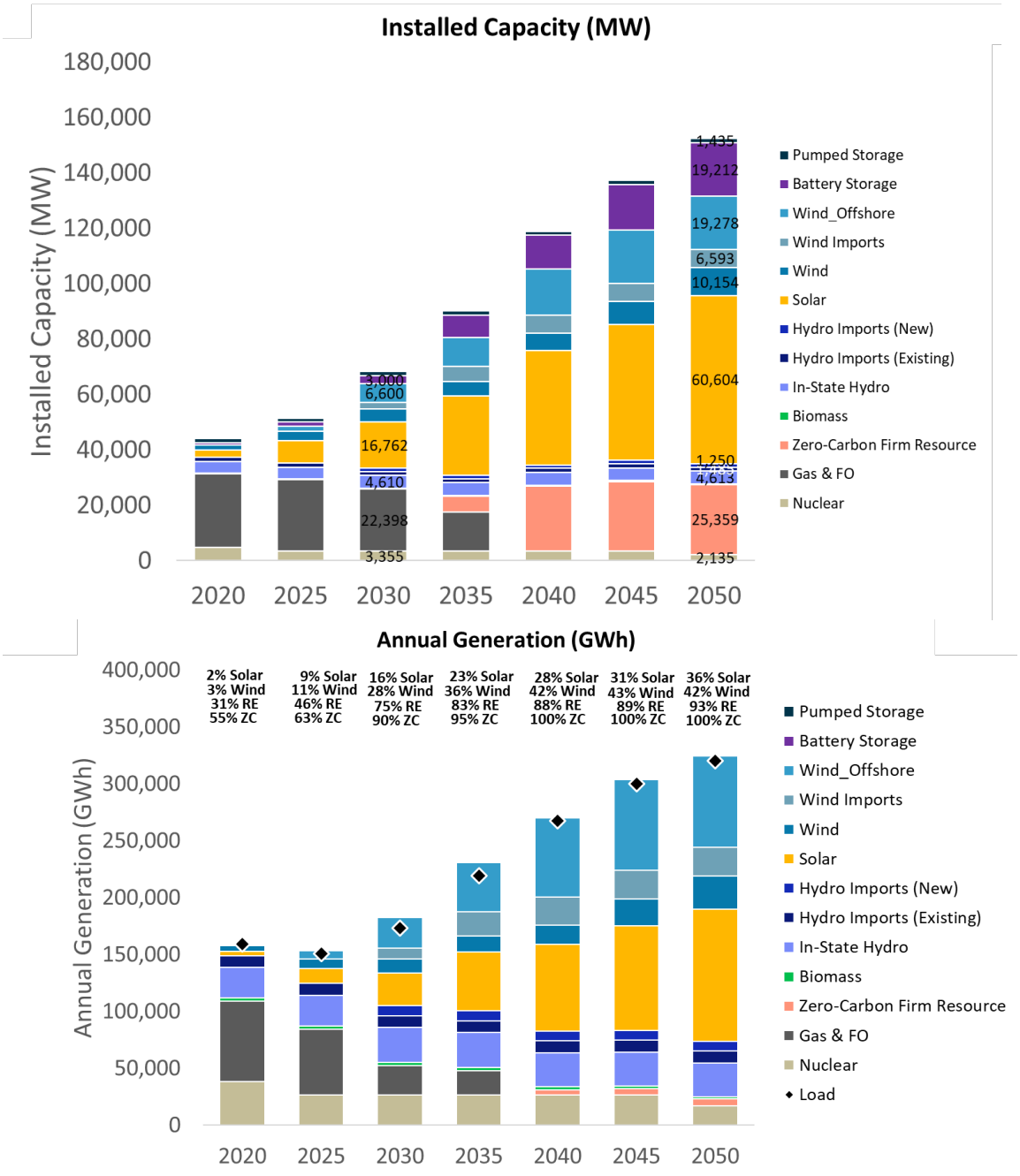
and the modeled pathways include the achievement of the recently-announced 10 GW BTM PV goal by 2030.

New transmission infrastructure is also expected to be an important part of the State's 70x30 and 100x40 goals. The pathways include the development of a 1250 MW line from Hydro-Quebec to New York City, as well as a 1300 MW line from upstate New York to New York City, both of which support the State's decarbonization efforts and in particular help reduce the need for fossil generation in Zone J. In addition to new bulk transmission infrastructure, multiple studies have found that investments in local system upgrades will be critical to reducing congestion and ensuring that new renewable generation can be delivered to load centers.[28,29] This analysis assumes that all new large-scale renewable projects are accompanied by investments in local transmission upgrades to "unbottle" renewables and ensure that new resources are fully deliverable. Between 2030 and 2050, New York must accelerate the build-out of new renewable resources to meet the 100% zero-emissions target and as electrification loads are added to the system. Figure 29 demonstrates the transformation of the New York capacity and generation mix over the 2020-2050 period.

[28] NYISO, 2019 CARIS Report, June 2020, *available at:* https://www.nyiso.com/documents/20142/13246341/2019_CARIS_Report_v20200617.pdf/fa44a341-786d-2b83-0c00-22951bb112a0, accessed December 2021

[29] New York Utilities, Utility Transmission and Distribution Investment Working Group Report, November 2020, *available at:* https://www.nyserda.ny.gov/About/Publications/New-York-Power-Grid-Study (App C), accessed December 2021

**Figure 29. Installed Capacity and Annual Generation for Scenario 3: Accelerated Transition away from Combustion[30]**




[30] In Scenario 3, the "zero-carbon firm resource" represents a combustion-free resource, and is modeled as a hydrogen fuel cell.

By 2050, across all modeled pathways, New York installs over 60 GW of solar capacity (both utility-scale and distributed resources), between 16-17 GW of new land-based wind capacity (including imported wind from neighboring ISOs), and between 16-19 GW of offshore wind resources, illustrated in Figure 30.

**Figure 30. Installed Capacity in 2050, All Scenarios[31]**

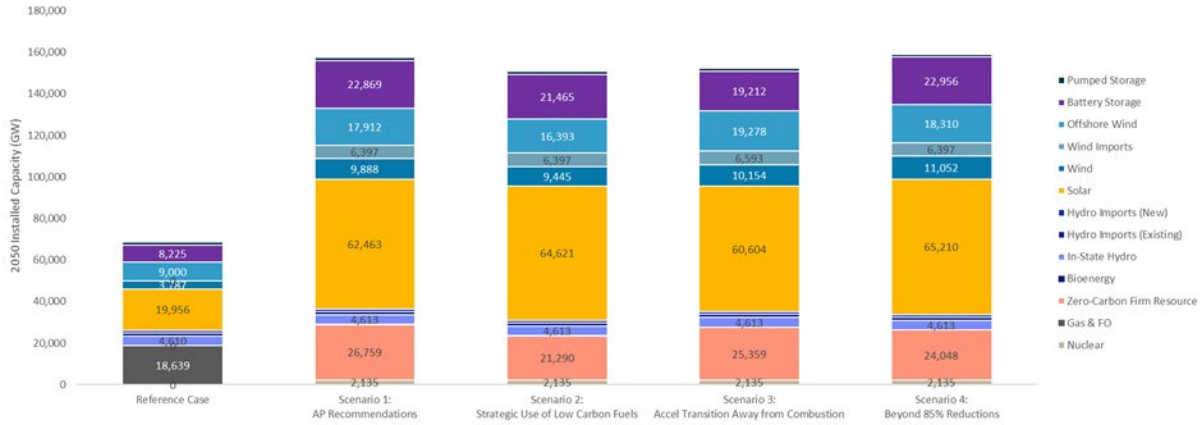
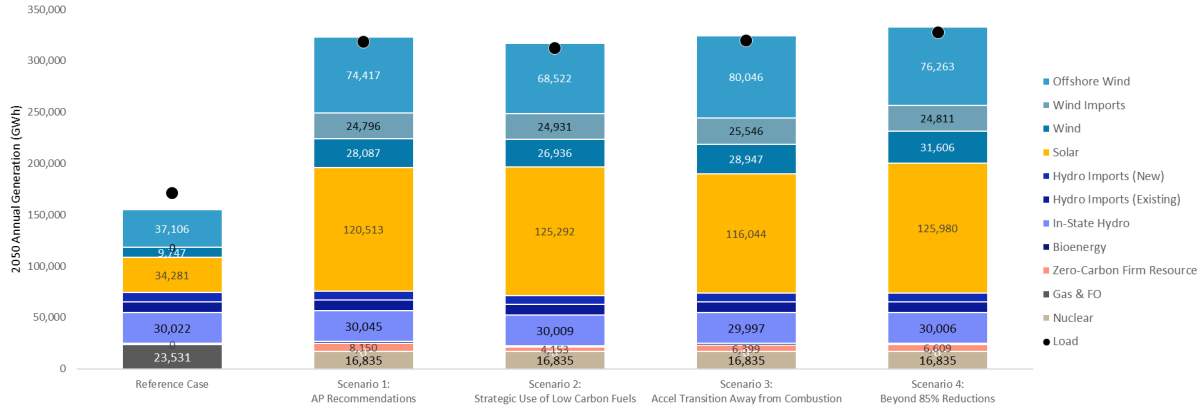



**Figure 31. Annual Generation in 2050, All Scenarios**




To integrate large quantities of intermittent resources into the New York electricity system, wind and solar output must be balanced with customer demand on multiple timescales, with different resources providing integration value over each timescale.

[31] In Scenarios 1, 2, and 4, the "zero-carbon firm resource" represents a combination of existing and new combustion-based resources (i.e. combustion turbines and combined cycle gas turbines) that convert to utilizing hydrogen as a zero-carbon fuel. In Scenario 3, firm zero-carbon capacity represents a combustion-free resource, modeled as hydrogen fuel cells.

On the intraday timescale, battery storage plays a critical role in providing flexibility and balancing renewables with customer loads on both an hourly and subhourly basis. At the hourly level, batteries can charge during times of high renewable output and discharge during times of lower renewable output or high customer demand, and batteries can also help meet subhourly reserve requirements. New York installs between 19-23 GW of battery storage across our modeled pathways. Dynamic end-use flexibility also has similar potential to help meet hourly balancing needs, if customers are incentivized to shift their demand to times of highest renewable output. The impacts of end-use flexibility on electricity system resource needs and system costs are examined in Section 3.5.

On the interday timescale, firm resources are needed to serve load and maintain system reliability during multi-day periods of low renewable output – periods in which the contributions of short-duration battery storage are limited. Our analysis identified a need for firm, zero-carbon capacity – in addition to the state's existing hydro and nuclear facilities – of between 21-27 GW to maintain system reliability while achieving a 100% zero-emissions grid.[32]

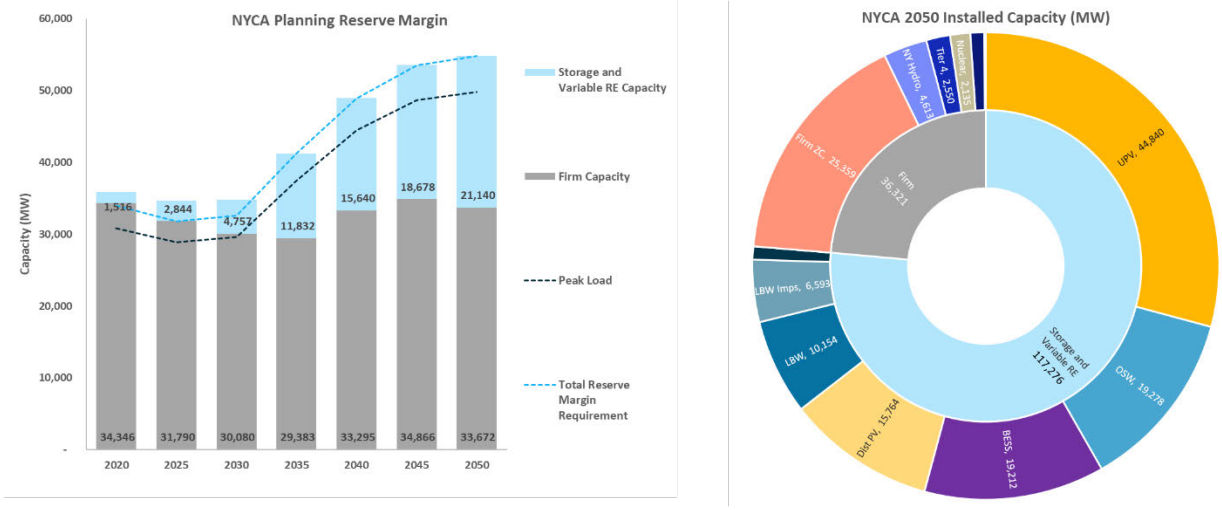
Ultimately, each resource category – renewables, battery storage, and firm zero-carbon capacity – will make important contributions to the state's achievement of a reliable carbon-free electric system. The reliability contributions of different resource types to statewide capacity requirements are detailed in Figure 32, which provides an alternative view of the 2050 resource mix in Scenario 3.[33] New renewable and storage resources provide significant reliability contributions, contributing over 21 GW towards statewide capacity requirements. However, at high penetrations of renewables and storage, the incremental reliability value of new resources is limited, because the most challenging periods for system reliability become times in which renewable output is low and storage is quickly exhausted. Firm zero-carbon capacity, including the existing nuclear and hydro facilities as well as new resources, contribute the remaining 34 GW of capacity requirements to ensure that the system is fully reliable, including during

[32] In Scenarios 1, 2, and 4, this firm capacity need is met by a combination of existing and new combustion-based resources (i.e. combustion turbines and combined cycle gas turbines) converting to hydrogen as a zero-carbon fuel. In Scenario 3, all existing fossil fuel resources are retired by 2040 and no new combustion-based (CCGT or CT) capacity is permitted. New firm capacity is provided by a combustion-free resource (modeled as hydrogen fuel cells).

[33] In all of the modeled pathways, the analysis ensures that the resulting electric system portfolios are reliable by enforcing the current statewide and local capacity requirements on a UCAP basis. The reliability contributions of intermittent and limited-duration resources (i.e. renewables and battery storage) towards New York's UCAP requirements are measured using an effective load carrying capability (ELCC) methodology. ELCC is the quantity of "perfect capacity" or UCAP that could be replaced with renewables or storage while providing equivalent system reliability. The analysis included loss of load probability modeling using E3's reliability model, RECAP, as detailed in Chapter 5.

extended periods of low renewable output. The following section details the contributions of each resource type at more granular timescales.

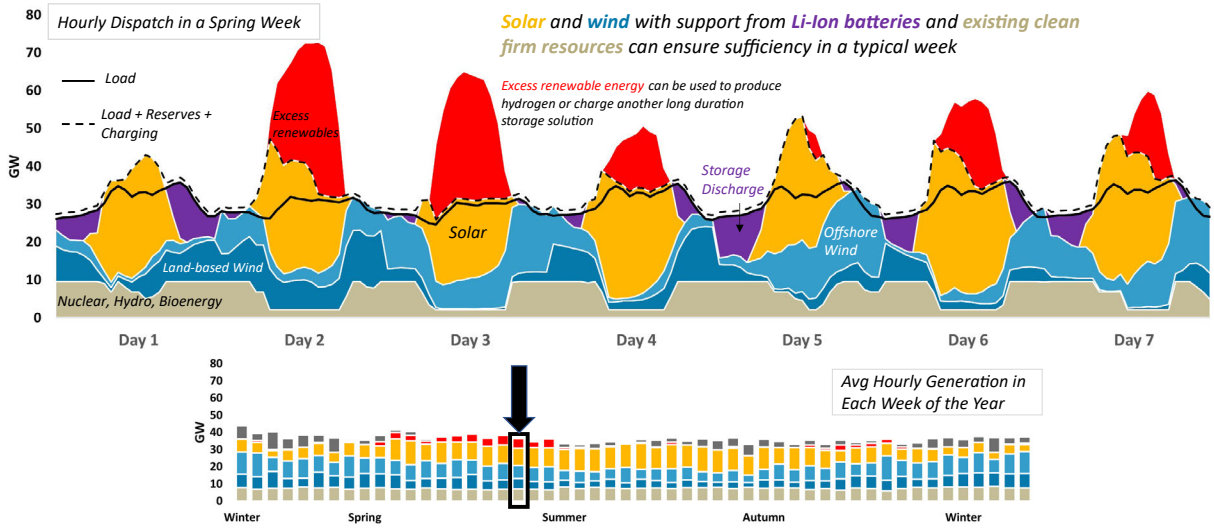
**Figure 32. Contributions to Statewide Capacity Requirements, Scenario 3**




## *System Operations and Reliability*

Wind and solar resources are foundational to New York's decarbonization goals and provide over 75 percent of annual generation. Their contributions vary over the course of the year, as indicated in the bottom of Figure 33. There are many weeks in which wind and solar, coupled with existing clean firm resources like the upstate nuclear and hydro facilities, meet the entirety of system needs over the course of the week. Figure 33 provides an illustration of system dispatch during a typical spring week, in which short-duration batteries provide intraday balancing by charging during times when renewable output exceeds demand and filling gaps of lower renewable output. Demand over the entire week is met with wind, solar, existing nuclear and hydro, and balancing from battery storage. There are also times during this week of excess renewable output – beyond what batteries are able to absorb – which could be used to produce green hydrogen or to charge a long-duration (e.g., 100+ hours) battery storage resource.

**Figure 33. Hourly Dispatch Over a Typical Spring Week In 2050**

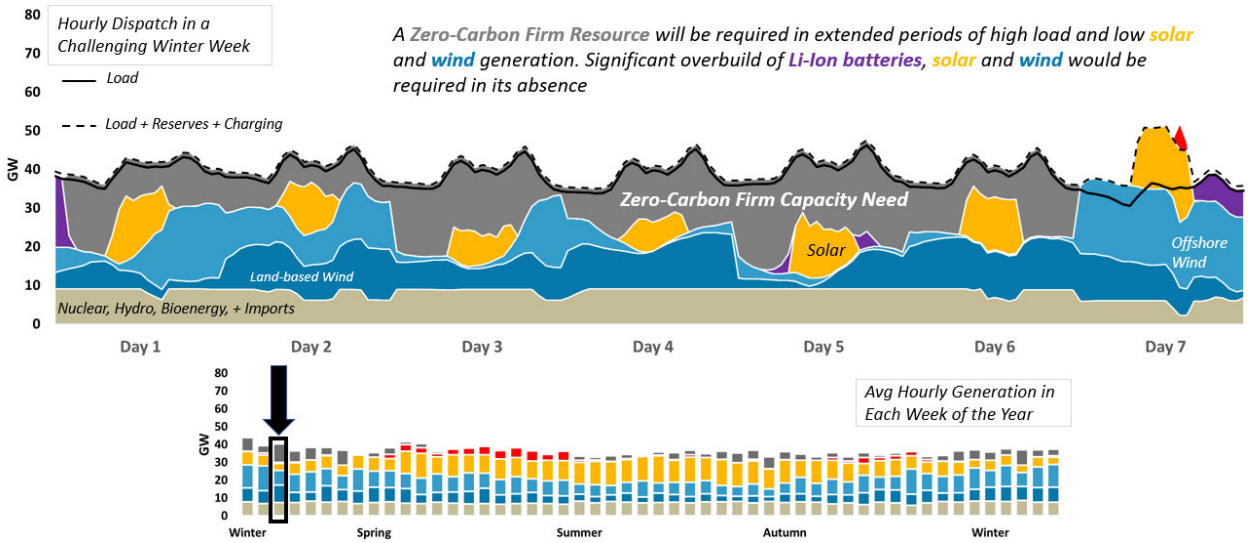



There are many weeks similar to the one described above over the spring, summer, and fall. However, as indicated by the gray contributions in the weekly generation chart, there are also many weeks in the year – especially during the winter – in which the contributions from renewables and existing clean firm resources are not sufficient to meet demand. During cold weeks, as a result of the electrification of building heating needs, electric demand will be much higher in the winter than it is today. Winter months also often coincide with extended periods of low renewable output.

During a week with persistently low solar and wind generation, additional firm zero-carbon resources, beyond the contributions of existing nuclear and hydro, are needed to avoid a significant shortfall; Figure 34 demonstrates the system needs during this type of week. During the first day of this week, most of the short-duration battery storage is quickly depleted, and there are still several days in which wind and solar are not sufficient to meet demand. A zero-carbon firm resource becomes essential to maintaining system reliability during such instances. In the modeled pathways, the need for a firm zero-carbon resource is met

with hydrogen-based resources; ultimately, this system need could be met by a number of different emerging technologies.[34]

**Figure 34. Zero Carbon Firm Capacity Need Over a Challenging Winter Week in 2050**



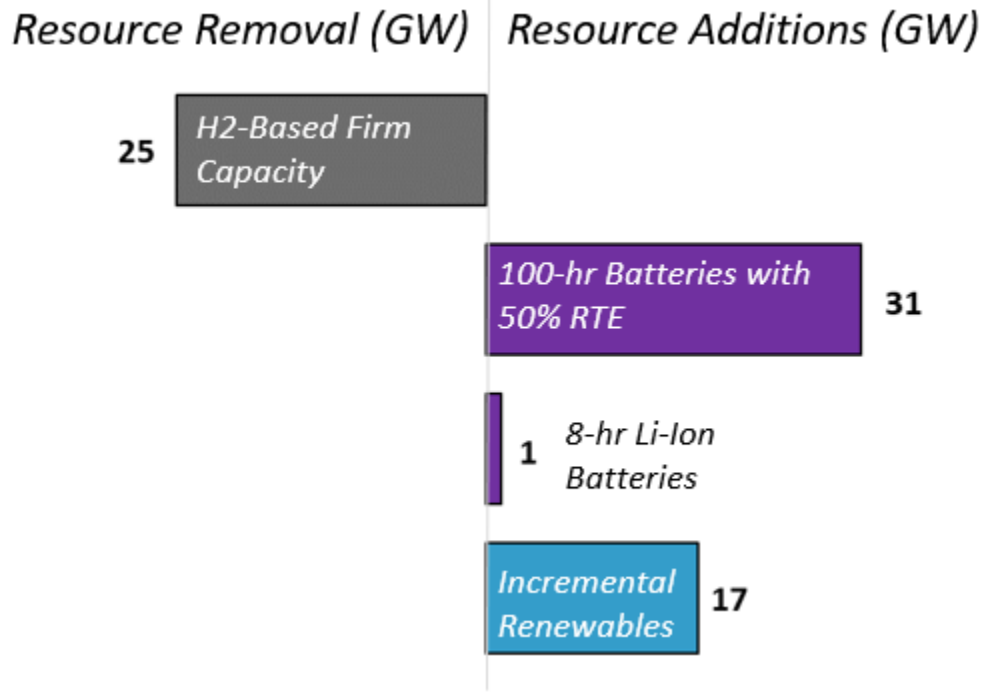

Hydrogen effectively provides a form of storage to the system on the order of hundreds of hours. Large quantities of fuel can be produced during the spring and summer and then utilized over the course of the winter provided that there is sufficient fuel storage. In addition to hydrogen-based resources, the analysis also examined the potential to meet reliability needs with a long-duration battery storage solution. In this assessment, the firm zero-carbon capacity, as well as renewable resources needed to produce hydrogen, were removed from the system, and the analysis identified a need for 31 GW of 100-hour battery storage to replace the contributions of 25 GW of a fully dispatchable hydrogen-based resource, along with 17 GW of incremental renewable resources to provide storage charging.[35] A 100-hour battery resource can provide firm capacity to meet system needs over several days. However, in contrast to a hydrogen-based

[34] Firm zero-carbon capacity needs could be met by a number of different technologies, including but not limited to: hydrogen or renewable natural gas utilization in combustion-based resources (e.g. CTs or CCGTs); hydrogen utilization in fuel cells; long-duration battery storage; or new nuclear technologies. These solutions are at varying levels of technology readiness, though none have been deployed at commercial scale to date, and continued innovation and progress towards commercialization will be needed to ensure this system need is met.

[35] Incremental resource builds are defined relative to the resources that would be needed for electrolysis to meet 50% of New York's hydrogen demand with in-state resources. The starting point for the reliability analysis was a case without in-state electrolysis loads or associated resources, and 26 GW of new renewables were added in total.

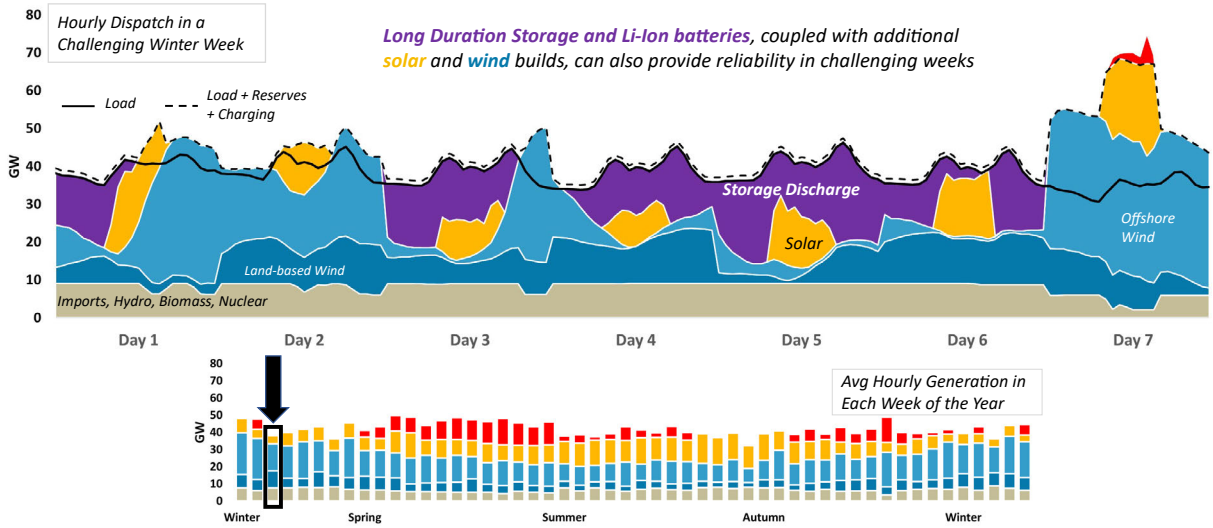
resource, if sufficient excess energy is not available to fully recharge the batteries following a challenging stretch, their ability to meet a similar system need in subsequent weeks of the winter is diminished. As a result, a higher amount of 100-hour battery capacity is needed to meet the same level of reliability as hydrogen-based resources.

**Figure 35. Replacement of Hydrogen-based Resources with 100-hour Battery Storage[36]**




[36] The starting portfolio already contains significant amounts of battery storage. As a result, the reliability value of incremental 8-hour storage was limited due to extended loss of load periods.

**Figure 36. Utilization of Long Duration Storage to Maintain Reliability over Challenging Winter Week**




## *Role of Hydrogen*

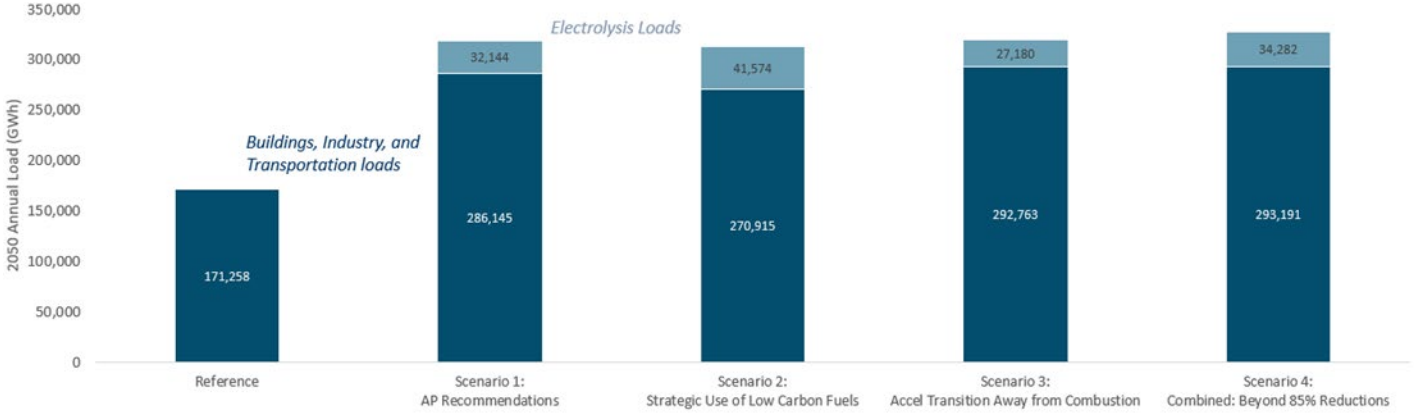
Hydrogen or bioenergy can play a critical role in decarbonizing sectors or applications that are difficult to electrify. By 2030, New York will likely need to spur initial market adoption of green hydrogen to help decarbonize medium and heavy-duty vehicles, as well as high-temperature industrial applications. In the longer term, low-carbon fuels may play critical roles in decarbonizing existing district heating and non-road transportation, including rail and aviation. Additionally, hydrogen-based resources can play a key role in the electric sector by providing firm capacity during extended periods of low renewable output, as discussed above.

Across all modeled pathways, New York's hydrogen demand is met with "green hydrogen," defined as hydrogen produced using electrolysis powered by renewable electricity. Hydrogen plays a strategic role across scenarios, with consumption ranging from 100-225 TBtu across modeled pathways in 2050. The production of large quantities of hydrogen can absorb excess renewable generation and prevent curtailment but will also require additional dedicated facilities to power electrolysis. In this analysis, our central assumption is that New York produces 50% of its hydrogen needs in-state and imports the remainder, with cost assumptions for that imported remainder consistent with the cost of "green hydrogen" produced in-state. Production costs for hydrogen were based on projections of electrolyzer capital costs and electricity prices, while transmission and storage costs were estimated assuming a 400-mile transmission pipeline and underground storage in salt caverns. Distribution costs for local hydrogen distribution via pipeline or freight truck were not included in this analysis, and it is important to note that there is significant uncertainty in future transmission and storage costs based on production location and

underground storage availability. The hydrogen supply and infrastructure costs included in this study are a proxy for a future system that combines both in-state and imported production of hydrogen with a build out of transmission and storage infrastructure, but they are not meant to represent an optimal configuration of hydrogen production and transmission and storage infrastructure.

Producing half of New York's hydrogen demand with in-state electrolysis results in up to 42 TWh of additional electricity demand, as shown in Figure 37. An additional sensitivity examining an alternative assumption of 100% in-state hydrogen production is included in section 3.5.

**Figure 37. Impacts of Electrolysis Loads on Total Electric Loads in 2050**



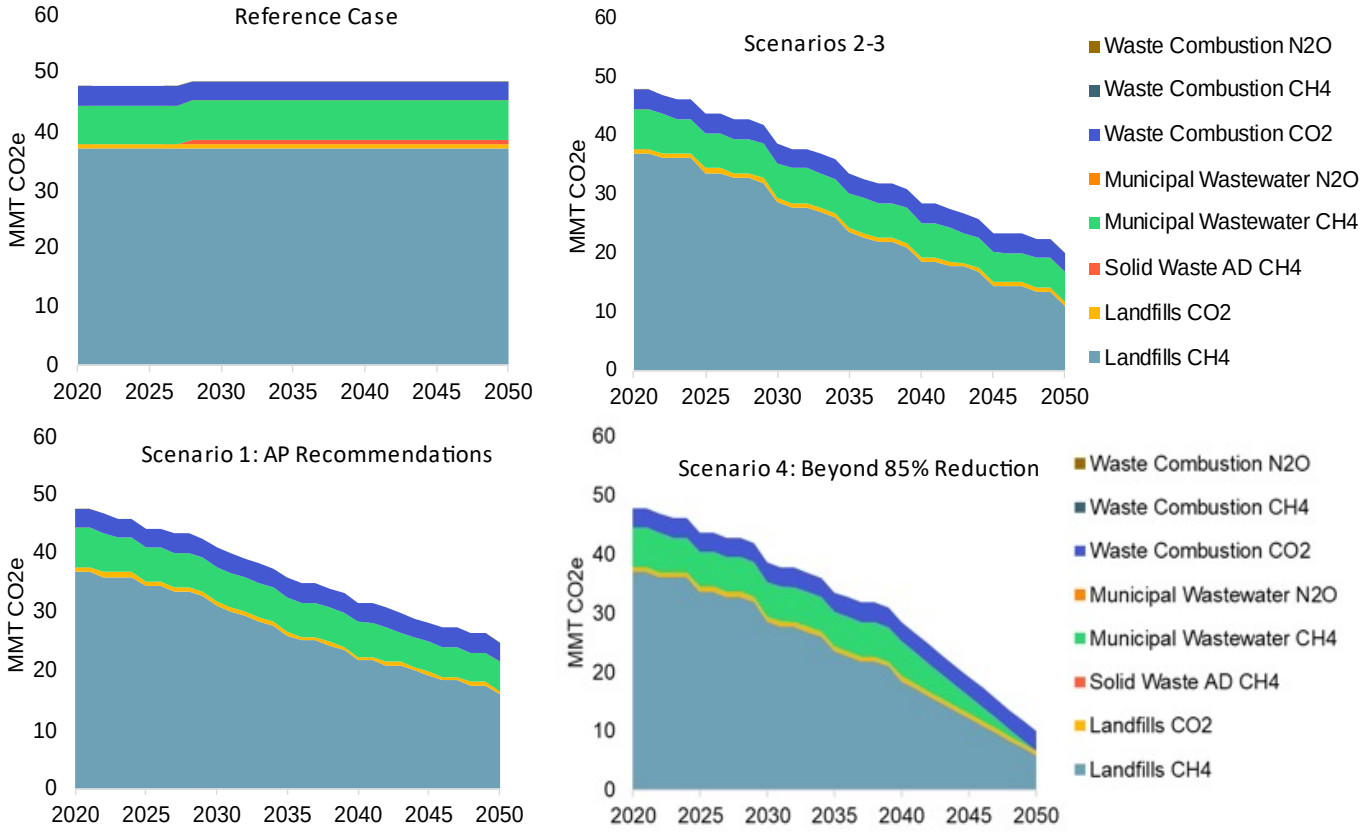

Electrolysis loads are highly flexible and can take advantage of excess renewables on a seasonal timescale, helping to balance and integrate renewables by serving as a form of long-duration storage that cannot be met with short-duration battery storage resources. However, although curtailed renewable electricity can contribute to a portion of hydrogen production needs, new renewable resources are also required to power electrolysis demand. These renewable resource needs are incorporated into the mitigation scenarios, and resource needs associated with 100% in-state hydrogen production are assessed in the sensitivity analysis included in section 3.5.

### *Waste*

Emissions in the waste sector are dominated by methane emissions from landfills and wastewater treatment facilities. Scenarios 2 and 3 include actions to divert 100% of waste from landfills and reduce methane leakage 10% every 5 years from existing landfills, with anaerobic digesters in solid waste running at capacity in 2030 with 75% methane leakage reduction by 2050, waste combustion held constant, and methane leakage reduction from wastewater treatment facility anaerobic digesters. Scenario 4 includes the same measures as Scenarios 2 and 3, plus characterization of uncertainty in potential for

additional innovation in methane management and capture, resulting in an additional 50% reduction in waste sector GHG emissions in 2050 relative to Scenarios 2 and 3.

**Figure 38. Greenhouse Gas Emissions in Waste Sector**

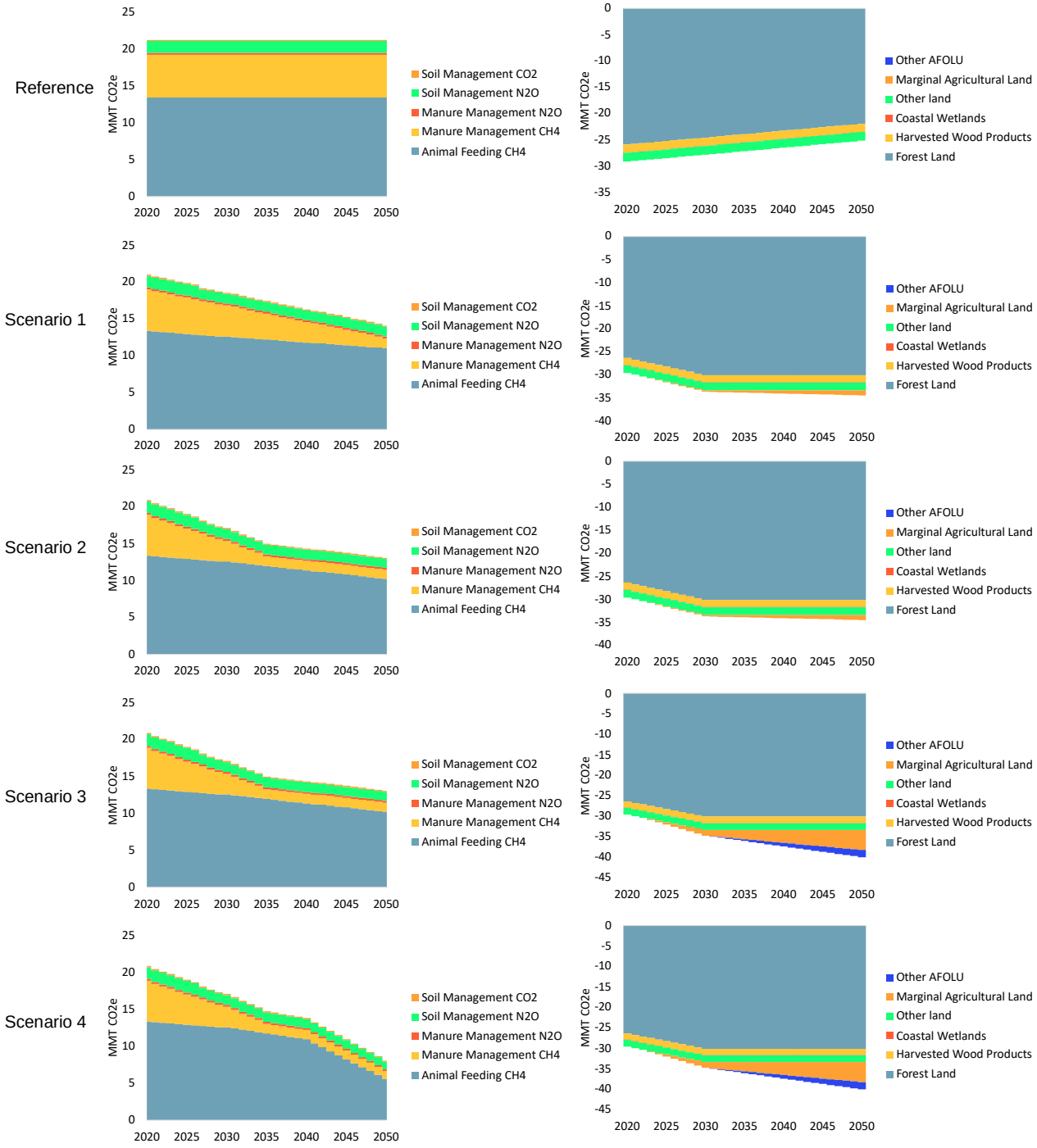



## *Agriculture, Forestry, and Land Use (AFOLU)*

Emissions within the AFOLU sector include emissions sources from agriculture and emissions sinks from forestry and other land use. Key measures in Scenarios 2 and 3 include achievable agricultural emissions based on Cornell University estimates[37] and expansion of carbon sequestration in forests to restore the sink to 1990 levels. Scenarios 3 and 4 include additional afforestation on marginal agricultural lands, and Scenario 4 includes potential additional innovation in agricultural practices for nearly an additional 40% reduction in GHG emissions from the agriculture sector by 2050, relative to Scenario 3.

[37] Wightman and Woodbury (2020)

**Figure 39. Emissions Sources in Agriculture (left) and Emissions Sinks in Forestry (right)**



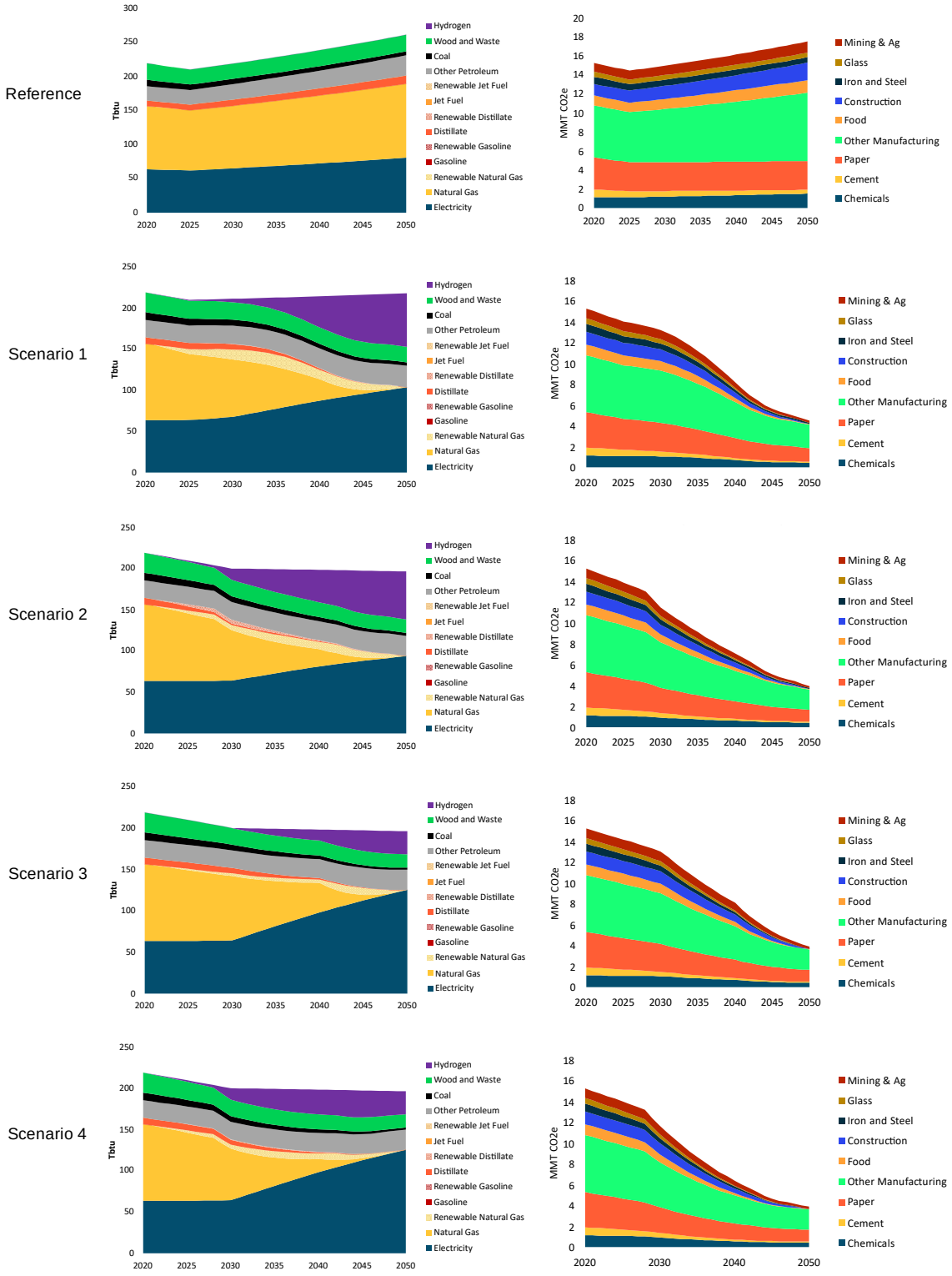

## *Industry*

### Industrial Energy Use

Industrial sector energy demand and GHG emissions are spread across a diverse range of subsectors in New York, with paper manufacturing, construction, and other manufacturing being particularly large

sources. Key measures in Scenarios 2 and 3 include manufacturing energy efficiency, electrification and hydrogen fuel switching, and carbon capture and storage for cement and iron and steel facilities. Scenario 2 includes a larger role for hydrogen and Scenario 3 includes more accelerated electrification, while Scenario 4 includes some amount of both increased low-carbon fuel use and increased electrification, in addition to the aggressive levels of energy efficiency and carbon capture and storage common to all mitigation Scenarios. Figure 40 below shows the dramatic shift from natural gas to electricity and hydrogen by 2050; together these fuels account for almost 80% of industrial final energy demand in Scenarios 2-4, although the respective shares of electricity and hydrogen vary by scenario. Base year energy consumption is shown both by industrial subsector and region and by industrial subsector and fuel in Annex 1, while annual final energy demand and GHG emissions for all scenarios are reported in Annex 2.

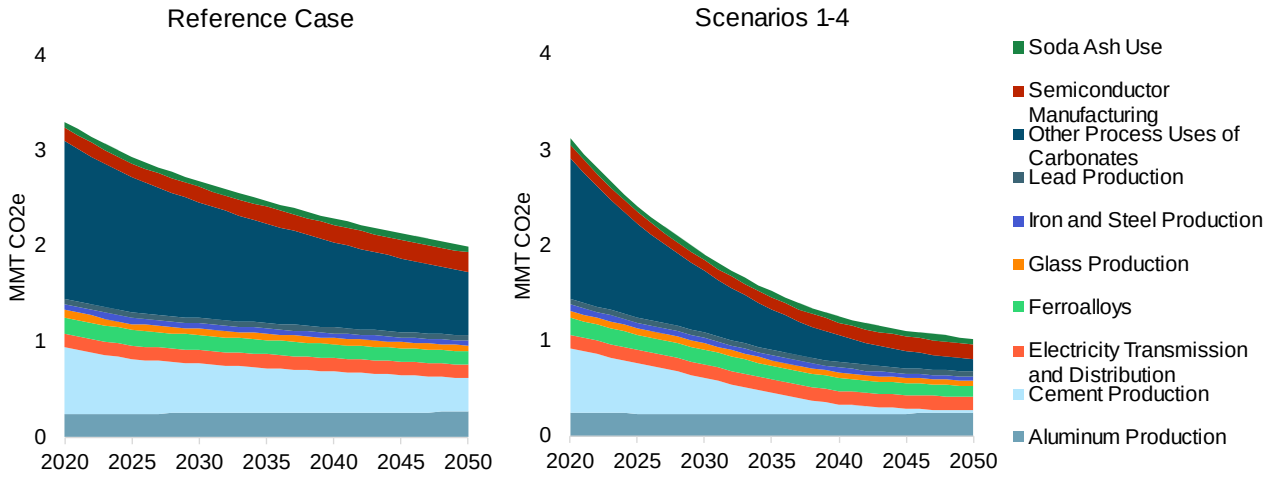
**Figure 40. Industrial Final Energy Demand (left) and Greenhouse Gas Emissions (right)**



## Industrial Process and Product Use

The industrial process and product use (IPPU) sector includes emissions from industrial processes (e.g., cement, aluminum) and product use, which is primarily from refrigerants. Key measures in industrial process emissions are historical declines in uses of carbonates and CCS for cement process emissions.[38]

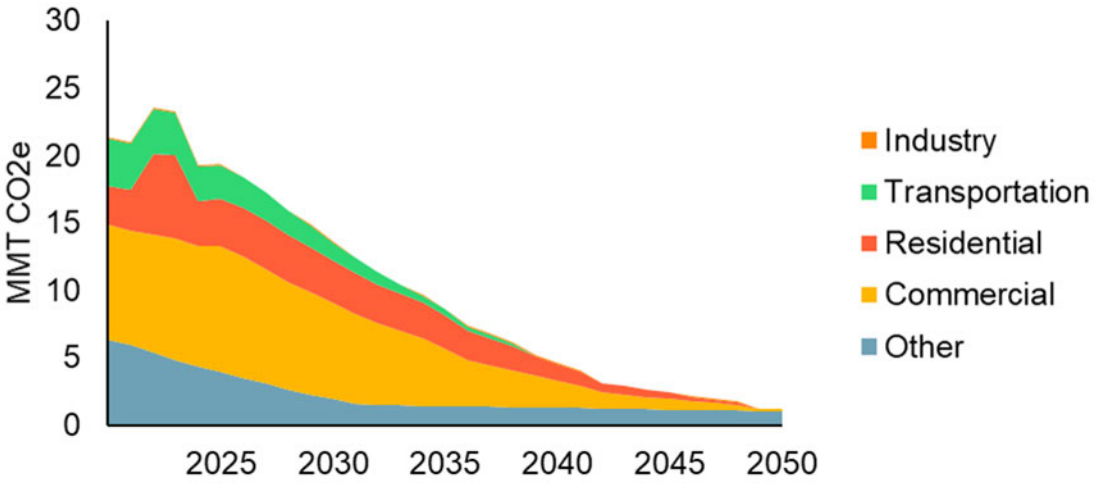
**Figure 41. Greenhouse Gas Emissions from Non-HFC Industrial Processes, Scenarios 1-4**




Hydrofluorocarbon (HFC) use has grown from near zero in 1990 to over 20 MMT $CO_2e$ in 2020, driven by the replacement of other refrigerants (CFCs/HCFCs) over that period. HFCs are a potent greenhouse gas but a critical part of the building electrification transition in New York. All mitigation scenarios include maximum adoption of ultra-low-GWP technologies for all building, transportation, industrial HVAC and refrigeration systems and maximum possible service reclaim at product end of life (90% recover rates).

[38] "Other Process Uses of Carbonates" includes flux stone use, flue gas desulfurization, magnesium production, acid neutralization, and sugar refining. Other non-$CO_2$ Industrial Process emissions are reduced based on incorporation of mitigation potential from EPA non-$CO_2$ report: available online: https://www.epa.gov/global-mitigation-non-$CO_2$-greenhouse-gases/global-non-$CO_2$-greenhouse-gas-emission-projections, accessed February 2021

**Figure 42. Greenhouse Gas Emissions from HFCs, Scenarios 1-4[39]**

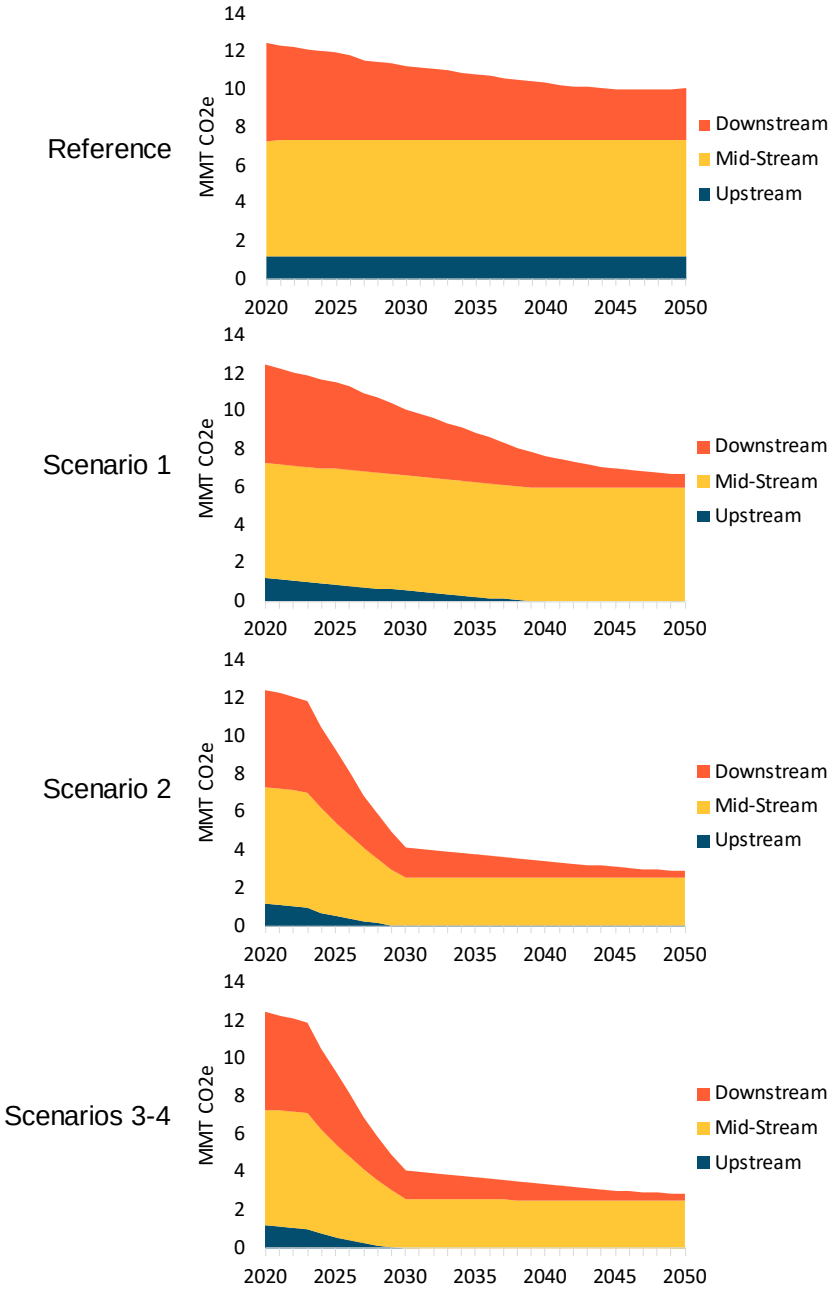



## In-State Oil and Gas

Emissions from New York's oil and gas industry are dominated by fugitive methane emissions in low-producing natural gas wells, transmission and storage compressor stations, steel and cast-iron pipes in the distribution system, and buildings. Key measures in Scenarios 2 and 3 include equipment replacement and Leakage Detection and Reduction (LDAR) at compressor stations, abatement at upstream sources, distribution pipeline decommissioning, and residential building disconnection and decommissioning.

[39] "Other" includes emissions from foams, aerosol propellants, solvents, and fire suppressants.

**Figure 43. Greenhouse Gas Emissions from In-State Oil and Gas[40]**



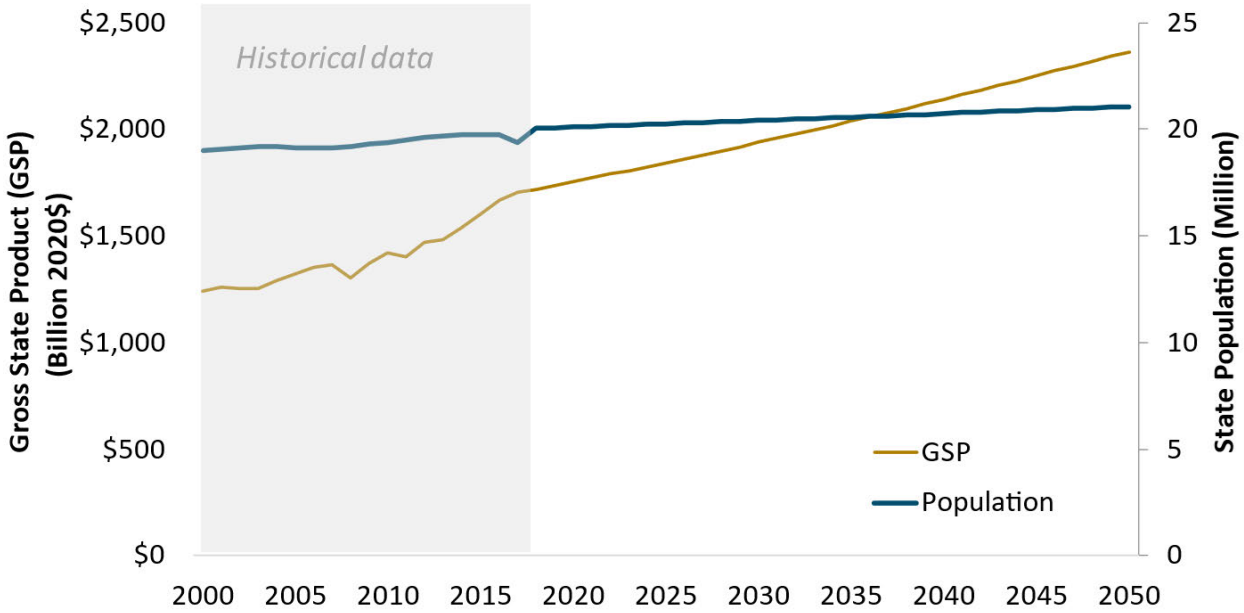

[40] Downstream includes distribution pipelines and building meters; Mid-stream includes gas transmission, compression, and storage; Upstream includes gas production and abandoned oil and gas wells

## 3.4 Benefits and Costs

### *Background*

New York's economy has been steadily growing for the last two decades and state economic output per capita has been growing even more quickly (Figure 44).

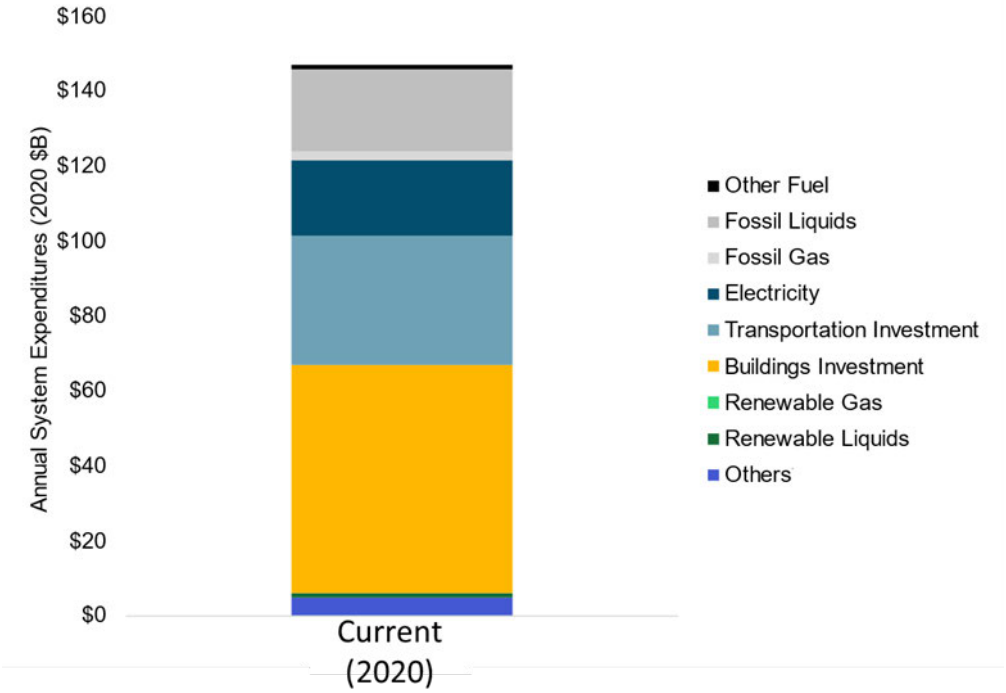
**Figure 44. Historical and Projected Population and Gross State Product[41]**




System expenditure is an estimate of the costs related to energy consumption in the state, which includes capital investments for energy consuming devices, liquid and gas fuel costs, and costs of in-state and imported electricity generation. While system expenditures are significant, these make up a small share of GSP (8.9% in 2020).

[41]NYSERDA Patterns and Trends (2021), Federal Reserve Economic Data (2021), Cornell Program on Applied Demographics

**Figure 45. Estimated Current System Expenditure by Category[42]**




Total annual energy expenditures are approximately $50 billion, and over half of that amount (almost $30 billion) is estimated to leave New York State. Petroleum fuel expenditures are the largest single category at approximately $24 billion. The buildings sector spends the most on energy services, followed by transportation. Current energy expenditures outline the opportunity for import-substitution through electrification, where a greater share of energy services is provided by in-state resources driving economic activity and job creation.

### *Integration Analysis Benefit-Cost Approach*

The integration analysis assessed benefits and costs of the decarbonization scenarios evaluated. The quantified benefits include the value of avoided GHG emissions and avoided health impacts. Cost categories include annualized capital, operations, and maintenance cost for infrastructure (such as

[42] Estimated system expenditures do not reflect direct costs in some sectors that are represented with incremental costs only. These include investments in industry, agriculture, waste, forestry, and non-road transportation

devices, equipment, generation assets, and transmission and distribution) and annual fuel expenses by sector and fuel (conventional or low-carbon fuels, depending on scenario definitions).[43]

**Value of Avoided GHG Emissions**

All scenarios model significant GHG emissions reductions, which avoid economic impacts of damages caused by climate change. The calculations of value of avoided GHG emissions are based on DEC Value of Carbon guidance, developed under the Climate Act.[44] The value of these avoided GHG emissions is measured in each scenario relative to the Reference Case. GHG emissions were measured using value of avoided carbon dioxide ($CO_2$), avoided methane ($CH_4$), avoided nitrous oxide ($N_2O$), and avoided hydrofluorocarbons (HFCs). For other GHGs, avoided emissions were converted to carbon dioxide equivalent ($CO_2e$) using the AR5-20year GWP values. The avoided GHG emissions time series in each year was multiplied by the annual social cost of GHG based on the DEC Value of Carbon guidance appendix, using the central case estimate for each GHG (2% discount rate for GHG emissions). When calculating NPV of avoided GHG emissions benefits, NPV calculations assume a discount rate of 3.6%.

**Health Co-Benefits**

The integration analysis also evaluated health benefits of mitigation scenarios relative to the Reference Case. For more information on these analyses, see Section II. Health Co-Benefits Analysis. Three categories of potential health benefits were modeled:

- Improvements in health outcomes due to improved air quality, including reduced incidence of premature mortality, heart attacks, hospitalizations, asthma exacerbation and emergency room visits, and lost workdays[45]
- Public health benefits from increased physical activity due to increased use of active transportation modes (e.g., walking, cycling) while accounting for changes in traffic collisions

[43] This analysis does not natively produce detailed locational or customer class analysis, but those may be developed through subsequent implementation processes.

[44] The value of avoided GHG emissions calculations are based on DEC guidance: https://www.dec.ny.gov/regulations/56552.html, accessed December 2021

[45] Health benefits are calculated as "High" and "Low." The economy-wide benefits applied the High case and the Low case are included in the uncertainty analysis. For more information see Section II. Health Co-Benefits Analysis

- Estimated benefits of energy efficiency interventions in low- and moderate-income homes

**Integration Analysis Costs**

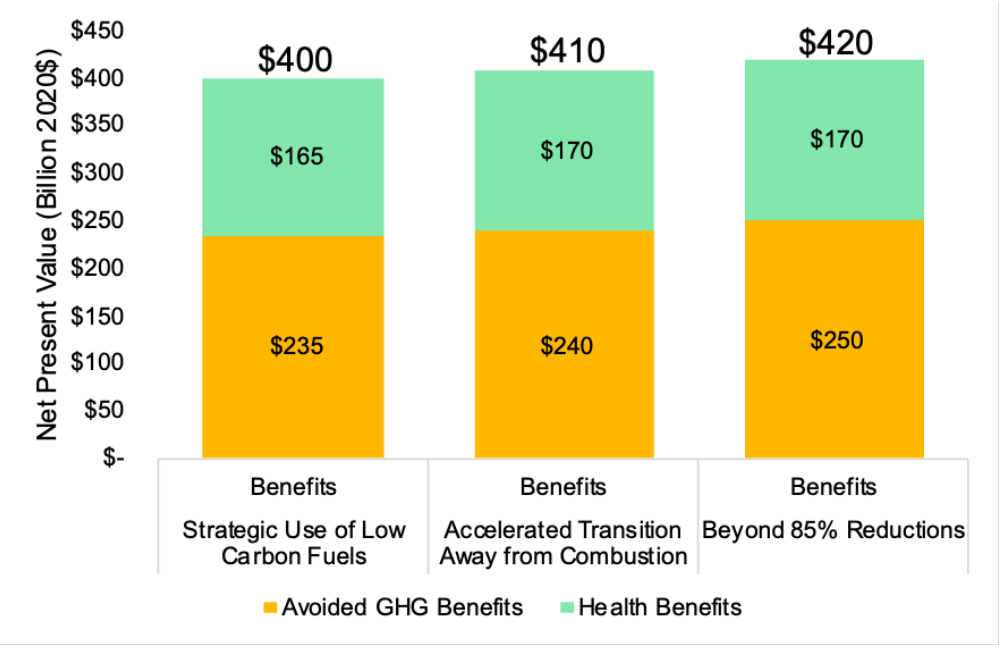
The pathways framework produces economy-wide resource costs for the various mitigation scenarios relative to a reference case. The framework is focused on annual societal costs and benefits and does not track internal transfers (e.g., incentives). Outputs are produced on an annual time scale for the state of New York, with granularity by sector. Cost categories include annualized capital, operations, and maintenance cost for infrastructure (e.g., devices, equipment, generation assets, T&D) and annual fuel expenses by sector and fuel (conventional or low-carbon fuels, depending on scenario definitions).[46]

**Value of Avoided GHG Emissions and Health Co-Benefits**

Reducing GHG emissions in line with Climate Act emissions limits avoids economic impacts of damages caused by climate change equaling approximately $235 to $250 billion. Improved health outcomes, including improvements in air quality, increased active transportation, and energy efficiency interventions in low- and moderate-income homes generate additional benefits ranging from $165 to 170 billion. As shown in Figure 46, collective benefits range from $400 to $420 billion over the next 30 years.

[46] This analysis does not natively produce detailed locational or customer class analysis, but those may be developed through subsequent implementation processes.

**Figure 46. Net Present Value of Benefits Relative to Reference Case (2020-2050)**




### *Integration Analysis Costs*

The integration analysis includes calculations for three different cost metrics: NPV of net direct costs, annual net direct costs, and system expenditure.

- **NPV of Net Direct Costs:** NPV of levelized costs in each scenario incremental to the Reference Case from 2020-2050. All NPV calculations assume a discount rate of 3.6%. This metric includes incremental direct capital investment, operating expenses, and fuel expenditures.
- **Annual Net Direct Costs:** Net direct costs are levelized costs in a given scenario incremental to the Reference Case for a single year snapshot. This metric includes incremental direct capital investment, operating expenses, and fuel expenditures.
- **System Expenditure:** System expenditure is an estimate of absolute direct costs (not relative to Reference Case). Estimates of system expenditure do not reflect direct costs in some sectors that are represented with incremental costs only. These include investments in industry, agriculture, waste, forestry, and non-road transportation.

Cost categories included in the metrics listed above are shown in Table 4.

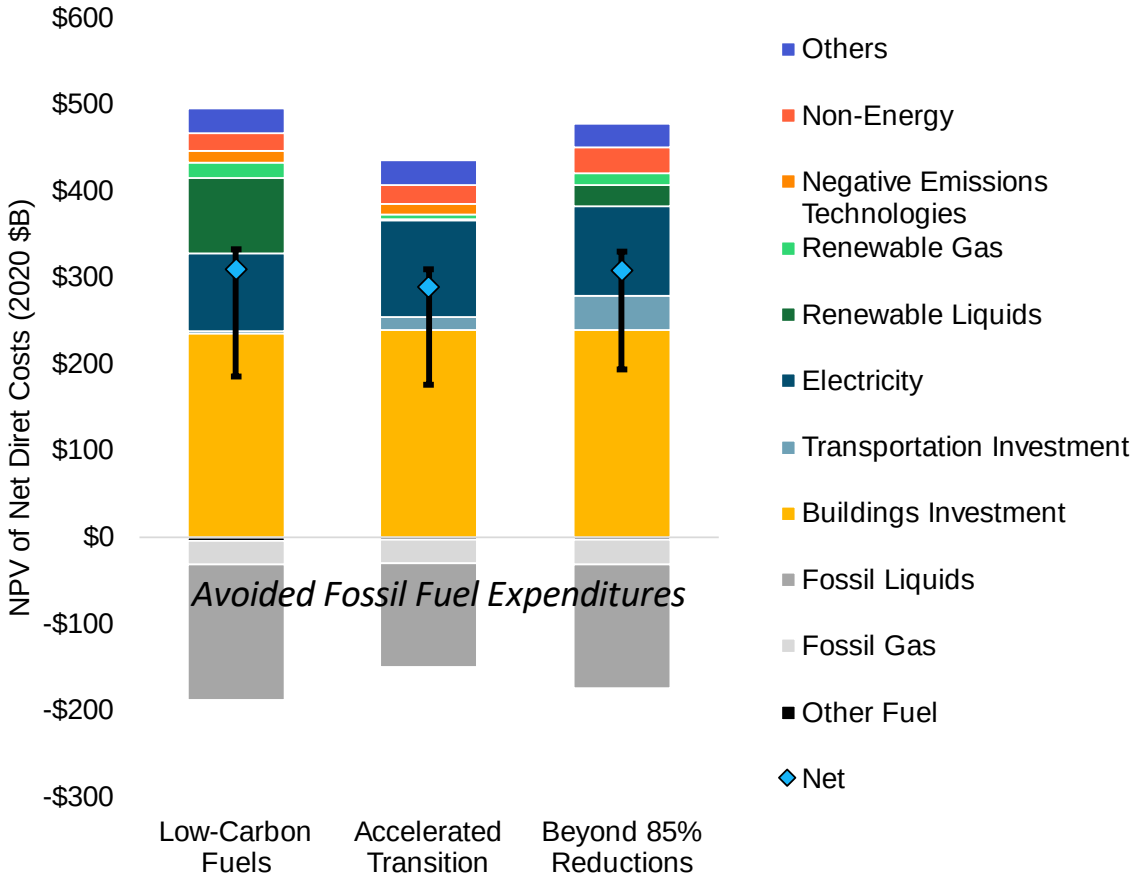
**Table 4. Integration Analysis Cost Categories**

| Cost Category | Description |
|---|---|
| Electricity System | Includes incremental capital and operating costs for electricity generation, transmission (including embedded system costs), distribution systems, and in-state hydrogen production costs. |
| Transportation Investment | Includes incremental capital and operating expenses in transportation (e.g. BEVs and EV chargers) |
| Building Investment | Includes incremental capital and operating expenses in buildings (e.g. HPs and building upgrades) |
| Non-Energy | Includes incremental mitigation costs for all non-energy categories, including agriculture, waste, and forestry |
| Renewable Gas | Includes incremental fuel costs for renewable natural gas and imported green hydrogen |
| Renewable Liquids | Includes incremental fuel costs for renewable diesel and renewable jet kerosene |
| Negative Emission Technologies (NETs) | Includes incremental costs for direct air capture of CO2 as a proxy for NETs |
| Other | Includes other incremental direct costs including industry sector costs, oil & gas system costs, HFC alternatives, and hydrogen storage |
| Fossil Gas | Includes incremental costs spent on fossil natural gas (shown as a negative for cases when Gas expenditures are avoided compared with the Reference Case) |
| Fossil Liquids | Includes incremental costs spent on liquid petroleum products (shown as a negative for cases when liquids expenditures are avoided compared with the Reference Case) |
| Other Fuel | Includes incremental costs spent on all other fossil fuels |

The NPV of net direct costs in Scenarios 2, 3, and 4 are in the same range given uncertainty and are primarily driven by investments in buildings and the electricity system (Figure 47). All scenarios show avoided fossil fuel expenditures due to efficiency and fuel-switching relative to the Reference Case (shown in the chart as negative costs). Scenario 2: Strategic Use of Low-Carbon Fuels includes significant investment in renewable diesel, renewable jet kerosene, and renewable natural gas. Scenario 3: Accelerated Transition Away from Combustion meets emissions limits with greater levels of electrification, which results in greater investments in building retrofits, zero-emission vehicles, and the electricity system. Scenario 4: Beyond 85% Reductions includes additional investment in transportation (rail, aviation, VMT reductions) and methane mitigation, and mitigates the need to invest in any negative emissions technologies. Scenario costs are sensitive to the price of fossil fuels and technology cost projections, as reflected in error bars.[47]

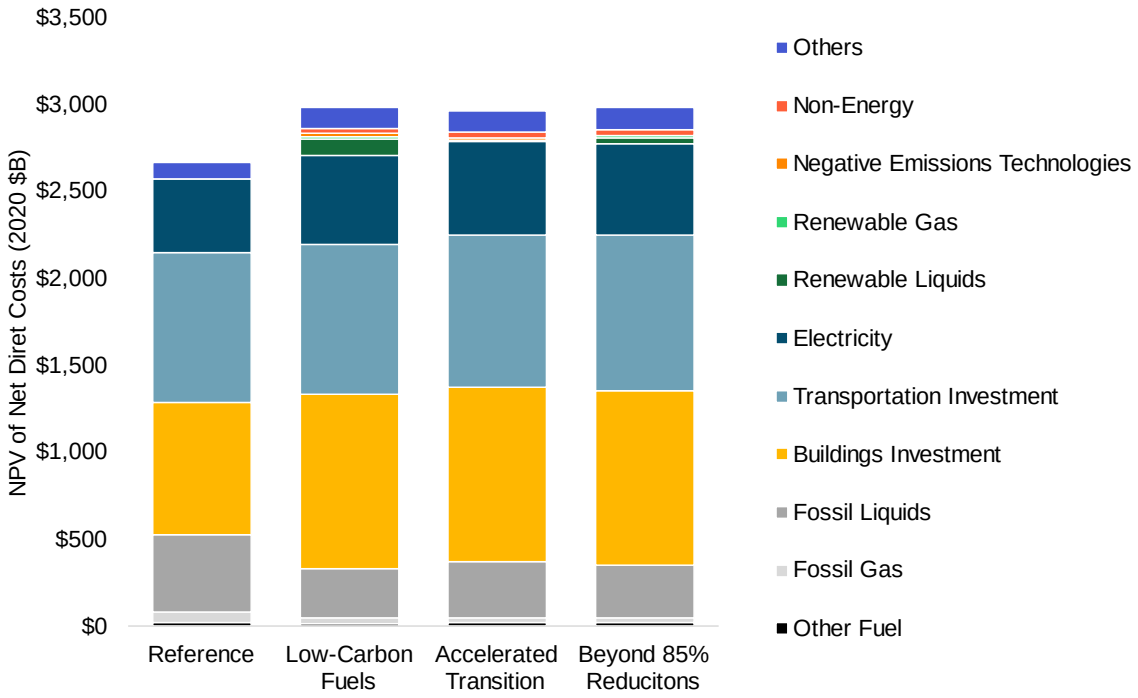
[47] Uncertainty error bars include low and high fuel price sensitivities from AEO 2021, and low technology costs for heat pumps, electric vehicles, low-carbon fuels, wind, solar, storage, and direct air capture of $CO_2$

**Figure 47. Net Present Value of Net Direct Costs Relative to Reference Case (2020-2050)**



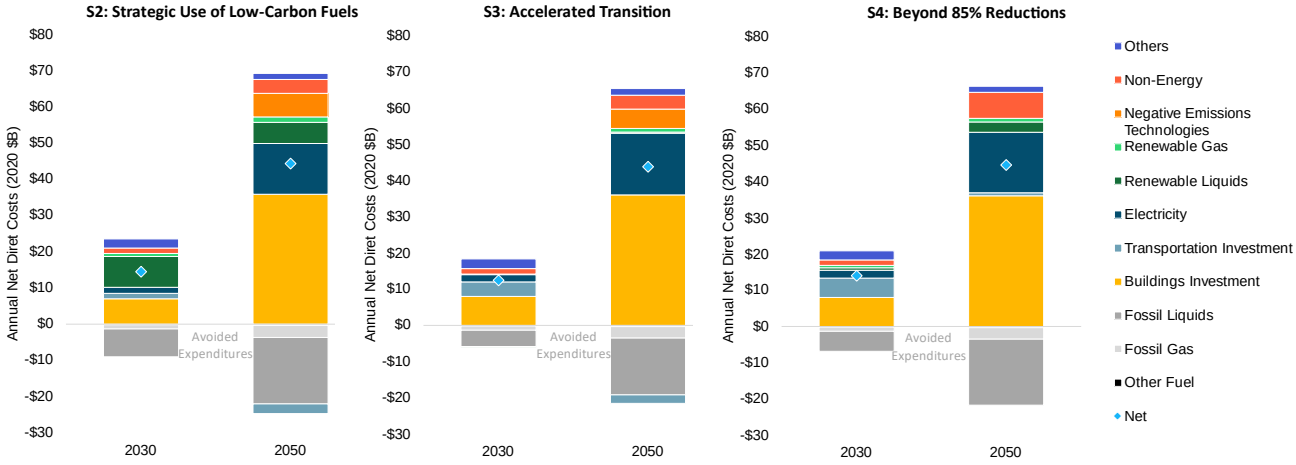

When viewed in from a systems expenditure perspective (Figure 48), the NPV of net direct costs for Scenarios 2, 3, and 4 are moderate, ranging from 11-12% as a share of the NPV of reference case system expenditures ($2.7 trillion). Because significant infrastructure investment will be needed to maintain business as usual infrastructure within the state irrespective of further climate policy, redirecting investment away from status quo energy expenditures and toward decarbonization is key to realizing the aims of the Climate Act.

**Figure 48. Net Present Value of System Expenditures in Reference Case and Scenarios 2-4 (2020-2050)**



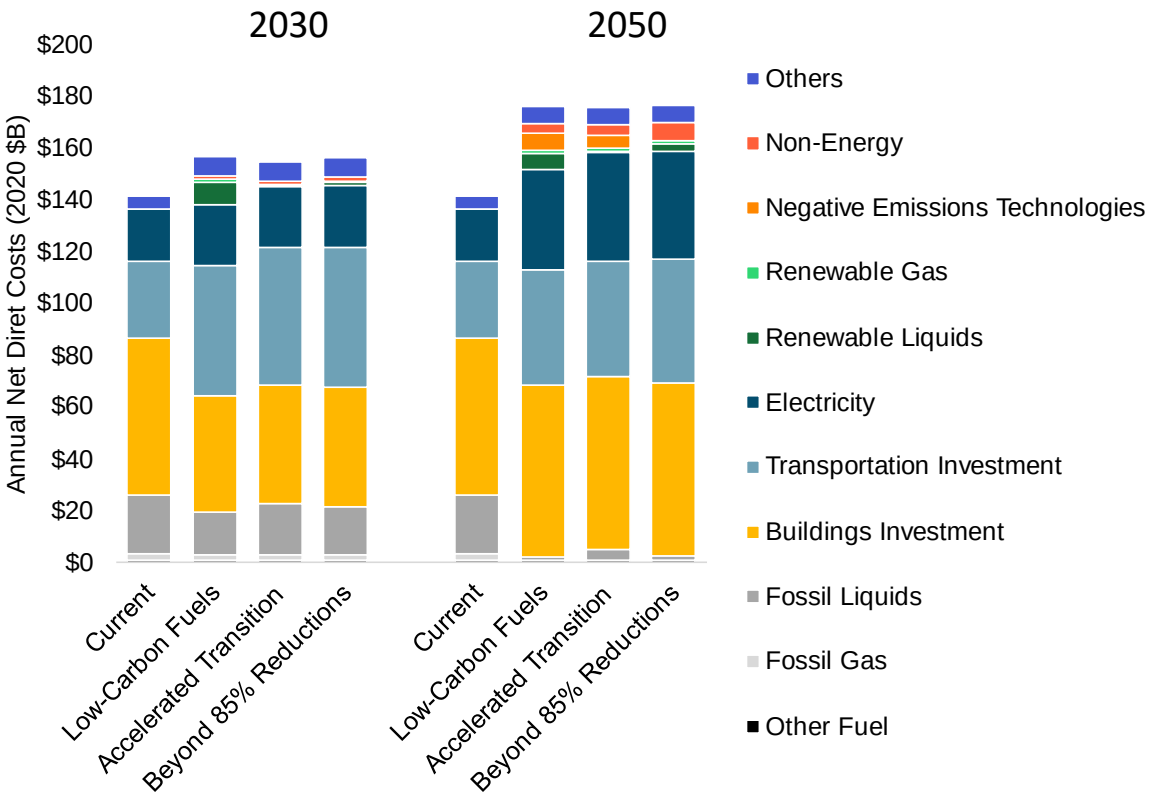

Annual net direct costs show the timing of key investments required to meet Climate Act emissions limits. Scenario 2 includes significant investment in renewable diesel, renewable jet kerosene, and renewable natural gas starting in the mid-2020s. Scenario 3 includes greater levels of electrification compared to Scenario 2, which results in greater investments in building retrofits, zero-emission vehicles, and the electricity system. Scenario 4 layers on even further investments in transportation and non-energy mitigation than Scenario 3 and includes a targeted investment in low-carbon renewable fuels, although not as intensive as that in Scenario 2. Both Scenarios 2 and 3 include investment in negative emissions technologies (NETs) to achieve net zero emissions by 2050, while Scenario 4 does not require any NETs to meet carbon neutrality by 2050. In 2030, annual net direct costs are on the order of $15 billion per year, approximately 0.6% of GSP; in 2050, costs increase to $45 billion per year, or roughly 1.4% of GSP.

**Figure 49. Annual Net Direct Costs Relative to Reference Case in Scenarios 2-4**




Net direct costs are measured relative to the Reference Case, but system expenditures are evaluated on an absolute basis. System expenditures increase over time as New York invests in infrastructure and clean fuels to meet Climate Act emissions limits. As a share of overall system expenditures, costs are moderate: 9-11% in 2030 and 25-26% in 2050 relative to current estimated expenditure levels.

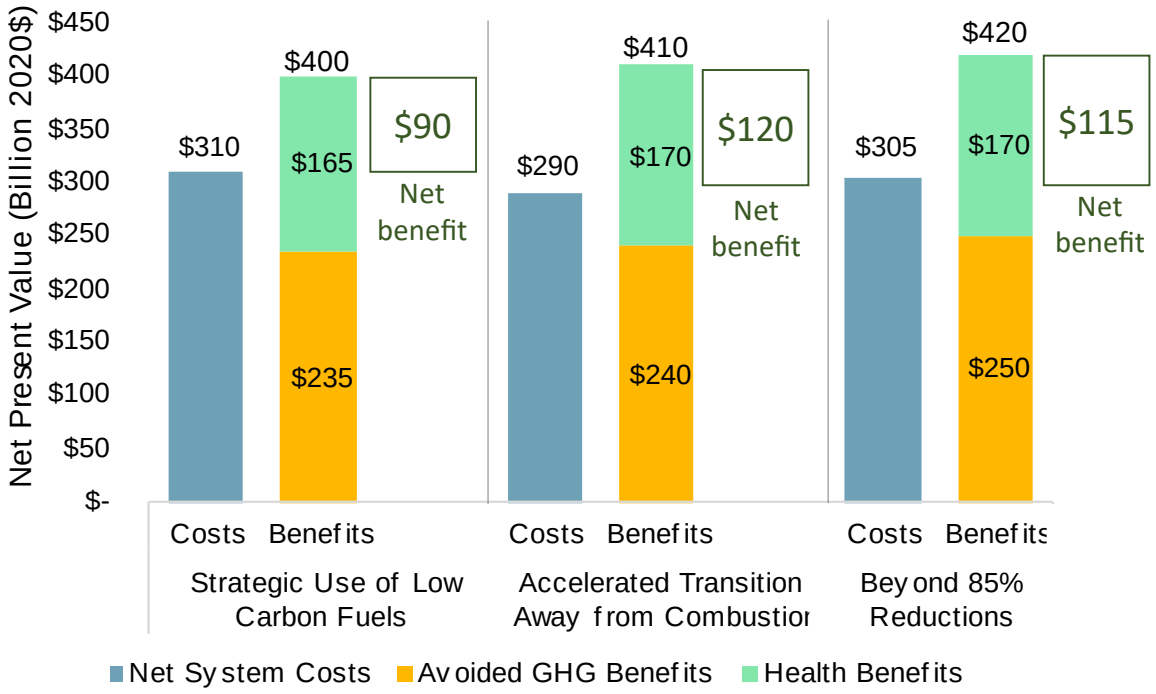
**Figure 50. Annual System Expenditures in Scenarios 2-4 (Compared to Current Expenditures)**



### *Benefit-Cost Findings*

Aggregating the impacts of benefits and cost analyses, mitigation cases show positive net benefits ($90-$120 billion) when considering the value of avoided greenhouse gas emissions and health co-benefits, in addition to cost savings from reduced fuel use.

**Figure 51. Net Present Value of Benefits and Costs relative to Reference Case, Including GHG benefits, Health Benefits, and Net Direct Costs (2020 – 2050)**




Key findings from the benefit cost analysis include:

- **Cost of Inaction Exceeds the Cost of Action by more than $90 billion**. There are significant required investments to achieve Climate Act GHG Emissions Limits, accompanied by even greater external benefits and the opportunity to create hundreds of thousands of jobs.
- **Net benefits range from $90-$120 billion**. Improvements in air quality, increased active transportation, and energy efficiency interventions in low- and moderate-income homes generates health benefits ranging from $165 - 170 billion. Reduced GHG emissions avoids economic impacts of damages caused by climate change equaling approximately $235 - 250 billion.

- **Net direct costs are small relative to the size of New York's economy**. Net direct costs are estimated to be 0.6-0.7% of GSP in 2030, and 1.4% in 2050.

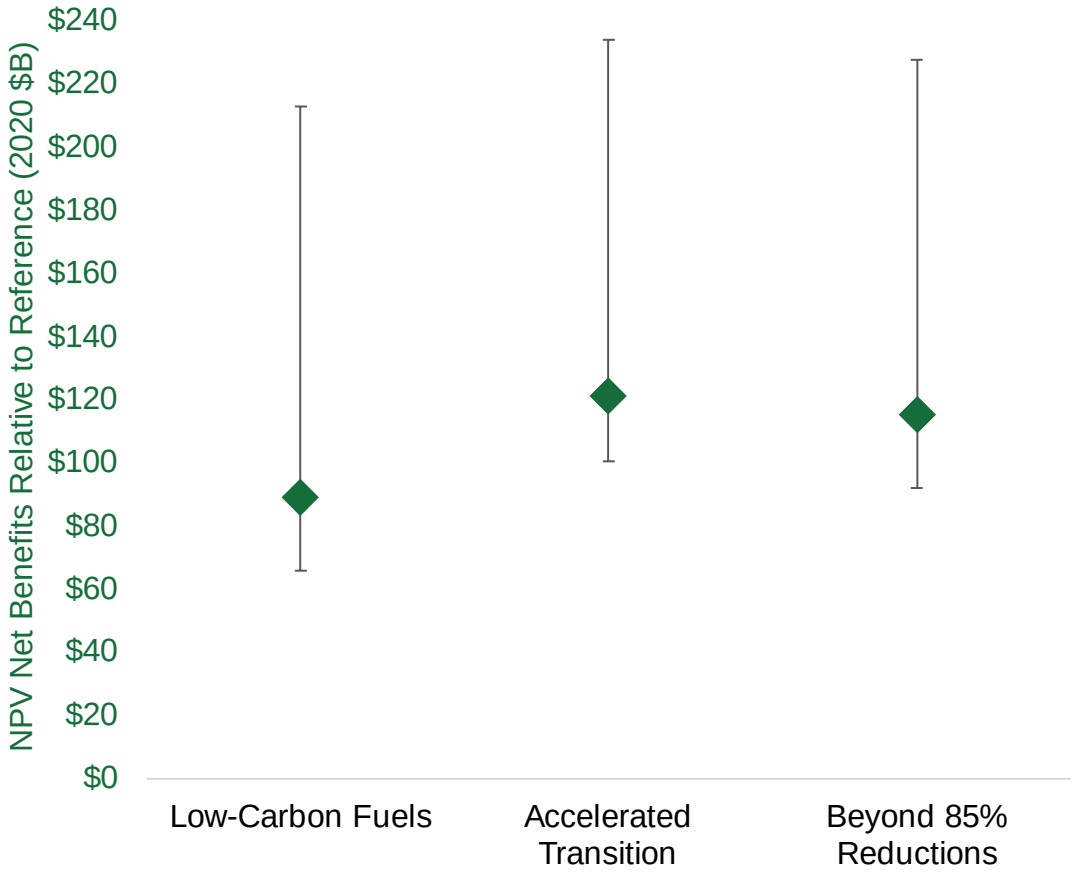
## 3.5 Uncertainty and Sensitivity Analysis

Because there is significant uncertainty in modeling changes to future energy demand and emissions and the benefits and costs associated with these changes, the Integration Analysis team performed a set of uncertainty and sensitivity analyses. This included estimating benefits and costs under a range of different fuel and technology costs and health benefits, evaluating the impact of demand-side measures like load flexibility and ground source heat pump deployment on the electric sector, and estimating the changes to final emissions results that would occur under different biofuels emissions accounting frameworks.

### *Benefits and Costs Sensitivity Analysis*

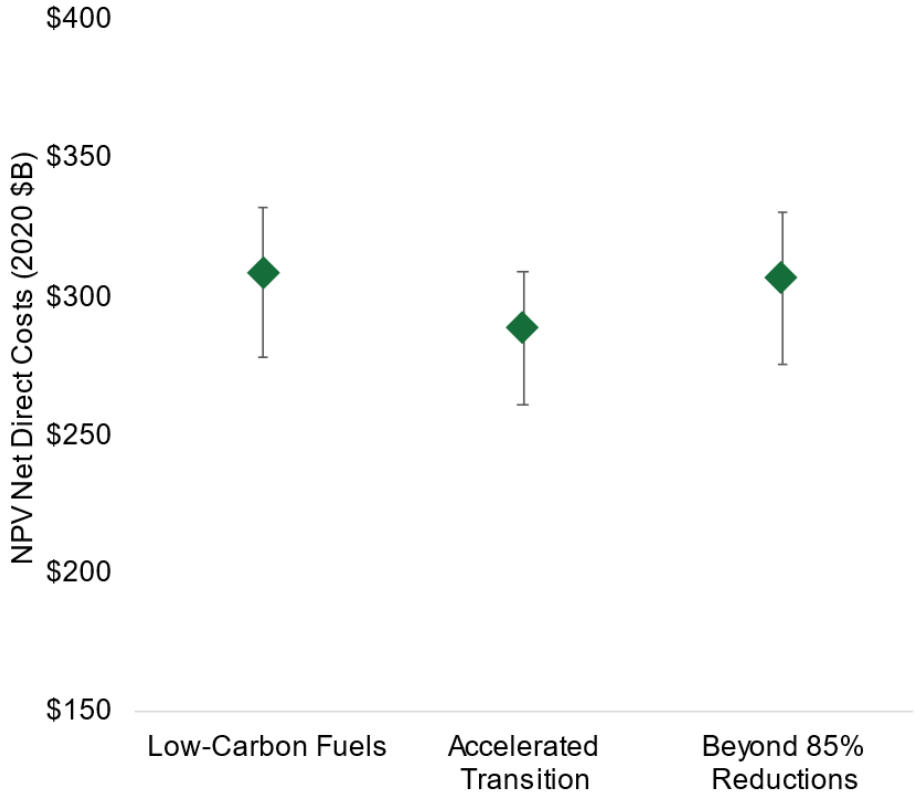
There is significant uncertainty in the value of costs and benefits, so to help characterize this uncertainty the Integration Analysis team measured a range of net benefits using a range of costs (Figure 52). The uncertainty analysis includes uncertainty in fuel prices and technology costs.

**Figure 52. NPV of Net Benefit of Mitigation Scenarios (2020-2050): Range Including Uncertainty in Fuel Cost, Technology Cost**



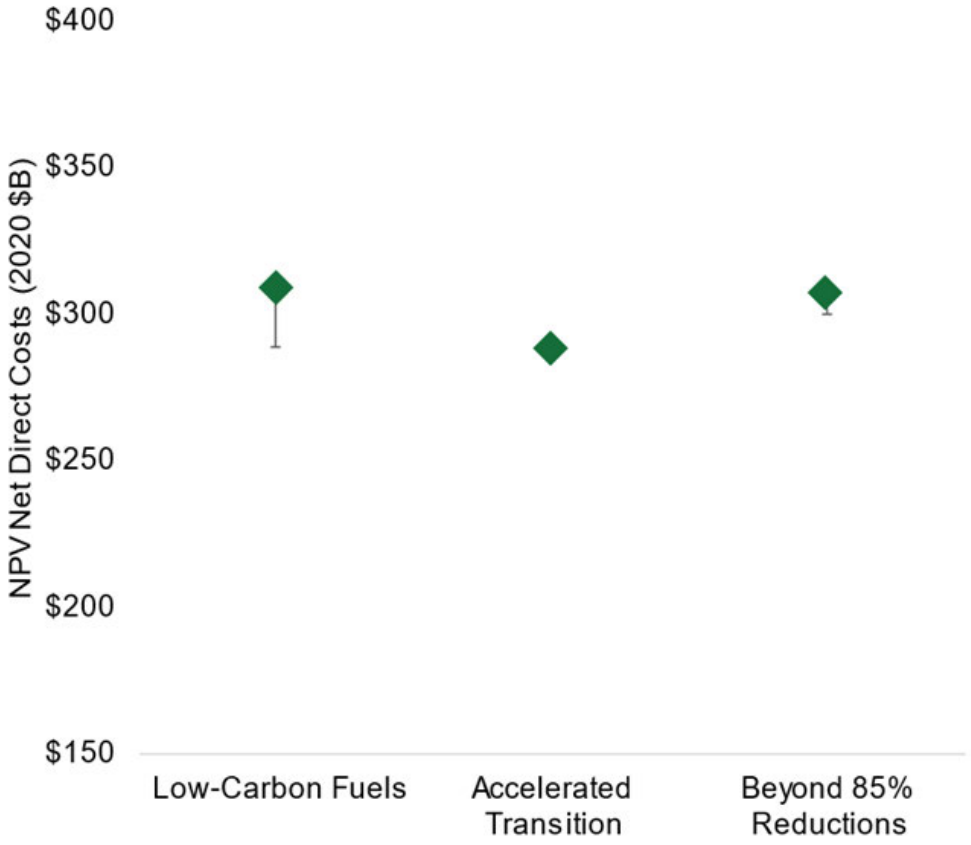

Uncertainty bounds for the benefits and costs of Scenarios 2 through 4 were evaluated using a range of values for fossil fuel prices, biofuels prices, technology costs. For fossil fuel prices, low and high ranges were taken from the Energy Information Administration's 2021 Annual Energy Outlook Report, specifically the High Oil and Gas Supply case (low fossil fuel prices) and Low Oil and Gas Supply case (high fossil fuel prices). When varying fossil prices within this range and holding other fuel and technology costs constant, the NPV of the net direct costs for Scenarios 2 through 4 changes between 7% to 10% depending on the scenario (Figure 53).

**Figure 53. NPV of Scenario Net Direct Costs: Fuel cost sensitivity for Scenarios 2 through 4**



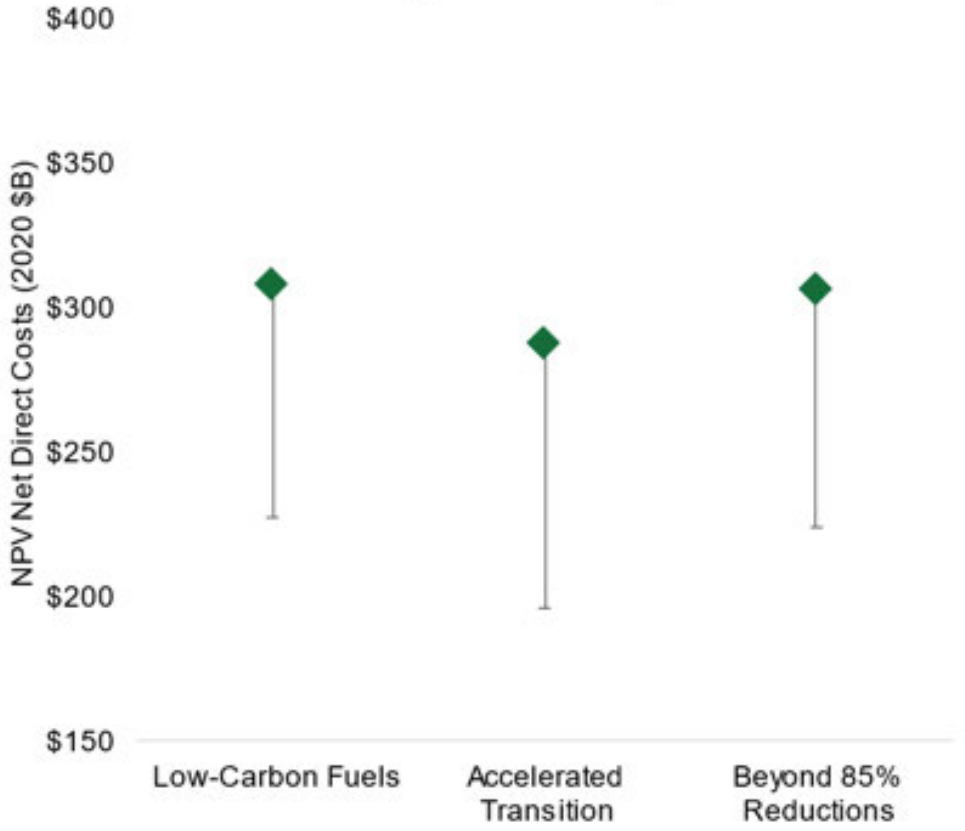

For biofuels prices, a lower price range was estimated assuming high innovation in biofuels production drives down costs. This is represented in the cost calculation as biofuels being sold at average production cost, rather than all biofuels being sold at marginal clearing prices. As shown in Figure 54, this change in biofuels prices only significantly affects Scenario 2, where the NPV of net direct costs in that scenario declines by 7%.

**Figure 54. NPV of Scenario Net Direct Costs: Biofuel cost sensitivity for Scenarios 2 through 4**




For technology costs, a lower cost range was estimated for key demand-side and supply-side technologies. On the demand-side, this included electric heat pumps, efficient building shells and retrofits, battery electric vehicles, electrolyzers for hydrogen production, and direct air capture (DAC) equipment. On the supply-side, lower cost trajectories for wind, solar, and storage technologies were used from NREL's Annual Technology Baseline (ATB). The end result is a 26% to 32% reduction in the NPV of net direct costs depending on scenario, as shown in Figure 55.

**Figure 55. NPV of Scenario Net Direct Costs: Technology cost sensitivity**




### *Electric Sector Sensitivities*

The following section details the system cost and resource mix impacts of varying assumptions in the electric sector. Additional modeling of the electricity system was performed to examine the changes on overall resource builds and system operations that would result from changes to key inputs and assumptions.

### *Firm Capacity Sensitivity Analysis*

Across a wide range of technology cost and fuel price sensitivities, New York is projected to power more than 90 percent of its electricity demand with renewable power from wind, solar, and hydro resources. Firm zero-carbon resources will be critical to providing the remaining 5-10% of demand during times of low wind and solar output and/or high demand.

This analysis examined several sensitivities regarding the availability of both existing and new technologies to meet remaining electricity needs. The analysis detailed below (and illustrated in Figure 56) focuses on sensitivities performed on Scenario 3. The cost assessment compares the costs of each

sensitivity relative to a version of the Reference Case that controls for electrification loads, to isolate the impacts of changes in the resource mix from changes in overall demand.

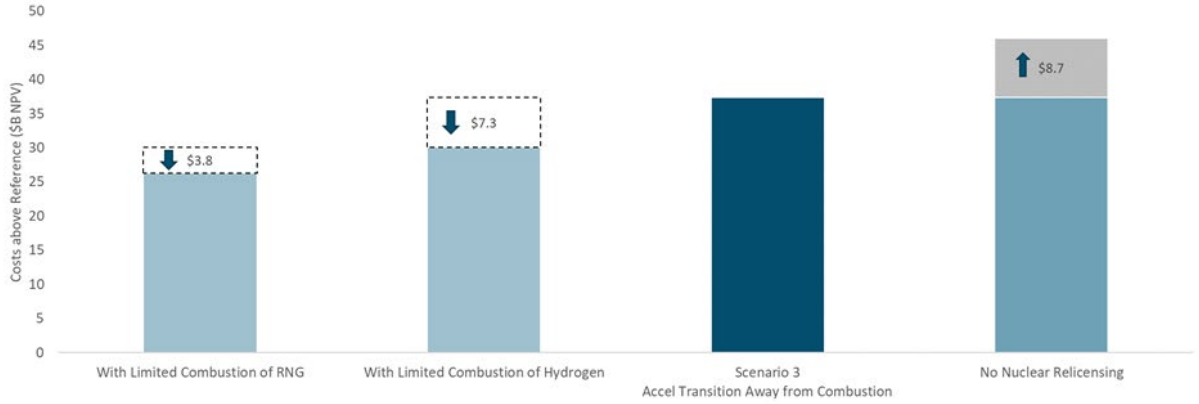
Under the primary assessment of Scenario 3, to facilitate a transition away from combustion in the electric sector, all existing fossil fuel resources are retired by 2040, and no new combustion-based resources are built (e.g., combustion turbines or combined cycle new firm capacity needs are met with a resource that avoids combustion and local air pollution).[48]

The overall electric system costs of Scenario 3 relative to a Reference Case, controlling for electrification loads, is $37B on an NPV basis over the 2020-2050 forecast period. The sensitivity analysis also examined a scenario in which upstate nuclear units do not receive license extensions and are retired at the end of their 60-year lifetimes; this places additional pressure on the New York system by (1) increasing the amount of zero-carbon energy needed from new renewable resources and (2) increasing the amount of new firm capacity that is needed to replace the energy and reliability contributions of nuclear generation during times of low renewable output. Retiring the upstate nuclear units at the end of their 60-year licenses would increase costs by $9B relative to Scenario 3.

The modeling also included sensitivities in which limited combustion of zero-carbon fuels such as hydrogen or renewable natural gas is used to meet firm capacity needs, similar to the assumptions in Scenarios 1, 2, and 4. Shifting from fuel cells to hydrogen combustion resources would reduce costs by about $7B relative to Scenario 3. Utilization of renewable natural gas (RNG), which is expected to be a cheaper fuel than hydrogen, would further reduce costs by about $4B, or $11B below Scenario 3.

[48] For the purpose of the cost analysis, this resource was assumed to be a hydrogen fuel cell; however, the need could be met by a number of emerging technologies. Analysis of long-duration (100-hour) battery storage is detailed in Chapter 9.

**Figure 56. Cost Impacts of Firm Capacity Sensitivities[49]**




## *Load Flexibility Sensitivity Analysis*

The analysis also examined the impacts of dynamic end-use flexibility on resource builds and resulting system costs. Dynamic usage can serve as a key strategy to help manage the peak load impacts of electrification, if customers are able to shift their consumption patterns in response to real-time price signals from the grid operator.

The Mitigation Scenarios each assume that light-duty electric vehicle charging is the primary focus of strategies to enable price-responsive load, and that by 2050 25% of LDV loads are shiftable within the day (while still constrained by customer driving behavior).

The analysis examined a "Low" sensitivity in which LDV loads are not dynamically managed, as well as a "High" sensitivity, in which 50% of LDV loads are flexible, and up to 60% of building end-uses are also capable of price-responsiveness, with the level of flexibility and hours of shift varying by end use. Detailed assumptions by end use for each sensitivity can be found in Annex 1.

In the Low Flexibility case, system peaks increased by over 3 GW by 2050 relative to Scenario 3, and in the High Flexibility case, dynamic end-use flexibility further reduced system peaks by nearly 5 GW by 2050 relative to Scenario 3, with system peaks ranging between 45 and 53 GW across the sensitivities.

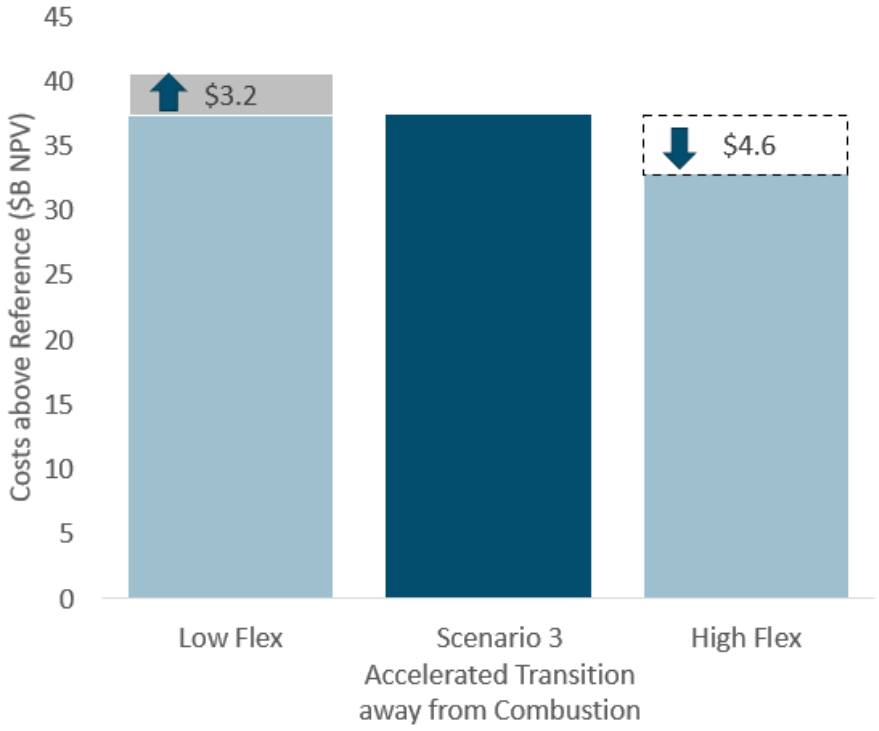
[49] The costs presented represent the costs relative to a Reference Case with equivalent levels of electrification loads, and as a result are not directly comparable to the electric sector costs presented in the economy-wide analysis, in which costs are measured relative to a Reference Case with Reference loads.

As a result of changes in end-use flexibility and resulting load impacts, the primary impacts on the electric system resource mix were the amounts of firm capacity and battery storage built by 2050. Increased amounts of end-use flexibility resulted in lower builds of new zero-carbon firm capacity, with firm zero-carbon capacity in 2050 ranging between 23 GW in the High Flexibility case to 27 GW in the Low Flexibility case. In addition to reducing peak demands, flexible loads also provide similar intra-day shifting services to battery storage, by moving customer demand to times of high renewable output. As a result, battery storage was the resource that was most impacted by flexible load assumptions, with storage capacity in 2050 ranging between 15 GW in the High Flexibility case to 24 GW in the Low Flexibility case.

**Figure 57. Electric System Resource Mix Impacts of Load Flexibility**


Driven by the changes in system needs and resource builds, the Low Flexibility case in turn leads to increased costs of $3.2B on an NPV basis, relative to Scenario 3. In the High Flexibility case, as a result of lower system needs and resulting declines in firm capacity and storage builds, system costs were reduced by $4.6B on an NPV basis relative to Scenario 3.

**Figure 58. Cost Impacts of Flexible Load Sensitivities[50]**




### *In-State Electrolysis Sensitivity Analysis*

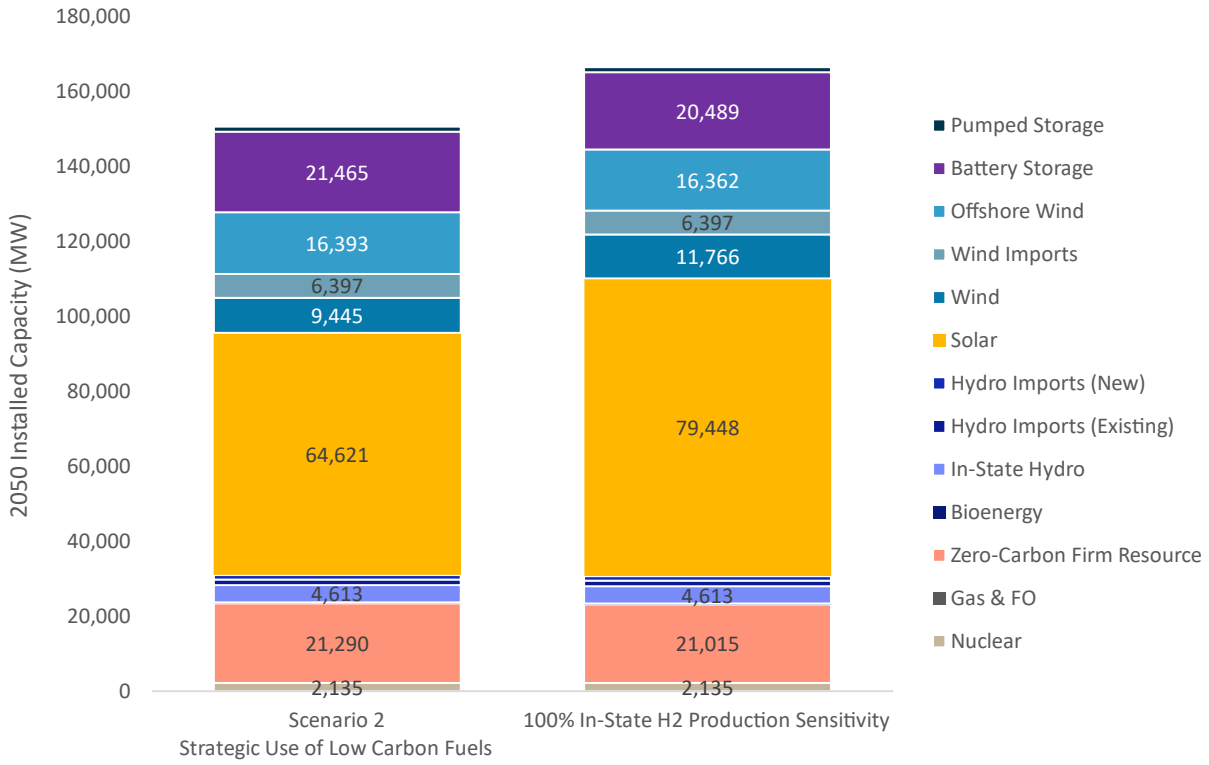
In each of the modeled pathways, New York is projected to rely on hydrogen usage as a key strategy to decarbonize sectors and applications that are difficult to electrify, in particular freight transportation, with consumption ranging between 100-225 TBtu across scenarios in 2050 (for more details, see the "Role of Hydrogen" section). All of New York's hydrogen demand is met with "green hydrogen," produced using electrolysis powered by renewable energy. For this analysis, the central assumption is that New York produces 50% of its hydrogen needs in-state and imports the remainder with cost assumptions for that imported remainder consistent with "green hydrogen" production. In addition, a sensitivity was performed on Scenario 2 to examine the impacts on the electric system resource mix of an alternative assumption of producing all (e.g., 100%) of New York's hydrogen demand in-state.

[50] The costs presented represent the costs relative to a Reference Case with equivalent levels of electrification loads, and as a result are not directly comparable to the electric sector costs presented in the economy-wide analysis, in which costs are measured relative to a Reference Case with Reference loads.

In Scenario 2, which has the highest reliance on hydrogen of the four scenarios, increasing in-state electrolysis loads to meet all of New York's hydrogen demand results in total electricity demand of over 350,000 GWh by 2050, with over 80,000 GWh of electrolysis loads needed to produce hydrogen.

The additional electrolysis loads in turn require additional dedicated renewables, with 2,300 MW of new onshore wind resources and 14,600 MW of new utility-scale solar developed to power the electrolyzers. The total in-state wind and solar capacity in the sensitivity analysis reaches 11,800 MW and 79,400 MW, respectively. The 2050 resource mix of this sensitivity is provided in comparison to the Scenario 2 resource mix in Figure 59 below.

**Figure 59. 2050 Installed Capacity, Scenario 2 and 100% In-State Hydrogen Production Sensitivity**



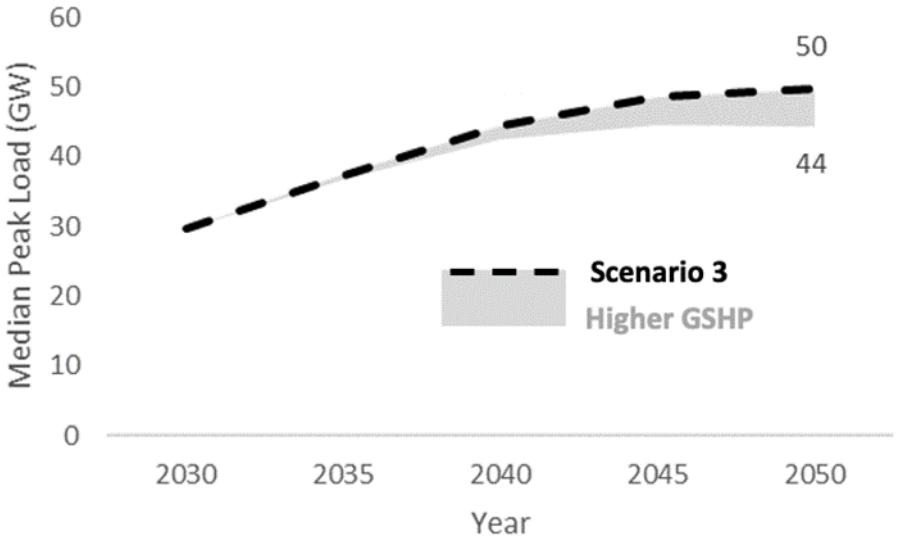

## *Ground Source / District Loop Heat Pump Deployment Sensitivity Analysis*

A high ground source/district loop heat pump system sensitivity was modeled to examine how more widespread use of ground source heat pumps and district geothermal systems could help reduce electric

grid system impacts from electrified space heating. This sensitivity was based on Scenario 3, and all measures are the same across scenarios except for the relative market share of heat pump technologies. This sensitivity represents a world view in which ground source/district heat pump systems help reduce electric grid system impacts from electrified space heating. The sensitivity includes an assumption of increasing ground source and district heat pump market penetration over time, with 40% of heat pump sales being assumed to be ground source/district heat pumps by 2035, 60% by 2040, and 80% by 2045.

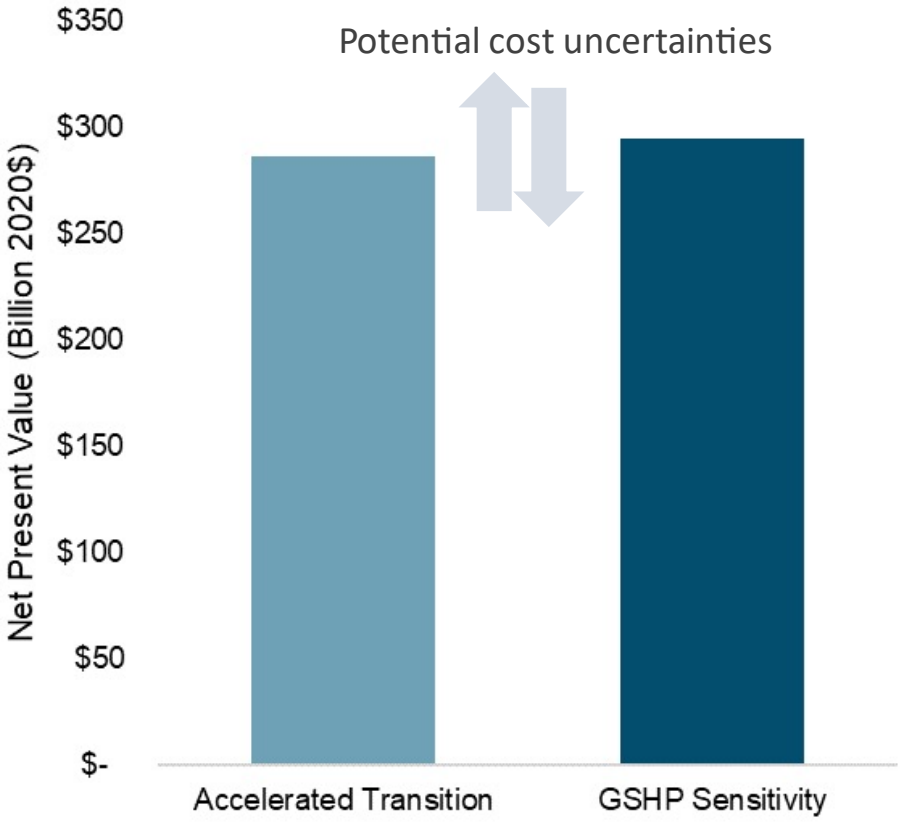
The higher penetration of ground source heat pumps and district geothermal heating in the ground source and district heat pump sensitivity lead to reduced annual and peak loads. Relative to Scenario 3, annual load is reduced by 5 TWh in 2040, from 267 to 262 TWh, and by 9 TWh in 2050, from 320 to 311 TWh. Median system peak loads are similarly impacted; 2040 peak is 2 GW lower than Scenario 3; 2050 peak is 5.4 GW lower.

**Figure 60. Higher Ground Source/District Heat Pump Sensitivity: Median Peak Loads Compared with Scenario 3**




The higher adoption of ground source/district heat pumps results in reduced electric sector costs and increased demand-side technology costs, for an overall increase in net NPV of about $10 billion relative to Scenario 3. Note that costs may shift due to significant uncertainty in cost of heat pump technologies, potential per-unit cost savings from district heating, potential evolution of heat pump peak performance, and the cost of electricity grid infrastructure. The large market size and uncertainty in pace of adoption indicates this sensitivity should be investigated further.

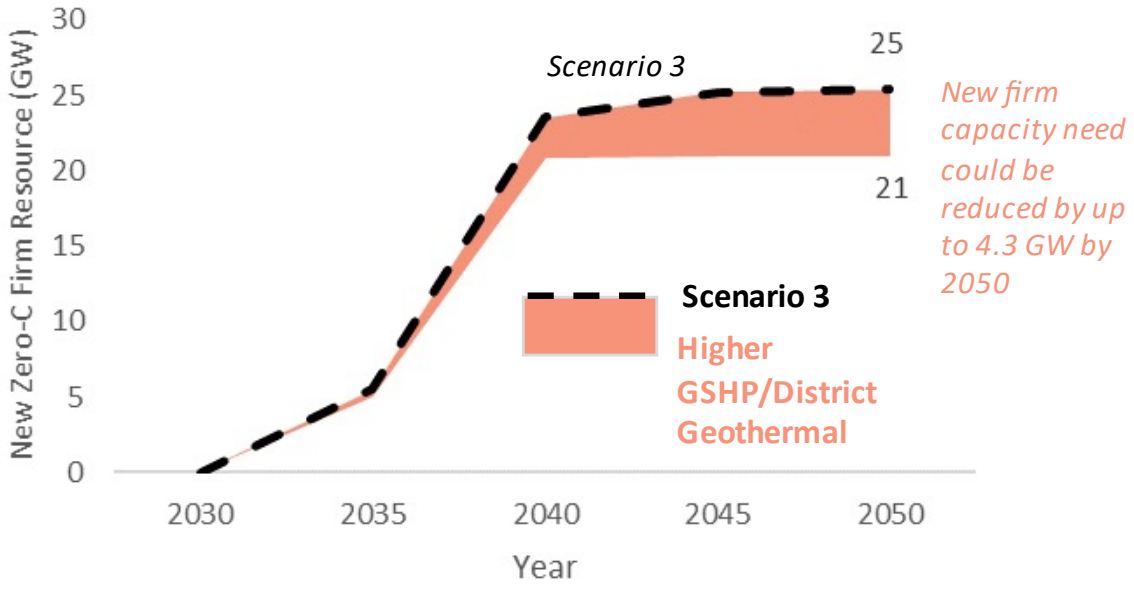
**Figure 61. NPV of System Cost for Ground Source/District Heat Pump Sensitivity Relative to Reference Scenario, Compared with Scenario 3**




The reduction in annual and peak loads results in small changes to selected electric system resource portfolios in the later years. In 2050, impacts to solar, land-based wind, and storage builds are very small; each are reduced by between 0.2 and 0.9 GW relative to Scenario 3. Offshore wind sees a slightly larger reduction of about 1.5 GW, likely driven by both lower energy and local capacity needs in Zones J and K, the 2050 requirements for which are lower than in Scenario 3 by 1.7 GW and 0.85 GW, respectively. The largest impact is to zero-carbon firm resource needs. In Scenario 3, 25 GW of zero-carbon firm resources are built by 2050, while in the GSHP sensitivity only 21 GW are needed.

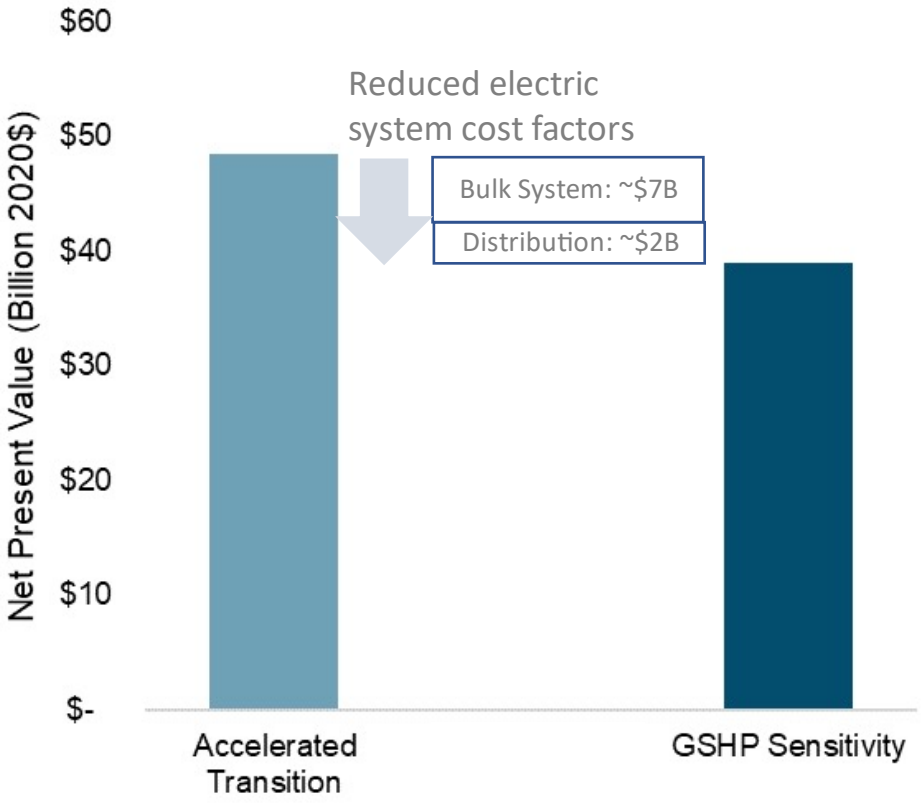
As shown in Figure 62, the reduction in peak demand leads to roughly 4 GW less of zero-carbon firm capacity needs in the electric sector.

**Figure 62. Zero-carbon firm capacity resources needed in Scenario 3 and High GSHP/District Geothermal sensitivity**




These builds are directly tied to peak capacity and reliability needs, which are lower in the GSHP sensitivity. Driven by the changes in system needs and resource builds, the ground source /district geothermal heat pump sensitivity leads to decreased electric system bulk costs of about $7B on an NPV basis, relative to Scenario 3, and reduced distribution system costs of about $2B on an NPV basis.

**Figure 63. NPV of Electricity Sector Relative to the Reference Scenario controlled for Electrification Loads ($B)[51]**




### *Treatment of Biogenic $CO_2$ under Net GHG Emissions Accounting*

In this analysis direct emissions from biogenic sources of $CO_2$ are included in both the gross and net GHG accounting. If biogenic $CO_2$ were omitted from the net GHG emissions accounting paradigm, Scenario 2 would include approximately $20 billion of additional GHG emissions benefits, a 5 percent increase, and Scenario 4 would include approximately $5 billion of additional GHG emissions benefits, a 1 percent increase. Cost reductions from less need for negative emissions technologies in Scenario 2 would be approximately $10 billion, a 3 percent decrease. Cost reductions from less need for additional methane emissions mitigation in Scenario 4 would be approximately $5 billion, a 2 percent decrease. This small

[51] The costs presented represent the costs relative to a Reference Case with equivalent levels of electrification loads, and as a result are not directly comparable to the electric sector costs presented in the economy-wide analysis, in which costs are measured relative to a Reference Case with Reference loads.

difference is well within the range of the cost uncertainty analysis, which is more than $150 billion across all scenarios.

# Chapter 4. Key Findings

The integration analysis finds that there are multiple pathways to achieving New York's Climate Act GHG emissions limits. Key findings based on the integration analysis include the following.

- **Achieving deep decarbonization is feasible by mid-century**. Achievement of emissions reductions to meet state law requires action in all sectors, especially considering New York State's novel emissions accounting. Every sector will see high levels of transformation over the next decade and beyond, requiring critical investments in New York's economy
- **Together, the benefits of avoiding economic impacts of damages caused by climate change and the improvements in public health total $400 – 420 billion**. Realizing these benefits will require an incremental investment over the 30-year transition of approximately 10 percent in additional spending, or $290 - $310 billion, in addition to redirecting the approximately $2.7 trillion in expected system spending under the reference case towards New York's low carbon future.
- **Energy efficiency and end-use electrification will be essential parts of any Pathway that hits NYS Emissions Limits**. Approximately 1 to 2 million efficient homes are electrified with heat pumps by 2030 across compliant scenarios. Approximately 3 million zero-emission vehicles (predominantly battery electric) are sold by 2030.
- **Consumer decision-making plays a large role, especially important for the purchase of new passenger vehicles and heating systems for homes and businesses through the next decade.** In all scenarios modeled, zero emission vehicles and heat pumps become the majority of new purchases by the late 2020s, and fossil-emitting cars and appliances are no longer sold after 2035.
- **New York will need to substantially reduce vehicle miles traveled while increasing transportation access**. This should include expansion of transit service structured around community needs, smart growth inclusive of equitable transit-oriented development, and transportation demand management.
- **Wind, water, and sunlight power most of New York's economy in 2050 in all Pathways**. Even with aggressively managed load, electric consumption doubles and peak nearly doubles by 2050, and NYS becomes a winter peaking system by 2035. Offshore wind on the order of 20 GW, solar on the order of 60 GW, and 4- and 8-hour battery storage on the order of 20 GW by 2050. Firm, zero-

emission resources, such as green hydrogen or long-duration storage, will play an important role to ensure a reliable electricity system beyond 2040.

- **Low-carbon fuels such as bioenergy or hydrogen may play a critical role in helping to decarbonize sectors that are challenging to electrify.** By 2030, scenarios include initial market adoption of green hydrogen in the following applications: medium and heavy-duty vehicles, and high-temperature industrial. Additional promising end-use applications include district heating and non-road transportation such as aviation and rail.
- **Large-scale carbon sequestration opportunities include lands and forests and negative emissions technologies.** Protecting and growing New York's forests is required for carbon neutrality. Negative emissions technologies (e.g., direct air capture of $CO_2$) may be required if the State cannot exceed 85% direct emissions reductions. Strategic land-use planning will be essential to balance natural carbon sequestration, agriculture activities, new renewables development, and smart urban planning.
- **Necessary methane emissions mitigation in waste and agriculture will require transformative solutions.** Diversion of organic waste, capture of fugitive methane emissions are key in the waste sector. Alternative manure management and animal feeding practices will be critical in reducing methane emissions in agriculture.
- **Continued research, development, and demonstration is key to advancing a full portfolio of options.** Additional innovation will be required in areas such as carbon sequestration solutions, long-duration storage, flexible electric loads, low-GWP refrigerants, and animal feeding.
- **Although benefits and costs are in the same range across mitigation scenarios, risk levels differ by scenario**. Although all scenarios involve a high degree of transformation across strategies and sectors, very high levels of transformation increase risk of delivering GHG emission reductions. Types of risk include reliance on technologies in early stages of *development* which require substantial innovation (e.g., negative emission technologies, carbon capture and storage, advanced low-carbon fuels), reliance on widespread adoption of technologies that are in the early stages of *deployment* (e.g., zero-emission vehicles, heat pumps), and reliance on strategies that require the highest levels of transformation of social institutions and business models (e.g., land use patterns, mobility practices, waste management).

# Chapter 5. Methods and Data

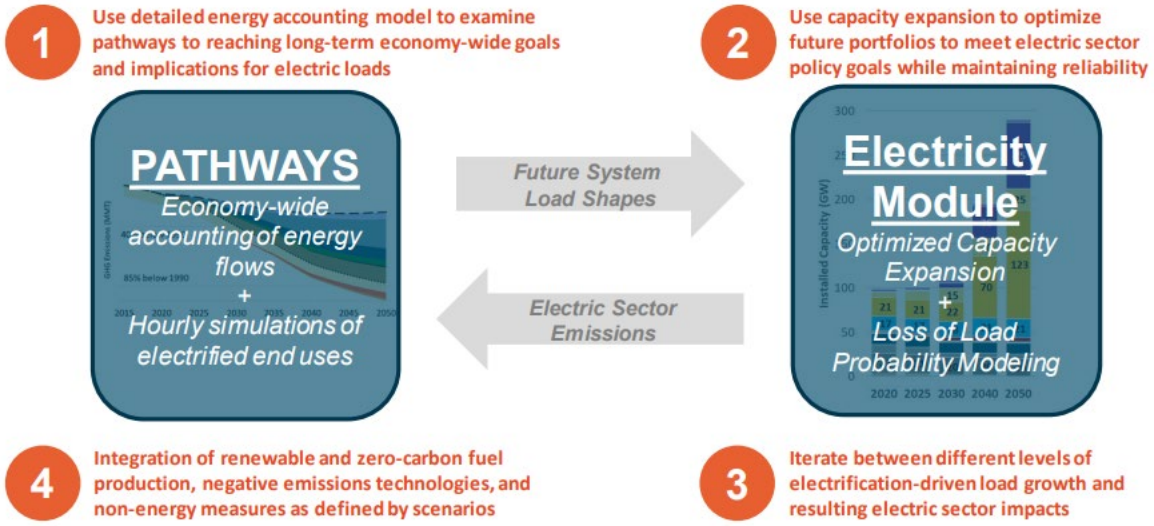
## 5.1 Methods

### *New York Pathways Model*

New York State Energy Research and Development Authority (NYSERDA) commissioned Energy and Environmental Economics, Inc. (E3) to investigate the transformation of New York State's economy to one which achieves the GHG requirements of the Climate Act. The study addresses New York's greenhouse gas emissions on an annual time scale, with key outputs including annual energy demand and emissions by fuel; stocks and sales of energy-consuming devices; and electricity supply infrastructure including both generation and transmission upgrades. Inputs to the models used in this study include sale shares of new devices (e.g., vehicles, building energy and efficiency systems), cost and performance characteristics of infrastructure (both supply- and demand-side), and projections of fuel prices.

To perform this analysis, E3 analyzed the evolution of energy demand, energy supply, and non-energy GHG emissions. E3 used a variety of tools in this analysis effort. A diagram of this multi-model framework is presented in Figure 64.

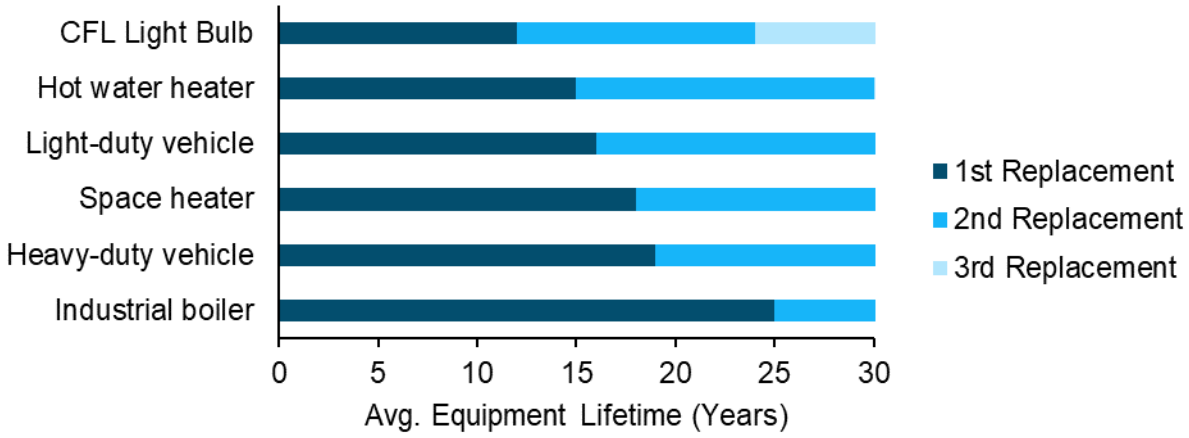
**Figure 64. Economy-wide energy model linked to electricity module**



This analysis used a suite of tools to characterize the evolution of New York energy infrastructure and emissions. The demand-side module calculated direct[52] energy use and associated GHG emissions, as well as non-combustion related emissions and sequestration. The demand-side module interacted with the low-carbon fuels and negative emissions technologies models, as well as the electricity modules. The electricity modules took electricity demand, projected by the demand-side module, and co-optimized investment and operations of the electric power system to meet electric load reliably while complying with applicable electric sector GHG emissions and renewable energy targets. The low-carbon fuels module calculated availability of low-carbon fuels, which were used within the demand-side module as an option to reduce emissions from fossil fuel combustion by substituting fossil fuel combustion with low-carbon fuel combustion.

The core analytical tool in analyzing energy demand was the New York PATHWAYS model. E3 developed the New York PATHWAYS model using the Low Emissions Analysis Platform (LEAP),[53] an application that tracks energy consumption and GHG emissions sources and sinks throughout the economy in user-defined scenarios. The time horizon for all scenarios is from 2018 to 2050; 2018 was selected as the base year because it was the most recent year for which complete federal and state data on energy consumption and GHG emissions were available when the study began, and 2050 was selected as

**Figure 65: Average equipment lifetimes for key technologies in PATHWAYS**




[52] Emissions from direct fuel use are emissions associated with fossil fuel combustion when fossil fuels provide energy service. For example, combusting natural gas to provide heat or combusting gasoline in an engine are examples of fossil fuel combustion which result in direct fuel use emissions. Indirect energy related emissions are emissions produced even when the fuel used at the device is GHG free. For example, electricity emits no GHG emissions at the point of use in buildings, industry, or transportation; nevertheless, the production of electricity may create emissions, and this report considers these indirect energy related emissions.

[53] Heaps, C.G., 2021. LEAP: The Low Emissions Analysis Platform. [Software version: 2020.1.49] Stockholm Environment Institute. Somerville, MA, USA. https://leap.sei.org

the final year to align with the final target year specified in the Climate Act. The New York PATHWAYS model outputs energy use and GHG emissions in all sectors of the economy except for emissions produced by electric generating units; these were represented in the RESOLVE electricity sector model and are described in more detail in the Electricity System subsection of this chapter. A key feature of PATHWAYS is its ability to characterize stock rollover in major equipment categories (energy uses in buildings and transportation fleets). By accounting for appliance and vehicle lifetimes, the stock rollover feature of PATHWAYS assists users in analyzing the rate of change necessary to achieve decarbonization goals and captures potential path dependencies. As shown in Figure 65, many energy-consuming devices have long lifetimes, meaning that timing for action is limited in terms of opportunities to replace fossil fuel-consuming devices with cleaner technologies before mid-century.

To characterize demand-side energy demand and associated emissions in this study, E3 used two approaches: a stock rollover approach for subsectors where sufficient data on the number and characteristics of energy-consuming devices were available, and a total energy approach where sufficient data were not available. In the stock rollover approach, E3 characterized infrastructure, energy, and emissions associated with energy consuming devices, as new devices were added and old devices were retired in each simulated year. In the total energy approach, E3 directly calculated energy consumption in each simulated year based on scenario-specific inputs regarding baseline energy demands, the amount of energy efficiency, potential for electrification, and potential for switching fossil fuel combustion to low-carbon fuel combustion. Non-energy sectors were represented by annual emissions by pollutant. A full representation of emissions categories is mapped out in Table 5.

**Table 5. Draft GHG Inventory Categories and Representation in NY Pathways Model**

| Emissions Category | | Emissions Sub-Category | GHGs Covered | Representation in NY Pathways Analysis |
|---|---|---|---|---|
| Energy | Fuel Combustion Emissions | Electricity | $CO_2$, $CH_4$, $N_2O$ | RESOLVE modeling, least cost optimization of capacity expansion and dispatch |
| | | Net Imports (of Electricity | $CO_2$, $CH_4$, $N_2O$ | RESOLVE modeling of imported electricity |
| | | Residential | $CO_2$, $CH_4$, $N_2O$ | PATHWAYS stock rollover analysis |
| | | Commercial | $CO_2$, $CH_4$, $N_2O$ | PATHWAYS stock rollover analysis |
| | | Industry | $CO_2$, $CH_4$, $N_2O$ | PATHWAYS total energy analysis |

| Emissions Category | | Emissions Sub-Category | GHGs Covered | Representation in NY Pathways Analysis |
|---|---|---|---|---|
| | | Transportation | $CO_2$, $CH_4$, $N_2O$ | PATHWAYS stock rollover analysis |
| | Upstream Fuel Emissions | Upstream Fuel Emissions | $CO_2$, $CH_4$, $N_2O$ | PATHWAYS stock rollover analysis; RESOLVE modeling |
| | Electricity Transmission and Distribution | Electricity Transmission and Distribution | $SF_6$ | Total emissions by pollutant |
| | Fugitive Emissions | Oil & Gas Systems | $CH_4$ | Total emissions by pollutant |
| Industrial Processes and Product Use | Minerals | Cement Production | $CO_2$ | Total emissions by pollutant |
| | | Soda Ash Use | $CO_2$ | Total emissions by pollutant |
| | | Limestone Use | $CO_2$ | Total emissions by pollutant |
| | Metals | Aluminum Production | $CO_2$, PFCs | Total emissions by pollutant |
| | | Iron & Steel Production | $CO_2$ | Total emissions by pollutant |
| | | Lead | $CO_2$ | Total emissions by pollutant |
| | | Ferroalloys | $CO_2$, $CH_4$ | Total emissions by pollutant |
| | Electronics | Semiconductor Manufacturing | PFC | Total emissions by pollutant |
| | Product Use | ODS Substitutes | HFC | Total emissions by pollutant |
| Waste | Solid Waste Disposal | Solid Waste Disposal | $CH_4$, $CO_2$ | Total emissions by pollutant |
| | Biological Treatment of Solid Waste | Compost and Anaerobic Digestion | $CH_4$ | Total emissions by pollutant |
| | Waste Combustion | Waste Combustion | $CO_2$, $CH_4$, $N_2O$ | Total emissions by pollutant |
| | Wastewater Treatment | Wastewater Treatment | $CH_4$, $N_2O$ | Total emissions by pollutant |
| AFOLU | Livestock | Enteric Fermentation | $CH_4$ | Total emissions by pollutant |
| | | Manure Management | $CH_4$, $N_2O$ | Total emissions by pollutant |
| | Aggregated Sources | Agricultural Soil Management | $N_2O$ | Total emissions by pollutant |
| | | Agricultural Soil Liming | $CO_2$ | Total emissions by pollutant |
| | | Settlement Soil Management | $N_2O$ | Total emissions by pollutant |
| | | Urea Fertilization | $CO_2$ | Total emissions by pollutant |

| Emissions Category | | Emissions Sub-Category | GHGs Covered | Representation in NY Pathways Analysis |
|---|---|---|---|---|
| | | Harvested Wood Products | $CO_2$ | Total emissions by pollutant |
| | Land | Forest Land | Net $CO_2e$ | Total emissions by pollutant |
| | | Cropland/Grassland | Net $CO_2e$ | Total emissions by pollutant |
| | | Wetlands | Net $CO_2e$ | Total emissions by pollutant |
| | | Settlement Land | Net $CO_2e$ | Total emissions by pollutant |
| | | Urban Trees | Net $CO_2e$ | Total emissions by pollutant |

### *Buildings*

The buildings sector in this study is subdivided into residential and commercial end use device types. Common energy demands for buildings include space conditioning, water heating, lighting, refrigeration, cooking, and a variety of other appliances.

E3 calculated buildings sector energy demand by breaking down energy demand into residential and commercial end use device types which provide distinct energy services and analyzing the energy demand of these end use devices. As an example, the annual energy demand for domestic hot water is the amount of fuel residential water heaters consume every year, while the energy services demand for residential water heating is the amount of hot water of a certain temperature which residences demand, regardless of water heater fuel type or efficiency of the technology delivering the hot water.

Energy demand for devices, in categories applying the stock rollover approach, was calculated by summing the energy demand for every end use device technology. In each simulated year, E3 calculated energy demand for each end use device technology by multiplying the energy service demand by the inverse of device efficiency. For example, if a residential household demanded 35 units of hot water per year and a natural gas water heater has an efficiency of 0.8 units of hot water output per unit of input natural gas, the demand for natural gas for water heating would be 35 * (1/0.8) = 43.75 units of natural gas. The stock rollover approach tracks the lifetimes and efficiencies of the fleet of devices within each end use device type and calculates the energy demand by summing the energy demand for each constituent end use device. For end uses where the total energy approach was applied, E3 characterized energy demand by fuel type directly based on scenario-specific user inputs characterizing energy

efficiency, potential for electrification, and potential for switching from fossil fuel combustion to low-carbon fuel combustion.

E3 simulated building energy and emissions based on data available from NEMS and the NYSERDA *Residential Statewide Baseline Study*. See Table 6 for a list of the end-use device category and the analysis approach used. Note that residential space heating was broken into different size classes to account for the differences in space heating demand by household size. This distribution was assumed to remain constant in future years – i.e., the portion of small single-family homes in the upstate region is constant as the total number of households evolves. For all other end uses, service demand was not differentiated for different household types.

The "Commercial District Heat" end use device type represents the heat demand for district heat located in New York City. A district heat system is one in which a central plant provides steam or hot water, pumped through a series of pipes to connected nearby buildings to provide space heating and/or hot water needs. The "Residential Other" and "Commercial Other" end use device types were characterized using the total energy approach to benchmark energy demand by fuel to account for all other energy demand within the residential and commercial buildings which do not appear in other end use device types. For example, residential televisions and computers demand electricity but their electricity demand was calculated within the "Residential Other" end use device type as E3 did not have detailed information on the number, efficiency, and usage patterns of televisions and computers within the state.

**Table 6. Building Sector Segmentation and Modeling Approach**

| Sector | Subsector | Modeling Approach | Estimated Energy Use in 2018 [TBtu] | Estimated % of 2018 Energy Use [%] |
|---|---|---|---|---|
| Residential | Residential Air Conditioning _ Central | Stock Rollover | 9.1 | 1% |
| | Residential Air Conditioning _ Room | Stock Rollover | 4.7 | 0% |
| | Residential Building Shell | Stock Rollover | N/A | N/A |
| | Residential Clothes Drying | Stock Rollover | 14.0 | 1% |
| | Residential Clothes Washing | Stock Rollover | 0.7 | 0% |
| | Residential Cooking | Stock Rollover | 29.6 | 2% |
| | Residential Dishwashing | Stock Rollover | 5.3 | 0% |
| | Residential Exterior Lighting | Stock Rollover | 1.5 | 0% |
| | Residential Freezing | Stock Rollover | 4.3 | 0% |
| | Residential General Service Lighting | Stock Rollover | 9.1 | 1% |
| | Residential Linear Fluorescent Lighting | Stock Rollover | 2.2 | 0% |
| | Residential Other | Total Energy by Fuel | 55.5 | 4% |
| | Residential Reflector Lighting | Stock Rollover | 2.3 | 0% |
| | Residential Refrigeration | Stock Rollover | 26.9 | 2% |
| | Residential Space Heating _ Large Multi Family | Stock Rollover | 96.3 | 6% |

| Sector | Subsector | Modeling Approach | Estimated Energy Use in 2018 [TBtu] | Estimated % of 2018 Energy Use [%] |
|---|---|---|---|---|
| | Residential Space Heating _ Single Family | Stock Rollover | 316.2 | 21% |
| | Residential Space Heating _ Small Multi Family | Stock Rollover | 142.3 | 9% |
| | Residential Water Heating | Stock Rollover | 129.4 | 9% |
| Commercial | Commercial Air Conditioning | Stock Rollover | 18.6 | 1% |
| | Commercial Building Shell | Stock Rollover | N/A | N/A |
| | Commercial Cooking | Stock Rollover | 34.2 | 2% |
| | Commercial District Heat | Total Energy by Fuel | 14.6 | 1% |
| | Commercial General Service Lighting | Stock Rollover | 7.6 | 1% |
| | Commercial High Intensity Discharge Lighting | Stock Rollover | 2.0 | 0% |
| | Commercial Linear Fluorescent Lighting | Stock Rollover | 35.3 | 2% |
| | Commercial Other | Total Energy by Fuel | 169.2 | 11% |
| | Commercial Refrigeration | Stock Rollover | 24.8 | 2% |
| | Commercial Space Heating | Stock Rollover | 270.6 | 18% |
| | Commercial Ventilation | Stock Rollover | 24.0 | 2% |
| | Commercial Water Heating | Stock Rollover | 66.0 | 4% |

### *Industrial Energy Use*

The Industry: Energy sector includes all energy and emissions associated with fuel combustion within New York's industries. Non-combustion emissions related to industrial processes and product use are covered separately. E3 used a total energy approach to characterize the industrial subsectors. Base year energy use by industrial subsector and region is reported in Table 7.

**Table 7. Industrial Fuel Demand by Subsector and NY Pathways Region [TBtu]**

| Subsector | Upstate NY A-E | Upstate NY F | Downstate NY - Lower Hudson Valley | Downstate NY - Long Island | Downstate NY - New York City | Total |
|---|---|---|---|---|---|---|
| Agriculture | 5.1 | 0.8 | 0.3 | 0.1 | 0.0 | 6.3 |
| Aluminum | 3.2 | 0.7 | 0.1 | 0.1 | 0.0 | 4.1 |
| Cement and Lime | 0.0 | 5.5 | 1.2 | 0.1 | 0.0 | 6.8 |
| Bulk Chemicals | 13.8 | 2.8 | 0.6 | 0.4 | 0.7 | 18.2 |
| Construction | 5.3 | 1.3 | 3.4 | 4.9 | 5.4 | 20.3 |
| Food | 8.2 | 2.5 | 2.0 | 0.5 | 2.0 | 15.2 |
| Glass | 5.0 | 0.8 | 0.1 | 0.3 | 0.5 | 6.7 |
| Iron and Steel | 10.8 | 0.0 | 0.3 | 0.0 | 1.4 | 12.5 |
| Metal Based Durables | 13.7 | 1.0 | 2.5 | 2.3 | 1.3 | 20.8 |
| Mining | 6.6 | 0.3 | 1.0 | 0.5 | 1.2 | 9.5 |
| Other Manufacturing | 19.4 | 12.3 | 7.3 | 6.7 | 5.9 | 51.6 |
| Paper | 18.8 | 9.3 | 2.9 | 3.0 | 4.8 | 38.8 |
| Plastics | 4.4 | 0.3 | 0.3 | 0.5 | 0.5 | 6.0 |
| Wood Products | 2.1 | 1.1 | 0.3 | 0.8 | 0.4 | 4.6 |
| **Total** | **116.5** | **38.4** | **22.3** | **20.2** | **24.1** | **221.5** |

## *Transportation*

The transportation sector includes a representation of on-road vehicles (e.g., passenger cars) and non-road transportation (e.g. aviation). For most on-road vehicle categories, E3 applied a stock rollover approach, but for non-road vehicle categories a total energy approach was used. See Table 8 for an overview of analysis approach by vehicle category.

**Table 8. Transportation Sector Segmentation and Modeling Approach**

| Subsector | Modeling Approach | Estimated Energy Use in 2018 [Tbtu] | Estimated % of 2018 Energy Use [%] |
|---|---|---|---|
| Light Duty Vehicles _ Cars | Stock Rollover | 273.0 | 25% |
| Light Duty Vehicles _ Trucks | Stock Rollover | 454.0 | 42% |
| Medium Duty Vehicles | Stock Rollover | 78.0 | 7% |
| Heavy Duty Vehicles | Stock Rollover | 68.0 | 6% |
| Buses | Stock Rollover | 19.0 | 2% |
| Aviation | Total Energy by Fuel | 104.0 | 10% |
| Marine | Total Energy by Fuel | 3.6 | 0% |

| Subsector | Modeling Approach | Estimated Energy Use in 2018 [Tbtu] | Estimated % of 2018 Energy Use [%] |
|---|---|---|---|
| Military | Total Energy by Fuel | 0.3 | 0% |
| Railroad | Total Energy by Fuel | 6.7 | 1% |
| Pipelines | Total Energy by Fuel | 27.3 | 3% |
| Other Nonroad: Industrial/Commercial | Total Energy by Fuel | 13.7 | 1% |
| Other Nonroad: Construction | Total Energy by Fuel | 1.0 | 0% |
| Other Nonroad: Agricultural | Total Energy by Fuel | 0.2 | 0% |
| Other Nonroad: Public Nonhighway | Total Energy by Fuel | 0.2 | 0% |
| Other Nonroad: Miscellaneous/Unclassified | Total Energy by Fuel | 0.0 | 0% |
| Other Nonroad: Lawn and Garden | Total Energy by Fuel | 16.0 | 1% |
| Other Nonroad: Marine/Boating | Total Energy by Fuel | 10.7 | 1% |
| Other Nonroad: Recreational Vehicle | Total Energy by Fuel | 7.2 | 1% |
| Other Nonroad | Total Energy by Fuel | 3.4 | 0% |

The unit of energy service demand for vehicle categories simulated with a stock rollover approach in transportation (Light Duty Autos, Light Duty Trucks, Medium Duty Trucks, Heavy Duty Trucks, and Buses) is VMT. The underlying future VMT growth in the Reference scenario was estimated using VisionEval-State, a disaggregate demand/aggregate supply travel demand model, combining the rich demographic and socioeconomic detail of simulated households with aggregate treatments of travel calibrated for New York State.[54] Modeled VMT reduction measures fall into three broad categories: enhanced transit & mobility, telework & transportation demand management (TDM), and smart growth & biking/walking modeshifting. In all scenarios, we assume a targeted effort to expand programs and policies in the 2020s and 2030s, with continuous investment to maintain levels of reductions beyond 2035 through mid-century. VMT reductions are high-level estimates meant to represent ambitious action in reducing VMT relative to a Reference scenario. The following is a brief description of the VMT reduction measures attributed to each scenario, while Table 9 and Table 10 show impacts of the VMT reductions by measure achieved by 2050.

[54] VMT modeling using VisionEval-State was conducted by RSG/Cadmus and leverages the Clean Transportation Roadmap modeling framework, which was calibrated to latest available starting year VMT data (2017)

**Enhanced Transit & Mobility:**

- Low VMT (Scenarios 1-3): Expansion in bus transit service statewide, enhanced transit service taken from Carbon Neutral NYC report.
- Very Low VMT (Scenario 4): Incremental reductions from enhanced in-state rail aligning with 125 MPH alternative detailed in Empire Corridor Tier 1 Draft EIS

**Telework & TDM:**

- Low VMT (Scenarios 1-3): Additional promotion and informational TDM programs and modest increase in teleworking reduces a small amount of VMT, while in NYC additional programs like congestion pricing and other measures modeled in Carbon Neutral NYC further reduce VMT, although we do not include full Carbon Neutral NYC impacts in this case
- Very Low VMT (Scenario 4): Further ambition statewide reduce LDV VMT and full adoption of congestion pricing and other policies in Carbon Neutral NYC reduce NYC VMT. Similarly to the Low VMT case, maximum reductions are achieved in the mid-2030s and maintained through 2050

**Smart Growth & Biking/Walking Modeshifting:**

- Low VMT (Scenarios 1-3): Focus on transportation-oriented development for new construction leads to reduced LDV VMT, with VMT impacts estimated using methodology from Growing Cooler report
- Very Low VMT (Scenario 4): Assume incremental ambition in smart growth development in co-locating residential and commercial development, and incremental ambition in biking/walking infrastructure investments, all which lead to greater reductions.

**Table 9. 2050 VMT Reduction Measures in Scenarios 1-3**

| Measure | State Total (million VMT) | Reduction vs Reference (%) | Sources[55] |
|---|---|---|---|
| 2050 Reference | 140,400 | N/A | N/A |
| *VMT Reductions:* | | | |
| Enhanced Transit and Mobility | 3,700 | 3% | Carbon Neutral NYC, E3 Internal Analysis |
| Telework and TDM | 2,300 | 2% | Carbon Neutral NYC, UCR COVID Impacts Study, FHWA Integrating TDM into the Transportation Planning Process |
| Smart Growth and Biking/Walking/Modeshifting | 2,900 | 2% | Carbon Neutral NYC, Growing Cooler: The Evidence on Urban Development and Climate Change |
| **Total Reductions** | **8,800** | **6%** | |

[55] Carbon Neutral NYC: https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf, accessed November 2021

UCR Covid Impacts Study: https://ucreconomicforecast.org/wp-content/uploads/2020/08/Mobility_Emissions_COVID19_CEFD_White_Paper_August_2020.pdf, accessed November 2021

FHWA Integrating TDM Into the Transportation Planning Process: https://ops.fhwa.dot.gov/publications/fhwahop12035/chap10.htm, accessed November 2021

Growing Cooler: The Evidence on Urban Development and Climate Change: https://www.nrdc.org/sites/default/files/cit_07092401a.pdf, accessed November 2021

**Table 10. 2050 VMT Reduction Measures in Scenario 4**

| Measure | State Total (million VMT) | Reduction vs Reference (%) | Sources[56] |
|---|---|---|---|
| 2050 Reference | 140,400 | N/A | N/A |
| *VMT Reductions:* | | | |
| Enhanced Transit and Mobility | 3,700 | 3% | Carbon Neutral NYC, E3 Internal Analysis |
| Telework and TDM | 7,200 | 5% | Carbon Neutral NYC, UCR COVID Impacts Study, FHWA Integrating TDM into the Transportation Planning Process |
| Smart Growth and Biking/Walking/Modeshifting | 10,800 | 8% | Carbon Neutral NYC, Growing Cooler: The Evidence on Urban Development and Climate Change |
| **Total Reductions** | **21,700** | **16%** | |

As E3 used a total energy approach for calculating energy demand and associated GHG emissions in the non-stock vehicle categories (e.g. aviation, marine), there is no fundamental energy service demand driver which is separate from energy demand for these non-stock vehicle categories.

Scenario 4 includes greater ambition in on-road transportation reductions (from greater VMT reductions and aggressive electrification levels) as well as greater levels of non-road ambition (such as increased rail, electric and hydrogen aviation); we include estimates for costs associated with this greater ambition, as summarized in Table 11.

[56] See footnote 55

**Table 11. Transportation-related Incremental Costs Associated with Scenario 4**

| Measure | Per-Unit Cost | Units | Sources[57] |
|---|---|---|---|
| VMT Reductions[58] | $.0309/mile | 14 billion LDV miles reduced relative to Scenarios 2/3 in 2050 | $/mile reduction costs based on Moving Cooler estimates |
| Rail Improvements | $6/mile | 200 million LDV miles reduced relative to Scenarios 2/3 in 2050 | Empire Corridor Draft 1 Tier EIS |
| Electric and Hydrogen Aviation Infrastructure | $30/MMBtu | 60 Tbtu in 2050 [47% of all aviation energy consumption in 2050] | E3 analysis of white paper on hydrogen fueling infrastructure in EU |

## *Electricity System*

### Electricity Load Shaping

Electrification is a central strategy to achieving New York's long-term climate goals. The scenarios in this study include significant adoption of electric vehicles and electrification of building heating systems, which will have an impact on both the magnitude and timing of electricity demands. This section describes the methods used in this study to convert annual electric load forecasts, calculated for each sector and end use device, into hourly electric load forecasts.

In this study, E3 scaled historical system load shape to future years, and this formed the basis of the hourly load forecast. E3 started with historical hourly load data, calculated by averaging 5-minute historical load data available from the NYISO. E3 used historical hourly load data from 2007-2012 to align with the calendar chronology of the renewable profiles used in this study.

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[57] Moving Cooler: http://www.reconnectingamerica.org/assets/Uploads/2009movingcoolerexecsumandappend.pdf, accessed November 2021

Empire Corridor Draft 1 Tier EIS: https://railroads.dot.gov/environment/environmental-reviews/empire-corridor, accessed November 2021

EU Hydrogen Aviation Study: https://www.fch.europa.eu/sites/default/files/FCH%20Docs/20200720_Hydrogen%20Powered%20Aviation%20report_FINAL%20web.pdf, accessed November 2021

[58] Scenario 2 and Scenario 3 include 9 billion LDV miles reduced in 2050 relative to Reference scenario, from enhanced transit and mobility; telework and travel demand management; smart growth and mode shifting to biking/walking; No $/mile cost was assessed for tranche of VMT reduction achieved in Scenarios 2-3. Table above shows incremental investment relative to Scenarios 2-3

E3 combined annual forecasted electricity demand by end use with normalized hourly load shapes by end use to create hourly end use load shapes in forecasted years. This methodology accounts for both load increases, such as electrifying buildings and vehicles, as well as load decreases, such as increased appliance efficiency (for example, LEDs have significantly lower loads than conventional lighting technologies). This process generated hourly load shapes based on the changing composition of end uses. For each forecasted year, hourly loads were simulated for six sequential weather years (2007-2012) to align with the calendar chronology of the renewable profile library developed for this study.

To calculate hourly load shapes for two particularly impactful set of electrified end uses (light duty transportation and electric space heating), E3 used E3's RESHAPE Tool. RESHAPE is designed to capture the diversity of space heating and transportation loads under higher levels of electrification. The tool does this by representing a diverse housing stock, including geographically explicit weather data, and using empirical estimates of hourly energy usage where possible.

E3 also used a regression analysis to extend historical system load shapes over 40 years (1979-2018) of daily temperature data. Combined with RESHAPE analysis that modeled the impacts of historical weather on electrified heating and cooling end uses, E3 developed hourly system loads for a future highly electrified system (i.e. representative of a modeled decarbonization pathway in 2050) over 40 years of historical temperature data to analyze median (1-in-2) system peaks.

### Electric Sector Framework

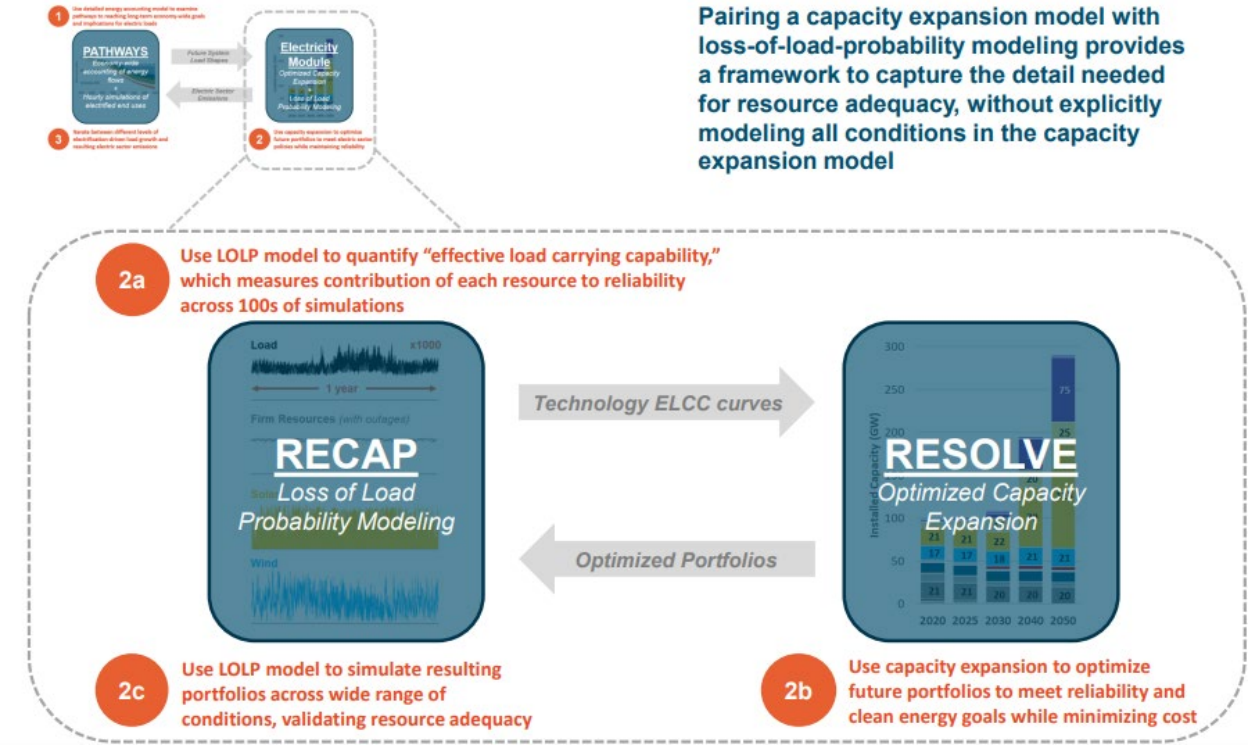
The electric sector analysis was performed using E3's capacity expansion and resource adequacy models, RESOLVE and RECAP. RESOLVE is an electricity-sector resource investment model that optimizes long-term generation and transmission investments subject to reliability, technical, and policy constraints. RECAP is a resource adequacy model that performs loss-of-load probability simulations to determine the reliability of resource portfolios. RECAP analysis was used in this work to determine the effective load-carrying capability (ELCC) of wind, solar, and battery storage resources. With annual and hourly load projections from PATHWAYS and ELCC curves from RECAP serving as inputs, RESOLVE was used to develop least-cost electricity generation portfolios that achieved New York's policy goals while maintaining electric system reliability.

The RESOLVE model was used in this study to determine the least-cost pathway to meeting New York's electric sector targets, including the requirement under the Climate Act to generate 70% of New York's electricity from renewable resources by 2030 and eliminate greenhouse gas emissions from the state's

electricity generation by 2040. Designed specifically to address electric sector capacity expansion questions for systems seeking to integrate large quantities of variable resources, RESOLVE layers capacity expansion logic on top of a production cost model to determine the least-cost approach to achieving renewable resource targets, accounting for both the upfront capital costs of new resources and infrastructure and the variable costs to operate the grid reliably over time. As the nature of electric system loads evolves over time, RESOLVE also captures key changes in demand-side behavior, such as increased flexibility in building loads and electric vehicle charging.

This study also used RECAP, a resource adequacy model that performs loss-of-load probability (LOLP) simulations, to assess the ability of renewable power generation and limited-duration storage to contribute to electric system reliability by determining the effective load-carrying capability (ELCC) of wind, solar, and storage resources as a function of their penetration on the system. ELCC curves developed in RECAP served as inputs to RESOLVE, which ensures that the simulated New York system meets system-wide and local resource adequacy constraints. Resulting portfolios in RESOLVE were also tested again in RECAP to validate resource adequacy and ensure that the portfolios met or exceeded statewide reliability standards (i.e., with LOLE at or below 1-day-in-10-years). Iteration between RECAP and RESOLVE is shown in Figure 66 below.

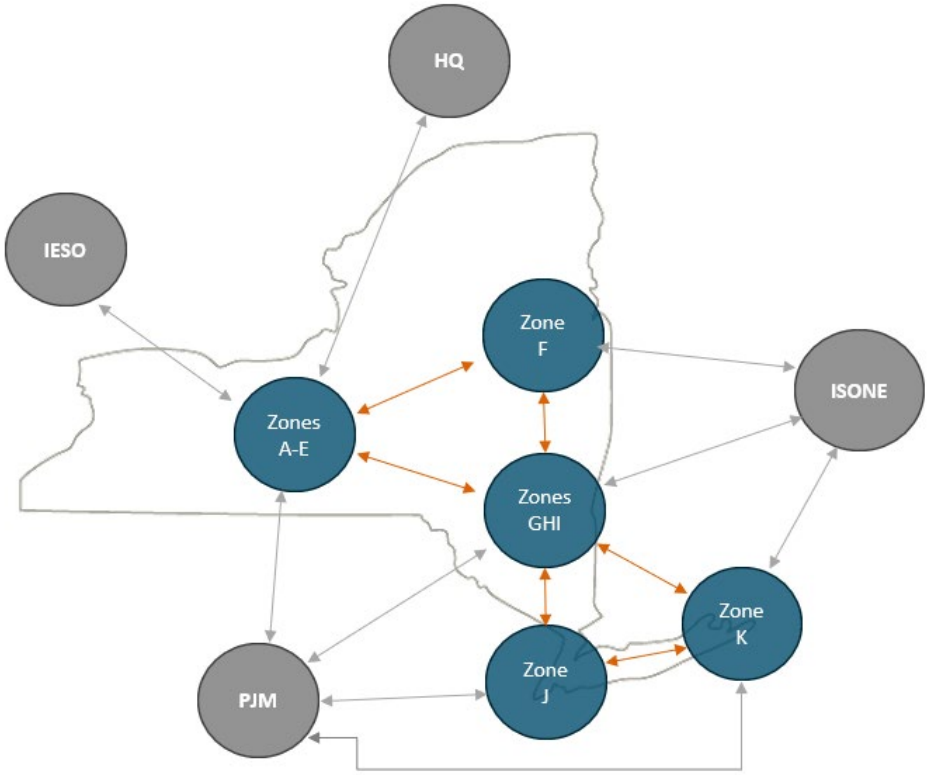
**Figure 66. Interactions between RECAP and RESOLVE within Electricity Module**



*Representation of New York and Neighboring Systems within RESOLVE*

RESOLVE has been configured to capture the operations of the New York electricity system as well as its interactions with neighboring power systems in the United States and Canada. For this study, RESOLVE was configured with nine zones: five internal zones representing zones A-E, zone F, zones G-I, zone J, and zone K within the New York electricity system; and four zones representing the external markets that interact with New York. The characterization of existing generators in New York was developed based on the NYISO Gold Book; more detail is provided in Annex 1.[59]

**Figure 67. Representation of New York and Neighboring Electricity Systems in RESOLVE**




[59] New York Independent System Operator, 2020 Load & Capacity Data "Gold Book", April 2020, supplemented by updates in the 2021 edition of the Gold Book: https://www.nyiso.com/documents/20142/2226333/2020-Gold-Book-Final-Public.pdf/, accessed November 2021

Within this configuration, RESOLVE optimizes investments only on behalf of the five New York zones[60] while optimizing the integrated operations of the entire system. Conditions and assumptions for the future loads and resources of neighboring markets are specified as inputs. RESOLVE's optimization capabilities allow it to select from among a wide range of potential new resources ("candidate resources"). The full range of resource options considered by RESOLVE in this study is shown in Table 12.

**Table 12: Candidate Resources in RESOLVE**

| Candidate Resource | Examples of Available Options | Functionality |
|---|---|---|
| Natural Gas Generation* | Simple cycle gas turbines<br>Combined cycle gas turbines | Dispatches economically based on heat rate, subject to ramping limitations<br>Contributes to meeting minimum generation and ramping constraints |
| Hydrogen Fuel Cells | Polymer electrolyte membrane (PEM) fuel cells | Dispatches economically based on efficiency<br>Contributes to meeting minimum generation and ramping constraints |
| Hydro Generation / Imports | Upgrades of Existing In-state Hydro<br>New Canadian Hydro Imports (coupled with Tier 4 transmission) | Imports from Hydro Quebec (HQ) are budget-limited over course of year, but are highly flexible resources and contribute to balancing renewables output |
| Renewable Generation | Utility-Scale Solar PV<br>Distributed Solar PV<br>Land-based Wind<br>Offshore Wind | Dynamic downward dispatch (with cost penalty) of renewable resources to help balance load |
| Energy Storage | Li-ion Batteries (4-hour or 8-hour)<br>Pumped Storage (12 hr) | Stores excess energy for later dispatch<br>Contributes to meeting minimum generation and ramping constraints |
| Transmission | Tier 4 Projects<br>Transmission upgrades required to access renewable resources | Power transfer between zones is constrained by transmission limits<br>New renewable resources will require additional transmission upgrades within the NYISO zone they are located |

*Natural gas generation resources can utilize zero-carbon fuels (e.g. hydrogen) in order to continue operating while being in compliance with the Climate Act 100x40 target.

[60] The optimization of investments on behalf of New York includes the ability to develop remote resources (e.g., PJM wind) that are delivered to serve New York load, but does not optimize the build-out of new generation portfolios to serve load in external areas.

To represent the costs of building new thermal generation (i.e. CT or CCGT), E3 used the NYISO Demand Curve study to develop zone-specific cost estimates for new resources.[61] E3 also applied a 25% cost increase to new resources that are projected to utilize hydrogen in order to continue operating under the Climate Act's 100x40 target.

To develop cost and potential estimates for candidate renewable energy resources, E3 relied on New York-specific and zonal-specific cost estimates developed as part of the Clean Energy Standard Cost Study as well as recent project data from the NY-Sun database for distributed solar resources.[62,63] For offshore wind, cost estimates were developed for fixed-bottom resources based on the CES Cost Study, and a multiplier for floating OSW resources was derived from NREL's Annual Technology Baseline (ATB) projections.[64] This study assumes that floating OSW resources are ultimately delivered into Zone J, which could be achieved through interconnection directly into Zone J or through interconnection into Zone K coupled with the development of new export capability from Zone K to Zone J. Future cost declines for each technology were applied to the zone-specific cost estimates based on projected cost trajectories from the CES Cost Study and NREL's ATB projections.

Hourly generation shapes for renewable resources were developed using NREL's Wind Integration National Dataset (WIND) Toolkit and NREL's System Advisor Model (SAM) simulator for wind and solar resources, respectively.[65,66] Hourly generation profiles were developed for each renewable resource in each NYISO zone to capture geographic and weather differences and associated resource diversity across New York State. Generation profiles and capacity factors for solar resources also capture

[61] Analysis Group, Independent Consultant Study to Establish New York ICAP Demand Curve Parameters for the 2021/2022 through 2024/2025 Capability Years – Interim Final Draft Report, August 2020, https://www.nyiso.com/documents/20142/14404876/Analysis%20Group%20Interim%20Final%20Demand%20Curve%20Reset%20Report.pdf/214567fb-b960-233f-bcda-4b919678bce4, accessed November 2021

[62] NYSERDA and DPS, Clean Energy Standard White Paper, Appendix A – Cost Study, prepared in collaboration with Sustainable Energy Advantage, LLC (SEA), June 2020, Case Number 15-E-0302, available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?Mattercaseno=15-E-0302., accessed November 2021

[63] NYSERDA, NY-Sun OpenNY Data, available at: https://data.ny.gov/Energy-Environment/Solar-Electric-Programs-Reported-by-NYSERDA-Beginn/3x8r-34rs, accessed November 2021

[64] National Renewable Energy Laboratory (NREL), Annual Technology Baseline 2020, available at: https://atb-archive.nrel.gov/electricity/2020/data.php, accessed November 2021

[65] NREL, Wind Integration National Dataset Toolkit, https://www.nrel.gov/grid/wind-toolkit.html, accessed November 2021

[66] NREL, System Advisor Model, https://sam.nrel.gov/, accessed November 2021

differences in installation configurations, with utility-scale solar candidate resources based on a single-axis tracking system and distributed solar resources based on fixed tilt projects.

Candidate resources in RESOLVE also include both 4-hour and 8-hour Lithium-ion batteries; the cost estimates for battery storage were developed using Lazard's Levelized Cost of Storage report as well as NREL's ATB long-term projections.[67]

In Scenario 3, fuel cell resources are available as a candidate resource to provide firm zero-carbon capacity while avoiding combustion. The costs and operating characteristics are derived from the Department of Energy's Fuel Cell Office technical targets, with cost declines that mirror projected cost declines for hydrogen electrolyzers.[68]

More details on the characterization of candidate resources is available in Annex 1.

*Operational Simulation*

RESOLVE's optimization includes the annual cost to operate the electric system across RESOLVE's footprint; this cost is quantified using a linear production cost model embedded within the optimization. The following are key components of the RESOLVE model and its representation of the operations of New York's electricity system:

**Zonal transmission topology:** RESOLVE uses a zonal transmission topology to simulate flows among New York and its neighbors. RESOLVE includes nine zones: five zones capturing the New York system and four zones representing neighboring power systems.

**Aggregated generation classes:** rather than analyzing each generator within the study footprint independently, generators in each region are grouped together into categories with other plants whose

[67] Lazard, Levelized Cost of Storage Analysis-Version 6.0, October 2020, available at: https://www.lazard.com/media/451566/lazards-levelized-cost-of-storage-version-60-vf2.pdf, accessed November 2021

[68] U.S. Department of Energy, Hydrogen and Fuel Cell Technologies Office, Multi-Year Research, Development, and Demonstration Plan, https://www.energy.gov/eere/fuelcells/articles/hydrogen-and-fuel-cell-technologies-office-multi-year-research-development, accessed November 2021

operational characteristics are similar (e.g., nuclear, gas CCGT, gas peaker, and fuel oil peaker[69]). Grouping like plants together for the purpose of simulation reduces the computational complexity of the problem without significantly impacting the underlying economics of power system operations.

**Linearized unit commitment:** RESOLVE includes a linear version of a traditional production simulation model. In RESOLVE's implementation, this means that the commitment variable for each class of generators is a continuous variable rather than an integer variable, which significantly reduces the amount of time the model needs to solve. Additional constraints on each generator class (e.g., minimum and maximum power output, ramp rate limits, minimum up and down time) are included to represent their operational characteristics and limitations.

**Co-optimization of energy & ancillary services:** RESOLVE includes reserve requirements in its generator dispatch, which is co-optimized to meet load while simultaneously reserving flexible capacity within NYISO to meet the contingency and flexibility reserve needs across the New York zones.[70]

**Smart sampling of days:** whereas production cost models are commonly used to simulate an entire calendar year (or multiple years) of operations, RESOLVE simulates the operations of the NY system for 30 independent days. Load, wind, and solar profiles for these 30 days, sampled from the historical meteorological record of the period 2007-2012, were selected and assigned weights so that taken in aggregate, they produced a representation of complete distributions of potential conditions. Daily hydro conditions were sampled separately from the period 1970-2016 to provide a complete distribution of potential hydro conditions. This allows RESOLVE to approximate operating costs and dynamics over an entire year while simulating operations over a smaller subset of days.

*Resource Adequacy Modeling Framework*

In addition to the operational constraints and hourly simulation described above, RESOLVE includes a statewide planning reserve margin (PRM) constraint and local capacity requirements (LCRs) as a function of system and local peaks, consistent with current NYISO requirements. To ensure that the system

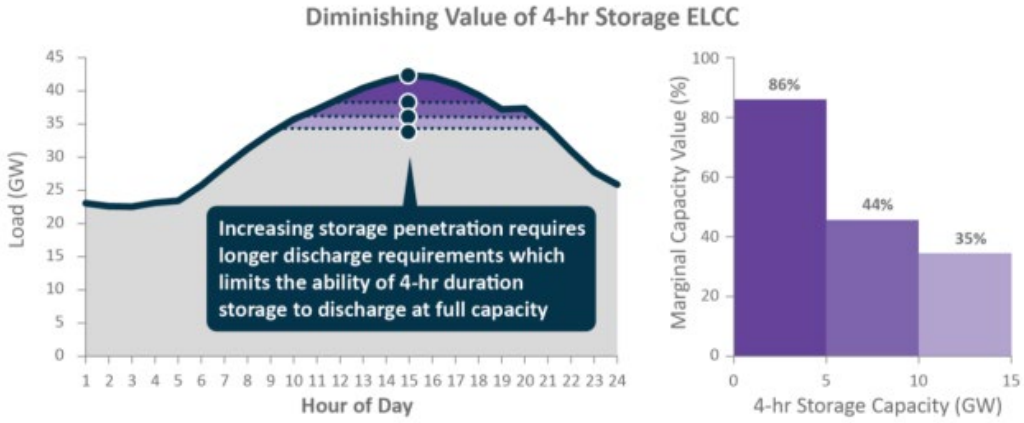
[69] "Peakers" is used very broadly in this study to refer to units with high heat rates and does not refer to a specific technology or to units below a certain capacity factor.

[70] Ancillary services, such as contingency and flexibility reserves, are services necessary to maintain electric system reliability that are provided outside of day-ahead and real-time energy markets.

remains reliable under changing load and resource conditions, the PRM and LCR constraints are applied on an unforced capacity[71] (UCAP) basis and capture the reliability contributions of renewables and storage through ELCC curves developed in RECAP. RECAP performs loss-of-load probability modeling over hundreds of simulated operating years, using 40 years (1979-2018) of weather data to capture linkages between weather, loads, and renewable generation conditions.

ELCC is the quantity of "perfect capacity" that could be replaced or avoided with renewables or storage while providing equivalent system reliability. For example, an ELCC value of 50% means that the addition of 100 MW of a variable resource could displace the need for 50 MW of perfect capacity without compromising reliability. For an individual intermittent or limited-duration resource, ELCC decreases with increasing penetration. As penetration of renewable resources increases, the net peak shifts to hours with less renewable production, which limits the ELCC that the next tranche of that renewable resource can provide. Storage also yields diminishing returns owing to increase in duration of the net peak; the net peak that remains after a tranche of storage is dispatched is longer in duration than it previously was, as illustrated in Figure 68. Combining resources of different types can yield a total ELCC that is less than or greater than the sum of its parts; an example of this dynamic is shown in Figure 69 for solar and storage resources.

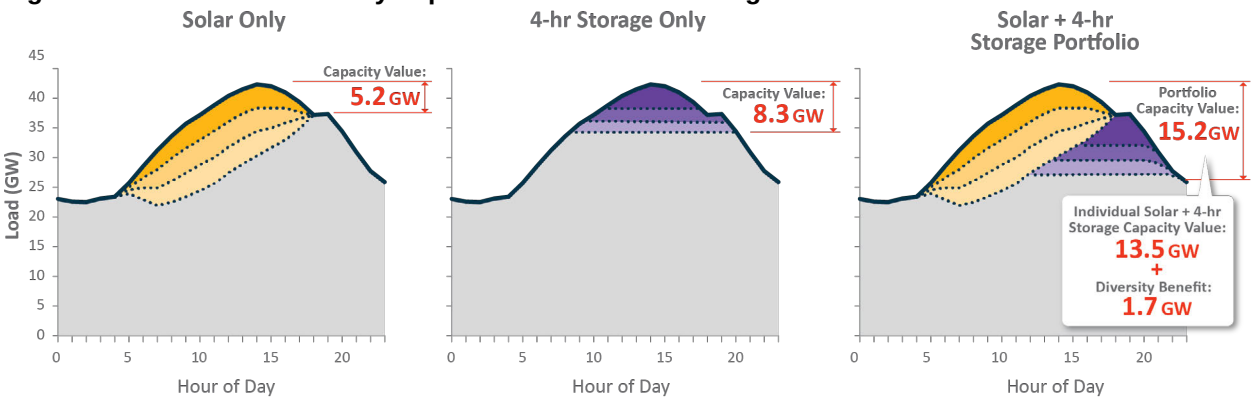
**Figure 68. Illustration of Declining ELCC Value for Storage as a Function of Penetration[72]**




[71] Unforced capacity is the capacity value of a generation asset after considering the asset's forced outage rate.

[72] E3, Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy, August 2020, https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf, accessed November 2021

**Figure 69. Illustrative Diversity Impacts for Solar and Storage[73]**




*Resource Adequacy Modeling Results and Inputs for Portfolio Development*

E3 used RECAP to develop multiple sets of ELCC curves, which served as inputs to the capacity expansion modeling in RESOLVE to ensure that the resulting portfolios are reliable over a wide range of potential weather conditions (i.e. that the portfolios continue to meet or exceed statewide and local reliability criteria, based on a loss-of-load expectation (LOLE) of 1 day in 10 years).

To capture diversity benefits between specific combinations of resources, E3 implemented two "surfaces", which capture the ELCC of a resource based both on its own penetration on the system as well as the penetration of the other resource. E3 analyzed one ELCC surface for onshore and offshore wind, and a separate ELCC surface for solar and 4-hour battery storage. The solar-storage surface is analyzed with a high bookend estimate of onshore and offshore wind already on the system under each scenario in order to capture potential additional portfolio benefits.

E3 performed this ELCC analysis at both the statewide and local capacity zone level to ensure that the contributions of each resource are appropriately credited towards each requirement, because ELCCs are in part a function of the magnitude of demand. For example, the average ELCC of 1 GW of battery storage will be significantly lower when counted towards Zone J capacity requirements (~10 GW peak in 2020)

[73] E3, Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy, August 2020, https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf, accessed November 2021

than towards statewide capacity requirements (~31 GW peak in 2020). The ELCC analysis also takes into account changes in both the timing and magnitude of system loads as a result of the electrification of buildings and vehicles in the Integration Analysis scenarios. E3 used RECAP to assess the reliability contributions of renewable and storage resources under both a Reference Case, in which the system remains summer-peaking throughout the modeled period, as well as a High Electrification case, which reflects levels of electrification consistent with the Integration Analysis scenarios and includes the impacts of New York's shift to a winter-peaking system by 2035. These ELCC surfaces are also scaled within RESOLVE to account for the differences in annual and peak load across the multiple Mitigation scenarios and across years leading up to 2050.

In today's system, the primary reliability challenge from a resource adequacy perspective occurs during summer afternoons and evenings, during peak load windows. As electrification loads are added and the system becomes winter-peaking, the reliability challenge shifts towards winter mornings and evenings, and is compounded by periods in which renewable output is also low during the winter, as shown in Figure 70. The shift in the timing of reliability challenges also has significant impacts on the contributions that renewable and storage resources can provide towards system reliability.

In the Reference Case, the system remains summer-peaking through 2050, and solar resources have a high starting point ELCC value due to strong alignment of solar output with summer afternoon peaks. The ELCC of solar declines steadily as a function of penetration, as the net peak load shifts away from high solar hours towards the evenings. Battery storage has a high starting ELCC value but declines fairly quickly once penetration exceeds roughly 10% of system peaks. Onshore wind has a low starting point ELCC value in the Reference Case due to lack of coincidence with summer afternoons and evenings, while offshore wind has more consistent output during the summer and therefore has a higher starting-point ELCC than onshore wind.

In the Mitigation scenarios, driven by the shift to a winter-peaking system, solar resources have a low ELCC value due to their lack of output during winter mornings and evenings, when system needs are greatest. Relative to the Reference Case, battery storage can provide substantially more reliability value as a function of its overall capacity in the Mitigation scenarios, because system peaks are significantly higher as a result of electrification loads. Onshore and offshore wind also both experience substantial increases in their starting point ELCC values as a result of electrification loads.

Statewide results for "slices" of each ELCC surface are provided in Figure 71 through Figure 74 below. A "slice" represents the contributions of one technology without taking into account the contributions of its complementary technology, e.g. the ELCC contributions of solar without any battery storage on the system. However, when translating ELCC results into RESOLVE, diversity benefits between solar and battery storage, as well as diversity impacts between onshore and offshore wind, are represented on a three-dimensional surface. The diversity impacts between each resource set are captured in Figure 75.

**Figure 70: Impacts of Electrification on System Reliability Needs**

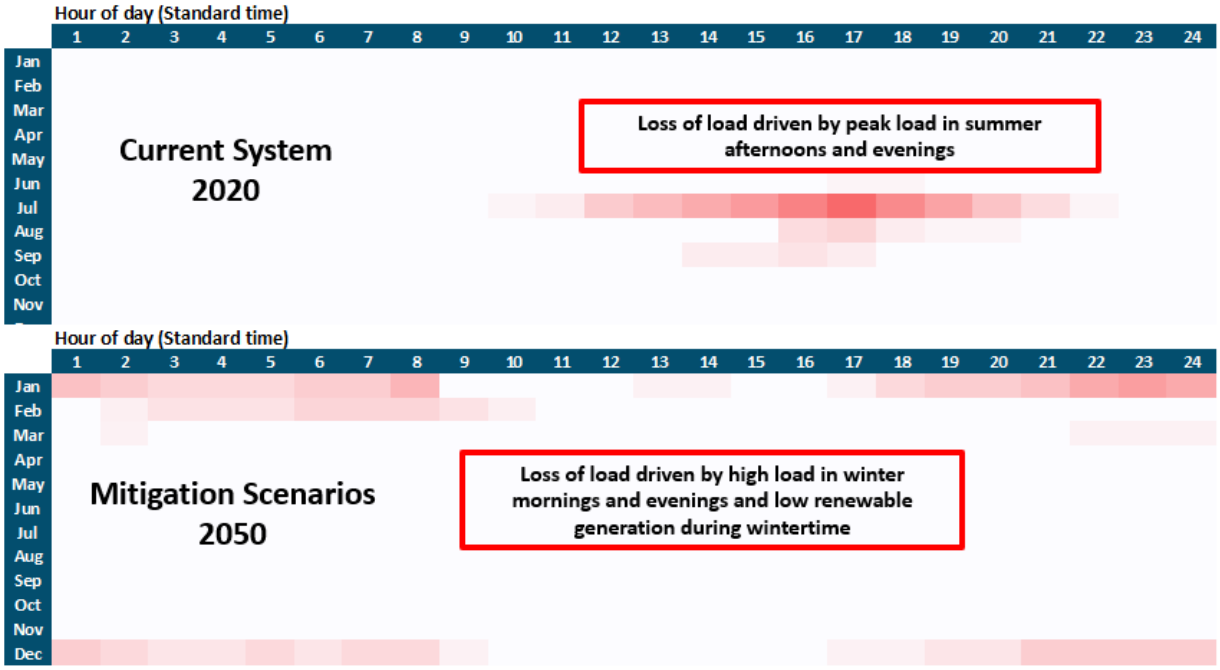


**Figure 71: Slices of NYCA ELCC Surface, Onshore and Offshore Wind, 2050 Reference Case**

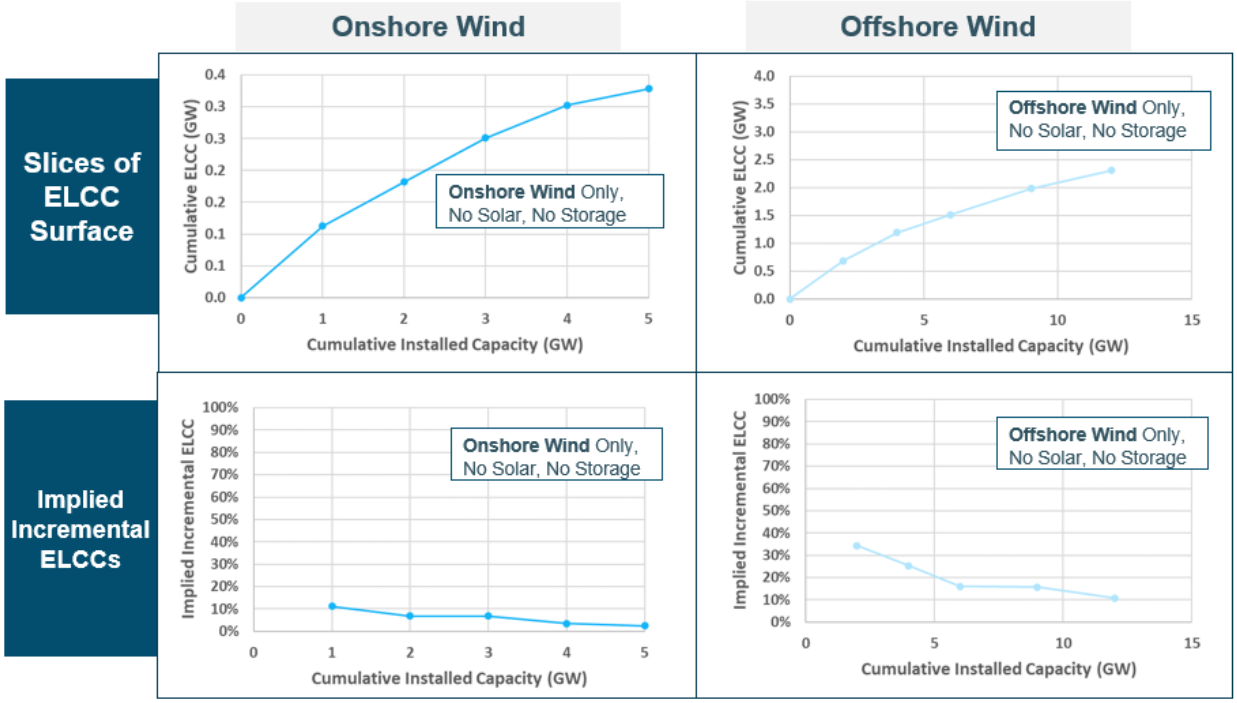



**Figure 72: Slices of NYCA ELCC Surface, Solar and 4-hour Battery Storage, 2050 Reference Case**

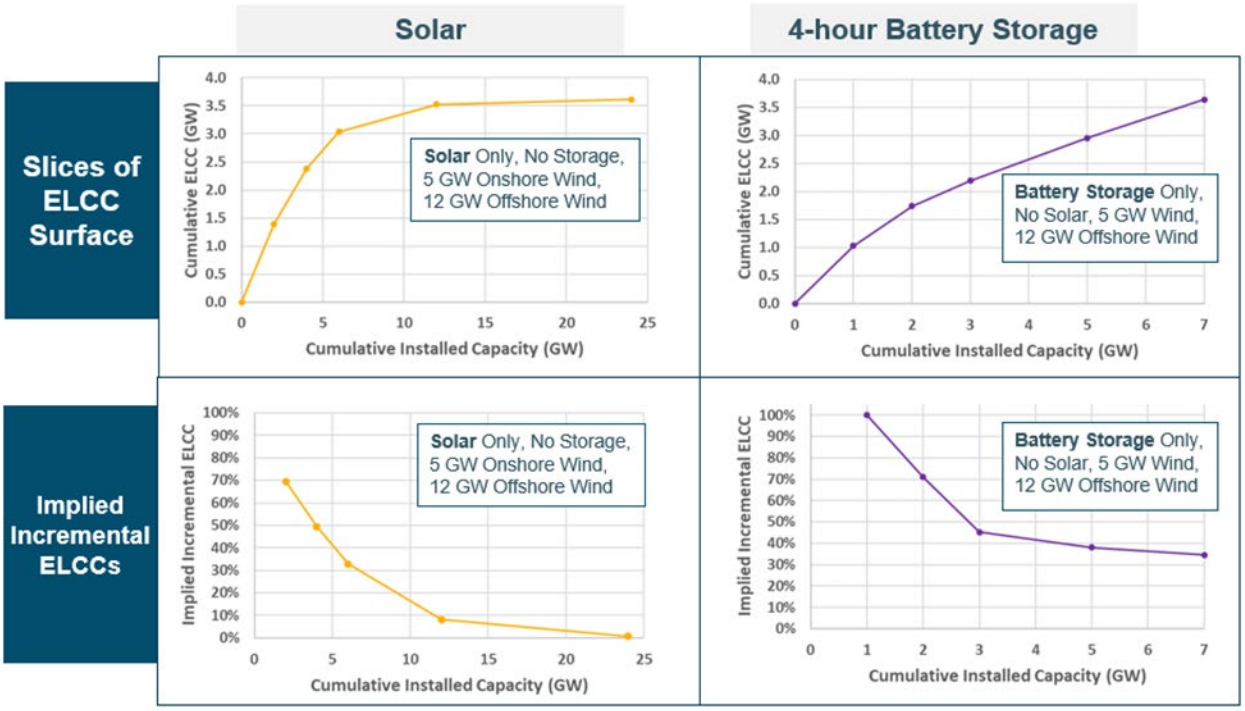


**Figure 73: Slices of NYCA ELCC Surface, Onshore and Offshore Wind, 2050 Mitigation Scenarios**

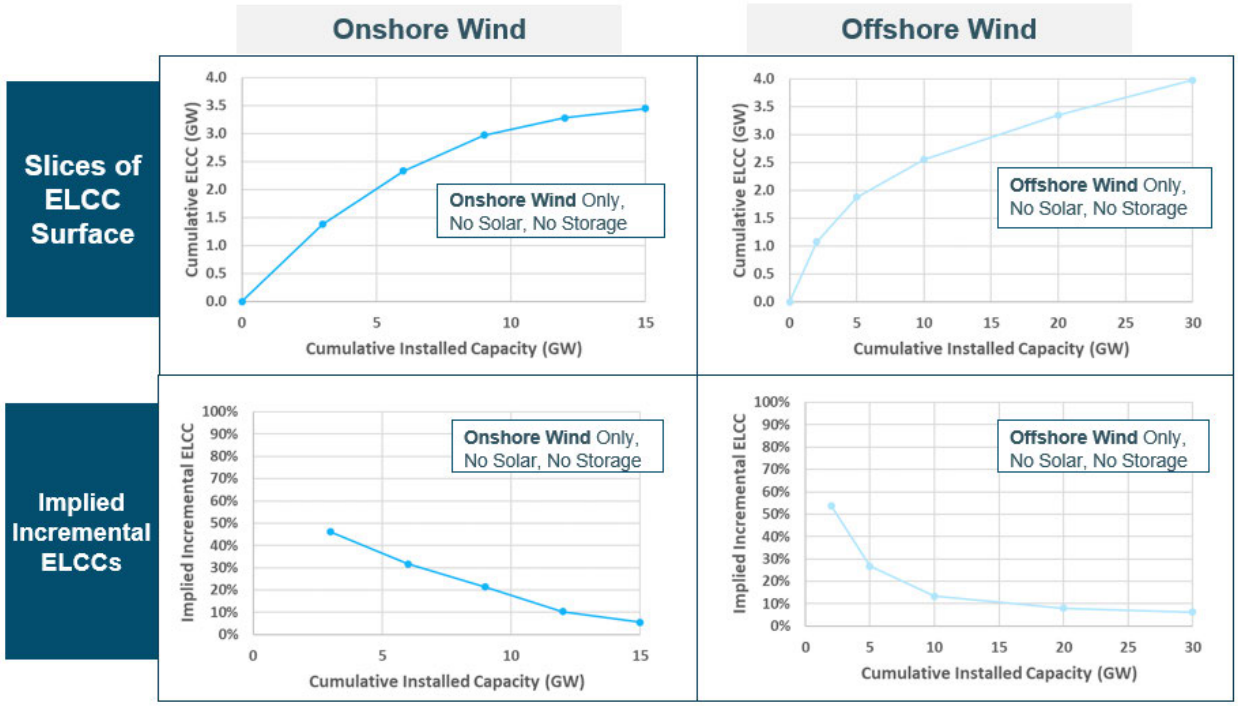



**Figure 74: Slices of NYCA ELCC Surface, Solar and 4-Hour Battery Storage, 2050 Mitigation Scenarios**

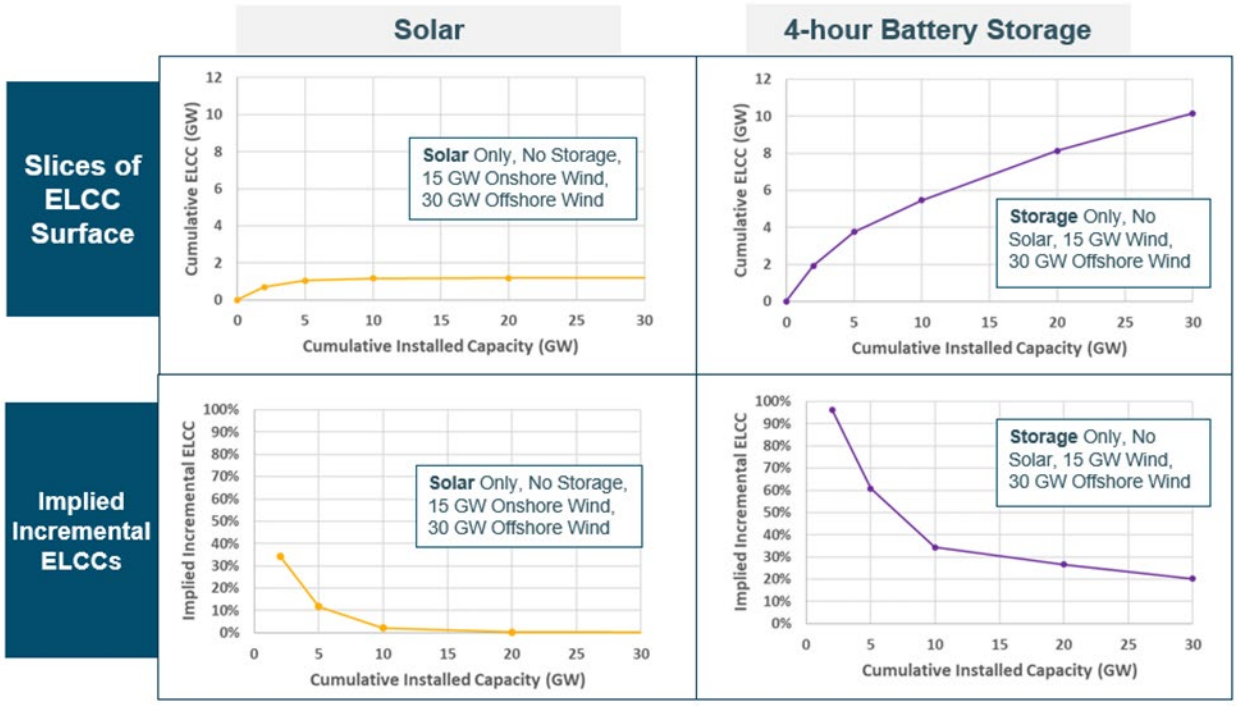
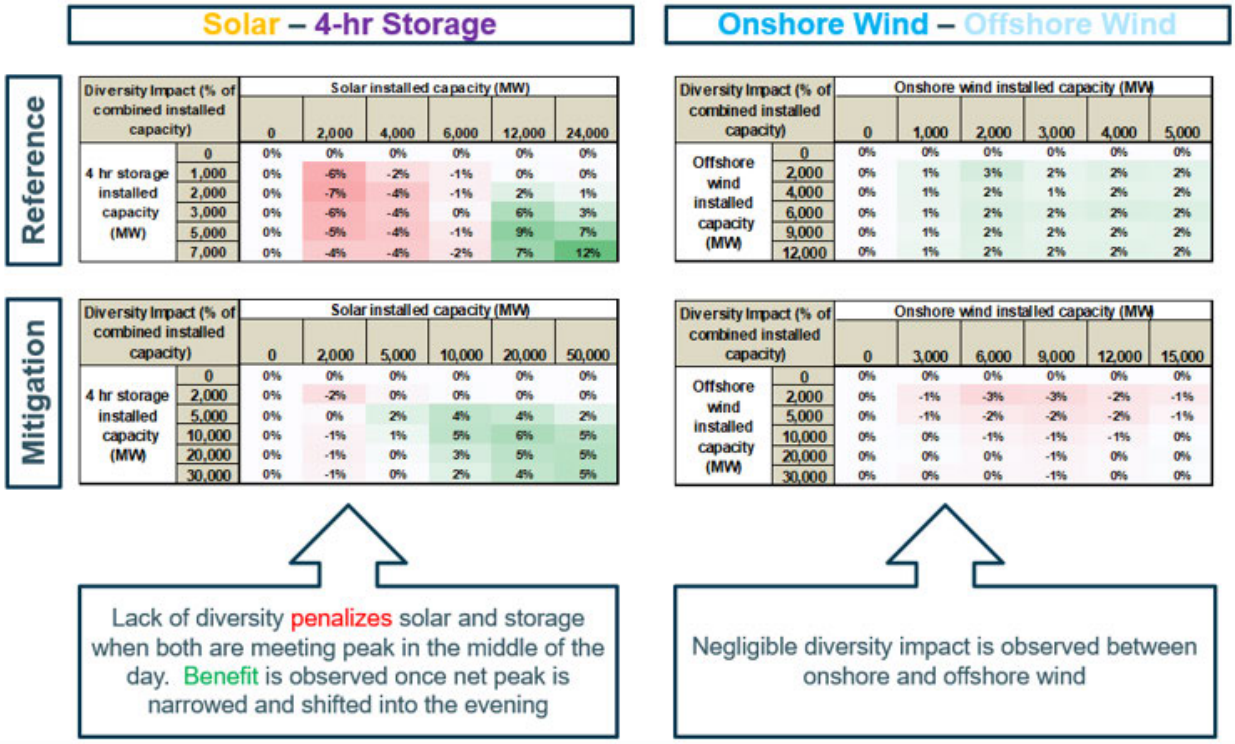


**Figure 75: Diversity Impacts in 2050**




### *Parallel Analyses*

The Pathways framework provides the final integration analysis for Scoping Plan, but incorporates insights and recommendations from Advisory Panels and interacts with complementary studies.[74]

**Power Grid Study**

**Buildings Roadmaps**

**Transportation Roadmap**

**In-State oil and gas systems mitigation potential study**

**HFC mitigation potential study**

### *Benefit-Cost Approach*

This study estimated benefits for two categories: Avoided damages from GHG pollution and avoided public health impacts. These benefits were then compared with energy system costs, which include the

[74] For more information, see https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions

capital costs of energy-consuming devices and energy supply infrastructure (including electricity generation and electricity imports) in addition to fuel costs. More information on underlying cost assumptions can be found in Annex 1, and more information on the health co-benefits analysis can be found in Section II.

### Calculating Benefits of Avoided GHG Emissions

The value of avoided GHG emissions calculations are based on DEC Value of Carbon guidance, developed under the Climate Act.[75] The DEC Value of Carbon guidance recommends a damages-based approach to valuing avoided GHG emissions, which means that the values are estimates of the monetary impacts on society of GHG pollution. In this study, the total value of avoided GHG emissions is measured in each scenario relative to the Reference Case. The total value of avoided GHG emissions was calculated individually for carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and hydrofluorocarbons (HFCs). For other GHGs, avoided emissions were converted to carbon dioxide equivalent ($CO_2e$) using the AR5-20year GWP values. The avoided GHG emissions time series in each year was multiplied by the annual social cost of GHG based on the DEC Value of Carbon guidance appendix, using the central case estimate for each GHG (2% discount rate for GHG emissions). When calculating NPV of avoided GHG emissions benefits to compare with NPV of costs, NPV calculations apply a discount rate of 3.6% to all annual benefit and costs streams. Table 13 below shows the social cost of GHGs used in 2020, 2030 and 2050 for this analysis:

**Table 13: Social Cost of GHG Pollutants ($2020/metric ton)**

| Pollutant | 2020 | 2030 | 2050 |
|---|---|---|---|
| CO2 | $121 | $137 | $172 |
| CH4 | $2,700 | $3,400 | $4,800 |
| N2O | $42,000 | $50,000 | $66,000 |

## 5.2 Data Sources

To characterize energy consumption and greenhouse gas emissions in New York, E3 relied on a variety of state and national data sources. These are summarized in Table 14 below and detailed further in Annex 1.

[75] The value of avoided GHG emissions calculations are based on DEC guidance: https://www.dec.ny.gov/regulations/56552.html, accessed December 2021

**Table 14. Key Data Sources for Integration Analysis**

| Sector | Source Type | Source |
|---|---|---|
| Global | State Data Source | Cornell Program on Applied Demographics |
| | Federal Data Source | EIA National Energy Modeling System |
| | | EIA State Energy Data System |
| | | EIA Annual Energy Outlook |
| | Complementary Study [76] | NYSERDA HFC Mitigation Potential Study |
| | | NYSERDA In-State Oil and Gas Systems Potential Study |
| | | Staff working group analysis of AFOLU and Waste sector emissions |
| | | Health Co-Benefits |
| Buildings | State Data Source | NYSERDA Residential Baseline Study |
| | | NYSERDA Commercial Baseline Study |
| | | NYSERDA New Efficiency New York Study: Analysis of Residential Heat Pump Potential and Economics |
| | Federal Data Source | EIA Residential Energy Consumption Survey |
| | | EIA Commercial Buildings Energy Consumption Survey |
| | | DOE LED Adoption Report |
| | | American Community Survey |
| | Complementary Study | Building Electrification Roadmap |
| Transportation | State Data Source | NYSDEC MOVES Modeling |
| | Federal Data Source | US Federal Highway Administration Highway Statistics |
| | Complementary Study | Clean Transportation Roadmap |
| Industry | State Data Source | NYSERDA Energy Efficiency & Renewable Energy Potential Study |
| | | NY Department of Labor Employment |
| | Federal Data Source | American Society of Manufacturers Survey |
| Electricity Generation | State Data Source | NYISO Gold Book |
| | | NYISO CARIS Study |
| | | NYISO Demand Curve Study |
| | | NYISO Reliability Needs Assessment |
| | | NYSERDA Storage Roadmap |
| | | NY DPS and NYSERDA Clean Energy Standard White Paper |
| | Federal Data Source | NREL Annual Technology Baseline |
| | | EIA Annual Energy Outlook |
| | | NREL Technical Potential Study |
| | National Data Source | Lazard Levelized Cost of Storage |
| | Complementary Study | Power Grid Study |
| | | Utility T&D Working Group Study |

## 5.3 Scenario Assumptions

The integration analysis evaluated a business-as-usual future (Reference Case) a representation of recommendations from CAC Advisory Panels (Scenario 1), and three scenarios designed to meet or

[76] For more information on complementary NYSERDA studies, see https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Greenhouse-Gas-Emissions

exceed GHG limits and carbon neutrality (Scenarios 2 through 4). Scenarios 2, 3, and 4 all carry forward foundational themes based on findings from Advisory Panels and supporting analysis but represent distinct worldviews. A detailed compilation of scenario assumptions can be found in Annex 2.

**Reference Case**: Business as usual plus implemented policies.

- Growth in housing units, population, commercial square footage, and GDP
- Federal appliance standards
- Economic fuel switching
- New York State bioheat mandate
- Estimate of New Efficiency, New York Energy Efficiency achieved by funded programs: HCR+NYPA, DPS (IOUs), LIPA, NYSERDA CEF (assumes market transformation maintains level of efficiency and electrification post-2025)
- Funded building electrification (4% HP stock share by 2030)
- Corporate Average Fuel Economy (CAFE) standards
- Zero-emission vehicle mandate (8% LDV ZEV stock share by 2030)
- Clean Energy Standard (70x30), including technology carveouts: (6 GW of behind-the-meter solar by 2025, 3 GW of battery storage by 2030, 9 GW of offshore wind by 2035, 1.25 GW of Tier 4 renewables by 2030)

**Scenario 1: AP Recommendations**: Representation of Advisory Panel recommendations. CAC AP recommendations provide a foundation for all scenarios, but scenario modeling shows that additional effort is needed to meet Climate Act emissions limit. This scenario includes:

- Rapid adoption of electric vehicles
- Critical role for smart growth, transit, and telework
- Rapid building electrification
- Zero emission power sector by 2040, including technology carveouts**:** (6 GW of behind-the-meter solar by 2025, 10 GW by 2030; 3 GW of battery storage by 2030; 9 GW of offshore wind by 2035; 2.55 GW of Tier 4 renewables by 2030)
- Ambitious reductions in emissions from refrigerants, agriculture, waste, and fugitive emissions

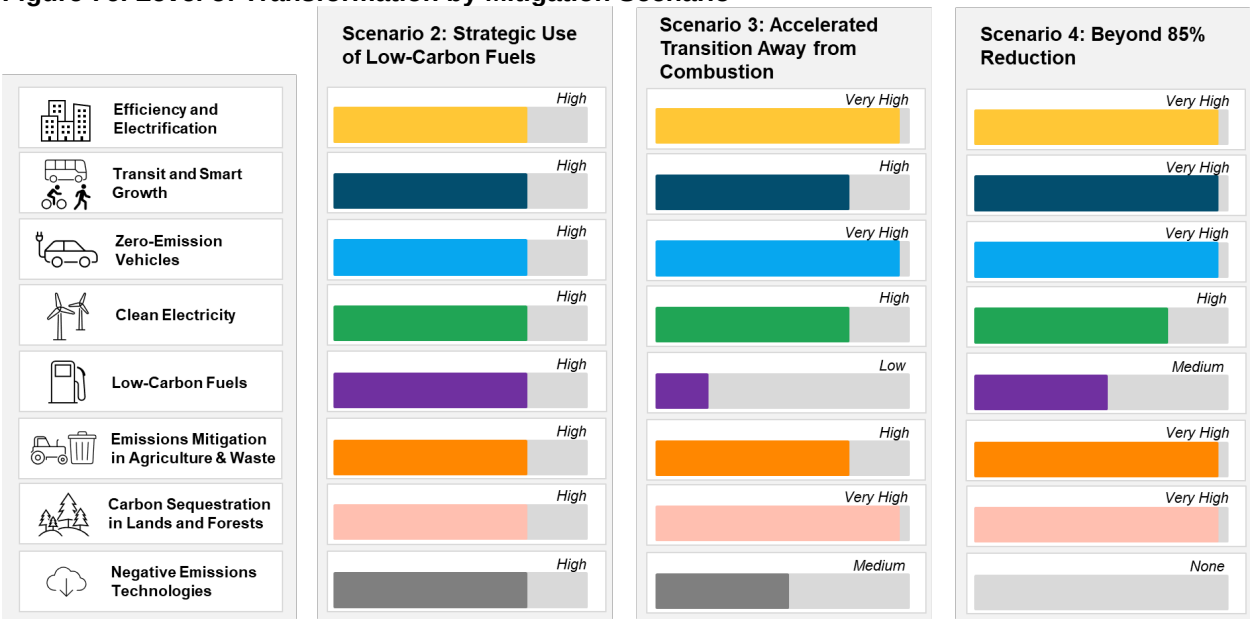
**Scenario 2: Strategic Use of Low-Carbon Fuels:** Includes the use of bioenergy derived from biogenic waste, agriculture & forest residues, and limited purpose grown biomass, as well as a critical role for green hydrogen for difficult to electrify applications, as well as limited use of negative emissions technologies to achieve carbon neutrality in 2050.

**Scenario 3: Accelerated Transition Away from Combustion:** Very limited role for bioenergy and hydrogen combustion and accelerated electrification of buildings and transportation, as well as limited use of negative emissions technologies to achieve carbon neutrality in 2050.

**Scenario 4: Beyond 85% Reduction:** Accelerated electrification and targeted use of low-carbon fuels. This scenario includes additional reductions from transportation emissions through additional smart growth, transit, telework, in-state rail, and hydrogen and electric aviation, as well as innovation in methane abatement. This scenario does not require the use of any negative emissions technologies to achieve net-zero by 2050.

Figure 76 highlights the key differences in assumptions across the three scenarios that meet or achieve New York's GHG emission limits and achieve carbon neutrality by midcentury. All scenarios share common foundational themes of decarbonization, including a zero-emission power sector by 2040, enhancement and expansion of transit, rapid and widespread efficiency and electrification, electric end-use load flexibility, and methane mitigation in agriculture and waste.

**Figure 76. Level of Transformation by Mitigation Scenario**




Scenario assumptions and level of transformation by sector and action for mitigation scenarios 2, 3, and 4 are summarized in the tables below.

## Buildings

### Table 15. Level of Transformation by Scenario: Buildings[77]

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
| | **Efficiency and Electrification** | *High* | *Very High* | *Very High* |
| | New Sales of Heat Pumps | 77% by 2029, 100% by 2030/2035 (SF/MF+Com) | 80% by 2029, 100% by 2030/2035 (SF/MF+Com), 10% early retirement by 2030 | 80% by 2029, 100% by 2030/2035 (SF/MF+Com), 10% early retirement by 2030 |
| | Mix of Heat Pump Technologies | 70% ASHP, 10% ASHP + fuel backup, 20% GSHP | 77% ASHP, 23% GSHP | 77% ASHP, 23% GSHP |
| | Share of Electrified Buildings | 18% by 2030, 92% by 2050<br>1.5 Mil. Households by 2030, 7.8 Mil. by 2050<br>1.1 Bil. Com sqft by 2030, 5.3 Bil. By 2050 | 22% by 2030, 92% by 2050<br>1.8 Mil. Households by 2030, 7.8 Mil. by 2050<br>1.4 Bil. Com sqft by 2030, 5.6 Bil. By 2050 | 22% by 2030, 92% by 2050<br>1.8 Mil. Households by 2030, 7.8 Mil. by 2050<br>1.4 Bil. Com sqft by 2030, 5.6 Bil. By 2050 |
| | Share of Buildings with Efficient Shell | 7% Deep Shell, 18% Basic Shell by 2030<br>26% Deep Shell, 66% Basic Shell by 2050 | 7% Deep Shell, 18% Basic Shell by 2030<br>26% Deep Shell, 66% Basic Shell by 2050 | 7% Deep Shell, 18% Basic Shell by 2030<br>26% Deep Shell, 66% Basic Shell by 2050 |
| | Air Conditioning Saturation | 100% saturation by 2050 reflecting climate trends and HP adoption | 100% saturation by 2050 reflecting climate trends and HP adoption | 100% saturation by 2050 reflecting climate trends and HP adoption |
| | NYC District Heat System | 3% annual efficiency improvement, 100% hydrogen conversion by 2050 | 3% annual efficiency improvement, 100% hydrogen conversion by 2050 | 3% annual efficiency improvement, 100% hydrogen conversion by 2050 |
| | Smart Devices and Conservation (AC, Space Heating) | 10% reduction by 2030, 15% by 2050 | 10% reduction by 2030, 15% by 2050 | 10% reduction by 2030, 15% by 2050 |
| | **Low-Carbon Fuels** | *High* | *Low* | *Medium* |
| | Hydrogen (via electrolysis) | NYC district heat converted to hydrogen | NYC district heat converted to hydrogen | NYC district heat converted to hydrogen |
| | Biomass feedstock availability | In-state + regional feedstocks incl. energy crops | None | In-state wastes and residues only |
| | Bioenergy utilization | 9% RNG, 75% renewable distillate by 2030<br>100% RNG and renewable distillate by 2050 | 4% RNG by 2030, 100% by 2050<br>(Limited volume from targeted methane abatement from landfills and wastewater only) | 7% RNG, 7% renewable distillate by 2030<br>100% RNG and renewable distillate by 2050 |
| | **Climate-Friendly Refrigerants** | *High* | *High* | *High* |
| | Transition to ultralow-GWP and natural refrigerant technologies | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors |
| | Service reclaim at end of life | 90% recover rate | 90% recover rate | 90% recover rate |

[77] Electrified buildings include all homes with a heat pump (ASHP, ASHP with fuel backup, GSHP) but do not include homes with electric resistance heat, which are appx. 470,000 in 2030).

Space heating demands are reduced by 27-44% with the basic shell package and 57-90% with the deep shell package, depending on building type. Air conditioning demands are reduced 14-27% with the basic shell package and 9-57% with the deep shell package. The total impact of building shell improvements on total HVAC service demand in buildings is a function of the market penetration of each package and distribution of building types. Building shell improvements include both retrofits and new construction, although all new construction in residential and commercial is assumed to be code -compliant and therefore has lower HVAC service demands relative to the existing building stock. E3 calculated the stock rollover of building shells with a 20-year lifetime to reflect improvements in new construction and opportunities for home retrofits.

Adoption of efficiency and electrification measures affect all existing fuels used for primary heating in buildings (e.g., natural gas, petroleum fuels, and wood).

# Transportation

## Table 16. Level of Transformation by Scenario: Transportation

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
|  | **Transit and Smart Growth** | *High* | *High* | *Very High* |
| | Bus Transit Service | Enhancement and expansion of bus transit, where service more than doubles in many areas of the state | Enhancement and expansion of bus transit, where service more than doubles in many areas of the state | Enhancement and expansion of bus transit, where service more than doubles in many areas of the state |
| | Telework + TDM, Walking/Biking, Smart Growth, Rail | Expansion of telework + TDM programs, urban infrastructure, and smart growth | Expansion of telework + TDM programs, urban infrastructure, and smart growth | Further expansion of telework + TDM programs, urban infrastructure, and smart growth, Strategic investments in rail |
|  | **Zero-Emission Vehicles** | *High* | *Very High* | *Very High* |
| | New Sales of LDV ZEVs | 90% by 2030, 100% by 2035, 90/10 BEV/FCEV | 98% by 2030, 100% by 2035, 100% BEV<br>10% early retirement before 2030 | 98% by 2030, 100% by 2035, 100% BEV<br>10% early retirement before 2030 |
| | New Sales of MDV ZEVs | 40% by 2030, 100% by 2045, 50/50 BEV/FCEV | 50% by 2030, 100% by 2045, 75/25 BEV/FCEV | 50% by 2030, 100% by 2045, 75/25 BEV/FCEV |
| | New Sales of HDV ZEVs | 40% by 2030, 100% by 2045, 25/75 BEV/FCEV | 40% by 2030, 100% by 2045, 50/50 BEV, FCEV | 40% by 2030, 100% by 2045, 50/50 BEV, FCEV |
| | New Sales of Bus ZEVs | 100% by 2030 | 100% by 2030 | 100% by 2030 |
| | LDV ZEVs on the Road | 2.7 Million by 2030, 10 Million by 2050<br>26% of fleet by 2030, 95% of fleet by 2050 | 3.4 Million by 2030, 10.1 Million by 2050<br>33% of fleet by 2030, 96% of fleet by 2050 | 3.4 Million by 2030, 10.1 Million by 2050<br>33% of fleet by 2030, 96% of fleet by 2050 |
| | LDV BEV Charging Flexibility | 25% of vehicles charge flexibly in 2030, 50% in 2050 | 25% of vehicles charge flexibly in 2030, 50% in 2050 | 25% of vehicles charge flexibly in 2030, 50% in 2050 |
| | MHDV ZEVs on the Road | 19,000 by 2030, 180,000 by 2050<br>8% of fleet by 2030, 77% of fleet by 2050 | 23,000 by 2030, 200,000 by 2050<br>10% of fleet by 2030, 86% of fleet by 2050 | 23,000 by 2030, 200,000 by 2050<br>10% of fleet by 2030, 86% of fleet by 2050 |
| | Bus ZEVs on the Road | 10,000 by 2030, 55,000 by 2050 | 10,000 by 2030, 55,000 by 2050 | 10,000 by 2030, 55,000 by 2050 |
|  | **Low-Carbon Fuels** | *High* | *Low* | *Medium* |
| | Hydrogen (via electrolysis) | Used for MHDVs and freight rail | Used for MHDVs and freight rail | Used for MHDVs, freight rail, and 50% of aviation by 2050 |
| | Biomass feedstock availability | In-state + regional feedstocks incl. energy crops | None | In-state wastes and residues only |
| | Bioenergy utilization | 75% renewable diesel by 2030, 100% by 2050<br>100% renewable jet kerosene by 2050 | None | 7% renewable diesel by 2030, 100% by 2050<br>71% renewable jet kerosene by 2050 |
|  | **Non-Road Transportation** | *Medium* | *Medium* | *Very High* |
| | Aviation | Efficiency for new airplanes | Efficiency for new airplanes | Efficiency for new airplanes, 16% electrification by 2050 (short haul flights), 50% hydrogen aviation by 2050 |
| | Marine and Ports | 75% renewable diesel in 2030, 100% electrification in 2050 | 100% electrification in 2050 | 7% renewable diesel in 2030, 100% electrification in 2050 |
| | Rail | 90% electrification, 10% hydrogen use in 2050 | 90% electrification, 10% hydrogen use in 2050 | 90% electrification, 10% hydrogen use in 2050 |

## Electricity System

### Table 17. Level of Transformation by Sector: Electricity System

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Combined: Beyond 85% Reduction |
|---|---|---|---|---|
| | **Clean Electricity** | *High* | *High* | *High* |
| Loads | **Annual Electricity Demands: Buildings, Transportation, Industry** | 164 TWh in 2030, 271 TWh in 2050 | 172 TWh in 2030, 293 TWh in 2050 | 172 TWh in 2030, 293 TWh in 2050 |
| | **Annual Electricity Demands: Hydrogen Electrolysis** | 5 TWh in 2030, 42 TWh in 2050 | 1 TWh in 2030, 27 TWh in 2050 | 3 TWh in 2030, 34 TWh in 2050 |
| | **Peak Electricity Demands** | 29 GW in 2030, 48 GW in 2050 | 30 GW in 2030, 53 GW in 2050 | 30 GW in 2030, 52 GW in 2050 |
| | **Peak Electricity Demands (with significant end-use flexibility)** | 29 GW in 2030, 45 GW in 2050 | 30 GW in 2030, 50 GW in 2050 | 29 GW in 2030, 49 GW in 2050 |
| Renewables and Storage | **Solar Deployment** | 18.8 GW in 2030, 64.6 GW in 2050 | 16.7 GW in 2030, 60.6 GW in 2050 | 18.0 GW in 2030, 65.2 GW in 2050 |
| | **Battery Storage Deployment** | 3 GW in 2030, 21.5 GW in 2050 | 3 GW in 2030, 19.2 GW in 2050 | 3 GW in 2030, 22.9 GW in 2050 |
| | **In-State Onshore Wind Deployment** | 3.7 GW in 2030, 9.4 GW in 2050 | 4.6 GW in 2030, 10.2 GW in 2050 | 3.7 GW in 2030, 11.1 GW in 2050 |
| | **Wind Imports** | 1.8 GW in 2030, 6.4 GW in 2050 | 2.4 GW in 2030, 6.6 GW in 2050 | 2.8 GW in 2030, 6.4 GW in 2050 |
| | **Offshore Wind Deployment** | 6.2 GW in 2030, 16.4 GW in 2050 | 6.6 GW in 2030, 19.3 GW in 2050 | 6.6 GW in 2030, 18.3 GW in 2050 |
| Other | **Upstate nuclear facilities** | 20-year license extension | 20-year license extension | 20-year license extension |
| | **Fossil units** | Significant decline in fossil utilization, hydrogen combustion starting in 2040 | Moratorium on new infrastructure, and existing fossil resources are retired by 2040. Firm capacity needs must be met with technology that avoids local emissions stemming from combustion | Significant decline in fossil utilization, hydrogen combustion starting in 2040 |
| | **Transmission** | Local upgrades required to integrate renewables to bulk system, plus new bulk transmission to deliver zero-emissions power to load centers | Local upgrades required to integrate renewables to bulk system, plus new bulk transmission to deliver zero-emissions power to load centers | Local upgrades required to integrate renewables to bulk system, plus new bulk transmission to deliver zero-emissions power to load centers |

# Waste

## Table 18. Level of Transformation by Sector: Waste

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
|  | **Emissions Mitigation in Waste** | *High* | *High* | *Very High* |
| | Waste diversion | 100% waste diversion | 100% waste diversion | Characterization of uncertainty in potential for additional innovation in methane management & capture for use in "no negative emission technologies" sensitivity analysis |
| | Reduced methane leakage from existing landfills | 10% reduction every 5 years | 10% reduction every 5 years | |
| | Anaerobic digesters in solid waste | Digesters running at capacity in 2030 with 75% methane leak reduction by 2050 | Digesters running at capacity in 2030 with 75% methane leak reduction by 2050 | |
|  | **Low-Carbon Fuels** | *High* | *Low* | *Medium* |
| | Methane capture and reuse | Optimistic growth in RNG capture from landfills, wastewater treatment, and manure<br>32 Tbtu RNG | Targeted RNG capture from landfills, wastewater treatment, and manure<br>25 Tbtu RNG | Targeted RNG capture from landfills, wastewater treatment, and manure<br>25 Tbtu RNG |

# Agriculture, Forestry, Other Land Use and NETs

## Table 19. Level of Transformation by Sector: AFOLU and NETs

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
|  | **Emissions Mitigation in Agriculture** | *High* | *High* | *Very High* |
| | Abatement in manure emissions | 50% reduction in 2030, 76% reduction in 2050 | 50% reduction in 2030, 76% reduction in 2050 | Characterization of uncertainty in potential for additional innovation in agricultural practices for use in "no negative emission technologies" sensitivity analysis |
| | Abatement in animal feeding emissions | 6% reduction in 2030, 18% reduction in 2050 | 6% reduction in 2030, 18% reduction in 2050 | |
| | Abatement in soil management | 17% reduction in 2030 | 17% reduction in 2030 | |
| | Additional abatement from future R&D | 1 MMT CO2e | 1 MMT CO2e | 2 MMT CO2e |
|  | **Low-Carbon Fuels** | *High* | *Low* | *Medium* |
| | Methane capture and reuse | Optimistic growth in RNG capture from landfills, wastewater treatment, and manure<br>32 Tbtu RNG | Targeted RNG capture from landfills, wastewater treatment, and manure<br>25 Tbtu RNG | Targeted RNG capture from landfills, wastewater treatment, and manure<br>25 Tbtu RNG |
|  | **Carbon Sequestration in Lands and Forests** | *High* | *Very High* | *Very High* |
| | Existing forest land management | Forest sequestration returns to 1990 levels | Forest sequestration returns to 1990 levels | Forest sequestration returns to 1990 levels |
| | Additional afforestation on marginal agricultural lands | 400,000 acres by 2050 | 1,700,000 acres by 2050 | 1,700,000 acres by 2050 |
| | Total Natural Sequestration | -35 MMT CO2 in 2050 | -40 MMT CO2 in 2050 | -40 MMT CO2e in 2050 |
|  | **Negative Emissions Technologies (NETs)** | *High* | *Medium* | *None* |
| | Total abatement from direct air capture of CO2 (DAC) or other NETs | -26 MMT CO2 in 2050 | -21 MMT CO2 in 2050 | 0 MMT CO2e in 2050 |

## Industrial Processes and Product Use

### Table 20. Level of Transformation by Sector: IPPU

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
| HFC | **Climate-Friendly Refrigerants** | *High* | *High* | *High* |
| | Transition to ultra-low-GWP and natural refrigerant technologies | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors | Max adoption for building, transportation, and industrial HVAC + refrigeration sectors |
| | Service reclaim at end of life | 90% recover rate | 90% recover rate | 90% recover rate |
| | **Industrial Processes** | *High* | *High* | *High* |
| | Process emissions from cement and iron & steel emissions | 100% CCS operations (at 90% $CO_2$ capture rates) | 100% CCS operations (at 90% $CO_2$ capture rates) | 100% CCS operations (at 90% $CO_2$ capture rates) |
| | Other processes | Maximum abatement from EPA non-$CO_2$ report | Maximum abatement from EPA non-$CO_2$ report | Maximum abatement from EPA non-$CO_2$ report |

## In-State Oil and Gas

### Table 21. Level of Transformation by Sector: In-State Oil and Gas

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
| | **In-State Oil and Gas Fugitive Emissions** | *High* | *High* | *High* |
| | Leak Detection (LDAR) at Compressor Stations | LDAR at 100% of stations phased in between 2023 and 2030 | LDAR at 100% of stations phased in between 2023 and 2030 | LDAR at 100% of stations phased in between 2023 and 2030 |
| | Pipeline Decommissioning and Building Disconnection | 91% commercial and 84% residential decommissioning and building disconnection | 99% commercial and 90% residential decommissioning and building disconnection | 99% commercial and 90% residential decommissioning and building disconnection |

## Industry: Energy

### Table 22. Level of Transformation by Sector: Industrial Energy Consumption

| | | Scenario 2: Strategic Use of Low-Carbon Fuels | Scenario 3: Accelerated Transition Away from Combustion | Scenario 4: Beyond 85% Reduction |
|---|---|---|---|---|
|  | **Industry Electrification and Hydrogen** | *High* | *High* | *High* |
| | Industry Efficiency | 20% increase in efficiency by 2030, 40% by 2050 for manufacturing | 20% increase in efficiency by 2030, 40% by 2050 for manufacturing | 20% increase in efficiency by 2030, 40% by 2050 for manufacturing |
| | Industry Electrification | 4% of natural gas use electrified by 2030, 33% by 2050 | 4% of natural gas use electrified by 2030, 83% by 2050 | 4% of natural gas use electrified by 2030, 83% by 2050 |
| | Hydrogen Fuel Switching | 17% of non-electrified natural gas use converted to hydrogen by 2030, 100% by 2050 | 0% of non-electrified natural gas use converted to hydrogen by 2030, 100% by 2050 | 17% of non-electrified natural gas use converted to hydrogen by 2030, 100% by 2050 |
|  | **Low-Carbon Fuels** | *High* | *Low* | *Medium* |
| | Hydrogen (via electrolysis) | High-temperature industries that are challenging to electrify | High-temperature industries that are challenging to electrify | High-temperature industries that are challenging to electrify |
| | Biomass feedstock availability | In-state + regional feedstocks incl. energy crops | None | In-state wastes and residues only |
| | Bioenergy utilization | 9% RNG, 75% renewable distillate by 2030<br>100% RNG and renewable distillate by 2050 | 4% RNG by 2030, 100% by 2050<br>(Volumes limited to targeted methane abatement from landfills and wastewater only) | 7% RNG, 7% renewable distillate by 2030<br>100% RNG and renewable distillate by 2050 |

# Section II. Health Co-Benefits Analysis

This section describes the methods and results of the public health benefits analyses undertaken for New York's Climate Act Scoping Plan Integration Analysis. Supplemental data can be found in Annex 3 to this document.

## Contents

# Acronyms and Abbreviations

| | |
|---|---|
| AEO | Annual Energy Outlook |
| CEC | Commission for Environmental Cooperation |
| CCS | Carbon capture and storage |
| COBRA | CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool |
| eGRID | Electricity Generation Resource Integrated Database |
| EGU | Electricity generating unit |
| EIA | Energy Information Administration |
| GHG | Greenhouse gas |
| ICI | Industrial, commercial, and institutional |
| ISO | Independent System Operator |
| ITHIM | Integrated Transport and Health Impact Model |
| LMI | Low and moderate income |
| MOVES | Motor Vehicle Emissions Simulator |
| NEEDS | National Electric Energy Data System |
| NESCAUM | Northeast States for Coordinate Air Use Management |
| $NO_x$ | Nitrogen oxides |
| NYC | New York City |
| NYS | New York State |
| PJM | Pennsylvania-Jersey-Maryland electricity grid |
| $PM_{2.5}$ | Fine particulate matter |
| $SO_2$ | Sulfur dioxide |
| S-R matrix | Source-receptor matrix |
| VMT | Vehicle miles traveled |
| VOC | Volatile organic compounds |

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# Chapter 1. Methodology

## 1.1 Health Analyses Approach Overview

The analysis of public health benefits associated with the Integration Analysis scenarios evaluated the potential for the scenarios to affect changes in public health outcomes relative to the Reference case. Three analyses were undertaken, evaluating the potential to--

- improve air quality and ensuing health outcomes through reduced combustion and associated pollutant emissions;
- improve public health through increased activity associated with active transportation modes such as walking and cycling; and
- improve health outcomes in homes, especially low and moderate income (LMI) homes, through energy efficiency interventions.

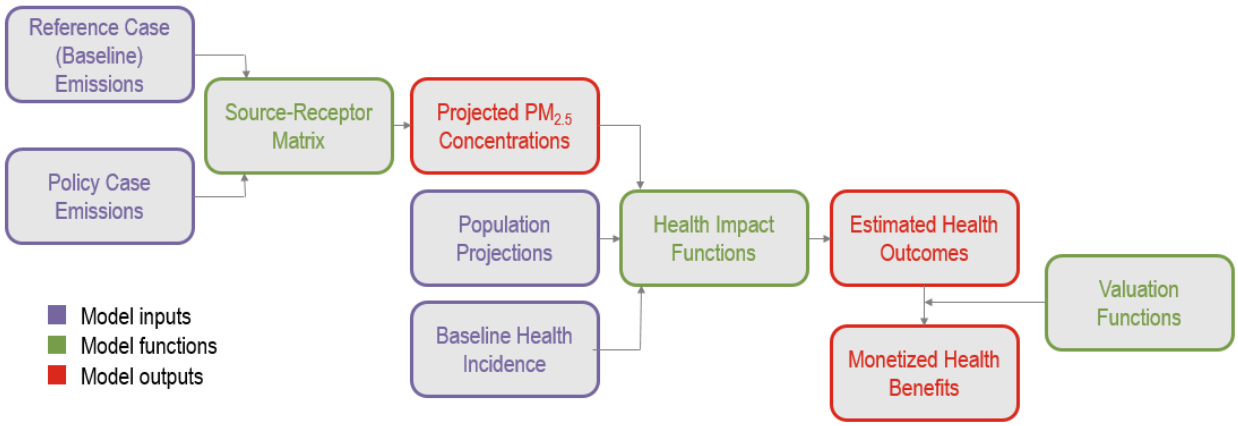
The air quality analysis applied EPA's CO Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool, customized with detailed inputs specific to New York State and the scenarios analyzed, to evaluate air quality and ensuing public health outcomes at the county level. COBRA evaluates ambient air quality based on emissions of direct fine particulate matter ($PM_{2.5}$) and its precursors (sulfur dioxide ($SO_2$), volatile organic compounds (VOC), and nitrogen oxides ($NO_X$)) and the ensuing changes in annual average total $PM_{2.5}$ concentrations. The results include 12 different health outcomes, such as premature mortality, heart attacks, hospitalizations, asthma exacerbation and emergency room visits, and lost workdays.

Results in COBRA are calculated as "High" and "Low", reflecting two alternative methods adopted by EPA for evaluating premature mortality and non-fatal heart attacks based on two epidemiological studies of the impacts of air quality on public health. For the Integration Analysis described in Section I of this Supplement, the economy-wide benefit results applied the High case, and the Low case is included in the cost and benefits uncertainty analysis.

See Figure 1 for an overview of the framework of inputs and outputs from the COBRA analysis. Note that COBRA does not include additional potential benefits from reduced ozone concentrations; the value of those benefits is estimated to be a few percent of the benefits associated with $PM_{2.5}$. Additional benefits not included are potential benefits associated with reduced nitrogen dioxide ($NO_2$) concentrations; and

reduced toxic pollutant emissions[1], which were not evaluated given the high uncertainty and lack of sufficient data to provide reasonable estimates.

**Figure 1. Framework of Inputs and Outputs for COBRA Analysis**




COBRA was applied to the Reference case and the scenarios described above for 2020 through 2050 in 5-year increments, and the value of the improved health outcomes was interpolated to estimate benefits for the entire period. The analysis includes emissions in all sectors throughout the continental U.S. and the effect of the scenarios on emissions in New York.

Potential public health benefits from increased physical activity due to increased use of active transportation modes, while accounting for potential increases in traffic collisions, were estimated using the Integrated Transport Health Impacts Model, customized to represent New York State.

Values from published literature on the health and safety benefits of energy system changes and weatherization programs in homes were used to estimate the potential benefits of energy efficiency interventions. These applied only to LMI homes expected to have upgraded systems and weatherization. While additional benefits may result from building changes in higher income homes, they would likely be lower, and no data is available to estimate those details.

[1] For a list of toxic air pollutants, see NYSDEC, DAR-1, https://www.dec.ny.gov/chemical/8568.html

## 1.2 Scenarios

NYSERDA analyzed the health impacts of three of the key scenarios in its Integration Analysis: the Strategic Use of Low Carbon Fuels scenario (Scenario 2), the Accelerated Transition Away from Combustion scenario (Scenario 3), and the Beyond 85% scenario (Scenario 4). Each of these scenarios includes assumptions about the rate of emission reductions due to climate change mitigation activities. The scenarios are each compared to a Reference case, which represents currently implemented policies, including:

- 70% renewable electricity,
- Energy efficiency targets under NYSERDA's New Efficiency: New York program,[2] and
- Zero-emission vehicle sales mandate[3] and related measures already implemented based on the memorandum of understanding[4] that New York signed with eight other states.[5]

The Reference case also includes business-as-usual growth in key drivers of energy activity, including population, households, and vehicle miles traveled (VMT). This scenario does not achieve the State's GHG emission reduction Limits and is used as a counterfactual to compare with the deeper emissions reductions under the scenarios.

Each scenario represents a potential pathway to reach the GHG Limits set out in the Climate Leadership and Community Protection Act that includes a diverse mix of measures such as:

- Additional building efficiency,
- Electrification of buildings and transportation,
- Advanced sustainable biofuels,
- Natural and working lands, and
- Direct air capture of $CO_2$.

[2] This program includes a suite of energy efficiency measures, including state appliance standards, building codes, and building electrification, with a target of 185 trillion British thermal units (Btu) of end-use energy savings in buildings and industrial facilities below the 2025 energy-use forecast. https://www.nyserda.ny.gov/About/Publications/New-Efficiency

[3] New York Codes, Rules and Regulations, Title 6, Subpart 218-4. "Zero Emission Vehicle Sales Mandate".

[4] New York, California, Connecticut, Maryland, Massachusetts, New Jersey, Oregon, Rhode Island, Vermont. "State Zero-Emission Vehicle Programs—Memorandum of Understanding". October 24, 2013. https://www.zevstates.us/

[5] The states have agreed to a target of at least 3.3 million zero emission vehicles operating in their states collectively by 2025.

These scenarios achieve at least 40% greenhouse gas (GHG) reductions by 2030 and 85% by 2050, relative to 1990 levels. They also achieve carbon neutrality by 2050. The scenarios also reach 70% renewable electricity by 2030 and 100% zero-carbon electricity by 2040.

The scenarios were all analyzed for the years 2025, 2030, 2035, 2040, 2045 and 2050. The air quality in each of the three scenarios was compared with the Reference case to determine the change in air quality and ensuing health impacts due to the GHG emission reduction pathways.

## 1.3 Ambient Air Quality Analysis

### *Input Data*

COBRA calculates annual health benefits based on the change in $PM_{2.5}$ concentrations at the county level using health impact functions from the epidemiological literature. As shown in Figure 1, above, the health impact functions in COBRA require four sets of inputs:

- Reference case (baseline) emissions of primary $PM_{2.5}$ and its precursors $NO_x$, $SO_2$, VOCs, and NH-$_3$;
- Scenario emissions of those pollutants;
- Population; and
- Baseline health incidence.

Each of these inputs must be developed for each analysis year: 2025, 2030, 2035, 2040, 2045, and 2050. The following subsections discuss the approach for developing each of these data inputs. To the extent possible, the same datasets and assumptions used in the Integration Analysis were applied to ensure consistency. The data development also applied assumptions used by New York State (NYS) in the development of air quality state implementation plans. The areas where different datasets and assumptions are used are discussed in more detail below.

## Population

Population estimates for each of the scenario years were developed for all counties in NYS based on data from Cornell University's County Projects Explorer.[6,7] This is the same dataset used to project energy demand in the Pathways Integration Analysis.

The Cornell population projections, which extend through 2040, were projected through 2050 based on linear extrapolation of the population trend in each county from 2025-2040. This is consistent with the approach used for the Pathways analyses that produced the energy and emissions scenarios.

For counties outside of NYS, population projections by age group from the Census Bureau,[8] which extend to 2060, were used.

## Baseline Health Incidence

COBRA requires data on baseline health incidence for each health endpoint to determine the change in public health benefits due to a change in ambient $PM_{2.5}$ concentrations. One of the most important health endpoints included in COBRA is avoided premature mortality, which typically accounts for more than 98 percent of the monetized health benefits from emissions reduction scenarios.

Projected baseline mortality rates used in the analysis were based on national-level projections of deaths by year and age group from the Census Bureau, which extends through 2060.[9] The national-level estimate of annual deaths in each age group were distributed to each county in the U.S. based on the proportion of projected population in each age group in that year.

The analysis also uses the incidence rates for other non-mortality related health effects, such as hospitalizations, asthma exacerbations, and lost work and school days, that are included in COBRA.

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6 Cornell University. 2018. County Projections Explorer. Ithaca, New York: Cornell Program on Applied Demographics. https://pad.human.cornell.edu/counties/projections.cfm

7 Cornell University. 2018. Projections Methodology. Ithaca, New York: Cornell Program on Applied Demographics. https://pad.human.cornell.edu/counties/downloads/2018Methodology.pdf

8 U.S. Census Bureau. 2017. Projected Population by Single Year of Age, Sex, Race, and Hispanic Origin for the United States: 2016 to 2060. https://census.gov/data/datasets/2017/demo/popproj/2017-popproj.html

9 U.S. Census Bureau, 2017. Projected Deaths by Single Year of Age, Sex, Race, and Hispanic Origin for the United States: 2016 to 2060. https://census.gov/data/datasets/2017/demo/popproj/2017-popproj.html

## New York City Health Impact Functions

In addition to the default health impact functions included in COBRA, the New York City (NYC) Department of Health and Mental Hygiene also regularly uses two health impact functions based on epidemiological studies of the impacts of $PM_{2.5}$ concentrations on health outcomes in NYC. Specifically, this analysis uses NYC-specific functions for respiratory-related emergency room visits[10] and hospital admissions for cardiovascular effects.[11]

The NYC health impact functions have the same functional form as those used in COBRA for these health endpoints:

$$DeltaIncidence = 1 - e^{-\beta \times AQ} \times BaselineIncidence \times Population \quad (1)$$

Where:

| | | |
|---|---|---|
| *DeltaIncidence* | = | The change in incidence of the health endpoint due to a change in $PM_{2.5}$ concentrations |
| $\beta$ | = | The beta coefficient, representing the impact of a change in $PM_{2/5}$ concentrations on the incidence of the health impact |
| *AQ* | = | The change in $PM_{2.5}$ concentrations ($\mu g/m^3$) |
| *BaselineIncidence* | = | Baseline incidence of the health endpoint |
| *Population* | = | County-level population |

The NYC functions differ from the default COBRA functions in the value of their beta coefficient, which is a unitless number that represents the impact of a change in $PM_{2.5}$ concentrations on the incidence of the health endpoint. The beta coefficient for cardiovascular-related hospital admissions is 0.000995. COBRA pools together health impact functions from five studies, with beta coefficients ranging from 0.00068 to 0.00189, with an average value of 0.0011. The NYC beta value falls within the range of default beta values used in COBRA.

Similarly, the beta coefficient used in the NYC function for respiratory-related emergency room visits is 0.004533. COBRA pools together three studies with beta coefficients ranging from 0.0029 to 0.0056, with an average value of 0.0041. The NYC beta value for this health endpoint also falls within the range of default beta values used in COBRA.

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[10] Ito K, Thurston G, Silverman R. 2007. Characterization of $PM_{2.5}$, gaseous pollutants, and meteorological interactions in the context of time-series health effects models. *Journal of Exposure Science and Environmental Epidemiology*, 17: S45-S60.

[11] Ito K, Mathes R, Ross Z, Nadas A, Thurston G, Matte T. 2011. Fine Particulate Matter Constituents Associated with Cardiovascular Hospitalizations and Mortality in New York City. Unpublished.

## Reference Case and Scenario Emissions

COBRA estimates the change in health impacts due to changes in $PM_{2.5}$ concentrations, based on emissions of primary $PM_{2.5}$ and precursors to secondary $PM_{2.5}$ formation, including $NO_x$, $SO_2$, $NH_3$, and VOCs. County-level emissions of these pollutants were estimated for each of the three scenarios and the Reference case, with a focus on the following sectors:

- Electric generating units
- On-road
- Non-road
- Buildings

The approaches used to estimate emissions in each sector differed for counties in NYS and counties outside of NYS, and are discussed in the subsections below. Emissions for all other sectors, such as aviation, agriculture, and wildfire emissions, were taken from the existing 2025 baseline in COBRA and were held constant in all years for the Reference case and all scenarios. Note that since the COBRA analysis is entirely dependent on incremental concentrations, these unchanged emissions do not affect the results. There are some mitigation strategies in the Integration Analysis that reduce GHG emissions, particularly methane, in the agriculture and waste sectors. While there may also be some reduction in VOC emissions associated with these methane emission reductions, they are not included in this analysis. These sectors account for less than 1 percent of the VOC emissions in NYS, so the VOC emission reductions associated with mitigation strategies in the Integration Analysis are assumed to be negligible.

### Emissions in Counties in NYS

The county-level emissions data for counties in NYS were estimated based largely on assumptions and results from the Integration Analysis, along with additional data provided by NYS Department of Environmental Conservation (DEC). The Integration Analysis generally estimated changes in fuel consumption and emissions at the regional level within NYS (the regions are described in Section I of this Supplement), though in some cases it estimated county-level emissions. The subsections below discuss the approach for estimating the county-level Reference case and scenario emissions for each sector, including the approach for distributing regional-level data to the county level as needed.

### Electricity Generation Sector

The analysis used county-wide emissions of $NO_x$, $SO_2$, and $PM_{2.5}$ from the electricity sector for both the Reference case and scenarios. These emissions were based on electricity sector modeling conducted for

NYSERDA by E3 LLC using the RESOLVE model. Analysis in RESOLVE provides the electric sector loads, peaks and the expected capacity mix by zone. These projections of loads and capacity mix were then modeled by ICF in PROMOD, an electric market simulation model, to project generation patterns that are used to calculate county-level emission projections. While RESOLVE models the electric system through a representation of generating units as aggregate blocks of capacity by zone and capacity type, PROMOD's representation of individual generators is a requirement to produce emission projections on the county-level. The electricity-sector emissions included emissions from electric generating units both within NYS and in the neighboring region, including the Independent System Operator (ISO) New England and Pennsylvania-Jersey-Maryland (PJM) electricity grids.

ICF estimated the criteria pollutant emissions from the electricity generation sector using $NO_x$, $SO_2$, and $PM_{2.5}$ emission rates from EPA data sources, including the National Electric Energy Data System (NEEDS)[12] and the Air Markets Program Data,[13] and the Emissions and Generation Resource Integrated Database (eGRID).[14] ICF benchmarked the emissions and generation projections, comparing to historical EPA emission data and generation reported from NYISO.

The emissions data developed by ICF did not include emissions of $NH_3$ or VOC from the electricity generation sector. As discussed in more detail below in the *Uncertainty and Limitations* section, emissions of these pollutants in the electricity generation sector were not estimated for the health analysis, based on the results from a sensitivity analysis conducted in COBRA.

While the electricity sector modeling included analysis of changes in emissions in PJM and ISO New England, in addition to NYS, it was felt that the results of specific emissions changes at specific locations outside of NYS were uncertain, particularly given uncertainty about decarbonization pathways for other states in the region. As a result, the core health analysis results only include benefits from emission reductions within NYS.

In Scenarios 2 and 4, from 2040 onwards, the remaining thermal electricity generating units (EGUs) are assumed to burn hydrogen. In addition, sensitivity analyses were included to evaluate the potential for the

[12] U.S. Environmental Protection Agency. 2019. National Electric Energy Data System (NEEDS) v6. https://www.epa.gov/airmarkets/national-electric-energy-data-system-needs-v6. Accessed September 2019.

[13] U.S. Environmental Protection Agency. 2019. Air Markets Program Data. https://ampd.epa.gov/ampd/. Accessed September 2019.

[14] U.S. Environmental Protection Agency. 2020. Emissions and Generation Resource Integrated Database (eGRID): eGRID2018. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid. Accessed July 2020.

same units operating on renewable natural gas, and to evaluate the uncertainty regarding $NO_x$ emissions from hydrogen combustion. Given the higher flame temperature of hydrogen, $NO_x$ emissions from combustion may increase. Based on the review of technical materials focused on hydrogen combustion, it was estimated, as a conservatively high assumption, that $NO_x$ emissions rates would double with hydrogen combustion relative to natural gas.[15] ICF and NYSERDA reviewed air permit data provided by NYSDEC and concluded that, for most EGUs assumed to be operating in 2040 and onwards, a doubling of $NO_x$ emission rates would result in emission rates above their current air permit limits. While pathways to maintaining emission rates under hydrogen combustion are currently still uncertain, there are many options for sources to transition to hydrogen combustion while further reducing $NO_x$ emissions. Technology solutions that would reduce $NO_x$ emissions under hydrogen consumption could include larger and/or more efficient selective catalytic reduction (SCR) control technology, a type of $NO_x$ controls currently in use in the power generation sector. Low NOx hydrogen combustions turbine systems are also under active development and feature advanced fuel mix systems, and while those system would require continued development to allow for 100% hydrogen combustion, active research indicates that lower than double $NO_x$ emission rates may be feasible starting in 2040.

Therefore, a sensitivity case was modeled where NOx emissions rates were maintained at current levels, assuming continued compliance with emission rates and successful control of $NO_x$ emissions at current rates under hydrogen combustion. These two $NO_x$ rate cases provide the best estimate for the range of outcomes associated with the potential combustion of hydrogen for electricity generation.

Overall, the sensitivity analyses included the following cases for evaluating the effect of fuel choice for the remaining thermal generation, all undertaken with Scenario 2:

- No combustion (hydrogen fuel cell or similar long-term storage technology)
- Renewable natural gas combustion ($NO_x$ and PM similar to natural gas)
- Hydrogen combustion – low-$NO_x$ ($NO_x$ emissions similar to natural gas, no PM emissions)
- Hydrogen combustion – high-$NO_x$ ($NO_x$ emissions double relative to natural gas, no PM emissions)

Due to time constraints, Scenario 4 was not run through the PROMOD analysis and county-level emissions were therefore estimated. Scenario 4 county-level emissions were projected using the

[15] https://www.ge.com/content/dam/gepower-new/global/en_US/downloads/gas-new-site/future-of-energy/hydrogen-for-power-gen-gea34805.pdf, figure 19 and accompanying text

relationship between Scenario 2 and Scenario 4 results in RESOLVE and the PROMOD projections for Scenarios 2. For each model region, year, and generation unit type, the ratio between thermal generation in RESOLVE for Scenario 2 and 4 was multiplied by the PROMOD generation and emissions from the Scenario 2 results for the respective regions, categories and years.

The ratios applied to the PROMOD Scenario 2 thermal generation mix and emissions to estimate Scenario 4 thermal generation and emissions were derived from zonal thermal generation in RESOLVE in Scenarios 2 and 4. In PROMOD, individual zones contribute different amounts to the statewide generation totals than in Scenario 2 in RESOLVE. When the RESOLVE-based ratios were applied to the PROMOD zonal generation in Scenario 2, this difference in zonal generation for Scenario 2 carries over into Scenario 4 estimates. To ensure that the estimated Scenario 4 thermal generation and emissions align with the state-wide trends identified in RESOLVE between Scenario 2 and 4, all zonal thermal generation and emissions by zone were scaled with a secondary factor. The secondary factor for all types of thermal generation and emissions was calculated as the ratio between the state-wide generation increase in RESOLVE between Scenarios 2 and 4 and the state-wide thermal generation increase between Scenario 2 and the estimated Scenario 4 thermal generation. With the zonal thermal generation ratios and the secondary factor, regional thermal generation trends as well as state-wide trends are maintained for the scenario 4 estimates of county-level emissions.

## On-road Sector

Emissions estimates from the on-road sector were developed using emission factors from EPA's MOtor Vehicle Emissions Simulator (MOVES)[16] and projections of VMT developed for the Integration Analysis. The process for developing the MOVES emissions factors and VMT are discussed in the following subsections.

### *MOVES Emissions Factors*

MOVES can be run in either "inventory mode" or "emissions factor mode." DEC typically runs MOVES in inventory mode, which results in estimates of hourly emissions by vehicle type, road type, and fuel type for each county. In emission factor mode, MOVES does not result in emissions, but rather emission factors, i.e., emission rates per VMT by vehicle type, road type, fuel type, and speed bin for each hour of the day and month of the year for each county. The Integration Analysis includes multiple scenarios with

[16] U.S. Environmental Protection Agency. 2018. MOtor Vehicle Emissions Simulator. https://www.epa.gov/moves

different assumptions about changes in projected VMT. As a result, running MOVES to generate emission factors, rather than emissions, provides more flexibility to analyze different scenarios.

Because MOVES can be a computationally intensive model to run, with run times taking hours or days, and because this analysis required multiple runs covering scenarios for several years, DEC and NYSERDA developed an approach to provide the necessary emission factors while minimizing the amount of modeling time required. This approach followed guidelines from EPA's Transportation Conformity Guidance for Quantitative Hot-spot Analyses from $PM_{2.5}$.[17] In particular, DEC developed emission factors for two representative counties in New York: Suffolk County to represent downstate counties, and Erie County to represent upstate counties. In addition, the emission factors were developed for the months of January and August, to cover the extremes of temperatures, rather than all months of the year. The emission factors were calculated for each hour of the day by speed bin for each analysis year.

DEC provided hourly data for each county on the proportion of VMT in each speed bin by vehicle type and road type. These data were used with the emission factors by speed bin to develop a weighted average emission factor for each vehicle type, road type, and fuel type in each county. The hourly emission factors by speed bin were weighted based on the proportion of VMT in each speed bin in each hour from the DEC data.

### *VMT Data*

The Integration Analysis used county-level projections of VMT by vehicle type and road type to develop scenarios with different levels of VMT reductions. The VMT used in each scenario and the Reference case of the Integration Analysis were aggregated to five regions (described in Section I of this Supplement) and were reported by vehicle type and fuel type, but not road type. However, because the weighted average MOVES emission factors differ by county and road type, the projected VMT from the Integration Analysis were disaggregated to the county and road type level.

Ratios from the VMT projections were used to disaggregate the regional VMT from the Integration Analysis scenarios into VMT by county, road type, vehicle type, and fuel type. For example, Albany County had approximately 30 percent of the passenger car VMT of the Region F counties in the disaggregated VMT data in 2030. Therefore, 30 percent of the projected VMT in Region F from the

[17] U.S. Environmental Protection Agency. 2015. Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and $PM_{10}$ Nonattainment and Maintenance Areas. Washington, DC. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NMXM.pdf

Integration Analysis scenarios was attributed to Albany County. Similarly, within Albany County, 50 percent of the VMT from passenger cars was on the Urban Unrestricted-Access road type in the disaggregated data. Therefore, 50 percent of the VMT estimated for Albany County was distributed to that road type.

### *Emissions Calculations*

The county level emissions were calculated by multiplying the weighted average VMT in each county for each road type, vehicle type, and fuel type, by the corresponding emissions factor, and then summing across road types and vehicle types.

$$E_{p,c,f} = \sum_{r,v} EF_{p,c,r,v,f} \times VMT_{c,r,v,f} \quad (2)$$

Where:

$E_{p,c,f,}$ = On-road sector emissions of pollutant *p* in county *c* from fuel type *f*

$EF_{p,c,r,v,f}$ = Weighted average emission factor for pollutant *p* from road type *r*, vehicle type *v*, and fuel type *f* mapped to county *c*

$VMT_{c,r,v,f}$ = Vehicle miles traveled on road type *r* by vehicle type *v* and fuel type *f* in county *c*

## Non-road Sector

The Reference case and scenario emissions from the non-road sector were developed for NYS counties using county-level non-road sector emissions projections provided by NYS DEC, which were developed using EPA's MOVES model. These estimates include emissions from combustion from non-road equipment in various sectors, such as construction, agriculture, lawn and garden, and support vehicles for ports, airports, and railroads.

MOVES does not include emissions from commercial marine vessels, locomotives, or aircraft. Emissions from commercial marine vessels and locomotives were estimated based on growing 2017 emissions in these sectors by the change in fuel consumption projected in these sectors as estimated in the Integration Analysis in the Reference case and scenarios. The regional-level data on fuel consumption in these sectors was distributed to the counties based on the proportion of $PM_{2.5}$ emissions in these sectors in 2017. This distribution assumes no major change in the geographic distribution in commercial marine or rail activity over time. The health impacts analysis excluded changes in emissions from aircraft; while some changes may occur in that sector in the scenarios, given the uncertainty in the location of those reductions, including both elevation and distance from populations, it was conservatively assumed that those changes

would not substantially impact public health. Furthermore, it is assumed that renewable jet fuel would not have a substantial impact on emissions relative to fossil jet fuel.

### Buildings Sector

The Reference case and scenario emissions from the buildings sector were developed for NYS counties based on the estimated fuel consumption in the industrial, commercial/institutional, and residential sectors from the Integration Analysis. Emissions in each sector were estimated using fuel- and sector-specific emissions factors from the EPA Industrial, Commercial, and Institutional (ICI) Emissions Tool and NYS DEC's Residential Emissions Tool. These emissions factors were multiplied by the estimated consumption of each fuel type in each sector.

$$E_{p,c} = EF_{p,c,f,s} \times F_{c,f,s} \quad (3)$$

Where:

Ep,c, = On-road sector emissions of pollutant p in county c

EFp,c,r,v = Emission factor for pollutant p from fuel type f in sector s in county c

Fc,f,s = Consumption of fuel type f in sector s in county c

Regional-level data on fuel consumption from the Integration Analysis were distributed to the county level based on distribution factors in the ICI and Residential Emissions Tools. In the ICI Tool, the distribution factors are based on data from the Census Bureau on employment in the industrial and commercial sectors.[18] In the Residential Emissions Tool, the distribution factors are based on the number of homes in each county that use each fuel type as a primary fuel source, from the Census Bureau's American Community Survey.[19]

There are two exceptions to this method. One is for residential wood consumption. Instead of using data from the Census Bureau to distribute the residential wood consumption from the Integration Analysis to the county level, the health analysis used county-level data on residential wood consumption in NYS derived from a survey conducted by the Commission for Environmental Cooperation (CEC) and the Northeast States for Coordinated Air Use Management (NESCAUM).[20] This is the same data used by the U.S. EPA to estimate criteria pollutant emissions for the 2017 National Emissions Inventory. The Integration Analysis data on regional residential wood consumption were summed to the state level and

[18] U.S. Census Bureau. 2018. County Business Patterns. https://www.census.gov/programs-surveys/cbp.html

[19] U.S. Census Bureau. 2019. American Community Survey. https://www.census.gov/programs-surveys/acs

[20] Commission for Environmental Cooperation. 2019. Residential Wood Use Survey to Improve U.S. Black Carbon Emissions Inventory Data for Small-Scale Biomass Combustion. Montreal, Canada.

distributed to the county level based on the proportion of wood consumption in each county from the CEC and NESCAUM data.

The other exception to the county-level distribution method is for industrial coal. Rather than using employment-based distribution factors, the analysis uses data on point source fuel consumption from DEC. In 2019 (the latest year of data available) there were four industrial facilities that used coal. The projected coal consumption from the Integration Analysis was distributed to these counties based on the proportion of their coal consumption in 2019.

### Emissions in Counties Outside of NYS

In addition to the emissions estimates for counties in NYS, emissions estimates were also developed for all other counties in the contiguous United States. This step is important, because the health benefits in NYS are dependent not only on emissions in the state, but also on emissions from other states that are transported in the atmosphere. The emissions in counties outside of NYS are generally not expected to differ between the Reference case and scenarios, with the exception of the electricity generation sector, in which mitigation activities in NYS may result in changes in emissions at electric generating units in other states in the region. Emissions from the electric generation sector in counties in the ISO New England and PJM Interconnection regional transmission organization areas were estimated as part of the modeling process described above for NY State counties.

Reference case and scenario emissions were developed for counties outside of NYS based on projected energy consumption from the Energy Information Administration's (EIA's) Annual Energy Outlook (AEO).[21] The AEO contains regional projections of fuel consumption by fuel type and sector by year through 2050. The 2025 emissions baseline from COBRA was adjusted to create new baselines for each scenario year based on the percent change in projected fuel consumption between 2025 and the scenario year. For example, the AEO projects that consumption of natural gas in the electricity generation sector will decrease by 15 percent between 2025 and 2030 in the New England region. Therefore, the emissions in the Fuel Comb. Elec. Util/Gas/Natural emissions tier in the 2025 baseline in COBRA was decreased by 15 percent for all counties in New England for the 2030 emissions baseline. This process was repeated for each region and for all fuel types in each sector, including the electricity generation, industrial, commercial, residential, and transportation sectors.

[21] U.S. Energy Information Administration. 2019. Annual Energy Outlook 2019. https://www.eia.gov/outlooks/aeo/

This approach is based on the approach used for an analysis of the health benefits of the Regional Greenhouse Gas Initiative.[22] That analysis required individual emissions baselines for the years 2009-2014, and the 2007 baseline from COBRA was adjusted based on percent changes in EIA data on fuel consumption to develop those emissions baselines.

## *Uncertainty and Limitations*

This analysis has multiple sources of uncertainty and limitations. Some of the sources of uncertainty are based on the use of the COBRA Tool, which is a screening-level tool for the assessment of health benefits from emission reductions. Other sources of uncertainty are based on simplifying assumptions used in the analysis and underlying uncertainties in the available data. Each of these sources of uncertainty is discussed below. Because this is a screening-level analysis, the uncertainty is not fully quantified, but it is generally discussed here qualitatively. In some cases uncertainty is discussed in a semi-quantitative manner, such as the results of sensitivity analyses.

### Uncertainty in Underlying Datasets

The health analysis relied on multiple underlying datasets, which have been projected through 2050, including energy consumption in each sector, VMT, and population. Each of these datasets has some degree of uncertainty; however, because the uncertainty of these underlying datasets is not quantified, it is not necessarily clear how it affects the results of the analysis. For this reason, this analysis is an estimate of health outcomes that could result from the outlined scenario and associated assumptions about energy consumption, emissions, and population growth in future years.

### Uncertainty in the Use of the COBRA Tool

One of the sources of uncertainty in this analysis is related to the use of COBRA, including uncertainty around both the air quality modeling and benefits analysis.

#### Air Quality Modeling

COBRA includes a reduced-form air quality model to estimate the impact of changes in emissions in a given county on the air quality in other counties, accounting for the transport of pollution in the atmosphere. While COBRA is considered a screening-level tool, it has been used in many analyses by

[22] Abt Associates. 2017. Analysis of the Public Health Impacts of the Regional Greenhouse Gas Initiative. https://www.abtassociates.com/insights/publications/report/analysis-of-the-public-health-impacts-of-the-regional-greenhouse-gas

NYSERDA, U.S. EPA, and other agencies to provide an estimate of the health benefits of emissions reductions.

The reduced form air quality model included in COBRA, called the Source-Receptor (S-R) Matrix, was developed using a more sophisticated model called the Climatological Regional Dispersion Model to establish relationships between sources of emissions and receptors at the county level. The development of the S-R Matrix involved modeling of all emissions sources in each county, including point sources, nonpoint sources, and mobile sources. Point sources were modeled based on their actual location, while nonpoint and mobile sources were modeled at the center of each county. The dispersion modeling produced a set of transfer coefficients for each county that represent the relationship between emissions in a source county and air quality concentrations in all other receptor counties (including within the county itself). There are four transfer coefficients in the S-R matrix for each county, based on four levels of stack heights: ground-level sources and low, medium, and high stacks.

COBRA estimates the formation of secondary $PM_{2.5}$ through the reaction of $SO_2$ and $NO_x$ with $NH_3$ to form ammonium sulfate and ammonium nitrate, as well as the oxidation of VOCs to form secondary organic aerosols. These reactions are based on the projected emissions of each pollutant, which were determined for each sector for this analysis as discussed above in the Input Data section. The atmospheric chemistry simulations in the model allow it to be flexible to account for changing air pollutant concentrations in NYS. For example, recent studies have shown a sharp decline in $SO_2$ emissions and resulting ammonium sulfate concentrations in NYS since the early 2000s.[23,24] Therefore, even while $SO_2$ and other pollutant emissions are projected to continue to decline in NYS, COBRA accounts for this in the resulting estimation of secondary $PM_{2.5}$ formation.

It should be noted that the S-R Matrix in COBRA is calibrated to reproduce observed $PM_{2.5}$ concentrations. In the most recent version of COBRA, the emissions from the 2011 National Emissions Inventory were run through the model and the results were compared to actual observed $PM_{2.5}$ concentrations. The differences between the modeled and observed concentrations were used to develop county-level calibration factors that were incorporated into the model. The county-level calibration factors are multiplied by the estimated $PM_{2.5}$ concentrations in each county, and the calibration factors

[23] Blanchard, C.L. S.L. Shaw, E.S. Edgerton, and J.J. Schwab. 2019. Emission influences on air pollutant concentrations in New York state: II. $PM_{2.5}$ organic and elemental carbon constituents. Atmospheric Environment: X, 3: 100039.

[24] Masiol, M., S. Squizzato, D.Q. Rich, and P.K. Hopke. 2019. Long-term trends (2005-2016) of source apportioned $PM_{2.5}$ across New York State. Atmospheric Environment, 201:110-120.

range from 0.16 to 3.53, with an average value of 0.91 across all counties. Nevertheless, this analysis focuses on the differences in air quality between the Reference case and each scenario, and the resulting health impacts, rather than the absolute estimated ambient $PM_{2.5}$ concentrations.

In addition, the S-R matrix used in COBRA has been compared favorably to the CALPUFF model in an analysis of emissions from power plants in Georgia, where it was reported that COBRA produced results that were generally similar to those from the more sophisticated dispersion model.[25] The results of that comparison indicated that estimates of primary $PM_{2.5}$ and secondary $PM_{2.5}$ formation from $SO_2$ emissions predicted by the S-R matrix were within 6 percent of those predicted by CALPUFF.

### Benefits Analysis

While the air quality model in COBRA is a reduced-form model, the approach used in COBRA to estimate the health impacts from changes in air quality is *not* a reduced-form approach. The health impacts included in COBRA are standard health impact functions used in EPA regulatory analyses, and are the same functions included in EPA's Benefits Mapping and Analysis Program. These health impact functions were developed from the epidemiological literature, which identified changes in health outcomes associated with changes in $PM_{2.5}$ concentrations. While these functions are commonly used to estimate changes in health outcomes, they also have some uncertainty. To address this uncertainty, COBRA provides the results of multiple health impact functions. In particular, COBRA estimates premature adult mortality using two separate health impact functions (Krewski et al.[26] and Lepeule et al.)[27]. The results from the health benefits analysis, including the monetized health benefits, are presented separately using these two health impacts functions, which can be seen as a high and low range of the estimates. As discussed above, the health analysis uses two additional health impact functions also regularly used by the NYC Department of Health and Mental Hygiene to estimate changes in cardiovascular-related hospital admissions and respiratory-related emergency room visits in NYC.

It should be noted that there are additional health impact functions that could be used in this analysis. For example, one recent study on $PM_{2.5}$ exposure in NYS used data from the Global Burden of Disease study

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[25] Levy, J., A. Wilson, J. Evans, and J. Spengler. 2003. Estimation of Primary and Secondary Particulate Matter Intake Fractions for Power Plants in Georgia. *Environmental Science and Technology*, 37:5528-5536.

[26] Krewski, D., Jerrett, M., Burnett, R.T., Ma, R., Hughes, E., Shi, Y., Turner, M.C., Pope III, C.A., Thurston, G., Calle, E.E. and Thun, M.J., 2009. *Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality* (No. 140). Boston, MA: Health Effects Institute.

[27] Lepeule, J., Laden, F., Dockery, D. and Schwartz, J., 2012. Chronic exposure to fine particles and mortality: an extended follow-up of the Harvard Six Cities study from 1974 to 2009. *Environmental health perspectives*, *120*(7), pp.965-970.

to estimate mortality impacts.[28] However, the health impact functions included in COBRA continue to be among the most widely used in benefits analyses, including in recent analyses of health impacts of $PM_{2.5}$ exposure in New York City, which used the Krewski function included in COBRA.[29,30]

Nevertheless, the health impact functions included in COBRA were developed from a specific population exposed to specific levels and compositions of $PM_{2.5}$, and conditions in NYS have changed since these functions were developed. For example, the health impact function from the Krewski study was based on examining mortality impacts from 500,000 people in 116 U.S. cities between 1980 and 2000. The levels and compositions of $PM_{.2.5}$ have decreased substantially since 2000, as discussed above, with sharp declines in ammonium sulfate, making ammonium nitrate and secondary organic aerosols relatively more important components of $PM_{2.5}$. However, the synthesis of the research into $PM_{2.5}$ impacts on public health conducted for EPA's draft Integrated Science Assessment for Particulate Matter indicates that the literature provides evidence that the health impact functions may be linear with no threshold below which reductions in exposure to $PM_{2.5}$ provides no benefits.[31] In other words, even though $PM_{2.5}$ concentrations have been reduced in NYS in the time since the health impact functions were developed, the evidence suggests that the functions can adequately estimate changes in health impacts even at relatively low levels of $PM_{2.5}$. Similarly, EPA's draft Integrated Science Assessment finds that the literature is unclear as to whether changes in the composition of secondary $PM_{2.5}$ species results in differential changes to health impacts. For this reason, this health analysis, along with most other similar benefits analyses, uses the total change in $PM_{2.5}$ concentrations to evaluate health impacts rather than looking separately at impacts by the different $PM_{2.5}$ species.

Another limitation in this analysis is that it focuses specifically on health benefits due to $PM_{2.5}$ reductions and does not estimate changes in health impacts associated with ozone. The focus on $PM_{2.5}$ reductions is based on the fact that health benefits from $PM_{2.5}$ reductions tend to be substantially larger than the health benefits from ozone reductions. For example, EPA found that $PM_{2.5}$ accounted for approximately 85

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[28] Jin, X, A.M. Fiore, K. Civerolo, J. Bi, Y. Liu, A. van Donkelaar, R.V. Martin, M. Al-Hamadan, Y. Zhang, and T.Z. Insaf. 2019. Comparison of multiple $PM_{2.5}$ exposure products for estimating health benefits of emission controls over New York State, USA. Environmental Research Letters, 14: 084023.

[29] Kheirbek, I., J. Haney, S. Douglas, K. Ito, S. Caputo, and T. Matte. 2014. The public health benefits of reducing fine particulate matter through conversion to cleaner heating fuels in New York City. Environmental Science and Technology, 48: 13573-13582.

[30] Kheirbek, I., J. Haney, S. Douglas, K. Ito, and T. Matte. 2016. The contribution of motor vehicle emissions to ambient fine particulate matter public health impacts in New York City: a health burden assessment. Environmental Health, 15: 89.

[31] U.S. Environmental Protection Agency. 2018. Integrated Science Assessment for Particulate Matter: External Review Draft. Research Triangle Park, North Carolina.

percent of the health benefits of emission reductions associated with the Clean Air Act, with ozone accounting for the remainder.[32] Similarly, a recent analysis of air quality implications of electrification in California found that $PM_{.2.5}$ accounted for 97 percent of the benefits, with ozone accounting for 3 percent.[33] The California electrification study is somewhat similar to this analysis in that it reduces emissions of all pollutants as a result of reduced combustion (as opposed to the Clean Air Act analysis which applied various different controls for different pollutants).

COBRA also does not estimate other benefits of reduced $PM_{2.5}$ concentrations, such as improved visibility and reduced ecological impacts. Furthermore, there may be some additional benefits associated with reducing toxic pollutant emissions not already accounted for within the $PM_{2.5}$ emissions, which were not accounted for given the limited health and emissions data and high uncertainty.

All of the above limitations indicate that while the analysis captures most of the benefits, there are some additional benefits which would accrue. Therefore, the benefits calculated in this analysis may be seen as a lower bound on the actual total benefits of the NYS GHG emission reduction pathways.

### Limited Pollutants in Electricity Generation Sector

The county-level emissions data from the electricity generation sector included emissions of $NO_x$, $SO_2$, and primary $PM_{2.5}$, but it did not include emissions of $NH_3$ or VOCs. However, since emissions of these pollutants from this sector are relatively minor they were not included; electricity generation accounted for approximately 1 percent of the $NH_3$ emissions and 0.1 percent of the VOC emissions in New York in the 2017 National Emissions Inventory. Emission reduction of these pollutants from other sectors, which were included, are substantially higher.

In addition, a sensitivity analysis was conducted, involving running multiple scenarios in COBRA, changing emissions of all five pollutants in some scenarios and only of $NO_x$, $SO_2$, and $PM_{2.5}$ in other scenarios. The results of these sensitivity analyses showed less than a 1 percent difference in the total health benefits between scenarios.

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[32] U.S. Environmental Protection Agency. 2011. The Benefits and Costs of the Clean Air Act from 1990 to 2020. Final Report – Rev. A. U.S. Environmental Protection Agency Office of Air and Radiation.https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1990-2020-report-documents-and-graphics.

[33] Alexander, M., et al. 2019. *Air Quality Implications of an Energy Scenario for California Using High Levels of Electrification.* Prepared by Electric Power Research Institute and Ramboll for California Energy Commission. Palo Alto, California.

As a result, $NH_3$ or VOC emissions from the EGU sector were not estimated for this analysis. This is a conservative assumption because including emission reductions from those pollutants would results in slightly higher total health benefits.

### Simplifying Assumptions in On-Road Sector Modeling

In the MOVES modeling for the on-road sector NYS DEC did not develop emissions factors for all 62 New York counties. Rather, emissions factors were developed for two representative counties: Suffolk to represent downstate counties and Erie to represent upstate counties. These emissions factors were used with county-specific data on speeds by road type to estimate emissions in each county. This is the same approach that EPA uses to estimate the emissions from the on-road sector for the National Emissions Inventory.

In addition, NYS DEC did not model emissions factors for all months of the year, but instead modeled emission factors for January and August. These simplifications are in line with EPA's guidance for transportation conformity quantitative hot-spot analyses of $PM_{2.5}$,[34] which specifies that the modeling can use representative months rather than all months of the year.

### Assumptions about Carbon Capture and Storage

The Integration Analysis is using a limited amount of CCS as a control strategy for some portion of the emissions in the industrial sector. The health analysis did not make any adjustments to the criteria pollutant emissions from any energy consumption in the industrial sector that uses CCS as a control technology. Most of the literature on criteria pollutant impacts of CCS has focused on the electricity generation sector, with relatively brief mention of the use of CCS in industrial settings. The literature suggests that this type of control has the potential to substantially reduce $SO_2$ emissions by more than 90 percent for coal-fired units, but the impacts on primary $PM_{2.5}$ and $NO_x$ are less certain.[35] Some studies suggest that pre-treatment of exhaust gases to remove primary $PM_{2.5}$, $NO_x$ and $SO_2$ prior to removal of

[34] U.S. Environmental Protection Agency. 2015. Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and $PM_{10}$ Nonattainment and Maintenance Areas. Washington, DC. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NMXM.pdf

[35] Koornneef, J, A. Ramirez, T. van Harmelen, A. van Horssen, W. Turkenburg, and A. Faaij. 2010. The impact of $CO_2$ capture in the power and heat sector on the emission of $SO_2$, $NO_x$, particulate matter, volatile organic compounds, and $NH_3$ in the European Union. Atmospheric Environment, 44: 1369-1385.

$CO_2$ increases the efficiency of the $CO_2$ controls.[36,37] The Integration Analysis does not specify whether additional criteria pollution controls will be added to industrial equipment to increase the efficiency of $CO_2$ removal. One type of post-combustion CCS technology—amine scrubbing—has the potential to increase $NH_3$ emissions, because emissions of the amine solvent used in the $CO_2$ control can oxidize to ammonia,[38] although the Integration Analysis does not specify whether this technology will be used in the industrial sector. $NH_3$ reacts with $SO_2$ and $NO_x$ to form ammonium sulfate and ammonium nitrate, which are key components of secondary $PM_{2.5}$. An increase in $NH_3$ emissions would lead to increases in secondary $PM_{2.5}$ formation only if there is excess $SO_2$ and $NO_x$ for it to react with. There have been large decreases in ammonium sulfate concentrations in New York State since the early 2000s, and little change in the ammonium nitrate concentrations. The Integration Analysis projects further decreases in both $SO_2$ and $NO_x$ emissions. Therefore, there may already be excess ammonia in NYS, suggesting that an increase in $NH_3$ emissions may not necessarily increase $PM_{2.5}$ formation.

Because it is unclear which specific type of CCS technology will be used in the industrial sector or whether additional criteria pollution controls will be employed, the health analysis made no adjustments to the criteria pollutant emissions for industrial sector facilities that use CCS. This assumption is likely to be conservative, given that CCS could also reduce criteria pollutant emissions and increase health benefits.

### Assumptions about Renewable Fuels

The Integration Analysis includes consumption of renewable fuels, including biodiesel and renewable diesel in both the Reference case and scenarios. Renewable diesel is a synthetic fuel that is chemically similar to petroleum diesel. Biodiesel has different characteristics and is therefore generally blended with petroleum diesel up to 20 percent. Biodiesel is currently blended into transportation fuels and heating oil in New York. For example, heating oil in NYC currently includes 5 percent biodiesel, increasing up to 20 percent by 2030.

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[36] Spigarelli, B.P. and S.K. Kawatra. 2013. Opportunities and challenges in carbon dioxide capture. Journal of $CO_2$ Utilization, 1: 69-87.

[37] Mukherjee, A., J.A. Okolie, A. Abdelrasoul, C. Niu, and A.K. Dalai. 2019. Review of post-combustion carbon dioxide capture technologies using activated carbon. Journal of Environmental Sciences, 83: 46-63.

[38] Heo, J., S.T. McCoy, and P.J. Adams. 2015. Implications of ammonia emissions from post-combustion carbon capture for airborne particulate matter. Environmental Science and Technology, 49: 5142-5150.

One of the potential GHG mitigation strategies included in the scenarios involves increasing consumption of renewable fuels in the transportation and building sectors. The literature is mixed on whether renewable diesel reduces emissions compared to petroleum diesel. Studies have found both increases and decreases in $NO_x$ emissions from renewable diesel compared to petroleum diesel, by +/-20%.[39,40,41] Studies have generally found that emissions of $PM_{2.5}$ from renewable diesel are similar to or lower than petroleum diesel by up to 40%.[39,41,42]

Similarly, studies of biodiesel have found both increases and decreases in $NO_x$ emissions compared to petroleum diesel.[43,44] Biodiesel also tends to result in lower $PM_{2.5}$ emissions compared to petroleum diesel, by approximately 6% for B20 blends.[45]

While there may be some emission benefits in terms of $PM_{2.5}$ and potentially $NO_x$ emission reductions from renewable diesel and biodiesel compared to petroleum diesel, given the uncertainties, the health analyses used the same emission rates for each fuel type. This assumption potentially conservatively underestimates the benefits of a switch to renewable fuels in the scenarios.

## 1.4 Increased Active Transportation

The public health benefits of increased active transportation were estimated using the Integrated Transport and Health Impact Model (ITHIM).[46] The analysis drew on modeling conducted for the New

[39] Singh, D., K.A. Subramanian, and S.K. Singal. 2015. Emissions and fuel consumption characteristics of a heavy duty diesel engine fueled with Hydroprocessed Renewable Diesel and Biodiesel. Applied Energy, 155: 440-446.

[40] Vojtisek-Lom, M., V. Beranek, P. Mikuska, K. Krumal, P. Coufalik, J. Siokrova, and J. Topinka. 2017. Blends of butanol and hydrotreated vegetable oils as drop-in replacement for diesel engines: Effects on combustion and emissions. Fuel, 197: 407-421.

[41] Singh, D. KA. Subramanian, and M.O. Garg. 2018. Comprehensive review of combustion, performance and emissions characteristics of a compression ignition engine fueled with hydroprocessed renewable diesel. Renewable and Sustainable Energy Reviews, 81: 2947-2954.

[42] Cadrazco, M., A. Santamaria, and J.R. Agudelo. 2019. Chemical and nanostructural characteristics of the particulate matter produced by renewable diesel fuel in an automotive diesel engine. Combustion and Flame, 203: 130-142.

[43] Nabi, M.N., M.M. Rahman, and M.S. Akhter. 2009. Biodiesel from cotton seed oil and its effect on engine performance and exhaust emissions. Applied Thermal Engineering, 29: 2265-2270.

[44] Zheng, M., M.C. Mulenga, G.T. Reader, M.P. Wang, D. Ting, and J. Tjong. 2008. Biodiesel engine performance and emissions in low temperature combustion. Fuel, 87: 714-722.

[45] O'Malley, J. and S. Searle. 2021. Air Quality Impacts of Biodiesel in the United States. The International Council on Clean Transportation. https://theicct.org/publications/us-biodiesel-impacts-mar2021

[46] Available at: http://cal-ithim.org/ithim/#Home

York State Clean Transportation Roadmap,[47] which estimated the increase in walking and biking trips resulting from a decrease in VMT.

ITHIM uses U.S.-level data from the *Global Burden of Disease* study[48] and other published literature to estimate the change in the relative risk of premature mortality due to increased physical activity. ITHIM also calculates the potential increase in pedestrian mortality from vehicle collisions, and it presents the net change in mortality for a given change in walking and biking activity.

In this analysis, the ITHIM model was customized with NYS-specific data on population, baseline mortality rates, and VMT, from the same data sources discussed above for the ambient air quality analysis, as well as baseline walking and biking activity taken from the Federal Highway Administration's *National Household Travel Survey*.[49]

The analysis valued the change in mortality using the value of a statistical life from COBRA to be consistent with the ambient air quality analysis.

The analysis used NYS-specific data where possible alongside the default equations within ITHIM to estimate the net change in mortality from increased walking and biking. These equations include default parameters based on national-level data to represent the change in relative risk of mortality from change in physical activity.

This analysis was conducted at the state level, rather than modeling changes in walking and biking activity due to changes in VMT within counties or individual communities. For this reason, the results of this analysis should be considered a first-order approximation of the benefits of increased active transportation.

[47] Cadmus. New York Clean Transportation Roadmap Preliminary Results: GHGs and Energy. Presentation to the Transportation Advisory Panel to the New York State Climate Action Council. April 9, 2021. https://climate.ny.gov/Advisory-Panel/Meetings-and-Materials.

[48] Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease (GBD). Seattle, WA: Institute for Health Metrics, University of Washington; 2015. http://www.healthdata.org/gbd

[49] U.S. Federal Highway Administration. 2021. National Household Travel Survey. https://nhts.ornl.gov/

## 1.5 Residential Energy Efficiency Interventions

Values from the published literature were used to estimate the public health and safety benefits of residential energy efficiency and weatherization interventions. Specifically, estimates of the average benefits per home in applicable weatherization programs were developed from three key studies.[50,51,52] These average benefits values were multiplied by the estimated number of homes projected to receive energy efficiency or weatherization interventions from the Integration Analysis. These benefits include reductions in thermal stress, asthma symptoms, trip and fall injuries, and carbon monoxide poisonings. These benefits are driven by different types of energy efficiency interventions. For example, reduced thermal stress results from improved air sealing and replacement of heating and cooling appliances, while reduced asthma symptoms are driven by improved ventilation.[50,51] Some health benefits are driven by interventions that provide relatively little energy benefit. For example, reduce trip and fall injuries are driven by the removal of trip hazards, such as torn carpets, roofing repairs to fix leaks, and improved lighting.[50] While the exact nature of the energy efficiency programs envisioned in the Integration Analysis is not specifically defined, the health analysis assumes these programs will provide multiple interventions, as they do today, in the homes with the potential to provide multiple benefits.

The published literature largely focuses on estimating the benefits of weatherization programs for low and moderate income (LMI) homes. For this reason, it was assumed that the estimated benefits per home were appropriate to be used only for LMI homes in this analysis. The definition of LMI is that the household income is 80 percent or less than the median income, or approximately 40 percent of homes in NYS. Therefore, the analysis calculated benefits for only 40 percent of the homes projected to receive energy efficiency or weatherization interventions. This assumption is likely conservative, as there are likely also health and safety benefits from these interventions in higher-income homes. However, due to a lack of data on the size of the benefits in higher-income homes, the analysis only included benefits for LMI homes.

[50] Tonn, B., E. Rose, B. Hawkins, and B. Conlon. 2014. Health and Household-Related Benefits Attributable to the Weatherization Assistance Program. Oak Ridge, TN: Oak Ridge National Laboratory, ORNL/TM-2014/345.

[51] Hayes, S., C. Kubes, and C. Gerbode. 2020. Making Health Count: Monetizing the Health Benefits of In-Home Services Delivered by Energy Efficiency Programs. Washington, DC: American Council for an Energy-Efficient Economy.

[52] Tonn, B. B. Hawkins., E. Rose, M. Marincic, S. Pigg, and C. Cowan. 2021. Health Benefits Attributable to Weatherizing Affordable Multifamily Buildings. Submitted manuscript.

# Chapter 2. Results and Discussion

## 2.1 Key Health Findings

Decarbonization of New York can result in a substantial health benefits from improved air quality, up to $120 billion from 2020 through 2050 (based on reduced mortality and other health outcomes) relative to the Reference case. Approximately 92% of the air quality health benefits are projected within New York State. The remaining 8% of benefits would occur in other states downwind of New York.

- Benefits would be experienced throughout the state and downwind in neighboring states.
- Benefits of reduced fossil fuel combustion are higher in urban areas due to both higher emissions and larger impacted populations.
- Benefits of reduced wood combustion are higher in upstate areas.
- Annual benefits would grow over time as pollution rates decrease.

Two additional other potential health benefit categories were estimated:

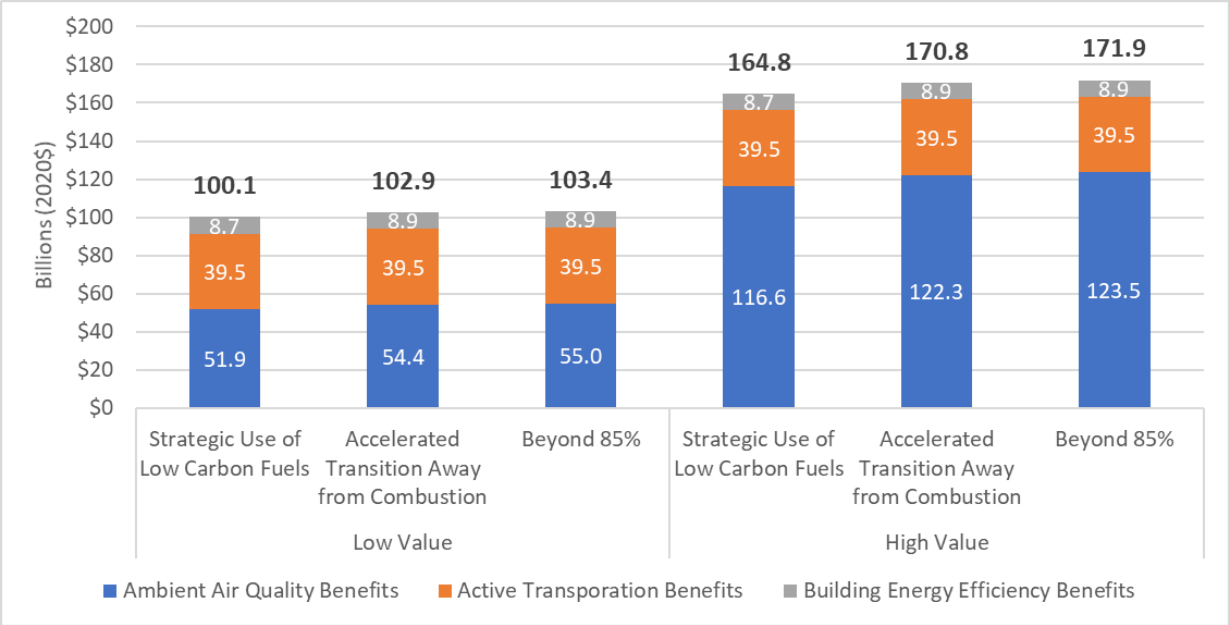
- $40 billion associated with the health benefits of increased active transportation (such as walking and cycling); and
- $9 billion associated with energy efficiency interventions in LMI homes (additional benefits, not quantified, may occur in other buildings as well).

The total projected potential health benefits associated with the scenarios analyzed are presented in Figure 2. Results are presented for the High and Low cases.

## 2.2 Ambient Air Quality Benefits

In all scenarios, air quality improvements can avoid tens of thousands of premature deaths, thousands of non-fatal heart attacks, thousands of other hospitalizations, thousands of asthma-related emergency room visits, and hundreds of thousands of lost workdays. This section describes the total ambient air quality health benefits across each scenario, as well as the benefits by sector and the geographic distribution of the air quality improvements and resulting health benefits.

**Figure 2. Total Projected Health Benefits (Net Present Value, 2020–2050)**




### *2.2.1 Total Health Benefits of Improved Ambient Air Quality*

The value of the benefits by scenario are presented in Figure 3. While a small amount of benefits would occur downwind of New York in neighboring states, the vast majority of benefits would occur within New York. A large portion of the projected benefits would result from reduced wood combustion. Benefits from reduced fuel combustion (excluding wood) would be larger Downstate, and benefits from reduced wood combustion would be larger Upstate. While the reduced wood combustion represents a small amount of the total reduced fuel combustion, it has an outsized impact on particulate matter emissions, resulting in substantially high benefits.

Benefits would increase over time as policies affecting emission reductions take effect, gradually increasing up to approximately $6 billion in the Low case and under $16 billion in the High case by 2050 (Figure 4).

**Figure 3. Total Projected Ambient Air Quality Health Benefits (Net Present Value, 2020–2050)**

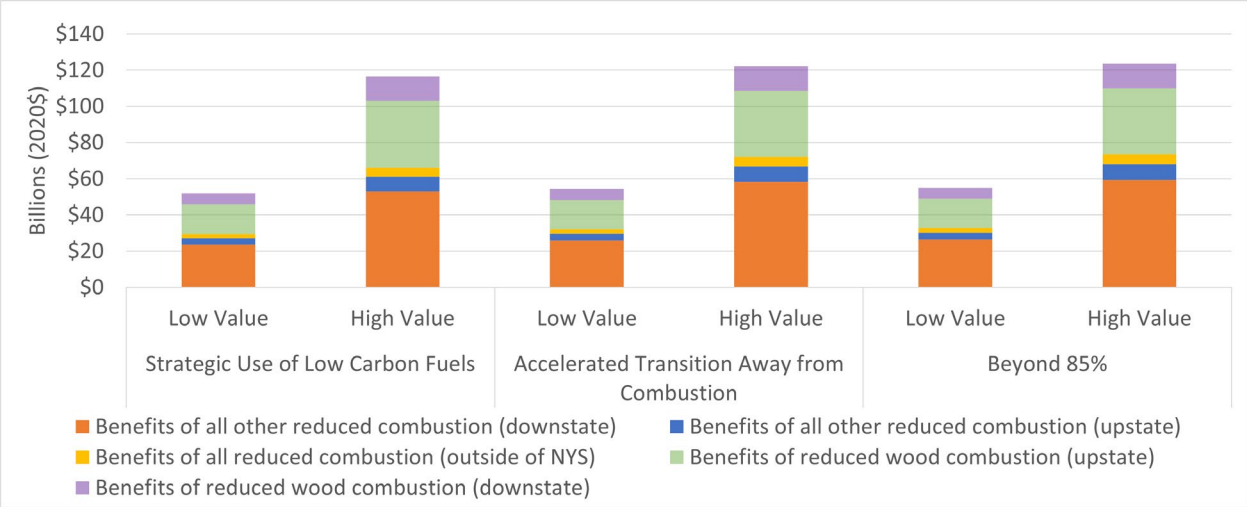
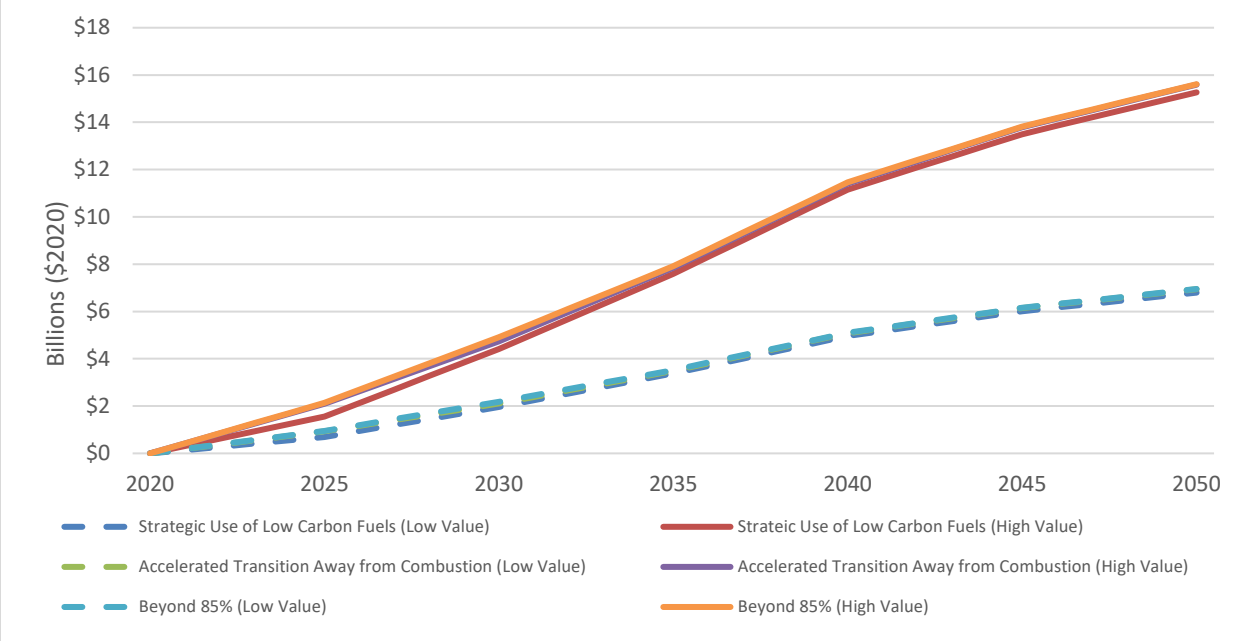



**Figure 4. Annual Projected Ambient Air Quality Health Benefits (2020-2050)**

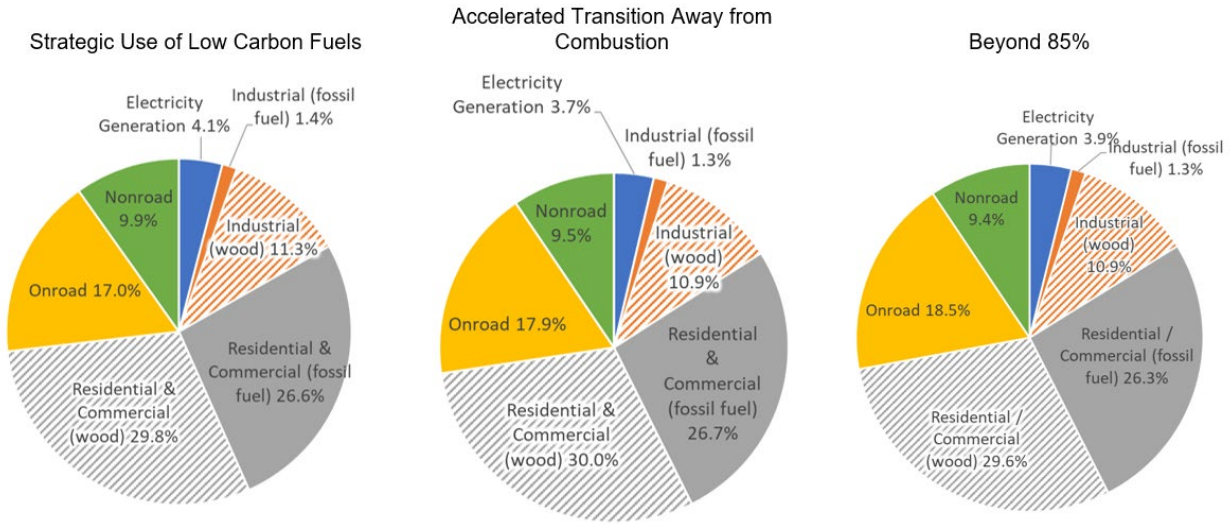



### *2.2.2. Benefits by Sector*

As presented in Figure 5, approximately 40% of the projected benefits are associated with reduced wood combustion in industrial, commercial, and residential uses. The remaining benefits are associated with relatively equal amounts from transportation (on-road and non-road) and building fuel combustion, and additional small fractions of the benefits are associated with reduced combustion in the electricity generation sector. While buildings and electricity generation have substantial emissions and ensuing

health impacts locally, much of the building energy and power in New York is based on natural gas, which burns much cleaner and therefore has a lower impact on particulate matter emissions and public health than oil per unit of energy. Oil combustion can have a much larger health impact locally, but the quantities of oil used statewide are much smaller. However, despite having lower particulate matter emissions than wood combustion overall, those oil and natural gas emissions from buildings do have a large impact on public health because they are in more populated urban areas, while wood combustion is more heavily weighted to rural areas with less dense population, resulting in similar health benefits from reducing wood and oil/gas (this is true also for renewable oil and gas).

**Figure 5. Health Benefits by Sector, 2020–2050**




The health benefits are driven by reductions in all air pollutant emissions, but reductions of primary $PM_{2.5}$ are the strongest driver of the benefits. Approximately three quarters of the Reference case $PM_{2.5}$ emissions in New York are from non-combustion sources, such as dust or biogenic sources (Figure 6). Of the one quarter of the $PM_{2.5}$ emissions that is from combustion sources, nearly all of it is due to residential or industrial wood combustion.

Figure 7 shows the $PM_{2.5}$ emission *reductions* by sector across each scenario, both with and without the benefits of avoided wood combustion. When all fuels are considered, the residential and commercial sector accounts for the majority of the $PM_{2.5}$ emission reductions, due mostly to reductions in residential wood combustion. When wood combustion is excluded, the $PM_{2.5}$ emission reductions occur largely in the onroad, nonroad, and electricity generation sectors.

**Figure 6. Sector-level $PM_{2.5}$ Reference Case Emissions (2025)**

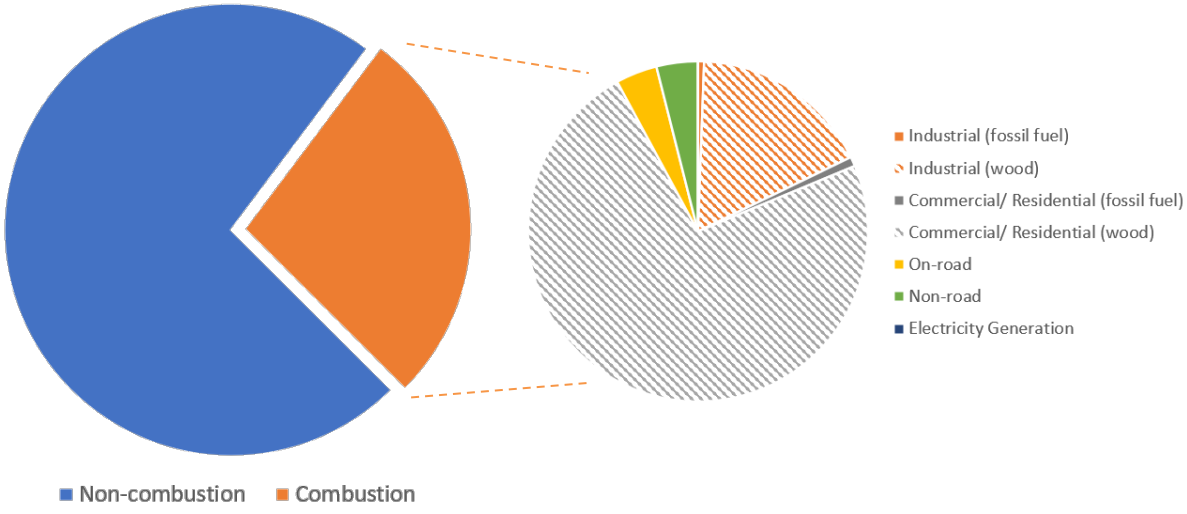
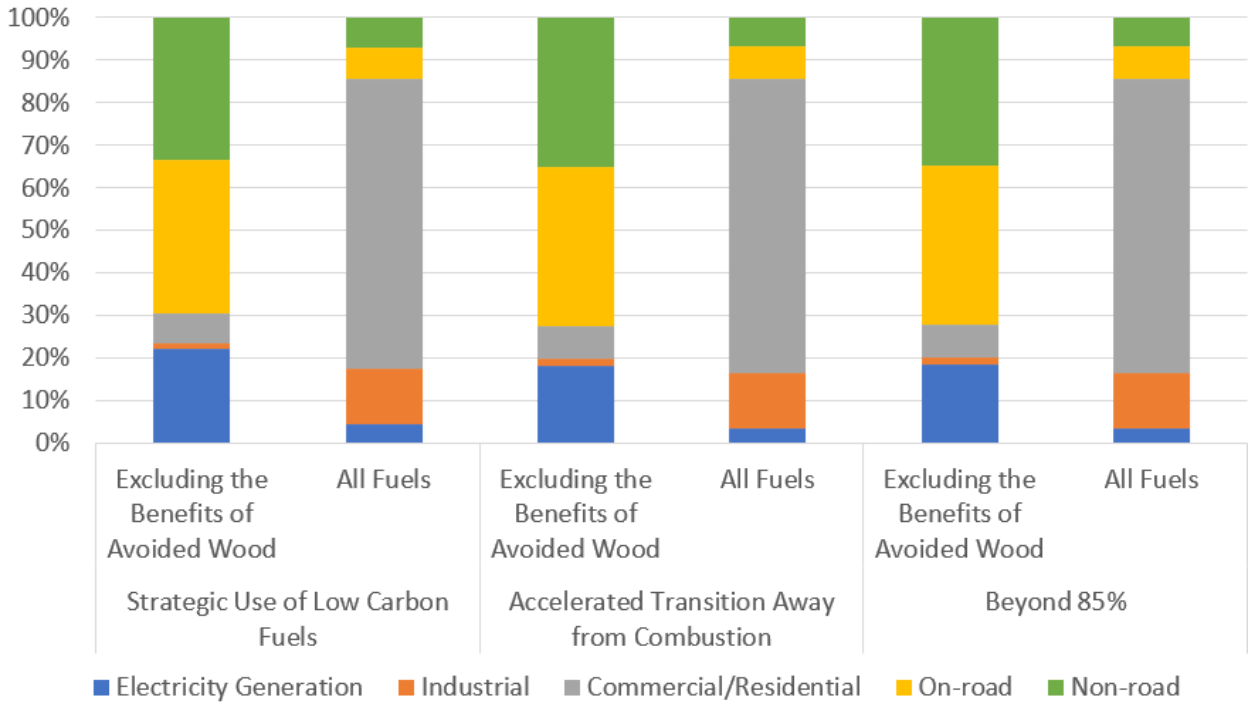



**Figure 7. $PM_{2.5}$ Emission Reductions by Sector (2025-2050)**




In terms of $NO_x$ emissions, approximately three quarters of the Reference case emissions come from combustion sources (Figure 8). The combustion-related $NO_x$ emissions are largely from the residential, commercial, onroad, and nonroad sectors. Unlike $PM_{2.5}$, there are relatively little $NO_x$ emissions from wood combustion compared to fossil fuels. Figure 9 shows that the residential and commercial sector accounts for most of the emission reductions, regardless of whether wood combustion is considered.

These emission reductions are largely due to reductions in natural gas and fuel oil combustion in buildings.

**Figure 8. Sector-level $NO_x$ Reference Case Emissions (2025)**

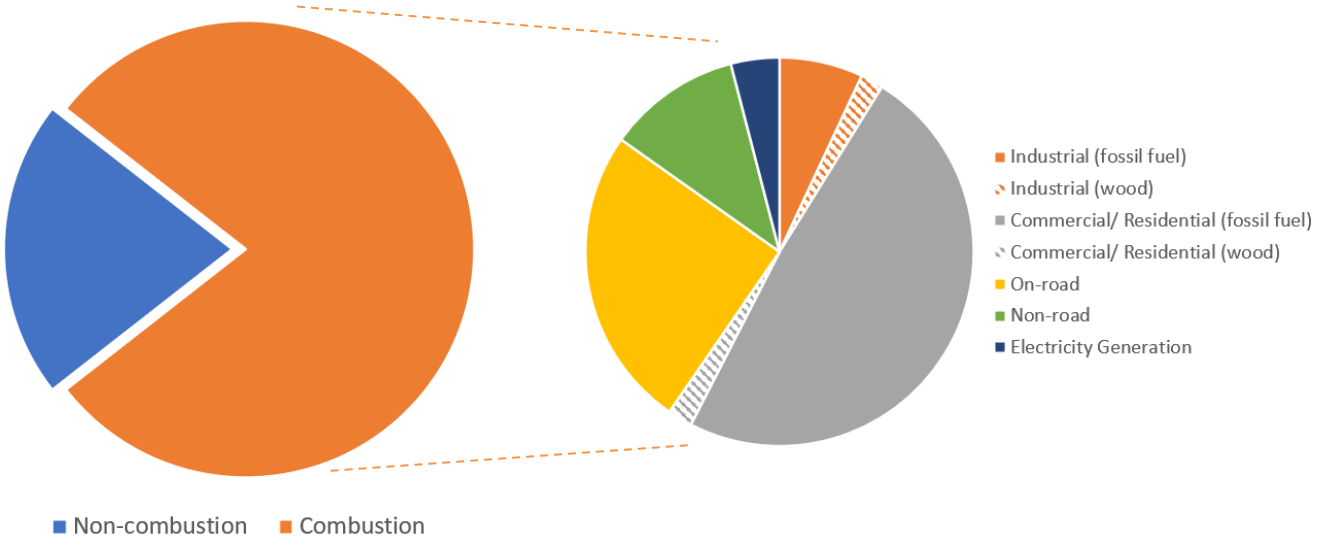



**Figure 9. $NO_x$ Emission Reductions by Sector (2025-2050)**

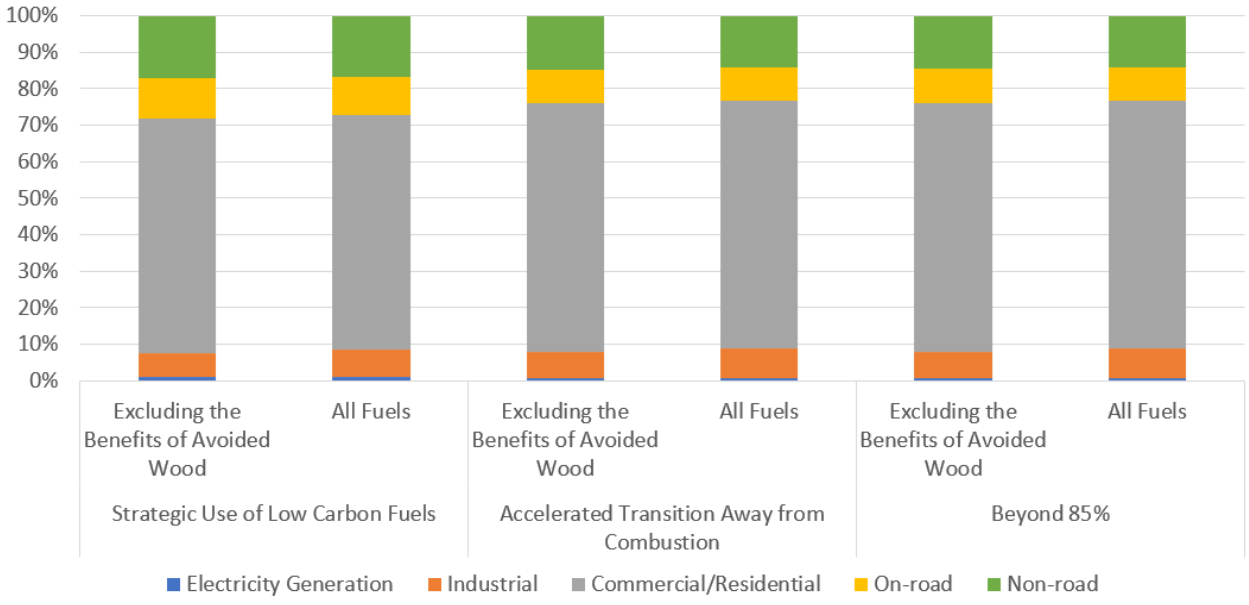
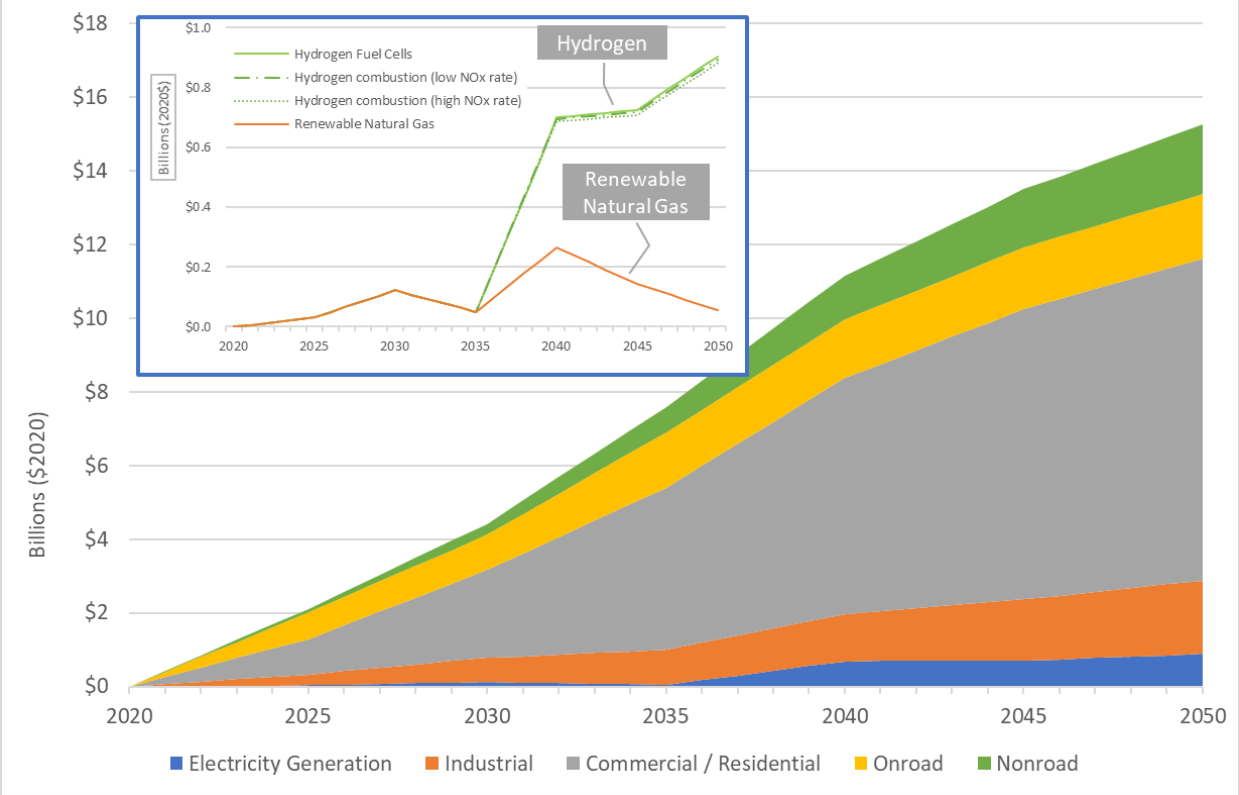



Figure 10 presents the annual health benefits (high value) by sector from the Strategic Use of Low Carbon Fuels scenario. These sectoral results show that the majority of the benefits over time are due to emission reductions in the commercial and residential sector. In addition, these results show that the benefits from

emission reductions in the electricity generation sector largely begin in 2040. The inset graph in that figure shows the results of a sensitivity analysis conducted for the Strategic Use of Low Carbon Fuels scenario. While the vast majority of electricity would be generated from variable renewable resources (e.g., solar, wind), this sensitivity analysis demonstrates the effect of the use of limited renewable natural gas, hydrogen fuel cells, or hydrogen combustion for baseload electricity generation in 2040 and beyond.

**Figure 10. Annual Health Benefits by Sector (high value) for the Strategic Use of Low Carbon Fuels Scenario**




For the hydrogen combustion cases, we analyzed two different emission rates for $NO_x$ emissions to reflect uncertainty in the $NO_x$ emissions from hydrogen combustion. We expect that the 'high $NO_x$' result is likely conservative given required $NO_x$ emission limits, and the 'low $NO_x$' result represents a scenario in which additional controls ensure no increase in $NO_x$ emission relative to what is currently allowed from the use of natural gas. The results shown in Figure 10 indicate that the benefits from all hydrogen cases, including fuel cells and both combustion cases (high and low $NO_x$), are very similar. The difference in the total net benefits from 2020-2050 between the hydrogen fuel cell case and the high $NO_x$ rate combustion case is $35 – 79 million (Low and High cases, respectively), or less than 0.1% of the total economy-wide air quality benefits. The renewable natural gas case shows lower benefits compared to the hydrogen cases,

with $1.4 – 3.1 billion lower than the benefits from the hydrogen fuel cell case (Low and High cases, respectively), or approximately 3% of the total economy-wide benefits.

### *2.2.3. Benefits by Geographic Location*

The maximum annual average $PM_{2.5}$ concentration reductions by county projected to be achieved by 2050 are presented in Figure 11. Note that the concentration reductions in all three scenarios are very similar. The distribution of benefits per capita are presented in Figure 12, both with and without the benefits of wood combustion. While much higher benefits overall would accrue in urban areas due to higher population, per-capita benefits are also higher in urban areas due to higher baseline health incidence and larger reductions in emissions (due to larger sources available to be reduced). The distribution of benefits is very similar in all three scenarios.

**Figure 11. Reduction in $PM_{2.5}$ Annual Average Concentrations, Strategic Use of Low Carbon Fuels, 2050**

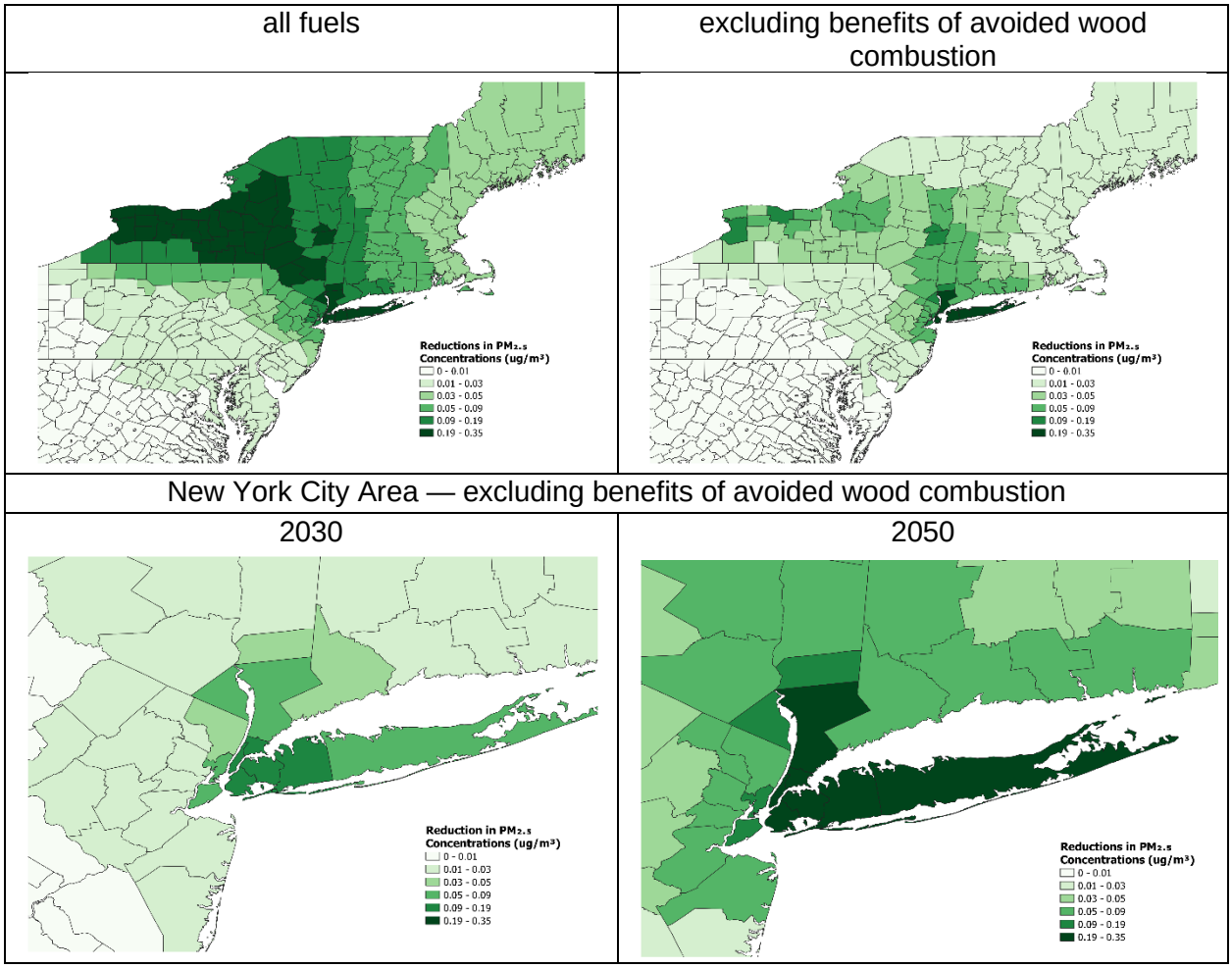
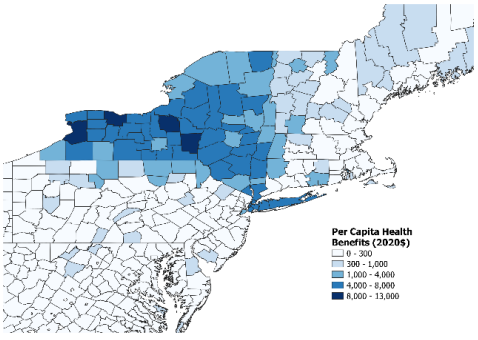
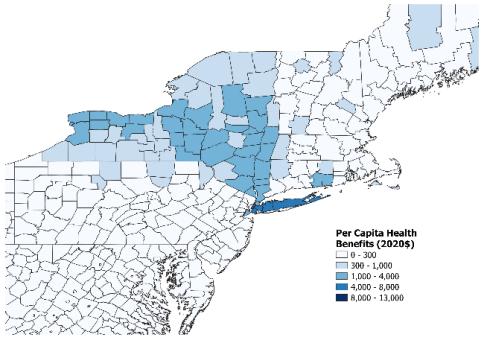
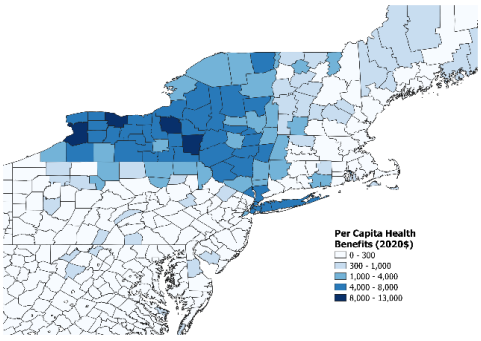
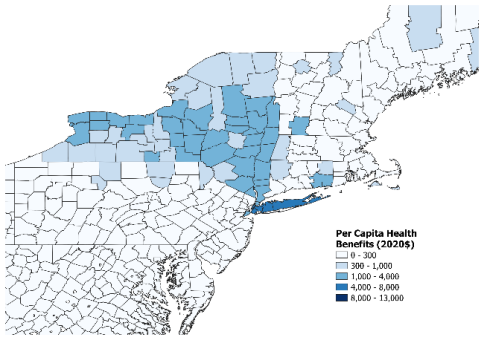
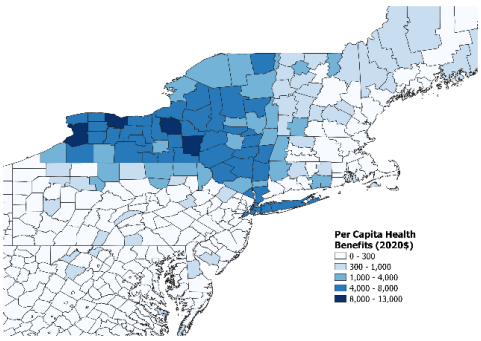
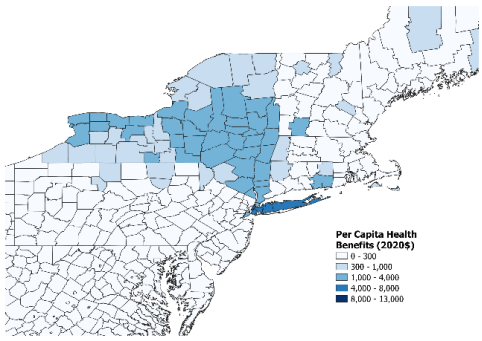


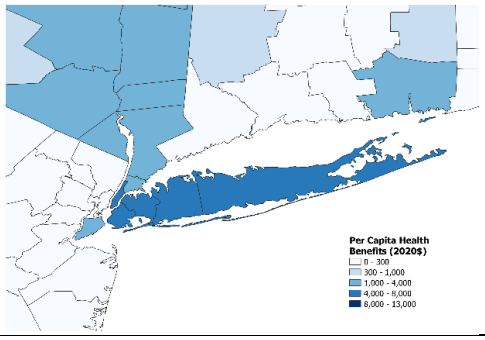
**Figure 12. Per Capita Health Benefits, 2020–2050**

| Scenario | all fuels | excluding benefits of avoided wood combustion |
|---|---|---|
| Strategic Use of Low Carbon Fuel |  |  |
| Accelerated Transition Away from Combustion |  |  |
| Beyond 85% |  |  |



**New York City area – excluding benefits of avoided wood combustion**

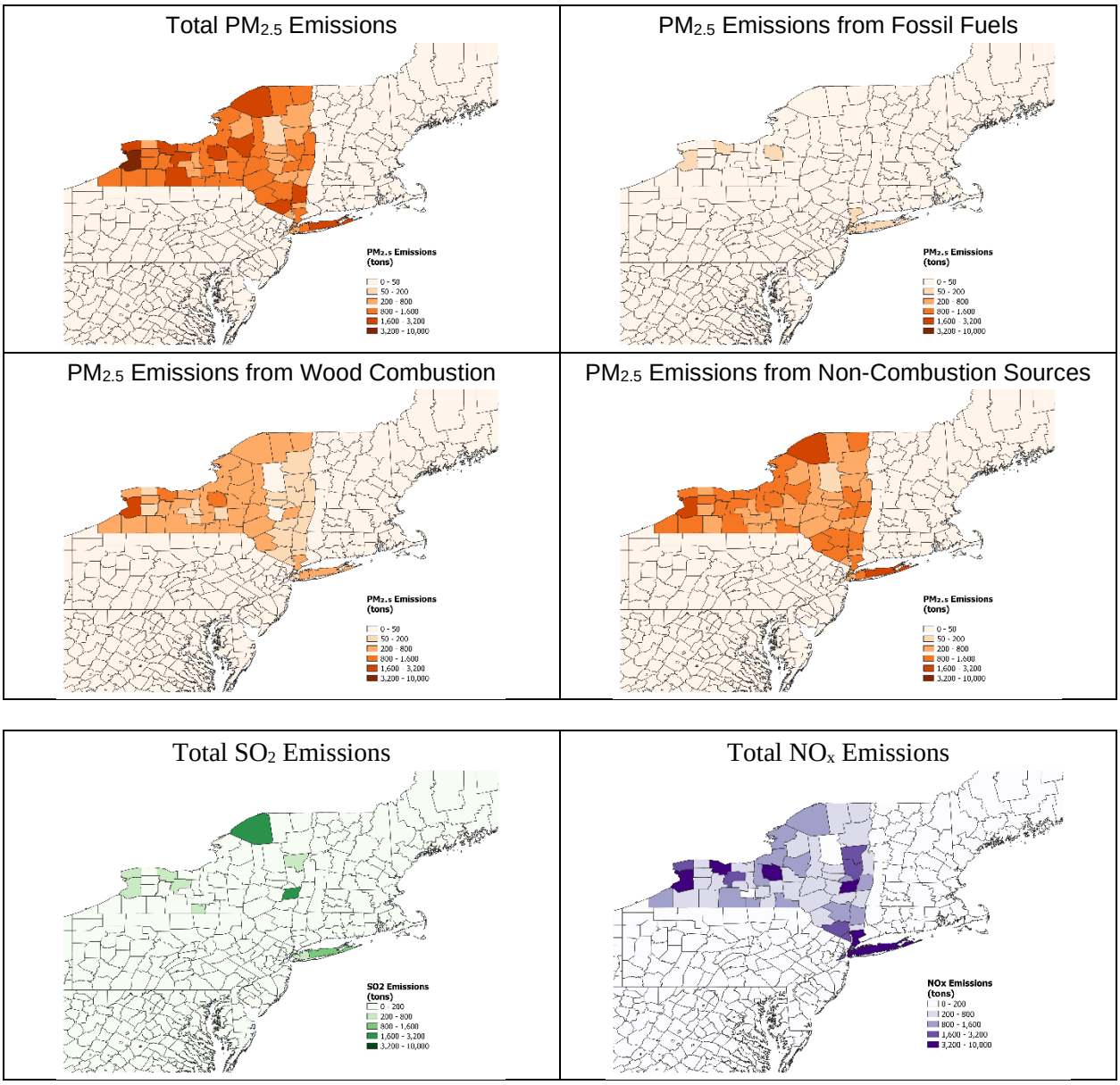
| | Low Carbon Fuels | Accelerated Transition | Beyond 85% |
|---|---|---|---|
| Bronx | $3,539 | $3,907 | $3,941 |
| Brooklyn | $4,532 | $4,894 | $4,944 |
| Manhattan | $5,263 | $5,648 | $5,685 |
| Queens | $5,907 | $6,347 | $6,440 |
| Staten Island | $3,092 | $3,317 | $3,359 |



### *2.2.4. Reference Case Air Pollutant Emissions*

Figure 13 displays the geographic distribution of the Reference case air pollutant emissions. The results show a trend also discussed above in the section on sector-level benefits—the majority of total $PM_{2.5}$ emissions are from non-combustion sources (such as dust or biogenic sources). The majority of $PM_{2.5}$ emissions from combustion sources is from wood combustion. The $PM_{2.5}$ emissions from fossil fuels and total $NO_x$ emissions tend to be higher in urban areas, including in the NYC, Buffalo, Rochester, and Syracuse areas. The $SO_2$ emissions are highest in Albany and St. Lawrence Counties, due to the presence of industrial facilities that use coal and/or generate process emissions of $SO_2$.

**Figure 13. Reference Case Emissions of $PM_{2.5}$, $SO_2$., and $NO_x$ (2025)**

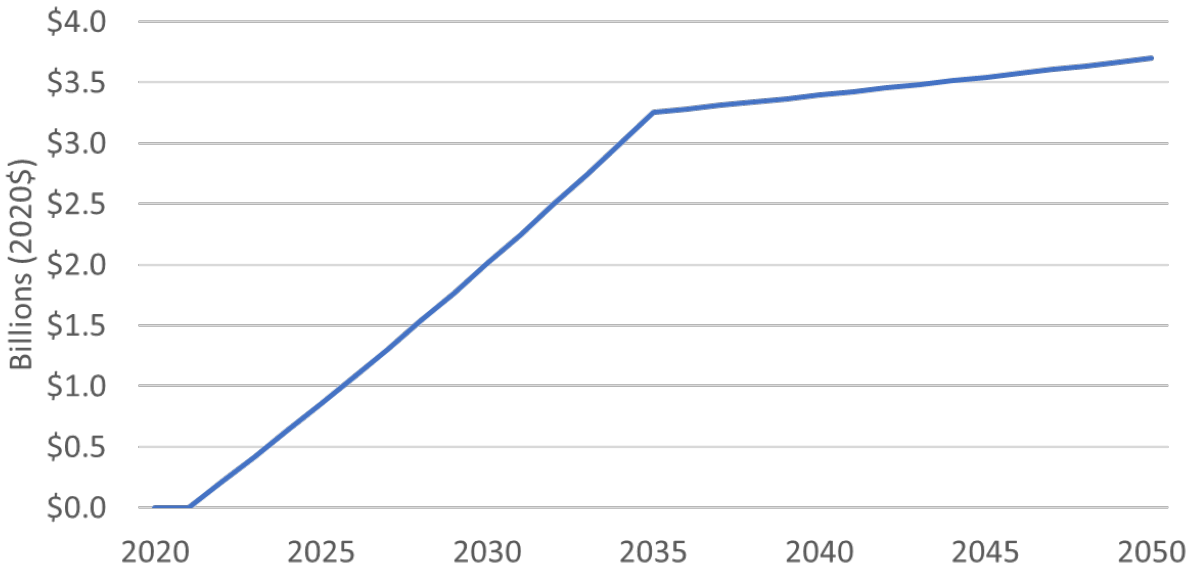


## 2.3 Health Benefits of Increased Active Transportation

The potential value of the net reduction in the number of deaths, including the decrease in deaths from increased physical activity and the increase in deaths from traffic collisions, is estimated to be a NPV of $39.5 billion (2020 to 2050). As presented in Figure 14, the values increase over the years as walking and cycling mode use increases with the introduction of infrastructure and other measures to encourage the use of these modes. Note that the projected decrease in premature deaths from physical activity far outweighs the potential increase in deaths from traffic collisions.

Active transportation benefits are the same for the Low Carbon Fuels and Accelerated Transition scenarios.

**Figure 14. Potential Annual Value of Public Health Benefits from Increased Active Transportation**




## 2.4 Health Benefits of Residential Energy Efficiency Interventions

Health benefits in residential energy efficiency interventions are expected to result from several factors listed in Table 1. These do not include all the potential benefits, but rather only those for which sufficient study of benefits per intervention was available to apply to the New York scenarios. Not included, for example, are benefits of indoor air quality associated with reduced indoor combustion of gas for cooking. Indoor air quality improvements can be achieved during such interventions by ensuring appropriate ventilation (often in cases where ventilation and existing conditions were not appropriate prior to the intervention) combined with heat recovery where needed. Crucial to this benefit is ensuring appropriate ventilation when tightening building envelopes.

**Table 1. Health Benefits Included in the Analysis of Residential Energy Efficiency Interventions**

| Health-Related Measure | Causes for each Benefit | Low-Income Single Family | Low-Income Multifamily |
|---|---|---|---|
| Reduced thermal stress – heat and cold | Building envelope tightening, appliance replacements | ☑ | ☑ |
| Reduced asthma-related incidents or reduced asthma symptoms | Improved ventilation | ☑ | * |
| Reduced trip or fall injuries | Removal of trip hazards, roofing improvements, lighting improvements | ☑ | ☑ |
| Reduced carbon monoxide poisonings | Appliance replacements, carbon monoxide monitors | ☑ | Not available |

* This was studied but no significant difference was detected.

In many cases, benefits occur due to programs ensuring that associated measures are taken at the same time, such as ensuring that carbon monoxide monitors are available where needed and that weatherization does not happen prior to fixing existing conditions such as mold caused by excess moisture in building envelopes and water leaks. Other indoor air quality considerations not related to energy efficiency interventions may include humidity control and filtration where appropriate.[53]

The analysis was undertaken at high-level, applying the number of homes to average benefits from the existing studies. Benefits were estimated only for LMI homes. There are likely also benefits for higher income homes, but data to estimate those benefits is not available.

Benefits would be highly dependent on the structure of the interventions. Energy efficiency programs differ based on whether they include appliance replacement, building shell retrofits, or other non-energy interventions (such as installing carbon monoxide detectors).

Following the current practice in NYSERDA's energy efficiency programs, the analysis assumes that a range of non-energy measures would be included as appropriate in each case.

The projected benefits by health measure and building type are detailed in Table 2 and Table 3 for the Strategic Use of Low Carbon Fuels and the Accelerated Transition Away from Combustion, respectively.

[53] For more information see ASHRAE, Indoor Air Quality Guide, https://www.ashrae.org/technical-resources/bookstore/indoor-air-quality-guide

**Table 2. Potential Public Health Benefits of Energy Efficiency Intervention (2020–2050) Strategic Use of Low Carbon Fuels**

| Health-Related Measure | LMI Single Family (billion $) | LMI Multifamily (billion $) | Total (billion $) |
|---|---|---|---|
| Reduced asthma-related incidents or reduced asthma symptoms | $3.0 | Not available | $3.0 |
| Reduced trip or fall injuries | $1.4 | $0.5 | $1.9 |
| Reduced thermal stress - cold | $0.4 | $0.9 | $1.2 |
| Reduced thermal stress - heat | $0.6 | $1.5 | $2.2 |
| Reduced carbon monoxide poisonings | $0.5 | Not available | $0.5 |
| **Total** | **$5.8** | **$2.9** | **$8.7** |

**Table 3. Potential Public Health Benefits of Energy Efficiency Intervention (2020–2050) Accelerated Transition Away from Combustion**

| Health-Related Measure | LMI Single Family (billion $) | LMI Multifamily (billion $) | Total (billion $) |
|---|---|---|---|
| Reduced asthma-related incidents or reduced asthma symptoms | $3.0 | Not available | $3.1 |
| Reduced trip or fall injuries | $1.4 | $0.5 | $1.9 |
| Reduced thermal stress - cold | $0.4 | $0.9 | $1.3 |
| Reduced thermal stress - heat | $0.6 | $1.6 | $2.2 |
| Reduced carbon monoxide poisonings | $0.5 | Not available | $0.5 |
| **Total** | **$5.9** | **$3.0** | **$8.9** |

# Appendix H: Adaptation and Resilience Strategy Components

## Building Capacity

The "Building Capacity" theme comprises of four strategies related to statewide planning, consideration of future conditions in state decision making, enhancement of general understanding of climate change improving the public's adaptive capacity, and identifying options for financing adaptation and reducing or shifting risk.

### *Commit to Creating, Implementing, and Updating a Comprehensive and Equitable State Climate Change Adaptation and Resilience Plan*

New York is vulnerable to a variety of climate hazards, many of which will become more severe as the climate changes and results in substantial property loss (Table H-1). Note that the values reported in the table include only personal and public property losses and does not include long-term economic losses, medical costs, or loss of life. Despite this vulnerability, New York has not committed substantial resources to comprehensive adaptation planning and coordination. The State should couple its nation-leading goals to mitigate climate change with similarly ambitious goals to adapt to it.

Table H-1. Average Annual Property Loss from Severe Hazard Events in New York, 1996–2017

| Hazard | Avg. loss | Hazard | Avg. loss | Hazard | Avg. loss |
|---|---|---|---|---|---|
| Flooding | $67,100,000 | Ice Storm | $1,670,000 | Lightning | $176,000 |
| Wind | $11,300,000 | Coastal Hazards | $1,620,000 | Heat Wave | $86,000 |
| Snowstorm | $9,400,000 | Cold Wave | $836,000 | Tsunami/Seiche | $18,000 |
| Hail | $3,330,000 | Hurricane | $470,000 | Wildfire | $4,640 |
| Tornado | $1,810,000 | | | | |

#### Components of the Strategy

- **Provide executive-level coordination of adaptation and resilience activities:** Appoint a chief state resilience officer and convene an adaptation and resilience sub-cabinet.

  No single executive within New York government is focused entirely on coordinating the activities of the many state agencies and authorities with a role in adaptation and resilience. The governor should appoint a CSRO and charge them with convening an executive-level adaptation and resilience sub-cabinet, ensuring interagency communication and coordination on adaptation

and resilience activities, and development of a comprehensive climate change adaptation and resilience plan.

- **Develop an adaptation and resilience plan:** Prepare for development of a comprehensive state climate change adaptation and resilience plan.

  The recommendations included in this document address only a small number of well-understood hazards and reflect recommendations made during prior initiatives and do not address the wide range New York's vulnerabilities. The governor should assign the CSRO the task of overseeing development of a comprehensive statewide climate change adaptation and resilience plan.

- **Complete vulnerability assessments and adaptation plans:** Complete preliminary agency vulnerability assessments and adaptation plans. Identify and prioritize state adaptation and resilience projects.

  DEC is coordinating development of assessments of climate change risks to assets and strategic missions for all agencies and authorities, with support from the OGS and consultants. DEC should prioritize completion of the remaining draft agency vulnerability assessment reports. Funding for current and planned consultant support has been allocated from the EPF Climate Change Mitigation and Adaptation Account.

- **Continue assessments and research:** Continue ongoing update to New York climate change assessment and initiate other research.

  Effective assessment, planning and regulation are dependent on actionable science-based projections, down-scaled to the lowest feasible level, and other research. NYSERDA or another agency should undertake comprehensive climate assessments on a regular basis, and DEC or other agencies should undertake or fund additional research as needs are identified.

### *Incorporate Equitable Adaptation and Risk-Reduction Considerations into Relevant State Funding and Regulatory Programs, Projects, and Policies*

Incorporating equity into adaptation considerations in state programs is important for ensuring Disadvantaged Communities are protected against the effects of climate change. Implementation of this strategy would include incorporating equity and justice considerations into these programs, consistent use of science-based projections in state decision making, and development of climate-resilient design guidelines for state-funded projects, among others.

## Components of the Strategy

- **Provide guidance on use of climate change projections:** DEC should release guidance describing projected climatic changes to support relevant decision making.

  CRRA, as amended by the Climate Act, requires DEC to, among other things, take action to support state agencies and other entities assess climate change risk on proposed projects.[1] DEC should release guidance on use of projections by state agencies, including coordinating activities of the Interagency Climate Adaptation and Resiliency Work Group (ICARWG)[2] and DEC internal work groups to identify those climate parameters of most relevance to agency decision making and develop guidance on their application. Upon completion of such guidance, the governor should direct all agencies to apply these projections where appropriate.

- **Coordinate infrastructure investments:** The CSRO should provide recommendations to the Executive Chamber to adopt a process to ensure integration of federal, state and local infrastructure investments to ensure efficient use of land and other resources, and consideration of adaptation and resilience. No mechanism currently exists to ensure that state investments, particularly in energy, transportation and housing infrastructure, and economic development are aligned to maximize efficient use of land and energy, and to reduce risks to climate hazards. The CSRO or other designated official should provide recommendations to the Executive Chamber on policies and procedures required to ensure integration and efficiency of state infrastructure and other investments.

- **Evaluate equity and justice:** The CSRO should develop a formal policy on evaluation of equity and justice impacts of state adaptation and resilience decisions and provide guidance on use of such evaluation to prioritize action in Disadvantaged Communities.

  New York's evaluation of effects of state decisions, particularly infrastructure investments, on Disadvantaged Communities, communities of color, or LMI households would gain consistency and transparency through development of a formal evaluation policy and framework. The policy shall include guidance on selection of relevant metrics. Upon completion of the report on barriers and opportunities facing Disadvantaged Communities currently under development and due by January 2022, DEC and NYSERDA should proceed with development of an evaluation framework and policy for evaluation of equity and justice impacts of state decisions.

[1] Community Risk and Resiliency Act § 17-a.

[2] The Interagency Climate Adaptation and Resilience Work Group is a self-directed body comprising representatives from more than 20 state agencies and authorities. DEC convenes the ICARWG to facilitate information sharing and other activities related to adaptation.

- **Adopt resilient design guidelines:** OGS and DEC should convene a work group to adopt climate resilient design guidelines for state-funded projects.

  Adoption of climate-resilient design guidelines for state-funded projects would secure state investments against future hazards while providing a model for privately funded projects and creating demand for skilled design professionals and tradespeople. OGS, in consultation with DEC, should convene a work group of infrastructure and economic development agencies, including staff with appropriate expertise in resilient design, for the purpose of adopting climate-resilient design guidelines for state-funded projects.

- **Amend the Smart Growth Public Infrastructure Policy Act:** The State should amend the Smart Growth Public Infrastructure Policy Act and similar statutes to require consideration of climate hazards and development of guidance by relevant agencies.

  The 2010 Smart Growth Public Infrastructure Policy Act (ECL Article 6) requires public infrastructure agencies to consider several smart growth criteria, including mitigation of future risk due to sea-level rise, storm surge and flooding, before undertaking, funding, approving or supporting a public infrastructure project. The State should amend the Smart Growth Public Infrastructure Policy Act to require consideration of mitigation of all relevant climate hazards and require relevant agencies to develop implementation guidance.

- **Enhance design capacity:** OGS should convene work group to establish policies and procedures to require design professionals and contractors on State-funded projects to consider future climate conditions.

  Incorporation of future conditions and natural resilience measures into state-funded projects will require the design community to be knowledgeable of forward-looking design guidelines and to understand applicability of natural resilience measures. Such policies and procedures should include consideration of changes in storm intensity and frequency and that design professionals are qualified to incorporate natural resources and nature-based features into project design.

- **Assess climate vulnerabilities during land and water planning:** DEC, DOS and other agencies that fund land or water planning activities should adopt policies to ensure all state-funded land and water use plans include assessment of climate vulnerabilities and, as appropriate, strategies to promote resilience and reduce risk.

  State agencies provide funding to support a variety of regional and municipal plans related to land and water use, including, but not limited to, comprehensive plans, source water protection plans, and local waterfront revitalization plans. DEC, DOS and other agencies that fund land or water

planning activities should adopt policies to ensure that state-funded plans include assessment of climate vulnerabilities and resilience strategies. The ICARWG should serve as a forum for reporting on agency activity in this area and information sharing.

### *Strengthen Meaningful Community Engagement and Public Education and Build Adaptive Capacity across All Sectors*

Public awareness of the need for the Climate Act and its implementing actions is critical to its ultimate success. Ensuring individual and household resilience will be crucial in reducing risks associated with climatic events. Climate adaptation provides significant opportunity for vocational training and job growth that can be targeted to vulnerable communities and those in transition from reliance on fossil-fuel based industries.

#### Components of the Strategy

- **Raise student and public awareness:** The State Education Department should convene a work group to establish a campaign to build student and public awareness of climate change effects and solutions.

  Public education and awareness programs are necessary to ensure public understanding and acceptance of the need for the Climate Act, and enhanced public understanding of risks would allow more informed decisions to reduce risks to health and safety. DEC has appointed a strategic communications director for climate. The State Education Department should convene a work group to develop and implement a comprehensive public education and awareness campaign.

- **Provide disaster preparedness and response training for building operations staff:** NYSERDA and partner agencies should establish a program to train building operations staff in disaster preparedness and response.

  Building operations staff, such as multi-family building superintendents, can enhance building resilience and assist residents in disaster preparedness and response, particularly to address risks associated with sea-level rise, stormwater runoff, flooding, extreme heat and high winds. NYSERDA and partner agencies should launch training to enhance building operations staff capacity to prepare for and react to severe events.

- **Establish a resilience audit program:** NYSERDA, in consultation with DEC, HCR, OTDA, and the Division of Homeland Security and Emergency Services (DHSES) should establish a residential and small business resilience audit program.

The resilience audit program should provide for grants, low-cost loans or tax exemptions to encourage homeowners and small businesses to undertake risk-reduction measures prior to a dangerous event. A resilience audit program could be modeled on, and perhaps combined with, energy audit programs currently available for residential building owners, farmers and tenants. NYSERDA, in consultation with DEC, HCR, OTDA, and the Division of Homeland Security and Emergency Services (DHSES), should incorporate resilience audits into existing energy audit programs, and the state should enact legislation to establish programs to reduce individual costs of risk-reduction measures.

### *Identify and Evaluate Options for Supporting Equitable Adaptation and Resilience Practices and Projects, and to Enhance Insurance Protection*

The costs of dealing with the effects of climate change will be significant and will continue to rise as the planet warms. These costs may include investments to reduce risk or costs to respond to, and recover from, natural events, exacerbated by climate change. Unfortunately, the benefits of these investments are often difficult to quantify as they generally consist of avoided remedial costs, and the payback is generally realized only after an event occurs, or some dangerous threshold is crossed. Although insurance can serve to spread risk, strategies to enhance insurance coverage must include consideration of renters and owners of at-risk properties who do not participate in the National Flood Insurance Program, and the potential effects of insurance premium increases on low-income households. The components of this strategy are intended to secure the funds necessary to make necessary investments in resilience and enhance insurance protection.

#### Components of the Strategy

- **Create a resilient infrastructure fund:** The State should create a resilient infrastructure fund through bonding.

  The Environmental Bond Act to be placed on the 2022 ballot likely represents the best opportunity to secure funding for many of the actions recommended in this scoping plan. All programs funded by a bond act, if approved, should include appropriate focus on Disadvantaged Communities.

- **Establish an insurance-premium surcharge for high-value, high-risk properties:** Impose a surcharge on insurance premiums for select lines of insurance to support risk-reduction and adaptation projects.

Insurance premiums for select lines of insurance affected by climate hazards will generate revenue for risk-reduction and adaptation projects. One study estimated that a 1.5% surcharge on property-casualty insurance on high-value, at-risk properties could generate more than $2.7 billion in revenues over ten years, which could be leveraged to address a substantial share of unmet adaptation and resilience needs. The State should enact legislation to approve a surcharge on property insurance premiums for high-value, at-risk properties to raise needed revenue to support risk-reduction projects and to disincentivize construction of such properties.

- **Authorize community preservation funds for all municipalities:** The State should enact legislation authorizing all municipalities to establish community preservation funds.

  Community preservation funds may be used for adaptation and resilience projects within the communities or their drinking water watersheds, or for upstream flood mitigation. The General Municipal Law and Town Law authorize establishment of community preservation funds for individual municipalities. Creation of such funds in additional municipalities can be a slow and burdensome process. The State should enact legislation to authorize all counties and municipalities to create, with voter approval, community preservation funds without the need to seek further approval from the Legislature. The authorizing statute should specify that community preservation funds may be used for adaptation and resilience projects within the boundaries of the county or municipality, or outside the county or municipality boundaries to project their drinking-water source or to mitigate upstream flood risk. The statute should also specify that community preservation funds may be raised via bonding, in addition to property-transfer taxes, and that the funds may be used as match for federal, state or other funding opportunities.

- **Focus anchor-institution investment on community benefit and wealth building:** DOH should encourage anchor institution (large, usually nonprofit organization tethered to their communities, like universities, medical centers, or local government entities) to focus community benefit investments on projects to equitably address climate change and build local community wealth.

  Hospitals and other anchor institutions have an opportunity to enhance community resilience and public health through investment of community benefit funds. DOH should convene a work group of relevant agencies, anchor institutions and stakeholders to develop a comprehensive strategy to encourage investment by anchor institutions and community wealth building.

- **Explore hazard mitigation funding alternatives:** The Division of Budget, or other appropriate agency, should report on options to enhance hazard mitigation funding and to prefund disaster recovery, and to transfer catastrophic risk to the insurance and capital markets.

  Although at least one authority (MTA) uses catastrophe bonding to reduce risk, financing and risk-transfer models related to damage to physical and economic resources due to climate-enhanced catastrophic events have not been well examined for possible broader use by New York. The Division of Budget or other appropriate agency, as designated by the governor, should provide an analysis of options and recommendations to ensure availability of funding in the event of climatic disaster and to transfer climate risks from state taxpayers.

- **Improve insurance coverage:** DEC and partners at all levels of government should implement strategies to increase take-up rates of flood insurance and other coverage related to climate hazards.

  A substantial number of New York property owners do not carry flood or other hazard insurance, despite the significant risk. DEC and partners should review available information and, if necessary, survey the amount and types of coverage purchases by property owners and develop strategies to increase participation.

- **Restrict anti-concurrent causation clauses:** The State should adopt legislation to prohibit or restrict anti-concurrent causation clauses for sewer backup insurance coverage where flooding is the cause.

  In a 2015 report, ordered by the Legislature, the Department of Financial Services recommended anti-concurrent causation clauses be prohibited for sewer backup insurance, but the Legislature failed to act on this recommendation. The State should adopt legislation to prohibit anti-concurrent causation clauses for sewer backup insurance coverage where flood is the cause.

## Communities and Infrastructure

The Communities and Infrastructure theme includes five strategies to assist municipalities prepare for and react to increasingly severe climate hazards. These initiatives include recommendations to expand State support for regional and local planning, and to assist municipalities in their efforts to incorporate future conditions into local planning and regulatory decisions. This theme also includes specific recommendations to address risks due to flooding and extreme heat, and to ensure resilience of the energy system.

### *Provide State Agency Planning and Technical Support for Equitable Regional and Local Adaptation and Resilience Plans and Projects*

Local officials have consistently advised that they lack resources, including not only funds, but technical expertise and access to information and decision-support tools to support effective adaptation planning. This strategy would accelerate current efforts to provide guidance, and financial and technical support for community and regional planning and implementation, for mainstreaming of climate change considerations into local planning and regulatory programs, and for consideration of local economic resilience under future climate conditions in planning decisions. This strategy would also provide planning for climate-induced migration, both into and within the State.

#### Components of the Strategy

- **Develop local adaptation capacity:** DEC, DOS and other agencies should support development of local resilience, continuity and adaptive capacity; and consideration of climate change in local regulatory and planning programs.

  All agencies should accelerate current efforts to provide guidance, and financial and technical support for community and regional planning and implementation, and for mainstreaming of climate change considerations into local planning and regulatory programs. DEC's Climate Leadership Coordinators should focus on supporting municipal adaptation planning and implementation, and DOS should continue to support county-level adaptation planning. DEC, DOS and DHSES should actively update guidance and requirements for funded local and regional planning to ensure consideration of future conditions The ICARWG should continue to facilitate information sharing and interagency coordination to support these program updates. As feasible and appropriate, materials should be made available in other languages, in addition to English.

- **Promote local economic resilience:** DOS, ESD, and other relevant agencies should support development of local economic resilience strategies, climate-adapted economic development, business continuity planning, and local government climate financing and budgeting.

  DOS, ESD, and other relevant agencies should continue to develop and expand programs, such as the BOA program and DRI, to provide climate-adapted economic development, particularly in Disadvantaged Communities or those in transition from a fossil-fuel based economy, and to provide guidance on business continuity planning.

- **Deploy online tools:** DEC and partner agencies, including DOS, NYSERDA, DHSES, and the Office of Information Technology Services, should support deployment of online tools to facilitate vulnerability assessments, adaptation planning and implementation.

Local governments and regional entities require decision-support tools to facilitate vulnerability assessments, and to aid in adaptation planning, project management, and selection of metrics. DEC and partner agencies, including DOS, NYSERDA, DHSES, and the Office of Information Technology Services, should accelerate current efforts to develop and deploy online tools to support local and regional facilitation. High-priority projects include an online adaptation portal for municipalities, a drought warning and communication tool and updates to DEC's Climate Smart Resiliency Planning self-assessment tool. The ICARWG should continue to facilitate and coordinate these efforts.

- **Support recovery planning:** DOS and DEC should support community-led pre-event, long-term recovery planning.

  Pre-event recovery planning allows communities to consider long-term plans to benefit the entire community and that consider future conditions before disaster strikes. DOS and DEC should adapt applicable Federal Emergency Management Agency (FEMA) planning guidance[3] for New York. Consideration should be given to supplement current funding to provide additional planning assistance through DEC's Climate Leadership Coordinators as local interest increases. Funding for implementation of pre-event long-term recovery plans, including consideration of community-led relocation, with strategic property buy-outs, strategic reuse of industrialized waterfronts, and economic repurposing of buy-out properties and stranded coastal assets should be enhanced.

- **Consider relocation and buyouts:** NYSERDA, in consultation with DEC, HCR, and DOS, should analyze relocation and buyout of properties as potential alternatives to electrification of at-risk buildings.

  Electrification or similar investments in publicly owned buildings located in at-risk areas may not warrant the investment. NYSERDA, in consultation with DEC, HCR, and DOS, should develop criteria to determine if relocation, including property buyouts, is a more protective and cost-effective alternative to publicly funded electrification of some individual buildings.

- **Establish post-disaster strike teams:** The CSRO should establish strike teams to equitably assist municipalities with resilient post-disaster recovery.

  Interagency teams should be trained in anticipation of deployment to disaster areas to facilitate recovery efforts. The governor should designate a lead agency for establishment of post-disaster

[3] Federal Emergency Management Agency. (2017). Pre-Disaster Recovery Planning Guide for Local Governments. FEMA Publication FD 008-03.

strike teams, and assign a work group, comprising DHSES, DOS, DEC, and the Governor's Office of Storm Recovery, to develop a work plan to prepare such teams for deployment.

- **Plan for climate migration:** DEC should convene a work group, to include NYSERDA, DOS, HCR, DHSES, Governor's Office of Storm Recovery, subject experts from SUNY or other universities, and refugee resettlement agencies, to develop a strategy to address climate migration, including consideration of differential effects of relocation strategies in disadvantaged communities.

  Significant immigration to the state by those escaping disasters, such as hurricanes and droughts, and those attracted by, for example, the state's abundant water resources, can be expected. Migration within the state as residents move to escape hazards such as rising seas or urban heat may also occur. DEC should convene a work group, to include NYSERDA, DOS, HCR, DHSES, Governor's Office of Storm Recovery, subject experts from SUNY or other universities, and refugee resettlement agencies, to develop a climate migration strategy.

### *Evaluate Opportunities to Ensure Equitable Consideration of Future Climate Conditions in Land-Use Planning and Environmental Reviews*

Work to mainstream consideration of climate change in environmental reviews is ongoing, but much remains to be done, and local governments require more explicit authority to consider climate change and biodiversity in comprehensive plans.

#### Components of the Strategy

- **Provide guidance on assessment of climate risks:** DEC should accelerate ongoing efforts to develop or update guidance for mitigation of climate change risks in permit and SEQRA reviews; and amend the SEQRA Handbook and workbooks.

  DEC should accelerate ongoing efforts to incorporate consideration and mitigation of climate change risks in permit and SEQRA reviews and complete revisions to all relevant permit guidance, workbooks and the SEQRA Handbook.

- **Facilitate adaptation projects:** DEC should amend the project review process to facilitate approval of climate adaptation projects.

  DEC should adopt a policy to include identification of adaptive, carbon-neutral or resilient projects, and procedures to facilitate project review, without jeopardizing opportunities for meaningful public engagement in the review process. The review should also include review of a potential incentive program for carbon-neutral or resilient development.

- **Consider climate and biodiversity in comprehensive plans:** Amend relevant legislation to include consideration of climate mitigation, adaptation and resilience, and biodiversity as potential topics in comprehensive plans.

  State law enumerates the topics that municipal comprehensive plans may include. The State should amend relevant statutes to explicitly empower municipalities to address climate change mitigation, adaptation and resilience, and maintenance of biodiversity in comprehensive plans.

## *Develop Policies, Programs, and Decision Support Tools to Reduce Risks Associated with Coastal and Inland Flooding*

Flooding is New York's primary climate hazard, and we can expect both insured and uninsured losses to increase as sea level continues to rise and more frequent extreme precipitation events result in more extensive and deeper floods, including dangerous flash flooding in urban areas not previously considered flood prone. Components of this strategy would provide improved map and other information resources, funding and regulations to reduce flood risks.

### Components of the Strategy

- **Increase pace of floodplain assessments:** Increase the pace of local floodplain assessments to identify flood hazards.

  DEC has funded approximately 48 local floodplain assessments, which provide a solid foundation for projects to reduce flood risk, including capacity to consider future conditions. DEC should increase the pace of completion of local floodplain assessments.

- **Right-size infrastructure:** DEC should hire a statewide technical assistance coordinator to support municipalities in right-sizing culverts and bridges to reduce flood risk and improve habitat connectivity.

  Incorrectly sized stream crossings (culverts and bridges) can create significant flood risks and negatively affect habitat connectivity for aquatic and terrestrial species. Analysis and flood modeling require technical expertise, and municipalities face challenges in using available data and technical analysis to prioritize stream-crossing projects and proceed to implementation, while fully considering future risks. DEC should hire a statewide technical assistance coordinator to support municipalities in prioritizing and implementing right-sizing projects. Funding for capital projects for projects designed to address future flood risk should be expanded.

- **Support Community Rating System participation:** DEC and DHSES should provide support and incentives for municipal participation in the Federal Emergency Management Agency's Community Rating System.

  The FEMA Community Rating System provides for reduced National Flood Insurance Program premiums for property owners within participating communities. However, the program has been criticized as a means by which risk taken by owners of at-risk properties are borne by all residents of the municipality. DEC and DHSES should continue to encourage and support municipal participation in the Community Rating System while seeking approaches to minimize costs to residents at large.

- **Strengthen State building code:** DOS should amend state building code to account for sea-level rise and enhanced riverine flooding, and potential use of innovative structures, such as amphibious buildings.

  The lack of flood risk maps that account for future riverine flows is an impediment to including future flood risk in the code, but additional measures of safety to account for projected sea-level rise could be added to the code based on current maps. DOS should update the Uniform Code to account for projected sea-level rise and to provide for use of innovative construction techniques to reduce flood risk, including use of amphibious buildings.

- **Develop statewide mapping strategy:** DEC should develop a statewide flood-risk mapping strategy.

  Current flood insurance rate maps and other mapping products do not indicate the projected wider and deeper floodplains expected as severe precipitation events become more common. DEC and other agencies should continue ongoing work to reduce risks of flooding, including through more effective mapping and development of a statewide mapping strategy to include analysis of the potential changes in riverine flood risk, an inventory of available mapping and related data, and an assessment of the potential for scaling results of novel mapping techniques that have been piloted in small areas to larger portions of the state. Development of this strategy should include exploration of the use of multi-hazard, climate-informed datasets on flood hazard to account for pluvial flood risk, combination flooding due to sea-level rise coupled with extreme precipitation, and other climate effects.

- **Digitize dam failure inundation maps:** DEC should digitize dam failure inundation maps and integrate with other geographic resources to improve emergency planning and response, and explore approaches to use these maps to enhance public information and outreach efforts.

  Dam failure inundation maps are not currently digitized, and some are out of date. Digitization would allow ready integration with other geographic resources to improve emergency planning and response. DEC should 1) fund a position to advance dam failure inundation map digitization, 2) complete map updates and digitization, and 3) and implement an outreach strategy to use these maps to enhance public information and outreach efforts.

- **Support dam removals:** DEC should support dam removals that reduce flood risk and improve aquatic habitat quality.

  Decisions regarding each individual dam represent a complex intersection of history, ownership, community perception, and trade-offs among flood-risk reduction, potential for hydropower, and fish and wildlife habitat. DEC has created a Dam Removal Working Group and directed it to provide recommendations to streamline DEC processes and practices regarding dam removals, outreach to dam owners and stakeholders, and potential funding opportunities. DEC should 1) commence implementation of the recommendations of its Dam Removal Working Group (due June 2022), 2) adopt a policy on dam removal, including consideration of creation of a general permit for dam removal, and 3) hire a technical coordinator to guide dam owners through the evaluation and permit process. State agencies that own dams should demonstrate leadership by example by undertaking a comprehensive review of dams on state property and initiating removals where appropriate.

### *Develop Policies and Programs to Reduce Human Health Risks Associated with New Patterns of Thermal Extremes*

In most years, more Americans die from the effects of extreme heat, than from flooding, and frequency of extreme heat events is one of the most direct effects of global warming. At the same time, changes in atmospheric circulation patterns, perhaps precipitated by loss of sea ice, may lead to periods of extreme cold in New York. Components to this strategy include support for cooling centers, heat emergency planning, weatherization, and access to thermal resilience programs for vulnerable populations.

## Components of the Strategy

- **Develop cooling centers and enhance accessibility:** DEC and DOH should continue to support development and operation of cooling centers, including assessments to increase accessibility via public transportation.

  DEC should continue to provide, and to the extent feasible, expand funding for development and operation of cooling centers. Cooling center planning should include an assessment of accessibility via public transportation and prioritize placement in vulnerable communities. DOH should continue to promote cooling centers and cooling center locations and continue work to improve community access to cooling centers during heat events and when public health conditions allow.

- **Develop regional and local heat emergency plans:** DOH should support development of regional and local heat emergency plans that prioritize the health and stability of vulnerable communities.

  DOH has developed county heat and health profiles that include temperature trends and projections, health effects, population vulnerability and availability of adaptation resources for every county except New York City. DEC's Climate Smart Community grants can be used for heat-emergency planning, but funding is limited, and uptake is low. DOH should build upon its county heat and health profile reports to develop regional and local heat emergency plans that prioritize the health and stability of disadvantaged communities.

- **Strengthen weatherization requirements:** DOS should amend the state building code to require more effective weatherization from thermal extremes.

  The DOS should amend the Energy Conservation Construction Code to require high-performance building envelopes in new construction and, as applicable, additions and alterations, of residential and commercial buildings.

- **Enhance thermal resilience in vulnerable populations:** OTDA and NYSERDA should promote and facilitate access to programs that provide cooling, weatherization, and solar assistance to vulnerable populations.

  OTDA's Home Energy Assistance Program provides air conditioners or fans to low-income households that include an individual with a medical condition that is exacerbated by heat, and the Weatherization Assistance Program provides energy efficiency measures to low-income homeowners, renters and owners of rental buildings. NYSERDA provides incentives for

residential solar installation. The State should consider the need to expand funding and eligibility for weatherization assistance and the feasibility of providing high-efficiency cooling units, including heat pumps, and addressing energy costs and insecurity, and additional barriers to their use. OTDA and NYSERDA should seek opportunities to integrate their respective weatherization and solar installation programs.

- **Conduct outreach to reduce risks of extreme heat:** DOH and others should assess adequacy of current advisories and adopt a plan to address deficiencies.

  DOH should convene an interagency work group, comprising DOH, DEC, DHSES and other relevant entities to assess adequacy of current extreme heat advisories and adopt a strategic outreach plan to address identified deficiencies. The strategic plan should include strategies to provide actionable information to outside workers and their employers, vulnerable individuals, and other key stakeholders, and training and guidance on reduction of thermal risks to local public health staff, local officials and other partners.

- **Adopt a green infrastructure plan:** DEC and others should develop a strategy to promote and incentivize use of green infrastructure and natural resources, including urban forests, to reduce climate risks.

  The State does not have a comprehensive, interagency plan to expand, promote and incentivize use of natural resources, nature-based features, shade structures, cool roofs, cool pavements, parks and spray pads to reduce individual risks and mitigate neighborhood climate impacts associated with extreme heat, flooding and stormwater runoff. Expanded green infrastructure programs and other programs to encourage or require resilient construction would drive demand for skilled design professionals and tradespeople. DEC should convene a work group, comprising DOH, DOS, OPRHP, DHSES, DOT, Environmental Facilities Corporation (EFC) and other relevant entities, to develop a strategy to promote and incentivize use of green infrastructure and natural resources, including urban forests, to reduce climate risks, and prioritizing investment to benefit disadvantaged communities. The strategy should include work with the Army Corps of Engineers to develop regional permits, or specific Nationwide Permit 54 regional conditions, to incentivize use of natural and nature-based features to enhance resilience and ecosystem benefits. All agencies should review existing and planned funding programs to identify opportunities to directly fund, prioritize or otherwise incentivize use of such measures, particularly in disadvantaged communities.

### *Ensure the Reliability, Resilience, and Safety of a Decarbonized Energy System*

The increasing frequency of severe climatic events has exposed vulnerabilities in the state's energy system and the need to improve the reliability and resilience of the energy system, as well as the resilience of those who depend on that energy system in buildings and for transportation. Assessment of system vulnerabilities to increasing climate hazards and investment to ensure system resilience will be required. Energy system providers must continually reassess infrastructure vulnerabilities across the entirety of their service territories to determine appropriate resilience initiatives to mitigate potential disruptions due to the effects of climate change and make their infrastructure more adaptable to weather extremes.

#### Components of the Strategy

- **Establish energy system resilience standards and assess vulnerabilities:** The PSC should establish resilience standards and require public and investor-owned utilities and generators to assess vulnerabilities to climate hazards and to develop and implement agency-approved risk-reduction plans.

  Near-term restructuring of the power grid provides an opportunity to ensure generation, transmission and distribution infrastructure is resilient to current and future climate hazards. The PSC should initiate a proceeding to 1) establish resilience standards, 2) require all regulated generators and utilities to conduct vulnerability assessments, and 3) require all regulated generators and utilities to complete risk-reduction plans for DPS approval. Risk assessment and planning should include assessment of the potential spread of chemical contaminants.

- **Develop strategies for grid outages and extreme weather events:** The CSRO or other designated individual should convene a work group, comprising DPS, DHSES, DOT, DEC, NYSERDA, NYPA and other relevant entities, to develop strategies to ensure availability of fuel and power for emergency vehicular fleet operations and essential public transportation during power grid outages. This work group should also establish a resilience plan for EV-charging infrastructure to ensure access to transportation, including evacuation during extreme weather events.

  Electrification of the transportation sector will require strategies to ensure availability and distribution - not only of fuel, but of power, to vehicles, including vehicles required for emergency response and potential evacuation. The CSRO or other designated individual should convene a work group, comprising DPS, DHSES, DOT, DEC, NYSERDA, NYPA and other

relevant entities, to develop strategies to ensure availability of transportation fuel and power in the event of emergencies.

- **Promote capital improvements:** NYSERDA, in consultation with DPS, DOS, and other relevant entities, should promote capital improvements in buildings to endure grid failures and to facilitate buildings' ability to accept power when system re-energized.

  High-performance building envelopes, batteries, and solar PV would enhance building occupant resilience to grid failures. Ability to accept power when system is re-energized without need for individual building inspection and service would enhance community recovery after grid failure. NYSERDA, in consultation with DPS, DOS, and other relevant entities, should implement a strategy to promote capital improvements to buildings to endure and recover from grid failures.

- **PV and EV-charging in building code:** DOS, in consultation with NYSERDA, should include requirements for PV and EV-charging readiness in the building code.

  PV and EV-charging readiness would not only result in GHG emission reductions but enhance household resilience to grid failures. DOS, in consultation with NYSERDA, should adopt amendments to the Uniform Code to require, as appropriate, new buildings are prepared for future installation of solar energy equipment, piping and wiring, and are constructed with electrical capacity and pre-wiring to allow future installation of electric vehicle charging stations.

- **Support local renewable systems:** NYSERDA, in consultation with DPS, DHSES, and local governments should develop a comprehensive strategy to support development of islandable microgrids and district systems using renewable sources of energy to provide locally generated power, especially in critical facilities during grid emergencies.

  NYSERDA, in consultation with DPS and DHSES, should complete an update of its current microgrid strategy to de-emphasize fossil generation in favor of renewable generation and storage, and to promote microgrids as the bases of resilience hubs.

## Living Systems

The Living Systems theme comprises of three strategies. The first is focused on addressing risks to our ecosystems and biodiversity and emphasizes the need to ensure conservation and connectivity of critical habitats. Also included are recommendations specific to the agricultural sector, and the ability of forests to serve as carbon sinks, due to the GHG emission mitigation and economic importance of these sectors.

### *Develop Policies and Programs to Reduce Risks Threatening Ecosystems and Biodiversity*

The components of this strategy provide for a variety of mechanisms to ensure conservation or protection of the most important pieces of our life-sustaining ecosystems. These initiatives include a focus on intentional planning to identify and protect critical ecosystems and to establish and protect connectivity at several scales, ranging from the landscape scale to enable populations to migrate northward and upward as the climate warms, to project-specific planning to ensure wildlife and aquatic organism connectivity.

#### Components of the Strategy

- **Improve local wildlife and aquatic connectivity:** DEC and DOT should improve local wildlife and aquatic connectivity, including through use of standardized environmentally friendly design features, during transportation infrastructure improvement projects, as practicable, and as identified by statewide critical terrestrial and aquatic habitat and conservation planning efforts.

  Routine projects to replace or improve transportation infrastructure, such as culverts and bridges, provide opportunity to address factors that limit connectivity. DEC and DOT should periodically review and make necessary updates to existing guidance regarding incorporation of recommended design features and BMPs to reconnect or enhance terrestrial and aquatic habitat connectivity during projects to replace or improve transportation infrastructure.

- **Expand conservation easements to include other areas** DEC and AGM should expand development of conservation easement and incentive programs (such as the Source Water Buffer Program) to include areas of farms set aside for conservation of wetlands, stream corridors, riparian buffers, or wildlife corridors.

  The Source Water Buffer Program, administered by AGM, is funded by the Clean Water Infrastructure Act of 2017 for purchase of easements on agricultural land to support or enhance public drinking water quality and provides for protection of wetlands, stream corridors and riparian buffers, but not for the explicit goals of wildlife habitat protection or enhancement. The state should amend the authorizing statute to allow AGM to expand eligibility for the Source Water Buffer Program to include wildlife habitat protection or enhancement and to recognize wildlife habitat protection or enhancement as an important co-benefit in selection of public drinking water source protection.

- **Incorporate BMPs from species management plans:** DEC, ORES, NYSERDA, DOS, and DOT should incorporate BMPs from species management plans into state and federally funded or regulated projects, including renewable energy projects, in or near occupied habitats to reduce and mitigate ecosystem impacts.

  DEC, ORES, NYSERDA, DOS, DOT and other relevant agencies should incorporate BMPs for threatened and endangered species into planning, funding and regulatory programs, including permit conditions for projects in or near occupied habitats (such as grasslands and tidal wetlands), to reduce and mitigate ecosystem impacts. ORES, in consultation with DEC, should amend its permitting procedures to reduce reliance on mitigation and to consider application of BMPs as the default practice.

- **Amend Real Property Tax Law to incentivize private forest stewardship:** The State should enact legislation to amend Real Property Tax Law to incentivize private forest stewardship for a broader range of goals, including biodiversity, wildlife habitat protection, water resource protection, outdoor recreation and carbon sequestration.

  Real Property Tax Law Section 480 provides a tax benefit in the form of a reduced assessment on qualifying lands maintained for forest production. The state should create a Real Property Tax Law incentive to allow private forest landowners to manage for other benefits (such as wildlife habitat) and, if desired by the landowner, to conserve their forests in natural conditions to participate in tax-incentive programs. This recommendation parallels a similar Agriculture and Forestry Advisory Panel recommendation.

- **Prioritize biodiversity and carbon sequestration:** DEC should heighten consideration of biodiversity and enhancement of carbon sequestration among the priorities in state forest land planning, and adopt guidance for development of unit management plans that includes conservation of biodiversity and increased carbon sequestration as priorities.

  The Strategic Plan for State Forest Management[4] guides management of state forests and is implemented through unit management plans that establish specific management activities on each local unit. DEC should include guidance on biodiversity conservation and carbon sequestration among management priorities in the next update to the Strategic Plan for State Forest Management.

[4] New York State Department of Environmental Conservation. (2011). Strategic Plan for State Forest Management. New York State Department of Environmental Conservation. Albany, New York.

- **Expand implementation of ISCMP:** DEC and AGM should advance biocontrol of forest pests, and expand implementation of relevant parts of the ISCMP, including two key ISCMP priorities: advance prevention and early detection, and improve the response to invasive species.

  The ISCMP[5] guides invasive species management by DEC and AGM. The plan is framed around 8 focal initiatives: partnerships and capacity, information sharing, setting priorities, engaging and informing the public, advance prevention and early detection, response, ecosystem resilience, and evaluation. Due to the potential economic and environmental harms caused by invasive species, aggressive implementation of the ISCMP should be a priority for DEC and AGM. DEC and AGM should evaluate opportunities to improve capacity for prevention and early detection of, and rapid response to, invasive species, as detailed in the management plan.

- **Ensure protection of stream buffers:** The State should create a regulatory program to ensure protection of stream buffers to protect and enhance water and habitat quality, reduce flood risk, and prevent soil erosion.

  Stream, or riparian, buffers, provide numerous environmental benefits, including streambank stabilization, erosion and sediment control, filtration, flood-risk reduction, wildlife habitat, and shade for streams, all of which will become increasingly important as temperatures rise and precipitation events become more extreme. The State should establish a regulatory program to protect stream buffers and associated environmental services.

### *Enhance Climate Resilience and Adaptive Capacity of Agricultural Sector, while Preparing to Take Advantage of Emerging Opportunities*

Included below are recommendations to improve water and energy efficiency on farms, incorporate other climate-resilient practices into farm operations and continue research and outreach to help farmers prepare for the effects of a warming climate. However, these recommendations do not address the entire gamut of climate hazards New York growers face and should not be interpreted as a complete agricultural adaptation plan.

#### Components of the Strategy

- **Establish a farm water and energy efficiency program:** AGM and NYSERDA should develop and support a water and energy efficiency realization program to meet agricultural needs related

[5] New York State Department of Environmental Conservation. (2018). New York State Invasive Species Comprehensive Management Plan. New York State Department of Environmental Conservation. Albany, New York.

to climate change, including decision-support tools, power upgrades and strategies to reduce equipment costs.

Elements of this recommendation are addressed by several current state programs. These programs include the AGM's AEM program; NYSERDA's Agriculture Energy Audit program, various guidance on best practices for dairy farms and greenhouses, financial assistance for energy efficiency measures and renewable energy, and the Clean Energy for Agriculture Task Force Strategic Plan.[6] AGM and NYSERDA should continue to evaluate existing agricultural water and energy efficiency programs and seek opportunities to improve and expand participation in them.

- **Promote resilient crops:** The State should expand support for research and outreach on climate-resilient crop varieties; technology to provide freeze and frost protection; strategies to address invasive species, pathogens and pests; and increased use of perennial crops for food and feed.

  The State should continue and expand financial support for Cornell's Integrated Pest Management and Soil Health programs and research on 1) plant breeding programs to develop and understand crop varieties' tolerance to weather variance, 2) risk of freeze damage from changing temperature patterns and use of technological developments to monitor freeze and frost protection on crops, and 3) suitable cropping systems and system analysis for perennial crops for food and feed production.

- **Promote agricultural and watershed-based BMPs:** AGM should assess, develop and promote agricultural and watershed-based BMPs for flood attenuation, drought mitigation and water quality protection.

  AGM's Ecosystem Based Management program focuses on resolving complex problems at a single location by coordinating relevant programs at all levels of government. The program provides targeted funding to fill gaps between other funding programs to achieve on-the-ground results. Pilot projects implemented by SWCDs have led to integration of Ecosystem Based Management program principles into AGM's AEM program and other existing programs. AGM should seek opportunities to expand the Ecosystem Based Management program and associated outreach.

[6] New York State Energy Research and Development Authority. (2011). Clean Energy for Agriculture Task Force Strategic Plan. NYSERDA. Albany, New York.

### *Preserve and Protect the Ability of Forest Ecosystems to Sequester Carbon*

In recognition of the important role healthy forests play in sequestering carbon, ensuring forests retain their sequestration potential under future conditions should be considered in state acquisition programs. As with agriculture, this strategy does not constitute a complete adaptation plan for our forests. Many recommendations described in strategy 21.2.10, Develop Policies and Programs to Reduce Risks Threatening Ecosystems and Biodiversity, also address the goal of protecting the ability of our forests to continue to sequester carbon. This strategy complements the strategies described in *Chapter 15. Agriculture and Forestry*, which serve to enhance the ability of our forests to remove $CO_2$ from the atmosphere and sequester it in healthy trees and forest soils.

#### Components of the Strategy

- **Consider resilience in land acquisition:** DEC, OPRHP, AGM, and other agencies and authorities should include resilience criteria in state acquisition programs.

  As originally enacted, the CRRA requires DEC, OPRHP, and AGM to consider mitigation of future physical risk due to flooding, storm surge and flooding in their respective land acquisition programs. As amended by the Climate Act, the CRRA requires DEC to help agencies assess a wide range of climate risks on projects. DEC, OPRHP, AGM, and other agencies and authorities should complete reviews of, and necessary updates to, all land acquisition programs, especially those covered by the CRRA, to ensure future conditions and applicable resiliency criteria are duly considered in acquisition decision making. Such reviews and updates should include not only sea-level rise, storm surge and flooding, as expressly required by the CRRA, but all climate hazards relevant to acquisitions.