FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT

In

CASE 03-E-0188 – Proceeding on Motion
Of the Commission Regarding a
Retail Renewable Portfolio Standard

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The Action in Case 03-E-0188 is the Adoption and Implementation of a Retail Renewable Portfolio Standard (RPS) in New York State.

Area Affected by Action: New York State

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Executive Summary of the Final GEIS for Case 03-E-0188

The 2002 State Energy Plan (SEP) recommended investigation of the feasibility of a statewide Renewable Portfolio Standard (RPS) to increase the amount of renewable energy in New York. Accordingly, the New York State Energy Research and Development Authority (NYSERDA) completed such a study and concluded that an RPS could be implemented in a manner consistent with the State's wholesale and retail markets and would complement the Commission's policies. Subsequently, on February 19, 2003, the Commission instituted Case 03-E-0188 for the purpose of developing and implementing an RPS for the electric energy retailed in New York State.

In March 2003, the Commission considered an environmental assessment prepared by its staff, and concluded that implementation of an RPS may have a significant affect on the environment and directed that a Generic Environmental Impact Statement (GEIS) be prepared. A notice of the Commission's declaration of Lead Agency determination and decision to prepare a GEIS was issued on March 18, 2003 and published in the Environmental Notice Bulletin (ENB) on April 2, 2003. Thereafter, the Commission's staff developed a Draft GEIS, and by Order issued April 8, 2004, the Commission determined that the Draft GEIS comported with the requirements of SEQRA and accepted it as complete.

Comments on the Draft GEIS were requested to be filed by May 14, 2004. Several dozen comments were submitted by interested parties in the case as well as other organizations and individuals; also, an estimated 1600 comments were submitted by interested citizens via e-mail, mostly in a standardized comment letter form. Further, the Administrative Law Judge (ALJ) in Case 03-E-0188 issued a Recommended Decision (RD) on June 3, 2004; subsequently, Briefs on Exceptions and Replies to Exceptions were filed on June 23, 2004 and July 8, 2004, respectively. As described more fully in Appendix D, Commission staff considered the comments in developing the Final GEIS. Modifications other than editorial were made in Section 2.0, Description of the Proposed Action; Section 4.0, Environmental Setting of New York State; Section 5.0, Alternative Actions Considered; Section 6.1, Overview of Generic Environmental Impact Approach; Section 6.2, Description of Renewable Technologies, Potential Levels of Development and General Environmental Impacts; Section 6.4, Changes in Fuel Mix

and Energy Security in New York State; Section 6.5, Cumulative Impacts and Benefits of RPS Alternatives and No Action Alternative; Section 10.0, Growth-Inducing Aspects and Socio-Economic Impacts of the Proposed Action; Section 11.0, Effects on Energy Consumption; and Section 12.0, Reference List.

The Action under consideration in Case 03-E-0188 is the adoption and implementation of an RPS Policy to increase to 25 percent the share of electric energy retailed in New York State from renewable resources. The proceeding examines the details, costs and benefits of an RPS policy; the Draft GEIS and the Final GEIS were prepared, pursuant to the State Environmental Quality Review Act (SEQRA), to evaluate the potential environmental impacts of the RPS policy under consideration. The location potentially affected by the Action is all of New York State. The Action also could subsequently induce construction of renewable energy projects outside of New York State.

In addition to providing details about the regulatory setting of the Action under consideration, the Final GEIS provides descriptions of the electric generating, transmission, and distribution systems in New York State, as well as a broad description of the environmental setting that could potentially be affected, either positively or negatively, by an RPS.

In Section 2.3 of the Final GEIS, numerous potential benefits are discussed. An RPS has the potential to: 1) reduce air emissions such as nitrogen oxide (NO_X), sulfur dioxide (SO_2), greenhouse gases, and particulates; 2) increase energy diversity and security; 3) spur economic development opportunities; 4) provide opportunities for increased distributed generation; and 5) increase customer choices by providing energy alternatives that promote a cleaner, healthier environment. Modeling reveals that the addition of new renewable energy sources at the 25 percent target level could annually reduce NO_X emissions by 4000 tons (6.8%), SO_2 emissions by 10,000 tons (5.9%), and carbon dioxide (CO_2) emissions by 4,129,000 tons (7.7%). Various alternative scenarios discussed in Section 6.5 demonstrated higher and lower results. The Final GEIS also provides an assessment of the potentially significant adverse impacts as a result of developing new renewable energy projects associated with an RPS Policy. Construction and operations of renewable energy projects have the

potential to adversely affect land use, aquatic and terrestrial resources, community character, culturally- and visually-sensitive resources and air emissions, as described in Section 6.2.

Preparation of the Draft GEIS was based on information contained in, and resulting from, the RPS Cost Study[1] (see Appendix A), as well as a review of literature regarding various technologies and emissions. The Draft GEIS considered alternative RPS scenarios, proposed by parties to the proceeding, consisting of different combinations of eligible generation technologies, various levels of commitment to an emerging technology tier, and variations in imports, load growth, program timing and pricing. The Final GEIS uses information from the RD Cost Analysis[2] (see Appendix B), which incorporates refinements resulting from the collaborative efforts in the proceeding. A comparison of several modeling results provides a general measure of differences between the ALJ's recommended proposal (RD Prime Case) and the previously evaluated scenarios. The RD Cost Analysis represents the best assessment of the assumptions and, as with any simulation modeling, is not meant to guarantee the modeling results, but, rather, to represent a likely outcome of the decision within a hypothetical (*i.e.*, modeled) range of possibilities. For planning purposes, the modeling assumptions used in the RPS Cost Study and the RD Cost Analysis assumed that full implementation of the RPS would be achieved in 2013, although benefits, and certain costs of renewables, would continue beyond that period and could vary depending on changes to the industry or to any of the variables used in the modeling analysis. The Final GEIS analyses are consistent with this study period. The Final GEIS also evaluates the RD Base Case, which is the No Action alternative.

A GEIS is not intended to review site-specific impacts. Section 6.2, however, contains impact evaluations that focus on each renewable technology, and Section 6.5 evaluates the statewide implications of increasing the proportion of renewable energy relative to the total electric energy produced and purchased in New York State.

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[1] New York Renewable Portfolio Standard Cost Study Report II Volume A (filed February 19, 2004, revised February 27, 2004) and Volume B (filed March 9, 2004) in Case 03-E-0188.

[2] New York Renewable Portfolio Standard Recommended Decision Cost Analysis, June 3, 2004.

Cumulative benefits and impacts are also addressed in Section 6.5. Results associated with the RD Prime Case in the Final GEIS show there will be emission decreases of NO_X, SO_2 and CO_2 in the years 2006 and 2013. Emission decreases are greater in New York City and the Long Island area than elsewhere in the State. Larger emission reductions in the most populous area of the State are especially beneficial because of the size and density of the population.

While regulation of emissions and enforcement of health-based standards are appropriately the primary responsibility of federal and state environmental agencies, the adoption of an RPS could result in the emission reductions noted above and consequently contribute to air quality improvements and a reduction in a wide range of impacts on the physical environment and human health. Reduction of NOx reduces the potential for ozone formation, thus reducing smog, human respiratory impacts, and acid deposition. SO_2 reductions result in reduced acid deposition and reduced fine particle formation. CO_2 reductions reduce the potential for global warming and contribute in part to reduction of the many undesirable consequences of global warming. Although not modeled, reductions in other emissions, such as mercury and lead, are likely to be a co-benefit of increasing renewable generation and the corresponding decrease in fossil generation.

Economic implications of the ALJ's recommended RPS were estimated in several ways. Assuming achievement of the 25% level, the cumulative cost of premium payments could be up to $868 million by 2013, but those payments could be offset by a cumulative reduction in wholesale energy costs of up to $513 million. While there would be a net financial cost, the resulting impact on customer bills would be relatively small. The most adverse cumulative bill impacts would be up to a 1.8% increase for residential customers, up to a 2.0% increase for commercial customers, and up to a 2.4% increase for industrial customers.

Site-specific impacts of the desired renewable resources are not known at this time. Appropriate federal, state and local approval processes would evaluate site-specific potential impacts. The Final GEIS provides a general description of potential environmental impacts on land and water resources, on agricultural, cultural, and

aesthetic resources, on terrestrial and aquatic biology, and on other individually relevant impacts.

Conclusion

The Action of developing and implementing an RPS for electric energy retailed in New York State will result in environmental benefits in the form of emission reductions from fossil-fuel facilities that are expected to operate less than they would without an RPS policy. This would, in turn, contribute to air quality improvements and a reduction in a wide range of impacts to the physical environment and human health. Also, an RPS policy would likely provide incentives for the development and growth of a renewable energy industry in New York State, which would, in turn, benefit the New York State economy. The development of specific renewable energy projects, however, may result in both short- and long-term adverse effects on the environment affected as a result of construction and operation of the specific facilities. Consequently, once the details and locations of such specific facilities are determined, proposed projects will be assessed individually pursuant to appropriate federal, state and local licensing, permitting, and environmental review processes.

1.0 COMPLIANCE WITH NEW YORK STATE ENVIRONMENTAL QUALITY REVIEW ACT (SEQRA)

The purpose of SEQRA is to incorporate consideration of environmental factors into the planning, review, and decision-making processes of New York State, regional, and local government entities. SEQRA requires all agencies to determine whether the actions they undertake, fund, or approve may have a significant impact on the environment. If it is determined that the action may have a significant adverse impact, then the government entity must prepare (or request to be prepared) an Environmental Impact Statement (EIS). The intent of SEQRA is to give appropriate weight to the protection and enhancement of environmental, human, and community resources in determining public policy by incorporating into a government entity's planning and decision-making process a suitable balance of social, economic, and environmental factors. SEQRA does not, however, require that environmental factors be the sole consideration in decision-making.

No government entity involved in an Action may undertake or approve an Action until it has complied with the provisions of SEQRA, but SEQRA does not change the existing jurisdiction of that entity. It also allows these entities to impose substantive conditions upon the Action to ensure compliance with SEQRA. These conditions, however, must be practicable and reasonably related to impacts identified in the EIS.

1.1 Preparation of a Generic Environmental Impact Statement – Purpose and Scope

SEQRA allows preparation of a Generic Environmental Impact Statement (GEIS) in several circumstances, including consideration of an entire program or plan having wide application or restricting the range of future alternative policies or projects.[3] A GEIS may be broader and more general than a site- or project-specific EIS. The GEIS should include the logic and rationale of the choices advanced, and may be based on conceptual information. The GEIS may also identify the important elements of the natural resource base, as well as existing and projected cultural features, patterns and character. SEQRA requires completion of a draft GEIS, which is made available for

[3] The required contents of an EIS are listed in the regulations that implement SEQRA (6 NYCRR Part 617.9 and 617.10) and generally provide the structure for an EIS, including a GEIS.

public comment; subsequently, the lead agency considers the comments and then prepares a final GEIS prior to reaching a decision on the Action under consideration.

At a regular session of the New York State Public Service Commission (PSC or the Commission) on March 18, 2003, the PSC considered an environmental assessment (EA) prepared by its staff, and concluded that the adoption and implementation of a retail Renewable Portfolio Standard (RPS) Policy in Case 03-E-0188 may have a significant effect on the environment. The Action involves potential changes in policy, practices, and economic arrangements affecting the choice and development of new sources of electric generation. The Commission determined that preparation of a broad-based GEIS would be more appropriate than a site-specific EIS because the proposed Action by itself would not involve any activities that would cause a direct effect on the environment at any specific location. Instead, the Action would likely create circumstances that could induce activities potentially affecting the environment. Preparation of a GEIS would allow the Commission to analyze and consider, in general and conceptual terms, hypothetical scenarios that are likely to occur as a result of the Action, and to evaluate the impact of those scenarios.

Notice of the PSC Declaration of Lead Agency Determination that the Action may result in significant environmental impacts, and the decision to prepare a GEIS, was issued on March 18, 2003. The notice was published in the NYS Environmental Notice Bulletin on April 2, 2003. By Order issued April 8, 2004, the Commission determined that the Draft GEIS comported with the requirements of SEQRA, and accepted it as complete.

Comments on the Draft GEIS were requested to be filed by May 14, 2004. Several dozen comments were received from parties in the case, as well as other organizations and individuals; also, an estimated 1600 comments were received by e-mail, mostly in a standardized comment letter form. Further, the Administrative Law Judge (ALJ) in Case 03-E-0188 issued a Recommended Decision (RD) on June 3, 2004; subsequently, Briefs on Exceptions and Replies to Exceptions were filed on June 23, 2004 and July 8, 2004, respectively. Where appropriate, and as noted in the responses to the comments, revisions were made to the Draft GEIS in the preparation of the Final GEIS. These changes, which are described more fully in Appendix D,

include modifications to Section 2.0, Description of the Proposed Action; Section 4.0, Environmental Setting of New York State; Section 5.0, Alternative Actions Considered; Section 6.1, Overview of Generic Environmental Impact Approach; Section 6.2, Description of Renewable Technologies, Potential Levels of Development and General Environmental Impacts; Section 6.4, Changes in Fuel Mix and Energy Security in New York State; Section 6.5, Cumulative Impacts and Benefits of RPS Alternatives and No Action Alternative; Section 10.0, Growth-Inducing Aspects and Socio-Economic Impacts of the Proposed Action; Section 11.0, Effects on Energy Consumption; and Section 12.0, Reference List.[4]

1.2 Process and Procedures

Preparation of the Draft GEIS, and collaborative meetings and technical conferences of the parties in Case 03-E-0188, were conducted simultaneously and, in part, addressed similar issues. After the close of the collaborative meetings and subsequent to the filing of written positions of the parties on the issues discussed in those meetings, the Commission determined that the Draft GEIS was complete and ready to be issued for comment. A minimum of 30 days was allowed for public comment.

2.0 DESCRIPTION OF THE PROPOSED ACTION

In meeting the health and economic needs of retail electric customers, as well as of all New Yorkers, the PSC is considering policies to support the development and commercialization of significant new renewable energy supplies to increase energy resource diversity and to reduce air emissions. To realize these objectives, the Commission instituted a proceeding to formulate a policy statement regarding a possible RPS. The proposed Action in Case 03-E-0188 is the adoption and implementation of an RPS policy to increase the share of electric energy retailed in New York State from renewable resources to 25 percent.

The key structural design elements of the RPS under consideration are as follows:

[4] See Appendix D, Revisions to the Draft Generic Environmental Impact Statement.

Eligibility

Resources and technologies considered eligible for New York State's RPS are specifically defined in Table 2-1 and Table 2-1A. In broad categories, eligible New York and out-of-state resources include consideration of:

- Wind;
- Hydroelectric – includes new low-impact, run-of-river hydropower facilities (defined as 30 MW or less with no new storage impoundments, per facility); new upgrades to existing hydropower facilities of any size, provided that such upgrades do not create new or enlarged impoundments; and small hydro facilities (10 MW or less) with expiring above-market contracts;
- Biomass – includes new biomass generation facilities that use clean, unadulterated woody or herbaceous material as a fuel source; biomass co-firing at existing fossil-fuel facilities; biofuels such as neat biodiesel and other neat liquid fuels derived from eligible feedstock sources;
- Biogas – includes methane-based landfill Gas, Sewage Gas and Manure Digestion; and other biogas from agricultural or food processing residues and by-products;
- Fuel Cells;
- Solar; and
- Ocean Energy.

Table 2-1
RPS Eligible Electric Generation Sources
Categorization of Source Generation Type

	Source	Other Requirements
Biogas	Landfill Gas (Methane)	
	Sewage Gas (Methane)	
	Manure Digestion (Methane) Other biogas digestion using agricultural or food processing residues and by-products	If required to have a SPDES permit by NYSDEC regulations, a Concentrated Animal Feeding Operation (CAFO) providing the manure must have and be in compliance with its current Agricultural Waste Management Plan (AWMP) developed by a duly qualified Agricultural Environmental Management (AEM) Planner and must be operating in compliance with a SPDES permit. If not required to have a SPDES permit, the CAFO must be operating in compliance with the best management practices for a facility of its size set forth in the *Principles and Water Quality Protection Standards* specified in the *Agricultural Environmental Management (AEM) Framework & Resource Guide* developed by the NYS Department of Agriculture and Markets and the NYS Soil and Water Conservation Committee.
Biomass (from unadulterated eligible sources of biomass)*	Biomass Direct Combustion	
	Biomass Combined Heat & Power	
	Biomass Co-fired with existing fossil-fuel Combustion	Only the electricity generated from the biomass portion of the fuel will be eligible.
	Biomass Gasification	
	Biofuels	
Fuel Cells	Solid Oxide Fuel Cells (SOFC)	
	Molten Carbonate Fuel Cells (MCFC)	
	Proton Exchange Membrane Cells (PEM)	
	Phosphoric Acid Fuel Cells (PAFC)	
Hydroelectric	Hydroelectric Upgrades	No new storage impoundment, eligibility limited to the incremental production associated with the upgrade.
	New Low-Impact Run-of-River Hydro	Facility capacity limited to 30MWs or less with no new storage impoundment.
	Existing Very Small Hydroelectric	Facility capacity limited to 10 MWs or less
Solar	Photovoltaics	
Ocean Energy	Tidal	
	Wave	
	Ocean Current	
	Ocean Thermal	
Wind	Wind Turbines	

***See definition of biomass in Table 2-1A**

Table 2-1A
Definition of Eligible Sources of Unadulterated Biomass

Agricultural Residue (woody or herbaceous)

Woody or herbaceous matter remaining after the harvesting of crops or the thinning or pruning of orchard trees on agricultural lands.

Harvested Wood

Wood harvested during commercial harvesting. The supplier must have and be in compliance with a current Forest Management Plan prepared by a professional forester that includes (a) standards and guidelines for sustainable forest management that require adherence to management practices which conserve biological diversity, maintain productive capacity of forest ecosystems, maintain forest ecosystem health and vitality, and conserve and maintain soil and water resources; (b) a harvest plan following production and harvest standards based on best management practices set forth in guides developed, tested and peer reviewed for USDA and USDOE; (c) the monitoring of harvest operations by a professional forester; (d) the reporting of harvest operations by a professional forester; and (e) periodic inspections of harvesting operations by state authorities or approved non-governmental forest certification bodies to assure that harvest operations conform to the standards.

Mill Residue Wood

Hogged bark, trim slabs, planer shavings, sawdust, sander dust and pulverized scraps from sawmills, millworks and secondary wood products industries.

Pallet Waste

Uncontaminated wood collected from portable platforms used for storing or moving cargo or freight.

Refuse Derived Fuel

The source-separated, combustible, untreated and uncontaminated wood portion of municipal solid waste or construction and demolition debris generally prepared by a densification process those results in a uniformly sized, easy to handle fuel pellet, briquette, or fluff material.

Site Conversion Waste Wood

Wood harvested when forestland is cleared for the development of buildings, roads or other improvements.

Silvicultural Waste Wood

Wood harvested during timber stand improvement and other forest management activities conducted to improve the health and productivity of the forest. The supplier must have and be in compliance with a current Forest Management Plan prepared by a professional forester that includes (a) standards and guidelines for sustainable forest management that require adherence to management practices which conserve biological diversity, maintain productive capacity of forest ecosystems, maintain forest ecosystem health and vitality, and conserve and maintain soil and water resources; (b) a harvest plan following production and harvest standards based on best management practices set forth in guides developed, tested and peer reviewed for USDA and USDOE; (c) the monitoring of harvest operations by a professional forester; (d) the reporting of harvest operations by a professional forester; and (e) periodic inspections of harvesting operations by state authorities or approved non-governmental forest certification bodies to assure that harvest operations conform to the standards.

Sustainable Yield Wood (woody or herbaceous)

Woody or herbaceous crops grown specifically for the purpose of being consumed as an energy feedstock (energy crops).

Urban Wood Waste

The source-separated, combustible untreated and uncontaminated wood portion of municipal solid waste or construction and demolition debris.

Tiers

The Tiers considered in the RPS consist of groups of eligible resources.

- Main Tier - This tier will account for 98% of the new renewable generation required by the RPS. All eligible resources described above will compete against each other on an economic basis.

- Behind-The-Meter Technology Tier – This tier will include renewables such as solar, small wind (up to 300 kW, but generally 10 kW in size) and fuel cells. This tier will provide 2% of the incremental MWh needed to satisfy the RPS requirement.

Procurement Structure

Each electric investor owned utility (IOU) will be required to either individually procure its share of renewable resources or opt into a cooperative central procurement system that could be administered by an agency such as the New York State Energy Research and Development Authority (NYSERDA). Alternatively, a sole central procurement model could ultimately be adopted. The choice of procurement structure is not expected to affect the overall environmental impacts examined in the Final GEIS.

2.1 Location of the Action

New York State.

2.2 Background and History of the Proposed Action

New York's electric markets have changed substantially since 1996 when the Commission issued Opinion and Order 96-12 in the Competitive Opportunities Bypass (COB) proceeding. That Order set forth the future regulatory framework for the movement towards competitive markets in the electric industry. The framework was designed to increase the efficiencies in the procurement of electricity while maintaining safety, environmental compatibility, affordability, and consumer protections. The benefits of greater competition, increased diversity in energy and resource supplies, greater supply and resource availability, and greater technological innovations are expected to be realized as the transition to competition continues.

The 2002 New York State Energy Plan (SEP) also provides, in part, a framework to help foster energy policies and long-range planning strategies to ensure that New York’s citizens are provided with competitively priced, clean, and efficient

energy resources. The SEP complements the initiatives and decisions of the Commission with respect to restructuring the electric industry, and encourages increased energy diversity, with an emphasis on renewable energy development. It also balances the need for new in-state electric generation facilities with the need to protect the environment and public health.

The SEP recommended initiation of an investigation by NYSERDA of the feasibility of establishing a statewide RPS for electricity generation and its compatibility both with a restructured and competitive electricity market and the State's goals for promoting renewable energy development. A preliminary report issued by NYSERDA suggested that an RPS could be implemented in a manner that is consistent with and supports the State's wholesale and retail markets and would complement the Commission's existing customer choice policies.[5] It also discussed the benefits of implementing an RPS policy, which are discussed in more detail in Section 2.3.

Subsequently, the PSC issued an Order on February 19, 2003 instituting a proceeding pursuant to Public Service Law (PSL) §§ 5 (2) and 66 (2) to develop and implement an RPS for electric energy retailed in New York State to increase the renewable energy share of New York's electric supply.[6] The Commission's Order stated that approximately 17% of the electricity used in New York State is provided by renewable resources, a decline from 25% of four decades ago.

2.2.1 The RPS Cost Study[7]

The Commission also directed in its February 19 Order that the proceeding examine appropriate methodologies for assessing benefits and costs of the RPS. In response to that directive, Commission staff prepared a Cost Study report to provide an estimate of the potential direct ratepayer costs to New York's retail electric customers of the implementation of an RPS to increase the renewable energy share of

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[5] See Preliminary Investigation into Establishing a Renewable Portfolio Standard in New York State, February 14, 2003.

[6] See Case 03-E-0188 – Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard.

[7] See New York Renewable Portfolio Standard Cost Study Report II, Volume A (filed February 19, 2004, revised February 27, 2004) and Volume B (filed March 9, 2004) in Case 03-E-0188, attached as Appendix A.

New York's electric supply from the current level to 25% by the year 2013 (RPS Cost Study). A secondary purpose of the report was to provide estimates of (a) the contribution of different resource types to meet the RPS, and (b) the displacement of existing generation sources and their air emissions. The Multi-Area Production Simulation (MAPS) Model was used to estimate the generation units that would be displaced by adding RPS resources and to quantify the air emissions effects of such displacement. The Cost Study appended to the Draft GEIS was further refined and modified based on comments and issues raised in the collaborative process and in written comments. The ALJ's RD utilized a refined Cost Study (RD Cost Analysis), which is also used in the Final GEIS assessment. The RD Cost Analysis is attached as Appendix B and its results are noted throughout this document.

2.3 Public Need and Benefits

The public benefits of implementing a statewide RPS have been the subject of many reports issued by renewable energy industry analysts, governmental task forces, NYSERDA, and proponents of renewable energy initiatives. Broadly defined, and discussed in more general terms below, an RPS has the potential to: (1) reduce air emissions including NO_X, SO_2, greenhouse gases, particulates and other hazardous pollutants ; (2) increase energy diversity and security; (3) spur economic development opportunities; (4) provide increased distributed generation; and (5) increase electric consumer choices by providing renewable energy alternatives that promote a cleaner and healthier environment than traditional fossil-fired electric generating plants.

2.3.1 Emission Reductions

Fossil-fueled electric generating plants nationally are responsible for approximately one-third of nitrogen oxide (NO_X) emissions, two-thirds of sulfur dioxide (SO_2) emissions, and one-quarter of carbon dioxide (CO_2) emissions. In addition, fossil-fueled plants release other hazardous air pollutants. The United States Environmental Protection Agency (EPA) estimates that electric utilities release approximately 48 tons of mercury emissions every year, primarily from coal-fired facilities. In New York, on an annual basis, each megawatt-hour (MWh) of electricity generation, given the State's

current mix of generation sources, produces 1.2 pounds of NO_X emissions, 3.2 pounds of SO_2 emissions, and 790 pounds of CO_2 emissions. Increased use of renewable energy that displaces or delays increased use of fossil fuels can reduce total emissions. The purchase of electric energy derived from cleaner, renewable resources will result in the displacement of some existing and planned electric generation resources. As a result, air emissions will be reduced in New York State. Modeling estimates show that statewide annual NO_X emissions will be reduced by approximately 4,000 tons (6.8%); SO_2 by 10,000 tons (5.9%); and CO_2 by 4,129,000 tons (7.7%) when the RPS reaches its target level. Emission decreases will continue even after renewable target levels are reached and the percentage of these decreases will depend on the changes to the electric industry in general. Emission reductions are an important environmental benefit because these emissions contribute to acid depositions (acid rain), ozone pollution (smog), and global warming, which have been linked to adverse health and welfare effects on the people and the environment of New York State. To fully appreciate the benefits of reducing hazardous air emissions that are associated with fossil-fueled generation, the effects of these pollutants are summarized below.

***Global Warming* -** CO_2 is by far the most prevalent greenhouse gas (GHG) associated with global warming, the name given to the trend of rising average global temperatures that leads to climate change. The earth is warmed by these GHGs, which trap heat in the atmosphere. The presence of some of these gases is natural and essential, but human activities – primarily energy production from fossil fuels – have accelerated the emissions of GHGs into the atmosphere. As the concentration of GHGs increases, more heat is trapped in the atmosphere, which causes an increase in temperatures and, ultimately, changes in climate patterns. Some scientists predict that, globally, these changes are likely to cause rising sea levels, more severe storms and droughts, and the loss of certain plants and animal species. For the Northeast Region, the predicted effects of climate change by the next century include: changes in the composition of forest species – including the elimination of some forest types; increased incidences of the 100-year flood event and coastal storm surges; and decreased ice cover on the Great Lakes (as well as a transient increase and intensity of lake effect

snows). The consequences of these climatic changes could result in adverse impact on the ecological, human and economic health of the region.

Acid Rain - The primary emissions responsible for acid deposition are sulfur dioxide (SO_2) and oxides of nitrogen (NO_X) from the combustion of coal, oil, and natural gas for electricity generation. Acid deposition is of particular concern to New York State because of important and sensitive ecosystems that lie immediately downwind of the largest mid-western utilities burning fossil fuels and emitting SO_2 and NO_X emissions in North America. An ecosystem is considered sensitive to acid deposition when it lacks adequate soil buffering capacity to counter the acids deposited to it. Sensitive regional ecosystems in New York State include the Adirondack Mountains, the Catskill Mountains and the Hudson Highlands.

Acid deposition also damages building materials by eroding the ornamental facades, statuary, and other vulnerable edifices that are an important part of our heritage. In addition to being the main pollutant in acid rain formation, SO_2 also leads to sulfate formation; these are acidic particles that can cause respiratory problems in humans.

Ozone - Near the ground, ozone is an air pollutant from man-made emissions. Ten to thirty miles overhead, it forms a protective layer that filters ultraviolet radiation from sunlight. Unlike oxygen (O_2), ozone (O_3) is a highly reactive gas that occurs naturally in only small amounts in our atmosphere. The earth's atmosphere continuously forms and destroys substances, including ozone. In a perfect environment, a natural balance maintains a stratospheric ozone layer as a protective sun blocker and dissipates concentrations of ground-level ozone that can harm human health and the living environment. Stratospheric ozone is being depleted, while ground level ozone sometimes builds up to unhealthy levels near and downwind of major urban areas.

The main contributors to stratospheric ozone depletion are compounds known as chlorofluorocarbons (CFCs) and halons produced and released into the atmosphere by human activity. They are very stable, and remain unchanged in the air for as long as a century. Other threats to the upper ozone come from chemicals found in certain degreasers, adhesives, dyes, pesticides, and fungicides.

Recent measurements show that the amount of ozone in the stratosphere has decreased by about two percent since 1967. It is estimated that up to eight percent of the protective ozone layer over the United States, Canada, and Europe has disappeared. Researchers report that the seasonal "hole" over Antarctica and some populated regions of the Southern Hemisphere thins the ozone layer at times by as much as 60 or 70 percent.

Scientists estimate that every one percent decrease in the ozone layer increases ultraviolet light intensity at the earth's surface by two percent. Known effects of ultraviolet exposure include greater incidence of skin cancer and eye cataracts among humans; diminished crop yields for foods such as peas, beans, squash and soybeans; and a decrease in phytoplankton that are a food staple for large marine mammals and fish.

Stratospheric ozone filters out dangerous ultraviolet radiation by means of a continuous cycle in which oxygen and ozone break down and reform, absorbing ultraviolet light. Without enough ozone, the effectiveness of the filter decreases and more ultraviolet radiation reaches the earth.

While the stratospheric ozone layer is being depleted, the atmosphere near ground level has the opposite problem--ozone buildup near major population centers, and the transport of that ozone to other areas. Near the earth's surface, small amounts of ozone are continuously created and destroyed in ongoing natural cycles. When NO_X (pollutants formed from the burning of fossil fuels) is added to the air, more ozone is created but then is quickly destroyed again. The balance of ozone creation and destruction shifts drastically, however, when hydrocarbons are added to the atmospheric mix. Hydrocarbons (vapors from solvents, gasoline, dry cleaning fluids and many other common substances) add to the creation phase of the ozone cycle, while circumventing the destruction phase. Summer heat and the increase in sunlight intensity speed the rate of these chemical reactions, triggering rapid formation of ozone. This is why ozone "health advisories" often are issued during the summer months, but not during the winter months.

Ozone can have an adverse effect on the human body. High ozone concentrations irritate nasal, throat and bronchial tissues. Ozone attacks certain

components of the body's defense system, raising concerns about the effects of ozone exposure on the human immune system. High concentrations of ozone can also harm forests, thereby altering wildlife habitats, lowering crop yields, and damaging materials such as rubber, plastics, synthetic fibers, dyes and paints.[9]

While ozone formation occurs most commonly over cities with large numbers of industries, power plants and vehicles, ozone pollution is also found in remote locations—such as the Adirondack Mountains. This occurs because hydrocarbons, NO_X and ozone itself are carried by the wind from their city origins, polluting rural areas. In large urban areas, ozone mixes with other pollutants to create smog. Smog reduces visibility and can irritate and inflame eye tissues. Generally, hot and dry weather fosters smog production.

Particulates - "Particulate matter" (PM) is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. For regulatory purposes, particulate matter has been classified in terms of the particle's aerodynamic diameter. $PM_{2.5}$ is particulate matter with an aerodynamic diameter of 2.5 microns or less. PM_{10}, which is already regulated pursuant to federal and New York's permitting programs, includes all particulate matter with an aerodynamic diameter of 10 microns or less. Thus, $PM_{2.5}$ is, by definition, a subset of PM_{10}. In general, the term "fine particulate matter" is used to describe $PM_{2.5}$, while "coarse" particulate matter describes particulate matter with an aerodynamic diameter of greater than 2.5 microns and equal to or less than 10 microns. Elevated levels of $PM_{2.5}$ in the atmosphere have been linked to serious health conditions in humans. Exposure to $PM_{2.5}$ has been closely associated with increased hospital admissions and emergency room visits for heart and lung disease, increased incidence of respiratory disease, including asthma, decreased lung function and premature death. Sensitive groups that appear to be at greatest risk of such effects include the elderly, individuals with existing cardiopulmonary disease, and children. To the extent NO_x and SO_2 are reduced, fine particulates formed from those emissions are also reduced.

[9] U.S. EPA: The Science of Ozone Depletion (www.epa.gov/ozone/science).

Mercury - is a toxic metal that persists in the environment and exists in several forms: (1) metallic mercury is a shiny, silver-white, odorless liquid at room temperature (2) inorganic mercury or mercury salts are usually white powders or crystals created when mercury combines with elements such as chlorine, sulfur, or oxygen and (3) organic mercury occurs when mercury combines with carbon, for example, methylmercury, a compound produced by small organisms in water and soil that can bioaccumulate up the food chain. Methyl mercury and metal vapors are the most harmful forms. Exposure to mercury at high levels may damage the brain, kidneys, and a developing fetus. Very young children are more sensitive to mercury than adults and may develop nervous and digestive system problems and kidney damage. Mercury is used in thermometers, barometers, hydrometers, pyrometers, mercury arc lamps, switches, fluorescent lamps, pharmaceuticals, anti-fouling paints, and agricultural chemicals. Mercury is naturally occurring in the environment, but human activities, primarily fossil fuel combustion, mining, smelting, and solid waste incineration, have resulted in additional mercury in the environment. Efforts are being made to eliminate the use of mercury containing products and recycle mercury in order to reduce mercury levels in the waste stream. To the extent that the operations of fossil-fuel power plants - particularly coal plants - are reduced by the addition of renewable resources, mercury emissions from those plants are reduced.

2.3.2 Increased Energy Diversity and Economic Security

Dependence on a limited number of energy resources can lead to greater potential for fuel supply interruptions and greater price volatility, which, in consequence, can ultimately affect energy and economic security. The additional new renewable electricity generation due to an RPS is expected to result in the displacement of existing generation supplies, including those that rely on oil and natural gas as fuel. As discussed in section 6.4, changes in generation resources in 2013 due to implementation of the RPS are expected to result in the displacement of over 7 million MWh of electric energy (or about a 11% decrease in energy) derived from oil and gas resources. That change, creating greater diversity in the State's electric energy supply portfolio, will likely reduce the exposure to wholesale oil and natural gas price spikes and supply interruptions, thereby increasing the security of the State's electric energy

supply. The displacement of gas and oil-fired generation will continue beyond the RPS target dates; the percent of each fuel displaced will depend on the fuel make-up of the industry and the continued operations of the renewables.

Furthermore, anticipated renewable energy development under the RPS will likely offset demand for natural gas at gas-fired electric generating facilities serving the State. The RD Cost Analysis shows a reduction in the natural gas demand under the RPS of approximately 47 million MCF in 2013, equating to a reduction of approximately 6.1 million MWh from electric generators using natural gas as the fuel. While not quantified specifically in this report, a secondary benefit of increasing renewable energy could be a reduction of natural gas prices in the State.[10]

2.3.3 Economic Development Benefits

Implementation of the RPS is expected to create greater regional benefits in New York State through economic development. Manufacturing of renewable energy equipment, procurement of fuel (biomass), and construction and operation of generating facilities will create both direct and indirect jobs, purchases of local products, which add revenues to local economies, and new and increased tax payments. Payments to local governments can take the form of property tax, sales tax (on materials and supplies purchased locally), or alternative payment agreements negotiated with the project developer. For many small towns in New York State, payments from renewable energy projects, such as wind and biomass, can result in a significant increase in revenue. Non-construction economic development benefits are expected to continue beyond the time that targets are met.

2.3.4 Distributed Generation ("Customer-Sited" Technologies)

These renewable technologies are generally installed on the customer side of the meter and are generally sized in relation to the customer's electric usage. They may, or may not, be part of a net-metering regime in which excess energy produced acts as a credit against energy purchased. These technologies typically include solar (PV), very small wind turbines (up to 300 kW, but generally 10kW in size), and fuel cells. A number of benefits can result from customer-sited generation, including: reduced customer electricity load and demand charges; increased electricity

[10] See RPS Cost Study, Section V-J, Impact on Natural Gas Prices.

system reliability; avoided investments in transmission and distribution (T&D) infrastructure and the avoidance of potential environmental impacts associated with siting and construction of new T&D lines; waste heat recovery and avoided transmission losses; and availability of power in remote locations. Small and modular renewable technologies can be sited in or near buildings where energy is used. These technologies typically require short lead times for installation and can add capacity in small increments as needed.

2.3.5 Increased Customer Choice

Finally, the concept of "value" is changing the perception of renewables, as is consumer choice. Surveys have shown that customers value the environmental benefits of renewable energy more than conventional energy sources and prefer electricity companies that supply at least part of their power from renewable energy technologies. The PSC is supporting development of renewable energy service programs in utility service territories across the state. As a result, Green Power service providers are offering a variety of renewable energy options. As an example, in the Niagara Mohawk Power Corporation service territory, approximately 9,500 customers have signed up for renewable energy through green marketing programs as of December 2003. Renewables provide options that service-oriented companies can use to increase customer satisfaction. They may improve a company's public image and may create profitable new business opportunities for electricity generation or distribution companies that are customer-oriented. The RPS Policy and Green Power program are complimentary initiatives that, together, will result in a greater portion of electric energy retailed in New York State produced by renewable energy resources.

2.4 Relationship to Other Plans, Programs, Policies and Initiatives

2.4.1 Competitive Opportunities/Bypass Case (COB)

In 1994, the PSC established a proceeding to address the numerous complex issues related to providing electric service (Case 94-E-0952). Following several collaborative discussions by the parties and an RD by an ALJ, the PSC issued Opinion and Order 96-12 in May 1996, covering many topics including the provision of a framework for the transition to competition of the commodity portion of electric service. The PSC Order addressed topics relating to the value of retail and wholesale

competition, the importance of maintaining system reliability, aspects of strandable cost and its recovery, costs that may be required to be spent on public policy programs, market power issues and corporate structure, and the need for the utilities to remain the provider of last resort to serve while also maintaining current customer protections. Retail access for customers for the commodity portion was phased in, with full access for all customers available in each utility service area by July 2001.

The State's retail electric industry is fully open to customer choice and many energy service companies (ESCOs) now operate in New York. Changes in the electric market allow utility customers in nearly all areas of the State to choose their supplier of electricity, while the delivery of electricity remains the function of the local utility. The transition toward retail competition has been evolving for several years, and it is expected that further evolution will occur. To enhance customer choice, the PSC has instituted other programs including:

Net Metering **–** This program allows residential photovoltaic customers, and customers operating generating systems utilizing biogas produced by the anaerobic digestion of agricultural waste, to net meter their consumption and generation and receive compensation if production exceeds usage over a given time period. A 25% tax credit (not to exceed $3,750) is available for the purchase and installation of a qualifying photovoltaic system. The PSC has developed and maintains interconnection standards that apply to these systems. As of December 2003, systems totaling approximately 6 MW have been interconnected in New York State.

Environmental Disclosure Program - The PSC requires electricity providers throughout the state to include “environmental disclosure labeling” information in electricity bills at least twice a year. The label included in each customer’s bill provides information on the mix of fuels used to generate the electricity sold by their supplier over a 12-month period. Customers see the percentage of their electricity that is derived from each fuel source, as well as the air emissions (CO_2, SO_2, NO_x) relative to the State average. This information empowers consumers to make informed choices about their energy sources and is an important aspect supporting Green Power efforts. Environmental Disclosure may also encourage generators to consider providing more green power among their supply offerings.

2.4.2 System Benefits Charge (SBC) Program

Following the opening of electricity markets to greater competition, the PSC enacted a public benefits program through which System Benefits Charge (SBC) funds (collected through a surcharge through delivery rates) are used to promote energy efficiency, assist low-income customers, encourage research and development (R&D) of energy efficient and renewable technologies, and protect the environment. This program helps to ensure that electricity service be provided safely, cleanly, and efficiently, and that continuing such public benefits programs beyond what competitive markets might provide was necessary. This program, administered by NYSERDA, is funded through June 2006 at $150 million annually. The program provides a wide range of services to residents and business and includes, among other things, support for R&D activities in renewable energy development. The SBC program, in part, provides a model for a behind-the-meter Tier considered in the RPS.

2.4.3 State Energy Plan (SEP)

The 2002 SEP recommends and supports policies designed to provide New York State's citizens with fairly priced, clean, and efficient energy resources. The SEP recommends that New York maximize the use of clean and efficient energy and transportation technologies to meet the State’s growing demand for energy. The SEP supports increased energy diversity, with greater emphasis on renewable energy development and improved energy efficiency, and innovations in regulatory policies that encourage and support development of competitive energy markets.

2.4.4 Executive Order 111

In June 2001, Governor George E. Pataki issued Executive Order 111 requiring all state agencies, departments and authorities to seek a 35% reduction in energy use by 2010, relative to their energy use in 1990. In addition, each agency, department, and authority is required to purchase 10% of its energy from renewable energy sources by 2005, increasing to 20% by 2010. Local governments and school districts are also being actively encouraged to comply with the Order.

2.4.5 Green House Gas (GHG) Reduction Initiative

On June 10, 2001, Governor Pataki announced the formation of a New York State Greenhouse Gas Task Force (the Task Force) to develop policy

recommendations for reducing the State's GHG emissions. The Task Force recommended that New York State establish a statewide target to reduce its GHG emissions to 5% below 1990 levels by 2010, and 10% below 1990 levels by 2020. This recommendation was adopted by the State's Energy Planning Board in the 2002 SEP as a statewide goal. The Task Force recommended a package of measures to reduce GHG emissions from the electric generation sector, which include: An extension of the State's strong energy efficiency programs; a renewable portfolio standard; and a cap on carbon emissions.

Energy Efficiency

Through the SBC fund, NYSERDA estimates that energy efficiency programs have reduced net electricity use in the State by about 1,000 GWh through year-end 2003, contributing to the New York's standing as the most energy-efficient state in the nation on a per-capita basis. Annual electricity savings are expected to reach 2,700 GWh when these programs are fully implemented in the next several years.

RGGI

In response to the recommendation by the Task Force, Governor Pataki called upon the governors of other northeastern states, from Maine to Maryland, to work cooperatively in a regional strategy to reduce CO_2 from power plants. This Regional Greenhouse Gas Initiative (RGGI) involves developing a cap and trade program with a market-based emissions trading system, initially targeted for the power plant sector. The program's design will: (1) emphasize uniformity to facilitate interstate trading of greenhouse gas allowances; (2) permit other states to join seamlessly when deemed appropriate; and (3) not interfere with other emission trading initiatives. The goal of the participating states is to have an agreement on a cap and trade program design by April 2005. Upon completion of a cap and trade program covering power sector emissions, development of off-set requirements and possible future program extensions to cover other sources, will be explored.

2.4.6 Acid Deposition Reduction (ADR) Program

The Acid Deposition Reduction (ADR) Program will result in regulations that will require New York's electric generation plants to reduce sulfur dioxide (SO_2) emissions by 50% below the levels required by the federal CAA Amendments of 1990. The ADR Program will also require such plants to implement year-round controls for nitrous oxides (NO_X), a substantial extension of the five-month summer ozone season controls required under current federal and State regulations. The first full year of fully implemented NO_X controls is scheduled for 2005; SO_2 controls will be fully phased in by January 2008.

2.4.7 NO_X Set-Aside Program

The energy efficiency and renewable set-aside component of the NO_X budget-trading program provides incentives to implement electric end-use energy efficiency and renewable generation projects by allocating three percent, or about 1,200 tons, of New York's ozone-season NO_X allowance budget to eligible projects, beginning in 2003. A pilot program under which 115 tons of NO_X allowances are available for end-use efficiency projects has been in place since 1999. Projects that can be bought and sold on the open market are certified as tradeable emissions allowances. This program provides a viable model for the planned development of a carbon registry for early reduction credits and trading.

3.0 HISTORY OF THE ELECTRIC INDUSTRY IN NEW YORK STATE

3.1 History - Competition and Restructuring

Historically, the seven IOUs[11] and the New York Power Authority transmitted and distributed almost the entire electric load in New York State as well as owned and operated most of the components of the State's electric system. The IOUs also had the exclusive right to serve the customers within their service territory. Municipal and cooperative utilities served customers within their borders. In 1998, the

[11] Central Hudson Gas and Electric Corporation (Central Hudson); Consolidated Edison Company of New York, Inc. (Con Ed); Long Island Lighting Company (LILCO); New York State Electric and Gas Corporation (NYSEG); Niagara Mohawk Power Corporation (NMPC); Orange and Rockland Utilities, Inc. (O&R); and, Rochester Gas and Electric Corporation (RG&E). NYSEG and RG&E are now subsidiaries of Energy East; O&R is now a subsidiary of Con Ed; NMPC is now a subsidiary of National Grid.

Long Island Power Authority (LIPA) was formed to serve the retail load on Long Island formerly served by LILCO.[12] The six remaining IOUs remain under the jurisdiction of the PSC.

Following the issuance of Order 96-12 in Case 94-E-0952 (the Competitive Opportunities Bypass proceeding), the IOUs agreed, in individual proceedings, to divest, or unbundle, their generation assets. Generally, IOUs no longer own the generation used to serve their customers, nor do they have the exclusive right to sell electricity. Instead, their generation assets, for the most part, were sold to independent companies through an auction process.[13] The IOUs do, however, retain the function of delivering energy, but the commodity market is open to Energy Service Companies (ESCOs) that sell energy directly to all customers, including residential.

Presently, electric customers in New York State are able to choose their energy provider or remain with their distribution utility. In addition to a competitive market for the electricity commodity, functions such as metering, billing, and other customer service functions are also open to competition.

3.2 The Present Electric System – Overview

3.2.1. Existing Generation and Baseline Mix

For the 12-month period ending December 2002, more than half (51%) of New York State's energy consumption was derived from fossil fuels (Natural Gas, 27.2%; Coal, 16.7%; and Petroleum Products, 7.5%). Nuclear fuel accounted for 29%, while hydro supplied approximately 18%. The remaining energy resources (solid waste, biomass, wind, fuel cells and solar) supplied approximately 2% to New York's generation mix.

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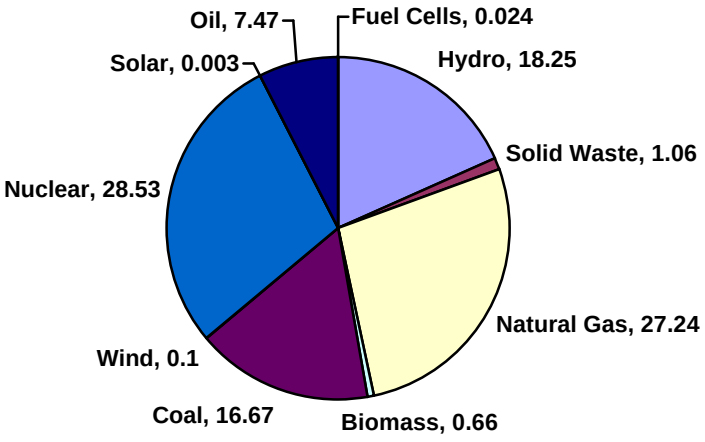
[12] Neither the New York Power Authority nor LIPA are subject to PSC jurisdiction, except for siting of transmission lines under Article VII of the PSL.

[13] Several units are still owned by the utilities.

NYS Generation Sources for 12 mo. ending December 2002 (%)



3.2.2. Ownership and Operation

As a result of regulatory initiatives, approximately 90% of former utility-owned generation capacity is now owned by more than two dozen independent power producers (IPPs). Generators sell energy directly to wholesale customers through bilateral contracts or to the wholesale markets operated by the New York Independent System Operator (NYISO). The NYISO took over operation of the state's electricity grid in 1999. Previously, the grid had been operated by the New York Power Pool (NYPP), which was formed in 1970, to assist in the coordination of the operation of the state's electric system to ensure reliability and realize savings from joint activities, such as economic dispatch of generation.

The New York Power Authority (NYPA) continues to own and operate the two major hydro-electric facilities in New York (Niagara Falls and St. Lawrence) and several other generation facilities, as well as major transmission lines. It also supplies generation to most of the municipal utilities in New York State and to some governmental and industrial customers.

Municipal and cooperative utilities serve small load areas scattered throughout New York, with a majority of them under jurisdiction of the PSC. Three of these entities own generation. In addition, privately-owned IPPs and on-site generators

have been operating a growing number of generating facilities around the State. While some IPPs supply only load at or adjacent to where the facility is located, most sell their output to the wholesale market or to investor-owned utilities through bi-lateral contracts.

3.2.3. Imports/Exports

Historically, New York has not been able to meet all of its electric load needs with in-state generation and so an additional portion is imported into the State. In 2002, approximately 12% of New York's electric consumption was imported.

There are four main sources of imports (Hydro Quebec, Ontario Hydro, New England, and PJM) coming into New York. Both Hydro Quebec and Ontario Hydro are Canadian sources of energy produced using a large percentage of hydroelectric and nuclear power. Electricity from New England and PJM is produced using fossil fuels as the main component.

While imports are a necessity for the reliable operation of the system, there are also contractual obligations that result in a small amount of electricity leaving the State. In 2002, approximately 2% of the energy generated in New York State was exported.

3.3 The Electric Transmission System in New York

3.3.1 The Transmission System Infrastructure

The existing New York State electric transmission system is predominately owned by the six IOUs,[14] LIPA and NYPA[15], also known as Transmission Owners (TOs). The statewide system includes over 10,000 overhead circuit miles, more than 600 underground circuit miles, and 30 interties with neighboring states and Canada. These facilities range from 115 kV to 765 kV. Table 3.3.1-1 below categorizes these facilities.

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[14] Central Hudson Gas & Electric Corporation; Consolidated Edison Company of New York, Inc., and its subsidiary Orange & Rockland Utilities, Inc.; New York State Electric & Gas Corporation and Rochester Gas & Electric Corporation (both Energy East companies); and Niagara Mohawk Power Corporation (a National Grid company).

[15] Approximately 21 circuit miles of 115 kV transmission line are owned by ALCOA, although operated by Niagara Mohawk Power Corporation. The 26-mile 150kV DC Cross-Sound Cable between Long Island and Connecticut is owned by TransEnergie. In addition, minor transmission line sections are owned by IPPs and others.

Table 3.3.1-1
Approximate Transmission Line Mileages[16]

	115kV	138kV	230kV	345kV	500kV	765kV
OVERHEAD	5960	392	1070	2442	5	314
UNDERGROUND	64	332	20	218	0	0
TOTAL	6024	724	1090	2660	5	314

In addition to the lines themselves, substations, switching stations, riser stations, and other such ancillary facilities are located throughout the systems. Lower voltage, sub-transmission facilities (generally in the 34.5 kV to 69 kV range) traverse most parts of the State and disperse the bulk electricity supplies to the distribution systems where it may be carried to most of the end-users (even though some customers take service at the transmission and sub-transmission levels).

While no exact figure has been determined, it can be estimated that the transmission system, including the sub-transmission and substation facilities, occupy an extensive amount of land area, in the order of 250,000 acres or more.

3.3.2 Transmission Interconnections and Constraints

New York's transmission system is extensively interconnected with surrounding states and Canada. Power flows continuously between New York and these areas depending on system needs and energy prices. When the energy is available in these areas, New York can import approximately 5,000 MWs, or one-sixth of the State's requirements. Table 3.3.2-1 below details the import and export capability between New York and surrounding areas.

[16] Mileages shown indicate design voltage; some facilities currently operate at lower levels. For example, 159 of the 314 miles of 765 kV line currently operate at 345 kV.

Table 3.3.2-1
Normal Power Transfer Capability – External Interties[17]

	IMPORTS	EXPORTS
Ontario to New York	1250 MW	
New York to Ontario		1675 MW
Quebec to New York	1500 MW	
New York to Quebec		1000 MW
New England to New York	1450 MW	
New York to New England		1325 MW
PJM to New York	2075 MW	
New York to PJM		1000 MW

It is expected that the transfer capability will change over time. As load grows and there are changes to the system (*e.g.*, new/retiring generation, new lines), the capabilities will no doubt be adjusted. Also note that the amounts shown are the maximum non-simultaneous import and export capabilities; maximum transfers on all interties cannot be achieved at the same time. The amount of power that might actually flow between the areas, within the limits indicated, depends on system needs, physical constraints, and market conditions. Generally, more power flows into New York State for consumption than is exported. However, New York often supports the New England and PJM systems at peak times and during emergency situations.

While the transmission system can reliably serve all load with the existing generation and interties, there are places in the system that are constrained. There are eleven significant congestion points in the transmission system, which are referred to as "interfaces." The lines that make up each interface are capable of moving power from one area in the State to the next up to the point indicated in Table 3.3.2-2. The flow of

[17] The source for these numbers are the NYISO's 2003 Load & Capacity Data report, the most recent available.

power within the State is generally from the west and north heading south to the New York City area and Long Island.

Table 3.3.2-2
Normal Power Transfer Capability – In-State Interfaces[18]

Dysinger-East	3700 MW
West-Central	2425 MW
Volney-East	5060 MW
Moses-South (South)	1875 MW
Moses-South (North)	1600 MW
Total-East	5025 MW
UPNY-SENY	4825 MW
UPNY-Con Ed	5850 MW
Millwood-South	8025 MW
Dunwoodie-South	6225 MW
Con Ed-LIPA	1000 MW

Note that the Dunwoodie-South interface includes the Y49 and Y50 cables into Long Island. As with the intertie limits, the in-state interface limits will vary with changes to the system such as load growth and integration of new generation.

3.3.3 Operational Structure

From the 1970s until 1999, the New York bulk transmission system (high-voltage transmission lines) was centrally operated by the NYPP. To serve the evolving competitive electric market, and to incorporate all market participants into policy making for the operation of the transmission system, the NYISO assumed control over bulk transmission facilities in 1999. The main characteristic of bulk facilities is their ability to move power across the state and into adjoining states and Canada. These facilities are mainly 230 kV and above, with some of the 115 kV system. The majority of the 115 kV system (area transmission) remains under the operational control of the utilities.

[18] *Ibid*.

The TOs maintain instrumentation that identifies the loading and state of each of the major lines in the State and supplies that information to the NYISO. The NYISO and TOs use a computer program called SCADA (System Control and Data Acquisition) for the direct operations of major components.

3.3.4 Planning Function

Until the formation of the NYISO, the planning function resided solely with the individual TOs. The NYPP reviewed all transmission plans of the transmission owners to ensure that any one utility's plans did not harm the systems of others. With the implementation of a competitive wholesale market structure, the planning function was transformed. In the previous environment, utilities generally had a good understanding of the location of new generation and how the plants would be dispatched; power flows on the transmission system were, therefore, fairly predictable into the future.

In the competitive market, almost all generation is privately constructed and dispatch is based on the actions of the market and the generation owners. Additionally, merchant construction and ownership of transmission facilities is possible. These factors result in the need for much closer coordination of the planning process, particularly on the bulk system.

The planning function, going forward, is in the formation process. TOs and the NYISO have been working cooperatively to ensure that the reliability of the transmission system is maintained. However, global planning of the system, and the process it should follow, is currently being debated by stakeholders.

Once there is a determination that a reliability system upgrade is required, or that an entity (utility or merchant developer) desires to build new transmission facilities, the entity starts the licensing process to site the facilities. For small lines, substation additions or simple upgrades, this might entail obtaining local permits and selected State approvals (*e.g.*, wetland permits, highway crossing permits). For major transmission facilities, Article VII of the Public Service Law requires that a Certificate of Environmental Compatibility and Public Need be obtained from the Public Service Commission before the facility is constructed.

3.3.5 Transmission Reliability

The transmission system in the State was designed to meet, or exceed, the requirements of the National Electrical Safety Code and other applicable codes and standards. In most cases, however, TOs have constructed their facilities to their own utility-specific standards. These utility-specific standards, besides complying with the required codes and standards, comport with industry practice and incorporate special conditions unique to an individual TO's service territory. In any event, the transmission system in New York is reliable and designed with redundancies and safety factors to avoid generally being the cause of customer outages. Most of the customer outages in New York are due to problems at the distribution system level. In addition, the transmission system is planned and expanded as necessary to ensure that the overall technical planning criteria of the electric utility industry are met. Where studies indicate a need to improve transmission system reliability, and where such a need can be justified, improvements are proposed. The New York State Department of Public Service, which is the staff arm of the PSC, monitors the reliability of the transmission system and the actions of the utilities to maintain the appropriate level of service for the customers.

3.3.6 The Regulatory Model

Regulation of the transmission system principally rests with the Federal Energy Regulatory Commission (FERC) through its tariff authority in the Federal Power Act. New York retains some authority over electric utility facilities with siting authority of transmission facilities and retail ratemaking authority over utilities as set forth in the New York Public Service Law, and as administered by the PSC. Therefore, regulation requires the close coordination of FERC and PSC policy direction.

3.4 Distribution Systems

3.4.1 Existing Distribution Systems

The distribution systems serve about 7.5 million customers across the State and provide the final step for most customers in receiving electricity. These distribution facilities pick up where the transmission and sub-transmission systems leave off. Generally, the electric distribution systems are designed for voltages from 34.5 kV down to 2.4 kV, with direct services to customers typically at 120/208 volts.

The most common primary service voltage for electric distribution systems in New York State is 13 kV. Some customers take distribution service at much higher voltage levels, even as high as transmission voltage levels. Both underground and overhead systems are used, with underground facilities generally being found in newer installations and in highly congested areas such as New York City. There are over 300,000 miles of distribution lines throughout New York State, with slightly more than half being overhead. Con Edison's system makes up a large percentage of the underground facilities in the State.

3.4.2 Operation and Control

The vast majority of distribution systems in New York State are operated and controlled by the six IOUs and LIPA. The 51 municipal utilities and cooperatives that own and operate their own distribution facilities represent over 150,000 customers. In most cases, the municipalities and coops are connected to the larger utilities, NYPA or LIPA and, therefore, have a limited operating flexibility.

3.4.3 Planning/Licensing of New Capacity

The planning and licensing of new distribution capacity/facilities is the responsibility of the local distribution company requiring the additional capacity. The local distribution company has the statutory responsibility to "distribute" the power from energy suppliers to the end user (*i.e.*, the customer). Licensing requirements for the siting of distribution facilities are normally governed by local jurisdictions and ordinances.

PSC regulations require that new distribution facilities installed in residential subdivisions be placed underground. The Commission also has rules governing the installation of small (up to 300 kVA) distributed generators to the distribution systems. These are referred to as Standardized Interconnection Requirements (SIR)

3.4.4 Distribution Reliability

The IOUs and municipal utilities and cooperatives are responsible for all aspects of their services (safety, reliability, metering, billing, complaints, *etc*.) to their customers. The Commission has oversight responsibility with respect to the IOUs and many of the municipal utilities. Oversight of the management of municipal electric

organizations, however, is generally handled by the locally-elected officials of the municipalities.

4.0 ENVIRONMENTAL SETTING OF NEW YORK STATE

4.1 Physiography

A large portion of New York State lies within the Eastern Appalachian Highlands physiographic region of North America, which extends from New England, south to Alabama and Georgia, and west to the continental interior plains. The area of New York State is 49,576 square miles; this figure includes 1600 square miles of inland water bodies.

The topography of New York State is generally hilly or mountainous in all areas except Long Island and the relatively level areas adjacent to Lake Erie, Lake Ontario, and the St. Lawrence River. The highest topographic variations are found in the Catskill and Adirondack Mountains where elevations reach over 4000 feet and variations between peaks and valleys can be up to 2500 feet.

4.2 Geology

The geology of New York State is varied and plays an indirect but important role with respect to the electric industry. Geology affects the types and distribution of soils, water drainage, topography and ecosystems, all of which affect human land use, population distribution and developments. An example of an indirect, but important, aspect from the perspective of the electric generation industry is the relationship of bedrock geology, soils, and waters in their ability to buffer the effects of acidic air pollutants resulting from electric generation and other industrial and transportation source.

A large part of New York State is underlain by shale and shale-sandstones. This bedrock dominates in the Appalachian Highlands, Hudson Valley, and the periphery of Tug Hill. Large areas of sandstone are found as narrow bands of bedrock along the northern edge of the Appalachian Highlands along the south shore of Lake Ontario, the St. Lawrence River plain, and the Catskill Mountains. There are several long narrow bands of limestone bedrock in New York, which provide greatest buffering capacity. These are found around the periphery of the Adirondacks, along the

Lake Ontario plain, the St. Lawrence River plain, and along the escarpment south of the Mohawk River and west of the lower Hudson River. There are major areas of limestone bedrock at the northern edge of the Hudson Highlands and along the Taconic Mountains.

With the exception of very small marble outcroppings, the Adirondack Mountains and Hudson Highlands are largely granitic rocks, which are very resistant to weathering and lack calcium carbonate. These rocks contribute very little buffering capacity to associated soils, and surface waters because of these characteristics.

Long Island is a very thick layer of sands and clays. This material is siliceous (containing silicates) and weathering of it produces little calcium carbonate to buffer acidity.

Most New York soils were formed on glacial tills or during glacial retreat some 8,000 to 10,000 years ago. Because of glacial transport, New York's soils and their parent material may differ substantially from underlying bedrock strata. Due to glacial scouring and subsequent fluvial transport of deposited materials, many areas of New York State have very thin soil mantles, and bedrock outcroppings are common in some areas of the State. Large areas of the Adirondacks, Catskills, and Hudson Highlands contain substantial areas of steep terrain with dominant rock outcroppings and thin or generally non-existent soils.

4.3 Demography

New York's population was 18,976,457 in 2000, an increase of approximately 986,002 (or 5.5%) over the 1990 census figure. About two-thirds of this total is clustered in the southeastern portion of the State in the New York City metropolitan area and Long Island. A significant portion of the upstate population is concentrated in the vicinities of major cities such as Buffalo, Rochester, Syracuse and Binghamton. Large parts of upstate New York are rural and heavily forested and have relatively sparse populations.

Although there is a direct relationship between population and energy use, many other factors such as social, political, economic, climatic, spatial, technological and developmental characteristics are also important and limit the use of population as a sole predictive measure of energy use. Location of New York's population

concentrations has dictated the configuration of electric generation and transmission in the State. The large demands of downstate New York require significant amounts of generating facilities within the high population areas as well as many transmission lines bringing outside generation into the area.

4.4 Air Quality

In 1970, Congress enacted the Clean Air Act (CAA) because of concern about the growing threat to public health and welfare from air pollution. The CAA required the EPA to establish primary national ambient air quality standards (NAAQS) for six criteria pollutants intended to protect human health, and secondary standards to protect public welfare from adverse effects, such as damage to property or vegetation. Sources of air pollution are categorized into stationary and mobile types. For example, air pollutant emissions from combustion of fossil-fueled electric generating facilities are sulfur dioxide, nitrogen oxides, particulates, Volatile Organic Compounds (VOCs) and carbon dioxide. Combustion of biomass fuels (*i.e.*, wood) and municipal solid waste also generate varying amounts of these air emissions. In addition to the direct effects of these pollutants, these emissions are also of concern because of their contributions to the formation of acid deposition (acid rain), ozone (smog) pollution, regional haze/visibility impairment, and global warming and their resultant health and welfare affects on the public and the environment**.**

When the NAAQS were first established in 1971, many were exceeded in one or more locations in New York State based on observations at monitor sites established by New York State Department of Environmental Conservation (NYSDEC) to detect pollutant levels. Air quality in the nation and in New York State has improved over the last three decades since the CAA was first adopted in1970. In New York State, concentrations of essentially all pollutants have declined to their lowest level in 25 years and have remained relatively unchanged in recent years based on data through 2002.

The State is currently in attainment of essentially all NAAQS, with the exception of ozone levels and particulates (PM_{10}) in Manhattan. Ozone is not directly emitted to the atmosphere, but is formed through complex chemicals reactions of its precursors, reactive hydrocarbons and nitrogen oxides, during warm weather conditions. Statewide ozone levels are exceeded in the summer months, mainly in the

downstate region. This can be attributed to the regional nature of the ozone formation and transport. Although many regions of the State are designated as attainment for the Ozone standards, the entire State of New York is located in the Northeast Ozone Transport Region (NOTR), and, as such, is classified as a moderate ozone non-attainment area for the purposes of control strategies to reduce regional ozone levels. This attainment problem is in part due to ozone transported from other regions.

In 1997, the EPA revised the ozone and particulates standards. The revision added fine particulate ($PM_{2.5}$) standards based on health effect studies identifying a direct link between these very small particulates and human health problems. Based on NYSDEC established monitor sites though-out the State, the revised eight-hour ozone standards is not being met at many parts of the State while the $PM_{2.5}$ standard is being exceeded in the New York City area. Similar to the acid deposition and regional haze problem, these high observed levels are exacerbated by emissions from other states as documented by various studies. That is, although concentrations of sulfur dioxide and nitrogen dioxide relative to their respective ambient air quality standards tends to be a more localized issue that affects smaller areas and is controlled by site-specific sources and conditions, secondary air quality effects of sulfur dioxide and nitrogen dioxide, due to formation and long-range transport of ozone, sulfates and nitrates are interstate and international in nature.

As reflected in statewide trends, considerable progress has been made in reducing the volume of emissions and ambient concentrations of the major air pollutants. This progress can be attributed to the CAA's focus on these pollutants, as well as actions initiated by New York State. More detailed discussion of recent air quality trends and current air pollution control programs in New York, in addition to statistical, narrative and graphical reports on air pollutants are routinely made to the public by NYSDEC and can be found on its website at www.dec.state.ny.us/website/dar/reports. Based on the recent determinations of non-attainment areas for the revised ozone and fine particulate standards, there is more work to be done to reduce the contribution of in-state and out- of- state emissions of these pollutants: precursors. The renewable energy sector can contribute to this reduction in emissions.

4.5 Solid Waste

The electric utility industry is a large but not dominant generator of solid waste in New York State. Approximately two million tons per year of fly ash, bottom ash and scrubber sludge are produced as a by-product of burning fossil fuels, primarily coal-fired units. Some of this solid waste is recycled; however, most of it is disposed of in landfills. By contrast, New York residents currently generate approximately 34 million tons of municipal solid waste (MSW) per year. Approximately 14 million tons are recycled, leaving about 20 million tons for disposal. Waste-to-Energy (WTE) facilities in New York currently burn about four million tons of MSW per year and produce electricity that is sold in the electric market. Currently there are 10 WTE facilities operating in NYS with a total capacity of 300 MWs. This represents about 1% of the electric power generated in the state. According to DEC, in 2003, the WTE facilities in New York produced approximately one million tons of non-hazardous combined ash (fly ash and bottom ash).

The State's six operating nuclear generating plants also produce both high-level (HLRW) and low-level (LLRW) radioactive wastes. These plants are storing more than 2,000 tons of spent fuel on-site in spent fuel pools.

4.6 Water Resources

New York is drained by five major watersheds. These are the Allegheny, Delaware, Great Lakes--St. Lawrence, Hudson and Susquehanna, and several minor drainage basins. Included in those watersheds are 2,270,000 surface acres and 356 shoreline miles of Lake Ontario, 373,760 surface acres and 83 shoreline miles of Lake Erie, 97,024 surface acres and 190 shoreline miles of Lake Champlain, 747,600 surface acres of some 4,000 inland lakes, ponds and reservoirs and 70,000 miles of streams and rivers. Water is used in most forms of electric power generation and, as a result, most of the state's electric power plants are located adjacent to major lakes, rivers, estuaries and coastal areas. Substantial quantities of water are withdrawn for cooling by most of the major fossil facilities and nuclear steam-electric plants. As a consequence of this water use, fish and other aquatic life may be drawn into the power facility and killed when they either become impinged on the intake screens (designed to keep debris in the water from entering the plant), or pass through the screen mesh and

into the station (a process called entrainment). Adverse impacts to aquatic life can also occur through the discharge of heated water back to the water source, a process known as thermal pollution. Thermal pollution can kill fish outright, block fish migration, cause the growth of nuisance species, and create other impacts, as well. Recent technological advances in cooling technology on new combined cycle generating facilities are decreasing water requirements and providing protective intake structures that can significantly reduce impacts on the State's aquatic resources.

Large hydroelectric plants are located at Niagara Falls and the St. Lawrence River, and approximately 300 small hydro plants are located on waterways throughout the state. The manner in which the project is operated can have significant effect on aquatic resources and other wildlife.

Certain water resources are afforded special protection such as the Nassau/Suffolk Groundwater recharge area and areas designated as coastal zone. Regulatory programs are in place, which require evaluation of impacts to the particular resources and consistency with the measures already adopted to protect those resources.

4.7 Land and Forest Resources

More than half of New York State is woodland (62%), and another quarter (25.9%) is active farmland. Freshwater and tidal wetlands make up about 8% of the land area of New York. Outdoor recreational land amounts to about 6.7%. Urban areas, which are composed of residential, commercial and industrial land uses, comprise 5.1% of the state. Residential land use accounts for most of this percentage. New York State is heavily forested and has more forests than any other northeastern state. Most of the forestland is classified as commercial and is eligible for harvesting. However, nearly 4.5 million acres of mostly forested land are public lands, including 3 million acres in the Adirondack Forest Preserve, 725,000 acres in State Forests and reforestation areas; 24,000 acres in the Catskill Forest Preserve; 330,000 acres in State Parks and 213,000 acres in Wildlife Management areas. There are also 3.5 million acres of private land in the Adirondack Park, most of which are heavily forested. Forests also are extremely valuable for their contribution to wildlife habitat, watershed protection, soil stabilization, recreational opportunities and ecological diversity.

The dominant direct land use by the electric utility industry in New York is for transmission and distribution lines. The statewide transmission system includes over 10,000 overhead circuit miles; more than 600 underground circuit miles and over 180,000 acres. In addition, there are thousands of miles of local distribution lines, which convey electric power to most of the state's customers. These transmission and distribution line corridors have various land use effects in terms of flora and fauna, aesthetics, water quality, open space, recreation and agriculture.

Forestlands support, both directly and indirectly, the procurement of biomass fuel for wood-fired electric generation facilities in New York that consume about 750 tons per day of wood fuel each. There are also approximately 500 acres in Central New York State that solely support biomass crops (willow and hybrid poplar) to supply fuel for electric generating facilities.

4.8 Agriculture

In 2002, there were 37,500 farms in New York operating on more than eight million acres of land. Crops were harvested on just less than 4 million acres from a total 5.4 million cropland acres. The remaining farmland is composed of improved pasture, permanent pasture, woodland and miscellaneous categories such as wetlands, excavations, and homestead sites. Dairy represents the major agricultural commodity produced in New York, with 680,000 milk cows producing 11.6 billion pounds of milk annually on approximately 13,000 farms. In the last ten years, the loss of 5,500 diary farms has mostly occurred among those farms with fewer than 50 milk cows. A much smaller, but extremely important, component of New York agriculture is fruit and vegetable production, with harvesting occurring on 112,000 acres (fruit) and 139,000 acres (vegetables). Total value of these crops in 2002 was about $1.2 billion.

Section 25-AA of the Agriculture and Markets Law authorizes creation of local agricultural districts pursuant to landowner initiative, preliminary county review, State certification and county adoption. One of the benefits of the program is the opportunity provided to farms to receive real property assessments based on the value of the land for agricultural production rather than development value. The program also requires jurisdictional agencies to minimize impacts of farms in a district and protects farms from unreasonably restrictive local laws.

Several farms in New York already produce or support renewable energy. Recently, wind developers have installed wind turbines on farms in central and western New York to provide power into the electric market and some farms are utilizing anaerobic methane digesters to create electricity from manure waste.

4.9 Fish and Wildlife

New York's nearly 50,000 square mile area supports an impressive array of physical and biological natural resources. Its major waters, such as Lake Ontario, Lake George and the Finger Lakes, provide excellent habitat for trout and salmon. Other lakes, such as Oneida and Chautauqua, are quite shallow, warm, rich in nutrients, and provide the habitat for a wide range of warm water fishes such as bass, walleye, muskellunge, and many pan fishes. Streams range in size from tiny, spring-fed brooks holding native brook trout to large rivers such as the Hudson supporting many species of fish including anadromous American shad and striped bass. Besides lakes and streams, there are nearly 1.2 million acres of salt and brackish water in the marine and coastal district and more than 2,800 miles of shoreline. Additionally, New York currently has over two million acres of freshwater wetlands and 25,000 acres of tidal wetlands. They cover about eight percent of the land mass of New York. Wetland types include marshes, hardwood, coniferous and shrub swamps; wet meadows; bogs; fens; and coastal marshes. Several species of wildlife that are rare or endangered in New York are partly dependent on wetlands for their survival.

The biological diversity supported by New York's complex physical resources is large. DEC reports that there are 455 species of birds, 97 mammals, 39 reptiles, 32 amphibians and countless invertebrates (insects and mollusks) in the State. Over 135 ecological communities have been classified and described in New York State. These communities represent areas where some of the 3,600 vascular plants and an estimated 500 non-vascular plants are located.

New York's fish and wildlife resources provide recreational and economic benefits for a variety of people. Nearly 10 million people annually participate in some form of wildlife-related recreation in New York, including consumptive uses such as hunting, fishing and trapping, and non-consumptive uses associated with tourism and observation. The economic value of freshwater sport fishing and wildlife related

recreation in New York is estimated to be more than $7.1 billion annually. The expenditures and economic activity associated with fish and wildlife recreation produce significant direct returns to the State. Emissions from fossil fuel combustion, among other factors, can result in both direct and indirect effects on New York's wildlife. The potential loss of habitat, as a result of climate change, may make some regions less hospitable then those regions are today.

4.10 Ecological Resources

New York State contains some of the last remaining wild lands in the eastern United States. The foresight of late 19th century New Yorkers provided for acquisition and constitutional protection of these undeveloped lands in the Adirondack and Catskill Forest Preserves. The land set aside in the Adirondack Forest Preserve is located within the six million acre Adirondack Park, the largest state park in the United States. The Adirondack and Catskill Forest Preserves contain many aquatic and terrestrial ecosystems, which are rare in the United States. Sensitive to environmental disruptions, these ecosystems have been partially protected from human influences by land use controls and public ownership. However, deposition of contaminants from transport of air contaminants adversely affects these unique resources.

The Forest Preserves contain many small lakes on high mountain terrain and in the peripheral foothill areas. Many clear, cool, well-oxygenated streams arise in these mountains and hills, and provide critical habitat for an extraordinarily diverse aquatic invertebrate community. The faunal communities of these remote ponds and streams also constitute unique and irreplaceable gene pools that are presently available to contribute genetic diversity for the future.

New York's Forest Preserves also contain many representatives of terrestrial communities that are unique in New York. In higher elevations are found examples of alpine meadows. The mountain spruce-fir forests of the Adirondacks and Catskills and large areas of "swamp" forests (red maple-tamarack, and black spruce-tamarack, etc.) are unusual and extremely valuable.

The Appalachian hardwood forests contained in Allegheny State Park, the Atlantic and Great Lakes coastal plain habitats, and the Hudson and Mohawk and other watersheds are important ecological resources defining the New York State

environment. Jamaica Bay and Montezuma National Wildlife Refuges are wildlife and fisheries habitats of national significance, and the State forest system and wildlife management areas provide extensive wildlife habitat and recreational opportunities throughout the State. Acidic deposition resulting from both in-state and out-of-state power plant emissions is a continuing source of concern because of adverse effects on certain forest lands and lakes in sensitive receptor areas, most notably the Hudson Highlands and the Adirondacks.

4.11 Cultural and Historic Resources

New York's statewide park system provides the public with a variety of cultural, recreational and historic resources. At present, the system contains 168 State parks, 35 State historic sites, and numerous other recreation areas that attract 65 million visitors a year. To date, the National Register of Historic Places lists well over 80,000 properties and over 130 historic districts in New York. To the extent park lands are affected by acid deposition or other pollutants from electric generation facilities, there is concern that these resources are adversely affected.

4.12 Aesthetic Resources

New York has one of the most geographically diverse and spectacular landscapes in North America. The particular and unique mix of mountains, forests, rivers and streams, ponds and deep glacial lakes, waterfalls, islands, barrier beaches, tidal estuaries, wetlands and ocean shore lands, constitutes a scenic landscape that has made tourism one of the State's most important industries. Because of their proliferation, electric generating facilities along with transmission and distribution lines, contribute to deteriorating aesthetic resources in certain locations. Aesthetic resources have also suffered some deterioration due to increased atmospheric haze associated with the long-range transport of air pollutants.

4.13 Socio-Economic Setting

The New York socio-economic setting that may be affected by an RPS consists of several aspects, namely, employment levels, property taxes and electric rates. Employment and property taxes are issues of local interest to the community and municipality in the area of utility facilities and electric rates are the concern of all New York State residents and businesses. Utility facilities employ workers and pay local property taxes. Changes in employment and property taxes may have local consequences. Higher or lower electric rates could have indirect environmental effects and are discussed in subsequent sections of this document.

5.0 ALTERNATIVE ACTIONS CONSIDERED

Preparation of the Final GEIS and the evaluation of a proposed RPS policy for New York State are based in large part on the ALJ's RD and information used by and provided in the RD Cost Analysis, which is attached to this document (Appendix B). The Draft GEIS considered alternative RPS scenarios that included different combinations of eligible generation technologies and various levels of commitment to the SBC-like Tier, as well as variations in imports, load growth, program timing, and pricing. The Final GEIS utilized the RD Cost Analysis, which considered parties' comments and refinements offered throughout the proceeding.

5.1 Tier Approach to RPS

Two independent supply curves were developed for the Cost Study. The first is designated the "Incremental" or "Main Tier" and is comprised of generators that will compete head-to-head for renewable energy demand and are expected to sell their output into the bulk wholesale market (and which are expected to earn wholesale market revenue). The second is an emerging technology tier that is comprised of generators expected to be installed by end users (called "customer sited resources" because their commodity value will be a function of the displaced retail rate). In the RD Cost Analysis, it was estimated that approximately 14,000,000 MWh in the Main Tier

and 275,000 MWh in the Emerging Technology Tier would be necessary to achieve a 25% level of renewables for the RPS in 2013.[19]

In constructing the supply curve, the following new renewable resources were assumed to be eligible: wind; hydroelectric (consisting of *new* low-impact hydro, *i.e.*, <30 MW, run-of-river, no new storage impoundment, and the incremental production associated with any upgrades to existing facilities so long as no new impoundments are created); biomass (including co-firing at coal plants, as well as other technologies using eligible fuels; electricity generated from landfill methane and manure digesters); solar; geothermal; ocean (*e.g.*, tidal, wave); and fuel cells using any fuel. A separate sensitivity analysis addresses WTE technologies as an eligible RPS resource in the Draft GEIS. Each of these resources, technologies, development potential and impacts are discussed in more detail in Section 6.2.

5.2 No Action Alternative

In the Draft GEIS, the RPS Cost Study (Appendix A) made certain assumptions about the amount and type of electric generation that is expected in the absence of an RPS policy for New York State. Assumptions were also made regarding load growth and future construction of conventional generating facilities and retirements and modifications to existing facilities. The details of the Base Case are described in that RPS Cost Study; the Base Case was considered to be the No Action alternative and each RPS scenario and sensitivity was compared to the Base Case in the RPS Cost Study.

The RD Cost Analysis (Appendix B) contains adjustments to the initial Baseline and also modifies the Prime Case used in the RPS Cost Study. The No Action alternative for purposes of the Final GEIS is the RD Base Case evaluated in the RD Cost Analysis.

[19] See Appendix B: New York Renewable Portfolio Standard Recommended Decision Cost Analysis: Tables 3 & 4. In this document the Emerging Technology Tier is referred to as the SBC-like Tier.

6.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The impact analysis of an RPS policy includes a No Action alternative and is compared with the several variations of an RPS policy contained in the RPS Cost Study initially evaluated in the Draft GEIS. Section 6.1 describes the approach, which includes a statewide assessment of emission changes and discussion of the potential environmental effects of each renewable technology, used to evaluate the environmental impacts of the RPS.

Section 6.2 contains impact evaluations that focus on each renewable technology, and, while the GEIS is not intended to review site-specific impacts, it will provide a qualitative evaluation of each technology including, as appropriate, an overview, the status of the technology in New York State and its potential level of development, general impacts and the licensing and permitting processes. Even though this GEIS is neither site- nor project-specific, conceptual information is provided, and important elements of the environment, and the potential effects of the renewables, are discussed.

Related non-environmental impacts are evaluated in Section 6.3 (Impacts of RPS Policy on Electric System Reliability) and in Section 6.4 (Impacts of RPS on Fuel Mix).

Section 6.5 evaluates the statewide implications of increasing the proportion of renewable energy relative to the total of electric energy produced and purchased in New York State. The primary evaluation tool is the MAPS Model, which simulates the New York State electric system and is used to determine, among other things, the generation capacity needed to serve demand in New York State. Among its output information is the fuel mix, air emissions, available exports, and required imports. The RPS Cost Study evaluated cost implications of RPS alternatives and utilized MAPS to calculate system-wide requirements and changes resulting from each alternative set of RPS assumptions. The Final GEIS evaluates the RD Cost Analysis and though this analysis is a refinement of the RPS Cost Study that was evaluated in the Draft GEIS, the two are generally comparable.

6.1 Overview of Generic Environmental Impact Approach

The RD Cost Analysis and all scenarios of the RPS Cost Study consider possible retirements and new additions of other generation and environmental regulations, as well as imports and exports expected during the study period. In the Draft GEIS, variations of the RPS scenarios were also examined to evaluate whether different mixes of renewables (within the desired incremental increase of renewables) would have any significantly different effects. The renewables scenario in the Base Case is the basis for the No Action alternative. Each scenario is projected out to 2013 although the actual implementation period could be different; any impacts and benefits will extend beyond the target dates.

The need for subsequent SEQRA compliance is anticipated by this Final GEIS for site-specific development proposals for new renewable sources of electricity generation because site-specific impacts cannot be addressed or analyzed in this document. However, it is not anticipated that any change in the actual implementation period or the level of the RPS targets, as modeled for the Final GEIS, would trigger the need for a supplemental EIS. This Final GEIS analyzes not only the quantities of renewable resources reached through 2013 using the projected scenarios, but also analyzes the maximum potential of developable quantities of renewable resources. Therefore, any change in the actual implementation period or the level of the RPS targets as modeled for the Final GEIS, so long as the change maintains the level of resources likely to be developed between the level of the No Action alternative and the level of maximum potential (see Table 6.1-2), would not require a supplemental EIS. Similarly, it is anticipated by this Final GEIS that because of the broad range of scenarios addressed, for any other RPS program changes that might occur there would be a very high threshold of change, resulting in impacts clearly beyond the broad range of impacts that have been addressed and analyzed in this Final GEIS, before a supplemental EIS might become necessary.

In its simplest terms, the RPS goal is to increase the renewables share of energy retailed in New York State to a 25% level. The statewide differences in outputs, *i.e.*, changes in emissions, are a measure of the potential effects of an RPS. The primary statewide impact differences will be air emissions – NO_x, SO_2, and CO_2. The analysis of the RD RPS Case as well as the Prime Case alternative scenarios evaluated in the Final GEIS show the RPS to be beneficial, *i.e.*, emissions are reduced statewide, although to different degrees.

6.1.1 Quantities of Renewables Developed

As previously discussed, the demand for electricity in New York State is satisfied by a mix of nuclear, fossil-fuel and renewable energy facilities. The RPS policy is intended to increase the current level of renewable energy that is retailed in the State to a 25% level. Table 6.1-1 below displays a breakdown of the general renewable resources that are estimated to be developed in New York during the study period, and the amount of energy (MWh) they are expected to produce.

Table 6.1-1
Quantities of Renewables Reached Through 2013

Resource	MW	MWh
Wind	2,950	8,083,254
Hydro	1,142	4,309,933
Biomass	294	1,573,734
Biogas	118	983,040
Solar PV	19	24,519
Fuel Cells	31	248,258
Totals	4,554	15,222,738

Table 6.1-2 summarizes the maximum potential developable quantity (in MW and MWh/yr) of each renewable resource through 2013 considered in the RPS Cost Analysis.

Table 6.1-2
Maximum Potential Developable Quantities of Renewable Resources

	2006		2009		2013	
	MW	MWH	MW	MWH	MW	MWH
Potential Wind Development						
Wind Farms	840.0	2,281,104	1,440.0	3,868,416	2,000.0	5,291,040
Wind Clusters	170.0	471,638	290.0	798,036	400.0	1,087,992
Wind Off-shore	267.0	795,233	890.0	2,650,776	890.0	2,650,776
Wind Farms – Imports	225.0	650,430	1,350.0	3,902,580	2,650.0	7,660,620
Wind Small	0.1	170	0.4	680	0.8	1,361
Totals	**1,502.1**	**4,198,575**	**3,970.4**	**11,220,488**	**5,940.8**	**16,691,789**
Potential Biomass Development						
Biomass Co-firing w/Coal	88.2	472,120	176.4	944,240	294.0	1,573,734
Biomass Co-firing w/Coal – Imports	847.0	4,238,526	1,027.0	5,263,446	1,267.0	6,630,006
Biomass Gasification	0	0	99.8	699,574	665.5	4,663,824
New Biomass CHP	4.5	33,507	18.0	134,028	40.5	301,563
Totals	**939.7**	**4,744,153**	**1,321.2**	**7,041,288**	**2,267.0**	**13,169,127**
Potential Biogas Development						
Manure Digestion	22.3	117,300	44.6	234,600	44.6	234,600
Landfill Gas IC Engines	63.7	530,320	103.0	857,512	117.1	974,199
Landfill Gas Microturbines	1.9	15,529	3.2	26,943	4.1	34,515
Totals	**87.9**	**663,149**	**150.9**	**1,119,055**	**165.8**	**1,243,314**
Potential Hydro Development						
New Low-Impact Hydro	6.3	31,974	18.8	95,922	43.3	220,622
New Low-Impact – Imports	263.8	1,505,625	327.5	1,784,850	412.5	2,157,150
Hydro Upgrades	67.4	180,900	93.8	248,333	147.8	386,550
Hydro Upgrades – Imports	290.0	1,104,780	980.0	3,709,560	1,100.0	4,182,600
Very Small New Hydro	1.9	9,812	5.8	29,437	13.3	67,706
Eligible Hydro Maintenance	15.1	46,298	26.4	81,035	41.5	127,333
Totals	**644.5**	**2,879,389**	**1,452.3**	**5,949,137**	**1,758.4**	**7,141,960**
Potential Fuel Cell Development						
Fuel Cell	7.00	55,168	24.5	193,090	31.5	248,258
Potential Solar Development						
Solar PV	2.33	3,065	9.33	12,260	18.7	24,519
Totals	**3,183.5**	**12,543,500**	**6,928.7**	**25,535,318**	**10,182.2**	**38,518,968**

6.1.2. Impacts of Specific Renewable Technologies

The wide range of probable renewable technologies produce different, and in some cases, non-comparable impacts. While there have been successful attempts to quantify environmental impacts that result from production of electricity, their validity was dependent on the ability to not only identify emissions and other effects of those emissions, but also design details and location. While some assumptions were made about broad regional locations, RPS policy development made only general assumptions about site-specific geographic locations because no specific projects or sites exist that will be approved or permitted by the PSC's action in this case. Therefore, Section 6.2 of the GEIS provides a general discussion of potential impacts and, as appropriate, addresses the range of severity, the likelihood of their occurrence, whether they would be long-term or short-term, whether cumulative impacts are pertinent, and whether they can be avoided. As appropriate for each technology, primary impact categories to be addressed are air emissions (NO_x, SO2, CO_2), water (consumption, thermal, flow, fish), land (acreage, compatibility), community character (visual, noise), terrestrial and other impacts unique to a particular technology.

6.2 Description of Renewable Technologies, Potential Levels of Development and General Environmental Impacts

6.2.1 WIND ENERGY

Technology Overview

The wind power industry uses a variety of sizes and types of turbines. Small wind turbines are typically less than 50 kW in size (but can be as large as 300 kW) and are designed for use in residential, agricultural, small commercial, and some industrial applications. In these applications, small turbines are usually “customer-sited” because they provide electricity for the end user to offset the use of grid power.

Large wind turbines have rated capacities ranging from 660 kW to 3.6 MW, are typically arranged in multiple arrays, and are intended to provide wholesale bulk electricity production for delivery on the local transmission system. Large wind turbines have also been installed in distributed generation applications consisting of a single turbine to several turbines connected directly to a distribution line. For offshore

environments, manufacturers are testing turbine designs in the range of 3-5 MW, which would also be developed in multiple arrays.

The primary components of a modern wind turbine are a tubular tower, a two- or three-bladed *rotor*, the *nacelle* that houses the drive train, electrical generator and control sensors, and the *yaw bearing* that allows rotation of the nacelle to keep the rotor oriented into the prevailing wind direction. A turbine tower sits on a foundation, which is designed based on the weight and configuration of each turbine, the expected maximum wind speeds, and the soil characteristics of each site. For modern utility-scale wind power plants consisting of multiple turbines, other components necessary for operation include:

- Electrical Power Collection System – On-site electrical collection lines placed underground between the pad-mounted transformer located at the base of each tower, and the project substation. These transformers occupy an area of about 8 ft. x 10 ft. and are used to transform the low-voltage power produced by each turbine to the higher voltage of the collection lines.

- Substation and Electrical Interconnections – For most wind energy projects, electrical energy produced by the turbines passes through a substation where it is metered and the voltage increased to match the voltage of the utility grid. Plant isolation breakers, power quality monitors, and protective equipment are also present in the substation to protect both the electrical grid and the wind turbines. Overhead transmission lines may be required to connect the substation to the electric power grid.

- Control and Communication Systems – In addition to individual turbine control systems on each machine, a wind project typically includes a Supervisory Control and Data Acquisition System (SCADA). SCADA systems consist of a central computer with control capabilities for individual turbines and the ability to collect, analyze, and archive time-series data. Communication cables connecting the central computer with the individual turbine controllers are commonly buried in the same trenches as the electrical collection system.

- Meteorological Towers (met towers) – Met towers are used to continuously record wind speed and direction data and are generally erected on a project site prior to full-scale project development to determine if the wind resources at a site are sufficient. Once a project is constructed, met towers continue to operate to maintain an accurate

record of the turbines' wind speed and direction. Met towers range in height between 100 feet and 165 feet. A large wind generator installation could require more than one met tower.

- Access Roads – Access roads to each turbine location are typically 18-20 feet wide. In hilly or complex terrain, access roads are constructed to specified slopes and turning radii that are necessary to allow delivery of large components such as blades and tower sections. During construction, crane pads are installed along the access road and adjacent to tower foundations. During project operation, the crane pads remain in place in the event that a crane is required to replace large turbine components.

- Operation and Maintenance – O&M facilities for wind power plants generally consist of an office and maintenance shop, control computers, and communication systems. These spaces can be located on- or off-site.

For any offshore wind development in the State, similar project components would be required, but the size of the turbines would likely be larger, up to 3-5 MW. These turbines are also connected to the grid via underwater electrical transmission facilities but are situated a considerable distance from land depending on water depths, shipping lanes, important aquatic habitats, and other environmental factors.

Status of Wind Energy Development in New York

Since 2000, three commercial wind energy projects have been installed in rural upstate New York, totaling approximately 48 MW. Two of the facilities, the Madison Windpower Project and the Fenner Windpower Project are located in Madison County, southeast of Syracuse. The third project, the Wethersfield Windfarm, is located in Wyoming County, southeast of Buffalo. Details of these projects are provided in Table 6.2.1-1.

Table 6.2.1-1

Wind Projects in NYS

Project Name	Madison Windpower, LLC	Wethersfield Wind Farm	Fenner Windpower, LLC
Town	Madison	Wethersfield	Fenner
County	Madison	Wyoming	Madison
Number of Turbines	7	10	20
Size of Turbine (MW)	1.6	.66	1.5
Rotor Diameter	216.5 ft. (66 m)	154 ft. (47 m)	231 ft. (70.5 m)
Hub Height	220 ft. (67 m)	213 ft. (65 m)	213 ft. (65 m)
Total Capacity (MW)	11.55	6.6	30
Annual Expected Energy (MWh)	24,000	19,000	89,000

Many small-scale single turbine applications are scattered throughout the State. The majority of these small systems have been used in remote locations to provide energy to cabins and trailers. These systems are typically installed by the end user and are not connected to the bulk transmission system.

Potential Development

The RPS Cost Study and RPS Cost Analysis identified large land-based and offshore wind projects as major sources of renewable energy for New York. Wind energy potential of New York State was assessed for four sizes and configurations of wind installations: 1) large wind farms composed of 600 kW – 1.5 MW turbines arranged in groups of 10 – 50 turbines; 2) smaller wind farm “clusters” composed of 600 kW – 1.5 MW turbines arranged in groups of 2 – 10 turbines; 3) small, stand-alone turbines rated from 1 kW – 300 kW; and 4) offshore wind installations composed of

1 MW – 3 MW turbines arranged in groups of 1 – 20 turbines. The study used broad criteria to define maximum potential development in each group.[20]

Rural areas of the State are continuing to receive increased attention from wind energy developers. The state's geographic location, good wind resources, and concerns over regional air quality, among other factors, have resulted in renewed interest in development where good wind resources have been identified. These areas include large hilltops in western, central, and north-central upstate regions and waters off the coast of Long Island, as well as areas along Lake Erie. Several projects are currently in the planning stages in New York State. While most of these proposals are for mid-size wind farms, one in the Tug Hill region consists of 188 turbines with a capacity of approximately 300 MW.

Table 6.2.1-2 provides a summary of potential wind energy development. In arriving at the potential numbers, factors such as proposed future projects and a general assumption as to the probability of development were applied. The RPS Cost Study assumed wind farm projects would be located primarily in Megazone 1 (upstate) with some in Megazone 2 (Capital District and Hudson Valley). Smaller wind clusters would also be located primarily in Megazone 1 and 2. Offshore wind potential was assumed in the Lake Erie area of Megazone 1 and the Long Island area of Megazone 3. The RPS Cost Study, contains further details of the amount and type of wind projects assumed in each Megazone.

[20] See Appendix A, Renewable Resources Cost and Characteristics of the Cost Study.

Table 6.2.1-2
Potential Wind Development

	2006		*2009*		*2013*	
	MW	**MWH**	**MW**	**MWH**	**MW**	**MWH**
Wind Farms	840.0	2,281,104	1,440.0	3,868,416	2,000.0	5,291,040
Wind Clusters	170.0	471,638	290.0	798,036	400.0	1,087,992
Wind Off-shore	267.0	795,233	890.0	2,650,776	890.0	2,650,776
Wind Farms – Imports	225.0	650,430	1,350.0	3,902,580	2,650.0	7,660,620
Wind Small	0.1	170	0.4	680	0.8	1,361
Totals	**1,502.1**	**4,198,575**	**3,970.4**	**11,220,488**	**5,940.8**	**16,691,789**

Environmental Impacts of Wind Energy

Wind energy facilities have important environmental advantages over conventional fossil-fueled power plants primarily because their operations do not generate any air or water emissions, and they do not produce any hazardous waste. According to the American Wind Energy Association:

> If wind energy were to provide 20% of the nation's electricity--a very realistic and achievable goal with the current technology--it could displace more than a third of the emissions from coal-fired power plants, or all of the radioactive waste and water pollution from nuclear power plants. Development of just 10% of the wind potential in the 10 windiest U.S. states would provide more than enough energy to displace emissions from the nation's coal-fired power plants and eliminate the nation's major source of acid rain; reduce total U.S. emissions of CO_2 by almost a third and world emissions of CO_2 by 4%; and help contain the spread of asthma and other respiratory diseases aggravated or caused by air pollution in this country. The 10 billion kilowatt-hours currently generated by wind plants in the U.S. each year displace some 13.5 billion pounds (6.7 million tons) of carbon dioxide, 35,000 tons of sulfur dioxide (98 tons per day), and 21,000 tons of nitrogen oxides (58 tons per day).[21]

[21] The most frequently asked questions about Wind Energy can be found at www.AWEA.org.

Wind energy facilities, nevertheless, like other power plants, have environmental impacts and raise community concerns. Wind projects may have long-term effects on land use, wildlife resources, ambient noise levels, historic and visual resources, and community character. During construction, wind projects may also result in short-term impacts to soils, vegetation, wetlands, wildlife habitat, and transportation resources. Impacts associated with wind energy facilities are more fully described in the following sections.

Land Use

In comparison with other forms of electricity generation, wind energy projects are land intensive, spreading over large tracks of land in order to maximize wind exposure. Total acreage required for a project will vary depending on topography, existing land use, and vegetation. The footprint for each turbine site is relatively small, occupying about 5,000 square feet. Turbines are typically spaced between 800 -1200 feet apart, and together with the other facility components, a project can utilize up to 50 acres per MW of installed capacity. Consequently, a 50 MW wind farm could encompass 2,500 acres of land but a much smaller land area would actually be occupied by physical facilities. Access roads are typically between 18-20 feet wide, and a substation and maintenance/office building can occupy a combined total of 1-2 acres. It is estimated that the percentage of land required to support the turbines and other components of a wind power plant is approximately 3-5% of the total project acreage. Therefore, land requirements will be quite substantial to support the wind energy facilities projected to meet the RPS demand.

The significance of the land use impact for site-specific projects will depend on whether the land between the turbines can be used. Wind energy facilities are generally considered compatible with most land uses because activities around the project site can usually resume normal operations once the project is completed. For the New York RPS, the majority of land-based wind generation is expected to be sited on agricultural lands in rural upstate areas. For the most part, wind energy development has been perceived as being beneficial to agricultural communities because of the supplemental income provided to farmers whose land the turbines are located, which may help keep the farms in operation and the land in agricultural use.

However, some permanent and temporary impacts will occur as a result of these facilities. Aside from permanent loss of agricultural land due to the project's footprint, the location of turbines, access roads and overhead transmission lines can bisect farm fields into small or irregular-sized parcels that could be difficult to farm. Also, soil erosion and/or soil compaction can lead to lower crop production. Temporary impacts during construction can result in crop damage due to equipment and vehicle movement, damage to farm infrastructure such as fences and subsurface drainage systems, and blockage of access to fields.

Residential and recreational land uses can also be affected by the construction and operation of wind energy projects. Wind turbines generate noise and can be perceived to be visually intrusive to local residents and tourists who may visit the area. The visibility of the turbines, along with some operational characteristics, could diminish the use or enjoyment of these properties or recreation sites for their intended purpose. Also, land occupied by wind facilities may limit further residential development.

Although similar land use impacts and community issues may result for the development of smaller wind systems and stand-alone units, impacts would be considerably less, if at all, due to the small land parcels required for their development.

Terrestrial and Aquatic Impacts

Large wind projects will likely traverse several habitat types that may include forested and wetland areas and surface waters including State-regulated and protected streams. Projects may fragment some of these areas, affecting species that thrive in these communities. Among the habitats particularly vulnerable to loss and fragmentation are large tracts of contiguous forest, wetlands and grasslands, and areas containing federal and state listed rare, threatened are endangered plant species, as each of these habitats supports relatively small and isolated populations of plant and animal species. Habitat loss can arise directly from the project's footprint, and indirectly by wildlife avoiding essential habitats near a project site that would otherwise be used for feeding and breeding. Direct construction-related impacts, associated with turbine placement and associated construction of electric interconnections and access roads, on terrestrial and aquatic wildlife may include incidental injury and mortality, habitat

destruction, temporary habitat disturbances, and increased silt and sedimentation impacts on aquatic organisms.

Avian Impacts

Wind energy facilities may impact both bird and bat populations. Impacts on avian populations have historically received the most attention, highlighted by the loss of large numbers of raptors colliding with revolving turbine at the Altamont Pass Wind Resource Area of California (AWRA). To date, no other wind energy facility site has been found to affect large numbers of raptors or any other birds.[22] Although advanced wind turbine technology (slower rotating blades, tubular towers, buried cables) and better siting considerations have minimized the number of avian casualties, large wind energy projects can still pose potential collision risks, particularly in locations where bird and bat migration pathways are known to exist. Raptor collisions are of particular concern, because, like many relatively large-bodied carnivores, most of theses species tend to reproduce slowly and are currently struggling to maintain healthy population growth rates. Also, bats and birds that are on the federal and state lists of endangered, threatened and species of special concern, along with resident and migrating passerines, may be adversely affected by the location and operation of wind facilities.

Potential impacts to avian species from proposed projects will need to be assessed on a site-specific basis and mitigated to the maximum extent practicable. Also, there have been no studies, to date, to determine the cumulative impacts of constructing approximately 2,400 MW of land based wind projects, which a New York RPS could potentially stimulate over the long term. Some studies suggest that as more facilities with larger turbines are built, the cumulative effects could potentially initiate or contribute to the decline of some wildlife populations, but this result would be highly dependent on the sizes and locations of installations relative to the migratory pathways and habitats.

[22] Researchers believe that the mortality observed at the AWRA site is anomalously high compared to that observed at other wind energy facilities because: (1) local raptor population densities are exceptionally high; (2) the wind energy facility originally supported 7000 linearly-arrayed wind turbines that were sited with little or no regard for existing avian use patterns; (3) early model turbines had fast rotating blades and were supported on lattice towers that provided potential perching and nesting sites for birds; and (4) many of the interconnecting transmission lines were sited above-ground.

With respect to off-shore development, some initial avian assessments conducted for wind projects off the coast of Long Island concluded that the risk to most species of birds from the facility is likely to be low, but because so little is known about the avian risks due to the presence of offshore wind facilities, more studies of certain species is required (Curry and Kerlinger, 2002). Likewise, wind projects developed off or near the shores of Lake Ontario and Lake Erie have the potential to affect avian populations, particularly projects sited in migration pathways.

Visual Impacts

The visibility of wind energy projects from the surrounding area is generally greater than for most other types of energy generation facilities. This is primarily due to three reasons: (1) the height and operational characteristics of the project's turbines; (2) the project's spread over a large land area; and (3) the location of the wind turbines along ridgelines or other open areas that may provide prolonged and unobstructed views for several miles.

Large wind turbines can reach heights of over 300 feet and will likely require day and night time lighting in order to comply with federal aviation regulations. These lights may affect the extent of visibility, particularly at night. In addition, a phenomenon known as "shadow flicker" - the shadow created by the revolving turbine blades when backlit by the sun – can cause an annoyance when cast on nearby roads, yards or residences. Typically, the nature of the visual impact of wind projects will be highly variable from the surrounding area because of the variations in topography, distances from the turbines, ambient lighting and weather conditions, screening effects of vegetation and buildings, existing land use characteristics, and viewers' attitude toward wind energy projects. Viewers from visually sensitive resources, including State parks, historic sites, designated scenic highways and rivers, and adjacent residential areas, are generally most affected by significant changes in the landscape. Adverse impacts can occur when a wind energy project is perceived by the viewer to impair the quality or character of a visual resource and diminish that person’s enjoyment of the area. Many viewers, however, may have positive connotations regarding wind power and believe turbines add interest to a view. This trend of acceptance, however, may not

continue as more, and larger, projects are proposed and constructed, occupying increasingly more rural landscape as a result of the RPS demand.

Regarding proposed offshore wind development, the majority of the visual impact concerns are associated with project visibility from shoreline communities and beaches and also from visual resources of statewide significance.

Cultural Resource Impacts

Wind energy projects have the potential to disturb or affect archeological resources as a result of vegetation clearing and ground disturbances for the installation of turbine foundations and other project facilities. The archeological sensitivity of a project area is influenced by a number of factors and varies according to localized topographic and environmental conditions. Projects located on landforms such as upland terraces or knolls adjacent to drainages or streams may have a relatively higher sensitivity for the presence of prehistoric sites. Project sites located in and around old farmsteads may also contain archeological deposits. Historic-architectural structures and historic districts listed or eligible for listing on the State and National Register of Historic Places can be affected by the visibility of wind energy projects, particularly those that are open to the public and those areas where the surrounding landscape contributes to the cultural significance of the property.

Offshore wind projects also have cultural resource considerations, particularly in locations where submerged archeological deposits, such as shipwrecks, may be present. While a wind project could be spread over a large area, the amount of land (or oceanbed) actually distributed is relatively small and towers could be shifted to avoid potential impacts.

Noise Impacts

Wind turbines emit sound due to the rotation of the blades and other equipment within the nacelle, which houses the gearbox, drive shaft and generator. Wind direction and speed, atmospheric conditions, vegetation cover, topography, and local background noise conditions all affect the reception of sounds from wind turbines. In typical rural areas, where most projects are likely to be constructed, the noise environment is typically between 40 and 45 decibels. In these areas, the noise producing sources include occasional vehicular traffic on local roads, farm equipment,

occasional use of recreational vehicles and distant noise related to railroad traffic. As a general rule, MW scale wind generators located at least 1,000 feet from the nearest residence have been found to produce minimal sound impacts, or about an increase of 5 decibels, at that distance. Noise from construction-related activity may cause some temporary annoyances at residences within and adjacent to the project site.

Transportation

Transportation impacts can be of concern, especially to rural communities where local roads may not be able to accommodate the transport of construction equipment and project components. Traffic delays, increased noise, dust, and damage to road surfaces may occur as a result of construction vehicles and the necessary upgrades to roads to support project construction. These upgrades often include increasing road widths, applying sufficient cover over road drainage features (*i.e.*, culverts), and upgrading bridges. Traffic may also increase as a result of local residents or tourists observing project progress.

Soil Erosion

The majority of civil, site preparation, and electrical work required to design and construct a wind energy project is similar to activities for other types of power plants. Conventional earth moving equipment such as excavators, bulldozers, graders, and dump trucks, along with cement trucks and other equipment, are used for site preparation and for the construction of access roads, foundations, and the installation of electrical infrastructure. Soil erosion can occur as a result of these and other construction activities, which can lead to loss of valuable topsoil in agricultural lands as well as siltation in nearby surface waters.

Mitigation

In order to avoid or minimize the environmental impacts associated with wind energy development that may occur as a result of an RPS, general, as well as site-specific, construction techniques and mitigation measures would be employed during project construction and operation. These measures would likely include:

- Proper siting consideration that would avoid placing structures in sensitive resources such as mature forests, wetlands and other important wildlife areas. Also, locating projects away from population

centers and residential development and adhering to appropriate set-backs from houses, property lines, roads and other structures will help minimize operational noise and visual concerns.

- Development and implementation of various "Best Management Practices" to control construction-related impacts.

- Developing plans, in consultation with the landowner and the appropriate resource protection agency, to protect resources such as soils, streams and wetlands, agricultural lands and archeological resources.

- Utilizing existing access roads when possible and locating new roads along field edges to avoid impacts on agricultural resources.

- Performing pre- and post- construction studies in consultation with relevant resource protection agencies and monitoring for potential operational impacts on wildlife resources and other community concerns.

General mitigation measures will likely include adherence to various local, state and federal ordinances and regulations, which are addressed below. Also, an environmental monitor is typically employed on a project to assure compliance with permit requirements and environmental protection commitments during construction.

Permits and Approvals

A number of governmental agencies on a federal, state, regional, and local level may be involved in the approval process for wind energy projects in New York State. A discussion of these agencies and their jurisdictions follows.

Federal

National Environmental Policy Act (NEPA)

In the majority of siting cases, wind energy projects have limited involvement with federal agencies unless they are located on federal lands or in federal waters, such as for offshore wind facilities. In these instances, projects are subject to the National Environmental Policy Act (NEPA), which can involve the review and approval of the following agencies:

United States Army Corp of Engineers (USACOE) – requires permit for location of structures in waters of the U.S. and/or for any dredging and filling that would occur.

Federal Aviation Administration (FAA) – requires a determination that the facility will not be a hazard to navigable airspace and typically requires light beacons to be placed on structures over 200 feet tall.

United States Coast Guard – requires permit for private aid to navigation and may require markings and other navigation aids (*i.e.*, fog horns).

In addition, consultation and a determination of impacts may be required by:

Department of the Interior

- *National Historic Preservation Act of 1980*
- *Endangered Species Act of 1973*
- *Fish and Wildlife Act of 1956*
- *Fish and Wildlife Coordination Act of 1958*
- *Estuary Protection Act*
- *Migratory Bird Treaty Act of 1918*
- *Abandoned Shipwreck Act of 1987*
- *Bald and Golden Eagle Protection Act*

Department of Commerce

- *Magnesium-Stevens Fishery Conservation and Management Act*
- *Coastal Zone management Act of 1972*
- *Marine Mammal Protection Act of 1972*

The majority of land-based wind development in New York State is likely to be on private land. Therefore, federal review will be limited to permitting requirements by the USACOE if fill or disturbance is required in any jurisdictional wetlands. Also, an FAA determination may be required. Table 6.2.1-3 provides a summary of federal permits that may be required for the construction of wind energy facilities.

Table 6.2.1-3
Federal Permits, Actions and Authorities

Agency	Permit or Action	Regulatory Authority
USACOE	NEPA	40 C.F.R. Part 1500
USACOE	Navigable Waters of US	33 C.F.R. Part 322
	Dredge or Fill	33 C.F.R. Part 323
FAA	Obstruction to Navigation	33 C.F.R. Parts 62, 64, 66
US Coast Guard	Private Aid to Navigation	33 C.F.R. Part 66

State

New York State Environmental Quality Review Act (SEQRA)

In New York State, the environmental impacts of a proposed wind energy project are typically assessed in accordance with the SEQRA, which requires that local and state agencies give consideration to environmental protection, human and community resources, and economic factors when considering proposed actions. The SEQRA process does not result in a permit; however, a SEQRA assessment must be completed before any agency decides to approve, undertake, or fund a private or public project. State agencies that may be considered an "involved" agency in the SEQRA process include:

New York State Public Service Commission (PSC) – A Certificate of Public Convenience and Necessity under NYS PSL Section 68 may be required. Also, a Certificate of Environmental Compatibility and Public Need under Article VII of the PSL, would be required if the transmission interconnection facility is over 125 KV and extends a distance of one mile or longer.

New York State Department of Environmental Conservation (DEC) – requires permits for wetland and stream disturbances, or construction or disturbance in coastal areas associated with offshore facilities.

New York State Office of General Services (OGS) – requires permits for underwater construction for offshore facilities.

New York State Department of Transportation (DOT) – requires special use permit for oversized vehicles on State highways and work permits for highway upgrades.

In addition, consultation and determination may be required from:

- New York State Department of Agriculture and Markets – requires that a Notice of Intent be filed for construction projects within county adopted, State certified agricultural districts.

- Office of Park Recreation and Historic Preservation – requires a determination of impact for projects that may be located in culturally sensitive areas.

- Department of State – requires an assessment be performed for projects located in coastal zone areas.

Table 6.2.1-4
State Permit, Actions or Authorities

Potential State Agency Involvement		
Agency	**Permit or Action**	**Regulatory Authority**
All Agencies	SEQRA	6 NYCRR Part 617
DEC	Freshwater Wetlands Tidal Wetlands	6 NYCRR Part 663 6 NYCRR Part 661
DEC	Coastal Erosion Hazard Areas	6 NYCRR Part 505
DEC	Protection of Waters SPDES	6 NYCRR Part 608
OGS	Grants of Lands Underwater	9 NYCRR Subdivision G, Part 271
PSC	Certificate of Public Convenience and Necessity	NYS PSL Section 68
PSC	Certificate of Environmental Compatibility (Transmission)	NYS PSL Article VII
DOS	Coastal Assessment Form	16 U.S.C. 1456; NY Executive Law 911
DOT	Special Use Permit for Oversized Overweight Vehicles – Highway Work Permit	NYS Vehicle and Traffic Law Title 3 Article 10 Title 5 Article 21-C Section 52

Regional and Local Government

Town boards, regional planning commissions, county agencies, and other local authorities will likely review and evaluate most wind energy projects. Local requirements include adherence to zoning rules, obtaining building, grading, or special use permits, and compliance with structural, mechanical, and electrical codes. The requirements associated with planning and permitting wind energy projects in New York vary depending on whether or not local land use or zoning rules exist for the land on which the project will be located. Many areas within New York do not currently have zoning or comprehensive plans in place. Wind energy projects located on land that does not fall under local zoning or land use regulations may only require a local building permit. In areas that are governed by these plans, wind energy projects are generally required to obtain Special Use or Conditional Use permits. A few local governments in New York State have established specific zoning requirements that apply to commercial or bulk generating wind energy facilities.

6.2.2 HYDROELECTRIC ENERGY

Technology Overview

In a conventional hydroelectric, or "hydro," generating unit, water under the force of gravity "falls" and rotates a turbine and electrical generator, thereby producing electrical power. The size and type of hydroelectric generating unit is determined by the available head (how far the water drops) and the available volume of water, which are both directly proportional to power output. Water may be stored in a reservoir, created by a dam from which water is released during times of electrical demand.

Conventional hydro stations are typically operated in one of two methods, namely "store-and-release" or "run-of-river." A variation of conventional hydro generation is "pumped storage."

Store-and-Release – These facilities impound water behind a dam, forming a reservoir. The reservoir is filled and emptied in a cyclical manner to provide power on demand. During periods of low electrical demand (nighttime, for instance), electrical generation is reduced or stopped and water is stored in the reservoir, to be released during periods of

high demand (during daytime). Consequently, the reservoir level, as well as the downstream flow patterns, will vary based on the particular operating characteristics of the generating station. Store and Release projects have the advantage of being able to be brought into service quickly to serve peak demand, and are thus often referred to as "peaking" facilities.

Run-of-River - These facilities are defined as a system where the discharge of water from the facility equals the inflow at any instant time. Run-of-river projects may utilize a low dam, or no impoundments at all, and the amount of water flowing through the turbines is determined by the available water in the river. Since water is typically not impounded and stored, the amount of electricity able to be produced at any one time is primarily determined by the amount of water naturally available. Run of river projects typically have less of an impact on upstream water levels and downstream water flow compared with store and release projects because the natural flow of the river is less disturbed.

Pumped Storage - In this system, water flows from an elevated source reservoir and through a turbine, as in a conventional cycle. However, the water is then stored in a reservoir at the outflow of the turbine. This stored water is then pumped back to replenish the upper reservoir, in a cyclical manner, which is then used to generate power again. Reversible turbines are typically used in a pumped storage system to both generate power and pump water back to the upper reservoir. In operation, water is released to generate electricity during high load periods when market prices are high (during the day on a daily basis and, in particular, during summer peak days). The water is then typically pumped back to the upper reservoir at night, when electricity demand decreases, and electricity market prices are low.

New York has two pumped storage facilities, each operated by the NYPA: the Blenheim-Gilboa facility in North Blenheim, New York, and the Lewiston Pumped Storage Facility located in Lewiston, New York. The Blenheim-Gilboa facility, in service since 1973, consists of four turbine generator units with a total electric capacity

of approximately 1,000 MW. The Lewiston facility is operated as part of NYPA's Robert Moses Niagara facility, which has a total facility output of approximately 2,400 MW.[23]

Status of Hydroelectric Development in New York

Hydroelectric power generation in New York, as throughout the United States, is the most mature and developed renewable technology. Hydroelectric facilities produced about 8% of New York's electricity in 2002, and these facilities comprise about 12% of New York's electric generating capacity. Three quarters of the hydroelectric generating capacity is located at the Niagara Falls and St. Lawrence River facilities operated by NYPA.

In addition to the NYPA pumped storage plants, and the Niagara and St. Lawrence facilities, there are 205 conventional hydroelectric generating stations (341 total units) licensed and available for operation in New York, each with 10 kW or greater rated capacity. The total summer peak capacity available from all hydro in 2002 is approximately 5,800 MW, and the winter peak capacity approximately 5,600 MW. A total of approximately 26,000,000 MWH of energy was generated by all hydro units in 2002 (NYISO 2003 Load and Capacity Data).

The following table illustrates the distribution of the existing capacity by station size.

Table 6.2.2-1
New York Hydro Capacity – Breakdown by Station Size
(Source: NYISO 2003 Load & Capacity Data)

Size Range (MW)	>1 MW	1-4 MW	5-100	>100
# of Stations	63	75	67	2*
Total Capacity (MW)	33	194	1,010	3,475

*St. Lawrence & Robert Moses

In addition to in-state hydroelectric plants, significant amounts of hydroelectric-generated electricity are also imported into New York State, primarily from

[23] NYISO 2003 Load and Capacity Data Report projects service through year 2021, the length of its current projection period.

two neighboring Canadian utilities, Ontario Hydro (OH) and Hydro Quebec (HQ). The following table summarizes the total amount of hydro imported into the state.

Table 6.2.2-2
New York Hydro Import Data
April 2001 - March 2002

Total Hydro Imported MWH	% of Total State Imports	Imports Consumed In State MWH	Imports Wheeled Out of State MWH
5,548,334	27.03	4,086,899	1,461,435

Potential Development

Development of large hydroelectric projects in New York is essentially complete, with the existing NYPA projects (St. Lawrence, Robert Moses/Lewiston, and Blenheim-Gilboa) expected to maintain a vital share of the State's energy supply.[24]

As noted in Section 2.0, the RPS proposal being modeled treats as eligible two categories of hydroelectric resources: 1) *new* low-impact hydro, defined as new facilities of up to 30 MW, so long as they are run-of-river, with no new storage impoundment; and 2) the incremental production associated with any upgrades to existing facilities so long as no new impoundments are created. In addition, the RD Cost Analysis assumed that existing small hydropower, 10 MW or less, will be considered eligible as their above-market contracts expire. The first category has been subdivided to carve out, as a separate block, very small hydro of less than 5 MW because hydro cost is a strong function of size. The three blocks modeled for the supply curve in the RPS Cost Study were therefore defined as:

(1) New Low-Impact Hydro (5-30 MW)

(2) Very Small New Hydro (<= 5 MW) and

(3) Hydro Upgrades.

Further, four classifications of incremental hydro production were identified:

[24] NYPA is actively engaged in upgrading and modernizing its St. Lawrence-FDR and Niagara facilities.

(1) *Repowering & Modernization*,

(2) *Expanded Capacity at Existing Dams*,

(3) *New Capacity at Existing Dam* and

(4) *New Capacity at New Dams*.

The RPS Cost Study aggregated hydroelectric production into the three NYS megazones, and interpolated quantities between years for which data was provided. In addition, the Cost Study estimated potential hydroelectric resources imported from Ontario and Quebec. Table 6.2.2-3 provides a summary of potential eligible hydro development through 2013.

Table 6.2.2-3
Potential Hydro Development

	2006		***2009***		***2013***	
	MW	**MWH**	**MW**	**MWH**	**MW**	**MWH**
New Low-Impact Hydro	6.3	31,974	18.8	95,922	43.3	220,622
New Low-Impact - Imports	263.8	1,505,625	327.5	1,784,850	412.5	2,157,150
Hydro Upgrades	67.4	180,900	93.8	248,333	147.8	386,550
Hydro Upgrades – Imports	290.0	1,104,780	980.0	3,709,560	1,100.0	4,182,600
Very Small New Hydro	1.9	9,812	5.8	29,437	13.3	67,706
Eligible Hydro Maintenance	15.1	46,298	26.4	81,035	41.5	127,333
Totals	**644.5**	**2,879,389**	**1,452.3**	**5,949,137**	**1,758.4**	**7,141,960**

Environmental Impacts

The environmental impacts of hydroelectric facilities depend on a number of variables, including the location, type and operational characteristics of a facility. It is difficult to generalize about these impacts because they will be site-specific and will depend on factors such as geology, river flows and the aquatic and riparian ecology of the area. Although the vast majority of incremental hydroelectric development to fulfill the RPS is projected to come from Canadian imports, new eligible facilities could

potentially be developed in New York, as indicated above, if the appropriate economic conditions existed.

The construction of a new run-of-river facility, eligible under the RPS, could potentially have a greater environmental impact than would re-powering or upgrading at an existing project site. However, because no new storage impoundments (reservoirs) will be associated with new eligible facilities, the impacts generally associated with conventional hydroelectric facilities, discussed below, are expected to be significantly less for any new facilities built under the RPS.

Water Quality Impacts

The development of dams and the operation of the powerhouse cause the majority of the environmental impacts associated with hydro power production. By diverting water out of the river for power, dams remove water needed for maintaining in-stream ecosystems. Impoundments can cause changes and variation in temperature or the amount of dissolved oxygen (DO) in the river. Surface temperatures in the impounded water may rise when the flow of the water is slowed. If water is released from the top of the dam, this warmer water may increase river water temperature downstream. Cooler downstream temperatures may result when cool water is released from the bottom of a reservoir. Such altered conditions can affect the habitat, growth rate, or survival of certain fish and other species.

Dams may also result in stratified temperature and nutrient levels as a result of the lack of natural mixing during winter and summer. Dissolved oxygen (DO) levels often may drop below minimum standards, which can lead to hypoxic or anoxic conditions for aquatic organisms. When this water is released from the bottom of a reservoir, DO problems can result in the downstream riverine reaches, affecting the aquatic biota. In addition, water passed over a spillway rather than through the turbines, causes air to be trapped in the water column. This condition may result in gas bubble disease that, in some fish species, could be lethal.

Habitat is also affected downstream of a dam. Store and release facilities that regulate downstream flow are responsible for creating a "tidal" effect downstream, as flows often fluctuate over the course of a day. In extreme cases, facilities without mitigation measures or minimum flow requirements may nearly stop all downstream

flow during non-peak operation hours in the summer during low flow conditions, thereby destroying riparian and upland habitat.

Another downstream effect of a hydroelectric dam is a change in the sediment load of a river. The impoundment reduces flow velocity, resulting in settlement of river sediment. The water discharged from the turbines is sediment deficient, leading to greater channel erosion and scouring downstream. Conversely, the impoundment area becomes sediment-heavy, reducing the depth and changing the shape of the impoundment. The deposited sediment may also contain chemical or industrial residues from upstream sources.

Water quality impacts may be mitigated by technological and operational enhancements at a facility (*i.e.*, using minimum flow turbines, re-regulating weirs, and pulsed operation at peak efficiency). Impoundments can be managed to create new upstream and downstream habitat for fish species. Fortunately, concerns about gas bubble disease have typically been addressed at New York hydroelectric facilities with properly designed spillways that avoid this impact.

Since new hydro projects proposed to be eligible for the RPS will have no storage impoundments, many of the water quality impacts noted above will likely be avoided.

Aquatic and Terrestrial Impacts

Fishery Resources

Fisheries are affected by riverine hydroelectric facilities both as a result of habitat change as well as physical damage caused by powerhouse operations. A dammed river can have an adverse effect on migrating fish. When fish, such as salmoinoids, hatch, the young are carried downstream by the river current. An impoundment delays or disrupts the migration downstream, and may cause disorientation as a result of reduced stream flow. To continue downstream, the young fish must either drop over a spillway or travel through the turbines causing stress, injury or mortality to the organism.

Spawning fish moving upstream are also affected by a dammed river. Hydroelectric facilities without any mitigation measures will prevent fish from reaching spawning grounds. Mitigation measures such as fish ladders or lifts can help to pass

fish upstream but these measures can increase their overall stress and energy loss when trying to reach the spawning area, possibly preventing successful spawning.

Dammed rivers cause physical habitat changes that can alter the normal fishery resource. Upstream of a dam, the impoundment often changes a cold water fishery into a warm water (*i.e.*, pond) fishery, resulting in the replacement of cold water fish species with warm water species. Also, some fish may not be able to tolerate the lower dissolved oxygen levels in an impoundment, leading to suffocation.

Fish habitat may be altered downstream of peak operating facilities as well. The fluctuating water levels have an adverse affect on macroinvertibrates, the major food base for many fish. Fluctuating flows can alter the population and diversity of invertebrate communities. The "tidal" effect of rapidly changing river levels can strand many invertebrates in dry areas, cause both a decrease in food supply to fish, as well as decreased usable habitat. This change in habitat and food availability can adversely impact the downstream fishery resource.

Wildlife and Botanical Resource

The creation of an impoundment on a river system can kill surrounding riparian vegetation and other sessile organisms, as well as fledgling birds, and other small mammals. The vegetation changes from a riparian community to a pond community. The effects of the change are mixed; a potentially healthy wetland community can form, but, on the other hand, the impoundment may be colonized by noxious weeds such as Eurasian watermilfoil and purple loose strife.

The riparian community downstream of a dam may be affected by fluctuating water flows during peak and non-peak operation. Water plants dependent on constant water flow are unable to become established along the perimeter, while some plants may be subject to very high stress as a result of changes in water levels.

The effects of bird habitat changes are mixed. The impoundment introduces new habitat for ducks and geese. However, fluctuating flows downstream may deplete the fishery resource, thereby potentially reducing the capacity for fishing birds, such as eagles, herons and kingfishers to thrive in that community.

Wildlife such as beaver, otter and white-tailed deer may have a net loss of habitat due to river impoundment and flow fluctuation. Vegetation and fish losses due to hydro facilities may lead to loss of food base for many animals.

Because RPS eligible facilities will be operated as run-of-river facilities with no new storage impoundments, the fluctuating flows inherent with peaking facilities, will be avoided, thereby greatly reducing most of the aquatic and terrestrial impacts discussed above.

Recreational Impacts

Impacts of a hydroelectric facility on local recreation are usually associated with water level fluctuations and water quality changes. Impoundments can have both positive and negative impact on recreational uses. An impoundment can create a new open water body with the potential for water-related activities such as fishing or boating. Mitigation on the large hydro facilities in New York has included creating recreational access and facilities such as campgrounds, ballparks and boat ramps.

Conversely, the fishery resource downstream of a hydro facility can be seriously impacted, and thus can be detrimental to fishermen seeking certain types of species (*i.e*., anglers who prefer trout fishing). Also, storage impoundments can affect whitewater boating since hydro facilities could potentially eliminate the whitewater boating potential for particular stretches of a river. Lastly, the visual intrusion of a new hydro facility – particularly the dam, powerhouse and transmission facilities – could affect other recreational activities such as hiking or wildlife viewing.

Construction Impacts

The construction phase of a new hydro facility can be a major source of environmental impacts. Construction activities will typically include clearing for the project site, and access, excavation and dredging for the dam, powerhouse, headrace and tailrace, spillways, penstock, transmission lines and other associated infrastructure.

Likely impacts include erosion of exposed soils and an increase of both turbidity and sedimentation downstream, which can affect the visual quality of the river resource as well as terrestrial and aquatic species. Additional effects related to project construction include increased noise, air and dust emission levels in the immediate

project vicinity due to operation of construction equipment. The use of "Best Management Practices" during construction will help alleviate the impacts associated with construction. Construction activities involved in run-of-river projects will be less significant than for storage projects since no reservoir and associated facilities are required.

Mitigation

Impacts associated with hydro facilities usually can be reduced or eliminated by altering the operations at the dam and powerhouse. Examples, mentioned above, include installing fish passages systems to reduce impacts on migratory fish, and changing the dispatch requirements of a store and release (peaking) facility to convert it to a run-of-river facility. This has the effect of reducing fluctuation in river flow levels (the tidal effect) that can adversely impact the riparian habitat. Since hydro facilities proposed to be eligible for the RPS only include run-of-river facilities, many of the impacts described above will be avoided. However, for any new eligible hydro projects that may be developed and constructed as a result of an RPS demand, the following requirements will help ensure that environmental impacts are minimized:

- Enforcement of all mitigation measures required as conditions of various state, local and federal ordinances, regulations and licenses that govern the construction and operation of a project.
- Within practical limits, and subject to regulatory approval, coordination of plant operations with any other water-control facilities that influence water levels and/or flows operating on the same waterway in order to mitigate impacts and protect indigenous species and the habitat upon which they depend.
- Compensation for loss of significant habitat by the creation of similar habitats, supporting the same stock, at or near the development site within the same ecological unit.
- Installation of fish passages to maintain pre-existing migration patterns both upstream and downstream.

- Installation of measures necessary to minimize fish mortality that would occur through impingement and entrainment (*i.e.*, trash racks, oversized intake structures, underwater strobe and sound, fish screens).

Permits and Approvals

Numerous laws govern the development of hydroelectric projects that would be eligible under the RPS. Pursuant to the Federal Water Power Act of 1920 and subsequent amendments, the FERC issues construction and operating licenses for hydroelectric projects larger than 5 MW that are located on navigable waterways.

In addition to the powers and responsibilities granted to FERC, several other federal laws and executive orders affect the licensing process. Among the most prominent are the National Environmental Policy Act (NEPA), Fish and Wildlife Coordination Act, National Historic Preservation Act, Endangered Species Act, Clean Water Act, Wild and Scenic Rivers Act, and Americans with Disabilities Act. Table 6.2.2-4 provides a listing of federal permits and approvals that are expected to be required for licensing hydro facilities.

Table 6.2.2-4
Federal Permits and Approvals

Agency	Permit or Action	Regulatory Authority
EPA	Clean Water Act	PL 95-217, Section 101
FERC	Environmental Policy	National Environmental Policy Act
FERC	Hydroelectric Licensing	Federal Power Act, Title 16 Chapter 12
Fish & Wildlife	Fish & Wildlife Coordination Act	PL 95-624
NY Dept of State	Coastal Zone	Coastal Zone Management Act
Fish & Wildlife	Endangered Species Act	PL 93-205
Interior	Land Management	PL 94-579
Housing and Urban Development	Flood Insurance Act	42 U.S.C. Sections 4001-4127
NY Parks & Recreation	Historic Preservation Act	PL 89-665
Interior	Wilderness Act	PL 88-577
DEC	Wild & Scenic Rivers	PL 90-542

FERC licenses (or re-licenses) hydroelectric projects, for periods up to 50 years, after reviewing the engineering, environmental, and economic aspects of the proposal. This process includes preparation of an environmental document that analyzes the project's effects and makes recommendations for mitigating the adverse effects; a review of the comments and recommendations submitted by other government agencies, interested organizations, and the public; and a determination that the proposed project is best adapted to a comprehensive plan for improving or developing a waterway or waterways for beneficial public uses.

An applicant must follow FERC's pre-filing consultation process, which requires consultation with appropriate federal, state, and local government agencies. Once an application for a license is filed, it must contain a complete engineering analysis, including dam safety, operation, and maintenance, and must also address economic and financial aspects of developing the project. In addition, it must contain an environmental report describing the effect the project would have on fish, water quality, wildlife, botanical resources, geology, soils, botanical resources, recreation, land use, and socioeconomic values. Such report also must include proposed mitigative,

protective, and enhancement measures. FERC provides the public and interested organizations several opportunities to participate in the licensing process. Federal, state, and local government agencies with an interest in the project must participate. Through public notices and direct mailings, FERC asks for any additional scientific studies that may be needed to analyze the effects of the proposal; requests comments on the application and FERC staff's environmental document; and requests recommendations for mitigation of adverse effects. Also, before FERC staff prepares an environmental document under the provisions of NEPA, it issues scoping documents and often holds scoping meetings. The scoping process enables interested agencies, organizations, and local citizens to assist FERC: (1) identify the significant issues; (2) determine those issues requiring, and not requiring, detailed analysis; (3) determine the depth of analysis required for each issue; and (4) identify appropriate alternatives to consider.

FERC may prepare an environmental document—environmental assessment, environmental impact statement, or sometimes both—on a single project or several projects, both existing and proposed, in a river basin. In all cases, FERC addresses any cumulative effects (combined effect of all proposals and existing projects) that would occur to the area's resources. Before issuing a license, FERC must then determine if a proposed project is best adapted to a comprehensive plan for improving or developing a waterway or waterways for beneficial public uses. FERC must consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the hydroelectric project. In addition, FERC must weigh the competing interests, including both power and non-power uses, to ensure a proper balance is achieved between developmental and non-developmental interests in any licensing decision.

FERC includes in the licenses it issues terms and conditions (license articles) that are the requirements a licensee must comply with to keep the license in effect. These include engineering, safety, economic, and environmental matters, as well as compliance with state and local Laws.

State and Local Authority

Concurrent with the FERC process, New York performs its own formal review with the DEC as the primary regulatory agency responsible for the process. Regulations used by both FERC and DEC are similar, and information is often exchanged between the two agencies. As previously mentioned, applicants must consult with state and local agencies prior to filing a FERC application.

During FERC licensing, state and local agencies with an interest in the project must participate in identifying issues, defining required analyses and alternative locations. As active parties, state and local agencies must provide FERC with their required conditions for incorporation into the license. The FERC license does not preempt state and local law not related to construction and operation. Concurrent with the issuance of a FERC license, or exemption, DEC issues a 401 Water Quality Certification for the protection of water quality and aquatic life.

Projects exempt from FERC's review may be subject to New York's own Water Power Law (Article 15 Title 17). The law requires approval for the construction, operation and maintenance of any power development (either mechanical or electric) that utilizes the flow of the State's waters. Any application under the Water Power Law is administered under SEQRA, which requires, for Type I actions, scoping, and application consultation with government, public and private interests. Table 6.2.2-5 identifies applicable permits, actions or authorities that may be required or involved in the licensing of RPS eligible hydro projects.

Table 6.2.2-5
State Permits and Approvals

Agency	Permit or Action	Regulatory Authority
DEC	Stream Protection	ECL Article 15, Title 5
DEC	Dam and Pondage Approval	ECL Article 15, Title 5
DEC	Wild and Scenic Rivers	ECL Article 15, Title 27
DEC	Clean Water Section 401	PL-95-217
DEC	Clean Water Section 402	PL-95-217
DEC	Mining Permit	ECL Article 23, Title 27
DEC	Freshwater Wetlands	ECL Sections 24,0101
DEC	Endangered Species	ECL Section 11.0535
DEC/ NY Parks, Recreation and Historic Preservation	Nature and Historical Preserve	ECL Section 45.0101
NY Ag. & Markets	Agriculture Districts	NY Ag. & Mkts. Law, Article 25AA
DEC	Hydroelectric Development	ECL Article 15, Title 17

6.2.3 BIOMASS ENERGY

The term biomass includes a wide-variety of closed-loop and open-loop organic energy resources. Closed-loop resources, which can be either woody (*i.e*., willow or hybrid poplars) or herbaceous (*i.e.,* switchgrass), are those that are grown exclusively for the purpose of being consumed as an energy feedstock. Open-loop resources are typically either woody residues produced as byproducts in the wood processing industry or are clean, non-treated, woody waste materials intercepted from the municipal solid waste stream. The use of biomass instead of fossil-fuels is considered a CO_2 reduction strategy. Biomass grown sustainably in a closed-loop system is considered to be carbon neutral (no net atmospheric carbon emitted) because the CO_2 released during combustion is the same as the CO_2 absorbed by the fuel crop plants from the atmosphere through photosynthesis. Examples of clean, unadulterated biomass resources are provided in Table 6.2.3-1.[25]

[25] See Tables 2-1 and 2-1A for a list of potentially eligible biomass energy resources.

Table 6.2.3-1
Biomass Energy Resources

Biomass Resource Class	Definition
Mill Residues	Wood residues produced in the primary and secondary wood products industries.
Silviculture Residues	Wood residues produced from commercial logging and silvicultural activities.
Site Conversion Residues	Wood residues produced when forested lands are converted for other uses (*e.g.*, for agriculture, roads, etc.).
Silviculture (other than residues)	Wood, other than residues, from silvicultural activities that could potentially be used for biopower (*e.g.*, net annual growth).
Woody Yard Trimmings	Woody materials from yard trimming activities that can be separated from the MSW stream.
Construction & Demolition Residues	The clean and available wood portion of the C&D waste stream.
Pallets and Other Waste Wood	Pallets, containers, discarded wood consumer products, scrap lumber (other than from construction and demolition), etc. that can be separated from the MSW stream.
Agricultural Residues	Corn and wheat residues.
Bio-energy Crops	Woody or herbaceous crops grown specifically for the solar energy stored during photosynthesis.

Technology Overview and Status of Technology in New York State

A variety of technologies can be used to produce electricity from biomass. In some cases, a particular biomass resource is more suitable for conversion to electricity using a particular technology. Primary types of energy conversion technologies from biomass, their corresponding market applicability, and the types of feedstocks most frequently used with the technology are presented in Table 6.2.3-2.

Table 6.2.3-2
Biomass Conversion Technologies

Biomass Technology	Electricity Markets	Potential Feedstocks
Customer-Sited Biomass Combined Heat and Power (CHP)	Primarily end-use, could involve sale into wholesale markets	Mill residues
Co-firing Biomass with Coal	Wholesale	All
Gasification	Wholesale or end-use	All – especially construction and demolition wood
Direct-Fire, Stand-Alone	Wholesale	All
Co-firing Gasified Biomass with Natural Gas or Coal	Wholesale	All

Co-firing Biomass with Coal - Biomass can be combusted in a coal boiler, thereby directly displacing a portion of the coal used in the combustion process. The typical application for co-firing coal with biomass is for larger base-load electricity generators. Biomass can be blended with coal on the coal-pile (mixed feed), or injected through a separate biomass transfer system. Co-firing installations involve a combination of traditional wood handling and processing equipment that is assembled together for power generation. Depending on site-specific conditions, this equipment could include a wood storage facility or silo, hammermills and/or grinders, bucket conveyors, blowers for pneumatic conveyance of processed biomass, and miscellaneous other components. While each co-firing system needs to be engineered to suit site-specific conditions, the individual components that comprise a co-firing system are readily available due to the demand for these components in other applications that require handling and processing of either coal or wood (*i.e.,* wood recycling and processing operations; pulp and paper manufacturers, agriculture and associated industries, biomass fueled heating and/or power plants, and coal fired power plants).

Currently, there are 10.7 MW of active co-firing capacity at Greenidge Station located in Yates County, NY, along with an additional (previously active, but currently unused) 11 MW of co-firing capacity at two other plants, Hickling Station and

Jennison Station, located in Chenango and Steuben Counties, respectively. Also, a 10-MW co-firing system has been installed at the Dunkirk Station, in Chautauqua County. While today co-firing biomass with coal is a minor activity in New York, most of the pieces are in place from associated industries and service companies for greatly expanded biomass co-firing activity.

Biomass Gasification - Biomass gasification is a thermal conversion technology that converts solid biomass fuel into a combustible gas. Gasification applies air to the biomass feedstock in a high temperature reactor to produce the product gas, which can then be used to generate electricity from standard gas turbines or in a combined cycle unit. Biomass gasifiers have the potential to be up to twice as efficient using conventional boilers to generate electricity. A typical scale of biomass gasification is from 5 MW to 40 MW and can be used in either a customer-sited application or for sale into the wholesale electricity market. Biomass gasification is still considered an emerging technology with only a few gasifiers in operation in the United States. Currently, there is no biomass gasification in New York State.

Biofuels – A variety of fuels can be made from biomass resources including the liquid fuels ethanol, methanol and biodiesel. Ethanol is made by converting the carbohydrate portion of biomass into sugar, which is then converted into ethanol in a fermentation process. Biodiesel is produced through a process in which organically derived oils are combined with alcohol (ethanol or methanol) in the presence of a catalyst to form ethyl or methyl ester. The biomass-derived ethyl or methyl esters can be blended with conventional diesel fuel or used as a neat fuel (100% biodiesel). Biodiesel can be made from soybeans, canola oils, animal fats, waste vegetable oils or microalgae oils. Biomass can be gasified to produce a synthesis gas composed primarily of hydrogen and carbon monoxide, also called syngas or biosyngas. Hydrogen can be recovered from this syngas, or it can be catalytically converted to methanol. Still an emerging technology, biofuels are primarily used to fuel vehicles, but can also fuel engines or fuel cells for electricity generation.

Customer-Sited Biomass Combined Heat and Power (CHP) - The typical scale of CHP technology is 1 – 30 MW. CHP systems produce both heat (for steam) and electricity from biomass residues, increasing the efficiency of the biomass resource. The technology is typically employed at wood processing facilities (especially in the pulp and paper industry) that have large electricity and steam needs and a captive supply of biomass residues. Opportunities also exist in some food products manufacturing facilities. Biomass CHP is often an end-use application, but electricity can be sold into the wholesale market. The technology is well-developed and economical. In New York, there are several mills that utilize biomass CHP, representing approximately 68 MW of electric generation capacity.

Direct-Fire, Stand-Alone Wood-Fired Power Plants - The typical scale of this technology is 1-50 MW. The technology consists of combustion of wood fuel directly to produce power, which is sold in the wholesale market. Efficiency is typically low (17 to 24%) relative to most other types of power plants. This technology is in widespread use nationally. New York currently has two operating direct-fire, stand-alone wood-fired power plants in operation - an 18 MW plant in Chateaugay, Franklin County, and a 21 MW plant in Lyonsdale, Lewis County.

Potential Development

The RPS Cost Study identified approximately 2,200 MW of biomass co-firing with coal (including imports from Ontario and the PJM service territory), gasification, and CHP technologies that could potentially be developed in Megazones 1 and 2 for the study period. Table 6.2.3-3 provides a summary of potential development levels through 2013.

Table 6.2.3-3

Potential Biomass Development

	2006		2009		2013	
	MW	**MWH**	**MW**	**MWH**	**MW**	**MWH**
Biomass Co-firing w/Coal	88.2	472,120	176.4	944,240	294.0	1,573,734
Biomass Co-firing w/Coal – Imports	847.0	4,238,526	1,027.0	5,263,446	1,267.0	6,630,006
Biomass Gasification	0	0	99.8	699,574	665.5	4,663,824
New Biomass CHP	4.5	33,507	18.0	134,028	40.5	301,563
Totals	939.7	4,744,153	1,321.2	7,041,288	2,267.0	13,169,127

Environmental Impacts

The potential environmental impacts of utilizing biomass as a fuel source depend upon both the conversion technology employed and the biomass resource class being combusted. Impacts arise not only from the potential construction and operation of a plant and ancillary facilities, but also from the production and procurement of the biomass resource used for the energy feedstock. Because of the complexity of the issues, impacts are discussed in general terms, addressing important distinctions between the technologies and fuel resources.

Air Emissions

The use of biomass in combustion technology will produce atmospheric emissions that will vary across biomass technologies, and will depend, in part, upon the properties of the fuel combusted. In addition, atmospheric emissions depend largely on the type and quality of emissions control technologies used, and the operating conditions employed at a particular power plant.

Typically, when co-firing biomass with coal, criteria pollutant emissions are either reduced or not substantially changed relative to coal-only operation. However, in some cases, particulate matter and NO_x emissions may slightly increase depending on the generation facility's permitting criteria.

In comparison to coal-fired power plants, co-firing applications, and direct-fire biomass applications; criteria pollutant emissions from biomass gasification are substantially reduced. Criteria pollutant emissions from biomass gasification plants are

similar to those from conventional natural gas turbine facilities, and may be slightly higher than those from natural gas combined-cycle applications.

Regarding reductions in GHG emissions, biomass technologies are often assessed in a life-cycle context. If the amount of biomass combusted is replaced by the applicable amount of biomass growth (*i.e.*, closed-loop), there are zero net CO_2 emissions in the lifecycle (exclusive of CO_2 emissions resulting from collecting and transporting the biomass material).

CO_2 reduction benefits are not usually attributed to open-loop biomass applications. However, if the open-loop biomass that is combusted would otherwise end up in a landfill that does not practice methane capture (or would decay uncollected), combusting the open-loop biomass avoids the emission of methane because most of the carbon is instantaneously oxidized (such that the open-loop CO_2 emissions are more than offset by the methane emissions reductions). This leveraged emissions benefit can be up to three tons of CO_2 equivalent (eq) emissions for every ton of biomass combusted.[26] The leveraged emissions benefit of combusting open-loop biomass does not exist if the biomass would otherwise go to a landfill that practices methane capture (in this case, the CO_2 emissions from combustion would not be offset by methane reductions). As stated above, atmospheric emissions from biomass are a complex issue and depend upon not only the conversion technology being used (along with emissions control technologies employed), but also upon the biomass resource being utilized. Therefore, emissions of SO_2, NO_x, particulates, mercury, CO, and CO_2 are addressed for each technology in general terms below.

<u>Co-firing</u>

Due to the nearly zero sulfur content of most biomass, co-firing biomass with coal reduces SO_2 emissions (relative to coal-only operation) on a one-to-one basis according to the amount of overall heat provided by biomass. Using biomass to replace 10% of the heat input from coal typically reduces SO_2 emissions by ten percent.

Due to the complexity of NO_x-formation chemistry, a blanket statement cannot be made about the impacts of co-firing on NO_x emissions (relative to coal-only operation). Many co-firing emissions tests, however, have resulted in reduced NO_x

[26] See NYSERDA Volume 4: Renewable Supply Technical Report, p. 4-24.

emissions relative to coal-only operation. NO_x increases have been observed in several cases.

Emissions of total particulates do not typically increase (relative to coal-only operation) during co-firing. However, emissions of PM_{10} and $PM_{2.5}$ can increase. Emissions of fine particulates during co-firing are an ongoing research issue that must be considered within the context of site-specific factors (biomass type, emissions control technologies, permitting restrictions, *etc*.). Biomass typically has very low mercury concentrations, thus co-firing typically reduces mercury emissions relative to coal-only operation.

Biomass co-firing involves combustion of carbon-containing fuels, producing CO and CO_2 emissions. Insignificant increases in CO emissions (relative to coal-only operation) during co-firing have been observed in some cases. On a lifecycle basis, co-firing biomass with coal may reduce a coal facility's greenhouse gas emissions. Lifecycle greenhouse gas emissions for each kWh of biopower produced are insignificant in many cases, depending upon the biomass resource utilized.

Gasification

Combustion of gasified biomass results in emissions of SO_2, NO_x, particulates, mercury, CO, and CO_2. In comparison to coal-fired power plants, co-firing applications, and direct-fire biopower applications, criteria pollutant emissions from biomass gasification are substantially reduced. Criteria pollutant emissions from biomass gasification plants are similar to those from conventional natural gas turbine facilities, and are reported to be slightly higher than those from natural gas combined-cycle applications. Mercury emissions from the combustion of gasified biomass are low compared to coal combustion. Lifecycle greenhouse gas emissions from the combustion of gasified biomass are not significant in many cases, depending upon the biomass resource utilized.

Combined-Heat and Power

Biomass CHP results in emissions of SO_2, NO_x, particulates, mercury, CO, and CO_2. Mercury and SO_2 emissions from biomass CHP are low compared to coal combustion. Lifecycle greenhouse gas emissions from biomass CHP are not significant in many cases, depending upon the biomass resource utilized.

Fuel Resource Production and Procurement Impacts

Wood Energy Crops – In New York State, there are several wood energy plantations (predominately fast-growing willow trees) that are managed as agricultural crops. These crops are grown exclusively to produce biomass fuel and have been used in co-firing applications at coal-fired plants. These trees are harvested once every three to four years and resprout after cutting, eliminating the need for the annual planting necessary for growing most agricultural crops. Willow trees grown in energy plantation are ten times more efficient at sequestering CO_2 than trees grown in native forests, and production per acre exceeds that of traditional crops.[27] When properly sited and managed, these crops can increase wildlife diversity and protect riparian habits, and improve landscape aesthetics and soil nutrient levels. Conversely, poorly sited and managed plantations (including harvesting methods) can increase the risk of soil erosion, result in pesticide runoff, and deplete the soil of nutrients.

Forest Resources - New York's forests have the potential to provide abundant sustainable biomass energy resources, without contributing to CO_2 levels. However, if large forested areas are not properly managed for sustainability, CO_2 levels will increase because those levels will not be recycled for new growth. Also, poorly managed timber harvesting operations can result in significant impacts to forest ecosystems (*i.e.*, destruction of significant habitats, uncontrolled soil loss, stream sedimentation and visual blight on the landscape). Conversely, if large non-forested areas are converted into biomass plantations, as discussed above, the overall increase in vegetation cover will reduce CO_2 levels. In addition, well-managed and controlled harvesting operations in forested areas can have beneficial impacts to forest ecosystems (*i.e.*, improved tree growth and species diversity through select thinning operations, which can improve wildlife habitat diversity, forest productivity, aesthetics and recreation). For the RPS, the eligibility of wood biomass resources for energy production will be conditioned on that use not adversely affecting long-term forest health, or compromising the sustainability of the biomass resource. As defined in Table 2-1A, regarding biomass resource eligibility, tree harvesting operations must be

[27] State University at New York College of Environmental Science and Forestry @ http:// www.esf.edu/willow.htm

performed in a manner that protects or improves forest productivity and conserves biological diversity, soil and water resources.

Wood Waste – With the exception of biomass gasification technologies, waste wood that is considered "clean" or "unadulterated" is proposed to be eligible as a biomass fuel in the RPS program (see Table 2-1A). Using clean biomass residues as fuel, rather than disposing of them in landfills, can reduce the need for additional landfill space and avoid production of GHG emissions (methane) from the decaying waste wood. For certain types of biomass gasification technologies that convert the biomass to a synthesis gas before it is converted to energy, some sources of adulterated biomass may be appropriate for feedstock.

Solid Waste Impacts

Ash from biomass electricity production will require disposal either by being spread over land, or in a landfill. An important benefit from using clean biomass resources is that it reduces the concentration of hazardous material created during combustion. In the alternative, if wood is adulterated (treated) with compounds such as chromium, chlorine and arsenic, the ash produced may have a higher concentration of hazardous materials resulting in greater environmental risks associated with disposal (*i.e.*, accidental release of ash into the atmosphere or leaching into groundwater).

Construction Impacts

Impacts associated with the construction of any new biomass facility would be typical of other electric generating facilities of similar size. Construction site activities such as clearing, grading, excavating, steel and building erection, equipment installation, and final restoration will potentially result in short-term increases in air emissions, dust, noise, traffic, visual intrusion, and ecological disturbances. As with the operational impacts, the extent of the site-specific construction impacts will vary according to the location of the site. Proper environmental management and construction standards and practices, as well as appropriate oversight, will help minimize the extent of these impacts during construction.

Permits and Approvals

Proposed solid fuel-fired stationary combustion facilities (such as a direct-fired wood biomass plant) are, at a minimum, regulated under *6 NYCRR Part 227*

(Stationary Combustion Installations), and would be required to control pollutants such as NO_x and PM administered by the DEC. These facilities may also be subject to other state and federal regulations such as New Source Review (NSR), New Source Performance Standards (NSPS) and Maximum Available Control Technology (MACT), which require the control of all criteria pollutants. The DEC also allows clean unadulterated wood (considered a traditional fuel) and other categories of waste wood (considered an alternative fuel) to be combusted at existing power generation facilities, as described in its Alternative Fuel Policy DAR-3. This Program Policy provides a mechanism for the review, test firing, and approval for the use of alternative biomass fuels.

6.2.4 BIOGAS ENERGY

6.2.4.1 Landfill Gas

Landfill gas (LFG) is generated when organic materials in Municipal Solid Waste (MSW) landfills naturally decompose by bacteria. The gas is approximately 50% methane, the primary component of natural gas. The other 50% of the gas is predominantly CO_2, with small amounts of NO_x, and trace levels of non-methane organic compounds (NMOC). These compounds consist of certain hazardous air pollutants (HAP) and volatile organic compounds (VOC) which can react with sunlight to form ground-level ozone (smog) if uncontrolled. All MSW landfills emit this gas in amounts that depend on a variety of factors, such as waste composition and the landfill size. LFG generation typically begins after waste disposal and can continue for 20 or 30 years after the landfill is closed. LFG can be used for on-site electricity generation, a use widely practiced throughout the United States with approximately 330 LFG-to-electricity (LFGTE) facilities currently in operation.

Technology Overview

LFG is typically collected by a series of wells placed strategically throughout the landfill. The wells are connected by a series of pipes leading to larger, header pipes that deliver the gas to a processing and conversion stations. Energy conversion technologies include: reciprocating (internal combustion) engines; combustion turbines; boilers with steam turbines, combined cycle systems; and microturbines. Although in the research and development stage, fuel cells also have

the potential to use LFG for power production. A brief description of these technologies, and their applicability, is set forth below.

Reciprocating Engines (internal combustion) – Internal combustion engines are the most common technology used to generate electricity from LFG. Engine models used at landfills range in size from approximately 0.5 to 3 MW, and are generally used in projects with capacities ranging from 0.8 to 6 MW (many with more than one engine). Recently, some smaller models have been developed. Reciprocating engines are usually the most feasible and cost-effective electricity generation technology for landfills containing approximately 1 million to 5 million tons of waste, and have been used for landfills with up to about 10 million tons of waste. (An MSW landfill with 1 million tons of waste in place can typically support a 0.8 to 1 MW electricity project).

Combustion Turbines – Combustion turbines are typically used at large MSW landfills containing over 5 million tons of waste with the potential to generate more than 5 MW of electricity. Gas turbines heat large quantities of compressed atmospheric air, which expands in the power turbine to develop shaft horsepower to drive an electrical generator. In selected situations, heat recovery steam generators (HRSG) are added to combustion turbines installations to improve fuel efficiency and generate additional power. Usually the captured steam is run through a steam turbine-generator for secondary power generation (combined cycle).

Boilers with Steam Turbines - These systems utilizes the same systems as steam-electric power plants. Water is heated to produce steam, which is expanded in a turbine to spin a generator, thus producing electricity. These systems have been used at only a few large landfills due to their capital intensive nature and size requirements. They are suitable for landfills containing 15 million tons of waste in place, or more, and typically produce at least 10 MW of electricity.

Microturbines - This recently commercialized technology is under demonstration at several MSW landfills. They are based on the same design principles as much larger

gas turbines, but generate smaller amounts of electricity. For example, typical microturbine models generate 30 to 100 kW of electricity. Their size makes them best suited for small applications, typically 1 MW or less.

Fuel Cells - Fuel cells in the range of 100 kW to 200 kW are being tested at several landfills. There are no commercial installations of fuel cells using LFG as a feedstock. The primary barrier to increased use of LFG with fuel cells is the cost required to pre-treat the gas to remove sulfides and other trace compounds that could damage the fuel cell. However, fuel cells are currently being located at wastewater treatment facilities to be utilized in conjunction with anaerobic methane digesters.

6.2.4.2 Methane Digesters

A methane digester system, commonly referred to as an anaerobic digester, is used for manure waste management on farms, or methane waste at wastewater treatment facilities. At farm locations, digesters promote the decomposition or "digestion" of the manure into methane gas. The manure is fed into an anaerobic (without oxygen) tank where bacteria convert the organic matter into methane, which is collected under a plastic dome or hard cover. The gas can be flared off into the air, piped to a boiler for hot water and space heating, or into an engine or generator to create electricity for farm use or for sale into a utility's grid. Scrubbers remove hydrogen-sulfide gas from the methane before the biogas is fed into a combustion engine.

Status of Biogas Development in New York

LFGTE projects have been in operation at large landfills in New York State for the past 20 years. There are approximately 15 in operation in the State with a total generating capacity of approximately 65 MW. A list of project sites is provided in Table 6.2.4-1.

Table 6.2.4-1
LFG Projects in New York

Facility/Location	MW
Al Turi, Goshen	5.0
Brookhaven, Brookhaven	5.0
Broome County Nanticoke, Binghamton	1.6
Greater Albany, Albany	1.9
High Acres, Fairport	3.2
Lancaster, Lancaster	5.2
Modern, Model City	5.2
Monroe, Livingston	2.4
Oceanside, Hempstead	3.0
Old Bethpage, Oyster Bay	1.2
Orange County, Goshen	3.2
Saratoga Springs, Saratoga	1.0
Seneca Meadows, Waterloo	11.2
Smithtown, Smithtown	1.2
Tripoli, Camillus	1.2

In addition, six farms generating electricity from methane digesters in upstate New York are participating in the net metering program, producing about one MW total of interconnected generation.

Potential Development

The U.S. EPA's Landfill Methane Outreach Program (LMOP)[28] identifies New York as having a high potential for continued development of LFG energy projects. In addition to the 15 currently in operation, the EPA identified 17 additional landfill sites as candidates for LFG energy recovery. The RPS Cost Study projected potential levels of development based on these and other analyses of specific landfills and waste generation patterns in New York State for the RPS study period.[29] Overall, the RPS Cost Study projected that LFG energy projects could potentially account for up to 120 MW of additional electric generation capacity in all three megazones (all of New York State), through 2013.

[28] EPA's LMOP is a voluntary assistance and partnership program that promotes the use of landfill gas as a renewable energy source.

[29] See RPS Cost Study, Volume A - Appendix A (Renewable Resource Costs and Characteristics), Section A.6.4-Landfill Gas.

In addition, the potential levels of development of manure digesters in New York were also projected in the RPS Cost Study. The assumptions were based on, among other things, the number of dairy farms and milk cows in the state. Overall, the Cost Study estimated that approximately 44 MW of potential generating capacity could be achieved within the RPS study period. Table 6.2.4-2 provides a summary of potential biogas development through 2013.

Table 6.2.4-2
Potential Biogas Development

	2006		2009		2013	
	MW	**MWH**	**MW**	**MWH**	**MW**	**MWH**
Manure Digestion	22.3	117,300	44.6	234,600	44.6	234,600
Landfill Gas IC Engines	63.7	530,320	103.0	857,512	117.1	974,199
Landfill Gas Microturbines	1.9	15,529	3.2	26,943	4.1	34,515
Totals	**87.9**	**663,149**	**150.9**	**1,119,055**	**165.8**	**1,243,314**

Environmental Impacts

Converting biogas into electricity has long been favored as an effective means to control air emissions of GHG, odors, and agricultural waste runoff.

Air Emissions

Biogas energy projects can significantly reduce emissions of GHG (specifically methane and CO_2), and other odorous compounds emanating from landfill sites, wastewater treatment facilities and farms. As with the combustion of biomass, the type and quantity of released criteria pollutants and trace amounts of other hazardous air pollutants (HAPs) depends on the composition of the biogas, combustion technology and air pollution controls employed. The amounts of HAP from biogas combustion is relatively small compared with other sources of fossil-fuels, and pose a less significant health and environmental risk than the release of methane, CO_2 and other HAPs from uncontrolled methane gas sources emitted form landfills, large farms and wastewater treatment facilities.

Water Quality Impacts

A primary water quality benefit of utilizing manure digestion systems on large dairy farms is the control of non-point source pollution caused by the runoff of manure into surface and subsurface waters. The current practice of storing and spreading manure over fields can often result in runoff of pathogens into nearby watercourses and groundwater. In contrast, controlled high temperature decomposition in a digester will reduce pathogens found in manure. Processed manure from a digester can be separated into an equal-to-pre-digested volume of liquid and solid byproducts. When spread on fields, much of the available nitrogen in the digested liquid is taken up by vegetation, making for less runoff into groundwater and surface waters.

Odors

Odors released from both uncontrolled landfills and livestock farming operations are often a frequent community complaint. Compounds found in landfill gas are associated with strong, pungent odors and can be transmitted off-site to residential areas, potentially lowering the quality of life for individuals who live adjacent to landfills. Along with reducing the air emissions cause by GHG's and other non-methane compounds, LFG energy projects can also be an effective means of reducing odors through the collection of gas for combustion.

Odors emitted from manure on farms can also be reduced through the use of manure digesters. Basically, an odor control system collects the biogas to fuel a boiler that, in turn, heats the digester. Heating a digester decreases the volume needed to stabilize manure by accelerating the biological (anaerobic) process that destroys odor-producing compounds in the manure.

Construction Impacts

Impacts associated with the construction of any new biogas facility would be typical of other electric generating facilities of similar size. Construction site activities such as clearing, grading, excavating, steel and building erection, equipment installation, and final restoration will potentially result in short-term increases in air emissions, dust, noise, traffic, visual intrusion, and ecological disturbances. As with the operational impacts, the extent of the site-specific impacts will vary according to the location of the site. Proper environmental management and construction standards and

practices, as well as appropriate oversight will help minimize the extent of these impacts during construction.

Permits and Approvals

Because of the benefits of collecting and controlling landfill gas, EPA *Standards of Performance for New Stationary Sources* (NSPS) and *Guidelines for Control of Existing Sources,* and the *National Emission Standards for Hazardous Air Pollutants* (NESHAP) require "large" MSW landfills to collect landfill gas and combust it to reduce NMOC by 98 percent (or to an outlet concentration of 20 ppmv).[30] Landfills are meeting these gas destruction standards using flares or energy recovery devices, including reciprocating engines, gas turbines, and boilers. In addition to gas destruction requirements, the NSPS and NESHAP require that gas collection systems be well designed and well operated. They require gas collection from all areas of the landfill, monthly monitoring at each collection well, and monitoring of surface methane emissions to ensure that the collection system is operating properly and to reduce fugitive emissions. Smaller MSW landfills are not required to control emissions by the NSPS or NESHAP, but can still greatly reduce emissions of NMOC by collecting and combusting landfill gas for energy recovery or in a flare. New York permitting standards would be in accordance with federal requirements described above. At a minimum, the energy recovery equipment would be subject to the requirements of 6 NYCRR Subparts 227-1 and 227-2 if they qualify as a major source.

Farms qualifying as a Concentrated Animal Feeding Operation (CAFO) may be required to have a State Pollution Discharge Elimination system (SPDES) permit issued by the DEC. Also, an Agricultural Waste Management Plan (AWMP) developed by a qualified Agricultural Specialist may be a condition of that permit.

[30] A "large" landfill is defined as having a design capacity of at least 2.5 million metric tons and 2.5 million cubic meters, and a calculated or measured uncontrolled NMOC emission rate of at least 50 metric tons (megagrams) per year.

6.2.5 PHOTOVOLTAICS

Technology Overview

Photovoltaic (or PV) systems convert light energy directly into electricity. Commonly known as "solar cells," PV systems are currently used for many simple applications such as powering small calculators and wrist watches. Larger and more complicated systems provide electricity for pumping water, powering communications equipment, as well as electric power generation.

The most important parts of a solar cell are the semiconductor layers, where the electron current is created. A number of different materials are suitable for making these semi-conducting layers. Each has benefits and drawbacks; no one ideal material exists for all types of cells and applications.

In addition to the semi-conducting materials, solar cells consist of a top metallic grid, or other electrical contact, to collect electrons from the semiconductor and transfer them to the external load, and a back contact layer to complete the electrical circuit. On top of the complete cell is a glass cover or other transparent encapsulant to seal the cell and keep weather out, and an anti-reflective coating to keep the cell from reflecting the light back away from the cell.

The "photovoltaic effect" is the basic physical process through which a PV cell converts sunlight into electricity. Sunlight is composed of photons, or particles of solar energy. These photons contain various amounts of energy corresponding to the different wavelengths of the solar spectrum. When photons strike a PV cell, they may be reflected or absorbed, or they may pass right through the cell. Only the absorbed photons generate electricity. When this happens, the energy of the photon is transferred to an electron in an atom of the cell (which is actually a semiconductor). With its newfound energy, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit. By leaving this position, the electron causes a "hole" to form. Special electrical properties of the PV cell—a built-in electric field—provide the voltage needed to drive the current to an external load (such as a light bulb).

The conversion efficiency of a PV cell is the proportion of sunlight energy that the cell converts to electrical energy. This is important when discussing PV

devices, because improving this efficiency is vital to making PV energy competitive with more traditional sources of energy (*e.g.*, fossil fuels). If one efficient solar panel can provide as much energy as two less-efficient panels, then the cost of that energy (not to mention the space required) will be reduced. For comparison, the earliest PV devices converted about 1%-2% of sunlight energy into electric energy. Today's PV devices convert 7%-17% of light energy into electric energy.

The largest drawback to solar power today is price, with electricity from PV systems costing about 30 cents/kWh. Although this price has dropped considerably in the last few decades, and will continue to drop as it becomes more widespread, currently, it is not very cost effective. Another drawback to PVs is that they only generate electricity during daylight, and are most efficient when the sun is shining. On a small scale, therefore, energy storage systems are required. Studies and field experience have shown that integrating intermittent PV-generated electricity into the electric grid provides few technical difficulties, even when considering much higher levels of solar power usage than current usage levels.

PV applications considered in the RPS Cost Study include:

- Residential systems – installed in both new construction and existing homes. A typical residential system can average 3 kW installed capacity, and take advantage of utility net metering. Net metering permits the customer to spin their meter backwards when the solar electric system produces more power than is consumed at the home, and receives retail credit for this power.[31]

- Commercial / Industrial sited systems – designed to maximize solar energy and capacity output. These systems, with an average installed capacity of 200 kW, will generally be sized so that they produce power "behind the meter" for the customer, and not export any power to the utility grid since they are not eligible for retail net metering. Nevertheless, although they are not exporting power to the grid, the electric and capacity benefits produced by these systems reduce the customer load, and therefore, directly off-set demands on the power grid.

[31] New York's Net Metering Law allows photovoltaic systems up to 10 kW to net meter. Credit for excess power is rolled forward on a monthly basis, with any annual surplus production to be reimbursed by the utility at wholesale rates. See PSL §66-j.

- Building integrated photovoltaic systems – typically vertically oriented on facades with orientations between east and west in a southerly direction. These systems will typically provide lower levels of solar output, due to orientation, but can provide building material cost reductions (for glazing or cladding materials) that can partially or wholly off-set the power production penalty. To take advantage of this benefit, building integrated systems are therefore most likely to be installed in new construction applications. These systems are primarily sized to meet loads on the customer's side of the meter.

Status of PV Development in New York

Although PV technologies have been demonstrated in New York through various programs, it remains a very small generation source in the current State energy mix (approximately 5,400 kWh generated in 2002).

Potential Development

Preliminary estimates of New York's PV potential development levels are discussed in the RPS Cost Study, as refined by the RD Cost Analysis, and are presented in Table 6.2.5-1. The market development and application of solar technologies will be greatly affected by cost factors. The primary factor underlying the technical potential is the availability of sites. Solar technologies are best suited for generation near points of electricity use. Therefore, deployable spaces are used as an upper limit for technology deployment. These spaces included roofs, facades, parking lots, and exclusion zones (*i.e.*, along roadways).

Table 6.2.5-1
Potential Solar Development

	2006		2009		2013	
	MW	**MWH**	**MW**	**MWH**	**MW**	**MWH**
Solar PV	2.3	3,065	9.3	12,260	18.7	24,519

The RPS Cost Study assigned photovoltaic technologies to the SBC-like tier using three technology approaches (residential, commercial/industrial, and building integrated. Solar photovoltaics are assumed to be located in all three megazones (*i.e.*, all of New York State).

Environmental Impacts

Typical PV cells are primarily composed of silicon, an inert, abundant substance found on Earth. PV systems operate without sound, air or water emissions, moving parts, and require little maintenance. Proper manufacture and installation of PV systems in New York is generally considered to have a negligible environmental impact.

6.2.6 FUEL CELLS

Technology Overview

A fuel cell generates electricity through an electrochemical reaction that requires an external source of hydrogen, either from a hydrogen storage system or an integral reactor that produces hydrogen from hydrocarbon fuels, such as natural gas or methanol. A fuel cell consists of two electrodes—a negative electrode (or anode) and a positive electrode (or cathode)—sandwiched around an electrolyte. Hydrogen is fed to the anode, and oxygen is fed to the cathode. Activated by a catalyst, hydrogen atoms separate into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity. The protons migrate through the electrolyte to the cathode, where they reunite with oxygen and the electrons to produce water and heat. Since fuel cells employ a chemical process instead of a combustion process, air emissions are considered negligible than those from combustion technologies.

Most stationary[32] fuel cell systems likely to be used for power generation will be installed with systems for heat recovery for creating hot water or steam. A combined heat and power (CHP) fuel cell system offers the inherent environmental benefits of fuel cells, along with much higher overall efficiencies obtained by using the heat output of the system.

The types of fuel cell technologies considered in the RPS Cost Study are described below.

- Polymer Electrolyte Membrane Fuel Cell (PEM) 5-10 kW. This technology will likely arise as the dominant technology for the residential and small commercial sectors. The operating temperatures for PEM cells are low (under 200ºF/93ºC), and can be used with or

[32] Non-stationary fuel cells are those used for transportation.

without heat recovery. The low temperatures allow for residential-grade water heating, but are too low for producing high-quality steam. The primary fuel for residential PEM fuel cells will be natural gas. Early market reports indicate that the adopters of residential fuel cells will be high-end new construction single family residences, most of which are built in areas with natural gas service. Other likely markets include: small businesses; customers in remote locations; and customers with high reliability needs.

- Phosphoric Acid Fuel Cell (PAFC) 200 kW. This technology is well-suited to commercial and small industrial applications, and is a good candidate for CHP. The technology remains expensive relative to other distributed generation technologies, but operating the units with heat recovery makes the economics more favorable. The initial market for PAFC's has typically been high-value niche industries. The technology is also attractive where a minimal environmental footprint is desired, as was the case with the New York Central Park police station. The market will likely continue to grow in these niche areas before being adopted by a broader audience. PAFC's also require a fuel reformer to extract hydrogen from a hydrocarbon fuel, whereas some of the higher temperature technologies, such as SOFC and MCFC, do not require this extra fuel treatment.

- Solid Oxide Fuel Cell (SOFC) 200-250 kW. Solid oxide fuel cells in this size range will compete with the currently commercialized phosphoric acid fuel cells in the commercial and small industrial market. SOFC can be used in facilities with high heating loads such as Internet data centers and industrial manufacturing facilities. This technology can be operated at high temperatures to eliminate the use of a fuel reformer. The higher operating temperatures, and higher electrical efficiency (40-50%), of the SOFC provide an attractive electricity and heat generating option.

- Molten Carbonate Fuel Cell (MCFC) 250-2000 kW. This technology is desirable because it does not require a fuel reformer. Direct fuel cells can be operated on many types of hydrogen-rich fuel. The direct fuel cell systems operate at higher temperatures than many technologies, making it a candidate for heat recovery and steam generation in industrial applications. Initial markets for MCFC include the biotechnology and pharmaceutical industries.

Status of Fuel Cell Development in New York

Fuel cells have only recently begun to be used as electrical generation sources in New York. Approximately 38,000 MWh of electricity were generated by fuel cells in New York in 2002. Although demand for fuel cells is reportedly greater than the

current supply, installation costs remain well above established conventional generation sources, making widespread implementation for electric generation uneconomic at this time.

Potential Development

Estimates for fuel cell development, as described in the RPS Cost Study, as refined by the RD Cost Analysis, are presented in Table 6.2.6-1.

Table 6.2.6-1
Potential Fuel Cell Development

	2006		2009		2013	
	MW	MWH	MW	MWH	MW	MWH
Fuel Cell	7.0	55,168	24.5	193,090	31.5	248,258

The RPS Cost Study assigned fuel cells to all three megazones using four technologies: PEM, PAFC, SOFC and MCFC.

Environmental Impacts

Fuel cells have the potential for the lowest level of air emissions of any fossil fuel-based electricity generating technology. Because fuel cells do not involve the combustion of a fuel, the NO_x and SO_2 emissions, typically by-products of electric generating technologies, are avoided. Additionally, as fuel cell technology continues to advance to include hydrogen as a fuel source, emissions will ultimately be zero.

6.2.7 OCEAN ENERGY

Technology Overview

Generating technologies that derive electrical power from the world's oceans include tidal energy, wave energy and ocean thermal energy conversion.

Tidal energy takes the highly predictable nature of the tides and converts its kinetic energy into electricity by placing turbine equipment in off-shore areas. It is only deemed practical at those sites where energy is concentrated in the form of large tides and where the geography provides suitable sites for tidal plant construction. These conditions are not commonplace, but several locations in Maine and Alaska have been identified as having the greatest potential in the United States. Most of the efforts in this field are taking place in Europe and Scandinavia. In the summer of 2003, the

world's first offshore tidal energy turbine was built off the Devon Cost in the United Kingdom.

Wave energy takes advantage of the ocean waves caused primarily by interaction of winds with the ocean surface. Unlike the tides, this is an irregular energy source. Many devices have been invented to harness the waves' power, but few have been tested. Of those that have, most have only been in artificial wave tanks.

Ocean thermal energy conversion works by converting the temperature difference in the ocean's surface and at depth into electricity. This is done by using the warmer water to heat a working fluid which evaporates at pressure and runs through a turbine. For the process to work, conditions require a temperature difference of at least 36ºF, at a depth of around 1000 meters. This limits the areas where this technology can be applied, with no real potential in and around New York State.

Although these technologies are under development, they are not yet ready for commercial use, and are not expected to become commercially available in New York State within the study period. More research and development remains, including cost reductions, efficiency and reliability improvements, and identification of suitable sites. The potential impacts to marine life and habitat will be an important siting consideration in New York.

Status and Potential Development in New York

In New York, a particular tidal hydroelectric project is the Roosevelt Island Tidal Energy (RITE) project in New York City. The RITE project aims to demonstrate and commercialize so-called "free-flow" hydroelectric generators, which rely on the kinetic energy of existing water flows without the need for impoundments or other major civil works. The technology utilizes small axial flow hydro turbine generators singly mounted on mono piles driven into a waterway basin (in this case, the East River of New York City). The turbine/generators are designed to rotate freely, in synchronization with changing tidal or river currents, and to generate electricity from the kinetic energy of those currents. In the demonstration phase of the project, now under review, a small number of the turbine generators would be installed and monitored to validate predicted performance and to optimize technology and resource factors to move towards

commercial installation. If proven successful, plans are to install up to 10 MW (by 2006) in the commercial phase of the project.

6.2.8 WASTE-TO-ENERGY

Municipal solid waste is the stream of waste generated by residential, commercial, and industrial sectors. MSW consists of items such as paper, yard and food waste, furniture, appliances, clothing, bottles, plastics, paint and batteries. It does not include hazardous or radioactive waste from medical, commercial and industrial waste, because under New York and federal laws, that waste is required to be treated separately.

MSW is managed by a combination of disposal in landfill sites, recycling, and combustion (incineration). For the past 20 years, combustion technology has grown to include energy recovery. Electricity can be produced as a by-product of combustion in what is commonly referred to as a Waste-to-Energy (WTE) or Resource Recovery Facility. WTE plants are unique in power production as they provide a means for municipal solid waste reduction and disposal in addition to power production. The combustion of MSW also offsets generation of GHG emissions from waste that would otherwise be decaying in landfills. MSW is composed of combustible (organic) and non-combustible (inorganic) components. Typically, about 75-80% of MSW is combustible by weight. (paper, plastic, food, yard waste, wood, rubber textiles and leather). About 20-25% is non-combustible (metal, glass, sand, brick, dirt, ash, and other materials). The Higher Heating Value (HHV) of MSW is typically between 4,500-6,200 Btu per pound, with an average HHV of about 5,400 Btu per pound. Potential power production in kWh per ton will vary with the HHV, but typically is about 500 kWh/ton.

Technology Overview

Current WTE technologies vary by manufacturer but the treatment of the waste is typically divided into two main categories of facility design:

1) Mass Burn Systems - where the MSW fuel stock is burned in an unsorted "as is" condition and,
2) Refuse-Derived Fuel (RDF) Systems – where the MSW is sorted and processed before burning.

These systems are described more fully below.

Mass Burn – Mass Burn is the predominant WTE technology. It involves the direct combustion of MSW in much the same way as fossil fuels are used in other direct combustion technologies. Mass Burn plants make direct use of waste in an "as is" condition. The heat produced from incineration is converted into steam, which then drives a turbine generator to produce electricity. Mass Burn plants typically consist of two or three units, as described below, consisting of independent feed, stoker (furnace), boiler, and an emission pollution control system, often supplying steam to a common turbine generator. Large combustion units typically handle 250 tons per day (TPD) or more of MSW; small units usually combust less than 250 TPD.

Receiving, storage and feeding system – The refuse is delivered either directly from the hauler or from solid waste transfer stations. MSW collection vehicles enter a weigh station and a tipping hall. The transfer station is generally expected to provide waste that is free of materials prohibited from combustion by law. In addition, all waste is subject to the WTE facilities' inspection program including radiation detection, visual screening, and radon inspections. Waste is unloaded directly into the refuse bunker and is mixed with grapple cranes and dropped into a hopper. A feeder pushes the waste into a roller grate system or conveyor belt.

Fuel combustion and steam generation system – The mixed waste enters a combustion chamber on the roller grate system or conveyor where it is incinerated at high temperatures to maximize combustion and minimize formation of dioxins and other hazardous compounds. The heat generated from incineration produces steam in a boiler that usually includes super heaters and economizers to increase energy recovery.

Turbine condensing and cooling system – The steam from the boiler drives the turbine generator to produce electricity. A separate cooling loop system condenses the steam and transports waste heat to a cooling tower. Some water is lost to the atmosphere as vapor, while the rest is recycled back to the condenser. Flue gases are cooled and then pass

through a series of pollution control devices to remove hazardous emissions produced as a result of combustion.

Air pollution control systems – The cooled combustion gases pass through a series of pollution control systems before they are released into the atmosphere through the stack. These systems can include:

- Scrubbers – a lime slurry is sprayed on the cooled gases to neutralize the acid gases and control metals;
- A fabric filter bag house – to capture the remaining particulate matter (fly ash);
- Electrostatic precipitators and /or fabric filters – to control fine particulate matter, selective non-catalytic reduction (SNCR) to control nitrogen oxides, and carbon injection to control mercury emissions; and
- Carbon injection systems – to blow charcoal into the flue gas to absorb mercury and organic emissions such as dioxins.

Ash handling systems – An "ash" or inorganic residue is created as a result of burning MSW and must be disposed. The two main types – fly ash and bottom ash – are treated throughout the various stages of the combustion process. Fly ash is the residue carried out of the burn chamber and collected by air pollution controls. Bottom ash is the residue left on the grate after the waste has been burned. Both bottom ash and fly ash are combined and wetted to reduce dust and then transported by a roller grate or conveyor for further processing to remove metals for recycling. After processing, the ash is moved to an ash storage area, where it may be mixed or processed as an additive to construction material such as road-fill or cement, or it may be transported to a landfill.

Electrical transmission systems – Electric transmission facilities, including a switchyard and/or substation, are necessary for on-site generation and for interconnection of a WTE facility with the electric power grid.

Refuse Derived Fuel (RDF) – RDF is a result of processing MSW to separate the combustibles from the non-combustibles and to create a fairly uniform material. RDF from MSW is predominately composed of paper, plastic, waste wood, food, and yard

waste. Although the level of pre-combustion processing varies among facilities, it typically involves shredding the MSW into uniformly sized particles or compacting the material into briquettes. Processed RDF generally has a higher heating content than untreated MSW because of the uniformity in the fuel and is typically more easily transported and handled. It has the potential of being co-fired with other fuels such as wood or coal in existing facilities. Although the technology is considered mature, it is less common than mass burning, typically because of higher operating costs.

Other emerging technologies for treating solid waste include anaerobic digestion and thermo-depolymerization – processes that convert waste into either a gas or liquid fuel. These technologies, however, will have to overcome significant technological and economical obstacles to be put into full scale commercial operation.

Status and Potential Development in New York

New York currently has ten operating WTE generation facilities that range from 2 MW to 78 MW in size, with a total installed capacity of approximately 300 MW. In 2002, WTE facilities in New York generated approximately 1,842,000 MWh of electricity. A summary is provided in Table 6.2.7-1.

Table 6.2.8-1

Waste-to-Energy Facilities in New York State

Facility	MW	In-Service	MWh (2002)	Current Air Permit Issued	Expires
Dutchess County	9.2	9/87	45,764	8/99	8/04*
Hempstead	78.6	10/89	541,649	8/00	6/05
Babylon	17	4/89	98,645	4/04	3/09
Huntington	25	12/91	169,448	4/01	4/06
Islip	12.5	3/90	36,339	2/00	3/05
Adirondack Resource Recovery	15	10/91	79,692	5/00	9/10
American Ref-Fuel Niagara	25	5/93	278,003	1/00	1/05
Onondaga	39.5	12/94	221,883	11/01	11/11
Oswego	1.8	3/86	3,549	5/00	5/05
Charles Point	74.5	4/84	367,119	8/96	7/06
Totals	298.1	N/A	1,842,041	N/A	N/A

*Application renewal filed 2/04, final decision pending.

Although WTE facilities in New York State have successfully met or exceeded federal and state air emission requirements, public concerns about emissions and possible health risks, discussed below, are still present. Experience shows that siting WTE facilities is difficult and controversial.[33] Generally, such plants are only successfully sited when the municipality charged with the responsibility for solid waste collection and disposal puts its governmental powers behind the siting effort. In the event new facilities were to be constructed, current market conditions suggest that they would likely be sited in New York City and other metropolitan areas where MSW disposal costs are high and long-term disposal options are uncertain. The RPS Cost Study, in a sensitivity analysis, estimated that perhaps two additional 50 MW WTE facilities could be sited in New York in the 2006 through 2013 timeframe. The study

[33] WTE facilities are subject to environmental review under SEQRA and have been exempt from the power plant siting laws (*i.e.*, Article X of the Public Service Law, which expired in January 2003). The exemption was based on recognition that Article X was not an appropriate process for a facility whose primary purpose is processing municipal solid waste and generating electricity only as a secondary output. SEQRA is a more appropriate process to address the major issues associated with WTE facilities.

assumed one in Megazone 2 (lower Hudson Valley) and one in Megazone 3 (New York City).[34]

Environmental Impacts

Air Emissions

Despite tightening of emission standards for MSW combustion, and considerable improvements in air pollution control technology over the past decade, WTE facilities produce significant emissions, including hazardous air pollutants.[35] The vast majority of emissions from WTE facilities are typical of other fossil-fuels plants (CO, CO_2,[36] NO_x, SO_2, and particulate matter (PM)).

Other hazardous emissions from WTE facilities, which are released at much lower concentrations, include hydrogen chloride (HCL), hydrogen fluoride (HF), volatile organic compounds (VOCs) as well as heavy metals such as mercury (Hg), lead (Pb) and cadmium (Cd). Mercury is of primary concern because it is extremely volatile and has the greatest potential of all metals commonly found in MSW to vaporize and pass through the stack. Airborne mercury is deposited in lakes and rivers where it can accumulate in sediments and be absorbed by plants and animals, leading to bioaccumulation in higher predators, especially fish and fish-eating mammals. In addition, hazardous compounds, such as polychlorinated dibenzodioxins and polychlorinated dibenzofurans (commonly termed dioxins and furans, respectively), are also formed during the combustion process.

The emissions from any given WTE facility will vary according to the technology and operating standards employed.[37] Many of the emissions can be minimized by using both advanced combustion and air pollution control technologies. In addition, the composition of the waste will affect emissions and will vary between and

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[34] See RPS Cost Study, Volume B, Section III-D, Waste-to-Energy Sensitivity.

[35] See Environmental Protection Agency: Electricity from MSW at http://www.epa.gov/cleanenergy/muni.htm.

[36] Although WTE plants emit CO_2, a primary greenhouse gas, most of it is considered to be a part of the natural carbon cycle.

[37] It is difficult to derive representative data on "average" WTE emissions, particularly with regard to heavy metals compounds. Instead, a good guide to the likely upper limit of emission levels can be obtained from current regulatory standards found at www.epa.gov/ttnatw01/129mwc.

within regions, by season, and with development of future waste disposal strategies such as recycling programs and initiatives.

Water and Aquatic Impacts

Although WTE facilities are smaller in scale than most base load fossil-fuel plants, their operation can require a similar amount of water per unit of electricity generated depending on the combustion, cooling, and air pollution control technologies used. Water for plant operations can come from a surface water body, such as a lake or river, on-site wells, a municipal water supply source, or from the effluent of municipal waste-water treatment plant. If process water comes from a surface water source, water in-take structures would be required to withdraw the necessary water for the plant's operation. Aquatic impacts can occur as a result of organisms being held against (impingement) or passed through (entrainment) the in-take screens, thereby causing stress or death. Thermal water discharges may also affect the aquatic environment by elevating water temperatures that may harm organisms, eliminate habitat, cause adverse changes to the composition of resident populations, and/or form barriers to migratory routes.

WTE facilities in New York State use a closed-loop cooling system by utilizing either dry (air-cooled condenser) or hybrid wet-dry cooling towers. Compared to an open loop system, water withdrawal and consumption is extremely low at these WTE plants, thus reducing or eliminating aquatic and other water-related impacts.

Solid and Liquid Waste

The solid and liquid waste generated by the operation of WTE facilities includes the bottom and fly ash, and wastewater used for specific pollution control technologies. In general, most of the inorganic pollutants (heavy metals) are present in the ash stream at higher concentrations than in the raw waste. The ash, if not incorporated into construction material or used for other purposes, is generally disposed of in a landfill. In New York State, the ash from WTE facilities is required to be tested on a semi-annual basis for hazardous material and routinely tests non-hazardous. This waste is essentially an inert material. Therefore, it will be released only as windblown dust (during transportation and landfilling) or from accidental leachate discharge from the landfill site.

Some combustion processes and abatement technologies may produce liquid effluents from ash quenching, boiler operation, and from gas cleaning equipment. Liquid discharges are controlled and treated prior to release into any water source.

Other Operational Impacts

Additional local impacts resulting from the operation of a WTE facility may include odors, litter, noise, vermin, visual intrusion, and excessive truck traffic. As with the operation of other generation facilities, impacts can be minimized with appropriate siting consideration, proper equipment design and layout, state-of-the art technology, and best management practices. For instance, modern WTE facilities are generally completely enclosed, including the waste tipping and storage area, thus reducing odors, wind blown litter, vermin and noise. Visual impacts can be mitigated by incorporating a low-profile building design and components, stack and cooling tower plume-abatement, and landscape screening.

Impacts associated with the collection and hauling of MSW to the plant site may be more difficult to mitigate. WTE facilities can adversely affect local communities due to additional vehicular emissions, congestion, noise, and odors from the transported waste along specific routes. Impacts associated with the construction and operations of a WTE facility in an urban community may be more difficult to ameliorate since urban residents already tend to experience compromised air quality, excessive traffic, and noise pollution. The location of the WTE site relative to the waste collection area will determine the magnitude of these impacts.

Construction Impacts

Impacts associated with the construction of any new WTE facility would be typical of other electric generating facilities of similar size. Construction site activities such as clearing, grading, excavating, steel and building erection, equipment installation, and final restoration will potentially result in short-term increases in air emissions, dust, noise, traffic, visual intrusion, and ecological disturbances. As with the operational impacts, the extent of the site-specific impacts will vary according to the location of the site. Proper environmental management and construction standards and practices, as well as appropriate oversight will help minimize the extent of these impacts during construction.

Permits and Approvals

The 1991 Federal Clean Air Act and subsequent amendments, address/govern air regulations for WTE facilities in New York State. DEC adopted these regulations in 1996. All WTE facilities in New York must meet federal New Source Performance Standards (NSPS), PSD, and National Ambient Air Quality Standards (NAAQS). All large WTE facilities (250 TPD) or greater in New York have been upgraded, as needed, to meet these regulations and amendments. Small WTE facilities (less than 250 TPD) have until 2005 to comply. The federal regulations containing the limits are:

40 CFR 60 Subpart Cb Existing Large (>250 TPD/unit);

40 CFR 60 Subpart Eb New Large (>250 TPD/Unit);

40 CFR 60 Subpart AAAA New Small (35 to 250 TPD/Unit) and,

40 CFR 60 Subpart BBBB Existing Small (35 to 250/Unit)

further broken down into Class I all units > 250 TPD and Class II all units <250 TPD.

Operating conditions, monitoring, reporting, and training requirements also apply under the Clear Air Act.

DEC issues permits relating to air emissions for both minor and major source types under federal authority delegated to the State by the U.S. EPA for federally enforceable permits (principally major sources), or under State authority (principally minor sources), or jointly by the New York City Department of Environmental Protection (NYC DEP) (principally minor sources) with the DEC.

Air pollution control projects are administered under the Uniform Procedures Act (UPA), Article 70 of the Environmental Conservation Law, and its implementing regulations, 6 NYCRR Part 621. In accordance with the UPA, permit applications are categorized as major or minor projects according to air emission type (contaminant) and potential annual emissions. Major sources under 6 NYCRR 201 are those that exceed the contaminant and quantity criteria in the affected area of the emission; all others are minor sources. DEC reports that every WTE facility in New York qualifies as a major source under Part 201. Major sources are subject to new source preconstruction permitting under 6 NYCRR Part 231 for non-attainment areas

and/or the federal Prevention Of Significant Deterioration (PSD) regulations under 40 CFR 52.21 for attainment areas on a pollutant specific basis.

Minor sources are permitted under SEQRA administrative procedures that serve to coordinate impact assessments, permits and local requirements. Minor sources seeking permits in the jurisdiction of New York City are permitted under joint or coordinated SEQRA and City Environmental Quality Review (CEQR) requirements that serve to coordinate State permit requirements and City permit requirements and, importantly, impact assessment requirements. In addition, federal guidelines and requirements for municipal waste combustors and DEC solid waste permit requirements would be applicable for WTE facilities.

6.3 Impacts on Electric System Reliability and Reserve Margin and Operation

As discussed in Section 6.0, the RPS has the potential to stimulate significant development of electrical energy requirements through the use of indigenous renewable resources, most notably wind. Large-scale wind generation can have impacts on power system operations because of its intermittent generation characteristics. While the impacts are considered relatively small at low penetration levels, significant penetration levels may require transmission system reinforcements and special planning and operating procedures for the overall transmission grid. Required transmission system reinforcements could induce construction activities necessary to upgrade transmission lines and substations. Special operating procedures could require additional operating reserves to guard against unexpected load fluctuations inherent in wind energy production.[38]

A preliminary study conducted to evaluate the reliability implications of increased wind generation concluded that New York State should be able to integrate wind generation estimated to meet the long term potential RPS demand (approximately 2,400 MW) without significant adverse impacts on the planning, operations, and reliability of the bulk power system, provided that appropriate wind farm requirements

[38] See RPS Cost Study, Section V-M, *Ancillary Transmission Services* for a more complete explanation of service requirements to maintain a reliable electrical system.

and operation practices are adopted when needed.[39] It should be noted that the study assumed the immediate inclusion of a relatively large amount of wind generation added to the state's bulk power system. In reality, the pace of development would be slower, with market and operating experience increasing with each new project development cycle. The NYISO has the responsibility for reviewing every proposed generation project, including wind, to ensure that all electrical reliability issues that could affect the state's overall bulk transmission system are addressed before recommending the project for approval.

6.4 Changes in Fuel Mix and Energy Security in New York State

The RD Cost Analysis used the MAPS model to evaluate the changes in fuel mix of electric generators in New York, and reported the implications of those changes to energy security.

The MAPS modeling results show that implementation of the RPS will result in displaced generation and underlying fuel usage due to the market effects of increased electric energy supply resources. See Table 6.4-1 below:

[39] "The Effects of Integrating Wind Power on Transmission System Planning, Reliability, and Operations" at http://www.dps.state.ny.us/03e0188.htm#related

Table 6.4-1
Fuel Usage Changes – Year 2013

Fuel Type	Units	Volume	Generation (MWh)
*Coal	TONS	(247,193)	(599,595)
Oil	BBL	(1,289,856)	(730,472)
Gas	MCF	(47,207,817)	(6,154,568)
Nuclear	MBTU	(6)	(1)
*Wood	TONS	(176)	(162)
Refuse	TONS	(434)	(215)
Landfill Gas	MBTU	13,300,569	980,991
TOTAL GENERATION			(6,504,022)

*These numbers do not include the additional wood co-fired in coal units. Therefore, the amount of coal reduction is understated and the wood reduction shown would likely be an increase instead of a reduction to account for co-firing.

It is expected that the addition of new renewable electricity supplies due to RPS demand will result in the displacement of existing generation supplies, including those that rely on oil and natural gas as fuel. In that regard, the changes in generation resources due to the RPS program, as estimated by the MAPS model, have been examined. In 2013, the peak year, the RPS will result in the displacement of approximately 6,885,000 MWh of electric energy derived from oil and gas resources. That change, creating greater diversity in New York's electric energy supply portfolio, will reduce by 11% the exposure to wholesale oil and natural gas price spikes and supply interruptions, thereby increasing the security of New York's electric energy supply (see Tables 6.4-2 and 6.4-3 below).

Table 6.4-2
Displacement of Generation Resources (GWh's)

	Base Case	Renewables Case	Difference
Oil	4,948	4,218	730
Gas	60,350	54,195	6,155
All Other	62,127	62,506	(379)
Totals	127,425	120,919	6,506

Table 6.4-3
Reduction in Fuel Price & Supply Risk (GWh's)

	Base Case	Renewables Case	Difference
Oil & Gas	65,298	58,413	6,885
Percent	100	89	11

6.5 Cumulative Impacts and Benefits of RPS Alternatives and No-Action Alternative

The RPS Cost Study utilized the MAPS modeling program to calculate and evaluate the changes in wholesale electricity costs and the various generation changes that would occur as a result of adoption of an RPS in New York. The MAPS model also calculated the emissions of NO_x, SO_2 and CO_2 for each of the RPS scenarios and sensitivities. The emission changes provide an approximate measure of impacts and benefits associated with emissions of those major pollutants.

The RD Cost Analysis includes updates to reflect current assumptions and in response to parties' comments. Thus, there is some variation with respect to the renewables' baseline, the penetration of green marketing, and the time period assumed necessary to meet renewable targets. It should be noted that while modeling comprises reasonable assumptions, the modeled outcome and results may or may not match

results of the real market 10 years in the future. It is also not practical to model and remodel every possible variation of assumptions and every possible market response.

In summary form, statewide emissions are characterized in Table 6.5-1 for 2006 and Table 6.5-2 for 2013. The results of the RD Cost Analysis were added to the Final GEIS Tables and those results can be generally compared to the scenarios evaluated in the Draft GEIS. Because there are emission decreases estimated for 2013, no potential adverse impacts are expected from adoption and implementation of the RPS.

Results associated with all scenarios evaluated in the Draft GEIS show there would be emission decreases of NO_x, SO_2 and CO_2. The Draft GEIS evaluated a range of reductions among the scenarios, but all produce fewer emissions than the Base Case (the No Action alternative). Statewide emission reductions in the year 2006 were not as conclusive as several scenarios showed a small increase in pollutants in the early years. While these small, short-term increases are not avoidable, they are not significant enough to drive or control the final selection of the RPS design. The results of the RD Cost Analysis and related MAPS modeling show emission reductions in all years up to 2013 and would be expected to result in reductions that continue beyond that time.

It is notable that the emissions decrease is greater in the NYC-LI area (which includes the lower Hudson Valley) than statewide. While it is not feasible to determine the actual reductions impact, it can be reasonably assumed that emission reductions in the most populous areas of the State are especially beneficial due to the size and density of the population potentially affected. Tables 6.5-3 and 6.5-4 show the emission changes in the NYC-LI area for the RD Cost Study results and for the scenarios previously considered in the Draft GEIS.

Table 6.5-1
2006 Statewide Emissions Summary
(x 1,000 tons)

Scenario	NO_x			SO_2			CO_2		
	NO_x	△ from base	% change from base	SO_2	△ from base	% change from base	CO_2	△ from base	% change from base
Base Case	46.4	-	-	117.7	-	-	45,491	-	-
RPS Prime Case	46.4	0.1	0.12%	116.7	-1.0	-0.84%	45,080	-411	-0.90%
0% SBC	46.4	0.0	0.10%	116.7	-1.0	-0.84%	45,078	-413	-0.91%
2% SBC	46.4	0.1	0.11%	116.7	-1.0	-0.86%	45,079	-412	-0.91%
5% SBC	46.4	0.0	0.08%	116.7	-1.0	-0.84%	45,071	-419	-0.92%
10% SBC	46.4	0.0	0.06%	116.8	-1.0	-0.81%	45,069	-422	-0.93%
No Imports	46.4	0.1	0.12%	116.7	-1.0	-0.84%	45,080	-411	-0.90%
MI Ramp	46.5	0.1	0.25%	117.7	0.0	0.01%	45,482	-9	-0.02%
CH Ramp	46.7	0.3	0.71%	117.3	-0.4	-0.37%	45,282	-209	-0.46%
No PTC	46.8	0.4	0.87%	117.8	0.1	0.08%	45,323	-167	-0.37%
Joint Utility 1	46.2	-0.2	-0.34%	116.7	-1.0	-0.87%	45,054	-437	-0.96%
Joint Utility 2	46.3	-0.1	-0.18%	116.7	-1.1	-0.90%	45,076	-414	-0.91%
	NO_x	△ from No Growth Base	% change from No Growth Base	SO_2	△ from No Growth Base	% change from No Growth Base	CO_2	△ from No Growth Base	% change from No Growth Base
No Growth Base Case	41.0	-	-	110.2	-	-	41,759	-	-
No Growth RPS	41.3	0.3	0.84%	110.1	-0.1	-0.14%	41,588	-171	-0.41%

	NO_x	△ from RD base	% change from RD base	SO_2	△ from RD base	% change from RD base	CO_2	△ from RD base	% change from RD base
RD Base Case	58.6	-	-	165.0	-	-	50,009	-	-
RD Prime Case	58.0	-0.6	-1.02%	162.6	-2.4	-1.47%	49,232	-776.8	-1.55%

Table 6.5-2
2013 Statewide Emissions Summary

(x 1,000 tons)

Scenario	NO_x			SO_2			CO_2		
	NO_x	△ from base	% change from base	SO_2	△ from base	% change from base	CO_2	△ from base	% change from base
Base Case	39.6	-	-	121.1	-	-	49,541		
RPS Prime Case	37.5	-2.1	-5.22%	113.7	-7.3	-6.04%	45,858	-3,683	-7.43%
0% SBC	37.6	-2.0	-5.09%	113.8	-7.3	-6.02%	45,920	-3,621	-7.31%
2% SBC	38.4	-1.2	-3.07%	119.5	-1.5	-1.26%	46,427	-3,114	-6.29%
5% SBC	37.3	-2.3	-5.88%	113.6	-7.5	-6.18%	45,633	-3,908	-7.89%
10% SBC	37.9	-1.7	-4.37%	118.6	-2.4	-1.99%	46,073	-3,468	-7.00%
No Imports	36.4	-3.2	-8.09%	115.7	-5.4	-4.46%	45,083	-4,458	-9.00%
MI Ramp	38.7	-0.9	-2.23%	118.4	-2.6	-2.16%	46,966	-2,576	-5.20%
CH Ramp	38.3	-1.4	-3.41%	118.1	-3.0	-2.46%	46,630	-2,911	-5.88%
No PTC	39.1	-0.5	-1.35%	113.0	-8.1	-6.66%	46,772	-2,769	-5.59%
Joint Utility 1	36.0	-3.6	-9.06%	114.9	-6.2	-5.10%	44,923	-4,618	-9.32%
Joint Utility 2	36.0	-3.6	-8.99%	114.7	-6.3	-5.21%	44,952	-4,589	-9.26%
	NO_x	△ from No Growth Base	% change from No Growth Base	SO_2	△ from No Growth Base	% change from No Growth Base	CO_2	△ from No Growth Base	% change from No Growth Base
No Growth Base Case	26.0	-	-	103.2	-	-	37,702	-	-
No Growth RPS	25.8	-0.2	-0.69%	101.0	-2.1	-2.08%	35,531	-2,171	-5.76%

	NO_x	△ from RD base	% change from RD base	SO_2	△ from RD base	% change from RD base	CO_2	△ from RD base	% change from RD base
RD Base Case	55.4	-	-	168.2	-	-	53,927	-	-
RD Prime Case	51.6	-3.8	-6.80%	158.3	-9.9	-5.89%	49,798	-4129.3	-7.66%

Table 6.5-3
2006 NYC-LI Emissions Summary
(x 1,000 tons)

Scenario	NO_x			SO_2			CO_2		
	NOx	△ from base	% change from base	SO2	△ from base	% change from base	CO2	△ from base	% change from base
Base Case	22.1			15.3			25,022		
RPS Prime Case	21.8	-0.3	-1.21%	14.8	-0.5	-3.34%	24,793	-229	-0.92%
0% SBC	21.8	-0.3	-1.24%	14.8	-0.5	-3.32%	24,791	-232	-0.93%
2% SBC	21.8	-0.3	-1.21%	14.7	-0.5	-3.45%	24,793	-229	-0.92%
5% SBC	21.8	-0.3	-1.23%	14.7	-0.5	-3.35%	24,792	-231	-0.92%
10% SBC	21.8	-0.3	-1.26%	14.8	-0.5	-3.12%	24,789	-234	-0.93%
No Imports	21.8	-0.3	-1.21%	14.8	-0.5	-3.34%	24,793	-229	-0.92%
MI Ramp	22.1	0.0	0.03%	15.3	0.0	-0.03%	25,024	1	0.01%
CH Ramp	22.0	-0.1	-0.29%	15.1	-0.2	-1.04%	24,938	-85	-0.34%
No PTC	22.0	-0.1	-0.35%	15.8	0.5	3.58%	24,934	-88	-0.35%
Joint Utility 1	21.8	-0.3	-1.44%	14.8	-0.4	-2.86%	24,776	-246	-0.99%
Joint Utility 2	21.8	-0.3	-1.20%	14.8	-0.5	-3.26%	24,796	-226	-0.90%
	NO_x	△ from No Growth Base	% change from No Growth Base	SO_2	△ from No Growth Base	% change from No Growth Base	CO_2	△ from No Growth Base	% change from No Growth Base
No Growth Base Case	18.3	-	-	11.7	-	-	22,167	-	-
No Growth RPS	18.1	-0.2	-1.01%	11.6	0	-0.78%	22,063	-104	-0.47%

	NO_x	△ from RD base	% change from RD base	SO_2	△ from RD base	% change from RD base	CO_2	△ from RD base	% change from RD base
RD Base Case	22.3	-	-	22.0	-	-	25,750	-	-
RD Prime Case	21.8	-0.5	-2.28%	21.2	-0.8	-3.84%	25,315	-434.9	-1.69%

Table 6.5-4
2013 NYC-LI Emissions Summary
(x 1,000 tons)

Scenario	NO_x			SO_2			CO_2		
	NO_x	△ from base	% change from base	SO_2	△ from base	% change from base	CO_2	△ from base	% change from base
Base Case	15.3			11.2			29,243		
RPS Prime Case	14.2	-1.1	-7.20%	10.4	-0.8	-7.09%	26,829	-2,414	-8.25%
0% SBC	14.2	-1.1	-6.89%	10.4	-0.8	-7.12%	26,889	-2,354	-8.05%
2% SBC	14.1	-1.2	-7.66%	10.6	-0.6	-5.42%	26,798	-2,445	-8.36%
5% SBC	14.0	-1.3	-8.54%	10.3	-0.9	-8.06%	26,640	-2,602	-8.90%
10% SBC	13.8	-1.5	-9.56%	10.1	-1.0	-9.36%	26,553	-2,690	-9.20%
No Imports	13.2	-2.1	-13.99%	9.1	-2.1	-18.45%	26,011	-3,232	-11.05%
MI Ramp	14.4	-0.9	-5.56%	10.1	-1.1	-9.43%	27,289	-1,954	-6.68%
CH Ramp	14.1	-1.2	-7.64%	10.0	-1.1	-10.25%	27,053	-2,190	-7.49%
No PTC	15.0	-0.2	-1.63%	11.2	0.1	0.53%	27,470	-1,773	-6.06%
Joint Utility 1	13.1	-2.2	-14.15%	8.7	-2.5	-22.27%	25,923	-3,320	-11.35%
Joint Utility 2	13.3	-2.0	-13.21%	8.7	-2.5	-22.08%	26,058	-3,185	-10.89%
	Nox	△ from No Growth Base	% change from No Growth Base	SO_2	△ from No Growth Base	% change from No Growth Base	CO_2	△ from No Growth Base	% change from No Growth Base
No Growth Base Case	7.6	-	-	5.5	-	-	20,831	-	-
No Growth RPS	7.2	-0.3	-4.57%	5.3	-0.2	-4.30%	19,298	-1,534	-7.36%

	NO_x	△ from RD base	% change from RD base	SO_2	△ from RD base	% change from RD base	CO_2	△ from RD base	% change from RD base
RD Base Case	19.0	-	-	21.6	-	-	29,642	-	-
RD Prime Case	17.2	-1.8	-9.26%	19.5	-2.1	-9.81%	26,998	-2644.6	-8.92%

Cumulative site-specific impacts of the renewable resources are not known at this time. However, appropriate federal, state and local approval processes will evaluate potential site-specific impacts. Section 6.2 of the Final GEIS provides a generic description of potential environmental impacts of each renewable technology on land and water resources, agriculture, cultural and aesthetic resources, terrestrial and aquatic ecosystems and other individually relevant impacts.

7.0 MITIGATION OF POTENTIAL ADVERSE IMPACTS

Mitigation of impacts resulting from an RPS policy can be discussed on two levels. First, statewide emissions reductions resulting from increased renewable electric generation do not pose a significant adverse impact. Mitigation of impacts is not applicable to an action that results in benefits. The degree of emission reductions, along with other factors, are being considered and balanced by the PSC in determining the details of the RPS. Second, although the RPS will provide incentives for new renewable projects to be constructed in New York, details of such projects are not known at this time; nor are site or community details. Therefore, site-specific impacts and benefits cannot be identified, and it follows that appropriate mitigation for individual projects cannot be determined at this time. However, as identified in Section 6.2, new projects will be subject to licensing and permitting, and the appropriate mitigation can be determined when project details are available, and a full impact analysis can be evaluated by the review and permitting agencies.

7.1 Project-Specific Permitting and Mitigation

Consideration of an RPS policy and the details of its implementation do not result in the selection of specific means of renewable electric generation, nor will it result in a preference for a particular technology at a specific site. Development of specific projects will result from decisions by interested developers who perceive the market conditions favorable to develop projects. Assuming those economic conditions exist, developers of specific renewable projects must then seek all applicable local, state, and federal approvals and permits in order to build the project. The type of permitting, and level of scrutiny, will vary with the type and size of the project. Federal approvals are required for major hydroelectric projects, and will trigger an environmental

review under the National Environmental Protections Act (NEPA). Major and minor combustion generation facilities in New York are required to seek approval from the DEC. Some projects, such as wind farms, could require local or state approvals that trigger environmental review under SEQRA. Electric generation projects may need to apply for a Certificate of Public Convenience and Necessity (CPCN) under PSL §68, and could also trigger SEQRA review separately, or as a coordinated review with other involved agencies (*i.e.*, other agencies that also have approval authority or issue permits for a particular project).

Key elements of NEPA and SEQRA are the identification of potential impacts, and potential mitigation of those impacts. It is appropriate, and most effective, to determine mitigation once the specific project is defined and a specific site is proposed. It is possible that the type, small size, or location of certain renewable generation may not trigger any discretionary environmental review process (*i.e.*, a generator proposed at a site already zoned to allow such generation). Section 6.2 includes a discussion of the regulatory framework and potential mitigation of impacts related to each renewable generation technology.

7.2 Environmental Justice

In addition to licensing and permitting requirements, some renewable resource projects will be subject to the provisions of DEC Commissioner Policy 29 – Environmental Justice and Permitting (issued March 19, 2003). While PSC consideration of an RPS policy may result in incentives for renewable technologies and projects in general, the policy will not consider or approve any specific project at any specific site. Hence, the case-by-case review of specific projects may trigger applicability of the Environmental Justice Policy, which is dependent on geographic location, the community demographics of the project area and existing impacts on that community. Applicability will be evaluated as future renewable projects seek permits.

However, a brief discussion of the Environmental Justice Policy and its potential applicability to renewable projects is addressed below.

Environmental Justice Policy

DEC Commissioner Policy 29 defines Environmental Justice as the

> . . .fair treatment and meaningful involvement of all people regardless of race, color, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policy. Fair treatment means that no group of people, including a racial, ethnic or socio economic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local and tribal programs and policies.

The procedures described in the policy are to be incorporated into the DEC permit review process when DEC receives an application for an applicable permit as specified in the Policy.

When DEC receives an application for a permit covered by the Environmental Justice Policy, DEC conducts a preliminary screen to identify whether the proposed action is in or near a potential environmental justice area, and to determine whether potential adverse impacts related to the project are likely to affect a potential environmental justice area. Depending on the outcome of the screening, DEC may provide guidance to the applicant, may require that an enhanced public participation plan be developed and may require an analysis to ensure that impacts do not disproportionately affect potential environmental justice areas, among other requirements. The disproportionate impact analysis is currently under development by DEC.

Not all renewable energy resources require permits triggering an environmental justice evaluation. However, of the technologies being considered in the RPS case, it is conceivable that several, such as WTE, hydroelectric and landfill gas, may meet the Environmental Justice thresholds. That determination would be made on a case by case basis at the time that permit application is filed. The details of the DEC Environmental Justice Policy CP 29 can be found on DEC's website (http://www.dec.state.ny.us/website/ej/index/html) along with a guidance document titled

"Tips for preparing a Public Participation Plan pursuant to DEC Commissioner Policy CR29 – Environmental Justice and Permitting."

8.0 UNAVOIDABLE ADVERSE IMPACTS

Section 6.0 discusses in detail the potential impacts that may result from construction and operation of renewable electric generating technologies. The impacts of conventional generating facilities are also discussed. The purpose of the GEIS and the RPS proceeding is not to evaluate and approve specific renewable projects or to evaluate site-specific impacts. As previously discussed, there could very well be unavoidable environmental impacts resulting from renewable projects. However, the severity of the impacts and the adequacy of mitigation, if any, are appropriate evaluations left to the project specific approval/permitting process and environmental review. Unavoidable impacts of the No Action alternative (*i.e.*, no adoption of an RPS) would be the continuation of impacts from conventional generating facilities; those impacts have previously been considered in approval and permitting actions for those facilities and, while the acceptability of some impacts may be challenged by some, for the most part, they have been supported by regulatory actions that have withstood these challenges. Discussion of avoided emissions is appropriate for inclusion in a GEIS, and is a desirable outcome of the RPS policy being considered.

9.0 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Adoption of an RPS by the PSC does not, in itself, result in irreversible or irretrievable commitment of resources because no particular renewable energy project or site will be approved or endorsed by approval of the Action. Potential commitment of resources related to technologies is discussed in Section 6.0, and different impact results of alternatives, including No Action, is discussed in Section 6.5. However, actual impacts and resource commitments are unknown until specific projects are proposed; irreversible and irretrievable commitments are more appropriately identified at that time.

10.0 GROWTH–INDUCING ASPECTS AND SOCIO-ECONOMIC IMPACTS OF THE PROPOSED ACTION

10.1 RPS Program Costs

Economic implications of the recommended RPS were estimated in the RD Cost Analysis. Assuming achievement of the 25% level, the cumulative cost of premium payments could be up to $868 million[40] by 2013 but would be offset by a cumulative reduction in annual wholesale energy costs of $513 million. The most adverse impact estimated on customer bills are expected to be small; cumulative bill impacts are estimated to be up to a 1.8% increase for residential customers; up to a 2.0% increase for commercial customers; and, up to a 2.4% increase for industrial customers. Tables 13 and 14 in the RD Cost Analysis show a diverse range of percentage increases and decreases in customer bills. The diversity of these ranges is a result of location differences in wholesale price effect, the differences in existing rates by service territory, service class, and also customer usage.

10.2 Economic Development Benefits

Although the RPS policy under consideration does not endorse or approve any specific renewables projects, it could provide an incentive for development of such projects. It is not feasible to attempt to determine actual socio-economic impacts absent specific geographic locations and other details of the renewable energy projects. Tax implications, employment, and other community benefits are dependent on the project details and the context in which it is proposed.

Although specific socio-economics impacts cannot be determined at this time, implementation of the RPS is expected to provide economic development benefits to New York. Incentives to spur further development of emerging technologies, and construction and operation of generating facilities, should result in the creation of both direct and indirect jobs, purchases of local products and services, which add revenues to local economies, and new and increased tax payments by employees and facilities. The following discussion explains, in general terms, some potential impacts and the

[40] Summary Table 8 in the RD Cost analysis reflects a figure of $1.35 billion for the Total Cost to Achieve the RPS, but that figure does not reflect current higher fuel costs. The figure when corrected for current higher fuel costs is $868 million, as shown on RD Cost Analysis 3 spreadsheet file "RD Case-Results-6-03-04.xls" of worksheet "RD Mkt Clr Approach (New Fuel)."

factors that should be considered in determining actual impacts of a project when its details are known.

Employment

New renewable energy projects have the potential to directly affect employment in several ways. First, during construction, a workforce is needed to prepare sites, and construct the facility and other necessary components, such as transmission lines and substations. The impact of this workforce depends on its availability in the area, whether it is temporarily imported, and the duration and scope of the project. Typically, once a project is built, the workforce consists of a smaller operations staff that might be provided by the existing workforce or, depending on the requirements, may come from outside the community.

There are also potential indirect employment impacts resulting from construction of renewable energy resources. Any new workforce in a community – whether construction or operation – affects local retail, supply, and service businesses. A new workforce in a rural, low population area could represent a substantial relative increase in secondary economic activity. Department of Labor statistics generally show that for every skilled industrial job created, an additional two retail jobs are created in that area.

A second potential indirect impact relates to the manufacture of renewable energy equipment. Manufacturing is generally a global activity, but as the RPS incentive increases the demand for renewable energy in New York, it is possible that manufacturers of the equipment, and providers of ancillary services associated with such equipment, may be attracted to sites in New York. Consequently, additional jobs would be created, which would benefit the local and state economies.

Development and operation of renewable resources may also indirectly impact employment. The adoption of an RPS could result in a reduction of conventional generating sources, which may decrease employment, depending on the degree of reduced operation and whether a facility closes or not. Several unknown factors make it impossible to determine actual employment reductions, if any. For example, owners of existing plants could take actions to increase their competitiveness, reduce emissions, or transfer workforce to other existing or new renewable generating facilities.

Tax Impacts

Traditionally, tax impacts/benefits would be determined by a project's value and the local taxing structure. In such a traditional circumstance, all that is needed is location, the project value, and a tax rate in order to compute the tax benefit. Alternatively, many new commercial and industrial developments negotiate a tax schedule, known as a Payment In Lieu Of Taxes agreement, or PILOT, that usually provides a tax break in early years (to encourage the project to locate in the area) and a gradual (*i.e.*, 10-15 years) ramp up to a fully taxed status. The impact of traditional or PILOT taxation also depends on the size of the existing tax base; a project of modest taxable value added to a large tax base would have little overall effect on local tax. In contrast, a large project in a rural area with a small tax base could add significantly to the local tax base.

Other Local Economy Impacts

To the extent renewable resources require lease or purchase of land from local owners, additional funds could find their way into the local economy and could stimulate other business. In rural areas, additional funds from lease agreements could supplement farm income, provide smaller farms and businesses opportunities for diversifying sources of income, or be used for agricultural improvements and increase productivity.

Waste-to-energy projects, to the extent they are considered in the RPS, may also potentially affect local economies. A WTE project typically has two revenue streams: tipping fees and income from the sale of electricity. The electricity income reduces local waste disposal cost, thus lowering the disposal cost to residents. The balance of the two revenue streams is complicated, and the actual economic impact can only be determined on a case-by-case basis. Additionally, consideration of WTE should also include project assessment of all impacts and their economic implications as well as the alternatives available.

11.0 EFFECTS ON ENERGY CONSUMPTION

The RPS is not expected to directly affect energy usage in New York. The RPS Cost Study assumed the same demand forecast for the Base Case as for the

alternative scenarios and sensitivities. The RPS will change the method of electric generation to a greater proportion of renewables, but is not expected to create an increase or decrease in the amount of electricity used. Table 11-1 illustrates the SEP forecast of electricity sales, and the amount of baseline renewable energy. Throughout the study period, renewable resources will be added as a result of the Executive Order 111, customer choices under the Green Power Program (Green Marketing), and by the incremental renewables target modeled for the RPS. As a result, the renewable share of sales will increase from 19.32% in 2005 to 25% in 2013. The incremental increase in renewables attributable to the modeled RPS Policy will be 7.5% but could vary depending on Green Marketing success and penetration.[41]

To the extent the RPS causes a significant increase in electricity prices, demand could be affected. Demand forecast, renewable baseline assumptions, green marketing potential, the time period in which targets are met and other underlying assumptions all have some potential to affect electricity prices and trigger demand changes. However, the range of small price fluctuations attributable to the RPS, as discussed in Section 10, is not expected to trigger demand changes.

[41] See RD Cost Analysis – Table 2 – Calculation of RPS Targets (MWh's).

Table 11-1
Renewable Resource Target Levels (MWh)

Year	SEP Forecast	Baseline	Executive Order 111	Green Marketing	Incremental Target	Total Renewables	Renewables Percentage	Incremental Percentage
2003	160,480,000	31,159,134	0	0	0	31,159,134	19.42%	
2004	162,844,000	31,405,565	0	0	0	31,405,565	19.29%	
2005	165,280,000	31,411,462	251,065	274,953	0	31,937,479	19.32%	
2006	167,490,000	31,417,358	283,192	274,953	1,577,518	33,553,020	20.03%	0.94%
2007	169,977,000	31,411,491	315,338	274,953	3,255,600	35,257,382	20.74%	1.92%
2008	172,404,000	31,405,624	347,505	274,953	4,956,086	36,984,168	21.45%	2.87%
2009	174,658,000	31,399,758	379,691	274,953	6,652,656	38,707,057	22.16%	3.81%
2010	176,910,00	31,393,891	411,897	274,953	8,380,737	40,461,478	22.87	4.74%
2011	179,031,000	31,388,024	394,132	274,953	10,159,859	42,216,968	23.58	5.67%
2012	180,907,000	31,382,158	376,366	274,953	11,909,571	43,943,047	24.29	6.58%
2013	182,866,999	31,376,291	358,601	274,953	13,706,906	45,716,750	25.00%	7.50%

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13.0 COMMONLY USED ACRONYMS AND ABBREVIATIONS

CO_2 – Carbon Dioxide

COB – Competitive Opportunities Bypass

DEC – NYS Department of Environmental Conservation

EJ – Environmental Justice

EPA – Environmental Protection Agency

ESCO – Energy Service Company

GEIS – Generic Environmental Impact Statement

GHG – Greenhouse Gas

Hg – Mercury

IOU – Investor Owned Utility

IPP – Independent Power Producer

LSE – Load Serving Entity

MAPS – Multi Area Production Simulation Model

MSW – Municipal Solid Waste

MW – Megawatt

MWH – Megawatt hour

NO_x – Nitrogen Oxide

NYISO – New York Independent Systems Operator

NYSERDA – New York State Energy Research and Development Authority

PSC – Public Service Commission

PM – Particulate Matter

PV – Photovoltaic

RD – Recommended Decision

RPS – Renewable Portfolio Standard

SBC – System Benefits Charge

SEP – State Energy Plan

SEQRA – State Environmental Quality Review Act

SO_2 – Sulfur Dioxide

SPDES – State Pollution Discharge Elimination System

TO – Transmission Owner

WTE – Waste-to-Energy

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