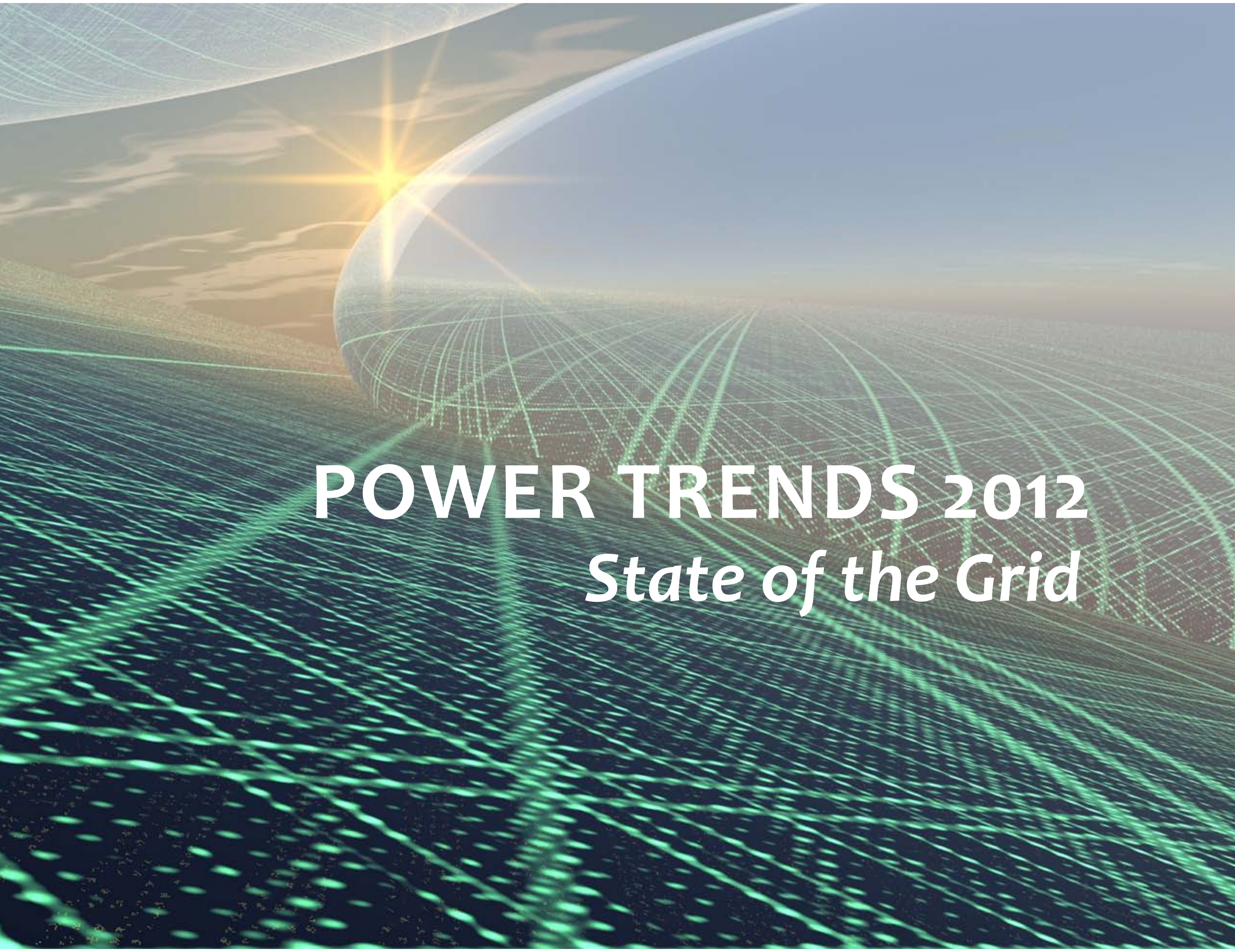

POWER TRENDS 2012
State of the Grid

NEW YORK INDEPENDENT SYSTEM OPERATOR

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Power Trends 2012 — by the Numbers

Power Resources

Generation

Total Generation -- 2012 .... 39,570 MW
Generation Added Since 2000 .... 9,174 MW

Transmission

Total Circuit Miles of Transmission -- 2012 .... 11,016 miles
Transmission Capability Added Since 2000 .... 1,640 MW

Demand Response

Total Demand Response available in Summer 2011 .... 2,173 MW

Reliability Requirements

Reliability Requirement -- Summer 2012 .... 38,622 MW
Total Resources Available -- Summer 2012 .... 43,686 MW

Renewable Resources

Total Renewable Resource Capacity -- 2012 .... 6,064 MW
Total Existing Wind Generation *(Nameplate Capacity)* -- 2012 .... 1,414 MW
Proposed Wind Generation *(Nameplate Capacity)* .... 3,986 MW
Percentage of Electric Energy from Renewables in 2011 .... 23.75%

Power Demands

Total Usage in 2011 .... 163,330 GWh
Total Usage in 2010 .... 163,505 GWh

Forecast Peak Usage for 2012 .... 33,295 MW
Actual Peak Usage for 2011 .... 33,865 MW
Record Peak Usage (August 2, 2006) .... 33,939 MW

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Executive Summary

The issues that face the electric system are complex, dynamic, and frequently interrelated. Economic, political, and technological factors are changing the industry in a number of ways. Yet, the fundamental concept of supply and demand provides a foundation to understand and address these issues.

The principle of supply and demand is at the core of the power system. Every moment of every day, grid operators must precisely balance the ever-changing demand for electricity with available supply. Power costs are also based on supply and demand. When resources are scarce, costs increase. As resources become more abundant, costs go down.

The current outlook for the supply of electricity is positive. Assuming trends continue as forecast, New York State is expected to have a sufficient supply of power to meet demand for years to come. Nevertheless, sustaining and enhancing the adequacy of the power supply requires attention to an array of factors, including:

> **Natural Gas –** The significantly increased availability of natural gas has already begun to transform the electric power industry. The abundance of these resources has had a dramatic impact on prices. In turn, this has changed the landscape for power generation, system planning and grid operations.
>
> **Aging Infrastructure –** With various components of New York's power system requiring upgrade or replacement, efforts are underway to address this pressing concern. Much of the state's power system infrastructure is a legacy from a different time, and the strategies for addressing aging infrastructure are aimed at supporting current and future needs.

Policy Coordination – Governmental policy has always played a significant role in shaping the electric power industry. The initiatives currently being discussed or implemented include efforts to upgrade and expand high-voltage transmission facilities, protect and enhance environmental quality, improve energy efficiency, promote renewable power resources, and close a nuclear power project in the downstate New York region. The cumulative effect of these initiatives has the potential to impact power system reliability as well as electricity market dynamics, and must be analyzed and understood. New York State's energy planning process provides an important venue for coordination of these policy considerations.

Regional Collaboration – New York State has long played a central role in the electric power system serving the Northeast. Recent, on-going efforts to optimize resources, mend seams between the region's power systems, and plan with a regional, collaborative focus have strengthened the state's connections with its neighbors.

Power Trends 2012 provides a summary of the current status of these issues. Any one of them is sufficiently complex to fill these pages and more. Yet, focusing on the fundamentals of supply and demand offers the reader a way to understand the scope and potential impacts of these issues. As a steward of New York's power system, the NYISO will continue to monitor and report on these issues as they evolve.

Introduction

The State of the Grid

The current outlook for New York State's power system remains consistent with recent trends – positive. The development of demand response programs, addition of new generation, and expansion of transmission have contributed to a more reliable system. Growth in the demand for electricity has been trimmed by the effects of the recession and investments in energy efficiency, while peak-shaving demand reduction programs have contributed to a surplus of supply.

The Natural Gas "Revolution"

Perhaps more than any other single factor, the emergence of new supplies of natural gas from unconventional sources is significantly impacting the electric system. These new natural gas resources – primarily from shale formations – have produced a "shale gale" that is "transforming the supply and price outlooks for natural gas and the competition among energy options." [1]

These developments in natural gas can be expected to affect the mix of fuels used to generate electricity, as well as increase the need for stronger coordination between electric grid operators and the natural gas industry.

Modernizing New York's Electric System Infrastructure

Neither the current adequacy of New York State's power resources, nor the potential impacts of plentiful natural gas, should distract attention from the need to upgrade and modernize New York's transmission and generation infrastructure. As of the close of 2010, 84 percent of the high-voltage transmission facilities in New York State went into service before 1980. Likewise, 59 percent of New York State's power plant capacity is pre-1980 vintage.

Governor Andrew Cuomo's call for a $2 billion, private sector-funded "energy highway" sends a strong signal about New York State's interest in addressing energy infrastructure needs. Studies by the NYISO and the owners of the high-voltage electric transmission system are helping to inform the debate.

A modernized transmission system will make better use of statewide generating resources and enhance access to power resources throughout the region – especially renewable power developed in locales remote from high-demand population centers.

Concerns about New York's lack of a centralized power plant siting law were addressed in 2011 with the enactment of the "Power NY Act" that included renewal of a "one-stop" approval process for new power generation facilities. By ending the nearly decade-long absence of a state power plant siting law, the new act sends a clear, consistent signal to potential developers. However, the effects of the national economic downturn and current market conditions are limiting capital investment in new generation.

Sustaining Environmental Quality and Preserving Electric System Reliability

As the state and federal governments enact regulations intended to protect and improve environmental quality, attention must also be paid to the cumulative impact of emerging environmental regulations on the reliability of the electric system as new rules affect the continued operation of various existing power plants. The combined effect of current and proposed regulations is estimated to impact more than half the installed generating capacity in the state.

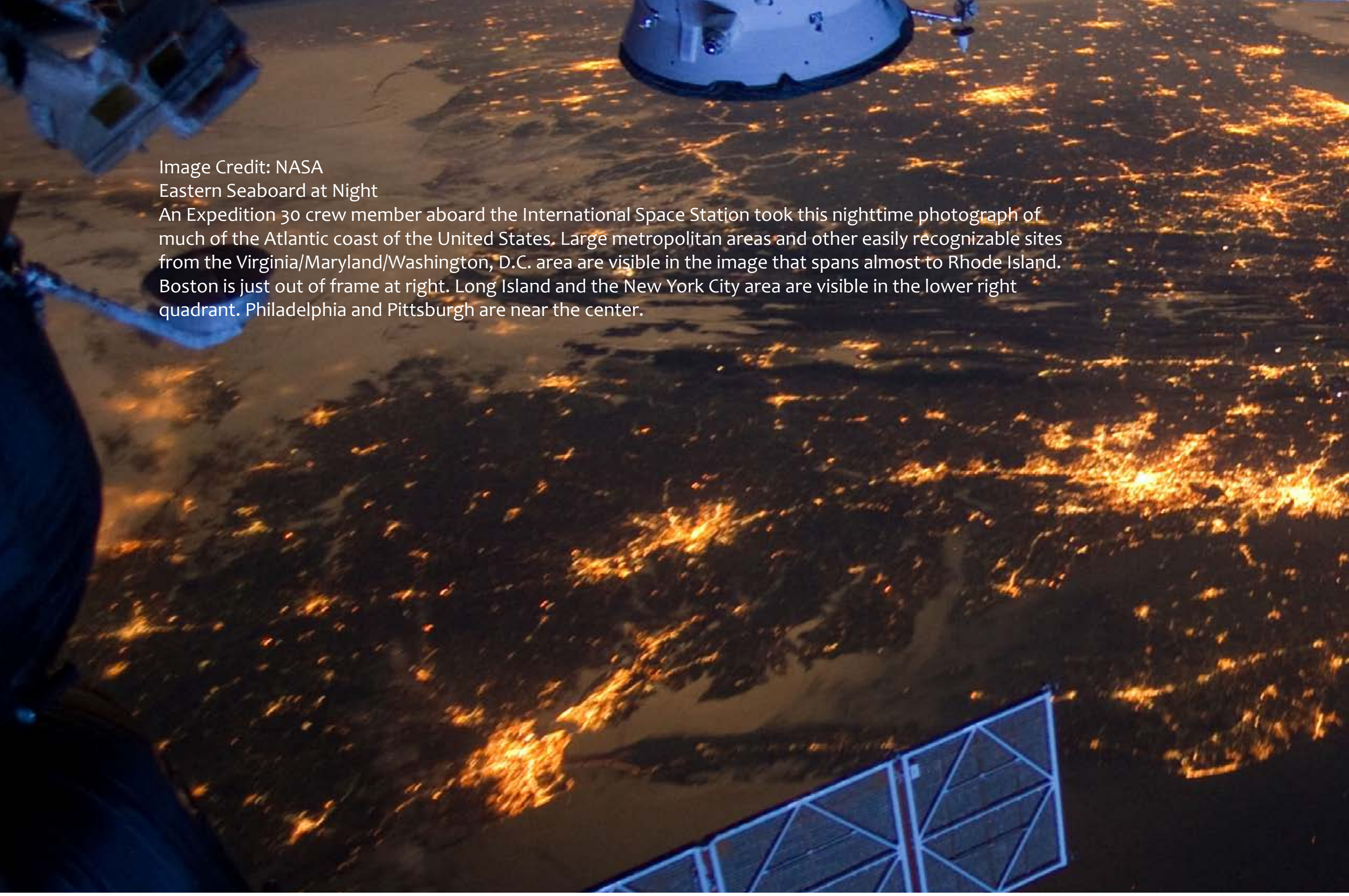


Image Credit: NASA
Eastern Seaboard at Night
An Expedition 30 crew member aboard the International Space Station took this nighttime photograph of much of the Atlantic coast of the United States. Large metropolitan areas and other easily recognizable sites from the Virginia/Maryland/Washington, D.C. area are visible in the image that spans almost to Rhode Island. Boston is just out of frame at right. Long Island and the New York City area are visible in the lower right quadrant. Philadelphia and Pittsburgh are near the center.

These regulations will influence both the total capacity and the mix of fuels used to generate electricity in New York State and throughout the nation. In addition to air and water quality regulations, New York State has adopted energy policies aimed to promote the growth of power supplies from renewable resources. Progress is being made in expanding "green power," such as wind and solar energy, but successfully integrating renewable resources requires recognition of the variable nature of generation that results from the changing availability of wind or sun to produce power.

While the owner of the Indian Point Energy Center has applied for a 20-year license renewal, various policy makers have advocated the retirement of that nuclear power complex. That course of action needs to be predicated on the development of adequate replacement resources to prevent serious reliability consequences, including the possibility of rolling blackouts.

Optimizing Resources by Expanding Horizons

Optimizing available energy resources 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 regional resources.

Collaborative efforts continue on the Broader Regional Markets initiative among the NYISO and grid operators serving the Mid-Atlantic, Midwest, and New England regions of the United States and the Canadian provinces of Ontario and Quebec.

The Eastern Interconnection Planning Collaborative (EIPC), consisting of 25 electric system planning authorities serving the eastern portion of North America, is moving forward with its analysis of stakeholder-selected scenarios of various energy futures.

State of the Grid

A Look at New York's Power Resources

The near-term outlook for New York's electric system is positive. The development of new demand response resources, addition of generation and expansion of interstate transmission has contributed to a more reliable system. Growth in the demand for electricity has been trimmed by the effects of the recession and energy efficiency programs, contributing to a surplus of supply.

New York State has a maximum of 43,686 megawatts of available resources to meet an anticipated 2012 summer peak demand of 33,295 megawatts and resulting reserve margin requirements totaling 38,622 megawatts. While the surplus of supply exists for the state as a whole, transmission constraints result in narrower margins of supply for downstate regions.

If demand grows as currently forecasted, existing supply is expected to be sufficient to meet resource adequacy needs through the end of the decade, assuming planned additions proceed and there are no significant unanticipated retirements. [2]

Demand Response

A decade ago, New York faced a "generation gap." With the emergence of New York's competitive marketplace for wholesale electricity, new resources were developed, including innovative demand response programs that enlist consumers to reduce their power use during periods of peak demand.

In 2011, the NYISO's two major demand response programs (the Emergency Demand Response Program and the Special Case Resource program) had more than 5,800 registered electricity customers capable of providing nearly 2,200 megawatts of demand response capability.[3] (See Figure 1.)

The Value of Demand Response

Power system reliability is maintained by requiring that sufficient resources be available to meet peak demand. In the past, generation was the predominant means of keeping pace with peak demand. As load grew, the number of power plants had to grow along with it. Since the advent of wholesale electricity markets, another option -- demand response -- has entered the mix.

Demand response programs encourages large power customers and aggregated sets of smaller consumers to reduce usage during times of peak demand – allowing load to increase without a corresponding build-out of new generation. Demand response programs provide incentives for power users to participate and respond when needed.

New York State's summer peak demand can spike 30-40 percent above the average level of electricity use. (See Figure 3.) The additional demand is equal to the output of thirty 500-megawatt power plants.

Reducing peak loads with demand response programs provides alternatives to investments in generation, transmission, and delivery infrastructure to serve short-term peak conditions, which helps to reduce costs for consumers.

Figure 1. Demand Response Resources in New York State: 2011

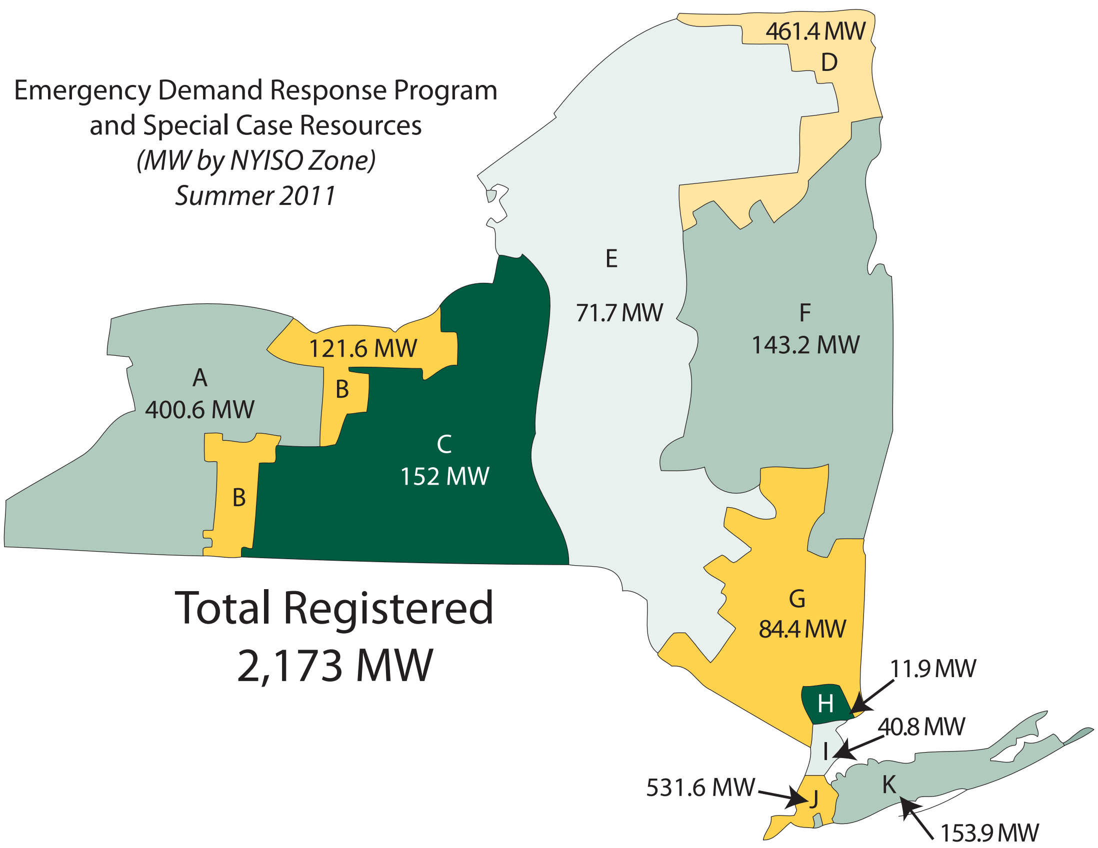


Figure 2. Demand Response Program Activations in New York State

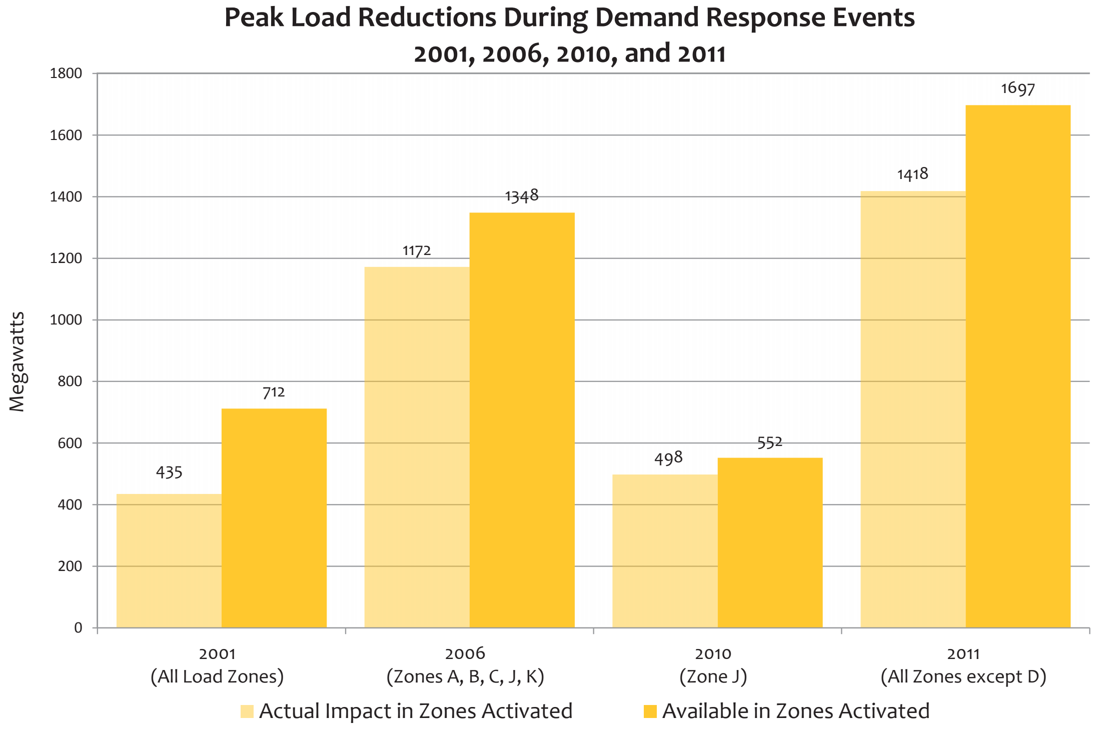
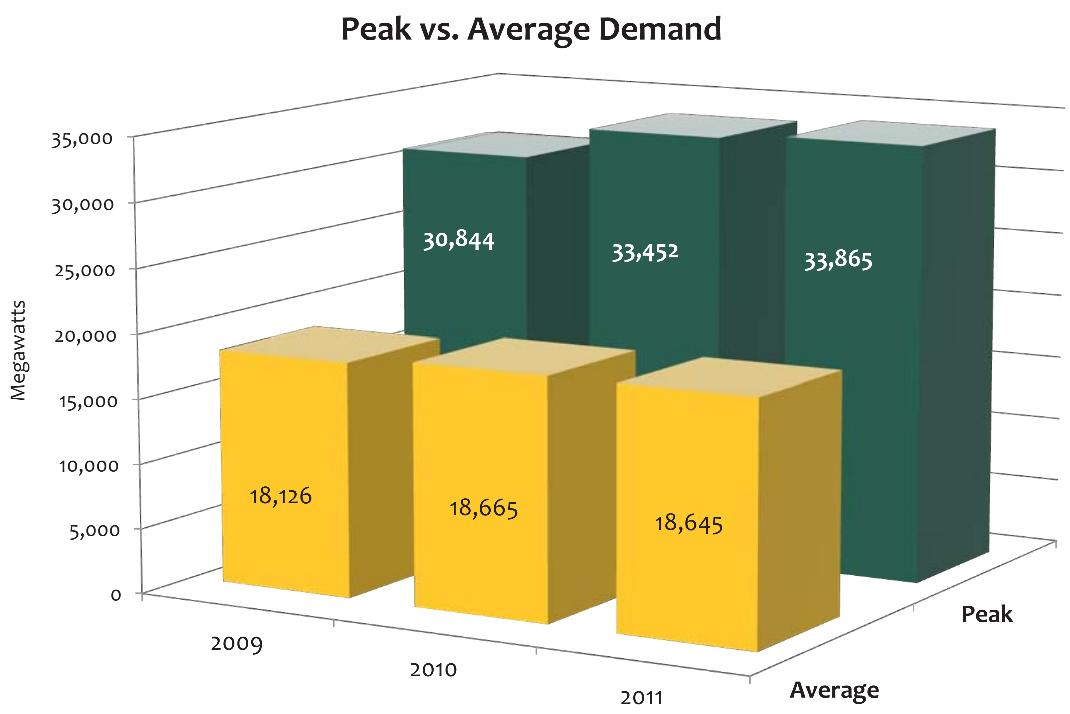


Figure 3. Peak vs. Average Demand in New York State: 2009 – 2011



When New York State experienced its all-time record peak demand of 33,939 megawatts in August 2006, demand response programs helped to "shave" the peak by almost 1,200 megawatts. Last year, July heat waves could have pushed demand to over 35,000 megawatts, a new record peak, had demand response programs not served to reduce load by more than 1,400 megawatts. (See Figure 2.)

Generation

Since 2000, private power producers and public power authorities have added nearly 9,200 megawatts of generation in New York State.

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 power demand is greatest. (See Figure 4.) Some generation additions have been determined by the suitability of wind conditions in the Northern and Western sections of the state. Other added generating capacity in upstate areas resulted from upgrades to existing nuclear and hydropower plants.

Locational price signals provided by New York's wholesale electricity markets have encouraged investments in areas where the demand for electricity and, consequently, power prices are the highest.

Transmission

The power needs of the high-demand metropolitan region of downstate New York have attracted the development of additional transmission projects. Since 2000, 1,640 megawatts of transmission capability have been added, including major facilities capable of bringing 1,290 megawatts to the downstate region from out of state. (See Figure 5.)

Resource Adequacy

The NYISO's latest assessment of the electric system's reliability needs has determined that New York has sufficient resources (generation, transmission, and demand response) to reliably serve load through 2020.[4]

In 2012, the maximum available statewide resources are anticipated to exceed peak demand and reserve requirements by more than 5,000 megawatts. (See Figure 6.)

This surplus of supply is available for the state as a whole, but transmission constraints narrow the margins of supply for downstate regions.

Figure 4. New Generation in New York State: 2000 – 2011

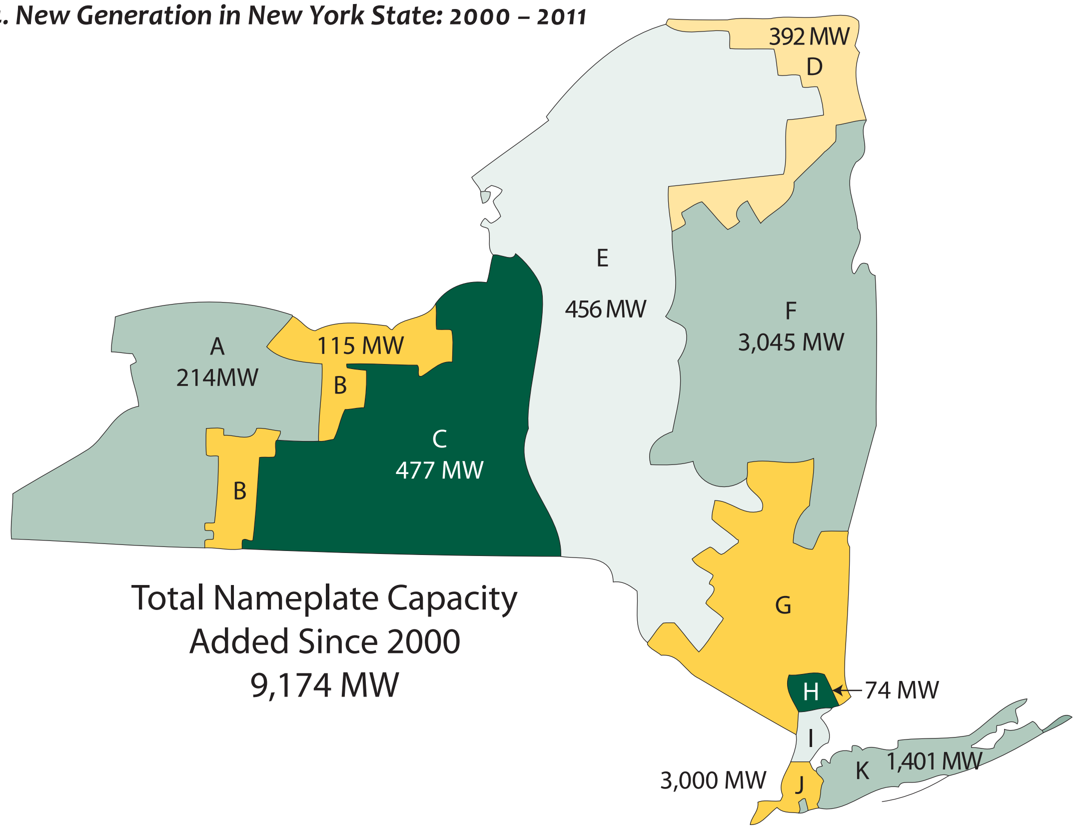


Figure 5. New Transmission in New York State: 2000 – 2011

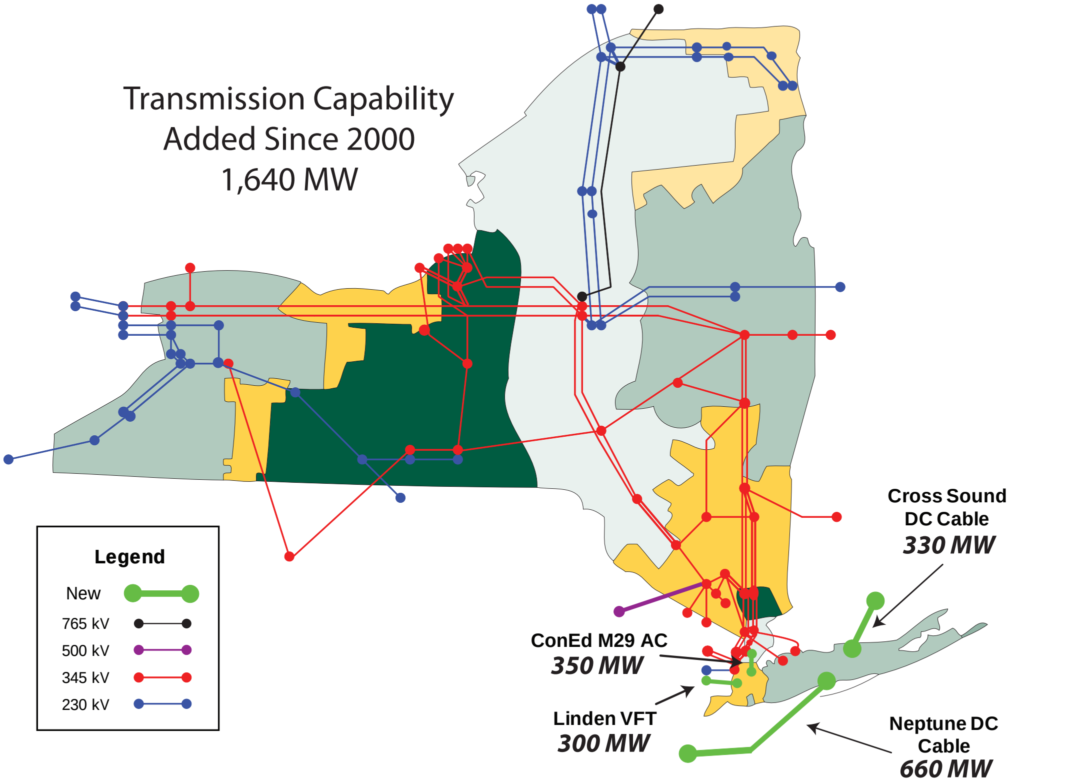
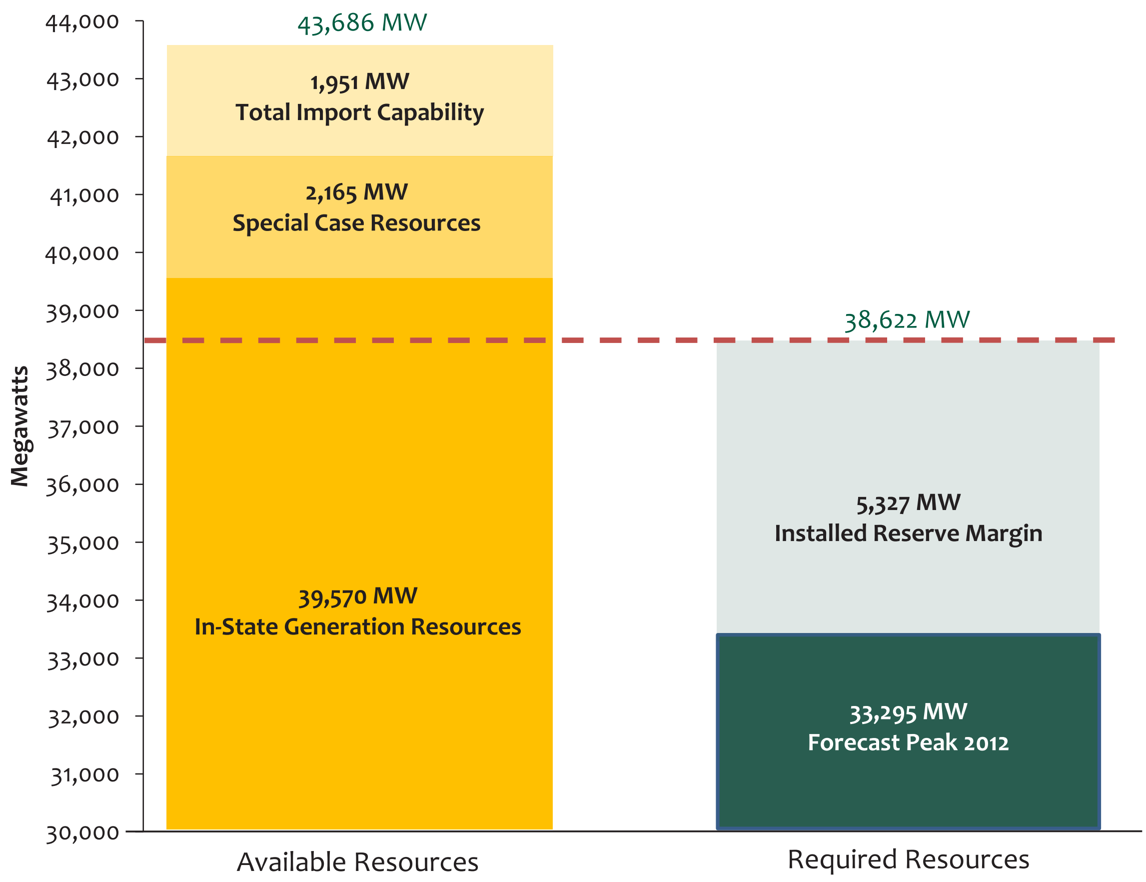


Figure 6. Resource Availability for New York State: Summer 2012



Power Costs and Prices

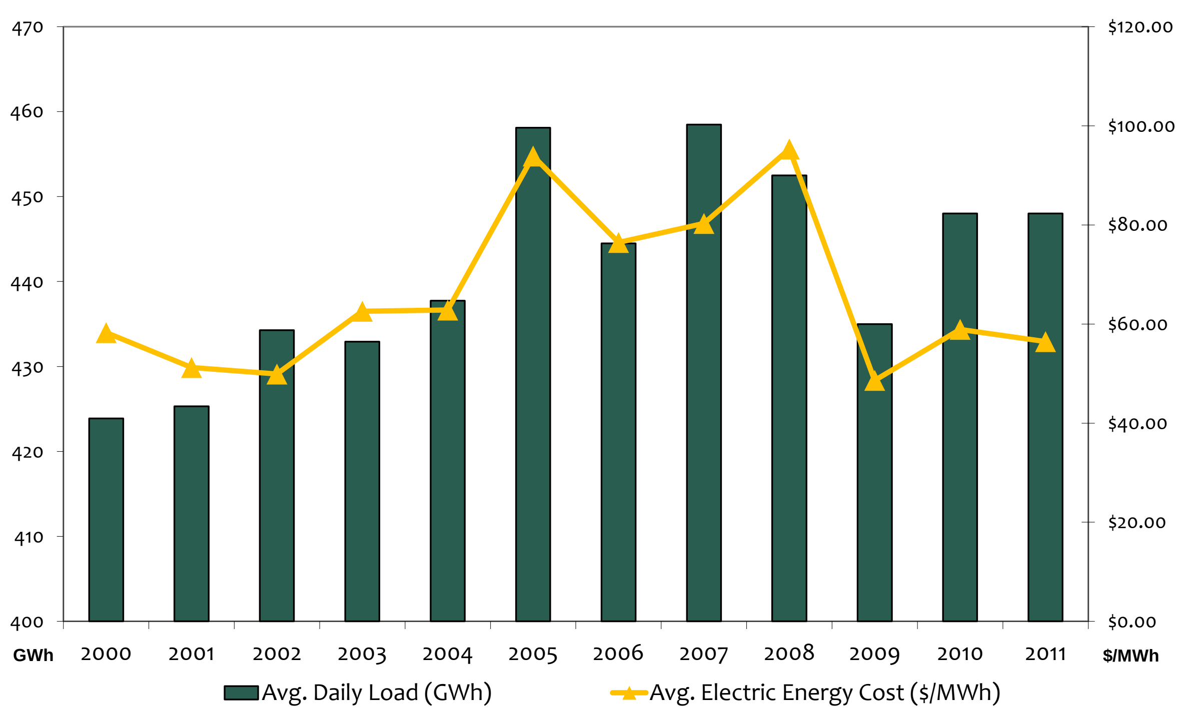
The average cost of wholesale electric energy declined moderately between 2010 and 2011. The average cost per megawatt-hour was $56 in 2011, down from $59 per megawatt-hour in 2010. Despite weather-related price spikes that exceeded 2010 levels, the annual average price in 2011 was lower due to factors such as a warmer-than-normal December and continued low natural gas prices.

Wholesale electricity prices are directly influenced by the cost of fuel used to supply power plants and demand for electricity.

In New York, the price of natural gas and the cost of electricity are closely correlated. Power plants with the ability to use natural gas account for more than half of the electric generating capacity in New York State. The cost of procuring fuel for these units is reflected in their offers. As natural gas prices climbed in 2005 and 2008, the cost of running these units increased. As the price of natural gas

Figure 7. Natural Gas Costs and Electricity Prices in New York State: 2000 – 2011

Figure 8. Electricity Demand and Prices in New York State: 2000 – 2011



dropped and remained low over the past three years, the cost of electricity closely tracked those changes. (See Figure 7.)

Similarly, power costs rise and fall fairly consistently with the average daily electricity usage. (See Figure 8.) Lower demand for electricity allows a larger proportion of electricity to be generated by more efficient and less costly facilities.

The close correlation of electricity prices with gas supplies and demand will likely persist. The continued development of unconventional sources of natural gas is expected to keep gas prices low for the near future. In addition, the pace of economic recovery and the persistence of energy efficiency efforts will have a direct influence on electric demand.

Demand Trends and Forecasts

Over the past fifteen years, electricity use in New York State increased by 11.4 percent, an average of 0.72 percent annually. (See Figure 9.)

The impact of the reduced economic activity on the use of electricity can be seen very clearly in the sharp decline of demand during the 2008-2009 recession. In New York State, following a 1 percent decline in 2008, there was a drop of over 4 percent in 2009.

In 2010, electricity use increased nearly 3 percent from 2009 levels. However, statewide energy use remained below pre-recession levels. In 2011, New York's electricity use declined about one-tenth of one percent from 2010 levels. (See Figure 10.)

Under the current forecast, average annual growth in statewide demand for the years 2012 through 2022 is expected to be 0.59 percent. (See Figure 11.)Last year, the average annual growth rate for the coming ten years was estimated to be 0.41 percent. The 2012 forecast is slightly higher due to a more optimistic economic forecast and refinements in projecting the amount of energy efficiency impacts.

Resource Diversity

Both the reliability of the system and the economics of electricity are closely linked to the mix of fuels used to generate power. A diverse fuel mix better enables the electric system to address issues such as price volatility, fuel availability and the requirements of public policy.

Figure 9. Electric Energy Usage in New York State: 1996 – 2011

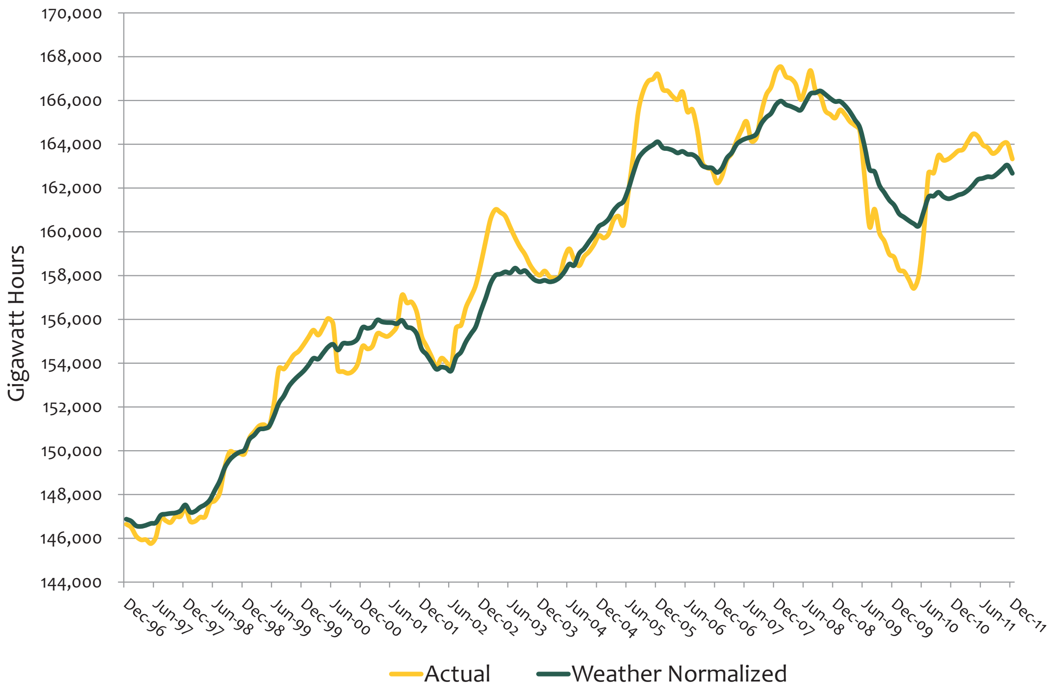


Figure 10. Annual Electricity Usage in New York State: 2008 – 2011

In the 2012 State of the Union Address, President Barack Obama called for an "all-of-the-above strategy that develops every available source of American energy" and proposed steps to enable the U.S. to employ its fossil fuel reserves as well as expand wind and solar resources.[5]

Different types of generation also possess unique attributes required to meet the various needs of the electric system. For example, large nuclear power projects are useful in producing base-load power, but lack the ability to quickly vary output to provide operating reserves. In contrast, gas-fired combustion turbines can change output with sufficient speed for such operating reserve requirements, but are less efficient if used for continuous base-load power.[6]

From a statewide perspective, New York's fleet of generation uses a fairly diverse set of fuels to produce electricity. At the regional level, however, the supply mix is less diverse. While most of the population and electric demand is situated in downstate New York, much of the state's electricity supplies (and particularly the sources that have historically had comparatively low operating costs – predominantly hydropower and nuclear) are located upstate. As a result of transmission limitations, reliability standards that require local generation in the downstate region, and stringent environmental regulations, the power demands

Figure 11. Energy Trends in New York State - Actual and Forecast: 2000 – 2022

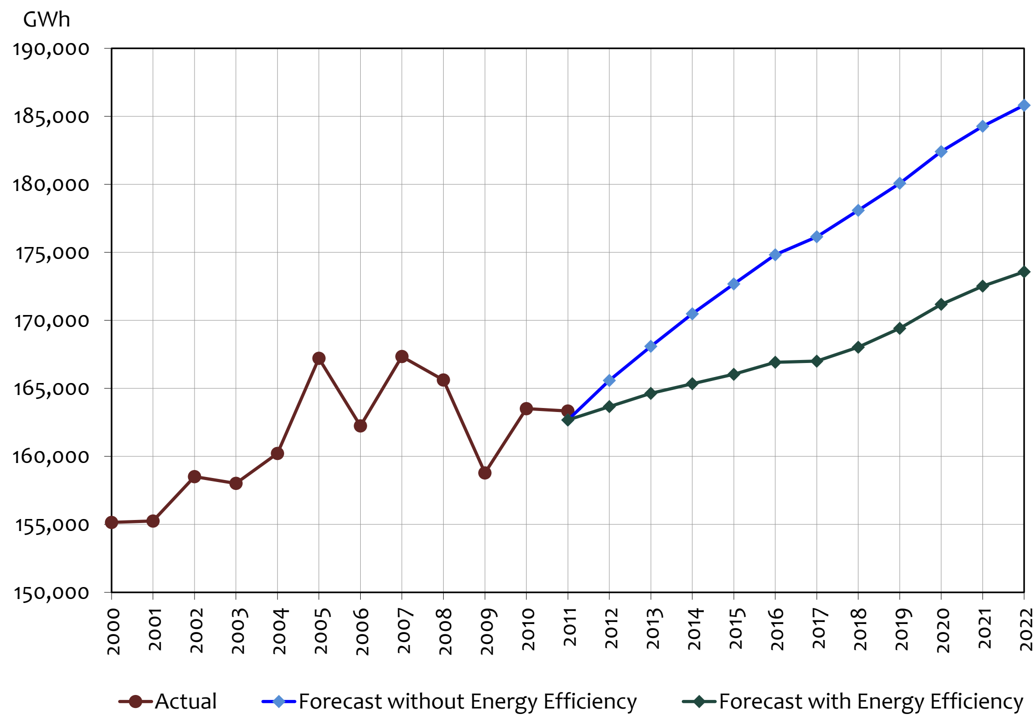
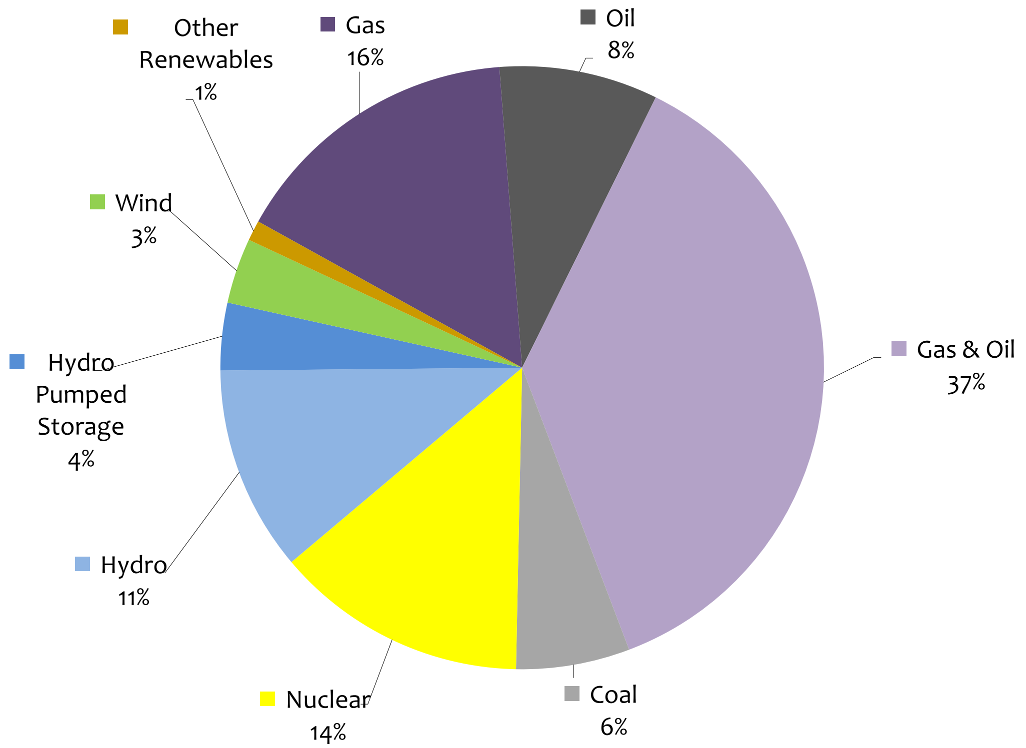
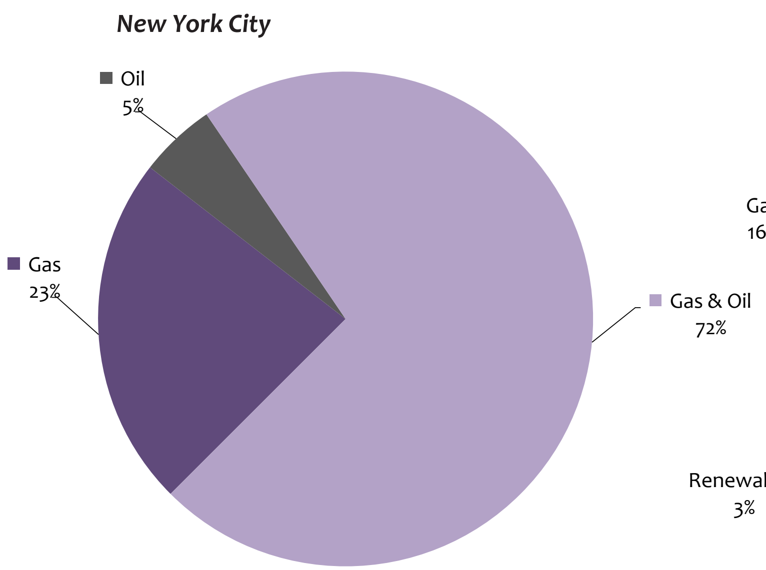
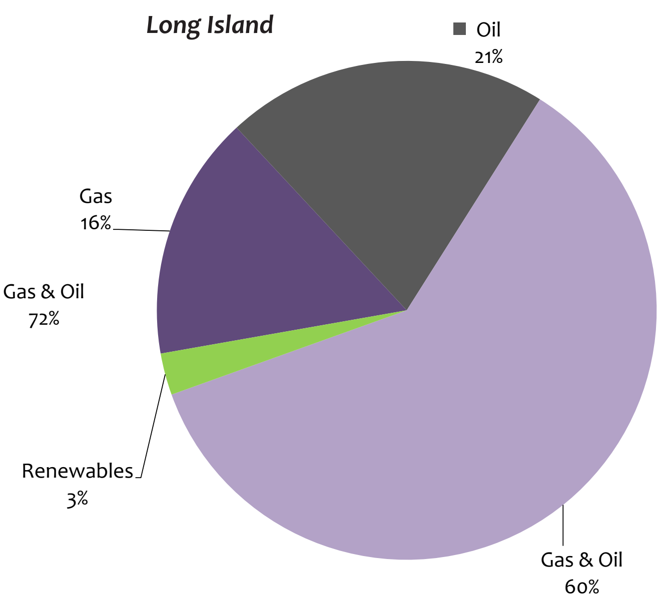


Figure 12. Generating Capacity in New York State by Fuel Source - Statewide, New York City and Long Island: 2012







Understanding Capacity vs. Energy

Grid operators, system planners, and market participants view electricity in two distinct ways – as capacity and energy. Capacity, measured in megawatts, represents the system's potential to generate power. In order to meet peak demand, the system must have sufficient capacity to provide the highest anticipated amount of electricity. Energy, measured in megawatt-hours, represents the actual amount of generation produced to meet demand over a given period of time.

For example, New York's electric system had 37,707 megawatts of installed capacity in Summer 2011. Of that total, generation powered by fossil fuels (natural gas, oil, and coal) made up 70 percent of all generating capacity. In contrast, fossil fuels provided 45 percent of all actual generation in 2011.

The difference in the amount of power potentially available (capacity) from any type of supply and the actual generation produced (energy) is a function of the supply offered to meet the demand bid in wholesale electricity markets. The NYISO market is designed to select the least-costly generation offered to meet demand. As a result, lower cost power offered by hydropower projects, windpower facilities, and nuclear plants were selected via the markets to supply generation in a proportion larger than their share of total capacity.

of New York City and Long Island are largely served with generation fueled by natural gas and oil. (See Figure 12.) While various efforts are being made to locate renewable resources (such as wind, solar and tidal power) within the downstate region, it is anticipated that downstate power needs will continue to be largely served by conventional resources for the near future.

Economic factors and policy considerations play significant roles in the generation fuel mix. Given the prospect of continued growth in the supply and affordability of natural gas, the role of that fuel source is expected to expand in New York and throughout the nation. (*See "The Natural Gas Revolution" section for more discussion.*)

New York State's Renewable Portfolio Standard has set ambitious goals for the expansion of wind, solar and other green power resources. (*See "Sustaining Environmental Quality and Electric System Reliability" section for more discussion.*)

> *The biggest energy innovation of the decade is natural gas—more specifically what is called "unconventional" natural gas. Some call it a revolution.*
>
> Daniel Yergin and Robert Ineson
> America's Natural Gas Revolution,
> Wall Street Journal, November 2, 2009

The Natural Gas "Revolution"

Over 80 percent of the total generation capacity added in the nation between 2000 and 2010 was natural gas-fired generation.[7] The majority of new generating capacity projected to be developed in North America over the next ten years will rely on natural gas as its primary fuel.[8]

The growth in the use of natural gas for power generation is a consequence of energy, economic, and public policy trends. In the 1970s, the oil crisis and natural gas curtailments prompted adoption of the Federal Powerplant and Industrial Fuel Use Act of 1978. That law restricted the use of natural gas and petroleum for power generation until its repeal in 1987. Since then, economic factors, such as relatively short construction times and lower capital costs for natural gas-fired power plants, as well as increasingly abundant supply of natural gas, contributed to the growing use of natural gas as fuel for power generation. In addition, increasingly rigorous air quality regulations have encouraged the use of natural gas, which produces fewer emissions per megawatt-hour of electricity generated than oil or coal.

In recent years, market forces have caused a steep drop in the price of natural gas. The primary drivers have been a decline in demand and an expansion of supply. As noted earlier (See *Demand Trends and Forecasts* section.), demand for electricity has declined as a result of the economic downturn that began in 2008. During this period, the supply of natural gas has significantly expanded. According to the U.S. Energy Information Administration (EIA), domestic natural gas extraction increased by over 24 percent between 2006 and the end of 2011.[9]

In 2011, production of natural gas in the U.S. increased nearly 8 percent, with the largest annual volumetric increase in history.[10]

In 2010, Cambridge Energy Research Associates (CERA) reported, "The unconventional natural gas revolution has lowered the natural gas price outlook and made gas more competitive while encouraging higher expectations for security of supply – a dramatic shift from just half a decade ago."[11]

Natural gas has increasingly become the fuel of choice. Among the projects proposed for interconnection with New York's electric grid, power plants capable of running on natural gas (natural gas units and dual fuel facilities) account for more megawatts of generation than all other fuel sources combined. (See Figure 13.)

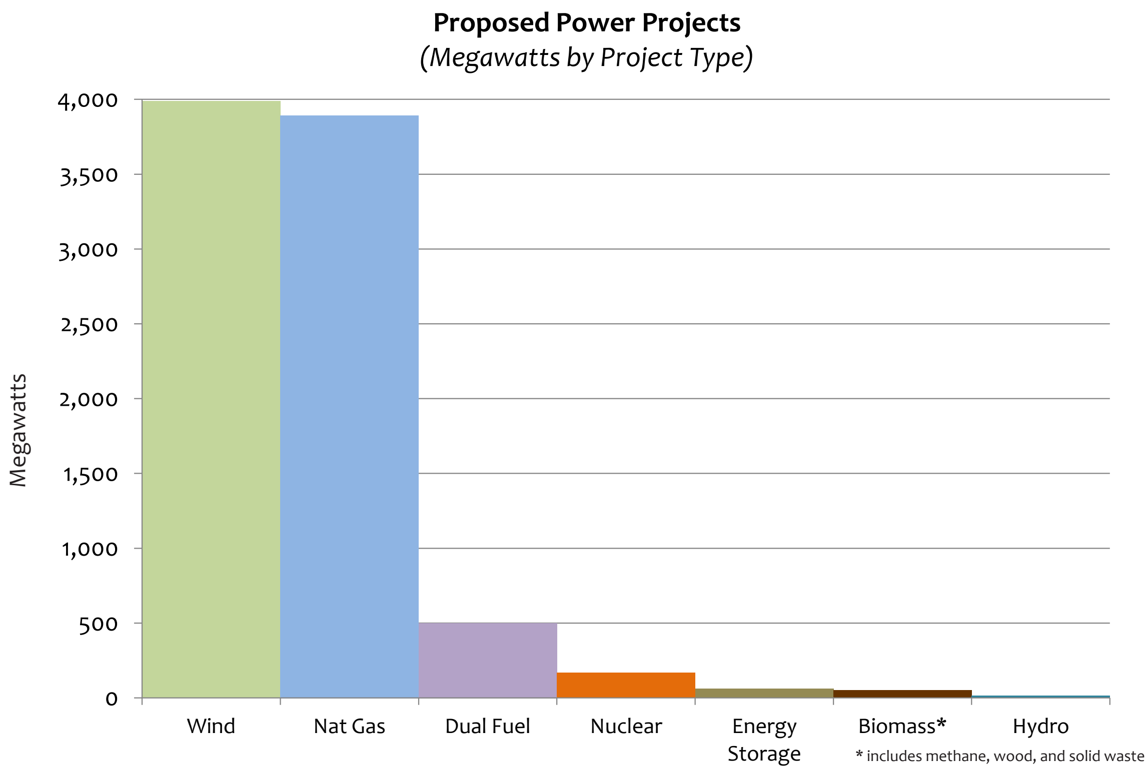
The production of electricity from natural gas in New York State has grown dramatically since the middle of the last decade. According to the EIA, roughly 27,000 gigawatt-hours of electricity were produced using natural gas in 2004. By 2011, the annual amount of electricity produced using natural gas rose to over 50,000 gigawatt-hours. During the same period, use of oil for electricity production declined dramatically. (See Figure 14.)

On a cautionary note, as dependence on natural gas for electric generation increases, the impact of natural gas supply on electric system reliability and power costs will also grow.

Disruptions in natural gas supply can affect the ability of gas-fueled generation to provide power, which could impact electric system reliability. (See following discussion, *Operational Connections,* for more detail.)

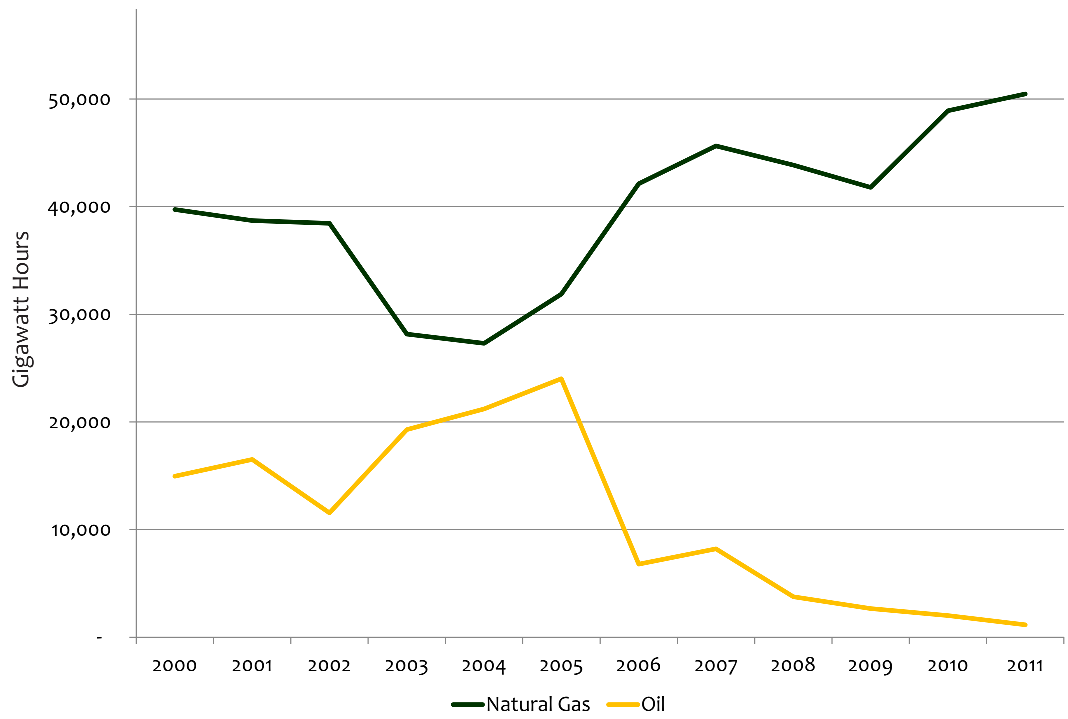
Likewise, power costs will be increasingly subject to volatility associated with future natural gas prices. Just as electricity prices declined with natural gas prices

Figure 13. Proposed Power Projects in New York State: 2012



SOURCE: *New York Independent System Operator Interconnection Queue, April 2012*

Figure 14. Generation by Natural Gas and Oil in New York State: 2000 – 2011



SOURCE: U.S. Energy Information Administration

in recent years, increases in natural gas prices can lead to wholesale electricity price increases, as occurred during the 2005-2008 period.

Because more than 60 percent of New York's generation fleet has the ability to run on gas and/or oil, plant operators are highly responsive to changes in fuel prices. During periods of high usage, dual-fuel plants are required by reliability rules to burn a minimum amount of oil. However, during typical load conditions, they have the ability to run on whichever fuel is cheaper. And for the past few years, that fuel has been natural gas.

"The role of natural gas in the world is likely to continue to expand under almost all circumstances, as a result of its availability, its utility, and its comparatively low cost," according to a 2011 report from the Massachusetts Institute of Technology (MIT) on the future of natural gas.[12]

The MIT study and numerous other reports suggest that natural gas can serve as a "bridge" fuel to a future of carbon-constrained energy supply. That role is expected to include replacing higher emission fossil fuels, such as coal, and serving to supplement the growing supply of power produced by renewable – but intermittently available – resources such as wind power and solar energy.

Operational Connections

Natural gas is delivered to power plants and other customers through a network of pipelines. Power plants rely on instantaneous delivery of natural gas – as they have no ability to store the fuel. A potential disruption to the supply of natural gas could impact the ability of a given plant to produce power in the absence of dual fuel capability to use oil as an alternative fuel. Such circumstances can compromise system reliability. These circumstances are most challenging during summer heat waves that produce peak power demand and during winter cold snaps that elevate heating fuel demands. The reliability rules for New York's electric system utilize "minimum oil burn" requirements for summer peak electricity loads in New York City and Long Island, and the NYISO has implemented a communication protocol that allows it to look for gas for key generators during a gas supply interruption.

In addition, power producers with natural gas-fueled generation have tended to procure much of their fuel supply using interruptible pipeline services. As a result, heating customers and industrial users with contracts for firm pipeline services have a higher priority during high-demand periods for natural gas. This dynamic adds to the complexity of coordinating electric and gas system operations.

In December 2011, the North American Electric Reliability Corporation (NERC) issued a "Special Reliability Assessment" focusing on natural gas and electric power interdependency.[13] Among its findings, the NERC report identified the need for increased coordination and communications between the industries.

The Federal Energy Regulatory Commission (FERC) is focusing on the increasing interdependency of the natural gas and electric power industries. In comments filed with FERC in March 2012, the NYISO and other ISO/RTOs noted that grid operators are in the process of identifying and addressing regional gas-electric coordination issues and urged the federal regulator to initiate an independent study of the nationwide issue, but facilitate regional approaches to solutions.[14]

In New York, the NYISO is actively engaged in addressing this concern. An Electric and Gas Coordination Working Group, established in the NYISO shared governance process, is meeting to address joint operational and planning issues. Following up on a 2002 study of electric-gas issues in New York State[15] and a 2003 regional electric-gas study[16] the NYISO has also initiated a new, regional gas study with neighboring electric grid operators.

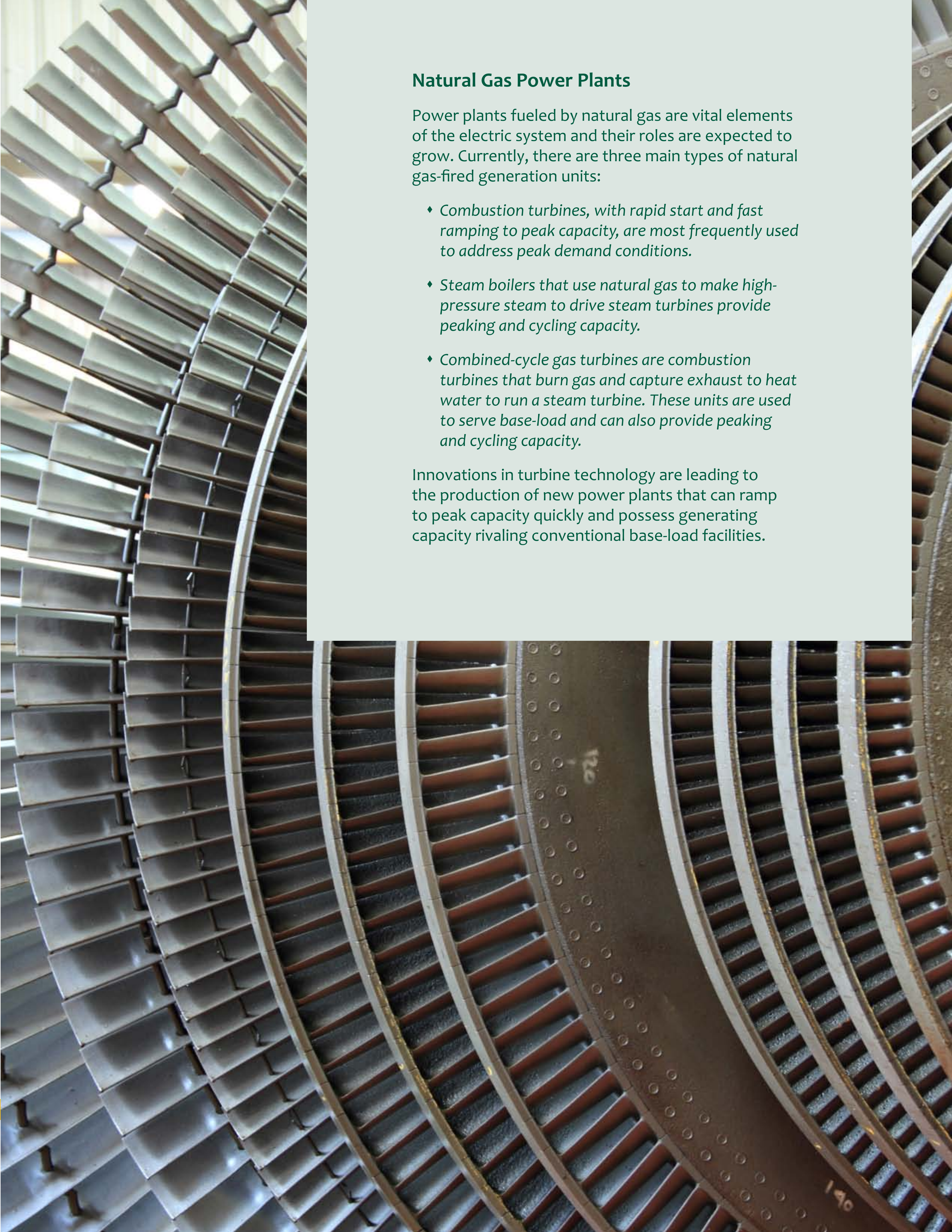
Beyond coordination of electric grid and gas pipeline operations, the opportunities for enhanced synergy between the electricity and gas industries may be found in evolving market designs that enable the marketplaces for both gas and electricity to better address their growing interrelationship.

Natural Gas Power Plants

Power plants fueled by natural gas are vital elements of the electric system and their roles are expected to grow. Currently, there are three main types of natural gas-fired generation units:

- *Combustion turbines, with rapid start and fast ramping to peak capacity, are most frequently used to address peak demand conditions.*
- *Steam boilers that use natural gas to make high-pressure steam to drive steam turbines provide peaking and cycling capacity.*
- *Combined-cycle gas turbines are combustion turbines that burn gas and capture exhaust to heat water to run a steam turbine. These units are used to serve base-load and can also provide peaking and cycling capacity.*

Innovations in turbine technology are leading to the production of new power plants that can ramp to peak capacity quickly and possess generating capacity rivaling conventional base-load facilities.



Modernizing New York's Electricity Infrastructure

Generation

The U.S. Energy Information Administration reports that 51 percent of all generating capacity in the nation was at least 30 years old at the end of 2010.[17]

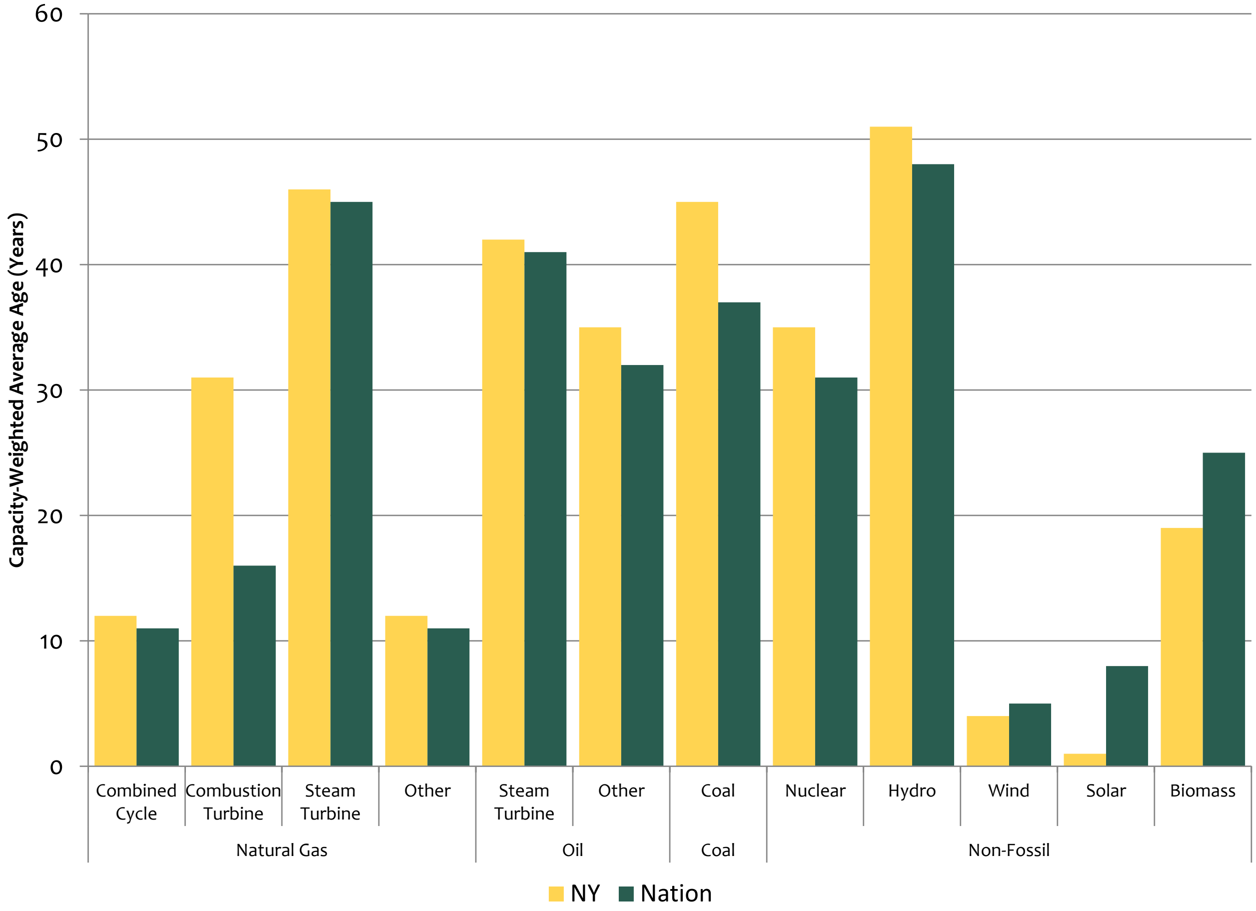
In New York, 59 percent of the state's generating capacity was put into service before 1980.

Steam turbines fueled by natural gas and/or oil have an average age of forty-plus years in New York and across the nation. In contrast, combined cycle units fueled by natural gas have an average age of little more than a decade. Renewable power projects such as wind and solar units are among the newest facilities, with the age of New York's wind and solar units less than the national average. (See Figure 15.)

The average age of New York's hydropower facilities is reported to be over fifty years. However, it should also be noted that judging the age of a power plant by its initial year of operation could be misleading. For example, the St. Lawrence-FDR Power Project began producing electricity in 1958, but a life extension and modernization program begun in 1998 is in the process of replacing all of that project's 16 turbines, with a scheduled completion date of 2013. Likewise, the Robert Moses Niagara Power Plant began operation in 1961; however, an upgrade and modernization program, completed in 2006, replaced all 13 of that hydropower facility's turbines.

Concerns about New York's lack of a centralized power plant siting law were addressed last year with the enactment of a new law, the "Power NY Act," that

Figure 15. Average Age of Generating Facilities in New York State and the Nation



SOURCE: SNL Financial, December 2011

included reestablishment of Article X of the New York State Public Service Law to provide "one-stop" approval for new power generation facilities by a centralized state siting board. The original Article X power plant siting law expired in 2003. By ending the nearly decade-long absence of a siting law, enactment of the Power NY Act is generally viewed as a positive signal to potential developers.

The current, abundant supply of generating capacity in New York is influencing plans for new generation. The economic downturn depressed demand for electricity, which in turn has dampened investment in new power resources and caused financial problems for some existing power providers. While forward-looking developers foresee a need for new resources to replace retiring units, project financing remains a hurdle for generation projects, including renewable resources.

One of the primary factors driving renewable development over the past few years was a federal renewable energy production tax credit. That credit is slated to expire for wind projects at the end of 2012, and for all other renewable projects at the end of 2013. As of this writing, the prospects for extension of the credit are unclear.

Project financing for electricity system infrastructure may also be affected by the implementation of the Dodd-Frank Wall Street Reform and Consumer Protection Act. While the final rules for the law are still under development, the potential exists to significantly alter the compliance landscape for entities that purchase and sell financial products in wholesale electricity markets as part of larger financing arrangements.

The outlook for return on investment is also unclear. Prices in the NYISO capacity market are reflecting an excess of available resources. The capacity market currently settles capacity requirements in three geographic areas – New York City, Long Island, and the "Rest-of-State". Recognizing that a more granular consideration of capacity requirements would be of value, the NYISO is currently evaluating the creation of additional capacity zones.

More extensive review of capacity markets is also planned by the NYISO in collaboration with stakeholders, including comparative analysis of the design and performance of the installed capacity markets in neighboring wholesale electricity markets, evaluation of forward capacity markets, and the potential for increased regional market coordination.

> *"Just as we built the New York State Thruway to unite distant parts of the state, we will develop an "Energy Highway" system that will bring excess fossil-fuel energy from Western New York downstate, and also tap into Upstate's potential for renewable energy, like wind power. Just like we built the Northway, we will develop an energy expressway down from Quebec. This will preserve Western New York's current allocation of low cost hydropower and at the same time help address the energy needs of Downstate."*
>
> Governor Andrew M. Cuomo
> 2012 State of the State Address
> January 4, 2012

Transmission

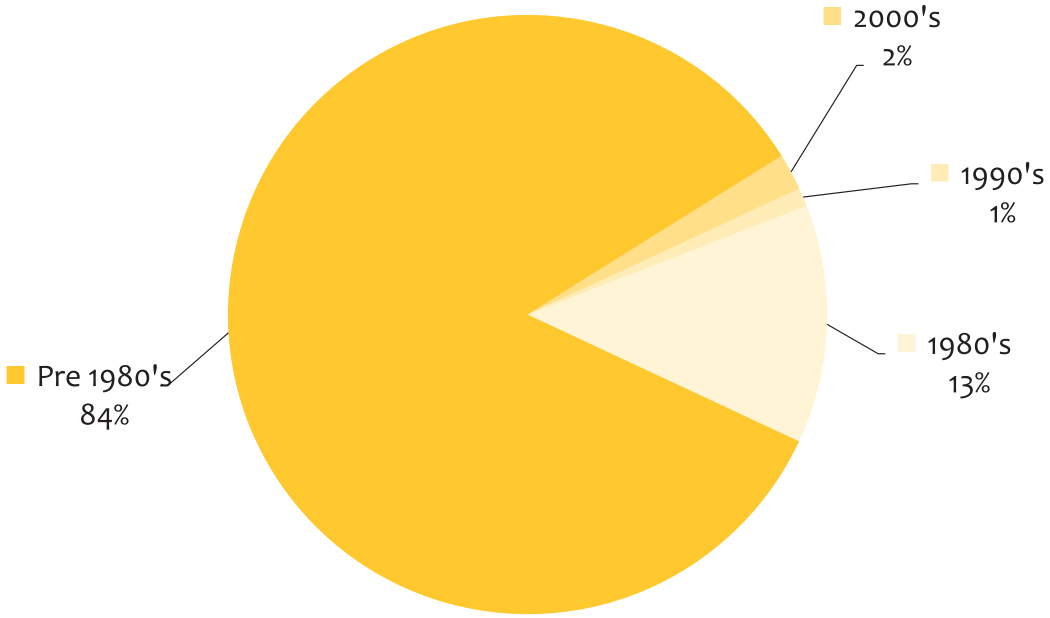
The supply of electricity to meet demand depends on the ability to transport power to where it is needed. Governor Andrew Cuomo delivered a powerful message about New York State's interest in addressing the electric system's transmission infrastructure needs in his 2012 State of the State Address. The Governor proposed a $2 billion, private sector-funded "energy highway" to transport surplus power supplies in upstate New York and north of the border in Quebec to high-demand regions in downstate New York.

Of the high-voltage transmission facilities serving New York State in 2010, 84 percent went into service before 1980. (See Figure 16.) Many of these facilities will require replacement over the next 20 years. Modernization and upgrades of New York's transmission system can make better use of statewide generating resources and enhance access to power resources throughout the region, especially renewable power developed in locales remote from high-demand population centers.

Major electric system planning efforts are available to provide a technical foundation upon which to build the "energy highway" proposed by Governor Cuomo.

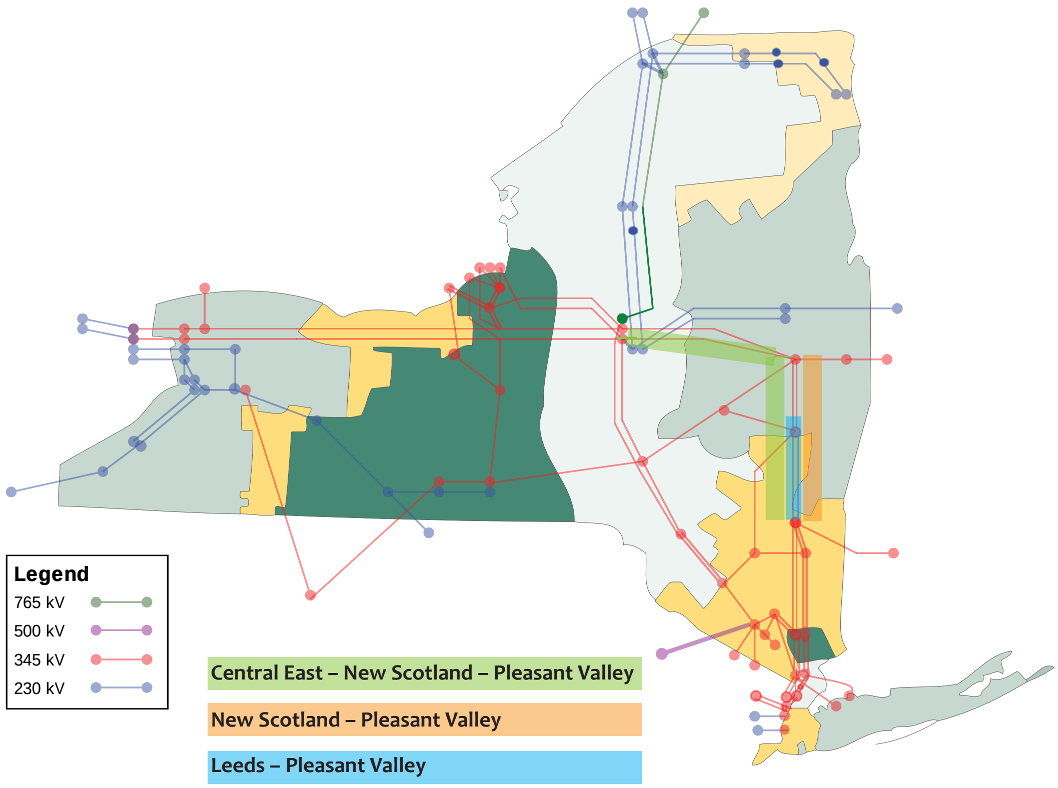
In addition to system planning focused on reliability, the NYISO conducts an economic analysis of transmission congestion and examines the potential costs

Figure 16. Age of Transmission Facilities in New York State



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

Figure 17. Transmission Congestion Corridors in New York State



SOURCE: *New York Independent System Operator 2011 CARIS Phase 1 Report, March 2012* and benefits of relieving such congestion. Called the Congestion Assessment and Resource Integration Study (CARIS), it is part of the NYISO Comprehensive System Planning Process, developed according to Federal Energy Regulatory Commission (FERC) requirements.

CARIS serves to screen the array of options available to address transmission congestion, including new or upgraded transmission, additional generation, or demand-side measures. It helps to set the stage for further, detailed analysis of specific solutions offered by developers, investors, utilities, and public authorities.

Transmission congestion results from physical limits on how much power high-voltage lines can reliably carry. Solutions to congestion may include building or upgrading existing transmission, building additional power supply resources in close proximity to an area needing supplies, or reducing the demand for power in the areas downstream from congested lines.

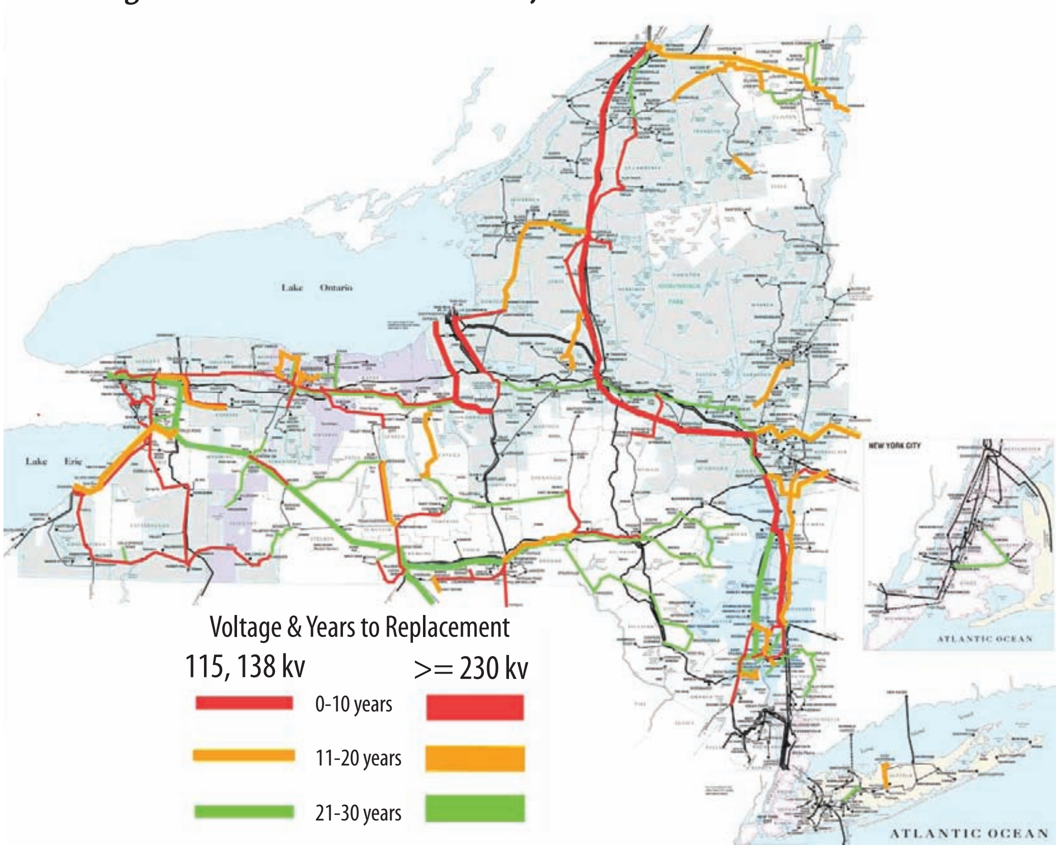
In March 2012, the NYISO completed the first phase of its most recent CARIS process.[18] The study identified the three most congested parts of the New York State bulk power system based upon historic data as well as estimates of future congestion. (See Figure 17.) They are:

- Central East - New Scotland - Pleasant Valley between the Mohawk Valley Region (NYISO Load Zone E), the Capital Region (Zone F) and the Lower Hudson Valley (Zone G);
- New Scotland - Pleasant Valley between the Capital Region (Zone F) and the Lower Hudson Valley (Zone G); and
- Leeds-Pleasant Valley between the Capital Region (NYISO Load Zone F) and the Lower Hudson Valley (Zone G).

The CARIS process analyzed generic solutions using assumptions related to the cost of adding transmission, demand response, and generation. The goal of this analysis was to determine projected production cost savings when serving statewide power demands with a generic congestion solution in place. Such reductions in the cost of generation ultimately yield savings for power consumers.

The analysis found that three of the generic solutions produced favorable benefit/cost ratios. Two of the generic solutions were transmission in the low-cost range serving the Leeds-Pleasant Valley and New Scotland-Pleasant Valley corridors. The other was demand response in the low-cost range serving the Central East - New Scotland - Pleasant Valley corridor.

Figure 18. STARS Age-Based Condition Assessment of Transmission



SOURCE: *New York State Transmission Assessment and Reliability Study, April 2012*

There are other benefits to developing transmission beyond the production cost savings analyzed by the CARIS benefit/cost process. These include reductions in capacity costs, economic benefits to existing upstate generation, reductions in emissions, improved fuel diversity, expanded opportunities for new and renewable energy development in the upstate region, and increased hydropower imports from Canada. While these economic and policy benefits are reviewed in the process, they are not eligible for inclusion in the benefit/cost metric.

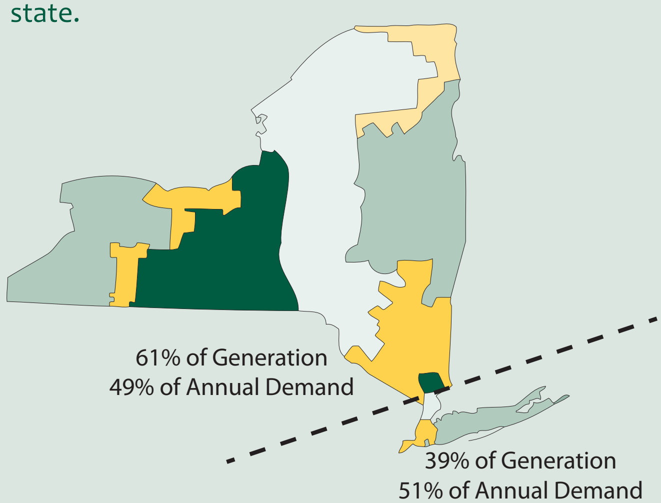
Other factors beyond the scope of the CARIS benefit/cost analysis are the costs of in-kind replacement of aging infrastructure and any offsetting financial benefits of upgrading and improving the transmission system infrastructure compared to the repair and maintenance costs that would otherwise be required.

Projects proposed to address the Governor's "energy highway" goals may also be studied during the next phase of the CARIS process, when the NYISO performs

Regional Differences in Supply and Demand

The need to move electricity throughout New York State may be best understood by examining the relative supply and demand for power in Upstate and Downstate New York.

More than half of the demand for electricity in New York occurs in the lower Westchester, New York City and Long Island zones. In contrast, more than 60 percent of the power supply from New York generators is located in the rest of the state.



a benefit/cost analysis for each specific transmission project proposed to address congestion on the New York State bulk power system.

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

The New York State Transmission Assessment and Reliability Study (STARS) is evaluating the lifecycle of New York's existing transmission assets and identifying potential transmission projects that would economically and reliably support New York State's energy needs over the next 20 years and beyond.
(See Figure 18.)

One of the key findings of the STARS initiative is that nearly 4,700 circuit-miles of the state's 11,000 circuit-miles of transmission lines will require replacement within the next 30 years, at an estimated cost of $25 billion.

Among the other STARS findings about the long-range investment needs of the state's transmission system are items relating to:

- Fully utilizing the windpower resources by upgrading some local transmission facilities in the event of additions to wind generation in northern regions of the state;
- Reducing congestion and providing economic benefits with new transmission projects in the Hudson Valley (such as a third Leeds-to-Pleasant Valley line, a third New Scotland-to-Leeds line, and a second Rock Tavern-to-Ramapo line), primarily using existing rights-of-way;
- Making cost-effective, incremental upgrades to existing transmission lines by increasing the capacity of such lines as the Moses-to-Marcy lines, the Marcy-to-Rotterdam section of the Marcy-to-New Scotland line and the Oakdale-to-Fraser line, also leveraging the use of existing rights-of-way.

Such strategic investments can improve the robustness of the transmission system, which could reduce the levels of generation reserves required to maintain system reliability.[19]

Smart Grid

Modernization of New York's electric system infrastructure also includes making the grid "smarter." The concept of "Smart Grid" encompasses a diverse set of technological solutions intended to enhance the operation of the transmission and distribution systems and ultimately improve the ability of electricity consumers to manage their use of power.

The NYISO and the state's transmission owners are working together on a $74 million smart grid initiative, supported by a U.S. Department of Energy (DOE) Smart Grid Investment Grant of more than $37 million. The project involves the installation of capacitor banks and phasor measurement units (PMUs) on the bulk transmission system throughout the state.

The capacitor banks will improve the efficiency of the state's bulk transmission system by reducing the amount of electricity that is lost when carried over long distances, thus reducing electricity costs in New York State by approximately $9 million per year.

The installation of PMUs and integration of their data provided will allow grid operators to see real-time power system conditions using sampling devices that provide data up to 60 times per second -- 360 times faster than currently possible. The enhanced visibility of system conditions may help to avoid future power system disturbances such as the 2003 northeast regional blackout.

The reliability of New York's electric grid -- and the dependability of the quality of the power it provides -- gives the Empire State a competitive edge in the worldwide competition for jobs. High-tech industries increasingly depend on a secure, sustained supply of power. Investment in New York's electric system infrastructure can help New York keep that competitive advantage.

Cyber Security

Protecting the grid from cyber attacks is a vital part of maintaining system reliability. As the systems that control and monitor the power grid become more technologically advanced and interconnected, the importance of cyber security increases.

Coordinating efforts among the transmission owners, grid operators, and all the other entities connected to the power system is vitally important. Yet, these efforts can be constrained due to an understandable reluctance to share sensitive information.

In January, the White House and the DOE announced an initiative to create a more comprehensive and consistent approach to maintaining the security of the nation's power infrastructure. The initiative will develop a "maturity model" to allow utility companies and grid operators to measure their current capabilities and analyze gaps in their cyber defenses. The initiative is being led by the DOE in partnership with the Department of Homeland Security. This initiative continues the direction set by the DOE with the release of roadmap and guideline reports in September 2011.[20] In addition, an array of legislation has been proposed in the U.S .Congress to enhance the cyber security protections of all key infrastructure, including the power industry.

The NYISO is actively participating in the development of industry cyber security standards at the North American Electric Reliability Corporation (NERC). The NYISO also collaborates with various agencies and entities involved in maintaining rigorous cyber security protections.

Sustaining Environmental Quality and Preserving Electric System Reliability

As a result of public policies aimed at setting power plant emission standards, and a relatively large supply of emission-free electricity from hydropower, nuclear energy, and wind power, New Yorkers are supplied by some of the cleanest energy resources in the country. The continuing efforts to modernize the power grid go hand-in-hand with efforts to transform the electric system's impact on the environment.

New power plants are generally more efficient, use cleaner-burning natural gas or are zero-emission, renewable resources. Competition in wholesale electricity markets has helped to stimulate investments in cleaner generation and encouraged operating changes to improve the overall efficiency – and reduced emissions – of power plants.

Power Plant Emissions

In New York State, the rate of power plant emissions of Sulfur Dioxide (SO_2), Nitrogen Oxides (NOx), and Carbon Dioxide (CO_2) has declined since 2000. The SO_2 rates have seen the most dramatic decline by dropping more than 86 percent. NOx rates dropped more than 76 percent and CO_2 rates dropped by 36 percent. (See Figure 19.)

New York is part of the Regional Greenhouse Gas Initiative (RGGI), which is a compact of several eastern states designed to reduce carbon emissions from power plants 10 percent by 2018.

Renewable Resources and Energy Efficiency

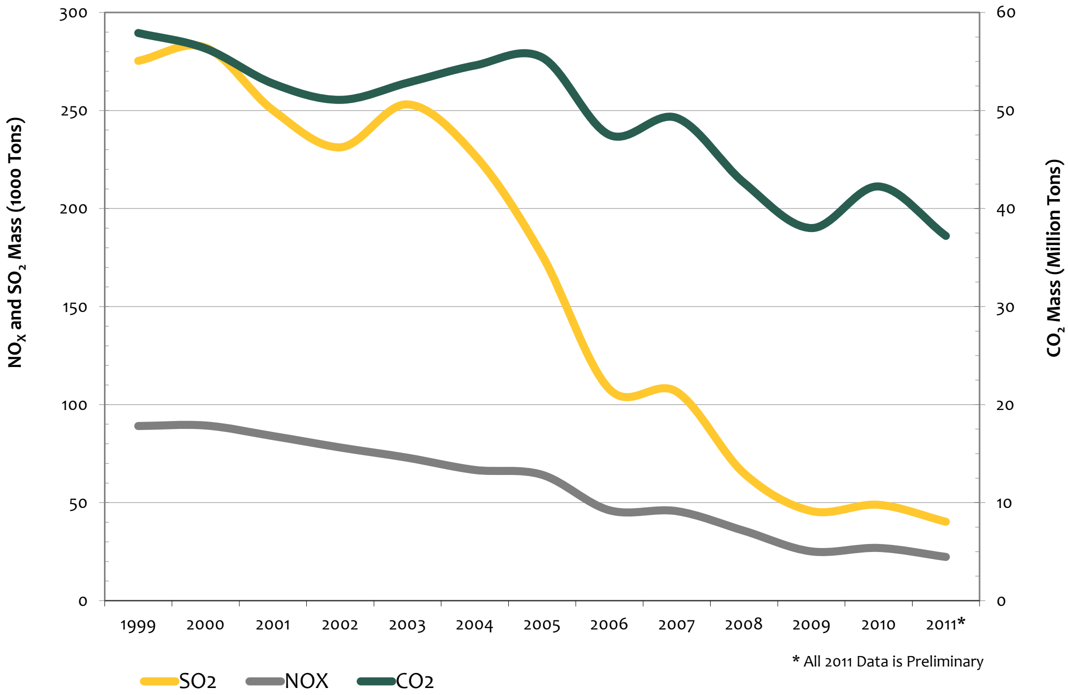
New York's Clean Energy Strategy contains an ambitious set of goals to reduce energy use, and increase the amount of power generated by renewable resources. The "45 x 15" framework aims to meet 45 percent of New York State's electricity demand through efficiency and renewable energy by 2015. To achieve these levels New York must simultaneously reduce energy use from forecasted levels 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.[21] The effective and expeditious implementation of energy efficiency programs is critical to realizing these targeted usage levels.

In addition, an estimated 47,100 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. In 2011, 33,251 gigawatt-hours of New York's electricity was supplied by renewable resources, 23.75 percent of New York's electric generation, up from 21 percent in 2010. (See Figure 20.)

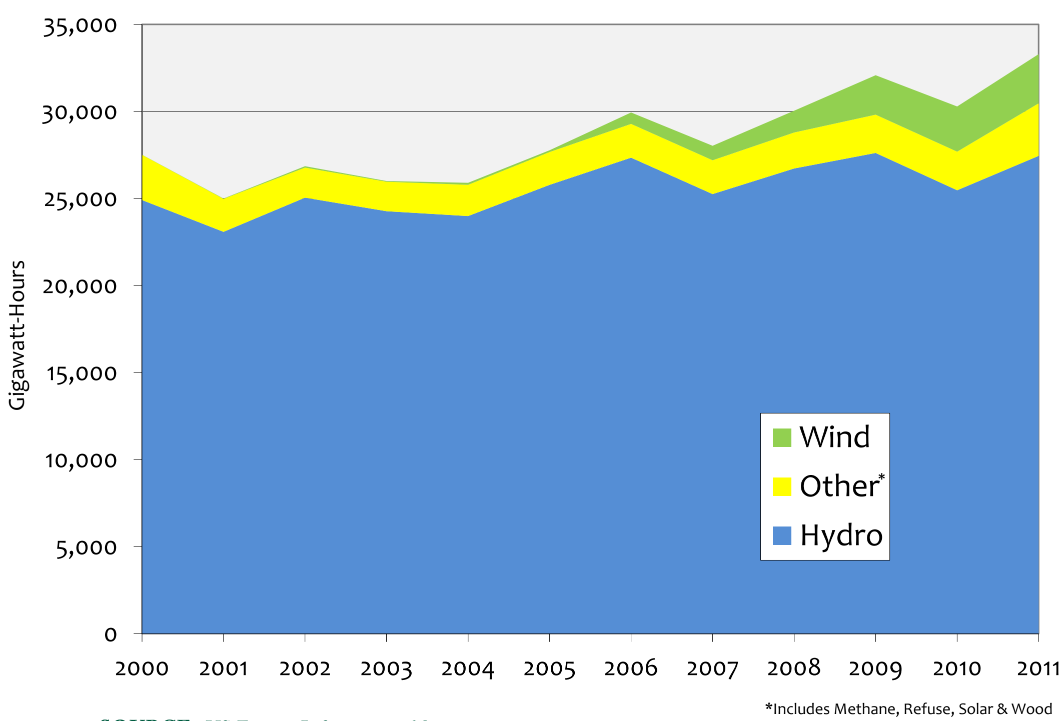
It is clear that continued expansion of renewable power resources is vital to meeting New York State's clean energy goals. New York's wholesale electricity markets have continued to evolve in an effort to cultivate the growth of green

Figure 19: Emission Rates from Electric Generation in New York State: 1999 – 2011



SOURCE: *USEPA Air Markets Program Data*

Figure 20. Electric Energy from Renewable Resources in New York State: 2000 – 2011



SOURCE: *US Energy Information Administration* power. A centralized wind forecasting system was established to better utilize and accommodate wind energy by forecasting the availability and timing of wind-powered generation. The NYISO became the first grid operator in the nation to integrate wind power in its economic dispatch system, fully balancing the reliability requirements of the power system with the use of the least costly power.

In response to the emergence of solar resources, new market rules were adopted to exempt solar power facilities from day-ahead bidding and scheduling obligations, while still providing full compensation for all solar energy production in New York State.[22]

Facilitating the integration of energy storage systems that can complement the integration of renewable resources, New York State's wholesale electricity markets were the first in the nation to enable new energy storage technologies, such as flywheels and advanced battery systems, to participate as frequency regulation providers.[23]

As of March 2012, a total of 1,414 megawatts of wind-powered generation is operating in New York State. In 2011, wind power projects produced 2,787 gigawatt-hours of electricity in New York State, a 10 percent increase over 2010. (See Figures 21 and 22.) In addition, projects capable of producing nearly 4,000 megawatts of wind power have been proposed for future interconnection with the New York bulk electricity grid.

The largest photovoltaic array in the eastern U.S., the 32-megawatt Long Island Solar Farm at Brookhaven National Laboratory, was completed in November 2011. To date, it is the only grid-scale solar power project in New York State.

New York City officials announced in March 2012 that they will seek solar and wind power project proposals for installation on Staten Island at the former Fresh Kills landfill. Officials estimate that the site could accommodate projects providing up to 20 megawatts of renewable power.[24]

Pioneering grid-scale energy storage has also developed in New York. An AES Energy Storage project in Johnson City was the first commercial grid-scale battery-based storage system to operate as a generator in the U.S. An energy storage plant developed by Beacon Power was the first full-scale flywheel energy storage facility to provide frequency regulation service in the U.S.

Figure 21. Wind Generation in New York State: Installed Capacity 2003 – 2012

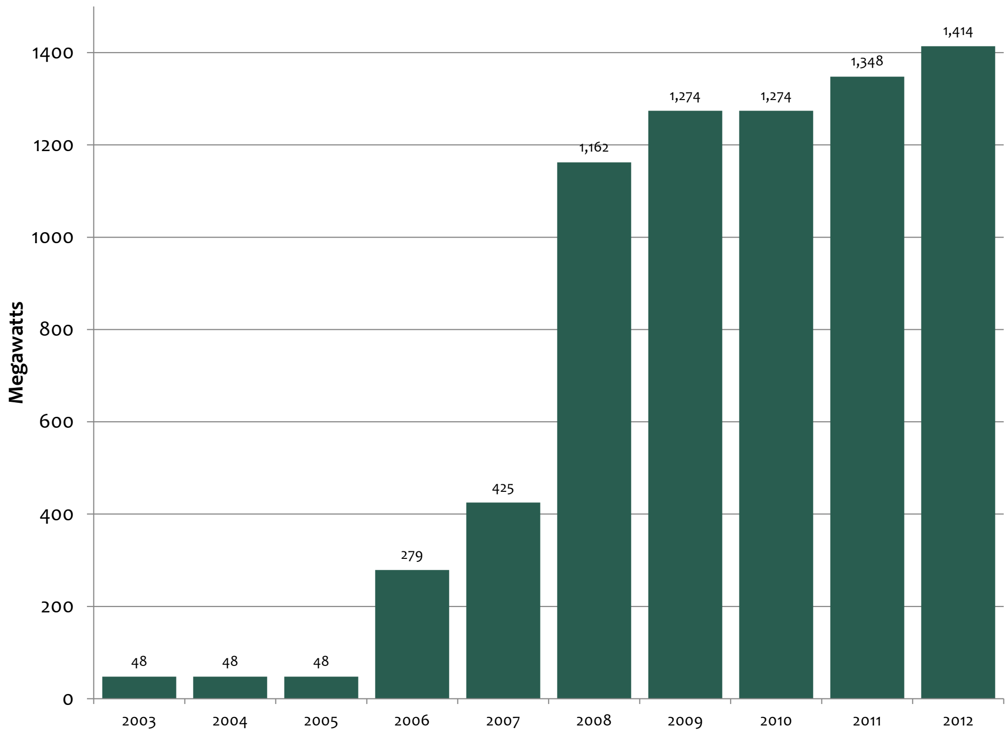
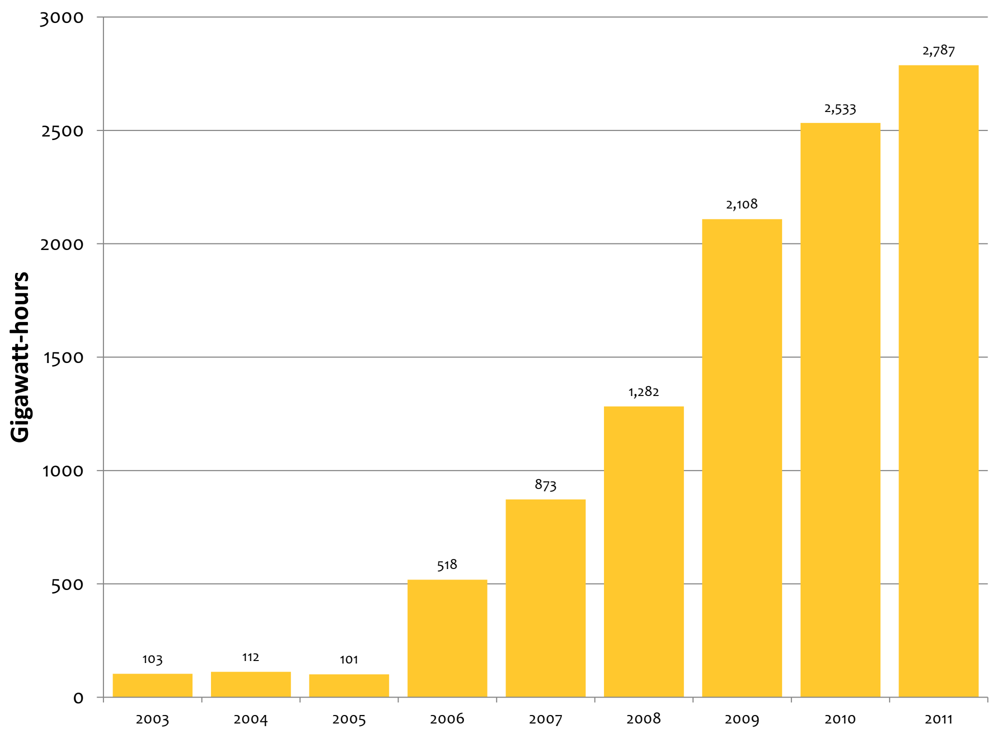


Figure 22. Wind Generation in New York State: Energy Produced – 2003 – 2011



The Future of Indian Point Energy Center

While the anticipated supply of generating capacity and other resources exceed the needs to reliably supply forecasted consumer demands over the next decade, the NYISO's planning process also identified risk scenarios that could adversely impact reliability of the electric system.[25]

These risks include the unplanned retirement of large amounts of generation due to opposition to the continued operation of the Indian Point Energy Center and/or the combined impact of environmental regulations.

The Indian Point Energy Center, located in Westchester County, includes two nuclear power generating units capable of producing 2,060 megawatts. The federal operating licenses for Unit 2 and Unit 3 of the Indian Point nuclear power project expire in September 2013 and December 2015, respectively. (Indian Point Unit 1 was shut down permanently in 1974.) The owner of the units has applied to the Nuclear Regulatory Commission for a 20-year renewal of the licenses.

To meet reliability requirements if the licenses are not renewed or the facility is otherwise retired, replacement resources have to be in place prior to a closure of the Indian Point Energy Center. Failure to do so would have serious reliability consequences, including the possibility of rolling customer blackouts.

Due to New York's existing transmission limitations, new generation, additional demand response, and limited transmission upgrades would likely be the potential solutions in response to an Indian Point closure in the next three to five years.

As noted previously, New York's transmission system is aging and many facilities will require replacement over the next 30 years. Whether Indian Point remains in service or not, it may be prudent to pursue upgrades to the existing transmission system to make better use of statewide generating resources, including renewable power from wind projects in the western and northern regions of New York.

While the debate over the future of the Indian Point Energy Center is often focused on safety concerns relating to its location in the densely populated metropolitan New York region, discussions about the future of nuclear power in electric generation continued worldwide. Concern about nuclear safety was elevated following the effects of the earthquake and tsunami that struck a Japanese nuclear plant in 2011. In the U.S., the Nuclear Regulatory Commission (NRC) has issued orders enhancing safety at U.S. reactors based on lessons learned from the accident at the Fukushima Daiichi nuclear power plant.[26]

In February 2012, the NRC approved licenses to build and operate two new nuclear reactors, at an existing nuclear power complex in Georgia. Prior to that action, of the 104 operating nuclear power reactors in the U.S., the last construction permit was issued in 1978 and the last operating license was issued in 1996.[27] In March 2012, the U.S. Department of Energy (DOE) announced the availability of $450 million in funds to support engineering and licensing of small modular reactors that are approximately one-third the size of current nuclear plants. DOE suggests that small modular reactors offer "compact, scalable designs that are expected to offer a host of safety, construction and economic benefits."[28]

Cumulative Impact of Environmental Regulations

The combined impact of proposed state and federal environmental regulations -- including control technology requirements for nitrogen oxides (NOx), mercury from coal plant emissions, interstate transportation of air emissions, and a proposed regulation requiring power plants to utilize closed-cycle cooling could result in unplanned plant retirements that may impact reliability. (See Figure 23.) The array of proposed regulations is estimated to potentially impact more than half of the installed generating capacity in New York State, with effects ranging from retrofitting pollution controls to reduced use or retirement.[29]

Compliance with these regulations, individually or cumulatively, 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.[30] 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 some facilities, which could adversely impact the reliability of the electric system.

The NYISO continuously monitors developments with these policies/programs and studies their potential impacts in its system resource planning processes.

Review of these and other energy policy considerations are also part of the New York State energy planning process. Under the provisions of a 2009 law, a new State Energy Plan is adopted every four years, with the next iteration of the plan scheduled for completion by March 2013. The law also requires a supplemental study of the overall reliability of the state's electric transmission and distribution system to be completed by September 2012. The NYISO, named as a non-voting member of the New York State Energy Planning Board by the 2009 law, is actively participating in the completion of that study, providing technical data and system modeling expertise.

Figure 23. Summary of Environmental Regulations Affecting New York State

Program	Description	Goal	Status	Compliance Deadline	Estimated Capacity Affected (MW)	Estimated Potential Retrofits (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%, from 58,000 Tons per Year (TPY) to 29,000 TPY	In effect	July 2014	28,000	4,200
BART Best Available Retrofit Technology	Requires an analysis to determine the impact of certain affected unit's emissions. 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 (SO2), nitrogen oxides (NOx) and particulate matter (PM) may be necessary.	In effect	January 2014	8,200	500
MACT Maximum Achievable Control Technology	Establishes limits for Hazardous Air Pollutants (HAP). Will apply to coal and oil-fired generators.	To limit emissions, under the federal Clean Air Act, of certain substances classified as hazardous air pollutants.	In effect	March 2015	11,300	350
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.	In effect	Upon Permit Renewal	18,000	4,400 to 7,300
CSAPR Cross State Air Pollution Rule	Limits Emissions of SO2 and NOx From Power Plants Greater Than 25 MW in 28 Eastern States through the use of emission allowances with limited trading.	Attain and maintain air quality consistent with Nation Ambient Air Quality Standards.	Implementation is stayed while the rule is in litigation	Jan. 2012 and Jan. 2014	26,400	1,100

Optimizing Resources: Expanding Horizons

While interconnected, the power grids and wholesale electricity markets serving various regions of the United States and Canada were developed separately and reflect differences in geography, climate, reliability requirements, and available power resources.

Where the various regions interface, the differences create seams in the overall fabric of the grid that can lead to market inefficiencies and inhibit efficient coordination of grid operations.

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 consumers.

Power flows change as older units retire and new generation comes on line. By removing barriers to the efficient flow of power throughout the region, the system will better accommodate these changes in generation resources. This will be particularly true with the continued development of renewable resources, which are variable in output and are predominantly located in regions remote from densely populated, high-demand areas. Similarly, changes to the transmission system are subject to increasingly rigorous scrutiny from a regional perspective. By evaluating impacts to the interconnected systems, planners will be better able to identify the most efficient solutions to anticipated needs.

In 2011, the Federal Energy Regulatory Commission (FERC) issued Order 1000 relating to transmission planning and cost allocation. The order provides clarification in several key areas and is intended to reduce barriers to transmission system investment.

The new FERC Order specifies that all transmission providers must have a regional transmission planning process in place that meets FERC's previously established planning principles and includes development of a comprehensive system plan. The NYISO planning processes already in place for reliability and economic projects have been previously approved by FERC.

FERC has added a new requirement that the regional planning process must consider transmission needs driven by public policy requirements. The NYISO is coordinating efforts with stakeholders and governmental entities to develop planning mechanisms beyond those already in place to consider public policy issues. FERC Order 1000 strongly encourages states to participate and provides all interested parties the opportunity to provide input into the development of such processes.

With regard to transmission cost allocation, the order specifies that costs must be "roughly commensurate" with estimated benefits. Costs are to be totally allocated within the region or regions in which the transmission facility is located, with no costs allocated outside that region(s) or to entities not receiving benefits. The NYISO uses a "beneficiaries pay" model for in-state reliability and economic projects.

FERC has directed NYISO to work with its neighboring regions to conduct planning on an interregional basis. In collaboration with its New England (ISO-NE) and Mid-Atlantic (PJM Interconnection) neighbors, the NYISO is working to build an expanded interregional planning process on the existing Northeast Coordinated Planning Protocol. The expanded process will include a cost-allocation process for voluntarily sharing the expense of interregional projects that are contained in each region's plan. As described below, the NYISO is also engaging in collaborative efforts with planning authorities across the entire Eastern Interconnection encompassing the area east of the Rockies in the United States and Canada.

Broader Regional Markets

The Broader Regional Markets initiative is an effort to mend seams, enhance utilization of existing resources, and reduce costs for power consumers.

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

A September 2010 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.[31]

The savings come from a number of different improvements, including reducing the need to use more expensive local power if less costly power is available from a neighboring grid operator; and shortening the time commitment for moving power into and out of the state – allowing faster responses to changing conditions.

Through the end of 2011, progress on the initiative includes a Market-to-Market Coordination arrangement between the NYISO and PJM Interconnection to minimize congestion within the two transmission systems that parallels the strategies employed between PJM Interconnection and the Midwest ISO. The proposed arrangement has been conditionally approved by the FERC.[32]

To facilitate more efficient use of transmission connections, the NYISO has moved to allow the scheduling of transactions with neighboring electric systems on a more frequent basis. In July 2011, the Enhanced Interregional Transaction Coordination (EITC) measures were implemented at the Chateauguay interface between New York and Québec, decreasing the scheduling interval from one-hour to 15 minutes. The NYISO plans to implement this capability with the PJM Interconnection by the end of 2012.[33]

In addition, FERC's recent approval of Coordinated Transaction Scheduling (CTS) between the NYISO and ISO New England will allow more efficient use of the transmission lines that connect the two regional power systems. Enhancements include increasing the frequency of scheduling energy transactions between regions, implementing software changes to enable the two grid operators to coordinate selection of the most economic transactions, and eliminating several fees that impede efficient trade between regions.[34] This initiative and related measures are intended to reduce transmission congestion costs, provide better integration of renewable resources, and lower total system operating costs.[35]

Expanded Interregional Planning

From a national perspective, the need for new and upgraded transmission facilities frequently focused on moving power generated by rural wind resources to power-hungry population centers. The "wires for wind" discussions included debate over who would pay for new transmission and the respective jurisdiction of federal and state authorities in siting transmission.

This issue was among the concerns that prompted 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. Prior to the creation of the EIPC, there was no single organization to look at interconnection-wide planning across the eastern portion of North America.

Consisting of more than two dozen electric system planning authorities from the Eastern United States and Canada, the EIPC adopted a "bottom-up" approach, starting with a roll-up of the existing regional grid expansion plans. Supported by $16 million in funding from the DOE, the EIPC engaged in identification and analysis of a large number of resource expansion scenarios selected through a 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 also was awarded DOE funding to participate in the collaborative process.

In December 2011, the EIPC announced completion of Phase 1, which included macroeconomic analyses of eight stakeholder-selected energy futures. The Phase 1 Report filed with the DOE in December outlined the process, presented the results of the macroeconomic analysis, and described the final three scenarios chosen by stakeholders for further study in Phase 2. The three scenarios are "business as usual," which assumes continuation of existing energy trends and policies; a national renewable portfolio standard implemented at the state and regional levels with the goal of providing 30 percent of the nation's electricity from renewable sources by 2030; and a combined federal climate and energy policy scenario, which assumes adoption of a carbon reduction goal of 50 percent by 2030 in addition to the RPS goal and extensive deployment of energy efficiency and smart grid programs.

A detailed transmission analysis will be developed in Phase 2 for each of the three selected scenarios, together with a production cost study and high-level cost estimates for the resources and transmission facilities associated with each scenario. The project schedule calls for a final project report to be filed with the DOE by the end of 2012.


Photo courtesy of New York Power Authority

Conclusion

There is an array of issues that must be monitored and addressed to ensure New York's energy future, and a close look at the details of the issues reveals the complexity of the challenges that we face.

Harnessing the "shale gale"

Significantly expanded supplies of natural gas are reshaping the landscape of power generation, electric system planning and grid operations in New York and across the nation. Focus is needed on both the diverse effects of "the shale gale" on energy economics and the need for enhanced coordination in the operation of the electric grid and gas systems.

Modernizing infrastructure

The aging transmission and generation infrastructure requires modernization that recognizes the value of upgrading rather than simply replacing facilities nearing the end of their useful lives. Evolution of wholesale electricity market design to sustain and enhance market signals for investment can play a significant role in that effort, as can the implementation of equitable cost allocation systems for electric system infrastructure expenditures.

Coordinating policies

The cumulative effect on the electric system of government policies intended to protect and enhance environmental quality, including expanded regulation of power plant emissions and the effort to close the Indian Point nuclear project, need to recognize the importance of accommodating the time needed to make required changes in the electric system. Such changes include time-consuming development and construction of infrastructure, as well as the conception and implementation of protocols, processes and products required to adapt policy into practice. With its comprehensive and inclusive planning process, the New York State Energy Planning Board's development of a State Energy Plan offers a valuable venue for the coordination and integration of economic, environmental and energy considerations in the development of state policy initiatives.

Optimizing resources

Addressing these and other issues can be well served by efforts to enhance the coordination of the various individual wholesale electricity markets and system planning authorities serving the Eastern United States and Canada.

Underlying the complexity of all these issues remains a few fundamental concepts: that the power system exists to serve customers, and that an efficient, well-regulated, competitive wholesale electricity market plays a vital role in the efficient allocation of resources and a thriving economy.

The energy issues facing New York are intricately interconnected and cannot be addressed in isolation. The NYISO was founded on the belief that active collaboration among all power system stakeholders is essential to the development of effective and equitable solutions.

New York's power system does not operate in isolation. This is becoming increasingly apparent as interregional planning and the Broader Regional Markets initiatives continue to evolve.

Planning for Change

All of these efforts must be built around the understanding that considerable lead-time is required for the realization of power infrastructure projects. While electrons can move instantaneously, it takes years to site, permit, finance, build and commission the lines that produce and transport those electrons.

Nevertheless, 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 help ensure a bright energy future for New York State.

Glossary

The following glossary offers definitions and explanations of terms and phrases used in Power Trends 2012 and others generally used in discussions of electric power systems and energy policy.

"45 x 15": An energy policy initiative which established the goal of meeting 45 percent of New York State's 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 percent and decreasing electricity usage by 15 percent from forecast levels (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 interval as specified by regulatory authorities. They also allow electricity consumers, suppliers, and service providers to participate in all types of price-based demand response programs.

Broader Regional Markets (BRM): A set of coordinated changes to the regions bulk-electricity markets that will reduce the inefficiencies of moving power between markets. In addition to the NYISO, the regional initiative involves Ontario's Independent Electricity System Operator, the Midwest Independent Transmission System Operator, PJM Interconnection, ISO New England, and Hydro Québec.

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 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.

Capacitor Banks: These devices are used to improve the flow and the quality of the electrical supply and the efficient operation of the power system.

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 of the New York transmission owners, followed by NYISO's Reliability Needs Assessment and Comprehensive Reliability Plan. Finally, economic planning is conducted through the Congestion Assessment and Resource Integration Study.

Congestion: A situation where all available transmission lines between two locations are fully utilized. Congestion can be relieved by increasing transmission, generation or by reducing load.

Congestion Assessment and Resource Integration Study (CARIS): Part of the NYISO's Comprehensive System Planning Process, 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 flow of power.

Day-Ahead Market (DAM): A NYISO-administered wholesale electricity market in which electricity, and ancillary services are auctioned and scheduled one day prior to use. The DAM sets prices based on a least-total cost methodology, based on generation and energy transaction bids offered in advance to the NYISO. More than 90 percent of energy is scheduled 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. These resources are paid the same market clearing price per megawatt as generators.

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.

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 (EEPS): A proceeding initiated on May 16, 2007 by the New York State Public Service Commission (NYSPSC) 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 NYSPSC determined that New York possesses sufficient potential energy efficiency resources to reduce electricity usage by 15 percent 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 tariffs 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 qualifying generator or load facility that can supply and/or reduce demand as directed by the NYISO.

Installed Reserve Margin (IRM): The amount of installed electric generation capacity above 100 percent 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.

Marcellus Shale: A black shale formation extending deep underground from Ohio and West Virginia northeast into Pennsylvania and southern New York. Geologists estimate that the entire Marcellus Shale formation may contain up to 489 trillion cubic feet of natural gas, although it is not yet known how much gas will be commercially recoverable from the Marcellus in New York.

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. It is generally estimated that a megawatt provides enough electricity to supply the power needs of 800 to 1,000 homes.

New York Independent System Operator (NYISO): Formed in 1997 and commencing operations in 1999, the NYISO is a not-for-profit organization that manages New York's bulk electricity grid, administers the state's competitive wholesale electricity markets, provides system and resource planning for the state's bulk power system, and works to advance the technology serving the 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.")

Phasor Measurement Units (PMUs): These devices will provide near instantaneous measurement and observation of bulk power system phase angles at strategic locations across the system. PMUs are expected to increase the NYISO's (and transmission owners') interconnection-wide awareness of the system's state and its vulnerabilities in real time.

Power NY Act: Energy legislation that encourages new investments in electric generating facilities across New York and creates the nation's first statewide "on-bill" recovery program to increase energy efficiency for homeowners and businesses. Signed into law by Governor Andrew M. Cuomo on August 4, 2011.

Regional Greenhouse Gas Initiative (RGGI): The first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

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 (NYSPSC), 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 percent to 25 percent by the year 2013. In October 2008, the NYSPSC initiated a proceeding to increase the RPS goal to 30 percent 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.

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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 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 more than 11,000 circuit-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 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.

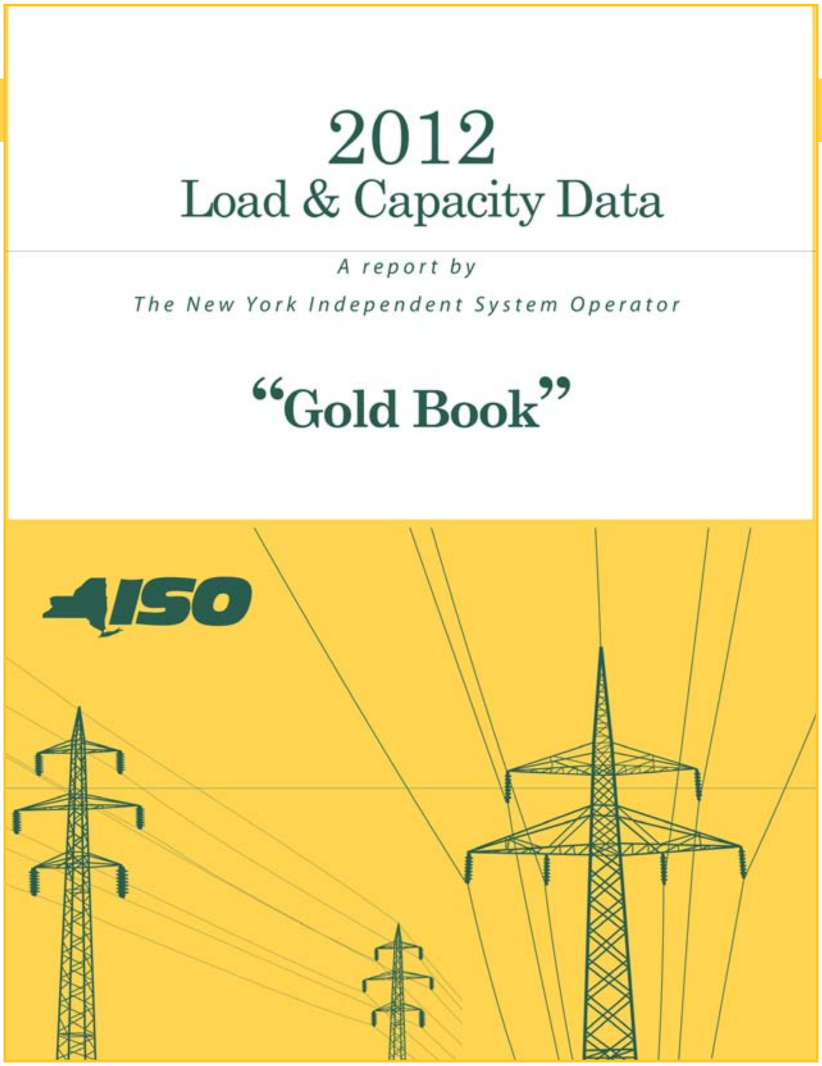
The NYISO is committed to transparency and trust in how it carries out its duties, in the information it provides, and in its role as the impartial broker of the state's wholesale electricity markets. Power Trends is the NYISO's annual analysis of factors influencing New York State's bulk power grid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

2012 Load and Capacity Data Report (the "Gold Book")

Data used in *Power Trends 2012*, unless otherwise noted, are from the *2012 Load and 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 2012 – 2022 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 on the NYISO website, www.nyiso.com.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Load & Capacity Data

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The New York Independent System Operator

"Gold Book"

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