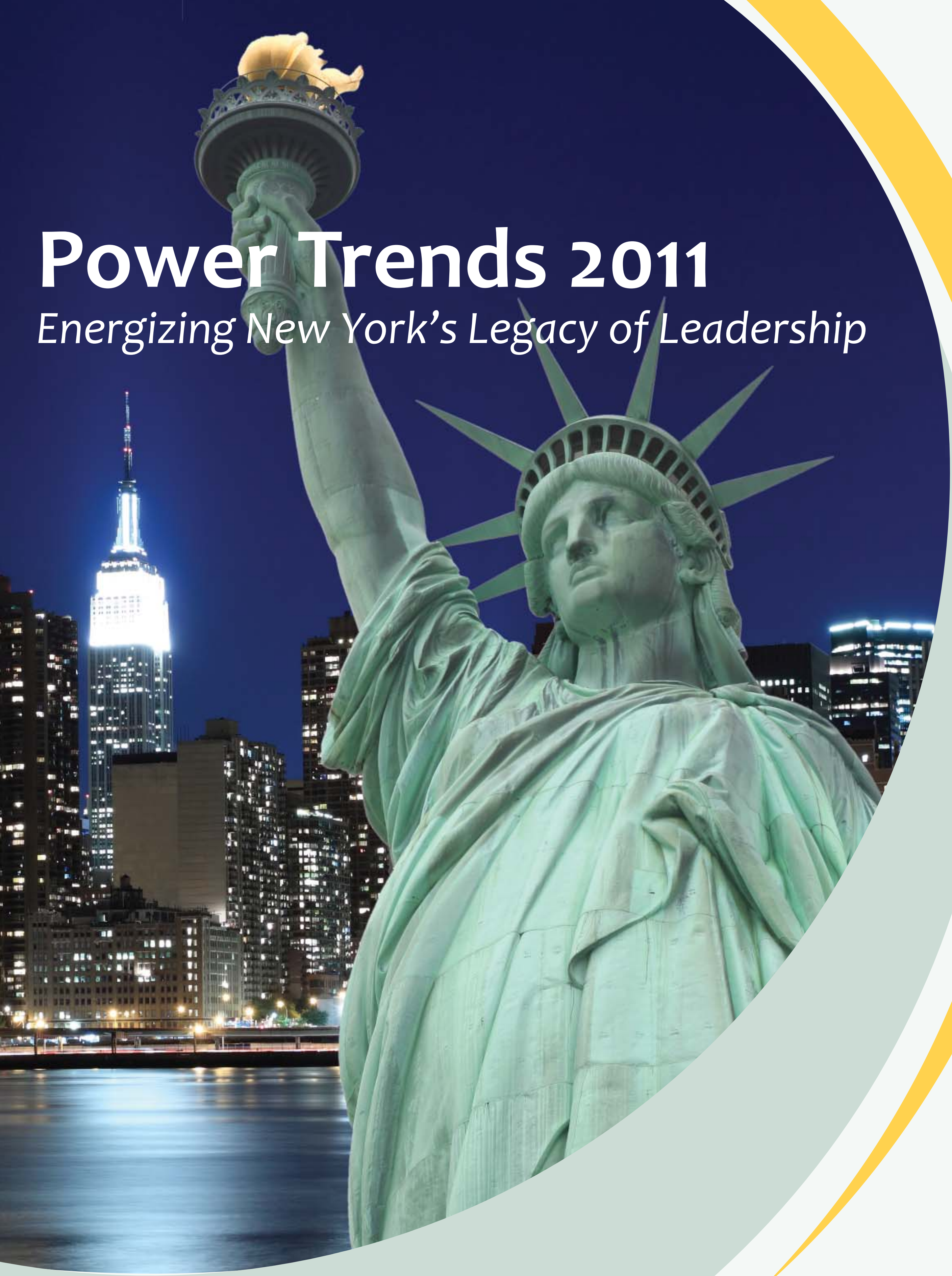
Power Trends 2011

Energizing New York's Legacy of Leadership



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Power Trends 2011 - *By the Numbers*

Power Resources

Generation

Total Generation -- 2011 .... 37,707 MW
Generation Added -- Since 2000 .... 8,650 MW

Transmission

Total Circuit Miles of Transmission - 2011 .... 11,009 miles
Transfer Capability Added -- Since 2000 .... 1,290 MW

Demand Response

Total Demand Response as of August 2010 .... 2,498 MW

Reliability Requirements

Reliability Requirement -- Summer 2011 .... 37,782 MW
Total Resources Available -- Summer 2011 .... 43,068 MW

Renewable Resources

Total Renewable Resource Capacity -- 2011 .... 4,776 MW
Total Existing Wind Generation (nameplate) -- 2011 .... 1,348 MW
Proposed Wind Generation (nameplate) .... 7,039 MW

Power Demands

Total Usage in 2010 .... 163,505 GWh
Total Usage in 2009 .... 158,780 GWh
Forecast Peak Demand for 2011 .... 32,712 MW
Actual Peak Demand for 2010 .... 33,452 MW
Record Peak Demand (August 2, 2006) .... 33,939 MW

Table of Contents

List of Figures

Executive Summary

New York's legacy of electric industry leadership dates back to the late 19th Century and the birth of the modern electric grid at Thomas Edison's Pearl Street Station in New York City. It extends to the 21st Century with the Empire State's array of private enterprise, public sector, and academic institutions focused on the future of New York's energy opportunities and challenges.

Positive outlook and emerging challenges

The immediate outlook for New York's electric system is positive. As a result of developments that have contributed to a more reliable system over the past decade, as well as planned additions in the near future, the adequacy of power resources is not an imminent concern. However, the sustained adequacy of resources may be challenged by several factors.

- *Considerable lead-time is required for power infrastructure project execution, given the time frames needed to finance, permit, and construct major energy projects. The planning horizons of policy makers and regulators should encompass the time required for the electric industry to address new laws and changes in regulatory requirements.*
- *Development of adequate replacement generation to serve southeastern New York is needed in the event of the retirement of the nuclear power units at Indian Point to prevent violation of mandatory resource adequacy reliability standards and maintain the supply of power and transmission voltage support needed to move electricity over power lines to serve customer demands in southeastern New York.*
- *As New York State works to sustain and enhance environmental quality, attention must also be paid to the cumulative impact of impending federal and state environmental regulations on the continued operation of various existing power plants. The array of proposed regulations is estimated to impact more than half the installed generating capacity in the state.*

Increasing renewable resources and energy efficiency

From a statewide perspective, the mix of fuels used to generate electricity in New York State is relatively diverse and balanced among hydropower, nuclear, coal, natural gas, and oil. However, fossil-fueled generation predominates in the high-demand downstate regions of New York due to stringent environmental requirements in that region.

New York State has adopted energy policies aimed to promote the growth of power supplies from clean and renewable resources. Progress is being made toward expanding "green power," such as wind and solar energy, and increasing energy efficiency and demand-side resources.

- *Successfully integrating increased supplies of electricity from renewable resources requires recognition of the variable nature of generation that depends on the changing availability of wind or sun to produce power. The NYISO has moved to facilitate the integration of renewables, with centralized wind forecasting, economic dispatching of windpower, and complementary action on energy storage systems.*
- *The variable nature of renewable resources has helped to highlight the value of energy storage.*

Pioneering grid-scale energy storage is taking shape in New York, with the battery and flywheel systems that came on-line in late 2010 and early 2011.

- *In 2010, the NYISO studied the prospect of expanding New York's wind-power generation from 1,275 megawatts to 8,000 megawatts by 2018. That study determined New York's electric system could accommodate a more than five-fold increase in wind generation without significant adverse reliability impacts.*

Expanding horizons

Taking full advantage of New York's energy resources also requires removing barriers to trade among regional power markets, improving coordination with and among neighboring grid operators, and combining the perspectives of energy system planners for a more comprehensive assessment of the most effective means to optimize existing assets and new renewable resources.

- *To improve coordination of power transactions, the NYISO -- in conjunction with grid operators serving the Mid-Atlantic, Midwest, and New England regions of the United States and the Canadian provinces of Ontario and Quebec -- is moving forward with a series of "Broader Regional Markets" initiatives estimated to yield annual savings of $362 million for the region.*

- *The Eastern Interconnection Planning Collaborative (EIPC), created in early 2009, is a pioneering effort that combines the expertise of more than two dozen electric system planning authorities from the Eastern United States and Canada to provide a grassroots, "bottom-up" approach to interconnection-wide planning issues.*

Aging infrastructure

The expected adequacy of New York's power resources over the next decade does not diminish the need to address aging generation and transmission infrastructure. As of the close of 2010, 60 percent of New York State's power plant capacity was put into service before 1980. Similarly, 85 percent of the high-voltage transmission facilities in New York State went into service before 1980.

- *When reliability needs are identified, solutions (generation, transmission, or demand-side measures) are solicited through the NYISO's Comprehensive System Planning Process. Competitive market-based solutions are given first priority because of their reduced risk to rate-paying consumers.*

- *As a complement to the NYISO planning process, the owners of the interconnected electricity transmission facilities in New York State initiated the State Transmission Assessment and Reliability Study (STARS), which is evaluating New York's existing transmission assets and identifying potential economically beneficial transmission projects that would reliably support New York State's energy needs well into the 21st Century. This effort includes life extension and modernization of existing facilities as well as potential expansion of transmission capabilities in existing transmission corridors to address constraints and congestion.*

Transmission congestion

Transmission congestion results from physical limits that prevent more economical power from being utilized. Solutions to congestion may include building or upgrading transmission, building less expensive power sources in closer proximity to areas needing supplies, or reducing the demand for power in the downstream region.

- *In 2010, the NYISO issued a first-of-its-kind economic analysis of transmission congestion on the New York State bulk power system and the potential costs and benefits of relieving that congestion. In the next phase of the process, developers are invited to propose specific transmission projects and the NYISO performs an analysis comparing the proposed projects' benefits and costs. If a project satisfies the benefit/cost threshold requirements and seeks streamlined regulated cost recovery, its costs would be allocated on a "beneficiaries pay" model that requires the consent of a super-majority (80 percent weighted vote) of the project's beneficiaries.*
- *Wind projects in New York are predominantly being developed in the northern and western portions of the state, while the population centers of southeastern New York are the regions with the highest demand for electricity. The NYISO's 2010 wind study found that more than 90 percent of the potential wind energy production from Northern New York would be deliverable to the bulk power system, with upgrades to the local transmission facilities.*

Smart Grid

The concept of "Smart Grid" encompasses a vast array of solutions intended to empower the end-use electricity consumer and enhance the operation of the transmission and distribution systems through the use of digital computer technologies.

- *With the support of federal stimulus funding, the NYISO and the owners of New York's transmission facilities are developing a statewide network to enhance detection of system vulnerabilities and installing capacitor banks in various locations throughout the state to improve the efficiency of power flows.*
- *The issues of smart grid technology include the need for new cyber-security enhancements to maintain reliability. Government authorities and the electric industry are now engaged in efforts to identify opportunities for enhancement of existing protection, resilience, and recovery capabilities.*

Dynamic Pricing

Consumer access to "dynamic pricing" involves providing a rate structure that reflects the changing (or dynamic) supply and demand conditions in the wholesale electricity market.

- *With access to power prices that change to reflect the actual cost of electricity, consumers would have the information needed to adjust energy usage to take advantage of lower-priced energy in low-demand hours and to limit consumption in high-demand, higher-priced hours. In addition to reducing their own bills,* *the combined effect of consumers cutting demand during peak periods can lead to a more efficient and lower-cost electric system.*

- *A 2009 study by the Brattle Group estimated market-based cost savings from dynamic pricing in New York ranging from $171 million to $579 million annually.*
- *Consumption of electricity in the top one percent of the hours of the year accounts for approximately 10 percent of the system's peak demand.Actions taken to reduce electric demand during this relatively small number of peak hours can substantially reduce overall electricity costs by lessening the need for expensive additional generation and transmission reserve capacity.*

Electric industry workforce

The North American Electric Reliability Corporation (NERC) has repeatedly identified the issue of the "aging workforce" and its impending impact on reliability in its Long-Term Reliability Assessments. "This loss of expertise, exacerbated by the lack of new recruits entering the field, is one of the more severe challenges facing reliability today," NERC has stated.

- *The Center for Energy Workforce Development, a consortium of utilities, reports that retirements and attrition would force the energy industry to replace roughly half of its engineers and skilled technicians by 2015.*
- *New York State, as home to various academic, industrial and government institutions engaged in pioneering smart grid and clean energy initiatives, can play a leadership role in developing the next generation of electric industry professionals.*

Conclusion

The global nature of environmental and energy concerns is made evident by elevated concern about nuclear safety prompted by the effects of the earthquake and tsunami that struck nuclear plants in Japan. Unrest in the Middle East continues to cause oil prices to fluctuate in markets across the world. Similarly, the increasing energy demands of developing nations on fuel supply will be felt in power costs here and abroad for the foreseeable future.

The electric power sector plays an extensive and vital role in the implementation of public policy energy goals and environmental initiatives. Coordinated efforts among government agencies and stakeholders throughout the electric industry are essential to achieving environmental goals in a manner consistent with electric system reliability requirements.

The analytical capabilities of the NYISO can provide reliable, objective analyses to policy makers as they consider programs that will affect the state's electricity industry, environment, and economy.

> *"What do you do about this in New York?"*
>
> Gov. Andrew Cuomo
> State of the State Address
> January 5, 2011.

1. Introduction

New York's Legacy of Leadership

In the 2011 State of the State Address, Governor Andrew Cuomo concluded his remarks by noting that New York has traditionally led the way in addressing pressing public issues and societal needs. When other states faced problems, they asked, "What do you do about this in New York?" The Empire State has a history of successfully confronting difficult challenges, Gov. Cuomo said, "…we solved them first and the rest of the nation learned from us."

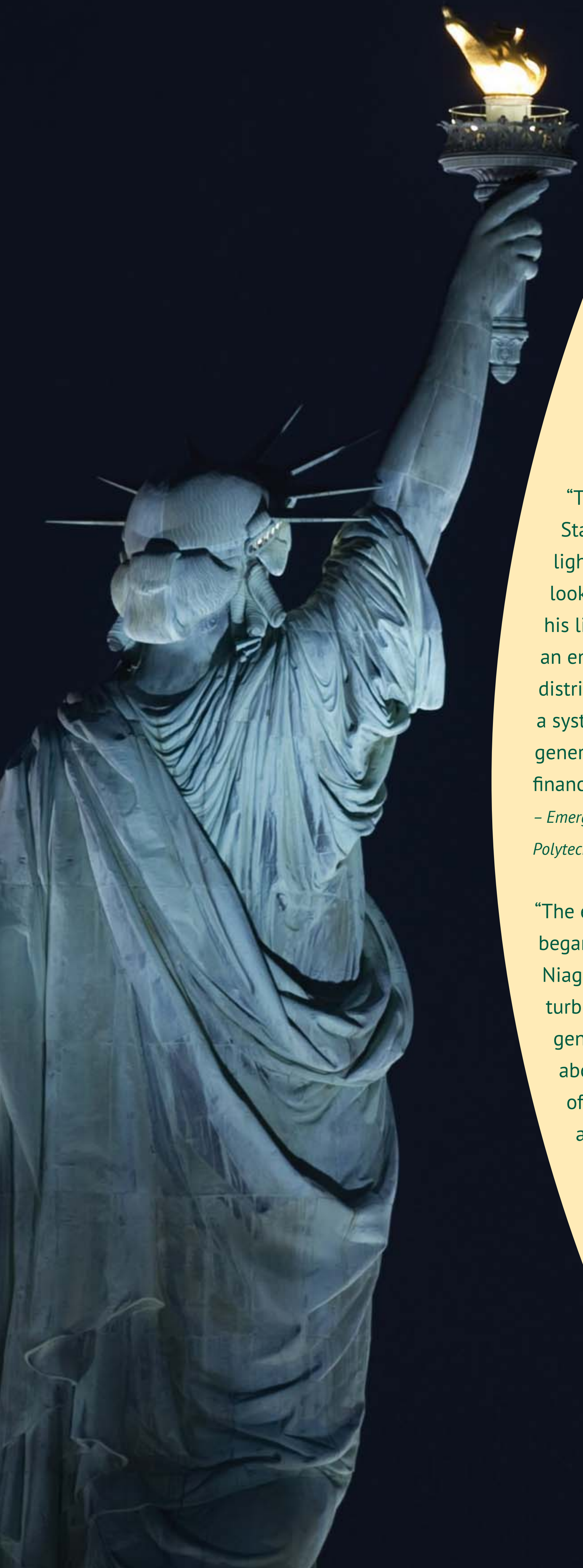
New York's legacy of leadership is especially evident in the history of the electric system. From Edison's pioneering work at Pearl Street Station in Manhattan to Westinghouse and Tesla finding new ways to harness and transmit the power of Niagara Falls, historic firsts in the electric industry dot the landscape of the Empire State.

That history was highlighted during a January 2011 visit to the birthplace of General Electric in Schenectady by President Barack Obama. Lauding GE's innovative work on high-tech steam turbines, advanced battery systems, and wind power technologies, the President said, "…it's part of a proud tradition, because GE has been producing turbines and generators here in Schenectady for more than a century."

While New York has an impressive record of accomplishment in the electric power industry, the Empire State faces serious economic and environmental challenges related to its energy future. Yet, those hurdles also present great opportunities to demonstrate that the Empire State's heritage of energy innovation is alive and well in New York's competitive marketplace for electricity. For example, competitive wholesale electricity markets have helped New York to lead the way by:

- *Developing demand-side programs that reduce peak demand and provide clean new resources beyond traditional generation, transmission and distribution infrastructure;*
- *Alleviating the need for potentially costly and controversial transmission projects by encouraging construction of cleaner and more efficient generation in closer proximity to high-demand regions;*
- *Integrating renewable resources and energy storage technologies to achieve ambitious goals for green power and energy efficiency; and*
- *Collaborating to enhance the efficiency of markets across regions and develop cooperative interconnection-wide system planning.*

Power Trends 2011 reviews these and other ongoing initiatives and examines an array of emerging energy challenges facing the Empire State.



Electric Power Pioneers in New York

"The modern electric utility industry in the United States can be traced to the invention of the practical light bulb in 1879 by Thomas Alva Edison. Always looking toward the marketplace, Edison realized that his light bulb would mean nothing unless he developed an entire electric power system that generated and distributed electricity. By 1882, he had developed such a system, and he installed the world's first central generating plant on Pearl Street in New York City's financial district."

– Emergence of Electric Utilities in America, Dr. Richard F. Hirsh, Virginia Polytechnic Institute and State University

"The era of large-scale electric power distribution arguably began on August 26, 1895, when water flowing over Niagara Falls was diverted through a pair of high-speed turbines that were coupled to two 5,000-horsepower generators. The bulk of the electricity was produced at about 2,200 volts and used locally for the manufacture of aluminum and carborundum. But the following year a portion was raised to 11,000 volts and transmitted twenty miles by wire to the city of Buffalo, where it was used for lighting and street cars."

– Origin of Electrical Power, Dr. Bernard S. Finn, National Museum of American History

SOURCE: Smithsonian Institution, Powering a Generation of Change (http://americanhistory.si.edu/powering)

2. A Look at New York …Now

Resource Adequacy

The immediate outlook for New York's electric system is positive. As a result of developments that have contributed to a more reliable system over the past decade, as well as planned additions in the near future, the adequacy of power resources is not an imminent concern.

A decade ago, New York was facing a "generation gap." New York now has a surplus of over 5,200 megawatts of available resources. If demand grows as currently forecasted, it will take at least 10 years for a capacity need to occur, assuming planned additions occur and there are no unplanned retirements.[1]

Among the major changes in New York's electric system that took place over the last decade was the development of a new set of resources - demand response programs - that enlist consumers to reduce their power use during periods of peak demand. In 2010, the NYISO's two major demand response programs (the Emergency Demand Response Program and the Special Case Resource program) had more than 4,300 registered electricity customers capable of providing nearly 2,500 megawatts of demand response capability.[2] [See Figure 1.]

When New York State experienced its all-time record peak demand of 33,939 megawatts on August 2, 2006, the NYISO's demand response programs helped to "shave" the peak by almost 1,200 megawatts. More recently, demand response programs in New York City provided nearly 400 megawatts to reduce peak demand during the July 2010 heat waves.[3] [See Figure 2.]

Since 2000, more than 8,600 megawatts of new generation have been built by private power producers and public authorities. Among the new power plants were numerous merchant projects, shifting the risk of building new power supplies from rate-paying consumers to investors.

Over 80 percent of the new generation has been sited in New York City, on Long Island and in the Hudson Valley, the regions of New York State where demand is greatest. [See Figure 3.] Much of the new generation developed in upstate regions is powered by wind; consequently, it was sited where wind resources are most available. Increased generation in upstate regions also resulted from upgrades in existing nuclear and hydropower plants. Almost all of the conventional new generation has been added near the load centers where power is needed the most.

Locational price signals in the NYISO energy and capacity markets have encouraged investments in areas where the demand for electricity and, consequently, power prices are the highest. These investments have alleviated the need to develop major, new intrastate transmission.

Figure 1. Demand Response Resources in New York State: 2010

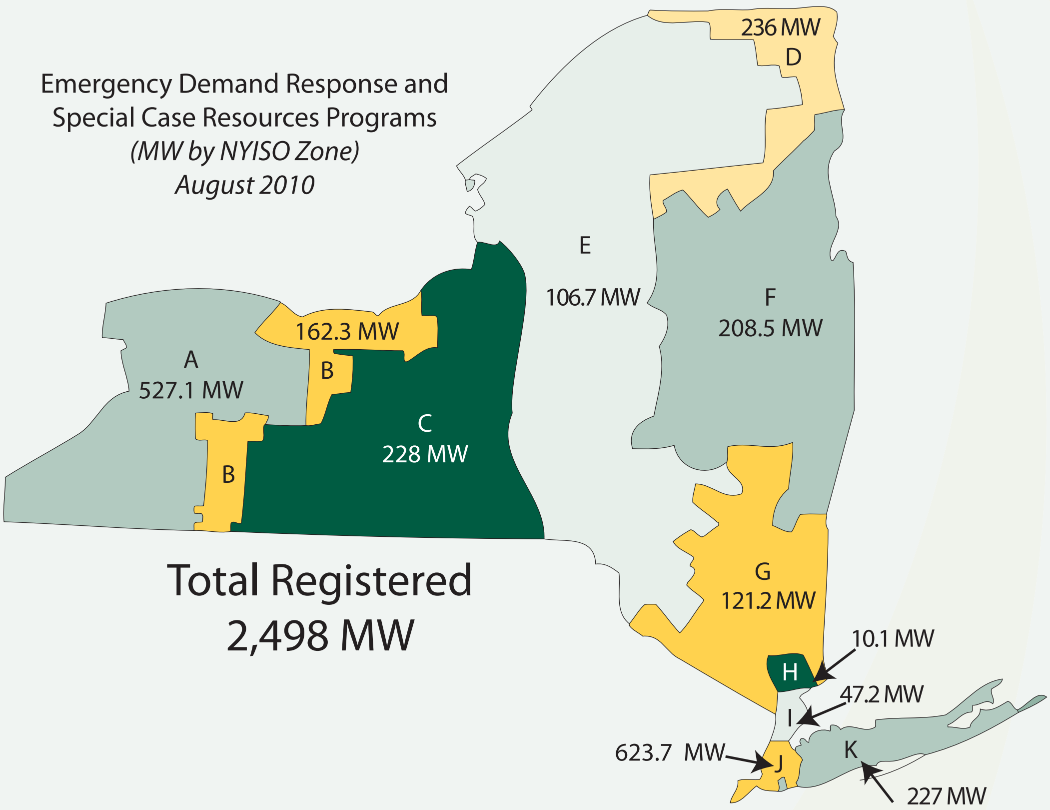


Figure 2. Demand Response Resources and Use in New York State

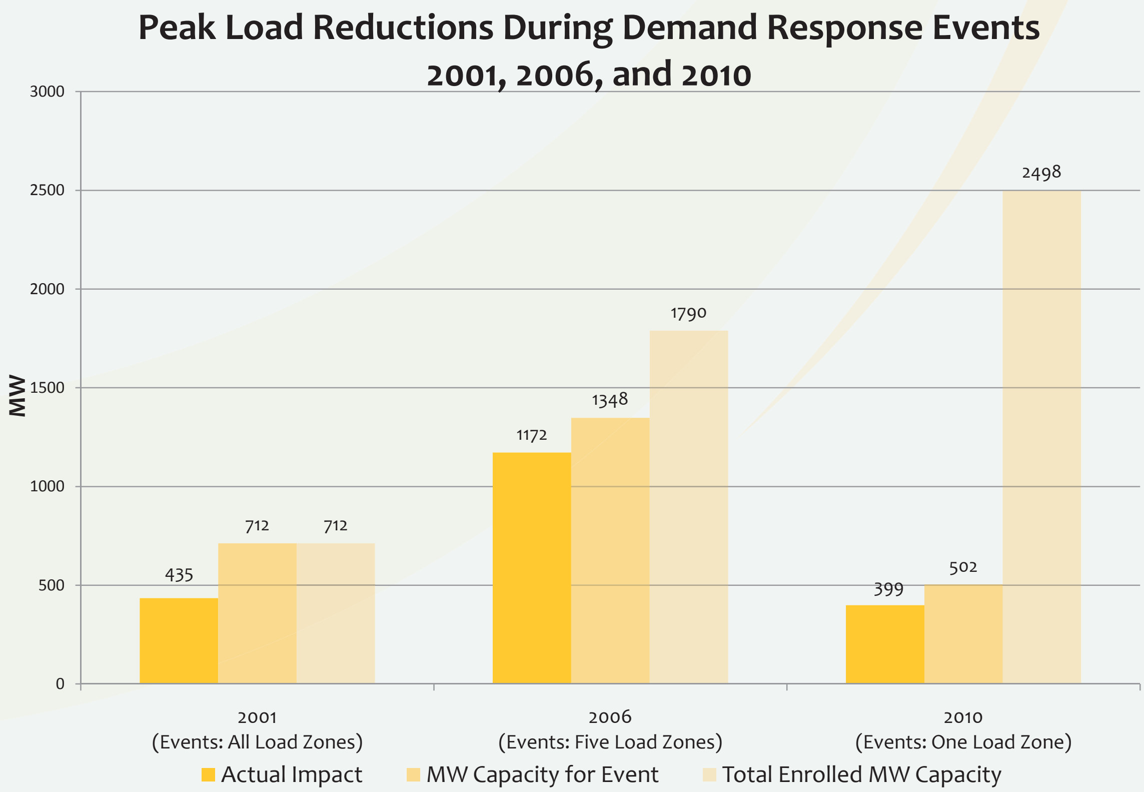


Figure 3. New Generation in New York State: 2000 — 2010

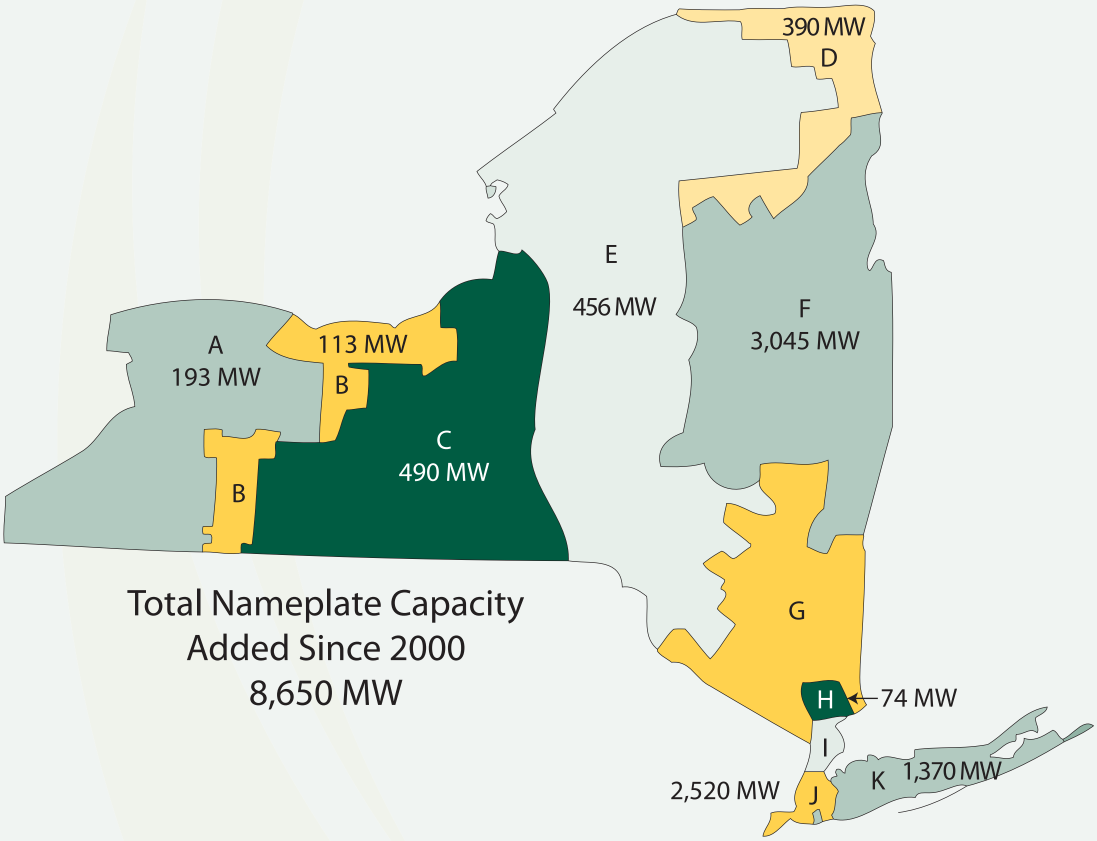
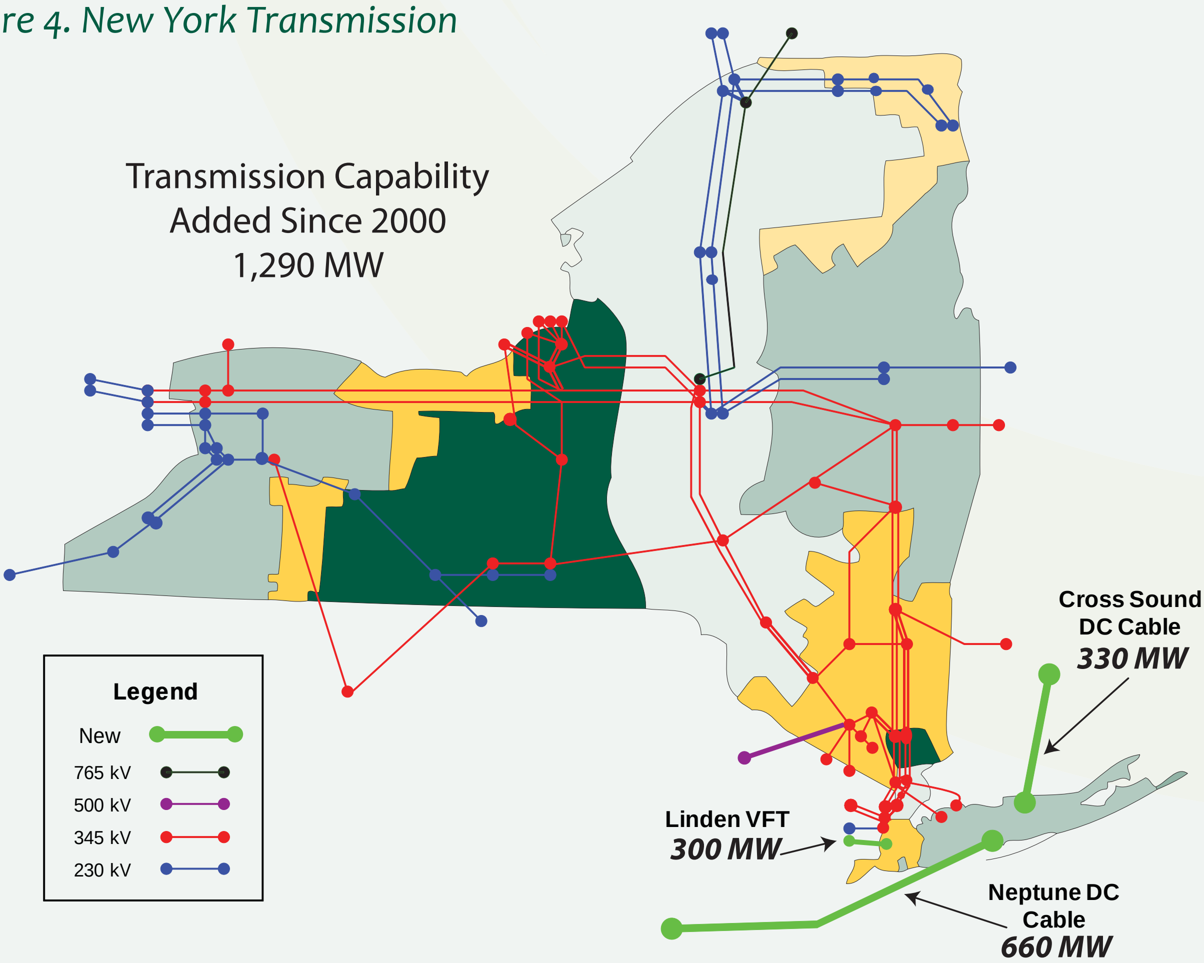


Figure 4. New York Transmission



Such avoided capital costs have been called "the value of not building things."[4] Based on the expense that would have been incurred to add new transmission capacity as well as transmission congestion costs, the NYISO estimates the savings from developing generation closer to high-demand areas at $500 million annually.[5]

The development of interstate transmission has also contributed to the effort to serve New York's most power-hungry regions. In addition to new generation resources, 1,290 megawatts of transmission capability were added to bring more power to the downstate region from out of state. [See Figure 4.]

The NYISO's latest assessment of the electric system's reliability needs reports that New York has sufficient resources (generation, transmission and demand response) to reliably serve load through 2020.[6] In 2011, resources are anticipated to exceed peak demand by more than 10,000 megawatts, and exceed reserve requirements by more than 5,000 megawatts. [See Figure 5.]

Emerging Risks and Challenges

New York's reliability outlook is positive through the next decade, assuming no large units are unexpectedly retired, and expected new units are successfully brought on-line. While there were no reliability needs identified in its planning process, the NYISO will continue to monitor potential reliability risks and other issues that may have the ability to affect the outlook of New York's electric system.

Among the reliability risk scenarios under scrutiny is the potential retirement of the Indian Point Energy Center nuclear power units when their current licenses expire.[7] Increasing public concern about nuclear safety in light of the crisis at a Japanese nuclear facility will intensify the debate over the future of nuclear power.

In addition, the cumulative impact of an array of impending environmental regulations on the continued operation of various existing power plants across New York State requires thorough attention. (See the "Looking Ahead" section for further discussion.)

When reliability needs are identified, solutions are solicited through the NYISO's comprehensive system planning process. Such solutions may include new generation and/or transmission to increase power supply and delivery, as well as demand-side resources to reduce electricity use. Competitive market-based solutions are given first priority because of their reduced risk to rate-paying consumers.

In addition, the NYISO's planning and interconnection study processes help to facilitate the integration of renewable power projects that will help to diversify New York's fuel mix and meet its renewable energy goals. In fact, wind and other renewable resources now comprise over half of the projects proposed to be studied for connection to the grid in New York. [See Figure 6.]

Figure 5. New York Resource Availability: Summer 2011

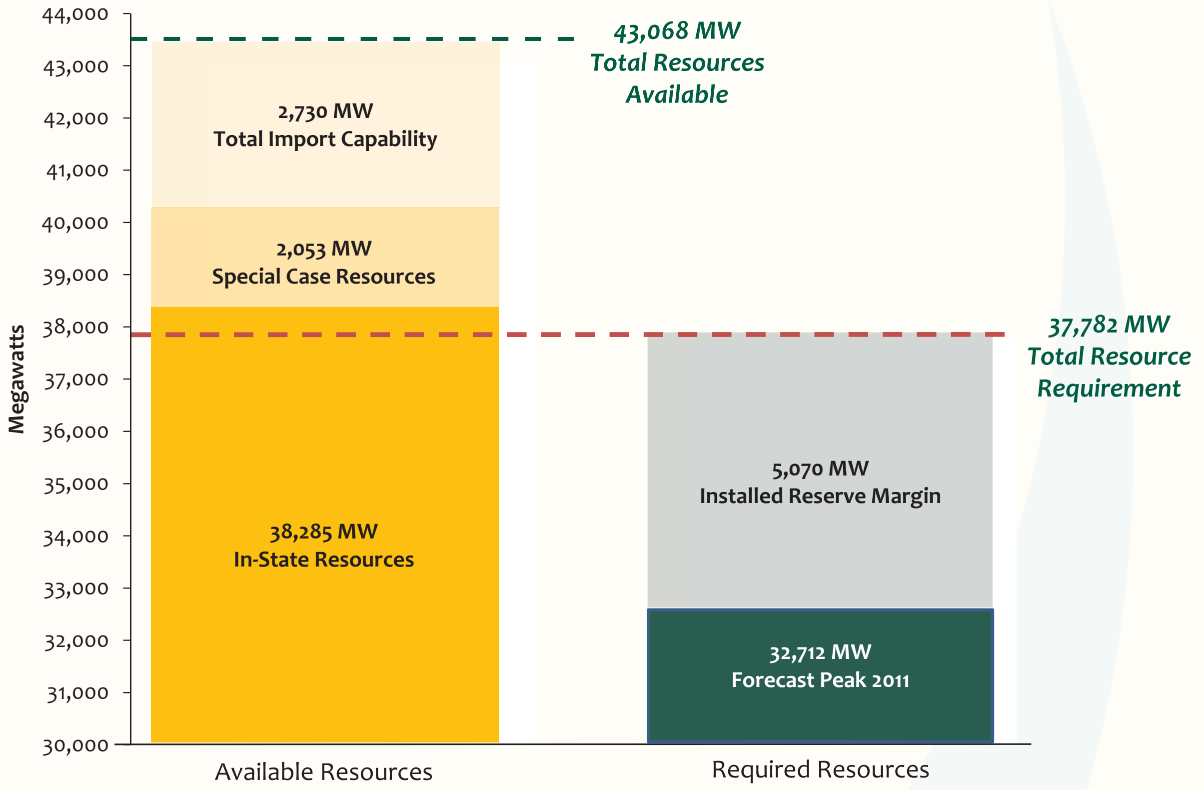
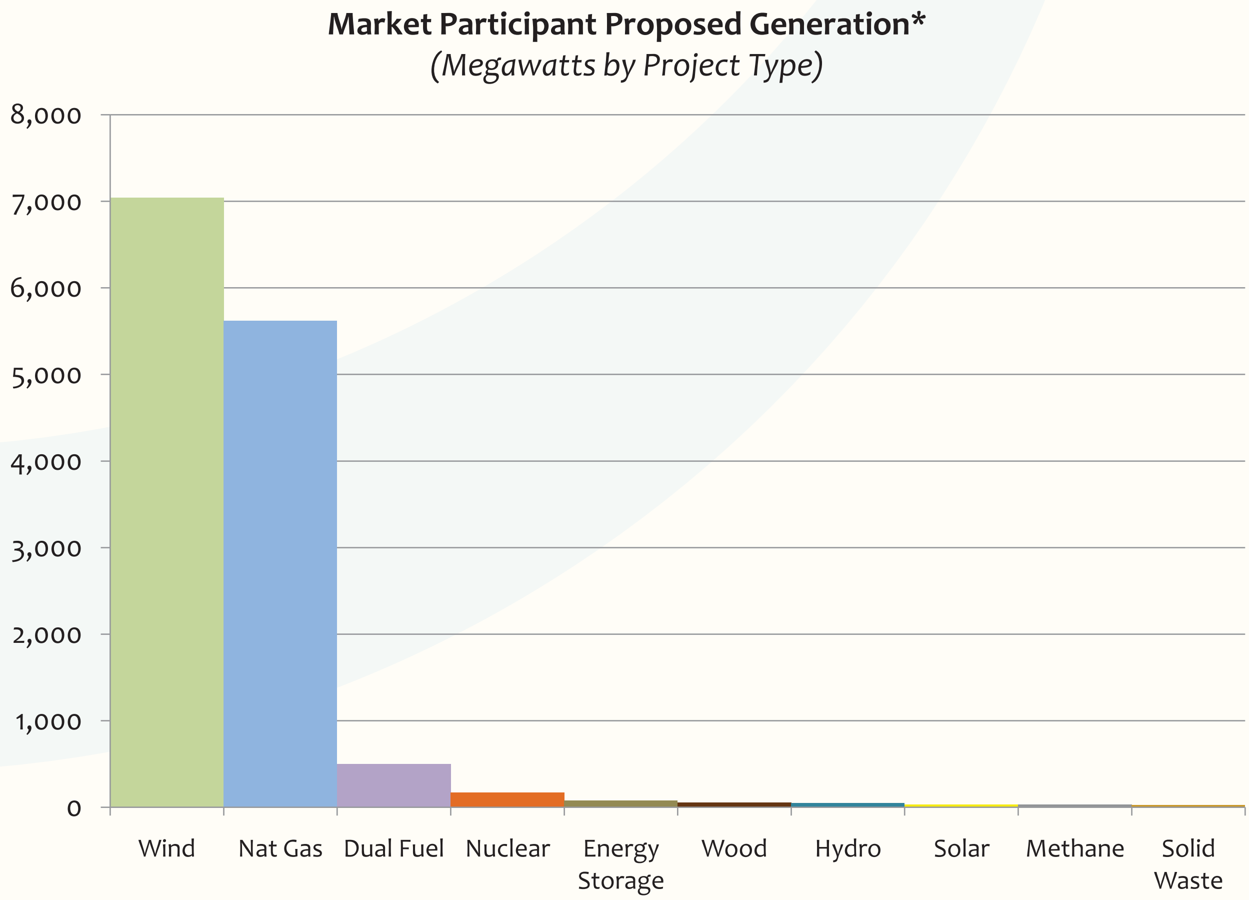


Figure 6. Proposed Generation by Project Type

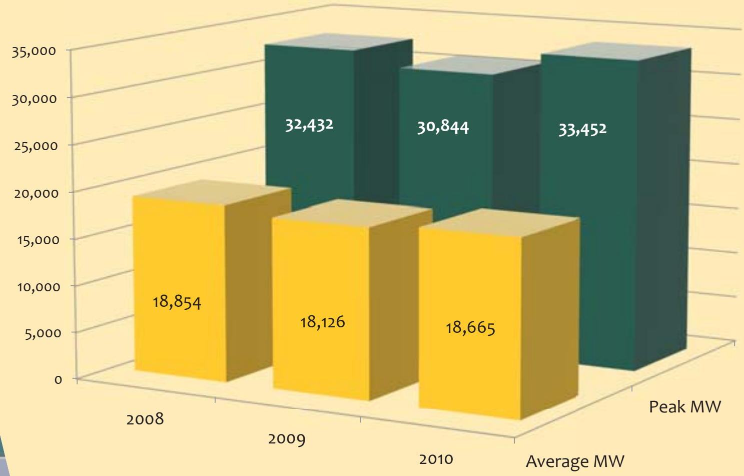


**New York Independent System Operator Interconnection Queue, February 2011*

Peak Load & Demand Response

Electricity demand is dynamic. It changes continuously as consumers use different amounts of power during the day and as their power needs change throughout the seasons of the year. For example, power usage increases sharply during times of extreme summer weather conditions. New York State's summer peak demand can spike 10,000-15,000 megawatts above the average level of electricity use. The additional demand is equal to the output of some 20 to 30 power plants (of 500 MW capacity) to supply the increased electricity needs of New Yorkers.

Peak vs. Average Demand



Reducing peak loads with demand response programs offers various benefits, such as providing alternatives to generation, transmission, and delivery infrastructure, which helps to reduce costs for consumers. Demand response also lessens the use of older, peaking generation, which improves overall generator efficiency and reduces emissions.

The NYISO's two major Demand Response programs include over 4,300 registered electric customers with a total capacity to reduce load by nearly 2,500 megawatts.

The expected adequacy of power resources, however, does not diminish the need to remain attentive to aging generation and transmission infrastructure. (See the Transmission Congestion discussion in the "Looking Ahead" section.) As of the close of 2010, 60 percent of New York State's power plant capacity was put into service before 1980. [See Figure 7.] Similarly, 85 percent of the high-voltage transmission facilities in New York State went into service before 1980. [See Figure 8.]

As a complement to the NYISO planning processes, the owners of the interconnected electricity transmission facilities in New York State initiated the State Transmission Assessment and Reliability Study (STARS), which is evaluating New York's existing transmission assets and identifying potential economically beneficial transmission projects that would reliably support New York State's energy needs. This effort includes life extension and modernization of existing facilities as well as potential expansion of transmission capabilities to address constraints and congestion.

In addition, the NYISO's planning process has examined potential risks to reliability presented by various economic, policy and regulatory developments. (See "Looking Ahead.")

Demand Trends

Electricity demand declined across the nation during the recent recession. In 2008 and 2009, electricity use fell in two consecutive years for the first time in the 60 years that the U.S. Energy Information Administration (EIA) has been keeping records of the data. In 2010, the rebound of economic activity and extreme weather contributed to increased power demands. According to EIA, net generation of electricity in the nation increased 3.1 percent from December 2009 to December 2010.[8]

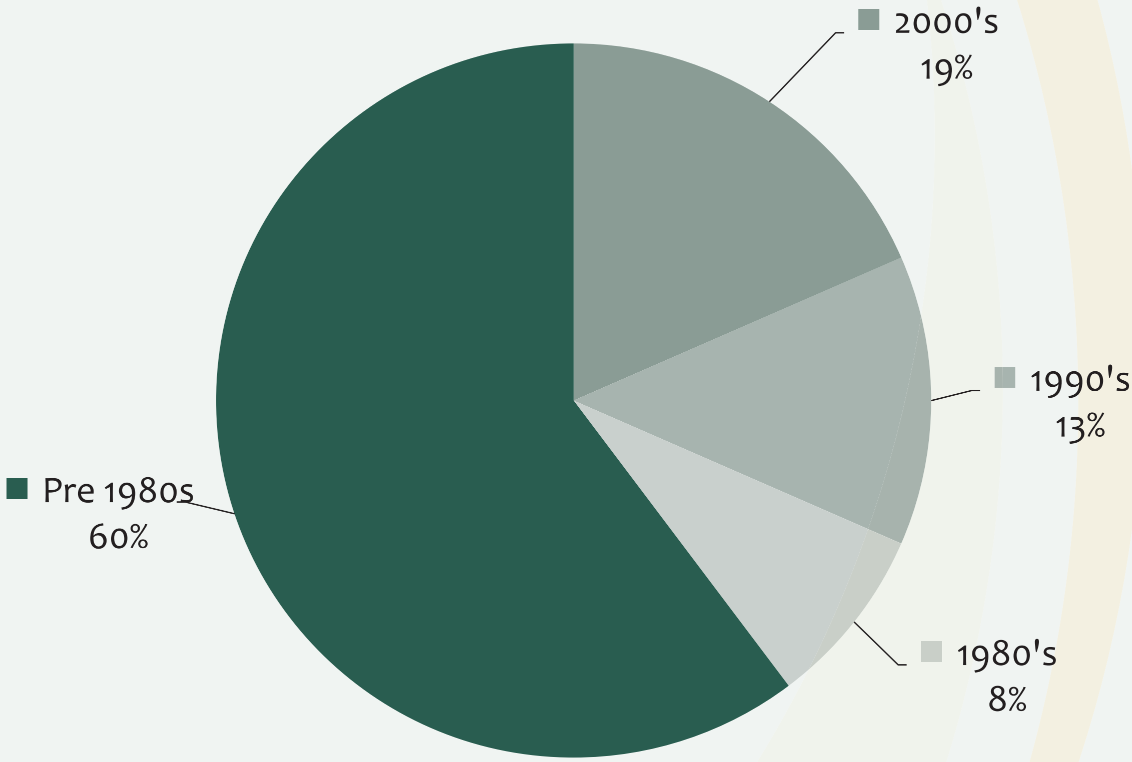
Since 1996, annual electricity use in New York has grown from 146,641 gigawatt-hours to 163,505 gigawatt-hours in 2010, an increase of more than 11.5 percent. [See Figure 9.]

During the recession, statewide energy use declined. Following a 1 percent decline in 2008, there was a drop of over 4 percent in 2009. In 2010, energy use increased nearly 3 percent from 2009 levels. While 2010 levels in the New York City and Long Island regions grew slightly above those of 2008, statewide energy use remained below pre-recession levels. [See Figure 10.]

The Federal Reserve reported in early March that nationwide "overall economic activity continued to expand at a modest to moderate pace" in the first two months of 2011. New York's economy was reported to show "stable to improving conditions."[9]

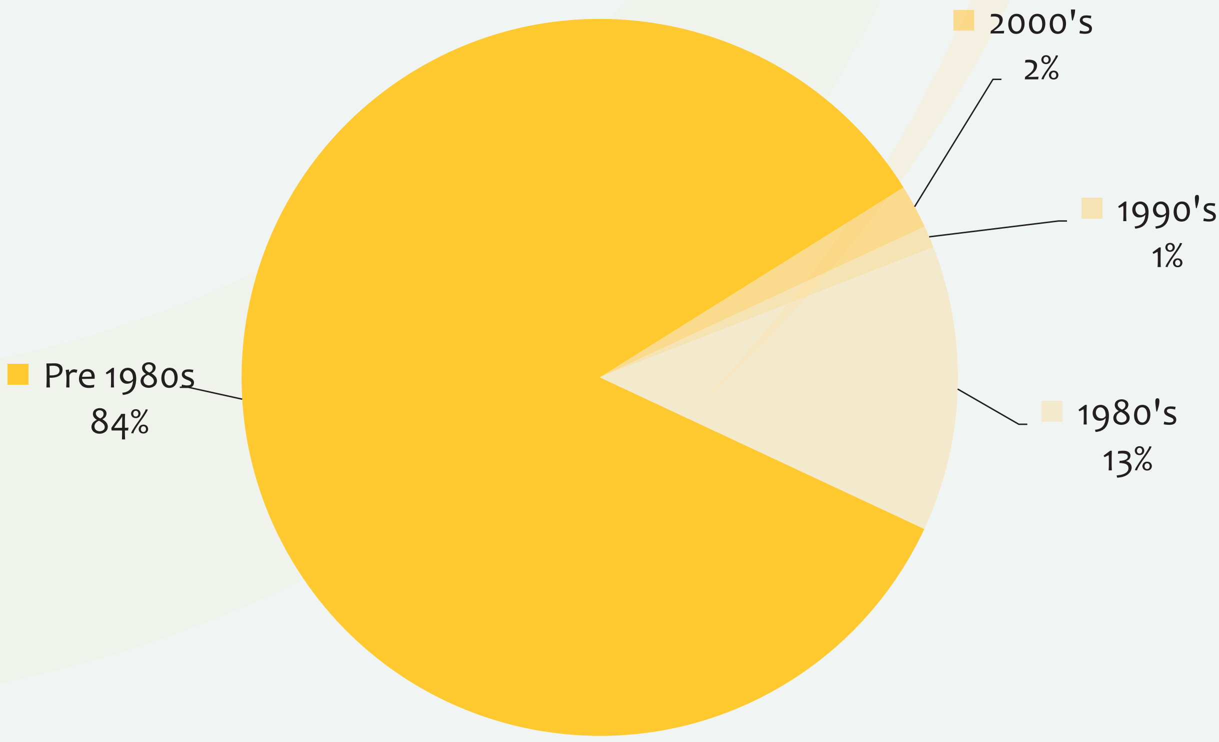
New York's power demand is expected to increase as economic growth returns. [See Figure 11.]

Figure 7. Age of Generation in New York State



percentage of megawatts of nameplate capacity by in-service date

Figure 8. Age of High-Voltage Transmission in New York State



percentage of circuit-miles – 230 kilovolt and above – by in-service date

Figure 9. New York State Electricity Energy Trends: 1996 — 2010

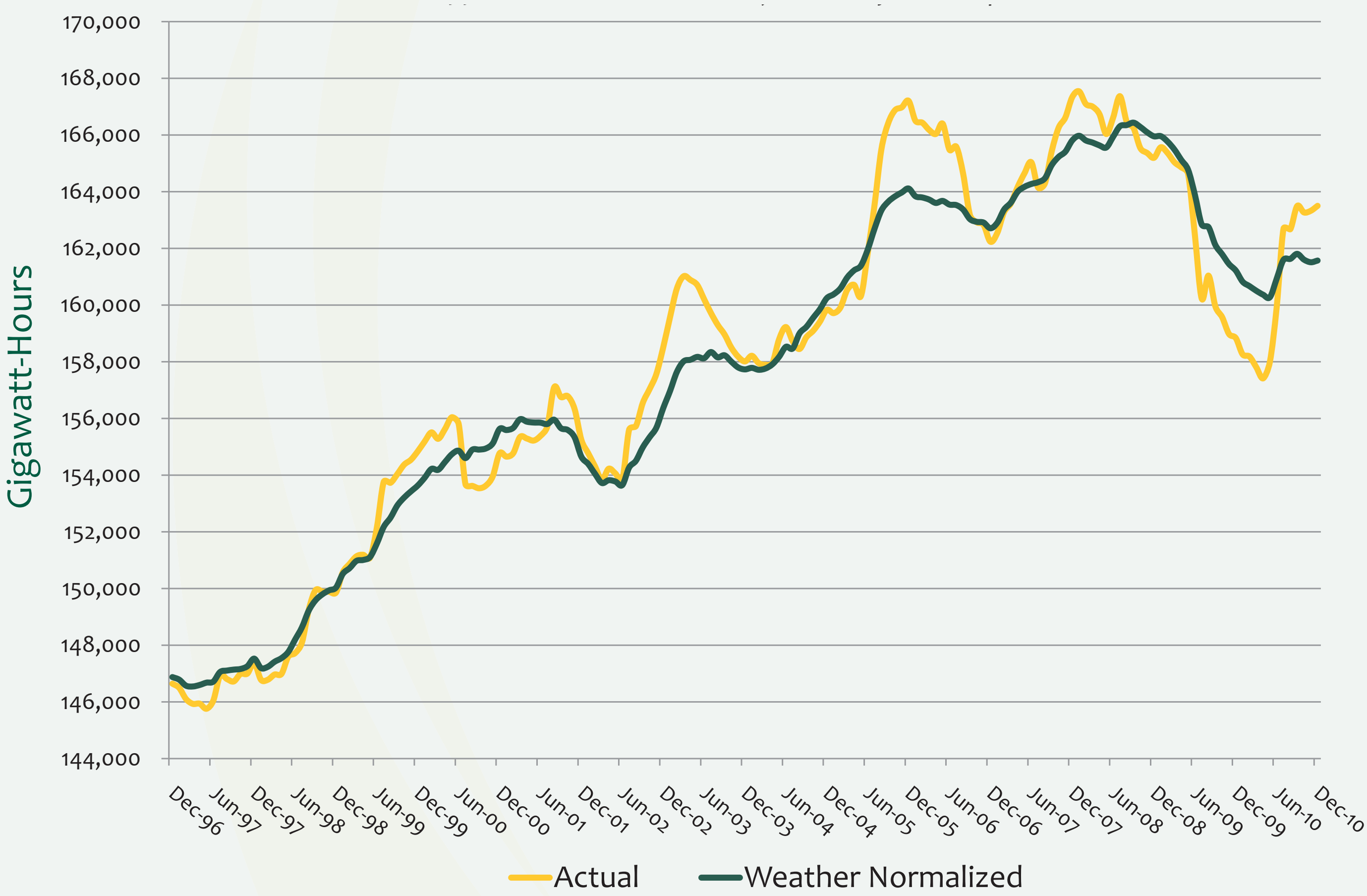


Figure 10. Annual Electricity Energy Usage: 2007 — 2010

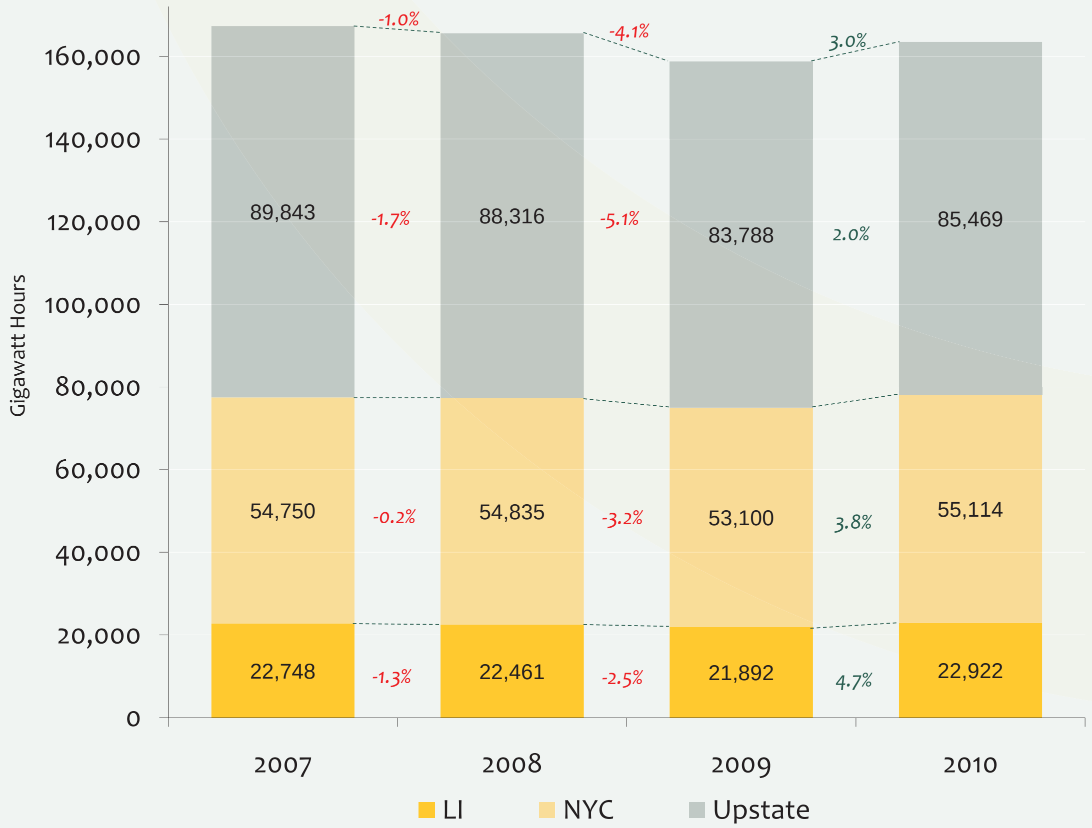
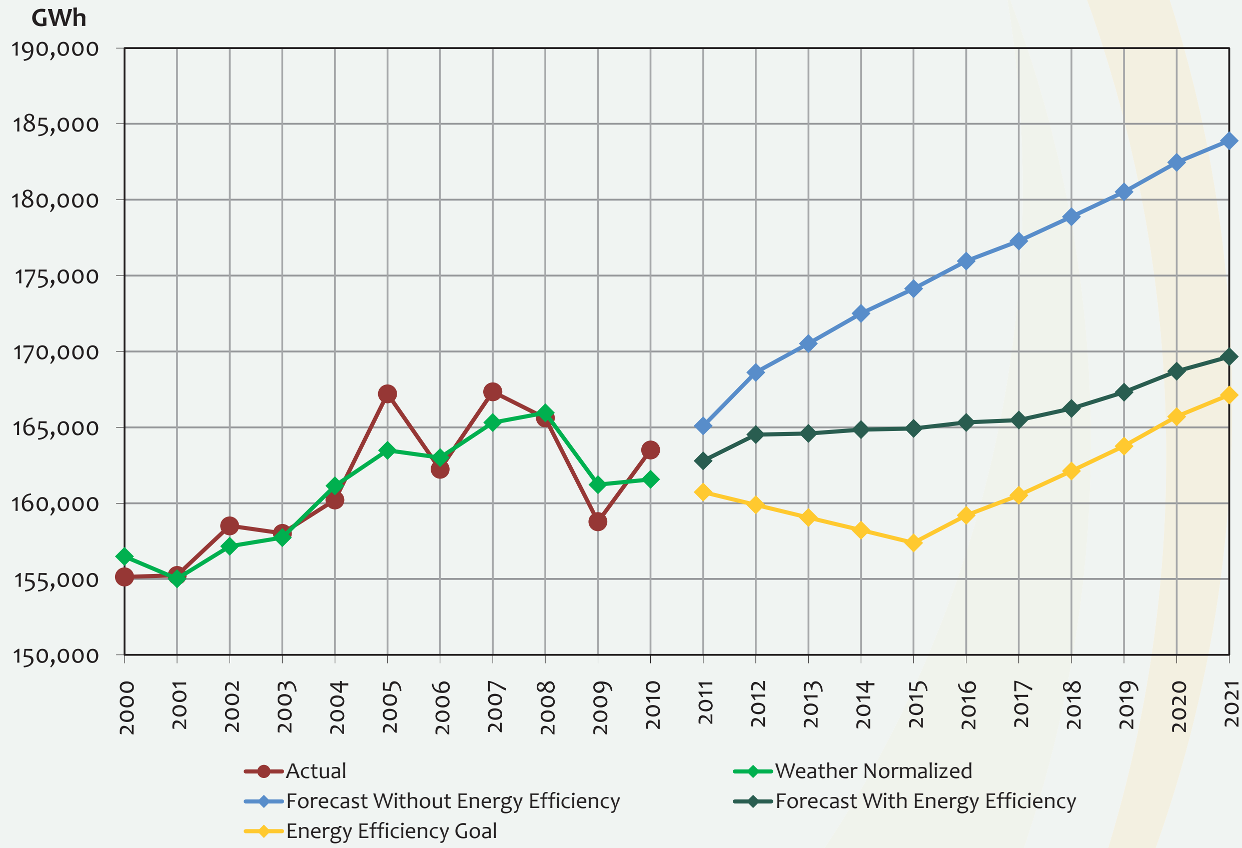


Figure 11. New York State Energy Trends: Actual & Forecast: 2000 — 2021



Fuel Mix and Energy Costs

Overall, New York has an enviable fuel mix. A statewide view of the array of fuels used to generate electricity in New York State shows a relatively diverse and more balanced fuel mix than states served predominantly by a single source of power generation.

However, a closer look at the various regions of the state reveals less diversity. While most of the population and electric load is downstate, much of the state's electricity supplies that have historically had comparatively lower operating costs (hydropower, nuclear, coal, and wind) are located upstate. As a result of enviromental requirements, transmission limitations, and reliability standards that require local generation in the downstate region, the power demands of New York City and Long Island must be largely served with generation fueled by natural gas and oil. [See Figure 12.] While efforts are being made to locate renewables within the downstate region, much of the region's power will be continue to be generated by conventional resources for the foreseeable future.

As the economic downturn reduced consumers' demand for energy, the price of natural gas dropped by 50 percent in 2009 and the price of electricity followed it closely. [See Figure 13.] The average cost of a megawatt-hour of electric energy in 2009 was the lowest in the history of New York's wholesale electricity markets.

As economic activity expanded in 2010, natural gas prices increased, as did wholesale electric energy costs. The average cost of wholesale electricity in New York was $59 per megawatt-hour in 2010. While that represents an increase over 2009's historic low of $49 per megawatt-hour, it is

Figure 12. Generating Capacity in New York State by Fuel Source - Statewide, New York City, and Long Island: 2011

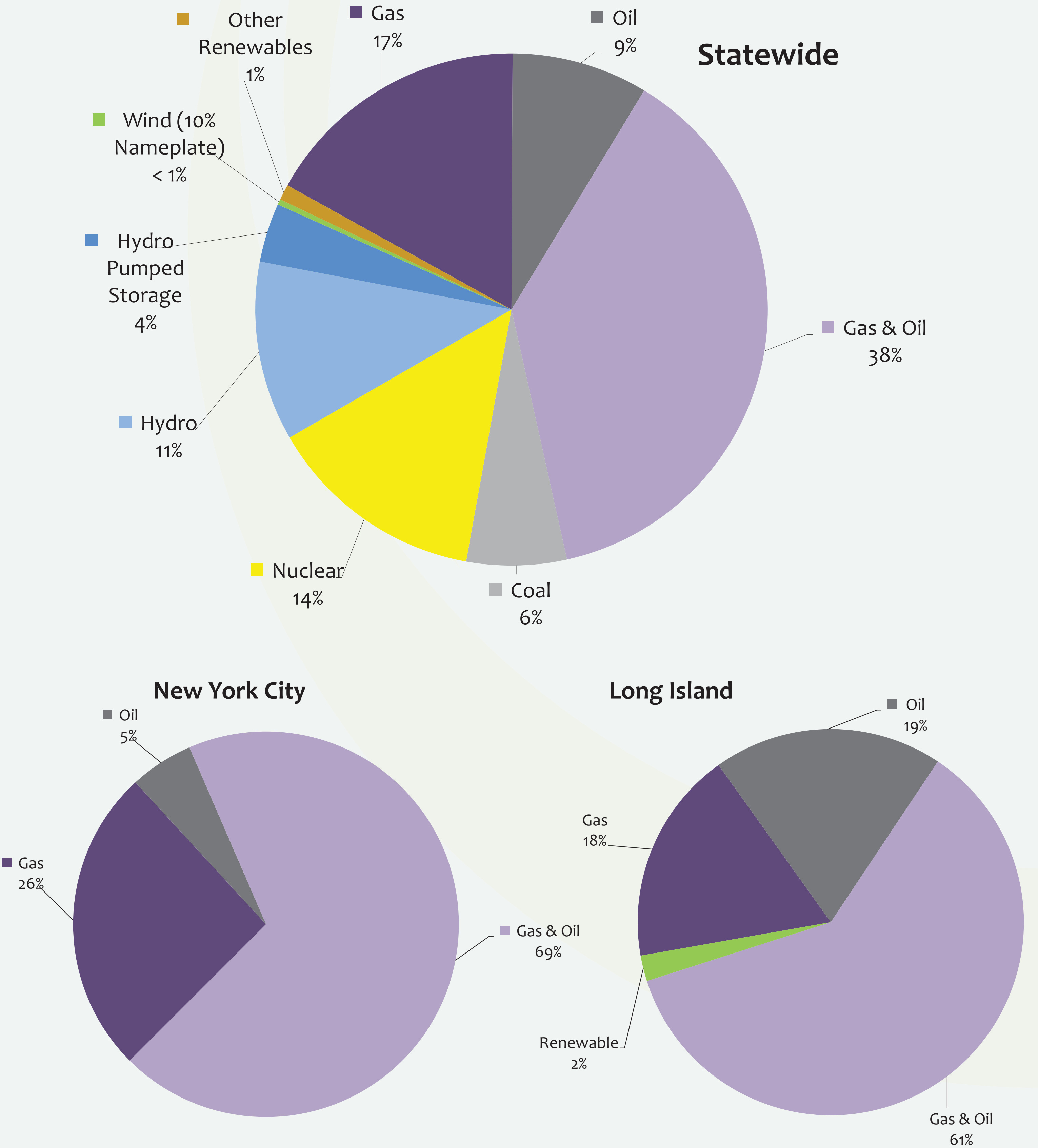


Figure 13. Natural Gas Cost and Electricity Price: 2000 — 2010

considerably below 2008 when costs averaged $95 per megawatt-hour. Electric energy costs in 2010 reflected increased demand for electricity due to both weather conditions and improving economic conditions. Last summer's heat waves led to more electricity being consumed in July 2010 than any previous month on record.

As the economy continues to recover and demand grows, natural gas prices are expected to increase. The impact on electricity prices will be influenced by changes in the cost of other fuels, as well as changes to inventories and the availability of new sources of natural gas. The price of oil is also subject to volatility, as recent developments in the Middle East have demonstrated.

Enhancement of pipeline and storage infrastructure is expected to improve the supply of natural gas in the Northeastern United States. In addition, there has been an increasing level of activity in accessing natural gas trapped in shale formations throughout various regions of the United States. While New York State has been evaluating the potential impacts of extracting native natural gas supplies, the level of activity in other states, particularly Pennsylvania, has helped to further expand the supply of natural gas in the Northeast. Nevertheless, it remains to be seen how robust the continued development of these new sources will be, as vigorous debate over the environmental impacts continues.

3. A Wider Horizon

New York's electric system does not operate in isolation. While the grid control area and wholesale power markets serving the Empire State are separate and distinct from those of its neighbors, New York is part of a vast, interconnected system of state, provincial, and regional electric systems that stretch from the Atlantic Ocean to the Rocky Mountains and from Canada to the Gulf of Mexico. Coordination among grid operators has always been an essential component of maintaining the reliability of the electric system. Active collaboration has become essential to meeting the complex energy challenges of the future.

New York has been actively engaged in leading the development of broader regional markets and expanded interregional planning in order to achieve the benefits of closer cooperation, expand the availability of resources for power systems in the region, and make more efficient use of the region's collective power assets to provide more economical electricity to the region's consumers.

As power systems move to expand the use of renewable power resources, close attention must be paid to the variable nature of such resources. Taking full advantage of wind power, which is among the fastest growing forms of power generation, can be accomplished with a combination of new technologies and removing barriers to trade among regional power markets.

Improved coordination will strengthen the ability of grid operators to adjust to the dynamic changes in system conditions, such as the ebb and flow of wind power. Likewise, combining the perspectives of energy system planners throughout the region can provide a more comprehensive assessment of renewable assets and the most effective means to utilize them.

Broader Regional Markets

In order to improve coordination of power transactions, enhance market efficiency, and provide cost-savings to consumers, the NYISO, in conjunction with neighboring grid operators, proposed a series of "Broader Regional Markets" initiatives to FERC in January 2010.

FERC conditionally approved the proposal in July 2010,[10] saying, "...these planned regional initiatives will be designed to reduce uplift costs and lower total system operating costs..."

The Broader Regional Market initiatives are intended to use existing generation and transmission resources more efficiently. An analysis of the benefits of the initiatives estimated regional annual savings of at least $362 million and savings associated with New York at $193 million annually.[11]

The Broader Regional Market proposals include both market-based and physical solutions. The market solutions include:

- *Interface pricing revisions, which would improve the pricing at the points at which energy moves between individual grid operators to allow for more efficient regional power transfers.*
- *Inter-regional transaction coordination, which would lower total system operating costs as transaction schedules more quickly adjust to market-to-market pricing patterns.*
- *Market-to-market coordination, which would increase the level of collaboration in congestion management between system operators in the region.*
- *Buy-through of congestion, which would require that the congestion cost of a transaction be charged based on the physical flow of power, unlike the current settlement determination that is based only on the contract path.*

In addition, the proposal includes the development of a parallel flow visualization tool designed to enhance the exchange of transmission system information, facilitate the calculation of regional dispatch impacts, and improve situational awareness for grid operators by providing common and consistent information regarding the sources of power flows and their impacts to all regions. It is also expected that the reactivation of a set of Phase Angle Regulators (PAR) on the Michigan-Ontario border will help to align the actual power flows around Lake Erie with the corresponding level of scheduled transactions.

In December 2010, FERC directed that priority be placed on the interface pricing revisions and the congestion management/market-to-market coordination initiatives.[12] The NYISO is working in close collaboration with neighboring regions to see that interface pricing methodologies are consistently applied throughout the region, for conditions with and without effective PAR controls in place. In addition, the NYISO is pursuing a Market-to-Market Coordination arrangement with PJM Interconnection that parallels the strategies employed between the Midwest ISO and the PJM Interconnection.

To facilitate more efficient use of transmission connections, the NYISO is moving to allow the scheduling of transactions with neighboring electric systems on a more frequent basis. Transactions are now scheduled on an hourly basis only. In March, FERC approved changes that will allow transactions at the NYISO's borders to be scheduled every 15 minutes and up to every five minutes in some cases. The Enhanced Interregional Transaction Coordination (EITC) measures will begin with the Chateaugay interface between New York and Québec. Over the next few years, the NYISO plans to implement this capability with the PJM Interconnection, and ISO New England.[13]

In addition, the NYISO and ISO New England are exploring opportunities to further enhance the use of transmission connections to deliver expanded consumer benefits through coordinated transaction scheduling protocols. This effort is intended to reduce transmission congestion costs, provide better integration of renewable and intermittent resources, and lower total system operating costs.[14]

Expanded Interregional Planning

Across the nation, there has been growing attention to the need for new and upgraded transmission facilities. Much of that attention has focused on moving power generated by wind resources located in areas remote from the population centers that consume large portion's of the nation's electricity. A nationwide "transmission superhighway" is among the concepts advocated to address the issue. However, this concept has also provoked debate over who would pay for the massive amount of new transmission that may be required and the respective jurisdiction of federal and state authorities in siting transmission.

That debate was among the factors that led to the creation of the Eastern Interconnection Planning Collaborative (EIPC) in early 2009. The Eastern Interconnection includes forty states and several Canadian provinces from the Rocky Mountains to the Atlantic Ocean and from Canada south to the Gulf of Mexico. [See Figure 14.] Prior to the creation of the EIPC, no single organization had previously existed to look at interconnection-wide planning across the eastern portion of North America. Stephen G. Whitley, NYISO President and CEO was named chair of the EIPC Executive Committee in 2009.

Formed under an agreement by over two dozen electric system planning authorities from the Eastern United States and Canada, the EIPC is focused on a "bottom-up" approach, starting with a roll-up of the existing grid expansion plans of electric system planning authorities, such as ISOs, RTOs and utilities, in the Eastern Interconnection. Supported by $16 million in funding from the U.S. Department of Energy, the EIPC is engaged in identification and analysis of a large number of resource expansion scenarios selected through a transparent stakeholder process that includes representatives of various interest sectors across the entire interconnection.

In addition to the EIPC, state governments have formed their own group, the Eastern Interconnection States Planning Council (EISPC), which was also awarded DOE funding to participate in the collaborative process.

In November 2010, the EIPC released the first-ever draft report summarizing the transmission and generation forecasted to be developed across the entire Eastern Interconnection over the next decade in accordance with the regional plans of the participating planning authorities. The draft report indicates that approximately 1,000 new and upgraded transmission facilities and some 750 new and upgraded generation resources will be serving the region by 2020.[15]

Mending Seams

While interconnected, the power grids and wholesale electricity markets serving the U.S. and Canada each developed separately and reflect differences in geography, climate, reliability requirements, and available power resources. The differences -- seams in the overall fabric of grid -- can lead to market inefficiencies and inhibit effective coordination of grid operations.

The Broader Regional Markets initiative is an effort to mend seams, enhance efficiency of existing resources, and reduce costs for power consumers. A September 2010 analysis by Potomac Economics estimated regional savings at $362 million a year and savings associated with New York to be $193 million annually.

The collaborative effort will help to optimize the use of existing resources and complement the development of new resources within New York and among the individual control areas of the region.

The regional initiative involves Ontario's Independent Electricity System Operator, the Midwest Independent Transmission System Operator, PJM Interconnection, ISO New England, and Hydro Québec.

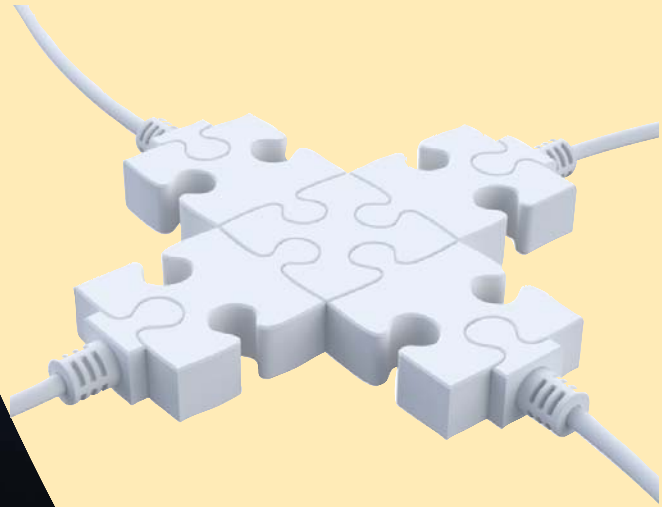
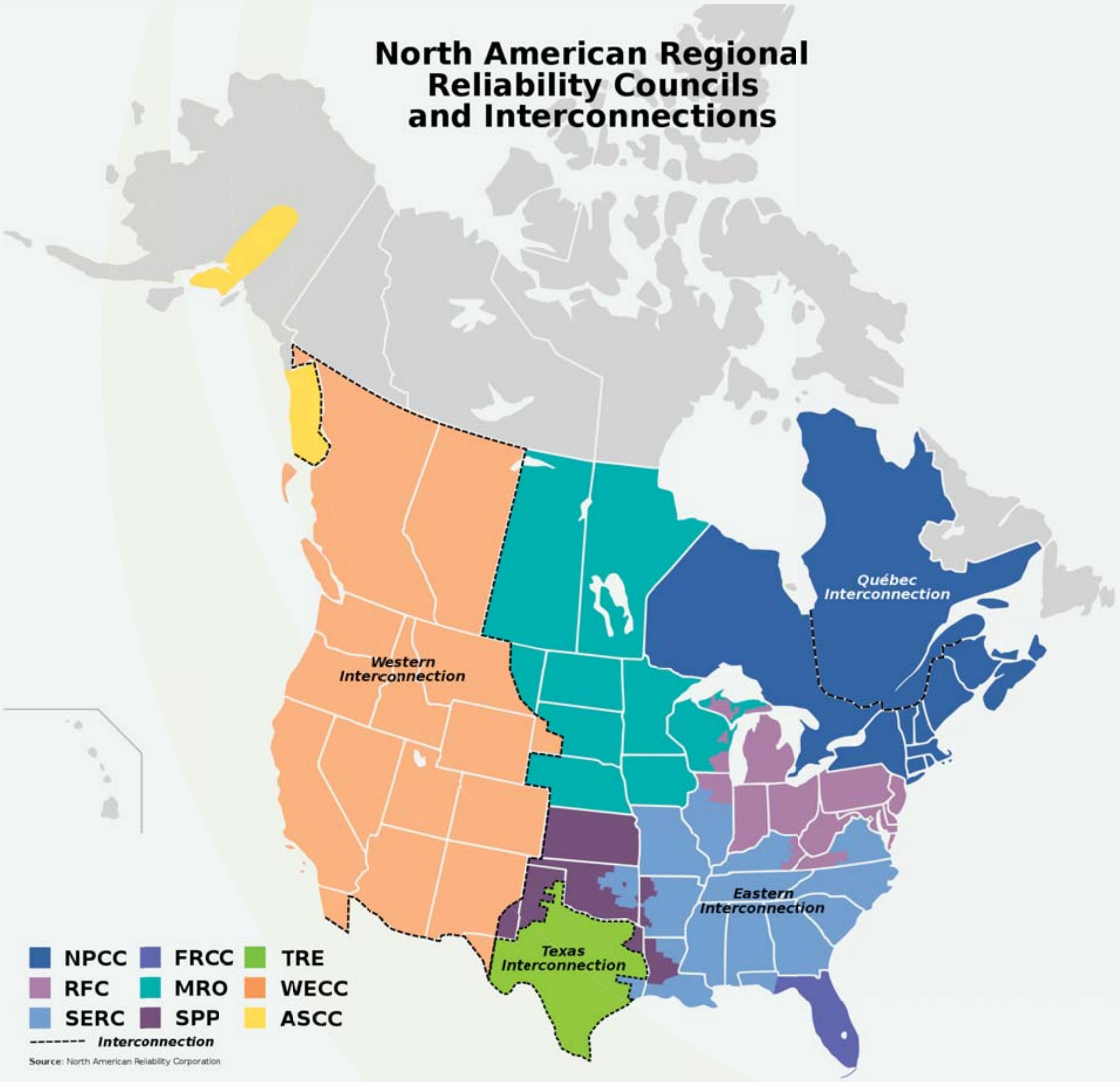


Figure 14. Electric Interconnections of North America



EIPC's economic analysis of stakeholder-selected energy futures is underway and is scheduled for completion by the end of 2011. Phase II of the DOE-funded project is scheduled to begin in early 2012 and will include the development of transmission alternatives to support the three resource futures selected by stakeholders for more detailed reliability and economic analysis. Phase II is scheduled for completion by the end of 2012.

4. Looking Ahead

Renewable Resources and Energy Efficiency

New York State has established an ambitious set of goals for encouraging energy efficiency and increasing renewable power. The "45 X 15" Clean Energy Strategy is aimed at meeting 45 percent of New York State's 2007-forecasted electricity demand through efficiency and renewable energy by 2015. To achieve these levels New York must simultaneously reduce energy use by 15 percent through efficiency, and supply 30 percent of its energy needs through renewable electric generation.

The goals of New York's Clean Energy Strategy include reducing annual electric usage to a level below 158,000 gigawatt-hours by 2015. The effective and expeditious implementation of energy efficiency programs is critical to realizing these targeted usage levels. In addition, 45,700 gigawatts-hours of the electricity used by New Yorkers will need to be produced by renewable resources in 2015 to achieve the 30 percent renewable goal.[16]

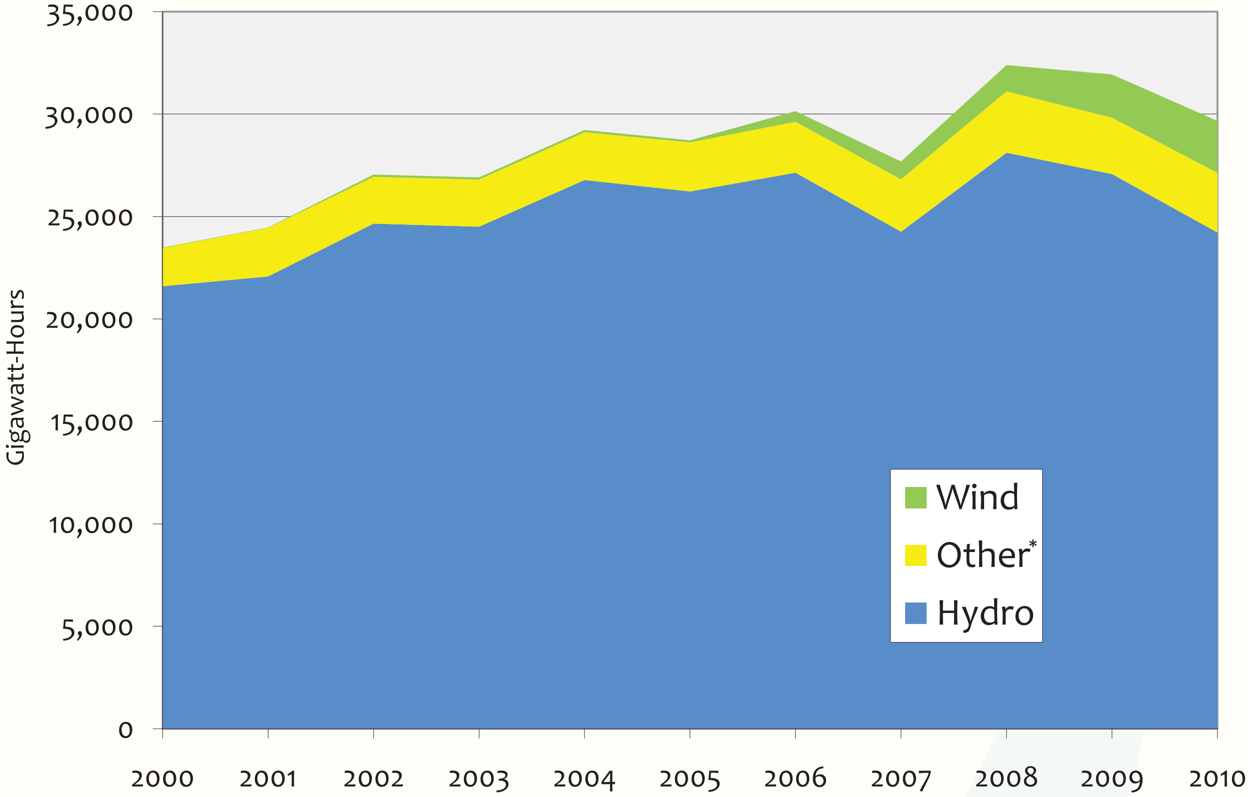
In 2010, nearly 30,000 gigawatt-hours of New York's electricity was supplied by wind, hydro and other renewable resources.[17] [See Figure 15.]

Continued expansion of renewable power resources is essential to meeting New York State's clean energy goals. In New York's wholesale electricity markets, efforts to cultivate the growth of green power have included such measures as:

- *Establishing a centralized wind forecasting system in 2008 to enable the NYISO to better utilize and accommodate wind energy by forecasting the availability and timing of wind-powered generation.*
- *Pioneering the dispatch of windpower, fully balancing the reliability requirements of the power system with the use of the least costly power available via "economic dispatch."*

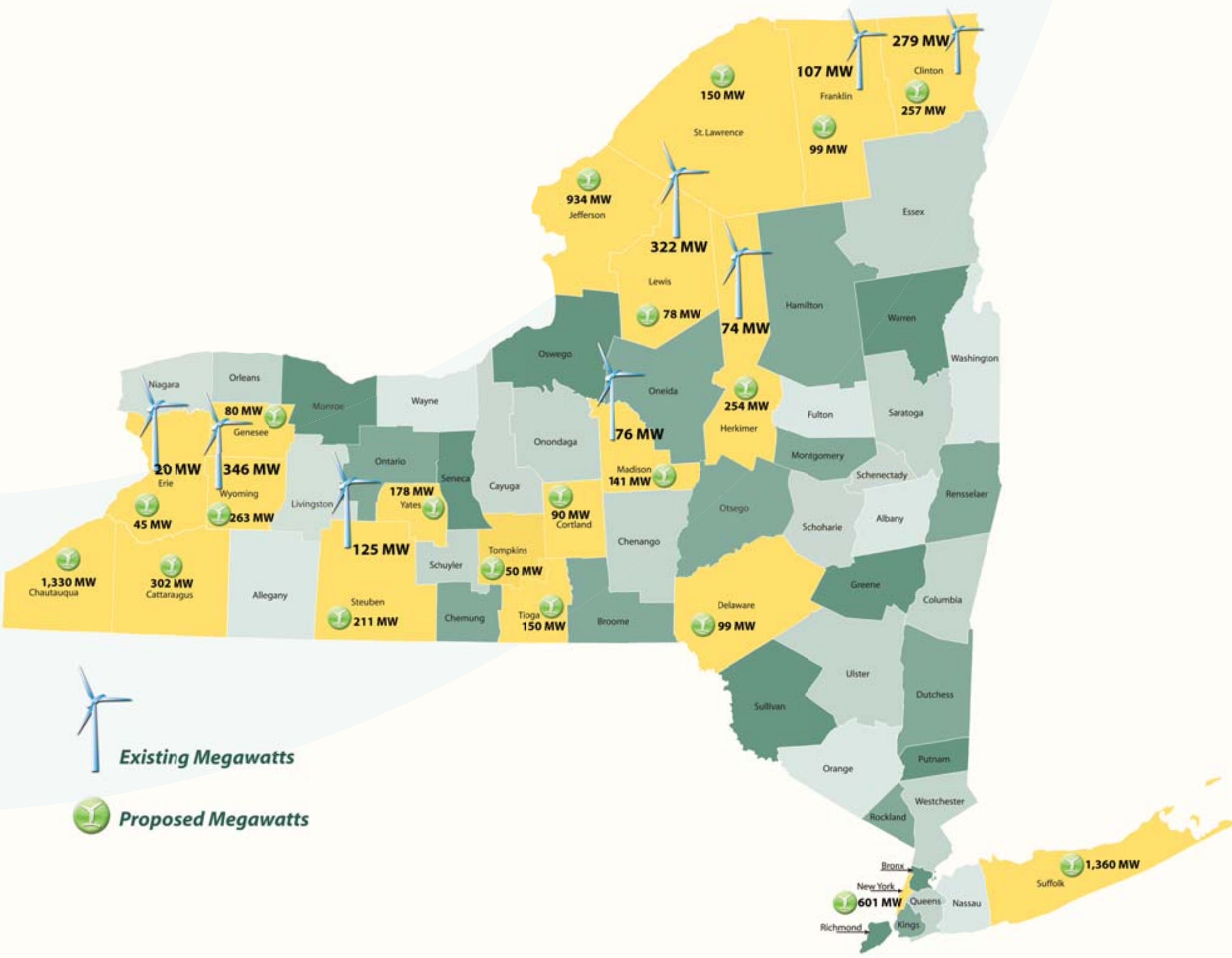
A total of 1,348 megawatts of wind-powered generation is in operation in New York State. In addition, over 7,000 megawatts of additional windpower has been proposed for interconnection with New York's bulk electricity grid. [see Figure 16.] Proposals for additional renewable energy resources include a 700-megawatt off-shore wind project that would feed directly into Long Island and New York City, as well as a 31-megawatt solar power project on Long Island.

Figure 15. Generation from Renewable Resources: 2000-2010



*Includes Methane, Refuse, Solar & Wood

Figure 16. Windpower in New York State — Installed and Proposed: 2010



Growing Wind in New York

Wind-powered generation could be increased by over five times the amount currently operating in New York. An extensive study, Growing Wind: *NYISO 2010 Wind Generation Study*, examined the prospect of expanding New York's wind-power generation from 1,275 megawatts to 8,000 megawatts by 2018.

The study determined that NYISO systems and procedures (which include centralized wind forecasting, economic dispatch, and the other operational practices) could allow the integration of the additional wind generation without adverse reliability impacts.

The study also found that less than 10 percent of the potential wind energy production from Northern New York would be undeliverable because of local transmission limitations. While feasible sets of transmission facility upgrades to eliminate the transmission limitations were identified, transmission upgrades and alternatives will require detailed physical review and economic evaluation.

Wind generation presents challenges to system operators due to the variability of output, and the fact that wind energy tends to increase much later in the day when power use is declining and decline in the morning when power use is increasing.

In addition, wind projects in New York are predominantly being developed in the northern and western portions of the state, while the population centers of southeastern New York are the regions with the highest demand for electricity.

Energy Storage

The variable nature of renewable resources has helped to highlight the value of energy storage. From conventional systems such as hydropower pumped storage to emerging new technologies, storage resources can complement the integration of renewable energy, as well as provide new tools to enhance overall reliability and create a more robust power grid.

Electricity is unique among energy sources because it must be produced, delivered, and consumed instantly. Other energy commodities (such as natural gas, oil, or coal) can be produced, and stored in massive quantities, to be delivered and consumed as demand requires. Electricity storage, in contrast, has been limited, costly and complex.

The most widely used means of storing electricity for use by the power system has been pumped storage hydroelectric projects that store water as potential energy during off-peak hours for later use when demand is higher. Pumped storage accounts for 4 percent of New York's generating capacity. While that level is twice the national average, it is not expected to expand due to the lack of sites where it may be permitted and economically constructed.

In addition, New York has access to additional "storage" in the form of conventional hydroelectric power projects with large reservoirs, both within the state and across the border in Quebec. The water that flows into the reservoirs is captured and released when needed to produce electricity.

An array of technologies has begun to provide new ways to address the challenge of electricity storage. They include flywheels, advanced batteries, compressed air energy storage, and off-peak usage by plug-in electric vehicles.

In 2009, the NYISO initiated new market rules to facilitate integration of these new energy storage systems. Specifically, these storage systems were enabled to participate in the markets as frequency regulation providers, delivering reserve capacity that helps grid operators maintain the balance between generation and load.[18]

A February 2011 report from KEMA, a global energy consulting, testing and certification firm, found that wholesale electricity markets are assisting the development of energy storage innovations.[19]

According to KEMA, wholesale electricity markets foster innovation by:

- *Requiring entities to compete for the provision of services based on performance and price;*
- *Creating a level playing field for participants to offer services;*
- *Providing a reward to incent participation and justify taking greater risk; and*
- *Having the potential reward be transparent so interested parties can gauge whether to attempt to provide services.*

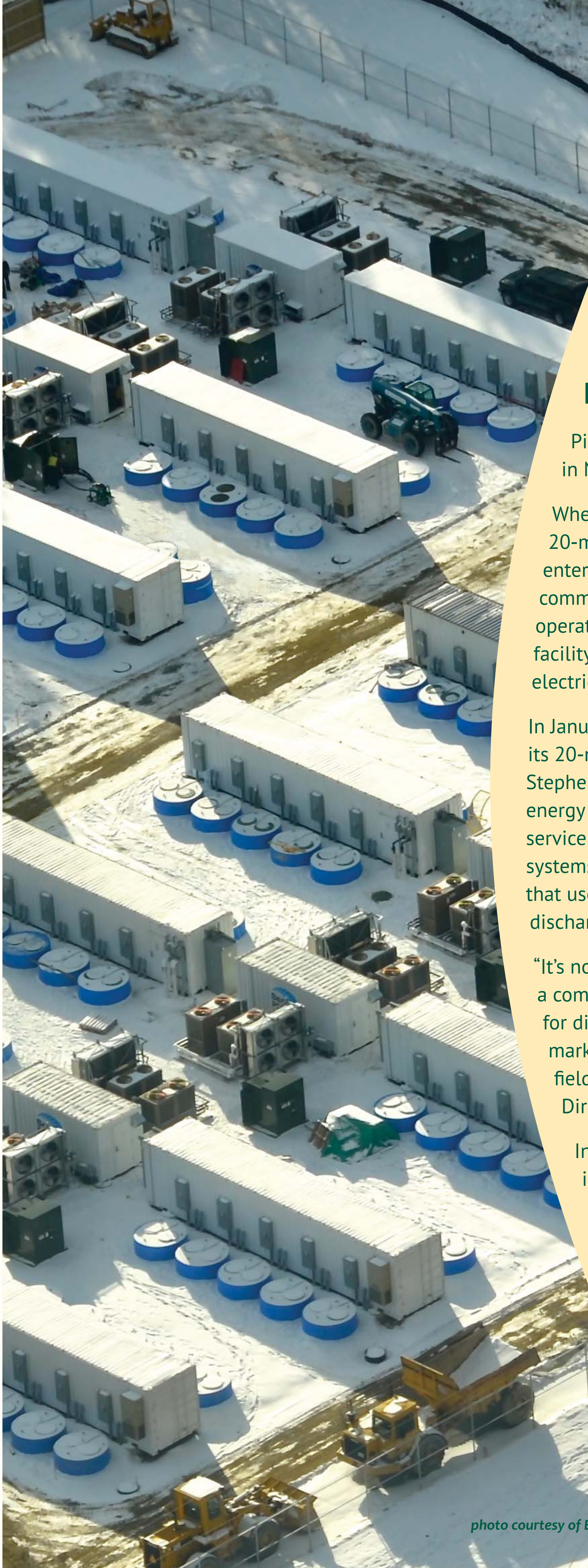


photo courtesy of Beacon Power

photo courtesy of AES Energy Storage

Energy Storage Firsts in New York

Pioneering grid-scale energy storage is taking shape in New York.

When the first phase of an AES Energy Storage 20-megawatt energy storage system in Johnson City, NY entered operation in December 2010, it became the first commercial grid-scale battery-based storage system to operate as a generator in the U.S. The AES Energy Storage facility uses advanced lithium-ion batteries that convert electricity into chemical energy for later release.

In January 2011, Beacon Power began operations at its 20-megawatt flywheel energy storage plant in Stephentown, NY, which is the first full-scale flywheel energy storage facility to provide frequency regulation service on the U.S. electricity grid. Beacon's flywheel systems are high-speed rotating mechanical devices that use the principle of kinetic energy to store and then discharge electricity from the grid.

"It's no coincidence that our facility is located in New York, a competitive market. By providing clear market tariffs for different technology solutions, competitive electricity markets like the one in New York level the playing field and drive innovation," according to Beacon Power Director of Corporate Communications, Gene Hunt.

In 2009, the NYISO became the first grid operator in the nation to implement federally-approved market rules that enabled storage systems to participate in the markets as frequency regulation providers, delivering reserve capacity that helps grid operators maintain the balance between generation and load.

Electric Vehicles

New Yorkers are expected to be among the early adopters of grid-connected electric vehicles.[20] Plug-in electric vehicles present both challenges and opportunities to grid operators.[21] Initially, the most significant impacts will be on the local electric distribution systems.

The impact of the additional demands that electric vehicles may create for the electric system can be managed with sufficient planning and appropriate rate design incentives. Vehicle charging staggered across off-peak (late night/early morning) hours would maximize the use of more affordable power. The mechanism for promoting off-peak electric vehicle charging may include rate designs that encourage consumers to respond to price incentives. Smart grid tools may enable vehicles to be managed remotely or programmed to automatically charge during off-peak periods.

The environmental impact of electric vehicles is also affected by the timing and location of vehicle charging. A February 2011 Carnegie Mellon study of potential emission impacts of electric vehicle in the NYISO and PJM interconnection territories found that "smart charging" (when a vehicle charges during periods of low electricity demand) offers emission benefits. "In NYISO, the smart charging scenario resulted in lower net emissions than work charging and lower or equal emissions compared to home charging," the study said.[22]

In the future, grid-connected electric vehicles may also serve as energy storage systems, providing power from vehicle batteries to balance local energy needs.

As the number of vehicles fueled by electricity continues to grow, more work will need to be done to integrate them, securely and effectively, into the power system.

Smart Grid

The concept of "Smart Grid" encompasses a vast array of solutions intended to empower the end-use electricity consumer and enhance the operation of the transmission and distribution systems through the use of digital computer technologies.

A June 2010 survey reported that 88 percent of Americans said they would be willing to use a smart device (meter, thermostat or appliance) if it would help to better manage their energy usage.[23]

Electric meters with enhanced communication capabilities are becoming more prevalent. In 2009, 39 percent of all the electrical customers in the nation had advanced meters, up from 32 percent in 2008. These totals include meters with one-way communications providing automated meter reading and so-called "smart meters" providing two-way communications. In 2009, 17 percent of advanced meters used two-way communication, up from 10 percent in 2008.[24]

The New York State Public Service Commission has commenced efforts to develop the regulatory framework for deployment of Smart Grid in the Empire State.[25] Commenting on those efforts, the NYISO noted that smart grid technologies have the potential to:

- *Lower costs to consumers and expand consumers' understanding and control of their electricity use;*

- *Enhance the reliability and efficiency of the power system by improving grid operators' situational awareness and control; and*
- *Assist the growth of renewable resources and complementary energy storage resources.*[26]

Smart grid will require significant adjustments to grid operations, as operators will have access to a vast new array of power system information.

In 2009, the NYISO and the owners of New York's transmission facilities were awarded $37.4 million from the U.S. Department of Energy's (DOE) Smart Grid Investment Grant program. These federal stimulus funds will support the creation of a statewide Phasor Measurement Network to enhance the NYISO's ability to detect system vulnerabilities and disturbances. The federal grant will also support the installation of capacitor banks in various locations throughout the state to improve the efficiency of power flows.

New York will also benefit from other DOE Smart Grid Investments, which include a Dynamic Thermal Circuit Ratings project that the New York Power Authority is implementing to improve the efficiency of its transmission lines, as well as a Smart Energy Corridor project on Long Island.

The DOE is also funding a Smart Grid Demonstration Project using the Brooklyn Army Terminal and a number of other publicly and privately owned large buildings in New York City as a showcase for the integration of distributed renewable generation, energy storage and demand-side management. The New York City Department of Economic Development in partnership with ConEd is combining a solar photovoltaic system, battery storage and a building management system at the Brooklyn facility. The project also plans to participate in NYISO demand response programs.

Also among the Empire State's smart grid initiatives is the New York State Smart Grid Consortium, a public-private partnership incorporated in 2009, to harness the unique resources of the state as it manages the collaborative development of the smart grid.

A 2010 study of the state legal and regulatory environment for smart grid, commissioned by the Galvin Electricity Initiative, suggests that states, such as New York, that have restructured their electricity industry offer a firm foundation for smart grid advances. "Progressive smart grid policy coupled with restructuring does appear to give states a head start on practices that foster smart grid implementation and enterprise," the report states.[27]

Power Grid Cyber Security

The impact of smart grid technology on the electric system is yet to be determined. However, the issues facing smart grid technology include the need for cyber security enhancements to maintain reliability. The Energy Policy Act of 2005 gave FERC oversight jurisdiction over the bulk electric power grid, including the approval of mandatory cyber security reliability standards. As the nation's electric reliability organization, NERC has the sole authority to propose reliability standards to FERC for approval. NERC developed critical infrastructure protection cyber security reliability standards, which FERC approved in January 2008. Entities performing the most essential functions were required to comply with 13 of the requirements by June 2008, with the remaining requirements phased in through 2009.[28]

In a January 2011 audit of FERC's cyber security monitoring, the U.S. Department of Energy's inspector general found that the commission might not be able to provide adequate oversight because FERC has only limited authority to ensure adequate cyber security over the nation's bulk power system.[29]

A U.S. Government Accountability Office report released in mid-January found that a lack of clarity between FERC and state regulators and fragmented regulation of the electric grid make it hard to ensure the cyber security of the evolving smart grid.[30]

In February, the DOE launched a collaborative, led by the DOE Office of Electricity Delivery and Energy Reliability, the National Institute of Standards and Technology, and NERC to develop a cyber security risk management process guideline for the electricity sector. NERC announced in March that it has formed the Cyber Attack Task Force to identify opportunities for enhancement of existing protection, resilience, and recovery capabilities.

The NYISO was found fully compliant in NERC Reliability Audits of Critical Infrastructure Protection Standards in 2009 and 2010. The cyber security field is rapidly evolving and presents many challenges. The NYISO continues to collaborate with cyber security authorities in industry and government to anticipate threats and leverage the latest technologies and best practices to provide rigorous cyber security protection.

Dynamic Pricing

While the actual cost of electricity varies on an hour-to-hour basis, most electricity consumers pay a rate that represents the average cost for each kilowatt-hour of electricity consumed over some period.

Consumer access to "dynamic pricing" involves providing a rate structure that reflects the changing (or dynamic) supply and demand conditions in the wholesale electricity market.

According to Garry Brown, Chairman of the NYS PSC, "New York has long been a leader in the use of time-based pricing, going back to the days of [former NYS PSC Chairman] Fred Kahn in the 1970s."[31]

At the wholesale level, the electric power industry in New York ceased the use of average cost pricing more than a decade ago when electricity markets were restructured. The NYISO, through its administration of wholesale electricity markets, provides transparent wholesale pricing that can enable utilities, energy service companies and others to provide retail customers with price signals that vary as wholesale prices change.

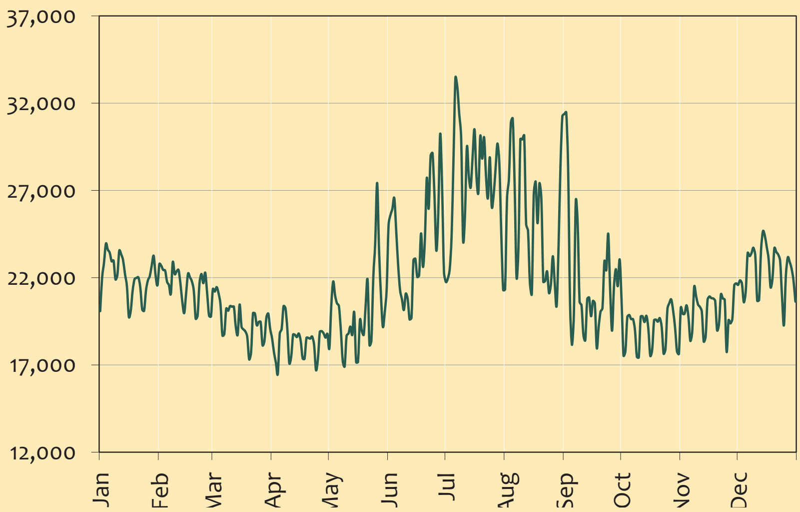
Since commercial and industrial power customers account for approximately two-thirds of the electricity consumed in New York, dynamic pricing efforts have initially focused on those sectors. Larger commercial and industrial customers with maximum peak demands above 500-kilowatt (approximately the size of a large office building) have been or will soon be afforded the opportunity to take advantage of dynamic electric rates.

The Benefits of Getting the Price Right

Power prices that change to reflect the actual cost of electricity could encourage consumers to adjust energy usage to take advantage of lower-priced energy in low-demand hours and to limit consumption in high-demand, higher-priced hours.

In addition reducing their individual monthly bills, the combined effect of consumers cutting demand during peak periods can lead to a more efficient and lower-cost electric system.

2010 Daily Peak Load



Because the consumption of electricity in the top one percent of the hours of the year accounts for approximately 10 percent of system peak demand, actions taken to reduce electric demand during this relatively small number of peak hours can substantially reduce overall electricity costs by lessening the need for expensive additional reserve generation and transmission capacity.

A 2009 study conducted by the Brattle Group for the NYISO concluded that "dynamic pricing can provide substantial benefits in New York State by reducing total resource costs, lowering customer market costs, and improving economic efficiency. With estimated market-based cost savings in the range of $171 million to $579 million per year, the benefits to electric consumers can be significant, especially when technology serves to facilitate demand response and energy conservation."

The New York State Public Service Commission has required hourly rates for all full-service utility customers above the 500-kilowatt threshold.[32] To date, about 6,000 megawatts (approximately 20 percent of the State's total electrical load) of demand by commercial and industrial customers use the hourly rate system. These customers, however, have the opportunity to switch to competitive energy service providers for their commodity electric service. They may enter into contracts that limit their exposure to daily price fluctuations (though their provider still faces the transparent wholesale market price). Over 80 percent of larger customers facing mandatory hourly pricing have chosen to switch to competitive energy providers. Some smaller retail customers have also chosen to switch to competitive energy providers. However, they have not been provided with access to prices that vary with the time of use. These customers may require enhanced metering and other energy management capabilities within their businesses and homes to take full advantage of dynamic prices.

Equipping smaller, retail customers with new technology may be facilitated by aggregators who combine the electric loads of numerous customers. Such aggregation is already taking place among companies that enlist customers to participate in demand response programs. A similar approach may provide the means to deploy advanced meters, distributed generation (such as solar photovoltaics), or other energy technologies across a spectrum of residential and smaller commercial and industrial power customers.

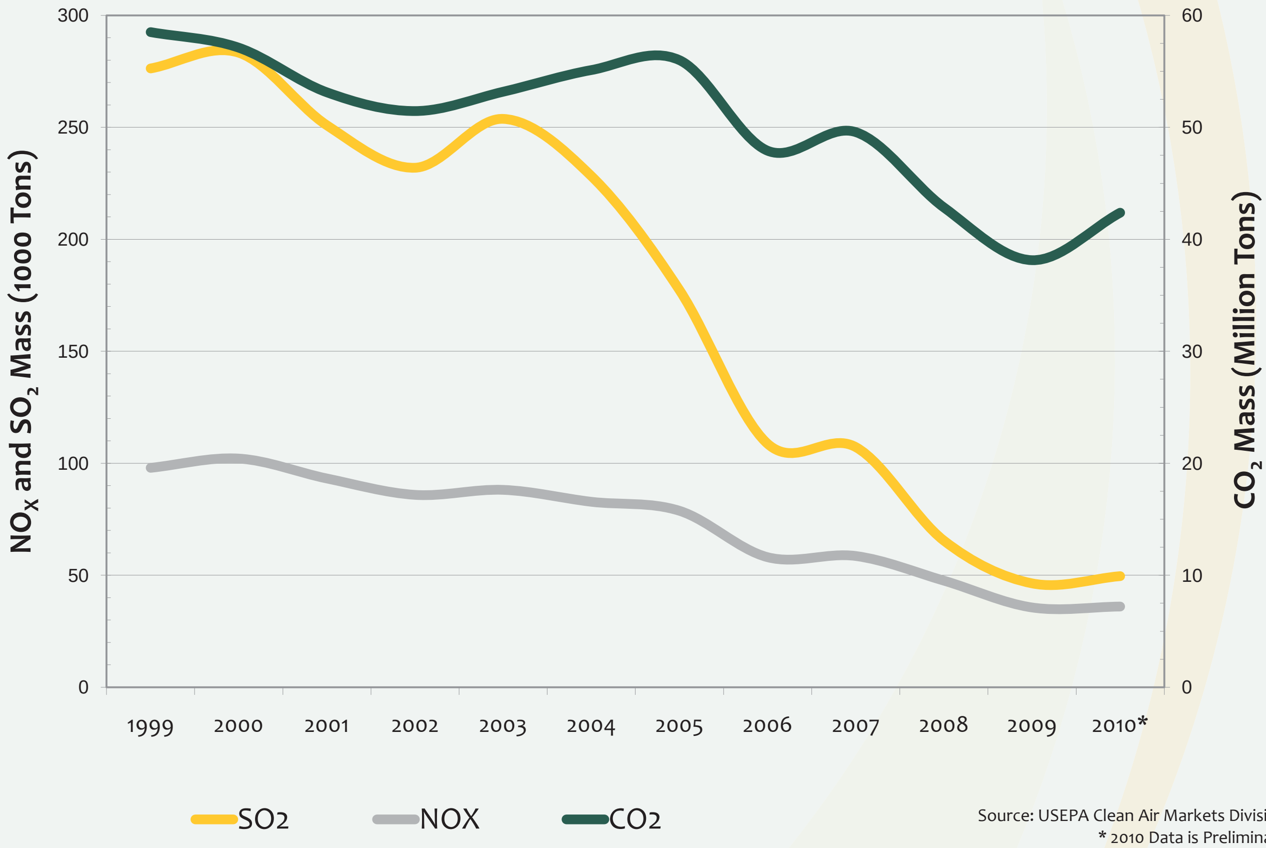
Environmental Quality and System Reliability

As previously noted, more than 8,600 megawatts of new generation have been added by private power producers and public authorities in New York since 2000. A preponderance of the new megawatts are generated by emission-free windpower and more efficient natural gas combined cycle facilities, which produce fewer emissions than older fossil-fueled power plants.

Since 2000, power plants with generating capacity totaling 3,510 megawatts have retired. Of that total, 3,500 megawatts were powered by fossil fuels, including 1,283 megawatts of coal-fired generation. New power plants are generally more efficient, use cleaner-burning natural gas or zero-emission renewable resources. In addition, wholesale markets have provided the incentive for an increase in output from nuclear plants, which are virtually free of air-pollution emissions.

In New York State, the rate of power plant emissions of Sulfur Dioxide (SO_2), Nitrogen Oxides (NO_x), and Carbon Dioxide (CO_2) has sharply declined since 1999. [See Figure 17.] The SO_2 rates have seen the most dramatic decline by dropping more than 80 percent. NO_x rates dropped more than 60 percent and CO_2 rates dropped by 25 percent. The emission rates of New York State's electricity generation – measured in tons per megawatt-hour – rank among the lowest in the continental United States. New York's CO_2 emissions rate ranks 10th lowest; its NO_x and SO_2 emission rates rank 12th lowest.[33]

Figure 17. New York State Power Plant Emissions: 1999 – 2010



Source: USEPA Clean Air Markets Division
* 2010 Data is Preliminary

New York is part of the Regional Greenhouse Gas Initiative (RGGI), which is a compact of ten eastern states designed to restrict carbon emissions from power plants. Currently the cost of obtaining emissions allowances is incorporated among the costs incurred by power producers and ultimately reflected in power prices.

As previously noted, the NYISO's planning process has found that the anticipated supply of generating capacity and other resources exceed the needs to reliably supply forecasted consumer demands over the next decade. However, the NYISO also identified risk scenarios that could adversely impact reliability of the electric system.[34]

The Indian Point Energy Center, located in Westchester County, includes two nuclear power generating units capable of producing more than 2,000 megawatts. The federal operating licenses for the Indian Point nuclear power facilities expire in September 2013, for Unit 2, and December 2015, for Unit 3. (Unit 1 was shut down permanently in 1974.) Without the development of adequate replacement generation in southeastern New York, retirement of both nuclear units at the Indian Point Energy Center when their current licenses expire would result in violations of reliability standards in 2016. Impacts would include loss of power supply and transmission voltage support affecting the metropolitan New York region.

The combined impact of proposed state and federal environmental regulations -- including control technology requirements for nitrogen oxides (NOx), a proposed regulation requiring power plants to

Figure 18. Summary of Emerging Environmental Regulations

The sustained reliability of New York's electric system is affected by the number of generating resources that may be impacted by emerging environmental regulations. A brief summary of the major regulations is presented below.

Program	**Description**	**Goal**	**Status**	**Compliance Deadline**	**Potential Impact (MW)**
NOx RACT Reasonably Available Control Technology for Oxides of Nitrogen	Limits emissions of nitrogen oxides (NOx) from fossil-fueled power plants by establishing presumptive limits for each type of fossil fueled generator and fuel used.	To reduce emissions from the affected generators by 50 percent, from 58,000 to 29,000 Tons per Year.	In effect	July 2014	9,515 MW
BART Best Available Retrofit Technology	Requires an analysis to determine the impact of certain affected units' emissions on regional haze. If the impacts are greater than a prescribed minimum, then emission reductions must be made at the affected unit.	To limit emissions that may impact visibility in national parks. Emissions control of sulfur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter (PM) may be necessary.	In effect	January 2014	8,940 MW
MACT Maximum Achievable Control Technology	Establishes limits for Hazardous Air Pollutants (HAP) including mercury. Will apply to coal-fired generators and may apply to electric generators that are fueled by heavy oil.	To limit emissions, under the federal Clean Air Act, of certain substances classified as hazardous air pollutants.	USEPA released proposed rule March 16, 2011	March 2015	11,091 MW
BTA Best Technology Available for Cooling Water Intake Structures	Would apply to power plants with design intake capacity greater than 20 million gallons/day and prescribes reductions in fish mortality.	To establish performance goals for new and existing cooling water intake structures, and the use of wet, closed-cycle cooling systems.	NYS DEC is currently reviewing comments	TBD	4,410 MW to 7,376 MW

utilize closed-cycle cooling, and other regulatory initiatives -- could result in unplanned plant retirements that may impact reliability. The array of proposed regulations is estimated to impact 23,957 megawatts of capacity, more than half the installed generating capacity in New York State.[35]

Compliance with these regulations, individually or taken together, could require substantial additional capital investment. For example, the New York State Department of Environmental Conservation estimated that the compliance cost of proposed closed-cycle cooling regulations could total more than $8.5 billion for 27 power plants over a 20-year time frame.[36] Faced with the decision to retrofit or retire affected units, the power plant owners could choose to avoid the cost of compliance by closing or mothballing facilities, which could adversely impact the reliability of the electric system.

Transmission Congestion

In 2010, the NYISO issued a first-of-its-kind economic analysis of transmission congestion on the New York State bulk power system and the potential costs and benefits of relieving congestion. Called the Congestion Assessment and Resource Integration Study (CARIS), it is part of the NYISO's expanded Comprehensive System Planning Process.

Transmission congestion results from physical limits on how much power high-voltage lines can reliably carry. Solutions to congestion may include building or upgrading transmission, building a less expensive power source in closer proximity to an area needing supplies, or by reducing the demand for power in the downstream region.

The study, developed with extensive stakeholder input, identified the three most congested parts of the New York bulk power system based upon historic data as well as estimates of future congestion. The NYISO developed and analyzed generic solutions involving generation, transmission, and demand response projects for each of the three congested areas. No routing, siting, engineering, or other specific analyses were conducted for any of the generic solutions, as these details can best be addressed by project developers.

In the next phase of the CARIS process, developers are invited to propose specific transmission projects to address congestion on the New York bulk power system. The NYISO will perform an analysis comparing the benefits and costs for each specific proposed transmission project.

If the developer of a project seeks streamlined, regulated cost recovery under the NYISO tariff, and satisfies the benefit/cost threshold requirements, the costs of the economic transmission upgrade would be allocated on a "beneficiaries pay" model that requires the consent of a super-majority (80 percent) of the project's beneficiaries.

As a complement to the NYISO planning processes, the owners of the interconnected electricity transmission facilities in New York State[37] initiated a joint study of the reliability of the state's bulk power system to help economically address future electric needs, support the growth of renewable energy sources, and protect the reliability of the power system.

Called the New York State Transmission Assessment and Reliability Study (STARS), the study is evaluating the lifecycle of New York's existing transmission assets and identifying potential economically beneficial transmission projects that would reliably support New York State's energy needs. [See Figure 19.] As noted earlier, New York has an aging power transmission infrastructure, with a significant portion of New York's high-voltage transmission lines built several decades ago. STARS will assess potential investment costs and benefits that may be realized from the identified transmission projects for various scenarios over a 20-year horizon.

As New York State faces challenges relating to aging infrastructure of the power system, significant environmental initiatives that may impact power resources, and elevated concern about nuclear safety issues, the ongoing transmission studies will offer vital contributions to protecting electric system reliability. New York has an opportunity to upgrade transmission capability along existing transmission rights-of-way as aging transmission facilities require replacement.

Electric Industry Workforce

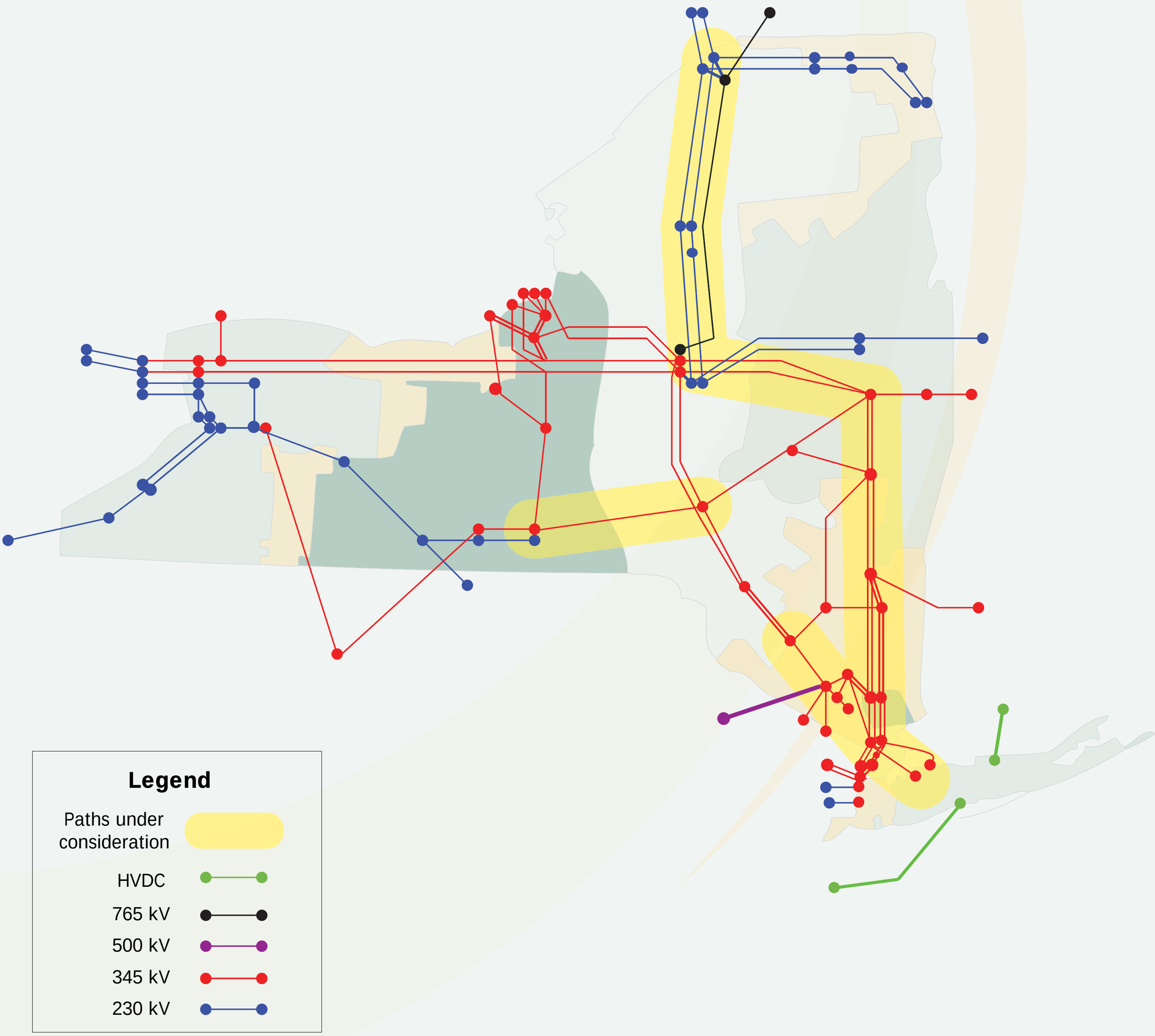
The Northeast Electricity Reliability Corporation (NERC) has repeatedly identified the issue of the "aging workforce" and its impending impact on reliability in its Long-Term Reliability Assessments. "This loss of expertise, exacerbated by the lack of new recruits entering the field, is one of the more severe challenges facing reliability today," NERC has stated.[38] The Center for Energy Workforce Development, a consortium of utilities, reports that retirements and attrition would force the energy industry to replace roughly half of its engineers and skilled technicians by 2015.[39]

In April 2010, the U.S. DOE announced the award of $100 million stimulus funding for "smart grid workforce training programs that will help prepare the next generation of workers in the utility and electrical manufacturing industries." Awardees in New York included Syracuse University, GE, Consolidated Edison, and the Workforce Development Institute.[40]

Growing interest in smart grid and clean energy offers the potential to attract a new generation of workers to the electric industry. New York State, as home to various academic, industrial and government institutions engaged in pioneering work in these areas, can play a leadership role in developing the next generation of electric industry professionals.

State policies and programs have put New York among the nation's clean energy leaders, with pioneering work on greenhouse gas controls, renewable portfolio and energy efficiency standards. New York is home to major corporations and electric utilities who are prominent players in clean energy and smart grid. New York's marketplace for wholesale electricity, administered by the NYISO, has been recognized for its role in cultivating innovation. State authorities, such as the New York Energy Research and Development Authority, the New York Power Authority and the Long Island Power Authority, are among the unique energy assets of the Empire State. Five U.S. DOE Energy Frontier Research Centers are located in New York State (Brookhaven National Laboratory, Columbia University, Cornell University, GE Global Research, and the State University of New York at Stony Brook.)

Figure 19. STARS Preliminary Transmission Paths



5. Conclusion

As Governor Andrew Cuomo noted in his 2011 State of the State Address, others look to New York for leadership. The pioneering heritage of the Empire State's electricity industry is part of that proud tradition. Energizing New York's legacy of leadership can light the way to a brighter energy future.

The global nature of environmental and energy concerns is made evident by elevated concern about nuclear safety prompted by the effects of the earthquake and tsunami that struck nuclear plants in Japan. Unrest in the Middle East causes oil prices to fluctuate in markets across the world. Similarly, the increasing energy demands of developing nations on fuel supply and power costs will be felt here and abroad for the foreseeable future.

Active collaboration among neighboring electric systems is essential, not just in the day-to-day operation of the grid, but also in working together to evolve the competitive marketplace for electricity and plan the power system of the tomorrow.

The planning horizons of policy makers and regulators should encompass the time needed for the electric industry to address policy changes and emerging regulatory requirements. Considerable lead-time is required for power infrastructure project execution. The average time frame needed to construct major energy projects is estimated to range from five to ten years.[41]

The electric power sector plays an extensive and vital role in the implementation of public policy energy goals and environmental initiatives. Collaborative and coordinated efforts among government agencies and stakeholders throughout the electric industry are essential to achieving environmental goals in a manner consistent with electric system reliability requirements.

The analytical capabilities of the NYISO can provide reliable, objective analyses to policy makers as they consider programs that will affect the state's electricity industry, environment, and economy. The NYISO has, and will continue to, commit its resources, in cooperation with stakeholders, regulators, and policy makers, to energize New York's legacy of leadership.

6. Endnotes

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[7] The NYISO *2010 Comprehensive Reliability Plan*, published in January 2011, stated, "The Indian Point Plant Retirement Scenario examined the impact on and risk to the electric system reliability of the unplanned retirement of both nuclear units (2060 MW) were these licenses not renewed upon expiration. The analysis shows that LOLE would exceed the threshold Reliability Criteria of 0.1 beginning in 2016 with a forecasted LOLE of 0.14 that would rise to 0.38 in 2020. In addition, transmission security analysis was performed which demonstrated thermal violations per applicable Reliability Criteria. Furthermore, under stress conditions, the voltage performance on the system without the Indian Point Plant would be degraded."

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7. Glossary

The following glossary offers definitions and explanations of terms and phrases used in Power Trends 2011 and others generally used in discussions of electric power systems and energy policy.

"45 X 15": An energy policy initiative announced by the Governor of the State of New York in the 2009 State of the State Address, the "45 X 15" plan establishes the goal of New York State meeting 45 percent of its 2007-forecasted electricity needs through improved energy efficiency and clean renewable energy by 2015. The plan includes increasing the state's Renewable Portfolio Standard (See "Renewable Portfolio Standard") to 30% and decreasing electricity usage by 15% (See "Energy Efficiency Portfolio Standard").

Adequate: A system is considered adequate if the probability of having sufficient transmission and generation resources to meet expected demand is greater than the minimum standard to avoid a blackout. A system has adequate resources under the standard if the probability of an involuntary loss of service is no greater than one occurrence in 10 years. This is known as the loss of load expectation (LOLE), which forms the basis of New York's installed capacity (ICAP) requirement.

Advanced Metering Infrastructure (AMI): Also known as "smart metering," AMI consists of two separate and distinct elements: (1) meters that use technology to capture the energy use information of a utility's customer, and (2) communication systems that capture and transmit such information in real time. Smart meters are capable of measuring and recording usage data in time-differentiated registers, including hourly or such other intervals as may be specified by regulatory authorities. They also allow electricity consumers, suppliers, and service providers to participate in all types of price-based demand response programs.

Bulk Electricity Grid: The transmission network via which electricity flows from suppliers to local distribution systems that serve customers. New York's bulk electricity grid includes all electricity generating plants, high voltage transmission lines, and interconnections with neighboring electric systems located in the New York Control Area (NYCA).

Capability Period: The Summer Capability Period lasts six months, from May 1 through October 31. The Winter Capability Period runs from November 1 through April 30 of the following year.

Cap and Trade: An environmental regulation mechanism that sets an overall limit on the emissions of a certain pollutant (such as CO2) but allows emission sources to trade their individual emission allowances. In theory, "cap-and-trade" systems use the marketplace to reduce emissions in a cost-effective and flexible manner. In practice, a cap is established that limits emissions from a designated group of polluters to some level below their current emissions. The emissions allowed under the new cap are then divided into individual permits – usually equal to one ton of pollution – that represent the right to emit that amount. The permits can be bought and sold bilaterally or through an auction mechanism.

Comprehensive Reliability Plan (CRP): A study undertaken by the NYISO that evaluates projects offered to meet New York's future electric power needs, as identified in the Reliability Needs Assessment (RNA). The CRP may trigger electric utilities to pursue regulated solutions to meet reliability needs if market-based solutions will not be available to supply needed resources. It is the second step in NYISO's reliability planning process.

Comprehensive System Planning Process (CSPP): The NYISO's ongoing process that evaluates resource adequacy and transmission system security of the state's bulk electricity grid over a 10-year period and evaluates solutions to meet those needs. The CSPP contains three major components -- local transmission planning, reliability planning, and economic planning. Each two-year planning cycle begins with the Local Transmission Plans (LTPs) of the New York transmission owners, followed by NYISO's Reliability Needs Assessment (RNA) and CRP. Finally, economic planning is conducted through the Congestion Analysis and Resource Integration Study (CARIS).

Congestion: Transmission paths that are constrained, which may limit power transactions because of insufficient capacity. Congestion can be relieved by increasing generation or by reducing load.

Congestion Analysis and Resource Integration Study (CARIS): Part of the NYISO's Comprehensive System Planning Process (CSPP), CARIS evaluates the economic impact of proposed system changes. It consists of congestion studies developed with market participant input as well as additional studies that individual market participants may request and fund. The CARIS is based on the most recently approved CRP.

Constraint: A transmission system restriction that limits the ability to transmit power.

Day-Ahead Market (DAM): A NYISO-administered wholesale electricity market in which capacity, electricity, and/or ancillary services are auctioned and scheduled one day prior to use. The DAM sets prices as of 11 a.m. preceding the day these products are bought and sold, based on generation and energy transaction bids offered in advance to the NYISO. More than 90% of energy transactions occur in the DAM.

Day-Ahead Demand Response Program (DADRP): A NYISO demand response program to allow energy users to bid their load reductions into the day-ahead energy market, as generators do.

Demand Response Programs: A series of programs designed by the NYISO to maintain the reliability of the bulk electricity grid by calling on electricity users to reduce consumption, usually in capacity shortage situations. The NYISO demand response programs include Day-Ahead Demand Response Program (DADRP), Emergency Demand Response Program (EDRP), and Special Case Resources (SCR).

Distributed Generation: A small generator, typically 10 megawatts or smaller, attached to the distribution grid. Distributed generation can serve as a primary or backup energy source, and can use various technologies, including wind generators, combustion turbines, reciprocating engines, and fuel cells.

Eastern Interconnection: The Eastern Interconnection is one of the three electric grid networks in North America. It includes electric systems serving most of the United States and Canada from the Rocky Mountains to the Atlantic coast. The other major interconnections are the Western Interconnection and the Texas Interconnection.

Electric Reliability Organization (ERO): Under the Energy Policy Act of 2005, the Federal Energy Regulatory Commission (FERC) is required to identify an ERO to establish, implement, and enforce mandatory electric reliability standards that apply to bulk electricity grid operators, generators and transmission owners in North America. In July 2006, the FERC certified the North American Electric Reliability Corporation (NERC) as America's ERO.

Emergency Demand Response Program (EDRP): A NYISO demand response program designed to reduce power usage through voluntary electricity consumption reduction by businesses and large power users. The companies are paid by the NYISO for reducing energy consumption upon NYISO request.

Energy Efficiency Portfolio Standard (EPS): A proceeding initiated on May 16, 2007 by the New York State Public Service Commission (NY PSC) to establish targets for energy efficiency, similar to the existing Renewable Portfolio Standard (RPS), and other programs intended to reverse the pattern of increasing energy use in New York. The NY PSC determined that New York possesses sufficient potential energy efficiency resources to reduce electricity usage by 15% of projected levels by 2015.

Energy Independence and Security Act of 2007: An extensive energy statute approved in December 2007. The stated purposes of the act are "to move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and other purposes."

Energy Policy Act of 2005 (EPAct): An extensive energy statute approved in August 2005 that requires the adoption of mandatory electricity reliability standards and gave the Federal Energy Regulatory Commission (FERC) the authority to site major transmission lines under certain circumstances in National Interest Electric Transmission Corridors (NIETC) identified by the U.S. Department of Energy. The EPAct also made major changes to federal energy law concerning wholesale electricity markets, fuels, renewable resources, electricity reliability, and the energy infrastructure needs of the nation.

Federal Energy Regulatory Commission (FERC): The federal energy regulatory agency that approves the NYISO's tariff s and regulates its operation of the bulk electricity grid, wholesale power markets, and planning and interconnection processes.

High Electric Demand Days (HEDD): Days of high electricity demand, which can dramatically increase ozone-forming air pollution from electric generation, often resulting in nitrogen oxide (NOx) emissions that can be greater than two times their average levels. Days of high electricity use often coincide with days with high ozone levels.

Installed Capacity (ICAP): A generator or load facility that can supply and/or reduce demand and qualifies as installed capacity in the New York Control Area (NYCA).

Installed Reserve Margin (IRM): The amount of installed electric generation capacity above 100% of the forecasted peak electricity consumption that is required to meet New York State Reliability Council (NYSRC) resource adequacy criteria.

Interconnection Queue: A queue of merchant transmission and generation projects that have submitted an Interconnection Request to the NYISO to be interconnected to the state's bulk electricity grid. All projects must undergo three studies – a Feasibility Study (unless parties agree to forgo it), a System Reliability Impact Study (SRIS), and a Facilities Study – before interconnecting to the grid.

Load: A consumer of energy (an end-use device or customer) or the amount of energy (megawatt hour - MWh) or demand (megawatt - MW) consumed.

Locational Installed Capacity Requirement: A NYISO determination of that portion of the statewide installed capacity requirement that must be located electrically within a locality to provide that sufficient capacity is available there to meet the reliability standards.

Loss of Load Expectation (LOLE): The amount of generation and demand-side resources needed (subject to the level of the availability of those resources, load uncertainty, available transmission system transfer capability and emergency operating procedures) to minimize the probability of an involuntary loss of firm electric load on the bulk electricity grid. The state's bulk electricity grid is designed to meet LOLE that is not greater than one occurrence of an involuntary load disconnection in 10 years, expressed mathematically as 0.1 days per year.

Market-Based Solutions: Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the Reliability Needs Assessment. Those solutions can include generation, transmission and demand response programs. Market-based solutions are preferred by the NYISO's planning process. The NYISO is responsible for evaluating all solutions to determine if they will meet the identified reliability needs in a timely manner.

Megawatt (MW): A measure of electricity that is the equivalent of 1 million watts.

New York Independent System Operator (NYISO): Formed in 1997 and commencing operations in 1999, a not-for-profit organization that manages New York's bulk electricity grid, administers the state's competitive wholesale electricity markets and provides system and resource planning for the state's bulk power system. The organization is governed by an independent Board of Directors and a governance structure made up of committees with market participants and stakeholders as members.

New York Control Area (NYCA): The area under the electrical control of the NYISO. It includes the entire state of New York, divided into 11 load zones.

New York Power Pool (NYPP): Established July 21, 1966 in response to the Northeast Blackout of 1965, a voluntary collaboration of the state's six investor-owned utilities plus New York's two power authorities created to coordinate the operations of the New York State power grid. The NYISO assumed this responsibility in 1999.

Peak Demand: The maximum instantaneous power demand averaged over any designated interval of time and measured in megawatt hours (MWh). Peak demand, also known as peak load, is usually measured hourly.

Peaking: Description referring to power plants that generally run only when there is the highest consumption of, or peak demand for, electricity (See "Peak Demand.")

Regulated Backstop Solutions: Proposals required of certain Transmission Owners to meet reliability needs as outlined in the Reliability Needs Assessment. Those solutions can include generation, transmission, or demand response.

Non-Transmission Owner developers may also submit regulated solutions. The NYISO may call for a gap solution if neither market-based nor regulated backstop solutions meet reliability needs in a timely manner. To the extent possible, the gap solution should be temporary and strive to ensure that market-based solutions will not be economically harmed. The NYISO is responsible for evaluating all solutions to determine if they will meet identified reliability needs in a timely manner.

Reliability Needs Assessment (RNA): A report that evaluates resource adequacy and transmission system security over a 10-year planning horizon, and identifies future needs of the New York electricity grid. It is the first step in the NYISO's reliability planning process.

Renewable Portfolio Standard (RPS): The New York State Public Service Commission (NY PSC), in September 2004, issued its "Order Approving Renewable Portfolio Standard Policy" that calls for an increase in renewable energy used in New York State from the then current level of approximately 19% to 25% by the year 2013. In October 2008, the NYS PSC initiated a proceeding to increase the RPS goal to 30% and extend the target date to 2015.

Special Case Resources (SCR): A NYISO demand response program designed to reduce power usage by businesses and large power users qualified to participate in the NYISO's installed capacity (ICAP) market. Companies that sign up as SCRs are paid in advance for agreeing to cut power upon NYISO request during periods of system stress.

Transfer Capability: The amount of electricity that can flow on a transmission line at any given instant, respecting facility rating and reliability rules.

Transmission Constraints: Limitations on the ability of a transmission facility to transfer electricity during normal or emergency system conditions.

NYISO at a Glance

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

The NYISO is governed by an independent Board of Directors and a committee structure comprised of a diverse array of stakeholder representatives. It is subject to the oversight of the Federal Energy Regulatory Commission (FERC) and regulated in certain aspects by the New York State Public Service Commission (NYSPSC). NYISO operations are also overseen by electric system reliability regulators, including the North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC).

The members of the NYISO's 10-member Board of Directors have backgrounds in electricity systems, finance, academia, information technology, communications, and public service. The members of the Board, as well as all employees, have no business, financial, operating, or other direct relationship to any market participant or stakeholder.

The NYISO does not own power plants or transmission lines. The NYISO's independence means that its actions and decisions are not based on profit motives, but on how best to enhance the reliability and efficiency of the power system, and safeguard the transparency and fairness of the markets.

The mission of the NYISO, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:

- *Maintaining and enhancing regional reliability*
- *Operating open, fair and competitive wholesale electricity markets*
- *Planning the power system for the future*
- *Providing factual information to policy makers, stakeholders and investors in the power system*

The NYISO manages the efficient flow of power on 11,000-plus miles of electric transmission lines on a continuous basis, 24 hours-a-day, seven days-a-week. As the administrator of the competitive wholesale markets, the NYISO conducts auctions that match the retail electric service companies looking to purchase power and the suppliers offering to sell it.

In addition to these functions, the NYISO has an expanding and increasingly important planning function to assess New York's electricity needs and evaluate the ability of planned new power facilities and other options to meet those needs. This planning process involves stakeholders, regulators, public officials, consumer representatives, and energy experts who provide vital information and input from a variety of viewpoints.

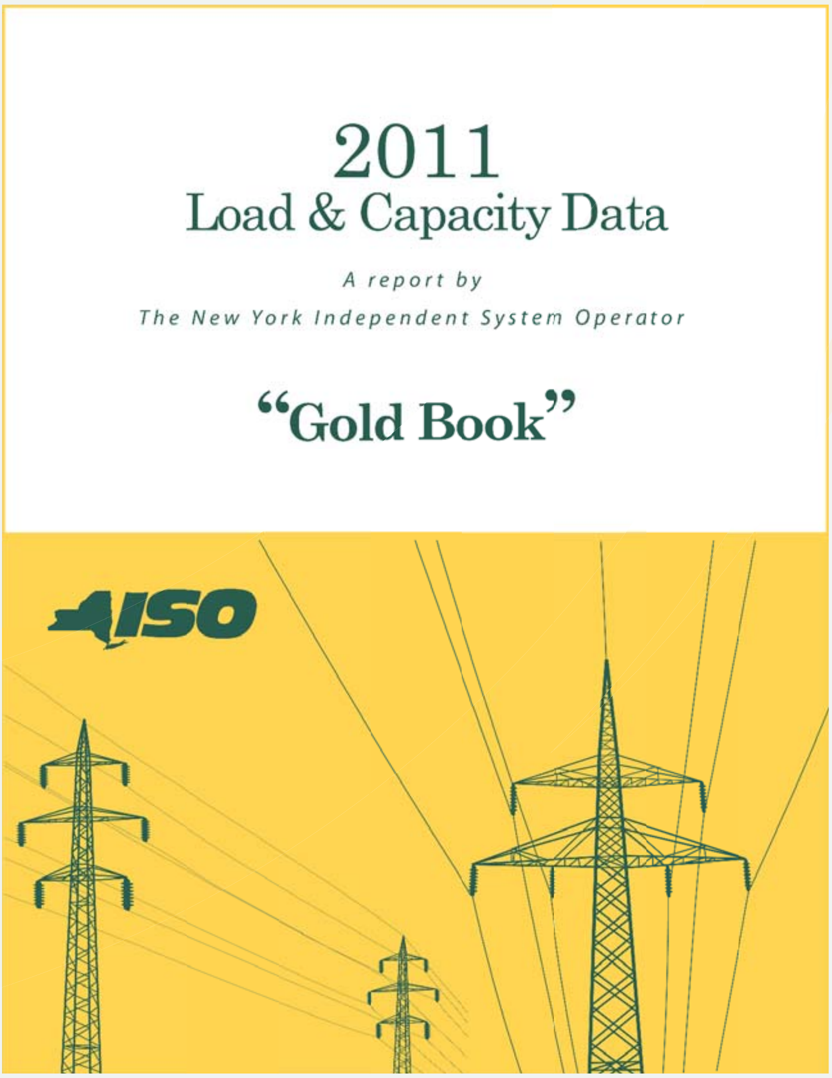
The NYISO is committed to transparency and trust in how it carries out its duties, in the information it provides, and in its role as the impartial administrator of the state's wholesale electricity markets. *Power Trends* is the NYISO's annual analysis of factors influencing New York State's bulk power grid and wholesale electricity markets. Begun in 2001 as *Power Alert*, the report provides a yearly review of key developments and emerging issues.

2011 Load and Capacity Data Report (the "Gold Book")

Data used in Power Trends 2011, unless otherwise noted, are from the *2011 Load & Capacity Data Report* (also known as the "Gold Book").

Published annually by the NYISO, the "Gold Book" presents New York Control Area system, transmission and generation data and NYISO load forecasts for the 2011 – 2021 period. It includes forecasts of peak demand, energy requirements, energy efficiency, and emergency demand response; existing and proposed resource capacity; and existing and proposed transmission facilities.

The "Gold Book" and other NYISO publications are available from the NYISO website, www.nyiso.com.



New York Independent System Operator
10 Krey Boulevard
Rensselaer, NY 12144
www.nyiso.com