Chapter 8
Power Supply and Delivery Mitigation

Sector Vision for a Low-Carbon Future

New York will have a safe, reliable, diverse, and extremely low-emitting electric power system that meets the needs of all its citizens and accommodates the widespread conversion of buildings and transportation from fossil fuel to electricity. The state will meet its energy needs in a manner that maximizes societal benefits, minimizes societal costs and avoids imposing an undue burden on any community.

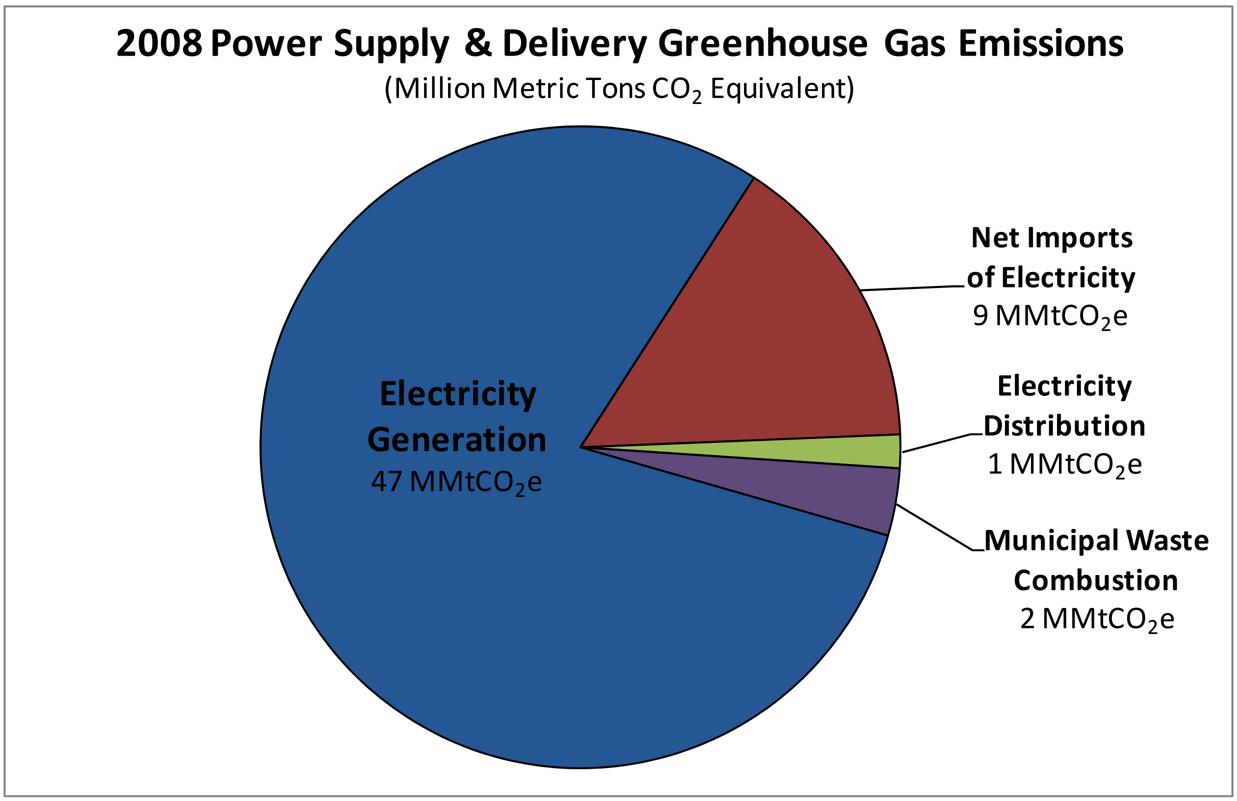
More specifically, New York's electric power system will have the following characteristics:

- **Electric generation mix:** New York's electricity will be generated by an optimal mix of renewable generation—both central station and distributed—complemented by safe nuclear power and fossil fuel-fired power plants that safely and permanently capture and sequester carbon dioxide (CO_2). Fossil-fired units existing today will have been retired, replaced with renewables or nuclear power, or repowered using carbon capture and sequestration (CCS) technologies.
- **Power transmission and distribution:** Transmission and distribution facilities will have been upgraded to reduce line losses and expanded to move electricity from new clean generation sources to the areas where demand exists.
- **Energy storage:** Centrally located energy storage systems (such as pumped storage, compressed air and flywheel), as well as batteries and other distributed storage technologies, will make it possible for variable renewable energy resources to meet system needs around the clock and will promote system reliability by helping to meet load-following, reserve capacity and frequency response needs.
- **Demand management:** Renewable distributed generation, energy storage, and smart grid technologies will enable New York's utilities to reduce or manage demand for grid-based electricity. In particular, smart grid technology allows sophisticated management of energy demand: it enables consumers to function as energy storage facilities and generators, helps minimize the disparity between base load and peak demand on the grid, and facilitates use of renewable resources whose energy output varies with weather conditions or by season.
- **Adapting to climate change:** The electric power system will be reliable in part because utilities have anticipated and counteracted the impacts of climate change on electric generation, transmission, and consumption. (Examples of such impacts are higher peak electricity loads and accelerated degradation of critical system components from warmer temperatures, or changes in availability and predictability of renewable energy resources due to changes in hydrology, wind patterns and solar incidence.)

Overview of GHG Emissions

The Power Supply and Delivery (PSD) sector includes greenhouse gas (GHG) emissions from the combustion of fossil fuels for the generation of electricity, the transmission and distribution of electricity, and the combustion of municipal waste at waste-to-energy facilities in New York. This includes both imported and New York-based generation. Electricity generation accounts for the vast majority of these emissions, representing 95 percent of New York's total PSD sector emissions in 2008. Total GHG emissions from the PSD sector are expected to represent 23 percent of New York's total consumption-based emissions in 2008 (Figure 8-1).

Figure 8-1. New York State Power Supply and Delivery Emissions, 2008



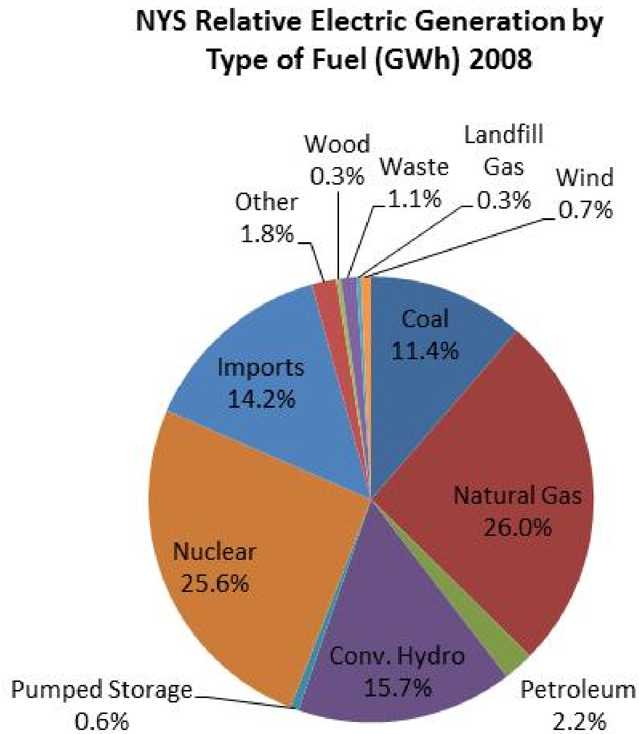
$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Note: 'Electricity Distribution' refers to emissions of sulfur hexafluoride.

Electricity Generation Fuel Mix

Electricity is generated using a variety of fuels in New York. The relative generation by fuel source in 2008 is shown in Figure 8-2. This mix of generation types has changed over time. In 1990, petroleum and coal represented 42 percent of the total generation by gigawatt-hours (GWh). By 2008, this had dropped to 14 percent, with natural gas (up 10 percent), hydro (up 4 percent), nuclear (up 9 percent) and imports (up 11 percent) making up most of the difference.

Figure 8-2. New York State Electric Generation by Type of Fuel, 2008[1]

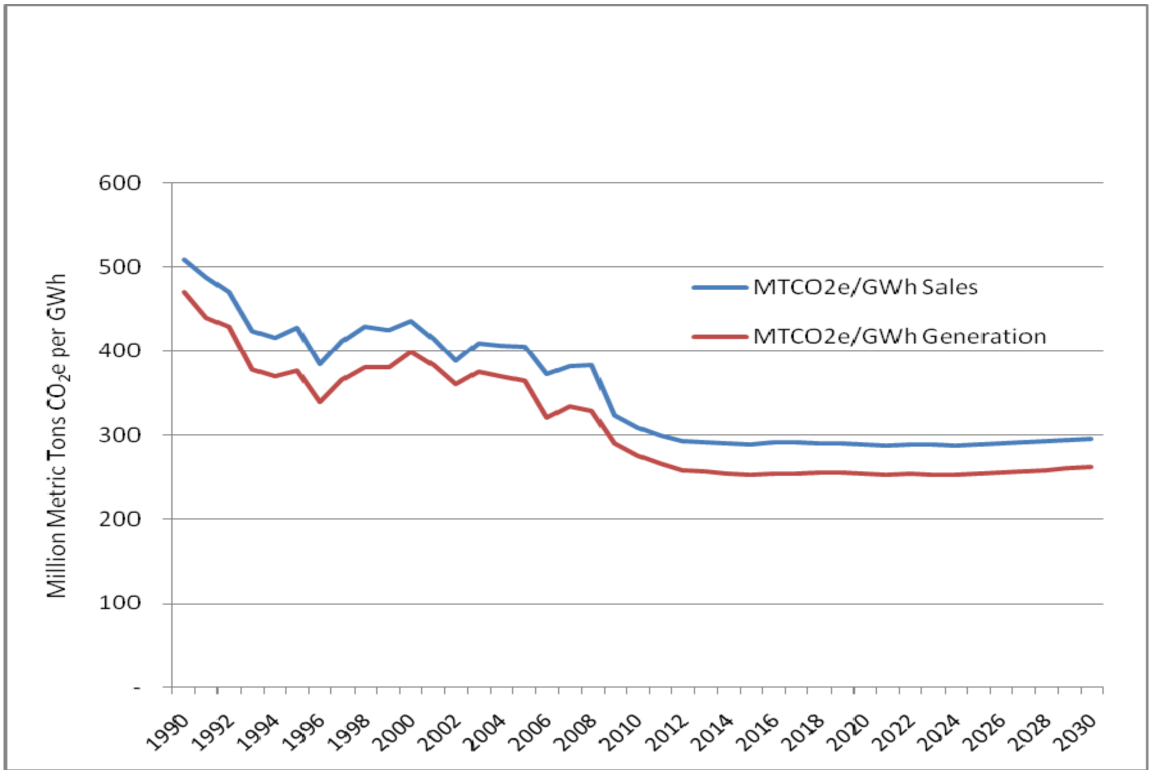


GWh = gigawatt-hour; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

This shifting of the fuel mix away from high-GHG fossil fuels to low-GHG fuels has resulted in an overall decline in emissions from this sector, even though total generation has increased. It is illustrated in Figure 8-3, showing the carbon intensity of electricity generated and sold (including imports) between 1990 and 2008, and expected using the reference case forecast through 2030. Over the 18-year period between 1990 and 2008 generation increased 17.5 percent, while GHG emissions associated with generation, including imports, declined by 16.2 percent.

[1] In New York State, the accounting convention for pumped storage works as follows: Generation required for pumping is included in the net energy for load total. More specifically, the electricity required for pumping water to a higher elevation is not deducted from the net energy for load value for hydroelectric plants, while the generation produced by pumped storage is reported separately as a positive value. In terms of tracking total amount of generation for load, the approach is fully equivalent to the approach where net generation for pumped storage is negative.

Figure 8-3. Historical and Forecasted Carbon Intensity for New York State Power Supply and Delivery, 1990–2030



GWh = gigawatt-hour; CO2e = carbon dioxide equivalent.

Roles of Imports and Emissions Accounting

New York has historically been a net importer of electricity. Electricity imports have been relatively small compared to total consumption but have increased from about 4,519 GWh in 1990 to about 23,900 GWh in 2008. Absent the implementation of new policies, imports are expected to increase to about 11 percent of total consumption in 2022 and remain at that level through 2030. In 2008, the emissions per GWh for imports were about 12 percent higher than the emissions per GWh for in-state generation.

There are two generally accepted methods to account for emissions associated with electricity generation from imports and exports. The consumption method includes emissions associated with all electricity consumed within the state regardless of where it is generated. The production method includes all emissions from electricity generated within the state regardless of where it is consumed. The development of the inventory and forecast of historical and forecasted GHG emissions in New York includes both methods but the consumption accounting method is used for the purpose of attributing both emissions and emissions reductions to New Yorkers.

Another accounting question has to do with direct emissions versus full fuel cycle emissions. In the case of electricity generation, direct emissions are those associated with the end use or combustion of the fuel. Full fuel cycle emissions include the direct emissions but also include the emissions associated with the extraction, processing, and transportation of the fuel. Both methods have been used in this study and analysis in the Appendices compares the two results.

Recent Actions to Promote Energy Independence

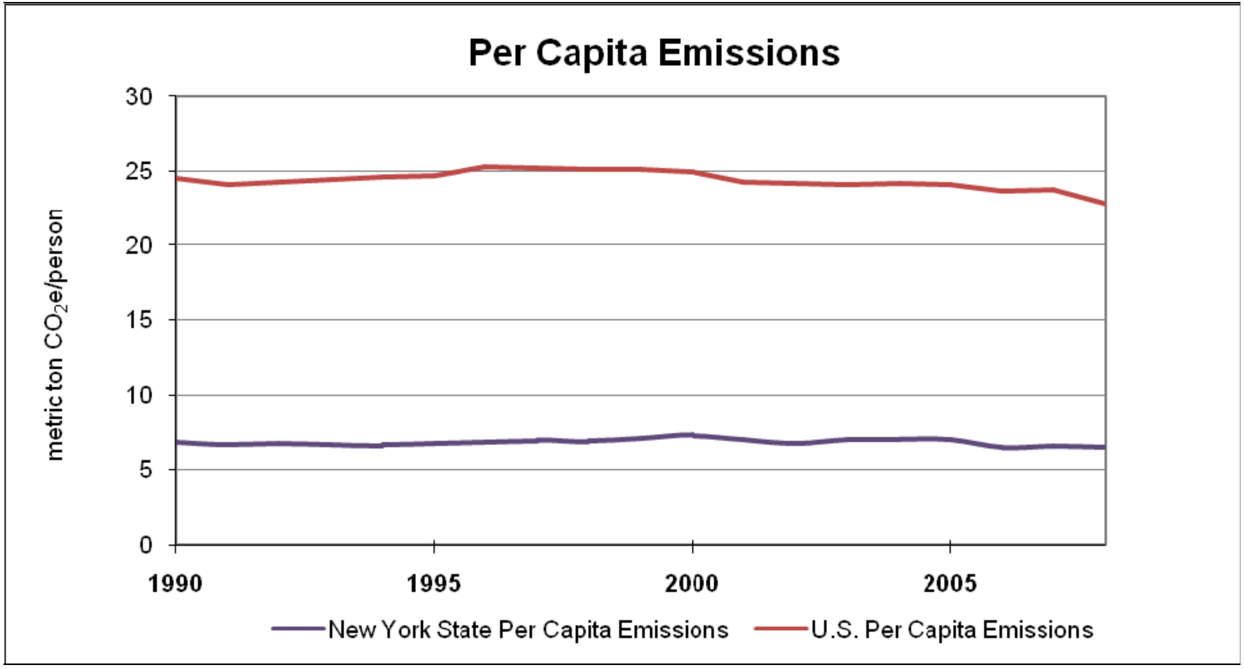
New York's innovation and leadership in the field of clean energy production and use goes back decades and includes the renewable portfolio standard, programs funded by the systems benefit charge, the net metering law, decoupled tariffs, a host of energy efficiency programs, and the creation of the New York State Energy Research and Development Authority, which remains a model for other states. The precedent-setting Regional Greenhouse Gas Initiative (RGGI), the only GHG cap-and-trade program currently operating in North America, was the result of a New York State initiative.

In his State of the State Address on January 7, 2009, Governor David A. Paterson announced his proposal for a "45 by 15" plan to reduce electricity consumption by 15 percent and provide 30 percent of the remaining electricity demand through renewable energy resources by 2015. This standard requires 30 percent of the state's electricity to be supplied from renewable energy sources by 2015 and provides financial incentives to support development of renewable energy sources. The renewable portfolio standard has supported 34 large-scale renewable projects (mostly wind) and approximately 330 customer-sited projects. New York is one of 27 states to use a renewable portfolio standard to drive a transition to renewable sources of electricity.

The state program to reduce energy consumption has a goal of reducing power demand 15 percent from forecasted levels by 2015 through energy efficiency. It includes eliminating a key conservation disincentive by decoupling utility profits from the amount of energy being consumed (this step is already underway), strengthening efficiency standards for appliances and buildings, and addressing New York's largest energy consumer—State government. When fully funded, this program is expected to provide more than $4 billion in benefits to customers, along with thousands of jobs to support energy efficiency programs, such as retrofitting outdated and inefficient residential, commercial, and industrial properties and installing new energy-efficient equipment.

As described in detail in Chapter 3, Inventory and Forecast, New York's long-standing leadership has contributed to New Yorkers having a dramatically lower carbon "footprint" than the average American. Figure 8-4 shows a comparison between the historical U.S. and New York GHG emissions per capita.

Figure 8-4. U.S. and New York Emissions per Capita



GHG = greenhouse gas; tCO_2e = metric tons of carbon dioxide equivalent.

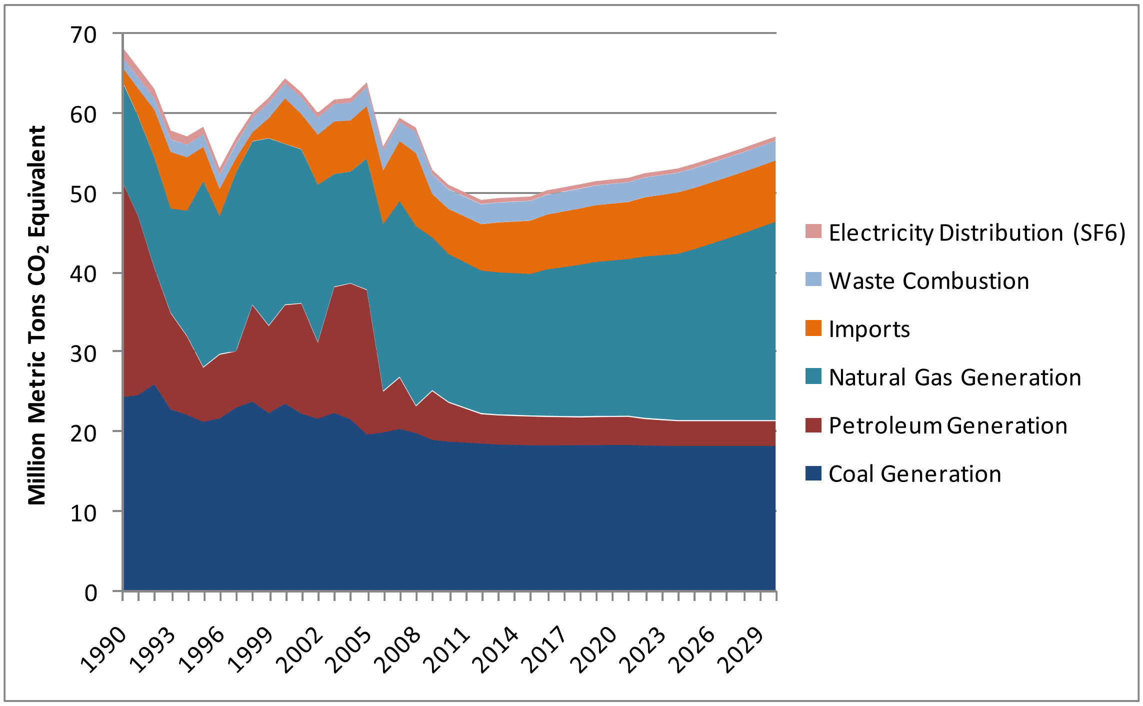
This progress is reflected in the reference case forecast of future emissions, which assumes past efforts will remain in place but no further actions are taken to reduce emissions. The reference case does not, however, assume that New York will achieve the full 15 percent reduction in electricity use established in the 45 by 15 goal. To be conservative, the reference case adopts the Reliability Needs Assessment 2008 forecast of a 27 percent achievement toward the 15 by 15 demand reduction portion of the goal. The policy scenarios developed by the technical work group assumed that new policies would build from the full 45 by 15 goal, so that proposed new policies initiatives do not take credit for the impacts of recent actions.

Power Supply and Delivery Emission Trends

In the absence of any additional mitigation efforts in the future, GHG emissions from New York's PSD sector are expected to decline and then return to roughly 2008 levels of 58 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) by 2030.

Figure 8-5 shows the historical and forecasted emissions from power supply and delivery in New York from 1990 through 2030. Note that since this is direct emissions, nuclear, hydro, and renewables are not included. The figure shows that although there has been a decline in electric sector emissions since 1990, assuming no new GHG reduction measures are enacted in the future it is expected that beginning around 2012 total emissions will rise, largely through the increased use of natural gas.

Figure 8-5. New York, State Historical and Forecasted Electricity Supply Sector Emissions by Source Type, 1990–2030 (2009–2030 forecasted)

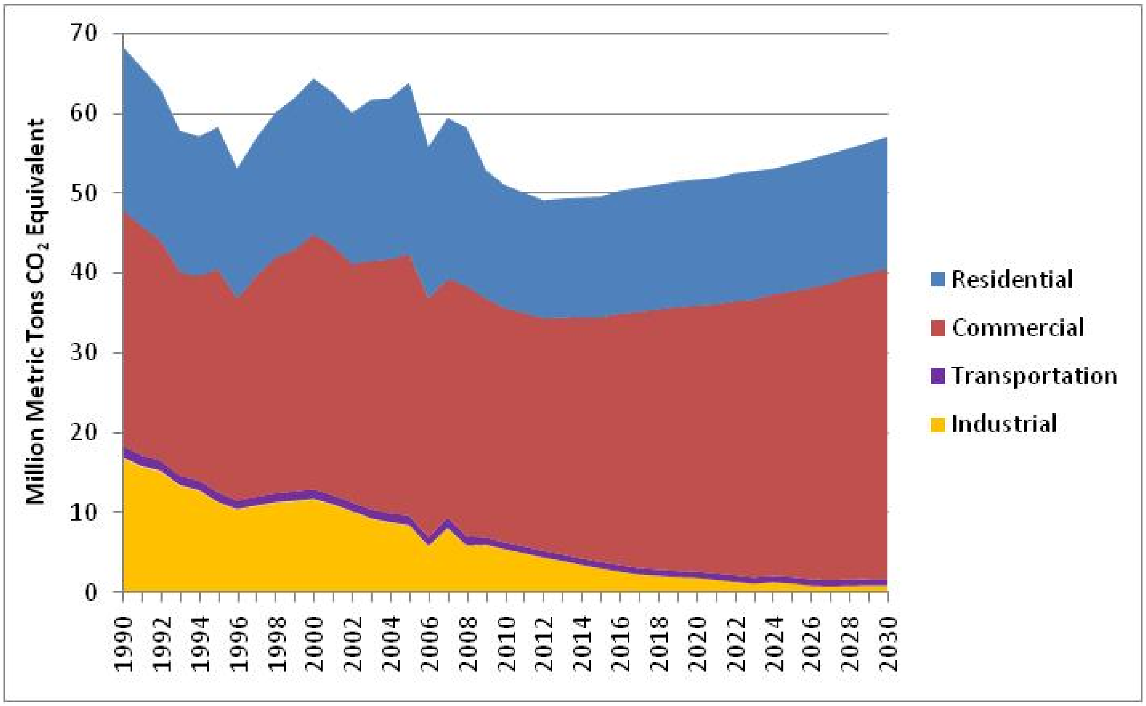


$MMtCO_2e$ = million metric tons of carbon dioxide equivalent. SF_6 = sulfur hexafluoride.

Relative to total forecasted emissions from all sectors, emissions from the PSD sector are expected to remain about the same, going from 23 percent of total emissions in 2008 to 21 percent of total emissions forecasted in 2030.

Also of interest is the demand for electricity. Figure 8-6 translates Figure 8-5 into the demand sectors in New York. All sectors in New York are assumed to generate emissions based upon the GWh each consumes, so this graph assumes that the mix of sources of generation are identical for each demand sector.

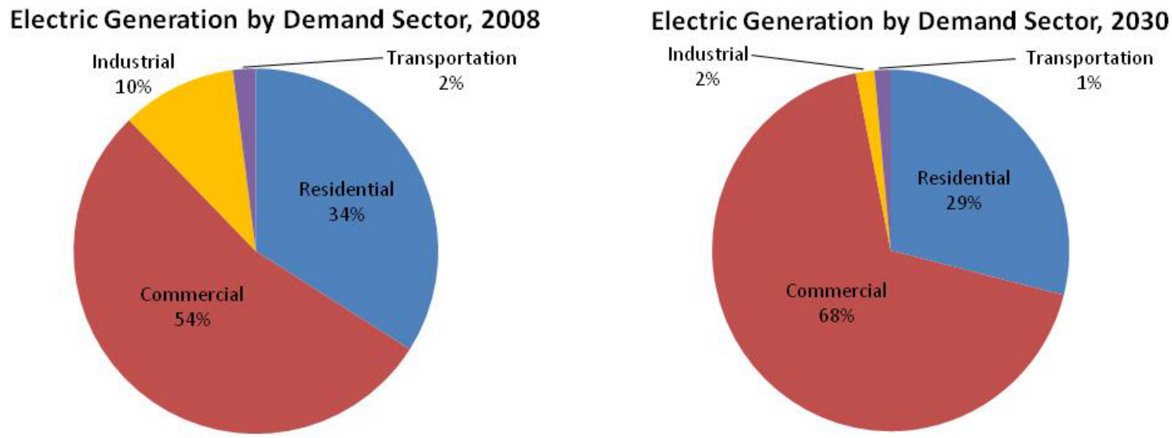
Figure 8-6. New York, State Historical and Forecasted Power Supply and Delivery Sector Emissions by Demand Sector, 1990–2030 (2009–2030 forecasted)



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

The forecasts indicate that industrial sector emissions in the reference case are expected to continue a slow decline while commercial sector emissions are expected to grow by 24 percent between 2008 and 2030. Over the same period residential electricity consumption-related emissions are expected to decline 17 percent. Demand sector contributions to total electricity demand emissions would therefore shift between sectors as indicated in Figure 8-7.

Figure 8-7. Electricity Generation Emissions Demand by Sector, 2008 and 2030



Overview of Policy Options and Estimated Impacts

Building a near-zero carbon electricity sector is the foundation of New York's transition to a low-carbon economy. New York already obtains more than 50 percent of its electricity from essentially carbon-free sources, including nuclear and hydroelectric and other renewable power. But for New York to achieve its goal of reducing GHG emissions 80 percent by 2050, close to 100 percent of New York's electricity will need to come from low-carbon sources—sources with near zero-carbon emissions—by 2050. Furthermore, as the use of carbon-intensive fossil fuels in the transportation and buildings sectors is phased out or reduced substantially, New York will need an adequate supply of low-carbon electricity to power those sectors. Therefore, over the next 40 years, New York will need to replace most of the existing fossil fuel-fired sources of electricity—coal, gas and oil-fired power plants—with low-carbon sources of power, including renewable, nuclear and possibly fossil fuel-fired plants equipped with CCS.

Fortunately, New York has a number of policies in place that begin this needed transformation. The Public Service Commission (PSC) recently approved expanding the State's renewable portfolio standard (RPS) to 30 percent by 2015. If coupled with the 30 percent of power currently provided by nuclear power plants, New York would have an electricity grid that is powered 60 percent by renewable or other low-carbon sources of electricity by 2015. New York is also a member of RGGI, a regional program to cap and reduce power plant emissions 10 percent below historic levels by 2018. While these existing programs provide a good start on building the low-carbon power sector, they are insufficient by themselves.

Therefore, a number of policy options should be considered to achieve this transition to a low-carbon electricity sector while maintaining the reliability of the electricity supply. In general, these policies fit into three categories: (1) policies that promote renewable energy and other low carbon energy sources, (2) policies to reduce carbon emissions from new and existing fossil fuel-fired power facilities, and (3) complementary policies that maintain the viability of an electric grid that relies increasingly on renewable sources of energy and supports electrification of the transportation system. These options will be evaluated further through integrated analysis.

Three policies will be responsible for most of the emission reductions from the electricity sector:

- The primary policy for achieving emission reductions in the relatively short term is the extension and expansion of the State's existing RPS. One option would be to substantially expand (more than double) the amount of electricity that is provided by new renewable energy by 2030, including deploying off-shore wind energy and solar energy. In addition to an expanded RPS, this policy would include complementary measures providing the early support needed to bring low-carbon renewable sources on line. (PSD-2)
- Another policy to consider is the implementation of a low-carbon portfolio standard (LCPS) that will build on the RPS, requiring regulated utilities and other load-serving entities to procure an increasing amount of low-carbon energy—renewables, appropriately sited nuclear, and fossil energy with CCS. This policy will initially supplement the RPS, requiring load-serving entities (LSEs) to provide an increment of low-carbon power beyond the renewable power attributable to the RPS. Eventually, after 2030, when CCS and new nuclear power may be more commercially viable, the LCPS can potentially supplant the RPS. (PSD-6a)
- National and regional action is needed to fully address climate change. Therefore, the State should work with its regional partners to build upon and strengthen the RGGI program. These joint efforts may result in expanding RGGI into a multi-sector cap-and-invest program that caps and reduces carbon emissions region wide, sets a price on carbon emissions, and invests proceeds from allowance auctions in building the clean energy economy in New York. Ultimately, New York would benefit by a national cap on GHG emissions but, until Congress acts, a stronger RGGI can serve as the model or foundation for a strong national carbon reduction program in addition to helping to achieve New York's climate goals. (PSD-6b)

It is worth noting that there is considerable interaction and policy overlap among the policy options identified. State policymakers would need to design and implement the policies that are selected in an efficient manner that takes account of the potential interactions between the policies.

In addition to the policies described above, other policies intended to reduce emissions from all new and existing power plants are proposed for further consideration. PSD-1 and PSD-10 work in unison to facilitate the siting of new lower-carbon power-generating facilities in New York. PSD-1 would require the enactment of a new, fuel neutral siting process for new plants, while PSD-10 includes a provision that all new plants sited in New York meet a GHG emission standard that is based on the emissions level of modern, efficient natural gas-fired plants. Together, these two policies would provide for siting new generating facilities in New York in a manner that is consistent with achieving the State's GHG reduction goals. Regarding existing plants, PSD-8 seeks to reduce emissions by requiring all existing plants to meet comparable emission standards after 2030 and providing incentives to encourage the repowering or replacement of such plants with more efficient, lower-emitting technology earlier than 2030.

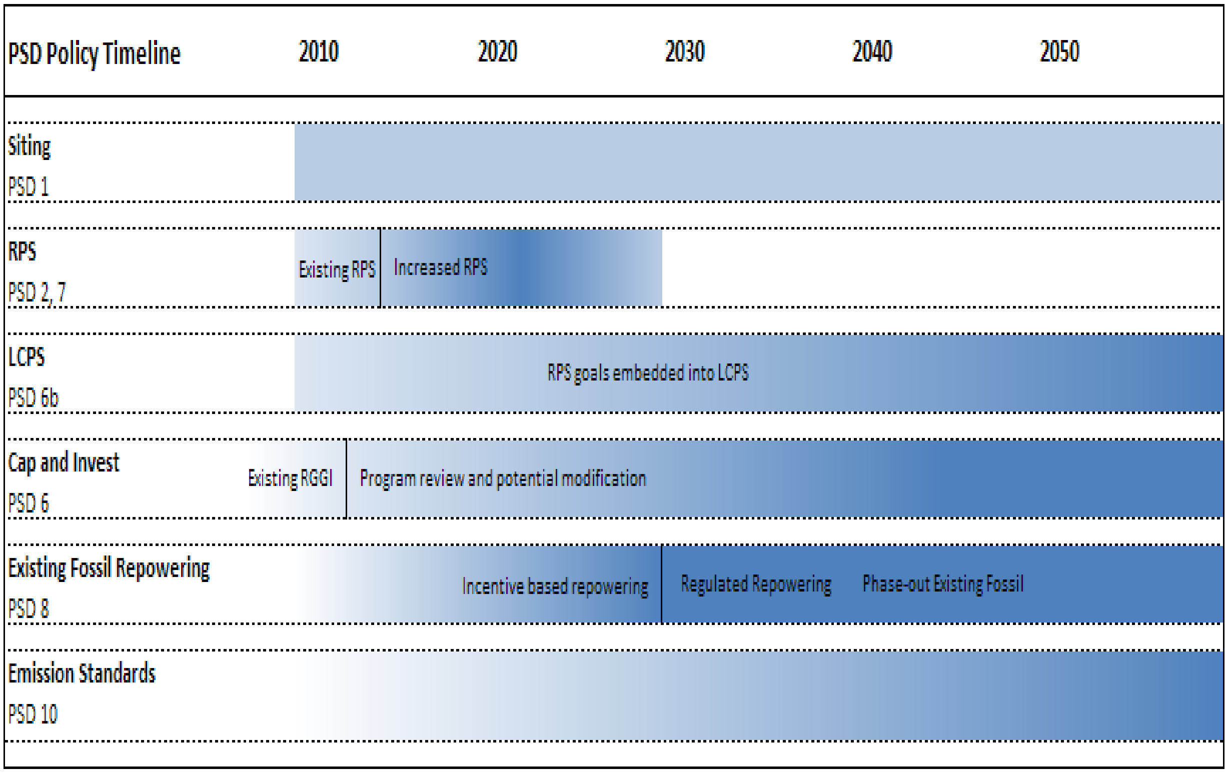
Collectively, these policies would ensure that all fossil-fired plants—existing now or built in the future—would have relatively low emissions by 2030.

Other policies are necessary to ensure that an electricity grid that relies increasingly on renewable and other low-carbon power sources continues to provide electricity in a reliable manner. PSD-4 recommends upgrades to the electricity distribution system to enable more reliance on distributed renewable energy sources and increased use of electric vehicles; a key recommendation of this policy is the continued development and deployment of smart grid technologies. PSD-5 recommends modernization of the electricity transmission network to enable the efficient transmission of renewable and other low-carbon energy from the point of generation to where the demand for electricity exists. PSD-3 recognizes the importance of energy storage in maintaining the reliability of an electricity grid that relies increasingly on variable, renewable sources of electricity.

Finally, PSD-9 recommends that continued investment in research, development, demonstration and deployment is needed to achieve the transition to a low-carbon power sector. Although many of the technologies needed to achieve the transition to a low-carbon electricity sector have been identified, continued research and development—at the federal, tate and commercial levels—will lead to technological advances that will enhance New York's ability to meet the challenge of building a clean energy economy in a cost-effective manner.

These policy options will help to achieve the transformation of New York's electricity sector in a manner that is consistent with the vision of a low carbon New York, in which electricity will be supplied by low carbon renewables, appropriately-sited nuclear power, and fossil-fired plants with CCS. In the near term, the deployment of renewables will be facilitated by the RPS and other renewables policies described in PSD-2, as well as the LCPS and cap-and-invest policies. In the longer run, as existing baseload fossil-fired plants are retired, new nuclear plants are expected to play an important role in New York's electricity sector, in addition to fossil-fired plants equipped with CCS. Figure 8-8 presents the proposed sequencing of policies in time, showing that a number of policies could be implemented immediately and that some could be phased-out based on successful implementation of new policy mechanisms.

Figure 8-8. Power Supply and Delivery Policy Options Timeline

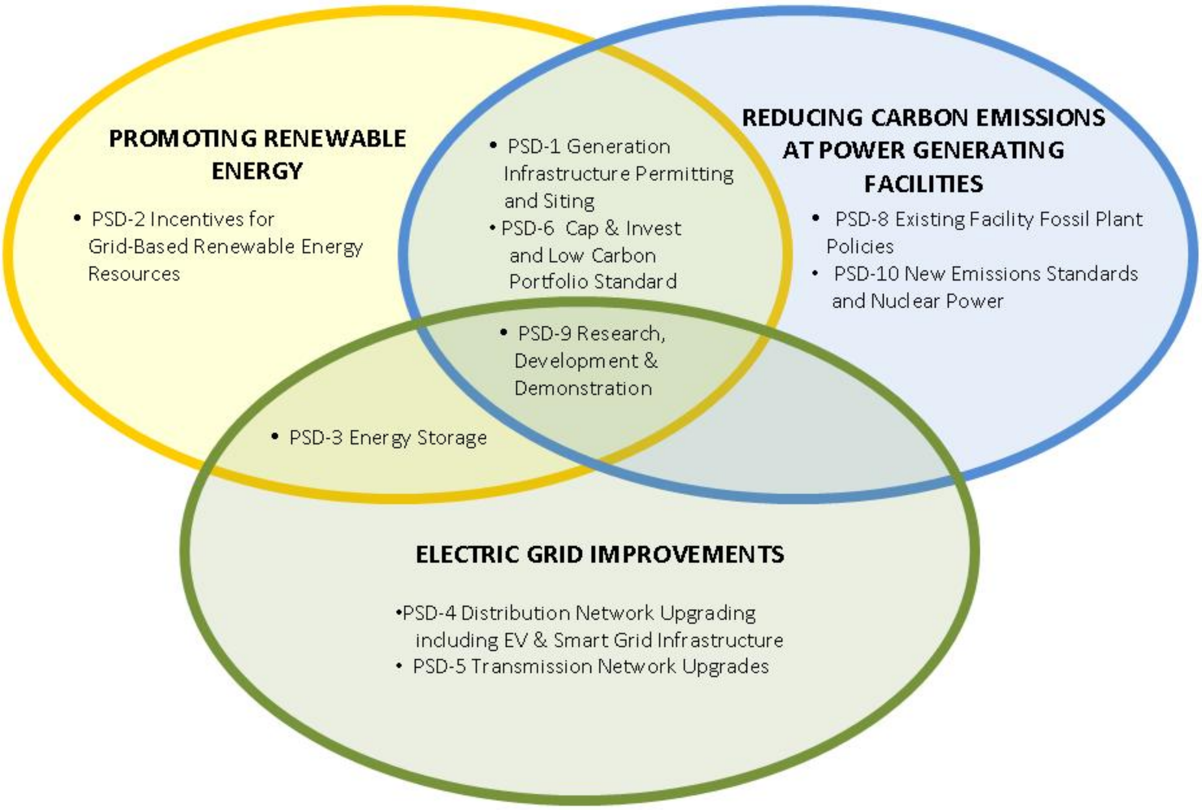


LCPS = low-carbon portfolio standard; PSD = power supply and delivery; RPS = renewable portfolio standard.

Although New York will rely on the federal government to provide most of the substantial financial support and loan guaranties that new nuclear plants currently require, it should be prepared to facilitate the siting of nuclear plants that receive such financial support. Likewise, when substantial federal investment in CCS research and development yields commercial-scale CCS projects, New York should be prepared to site such projects in New York. A number of policies support these goals, including the siting processes of PSD-1 and the emission standards of PSD-10. Most importantly, the LCPS will create a fertile market for nuclear power and CCS (as well as renewables) and will lead utilities and other LSEs to enter into long term contracts for low carbon power.

In further developing, designing, and implementing the policies that are selected, the State will need to continue to preserve the reliability of the electricity system and strive to minimize costs while maximizing benefits. In the context of planning for a New York energy future with greatly constrained emissions of GHGs, it is important that the State review carefully the current design of the structure of the electricity markets (energy, capacity, and ancillary service markets) to see if there are ways to improve their overall efficiency and effectiveness. In addition, the State should continue to assess the reliability of the electricity system as it designs and implements the policies selected, many of which will constitute transformative changes in the way in which electricity is generated and used. To support that process, the State should urge the New York Independent System Operator to include 20-year sensitivity analyses in its Comprehensive Reliability Planning Process/Reliability Needs Assessment that incorporate supply strategies recommended herein as well as load-altering policies in the transportation and land use (TLU) and residential, commercial/institutional, and industrial (RCI) sectors.

Figure 8.9 Power Supply and Delivery Policy Options



Policy Scenario Quantification Summary Table

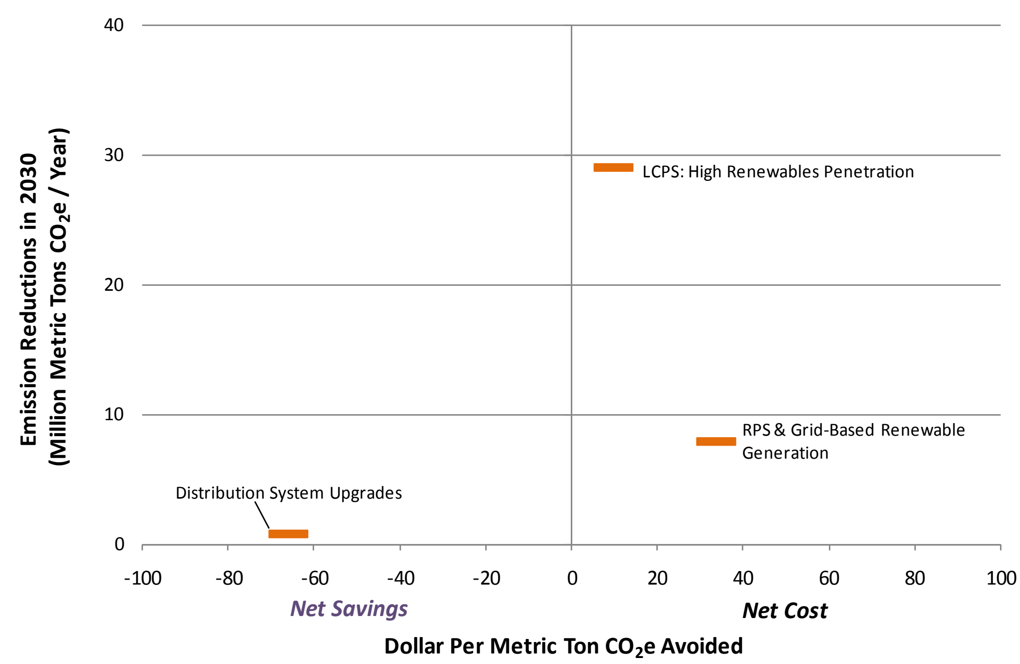
Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value: Cost/Savings (Million 2005$)	Net Cost/Savings per Avoided Emissions (2005$/$tCO_2e$)
		2020	2030	Total 2011–2030		
PSD-2	Renewable Portfolio Standard (RPS) and Incentives for Grid-Based Renewable Generation	2.8	7.9	65	$2,200	$34
PSD-4	Distribution System Upgrades	0.3	0.8	6.3	-$420	-$66
PSD-6	Low-Carbon Portfolio Standard (LCPS): High Penetration of Renewables	7.3	29	220	$2,100	$10

$/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; EV = electric vehicle; GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; N/A = not applicable.

Negative values represent savings.

The numbering used to denote the above policy recommendations is for reference purposes only; it does not reflect prioritization among these important policy recommendations. The policy numbers that appear in this table are not consecutive because they reflect only those policies for which quantification has been completed, and not all policies are amenable to quantification.

Figure 8-10. Estimates of Cost and GHG Emissions Reductions for PSD Policy Options.



NOTE: Scenario results are not additive as synergies and overlap have not been estimated.
Additional economic analyses need to be conducted to assess macroeconomic impacts and co-benefits.

INCENTIVES for GRID-BASED RENEWABLE GENERATION (PSD-2)

Policy Summary

This policy promotes the development of low-carbon renewable energy resources in New York over the period from 2015–2030 by increasing incentives and removing existing barriers for grid-connected renewable energy resources. This policy is intended particularly to increase investment in and development of in-state renewable energy resources such as wind (both onshore and offshore), solar photovoltaic (PV), low-carbon sustainable biomass/biofuels, and others.

This policy option would increase the amount of new renewable power from approximately 10 million MWh in 2015 (when the current RPS of 30 percent by 2015 is fully implemented) to 23–24 million MWh by 2030. Assuming that the energy efficiency policies developed by the RCI Technical Work Group keep electricity demand from growing in New York, this policy could increase the renewable portion of New York's electricity supply to approximately 40 percent by 2030. Specified targets would be identified for both offshore wind and grid-based solar power. The State could achieve these goals through a variety of policy mechanisms, starting with the continuation and expansion of an RPS program using funds raised through charges on utility bills. Achieving the goals outlined above, including the diversity in renewable resources, may benefit from supplementing existing funding mechanisms with other incentives, such as power purchase agreements, whereby the New York Power Authority and Long Island Power Authority purchase power or renewable attributes from renewable energy providers, and renewable energy payments (also known as feed-in tariffs) for specific categories of smaller renewable energy projects. These incentives can be designed to assist in the implementation of developing and emerging technologies. The State should continue to monitor changes in the price differential between grid-based solar power, offshore wind, and other renewable sources so that incentives can be adjusted in accordance with their economic and technical viability.

Additionally, in order to further encourage these clean energy resources, New York State should examine any remaining barriers that prevent market-based development of utility-scale renewable energy generation projects. Possible policy approaches include: (1) specific standards and fees for interconnecting renewable energy resources into the grid, (2) establishment of renewable energy development zones that allow for concentration of transmission grid upgrades to efficiently deliver renewable power to end-user consumers, and (3) specific regional siting policies for technologies such as offshore wind. Coordinated studies could identify additional barriers to development and design strategies to alleviate them.

Quantification

The Technical Work Group explored two scenarios[2] with different renewable penetration levels (13,000 GWh and 14,000 GWh), above and beyond the approximately 10,000 GWh goal

[2] Additional scenarios were studied. These results are in the summary table on page 8-14.

established under the current 30 percent RPS program to be achieved by 2015. To promote diversity, the 13,000–14,000 GWh of new grid-based renewable resources could be required to include at least 3,000 GWh of offshore wind projects and at least 1,000–2,000 GWh of grid-based solar power.

The order of magnitude impacts of the Net Present Value and Cost-Effectiveness metrics for both scenarios were essentially the same. Therefore, the higher renewable penetration scenario is included here, which assumes the addition of the following renewable generation by 2030: 2,000 GWh of biomass co-firing, 2,000 GWh of solar PV, 7,000 GWh of onshore wind, and 3,000 GWh of offshore wind. The other scenario may be found in the full Technical Work Group policy option document.

The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by net cost per avoided emissions – 2005\$/tCO_2e) for the policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions (MMtCO_2e)		Net Present Value Cost (Million 2005\$)	Net Cost per Avoided Emissions (2005\$/tCO_2e)
2030	Total 2011–2030		
7.9	65	\$2,200	\$34

\$/tCO_2e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

Special Considerations

- In the next two decades, this renewables incentive policy will be the primary mechanism to facilitate the development of the renewable resources needed to move New York to a lower carbon power sector. Over time, this policy could be phased out in favor of programs such as the low-carbon portfolio standard and an expanded regional cap-and-invest program.
- The implementation of some GHG reduction programs at the federal level (e.g., RPS, cap-and-invest) may require that New York modify its RPS implementation and administration strategies.
- The Federal Energy Regulatory Commission (FERC) has exclusive jurisdiction under the Federal Power Act to regulate rates and conditions of sales for resale of electric energy in interstate commerce. The States are pre-empted from setting wholesale power rates that exceed utility avoided costs. New York's utility-based incentive programs for supply from renewable sources will need to be developed in compliance with this federal requirement. (Source: FERC, Order on Petitions for Declaratory Order, issued July 15, 2010).
- A substantial amount of pre-development work (e.g., engineering studies and surveys) is necessary to foster market introduction of a broad range of promising renewable energy technologies in New York, including advanced biomass, tidal, and off-shore wind technologies. Meeting electric demand in a manner that satisfies climate protection goals will also require continued advances in the performance of current and emerging renewable

generation technologies. PSD-9 (Research and Development) includes policy initiatives focused on ways in which New York can help address these needs.

- Consistent with other PSD policies, a thorough assessment should be conducted to evaluate the energy storage, transmission, and distribution requirements that will support the expanded use of renewable power generation technologies in a reliable manner.
- The investment of funds in support of this goal is likely to create large numbers of jobs installing and maintaining renewable energy systems. Early investment in emerging technologies will contribute to lowering the price of such technologies so that they can be more competitive in the future.
- Additional analyses will be conducted in the next phase of the Climate Action Plan process to separately quantify the potential benefits and costs of utilization of biomass for application in the PSD sector.

GHG REDUCTION MARKET MECHANISMS: CAP-AND-INVEST AND LOW-CARBON PORTFOLIO STANDARD (PSD-6)

Policy Summary

This policy option identifies two market-based policy mechanisms that could provide strong economic incentives for private sector investment in low-carbon emitting sources of energy and other low-carbon technologies: (1) a low-carbon portfolio standard, which would require all providers of electricity to obtain a portion of the electricity they sell from low-carbon energy sources; and (2) a cap-and-invest program, which would be implemented on a regional basis and could include the power sector and other sectors within its coverage.

Low-Carbon Portfolio Standard (PSD-6a)

Under this policy, utilities and other LSEs would be required to provide a specified portion of their electricity sold from low-carbon sources (renewable, nuclear, fossil with carbon capture and sequestration). Currently, approximately 50 percent of the electricity generated in New York would qualify as low-carbon. That portion would have to grow to close to 100 percent by 2050. The policy would likely be implemented through low-carbon electricity credits that would be sold to LSEs by developers of low-carbon electricity. Imports could be treated the same as power generated within New York. Implementation of this policy would provide strong market signals for the development of renewable energy and other low-carbon sources of electricity.

Cap-and–Invest (PSD-6b)

New York should support the establishment of a strong federal cap-and-trade program that places a national price on carbon emissions. In the absence of a federal policy, New York should build on the successful RGGI effort and work with its regional partners in RGGI to construct a cap-and-trade, or cap-and-invest, program that would cover large stationary emission sources in addition to the electricity-generating sources included in RGGI. The program would be designed to reduce emissions from the covered sectors by approximately 2.2 percent per year so that the 2050 cap is 80 percent below today's levels. It would also provide a source of revenues for clean energy investments that contribute to economic development and job growth in New York by providing that all proceeds from the auction of allowances are reinvested in complementary programs to deploy energy efficiency, renewable energy and other low-carbon technologies or policies. Steps would have to be taken to address leakage/imports of electricity from sources in uncapped jurisdictions.

At this time, RGGI covers only the power sector but this policy recommends that consideration be given to including industrial sources in the program as well as fuels used in the transportation and building sectors. The program would be designed to mitigate impacts on energy-intensive industries that are subject to interstate or international competition.[3] As an alternative to including the emissions associated with transportation and building fuels in the cap, a carbon fee could be applied to the use of those fuels at a per ton carbon level that is comparable to, or based on, the clearing price for allowances used in the cap-and-invest program. Placing a carbon price on building and transportation fuels would provide an incentive for energy efficiency and low-carbon renewable sources of energy and a source of revenues to fund some of the policy initiatives discussed in the RCI and TLU sections of this report. In addition, if the scope of the cap-and-invest program is expanded beyond RGGI, offsets should be expanded beyond those available under the current RGGI program if the offsets meet the fundamental requirements of RGGI and other credible emission reduction programs (the offsets must be real, additional, verifiable, enforceable, and permanent).

Quantification

Cap and Invest

The cap-and-invest policy will be quantified after integrated cost curves are completed in the next stage of the planning process.

Low-Carbon Portfolio Standard

The Technical Work Group explored several scenarios for achieving a possible LCPS goal where 75% of the electricity generated in New York would come from low-carbon sources in 2030. Three scenarios that bound the analysis are described below. The other scenarios may be found in the full Technical Work Group policy options document.[4]

The first scenario focused on achieving the goal with a high penetration of new renewable generation. It assumed the addition of 9,000 GWh of lower-carbon sustainable wood and other biomass, 10,000 GWh of solar PV, 16,287 GWh of onshore wind, and 9,198 GWh of offshore wind generation by 2030. The GHG reduction potential, total cost, or savings (as measured by

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[3] The recommendation to include industry sources in the cap-and-invest program would not conflict with the RCI Technical Work Group's recommendation of voluntary efforts only if measures are included in the cap-and-invest program to protect energy-intensive industries, such as free allocation of allowances.

[4] Additional scenarios were studied. These results are in the summary table on page 8-14.

net present value), and cost-effectiveness (as measured by 2005$/t$CO_2$e) for the first policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions ($MMtCO_2e$)		Net Present Value Cost (Million 2005$)	Net Cost per Avoided Emissions (2005$/t$CO_2$e)
2030	Total 2011–2030		
29	220	$2,100	$10

$/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

A variation of this scenario, which supplements renewables with energy efficiency as a low-carbon supply-side resource, results in similar reductions at a lower cost per ton avoided of $4.

The second scenario assumed that the 2030 goal would be met with a mix of renewable generation and new coal with CCS. It assumed the addition of 7,274 GWh of coal integrated gasification combined-cycle technology with CCS, 9,000 GWh of wood and other biomass, 3,333 GWh of solar PV, 16,287 GWh of onshore wind, and 8,590 GWh of offshore wind generation by 2030. The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by $/t$CO_2$e) for the third policy scenario quantified by the Technical Work Group are presented below.

GHG Reductions ($MMtCO_2e$)		Net Present Value Cost (Million 2005$)	Net Cost per Avoided Emissions (2005$/t$CO_2$e)
2030	Total 2011–2030		
28	200	$2,200	$11

$/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

A third scenario assumed that the 2030 goal would be met with renewable generation and a greater use of new nuclear energy. It assumed the addition of 30,748 GWh of nuclear (i.e., generation associated with 3 units of 1,300 MW each), 3,442 GWh of wood and other biomass, 3,333 GWh of solar PV, 5,429 GWh of onshore wind, and 1,533 GWh of offshore wind generation by 2030. The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by 2005$/t$CO_2$e) for this policy scenario are presented below.

GHG Reductions ($MMtCO_2e$)		Net Present Value Cost (Million 2005$)	Net Cost per Avoided Emissions (2005$/t$CO_2$e)
2030	Total 2011–2030		
27	120	$3,000	$24

$/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

Special Considerations

- The LCPS would build upon and could eventually supplant the RPS by 2030. The LCPS would require LSEs to procure only the additional low-carbon power that is needed to achieve the specified targets after consideration of existing renewable and other low-carbon (nuclear) resources as well as renewables being developed by the RPS. After 2030, State support in the form of the Main Tier RPS for central power could be discontinued, allowing additional low-carbon power procurements by LSEs under the LCPS to drive the continued development of the low-carbon electricity sector in New York.
- The proposal for the State's LSEs to provide a percentage of electricity to consumers from low-carbon sources of generation will require further analyses, including impacts on the State's deregulated wholesale generation market and dispatch, potential increases in retail electric prices for consumers, forecasts of available low-carbon electric supply sources (including imports), and costs and requirements to maintain the reliability of the state's electric transmission and distribution system.
- Design of the cap-and-invest program will need to address leakage of emissions. Among the mechanisms to be used would be implementation of complementary measures to reduce electricity demand and deploy renewable energy (including the RPS and LCPS), allocating a portion of the allowances for free to sources in energy-intensive, competitive industries, and including imported energy within the scope of the program. Regulating the carbon intensity of electricity imported into the state would have to be implemented in a manner that complies with the constitutional principles governing state regulation of interstate commerce.
- In designing these programs, State policymakers will need to be mindful of the interactions between the programs and their applicability to state power programs and customer classes. Although further evaluation of the interactions will be needed, some preliminary conclusions can be drawn. For example, implementing strong complementary measures directed at the power sector, such as the LCPS and RPS, will have a tendency to reduce the cost of emission allowances under the cap-and-invest program, thereby reducing the cost to New York ratepayers. However, if other states participating in a regional cap-and-invest program do not make similar investments, this benefit will be diluted, thereby raising the cost of the cap-and-invest program to New York. Therefore, New York would need to work with its partners in the RGGI to seek deployment of similar programs in the other RGGI states and explore the possibility of regional implementation of an LCPS. Another possible way of ensuring that New York reaps the benefits of its other policies is to base the percentage allocation of allowances that New York receives in a regional program on state emissions baselines that do not consider the emission reductions that will result from other policies, such as implementation of the LCPS, expanded RPS and other complementary measures.
- Ideally, in the long term, the regional cap-and-invest program would transition into, or form a part of, a national program that is enacted through legislation or regulation. In deliberations over the design of a federal cap-and-trade program, New York should advocate for measures to ensure that emission reductions achieved under an LCPS or other similar measures have value when a federal cap is in place.
- Achieving the goals of these two policies will require the implementation of other measures recommended in the PSD chapter of this report, including energy storage (to enhance

reliability of a grid that relies increasingly on renewables), a siting process for new low-carbon energy facilities and upgrade of electricity transmission and distribution systems. The cap-and-invest program could provide a revenue stream to enable the funding of many of the other policies recommended in this report.

- Additional analyses will be conducted in the next phase of the Climate Action Plan process to separately quantify the potential benefits and costs of utilization of biomass for application in the PSD sector.

GENERATION INFRASTRUCTURE PERMITTING and SITING (PSD-1)

Policy Summary

The current siting process for power plant facilities is left to a patchwork of local and State regulatory processes. An opportunity exists to re-create a more streamlined process for the siting of power plants.

There are many components to consider in an authorization statute for power plant siting, including:

- A siting process that combines and coordinates numerous regulatory authorizations and procedures into a single fuel- and technology-neutral approval process that provides greater market certainty to developers and investors;
- A time-certain framework for rendering a decision on an application;
- A provision for the override of the application of local substantive legal requirements that are unreasonably restrictive in view of factors specified in the statute;
- An analysis of alternative sites similar to that required by State Environmental Quality Review Act;
- A finding and determination that the authorized generating facility minimizes and mitigates predictable, significant, and adverse disproportionate environmental impacts, considering the cumulative effect of emissions from other major facilities and the goal of reducing net emissions or, at a minimum, avoiding increased pollution in communities that bear a disproportionate burden of emissions;
- Opportunities for extensive public involvement, including improved notice provisions, so as to address environmental justice and other public concerns associated with the construction and operation of the proposed electric generating facility;
- Availability of intervenor funding, starting at the pre-application phase, for technical and legal services.

Regarding carbon capture and sequestration, a regulatory and statutory framework should be considered for the development and use of CCS technology. One aspect of such framework is to amend the existing major transmission facility siting process (reflected in Article VII of the

Public Service Law) to establish a mechanism for the review and siting of a captured carbon transmission pipeline. In addition to this PSC-led activity, legislation could provide the New York State Department of Environmental Conservation with responsibility for CCS oversight, including a review process for obtaining a carbon sequestration permit, the injection of captured carbon into a reservoir, and the observation and monitoring of the carbon sequestration reservoir and its buffer zone boundaries.

Quantification

This policy option has not been quantified.

Special Considerations

- It will be challenging to balance the need for efficient and predictable permitting with expanded opportunities for extensive public involvement, including improved notice provisions, to address environmental justice and other public concerns associated with the construction and operation of proposed electric generating facilities. This policy proposes a revised process that serves both goals because unless progress is made in both areas it is doubtful that sufficient support can be mustered to accomplish either.
- A coordinated project review under the power plant siting law could result in greater efficiency and lower costs for state agencies and municipalities from not having to conduct individual and possibly duplicative review processes. Also, permitting costs should be reduced with the use of a shorter and more certain regulatory process. This should result in lower costs to the developer. In addition, a more predictable permitting process might encourage a larger number of projects to be proposed, affording the state a wider range of future generation options.
- The concern expressed by certain stakeholders that a siting bill could be used to site high-emitting facilities contrary to the 80 by 50 goal will be addressed by the implementation of PSD-10, which will require that all new or rebuilt power plants meet stringent emission standards for GHG emissions. Consideration could also be given to providing expedited treatment in the siting process to low-carbon and environmentally beneficial repowering proposals.

NEW FACILITY EMISSIONS STANDARDS and NUCLEAR POWER (PSD-10)

Policy Summary

In the next 20 years, New York should integrate new baseload fossil fuel-fired generation into the generation mix in a manner that is consistent with maintaining reliability and reducing system-wide GHG emissions. To reach the goal, this policy option supports the development of a low-carbon emission standard aimed at ensuring that the development of new power generating units contributes to the reduction of the State's GHG emissions. This standard would require that new or reconstructed fossil fuel-fired electric generating units that produce power for sale in New York and new power purchase agreements for delivery of electricity into the New York

Independent System Operator (NYISO) control area would achieve CO_2 emission rates (pounds of CO_2/MWh gross) that are based on the best available operating technology. For baseload units, the standard would be set at a level that can be achieved by combined cycle natural gas-fired technology. Gas turbines that are used for peaking purposes would be subject to a higher rate. In either case, the rates would allow for use of oil as a back-up fuel, consistent with reliability guidelines. In accordance with this proposed standard, new coal-fired power plants should not be built until CCS is available. For future decades, the emission standards could be revised based on the best available operating technology that arises in those periods.

Nuclear power plants currently play an important role of providing necessary baseload power in New York's electricity system. New York could strive to maintain the net installed capacity of power from nuclear plants that can continue to operate in an appropriate location and safe manner consistent with all environmental requirements and eventually replace the capacity of the units that are not relicensed with new nuclear or other low-carbon baseload plants. In all cases, the relicensing, replacement with new units at the same facilities, or the development of new nuclear energy (or other zero GHG emitting base-load generation) facilities needs to be done in a safe and environmentally sound manner. In addition to the traditional large-scale reactors, opportunities may arise to site newer smaller scale units.

Quantification

This policy option has not been quantified.

Special Considerations

- The goal of promoting the development and operation of power generation facilities that will have zero- or very-low-carbon emissions is also promoted by the policy of developing an LCPS for power plant emissions (PSD-6). In addition to promoting statewide emission reductions, the instant policy—along with the siting policy (PSD-1)—will reduce the adverse environmental impact of new facilities on particular communities.
- The evolving role of the federal government is critical in the expansion of the nuclear industry and creating the policies and mechanism(s) for long-term storage, reprocessing, or neutralization of used nuclear fuel.
- Currently, the two units at Indian Point are in the re-licensing process as their licenses expire in 2013 and 2015. If these (or other) facilities are not relicensed, then plans for the siting or expansion of new nuclear units (or other zero-GHG-emitting baseload generation) at new or existing facilities would be needed eventually to attain the same level of power currently provided by nuclear energy in the state.

EXISTING FOSSIL PLANTS (PSD-8)

Policy Summary

New York's current fleet of fossil-fired plants includes plants—fired by coal or other fuels—with relatively high rates of carbon emissions. The purpose of this policy is to reduce emissions from these facilities by repowering and replacing existing fossil-fired facilities with more efficient, lower-emitting and less carbon intense generators. This goal would be achieved through a combination of incentives and emission standards.

Initially, the State would rely on market-based solutions to promote repowering, including: (1) Request for Proposals open to repowered resources, regardless of technology; (2) market-based credits (similar to the REC market); or (3) long-term contracts. The PSC could work with the NYISO, the New York State Reliability Council, and market participants to identify fair and cost-effective incentives for the repowering of facilities to modern, state-of-the-art generation. Repowering would also be supported by the cap-and-invest program, as well as other market-based and regulatory efforts.

Eventually, however, existing sources would have to meet emission standards that would be applicable in 2030 after the above policies have been given a chance to work. These standards could be based on the standards applicable to new sources in PSD-10 (based on the emissions of natural gas-fired plants). Depending on the level of their emissions, existing sources would have a number of options available to meet specified emission standards, including efficiency upgrades, repowering with lower carbon fuels, co-firing of lower-carbon, sustainable biofuels, and the use of CCS (when it becomes commercially available). Flexibility may be provided by allowing the grouping or system-averaging of unit emissions to demonstrate compliance with applicable emission limits.

Quantification

This policy option has not been fully quantified.

Special Considerations

- The State should consider postponing the applicability of any performance standard to any source that is, at the time of rule or regulation effectiveness, in contract for power sale until the expiration of that existing contract.
- Consideration could be given to incorporating incentives for repowering proposals that reduce emissions of all relevant pollutants in the new facility siting process recommended by PSD-1.
- In developing and implementing the policy, the State should ensure that any incentives are cost-effective and it should avoid providing incentives to plants that are not expected to operate many years into the future.
- Implementation of this policy is important to environmental justice communities that are burdened inequitably by existing fossil fuel-fired plants.

DISTRIBUTION NETWORK UPGRADING INCLUDING EV and SMART GRID INFRASTRUCTURE (PSD-4)

Policy Summary

The electric power distribution system represents the critical linkage between the high-voltage transmission system and a wide variety of end-use consumer loads and functions as the injection point for distributed generation. An effective and reliable interface must be maintained between both systems as New York transitions to a low-carbon economy. The distribution system serves as an enabling technology to allow for greater market penetration of customer-sited low-carbon technologies (rooftop PV, electric vehicles [EVs]). Improved distribution monitoring, diagnostics, and interactive communication systems would be necessary to realize carbon reduction targets and concurrently maintain system integrity. Accurate monitoring of upstream transmission system status and downstream end-use conditions in real-time represents an essential component of the smart distribution network, and secure data exchange protocols would need to be simultaneously implemented at both ends of the system. Smart distribution also improves system reliability and can improve the efficient operation of distribution circuits with voltage conservation and improved reactive power control. To accommodate high-penetration EV charging, some upgrades to the distribution system at the local level involving distribution transformers and customer service will be required. Stationary electrical storage may be necessary to deploy fast charging of EVs without negative grid impacts.

The PSC has instituted a proceeding aimed at establishing a strategic vision and plan for investing in smart grid technology for New York that will guide future research, development, and demonstration in New York in support of the policy objectives stated herein. In addition, the following initiatives should be pursued to support these policy goals:

- Pilot projects should be undertaken to both quantify energy efficiencies from various approaches to smart distribution and to establish best practices.
- PSC rate cases could require regulated utilities to consider the use of smart grid distribution technologies that would support the achievement of lower GHG emissions.
- The New York State Smart Grid Consortium's strategic roadmap should be used to guide smart grid roll out.
- Utilities regulated by the PSC could have load factor targets and incentives to implement appropriate technologies to achieve them.
- Develop and implement improved distribution circuit performance indices that better incorporate distribution automation and/or smart grid operations.
- New rate tariffs could be established that provide incentives to customers to improve their power factor.
- A workshop could be held annually with industry experts and stakeholders to conduct a smart grid technology assessment.

Quantification

Three policy areas were identified for quantification: (1) expanded use of smart meters, (2) reduction of distribution system losses, and (3) smart charging of electric vehicles. The benefits related to smart charging are being evaluated under TLU-4, Alternative Fuel Related Measures and Infrastructure.

The literature suggests that smart grid deployment can result in very cost-effective emission reductions under some circumstances. However, because costs and savings are both highly site-specific, a reliable quantification of emission reductions and costs associated with extensive deployment of smart grid technology in New York cannot be made at this time. The cost-effectiveness of smart grid technology is being evaluated in an ongoing PSC proceeding that may provide the basis for more precise quantification in the future.

The Technical Work Group also investigated the potential for distribution loss savings. These savings can be accomplished in a number of ways, for instance, by upgrading transformers and by reducing reactive power losses (installation of capacitors). The table below contains the results of a quantification built upon a study conducted by the NYISO that estimates that it is possible to improve distribution system losses by up to 30% (this would reduce current losses from approximately 6 percent to 4 percent).[5] The GHG reduction potential, total cost or savings (as measured by net present value), and cost effectiveness (as measured by 2005$/t$CO_2$e) for this policy scenario are presented below.

GHG Reductions (MMtCO_2e)		Net Present Value Cost (Million 2005$)	Net Cost per Avoided Emissions (2005$/t$CO_2$e)
2030	Total 2011–2030		
0.8	6.3	-$420	-$66

$/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; GHG = greenhouse gas; MMtCO_2e = million metric tons of carbon dioxide equivalent.

Negative values represent savings.

Special Considerations

- Substantial additions of electric vehicles and other technologies will require upgrades to the distribution network. The geographical distribution of these technologies will have a large influence on this matter. For instance, local concentrations of EVs may seriously strain the distribution system, especially if they require fast charging. Many of these issues and potential solutions were summarized by a cross-sector task force.[6]
- The policy will consider any/all unique circumstances associated with individual electric service territories throughout New York including, but not limited to, geographic topology

[5] Chao, H. and J. Adams (NYISO), *Benefits of Reducing Electric System Losses*, April 9, 2009, p. 17.

[6] *Report of the Cross-Sector Electric-Grid-Powered Vehicle Sub-group.*

that may impact communications infrastructure, expected market adoption rates for electric vehicles and market penetration of demand side resources.

- The use of smart grid technologies provides customers with greater flexibility and resources to manage energy demand and costs. Electricity system reliability is also enhanced with smart grid technologies.

TRANSMISSION NETWORK UPGRADES (PSD-5)

Policy Summary

This policy option encourages and supports cost-effective transmission system improvements that reduce GHG emissions while improving efficiency, satisfying electricity demand, and maintaining reliable and secure system operations. It is expected that this policy would facilitate the development of generation that would be influenced by other policies (PSD-2, PSD-6, PSD-10, RCI policies, etc.)

The Technical Work Group focused on ways to encourage cost-effective transmission system upgrades, expand transmission capacity, and reduce sulfur hexafluoride (SF_6) emissions from transmission-related equipment. It recommended that renewable energy and GHG emissions policy goals be incorporated into existing and ongoing centralized system planning studies. Through this, system planners may identify cost-effective upgrades to existing infrastructure (including opportunities to incorporate smart grid technology) that reduce system losses and new transmission that interconnects remotely-located clean energy resources to the power grid. Utilizing existing rights-of-way should be encouraged to the extent practicable. The policy also recommends that system planning studies identify areas or zones within the New York Control Area that have high potential to provide clean energy, and then target these zones for transmission expansion to accommodate clean resources.

The NYISO and PSC will need to develop regulatory mechanisms, market signals, and/or incentives to encourage upgrades and interconnections that facilitate the State's climate and energy goals. This includes regulatory mechanisms that expedite decisions on cost recovery and cost allocation for New York Transmission Owners (NYTO) that invest in loss-reducing equipment and upgrades. In the Article VII process, PSC could give greater weight to a proposed project's contribution to state climate and energy policy goals in the determination of project need.

To reduce the emissions of SF_6 from transmission operations, the policy calls for all NYTOs to sign on to the U.S. Environmental Protection Agency's SF_6 Emission Reduction Partnership for Electric Power Systems and set goals for reducing SF_6 emissions, and to establish a New York State working group including the NYTO and other stakeholders, to share best practices and develop strategies to meet the Partnership's goals. The State could also support the development of environmental regulations, manufacturer incentives, and federal SF_6 emissions performance standards to encourage the use of environmentally-friendly equipment that limits emissions of

SF_6, and encourage research and development programs to find ways to limit and/or replace SF_6 technologies.

Quantification

This policy option has not been quantified.

Special Considerations

- Siting of transmission projects can be complex and contentious due to regulatory issues at the State and federal level, differing perspectives on the benefits and cost burdens, opposition at the local level, and potential environmental and visual impacts.
- There are transmission technologies—forecasting software for solar and wind resources, energy storage technologies, etc.—that are in early stages of development. These technologies, when technically and commercially viable, will be needed to facilitate large-scale integration of variable renewable resources while maintaining high levels of reliability. Technological developments will happen, but may not break through at the pace and/or scale needed to meet the renewable energy goals of the Climate Action Plan. PSD-9, Research and Development for Electric Energy Supply and Delivery, focuses on developing new sources of renewable generation and developing mechanisms to enable the efficient and cost effective delivery of electric energy.
- Transmission expansion and interconnection intended to satisfy energy and climate policy goals will be evaluated by developers and regulators on an economic basis before getting approval. For example, the NYISO Congestion Assessment and Resource Integration Study process requires a benefit-cost ratio higher than 1.0 before considering a project for cost recovery through the tariff. Incorporating the benefits of meeting climate goals into a tariff, like other changes to the NYISO tariff, will require stakeholder acceptance and FERC approval. New projects must also be evaluated and approved by the PSC through the Article VII process.

ENERGY STORAGE (PSD-3)

Policy Summary

To achieve the 80 by 50 goal and the benchmark interim goal of 40 by 30, while maintaining electric system reliability, the State will need to move toward an extremely low-carbon electricity sector. Achieving an extremely low-carbon electricity sector will, at a minimum, require the successful implementation of two distinct sets of strategies: (1) a very substantial increase in the use of mostly intermittent renewable sources of generation, as proposed in PSD-2, Renewable Portfolio Standard and Incentives for Grid-Based Renewable Generation, and in RCI-3, Renewable Energy Incentives; coupled with (2) a steady reduction in the use of fossil fuel generation, as proposed in PSD-6, GHG Reduction Market Mechanisms, PSD-8, Existing Fossil Plants Policies, and PSD-10, New Facility Emissions Standards and Nuclear Power.

One of the most important challenges that the state's electric system faces is the need to assure that system reliability is maintained. At present, balancing system load and supply conditions, and addressing short and long term system disruptions, are addressed by calling on various load-following fossil fuel generation plants and/or demand response for reduced load. One challenge the State will face in meeting the 80 by 50 GHG reduction goal will be the need to find clean energy substitutes for the set of fossil fuel generation facilities that are called upon to address those circumstances. For example, the prospect of minute-to-minute rapid changes in the output of the state's generation mix remains likely while, at the same time, the types of fossil fuel generation historically relied on to address fluctuations in demand may no longer be operating.

Energy storage—in its many forms—can be used to help ensure that the State will be in a position to implement these strategies in ways that maximize the potential contribution of intermittent renewable generation, maintain reliability at every level of the electric system, and make full use of market efficiencies.[7] Energy storage facilities of sufficient capacity as measured in megawatts and total energy as measured in MWh, whose output may need to be called upon for hours, days, weeks, or even months, as well as facilities that could respond to system changes almost instantaneously but only briefly (labeled Limited Energy Storage Resources by the NYISO), will likely be critical to support routinely reliable operation of the electric system and to respond to system contingencies when and where they occur.

A thorough assessment should be conducted to evaluate the energy storage, transmission, and distribution requirements that will support the expanded use of renewable power generation and electric vehicle technologies in a reliable manner, for the 40 by 30 benchmark and the 80 by 50 goal. This should include an engineering and economic analysis, identification of institutional barriers and financing strategies, and identification of New York-specific needs for technology improvements. The expertise resident in both the New York Smart Grid Consortium and the New York Battery and Energy Smart Technology Consortium will be valuable in this assessment. In addition, given the significant need for fundamental improvement in Energy Smart cost and performance, New York State should advocate for substantial and increased federal investment in research and technology development.

Quantification

This policy option has not been quantified.

Special Considerations

- At the transmission system level, increased use of pumped-storage hydro and the introduction of compressed-air energy storage facilities (CAES), flywheels, and batteries could be developed as an alternative to curtailing renewable generation for system stability and to avoid choosing among renewable generation sources that would otherwise face

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[7] Energy storage will not be the only tool available. Shifting electricity usage to hours where excess generation supply is available and demand curtailment, for example, are more efficient and cost effective than any currently available means to store and later retrieve such energy and helps avoid the use of inefficient peaking generation sources. Transmission and distribution system enhancements, as proposed in PSD-4 and PSD-5, will also support this effort.

transmission constraints. As renewable energy supplants larger quantities of fossil energy, the role of storage may transition to providing capacity and energy to compensate for sudden changes in the output of wind and solar generation caused by short term weather changes. While the state already has two large pumped storage facilities, studies will need to be undertaken to identify other potentially feasible sites for additional large pumped-storage facilities including options outside of New York's borders. CAES facilities are an option, but also require appropriate underground geologic structures (e.g., salt domes) and proximity to both natural gas supply and transmission capacity.[8]

- At the distribution system level, storage facilities—primarily batteries—could provide ancillary services and provide clean energy alternatives to generation facilities in load pockets. Installation of local storage systems could also avoid the need to make potentially more costly distribution system enhancements. Storage of delivered electricity in the forms of ice systems for cooling and thermal storage for heating may also be effective technologies to reduce peak demand while accommodating the cross-sector migration of building heating and cooling loads.
- There are institutional, regulatory, and financial barriers that must be overcome to facilitate the expanded use of energy storage. For instance, an efficient regulatory mechanism needs to be created to support the siting of facilities that use energy storage.
- Although a number of energy storage technologies are currently available, additional advanced energy storage systems will need to be developed to support the achievement of the State's GHG reduction goals. PSD-9 elaborates further on the research and development activities that should be pursued to support these objectives.

RESEARCH, DEVELOPMENT, AND DEMONSTRATION NEEDS FOR THE POWER SUPPLY AND DELIVERY SECTOR (PSD-9)

See Chapter 10 for a complete presentation of Research, Development, and Demonstration needs for this sector.

[8] As currently conceived, CAES facilities would utilize nighttime generation to inject air into an appropriate storage structure and then during the day release the heated compressed air into a combustion turbine, burning natural gas, to dramatically increase the combustion efficiency of the turbine. Thus, use of natural gas in CAES facilities would need to be accounted for in the future emissions of the electricity sector. As a future possible alternative, it would be appropriate to also consider the use of compressed air energy storage without the use of fossil fuels.