NEW YORK INDEPENDENT SYSTEM OPERATOR

Fuel Diversity in the New York Electricity Market

A New York ISO White Paper

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The purpose of this paper is to explore the various meanings of fuel diversity and its impact on the New York electricity market.

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1. Introduction

In today's era of high energy prices, observers often point to improving our fuel diversity and energy independence as ways to mitigate the impacts of fuel price increases on consumers, and improve supply reliability. Calls for greater fuel diversity are now common — whether from elected officials or regulators seeking to buffer their electricity consumers from price increases in global energy markets, or from representatives of the energy industry looking for strategies to mitigate price increases and boost reliability.

The New York Independent System Operator (NYISO) asked Susan Tierney of Analysis Group, Inc., to assist in the preparation of a white paper on fuel diversity in New York's wholesale power market. This paper identifies trends that have led to the electric industry's focus on fuel diversity. It examines various meanings of fuel diversity within an electricity market; discusses various economic, reliability and environmental dimensions of fuel diversity; explores the impacts of various events on fuel or technology-dependent energy systems; looks at approaches used in other regions to address fuel diversity; and identifies options to address fuel diversity that are both well aligned and poorly aligned with New York's electricity markets.

Recent appeals for diversifying electricity supplies stem from several conditions. Most new power plant capacity added in the U.S. in the past decade relies on natural gas to generate electricity. Natural gas prices have increased dramatically over that same period. While the overall percentage of power generated by natural gas increased only modestly nationwide, natural gas price increases have a disproportionate effect on wholesale electricity prices in certain power markets in the U.S, including in New York. These conditions have contributed to recent and heightened calls for actions to diversify our electricity mix.

A common goal among advocates of greater fuel diversity is the hope that diversifying a power system's fuel and technology mix will enable the system to withstand fuel price volatility, fuel supply or delivery disruptions, or technical disturbances on the system. But apart from these rationales, there is little consensus on what "fuel diversity" would look like if we had it. Advocates draw analogies to the well-understood attributes of a diversified stock portfolio, or the common-sense appeal of "not having all of your eggs in one basket."

There can be other motivations. Sometimes, calls for greater fuel diversity are less an appeal to diversity as a goal in itself but rather an indirect statement by one group or another that there is not enough of his or her preferred fuel or power-generation technology in a system's mix. Some observers' calls for greater fuel diversity in an electric system can be interpreted as a somewhat veiled critique, indicating their disappointment with the outcome of market forces.

Another common theme of many fuel-diversity discussions is the link to energy security or energy independence. The point is that a national or regional economy whose energy system is fundamentally vulnerable to strategic actions of others who control a particular fuel or resource is structurally weaker than economies with more robust, balanced, or diverse energy systems.

New York State's overall electric system is actually more diverse than is typically thought. No one fuel is used to generate more than a third of the state's power, for example. In fact, the statewide generation mix could be viewed as more diverse and more balanced than many other states that are much more dependent on coal or nuclear or hydroelectric power.

The statewide picture, though, does not represent different regions of New York's power market. While most of the population and electric load is downstate, much of the state's lower-cost electricity supplies (hydroelectric, wind, nuclear) are located in the upstate zones. Typically, the NYISO cannot fully dispatch all low-priced power production facilities (such as wind) in the upstate region to meet downstate loads because of electrical overloading of the transmission system that would occur with the north-to-south flows on the system. As a result, more expensive plants (gas-fired peaking plants, oil plants) must by physically located downstate, and then operated locally to keep the lights on in New York City and Long Island.

It has been easier to site relatively large and diverse power plants (including hydroelectric, nuclear, coal, and natural gas projects) upstate. Some upstate areas have significant indigenous resources for power generation (e.g., wind and hydroelectric resources). Electricity prices in the upstate zones are much lower on average than in New York City and Long Island. These differing conditions have significant fuel diversity implications for the upstate and downstate areas of New York. Without changes in the infrastructure allowing other generating resources to be available to the downstate region, prices will continue to be shaped by the relatively expensive fossil fuels used there.

In spite of these challenges in the near term, various features of New York State's overall economic, social, and natural resources may provide opportunities for the state to support a more resilient electric system. For example, the New York metropolitan port area has the ability to move energy products in and out of the downstate area. New York's off-shore resources include renewable resources (e.g., off-shore wind, tidal) that could be developed, providing some indigenous sources of power. New York's significant municipal solid waste and demolition waste streams might provide fuel for projects using new gasification technologies that gasify wastes for combustion in power plants. Both downstate and upstate regions of the state are proximate to regional wholesale markets (e.g., PJM, Eastern Canada, ISO New England or ISO-NE) with relatively similar market designs and inter-regional cooperation which offer the prospect for enhanced trade, should infrastructure developments reinforce the interconnections between the regions. While ISO-NE's electric system is highly dependent on natural gas, PJM's and Eastern Canada's are not.

Today's electricity and energy mix in New York is the result of countless decisions by public and private decision makers. Considerations have included a complex array of public policies, economic and technology conditions, capital market conditions, electrical infrastructure layout, consumer preferences, and siting politics highlighted by "not-inmy-backyard" or NIMBYism. As a consequence, today's fuel diversity profile in New York is neither "good," nor "bad," but consists of electricity production, delivery and use which present various risks and/or unanticipated consequences. Even so, the primary consequence of a less than optimally diverse energy resource mix ends up hitting the pocketbook: consumers face the risk of higher and more volatile prices.

If the primary concern about the electric system configuration in the downstate area of New York is economic in nature, what then, are the options available to address fuel diversity, and what are the implications of taking steps to implement them? This paper examines a variety of ways in which public policy makers in New York, as well as the market itself, have responded by diversifying and reinforcing some sources of supply to the industry.

Additionally, the paper explores a number of possible short- and long-term policy options which could change the signals in the market place and/or allow customers and suppliers to better withstand shocks to the system.

Some options described in this paper include:

- Enhancing the ability to operate power plants using alternative fuels
- Increasing the penetration of energy efficiency and other strategies on the customer's premises
- Encouraging hardware and software investments that make the system more resilient and able to deliver non-gas resources to different parts of the state
- Creating incentives for improved hedging to address price volatility
- Introducing regulatory policies and market rules to encourage investments in transmission, generation, communications, fuel delivery, storage, and other infrastructure allowing for a more diverse system
- Putting in place emergency measures to mitigate the effects of certain types of adverse events on the system

Each of these approaches involves trade-offs, and this paper is intended to inform policy makers and other stakeholders of many of the issues as they consider whether and how to address fuel diversity issues in New York State in the future.

2. Background

Given high and rising energy prices, observers often point to improving fuel diversity — as well as energy independence — as a way to mitigate the impacts of recent price increases on consumers. In the past few years, extensive reliance of particular sectors of the economy on specific fuels has become a focus of attention: Price increases in crude oil in 2008 led in part to record-high prices for gasoline in the transportation sector; and rising natural gas prices since 2000 have driven up electricity prices in the parts of the country that are heavily dependent on natural gas to produce power.

Calls for greater fuel diversity are now common, as noted above. The objectives of this paper are to:

- Identify trends that have led to the electric industry's focus on issues surrounding fuel diversity
- Explore and explain various meanings of fuel diversity within an electricity market
- Discuss the sources of and economic, reliability and environmental dimensions of fuel diversity.

This paper will also explore different approaches that other electricity regions have used or are now seeking to address fuel diversity, and the challenges associated with these various strategies; and identify options to address fuel diversity that are well aligned and poorly aligned with New York's electricity markets.

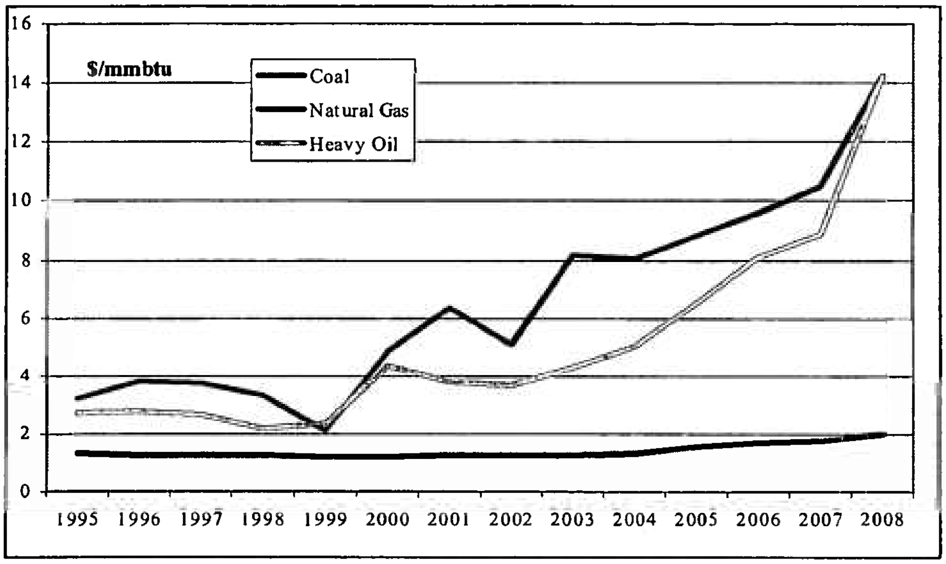
Recent Trends Affecting Fuel Diversity in the Power Sector

Recent appeals for diversifying supply in the electricity sector stem from several developments, including:

1) Natural gas has accounted for 91% of the new power plant capacity added in the United States in the past decade. Natural-gas fired combined cycle power plants were the dominant choice by developers and investors starting in the mid-1990s, given this technology's low capital costs, relatively high efficiency, low air emissions, relatively fast permitting process, and the outlook (at the time) for continued low prices for natural gas.

2) After remaining relatively flat in the 1990s, natural gas prices for electricity generation have increased dramatically since and have risen nearly seven-fold since 1999. (See Figure 2-1, below.) 3) While the overall share of power generated by natural gas increased only modestly (from 13% in 1996 to 21% in 2007) nationwide, gas price increases have had a disproportionate effect on wholesale electricity prices in certain restructured power markets in the U.S. (such as those in New York, New England, Texas, and much of the Mid-Atlantic and Midwest regions). In these power markets, hourly energy prices are heavily influenced by the price of the fuel used by the marginal power plant in that hour. In many of these markets — notably ISO-NE and Electric

Reliability Council of Texas (ERCOT), and to a lesser degree in the NYISO and PJM — natural-gas power plants are the marginal producers during a high percentage of hours of the year.



Source: Energy Information Administration[1]

Figure 2-1: Fuel Prices to the U.S. Electric Sector – 1995-2008

As of the last quarter of 2007, over 90% of the new fossil-fuel power plants proposed in the U.S. were natural-gas-fired power plants. As of the summer of 2008, the Energy Information Administration (EIA) estimated that average natural gas prices in 2008 would be 60% higher than they were in 2007.

These conditions have contributed to recent and heightened calls for actions to diversify our electricity mix. In the recent appeals for greater fuel diversity, one thing is clear: there is no common definition of what the concept means.

Defining Fuel Diversity

Customarily, enhancing "fuel diversity" means adding variety to a power system's fuel and technology mix in order to enable the system to withstand fuel price volatility, fuel supply or delivery disruptions, or technical disturbances on the system.

A typical example of what "fuel diversity" means can be found in the position of many of the nation's electric utility regulators. The National Association of Regulatory Utility Commissioners (NARUC) recently passed a resolution encouraging "state commissions and other policy makers to support the concept of fuel diversity for electric generation." Concerned about the increasing dependence of the nation's generation mix on natural gas at a time of rising prices, NARUC's 2004 Resolution on Fuel Diversity called for a "reliable and balanced long-term fuel mix" for power production.[2] In a prior resolution on national electricity policy, NARUC supported actions and policies to "assure adequate, reasonably priced, reliable, safe, and environmentally sound electricity." To achieve this goal, NARUC called for federal legislation to encourage (among other things) "diverse, plentiful and environmentally responsible energy supplies," with "additional fuel- and technology-diverse supply resources to meet the nation's growing energy demands."[3]

But apart from these appeals for fuel diversity, there is little consensus on what it ought to entail.

Kenneth Costello of the National Regulatory Research Institute, for example, has stated that "the primary justification for fuel diversification lies with the objective of reducing risk, a strategy parallel to investors' diversification of their financial assets to achieve tolerable risk and, at the same time, earn reasonable returns."[4] He argues that ideally, a 'portfolio' of generation technologies would be such that the various fuel prices are not correlated and move in opposite directions to nullify each other's volatility by creating a hedge against volatile and uncertain fuel prices — much like how a financial portfolio would be structured. Understandably, there are certain types of risks that affect fuel prices (such as macroeconomic conditions) that are not likely to be mitigated through a fuel-diversification strategy.

Sometimes, calls for greater fuel diversity are attempts to promote a particular fuel in a system's power-generation technology mix. There are many familiar examples, whether from pro-nuclear, or pro-coal, or pro-renewables partisans, each of whom may view the recent movement toward dependency on natural gas as disfavoring these other resources.

Some observers' calls for greater fuel diversity in an electric system can be interpreted as a somewhat-veiled critique, indicating their disappointment with the outcomes of market forces. In other words, given the role of markets in our energy industries, whatever level of fuel/technology diversity that exists in an electric system at a point in time is likely to be the result of rational responses of countless public and private decision-makers to the constellation of market, regulatory, tax, and other policy signals existing at the time these myriad decisions were made. The past decade's significant investment in natural-gas-fired generating capacity could be seen as sensible responses of innumerable private and public actors to conditions in fuel markets, restructured electricity market design and policy, permitting and environmental policies of states and the federal government, opportunities in financial markets and the risk appetite of various players. While some of the signals — such as natural gas prices — changed over time in ways that made the investment outcomes less attractive for some market participants (e.g., consumers, state elected officials, even some investors), the individual decisions that led many regions to become more dependent upon natural gas may not have been unreasonable at the time, given the signals in the marketplace.

In fact, without interventions that modify some of those signals, it may not be reasonable to expect future investment patterns to lean significantly toward a different fuel and technology mix than has been seen in recent years. Thus, without changes in such things as the public's appetite to tolerate the siting of new nuclear generating capacity, or new policies that encourage long-term contracting and/or new subsidies for advanced coal-fired generation technologies, or the adoption of policies that put a price on carbon emissions, one might continue to see investor interest in natural-gas-fired generating projects in many parts of the country. (These issues are discussed in greater detail in subsequent sections of this paper.)

Finally, a common theme of many fuel-diversity discussions is the link to energy security or energy independence. The popular version of this argument is often voiced by elected officials, who advocate that our energy systems should be free from reliance on imported fuels. The standard target of this view is our oil-dependent transportation sector, but the perspective has arisen in discussions about growing reliance on natural gas in the power sector and its implications for an increasing dependency on imported liquefied natural gas (LNG) from countries with a history of withholding energy supplies for political purposes, for example Russia.

While there are sophisticated and sometimes spirited debates over the strengths and weaknesses of the energy independence argument, there is one strong argument that seems relevant for this paper's discussion of fuel diversity in the power sector. This is the point that a national or regional economy whose energy system is fundamentally vulnerable to strategic actions of others who control a particular fuel or resource is structurally weaker than economies with more robust, balanced, or diverse energy systems. In this view, an "energy independence" strategy is not one aimed at cutting a country or a region off from its ties (and imports) from others; rather, it is a strategy of stripping a particular fuel from its strategic value.[5] In this view, a region may use a variety of strategies to diversify its energy sources, making the country less vulnerable to the strategic geo-political-economic actions of a particular set of sovereign or commercial actors. As described in greater detail in a later section of this paper, such actions might involve:

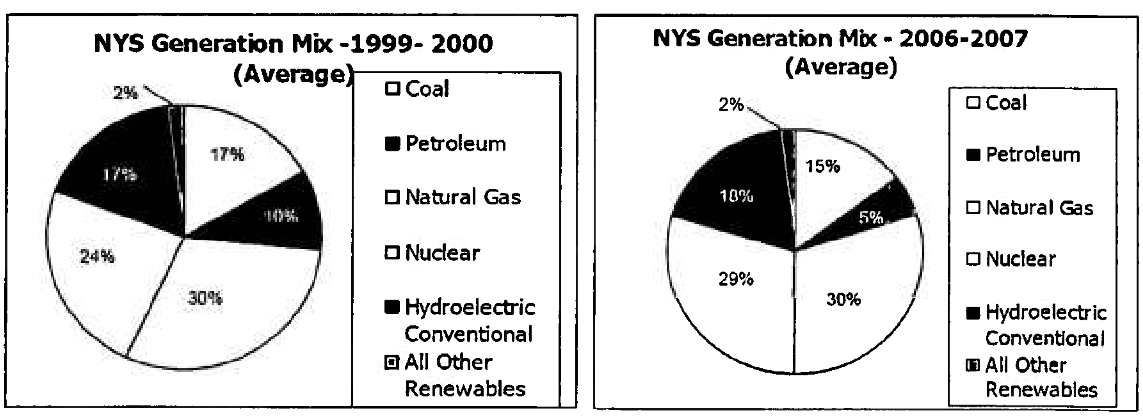
- Diversifying of the sources of supply of a fuel (e.g., pipeline additions and LNG terminals that allow a region to draw natural gas supplies from a variety of gas-supply basins and suppliers)
- Enhancing the ability to rely on fuel substitution (e.g., plug-in hybrid electric vehicles as a replacement for gasoline-powered automobiles, or biofuels to blend into gasoline supplies, or adding dual-fuel capability to a single-fuel power plant)
- Diversifying the array of resources used in a particular sector (e.g., developing a deliberately broad portfolio of power generation technologies that rely on different types of fossil and non-fossil fuels, and distributed and central-station generation systems)
- Relying on a network of infrastructure that allows subregions of a larger area to call upon resources from a neighboring region when a particular action affects one area and not the other (e.g., building a high-voltage transmission overlay system to interconnect various sub-regions, and to allow greater trading and interdependence among the regions)

Perspectives on Fuel Diversity

All electric systems have some inherent attributes of diversity with respect to fuel, and all electric systems end up with a particular mix of generation resources that more or less reflects the technical requirements of satisfying their loads. But this aspect of fuel diversity is not what most of us have in mind when we consider whether or not an electric system is diverse. We take for granted that functional diversity will exist in just about every electric system, and look beyond it to determine whether the system is composed of a diverse — that is, varied, balanced, or robust — set of resources from a fuel mix and/or technology and/or locational perspective.

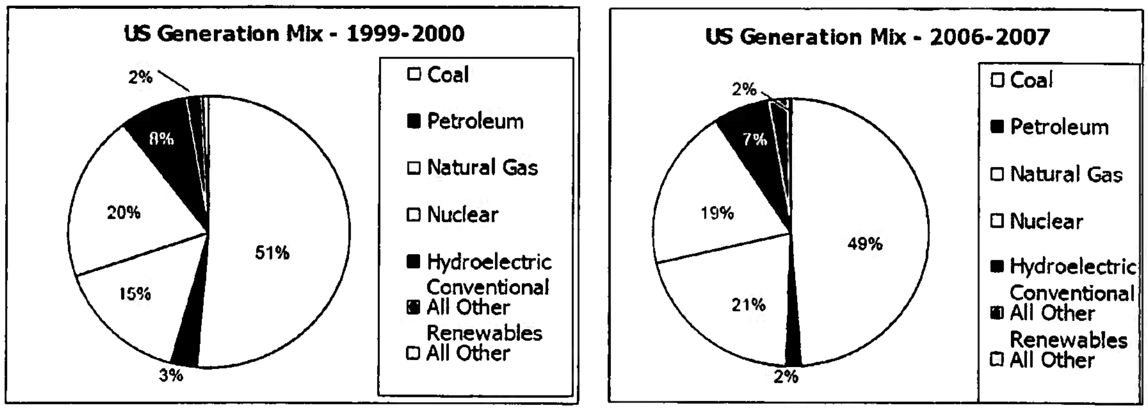
Focusing on these features, what systems do we conventionally think of as being diverse from a fuel, technology, and/or locational point of view? New York's electric system may not be the first that comes to mind, yet from a statewide perspective, its generation mix is relatively diverse. And counter to conventional wisdom, New York State's fuel mix in recent years (2006-2007) is roughly the same as it was at the time the NYISO began administering the wholesale power markets (1999). In 1999-2000, natural gas had the highest share of generation (30%), followed by nuclear (24%), conventional hydro (17%), coal (17%), petroleum (10%), and other renewables (2%). The mix more recently (2006-2007) is roughly the same, with a somewhat smaller share of petroleum (5%) and somewhat larger share of nuclear (29%), but about the same percentage output from natural gas, hydro and coal.

Comparatively, the U.S.'s overall generation mix is less diverse than New York's in both periods, with a much higher percentage of power from coal (with the U.S.'s dependence on coal roughly three times that of New York's), and less power from natural gas, nuclear and conventional hydropower. Using these data to contrast the two power systems, New York's might be considered *more* balanced from a fuel diversity point of view, as summarized in Figures 2-2 and 2-3.



Source: EIA, 902 Electric Generation Data

Figure 2-2: New York State Generation Mix



Source: EIA, 902 Electric Generation Data

Figure 2-3: US Generation Mix

In contrast, the ISO-NE's system, which is well-known for its dependence on natural gas, had 40% of its generation in 2007 fueled by natural gas. While ISO-NE's generation is the least balanced electrical region in the Northeast from a fuel-diversity point of view, its dependence on a single fuel — i.e. natural gas — is relatively moderate as compared to a large fraction of the nation. Some prime examples of generation mixes being highly reliant on a single fuel are:

- Natural Gas: Nevada – 67 %; Alaska – 57 %; California – 55%; Texas – 49%; Louisiana and Oklahoma – 46%; Florida – 45% [6]
- Coal: West Virginia – 98 %; Wyoming – 95 %; Indiana and North Dakota – 94 %; Kentucky – 93 %; Ohio – 86 % [1,7]
- Hydroelectricity: Idaho – 79 %; Washington State – 73 %; Oregon – 62 %
- Nuclear: South Carolina – 51%; Illinois – 48%

The apparent lack of attention being paid to the high dependency of regions on coal, nuclear, or hydroelectric power might reflect that policymakers' and regulators' concerns about fuel diversity are more than offset by economic factors since electricity prices are largely driven by fuel prices. This indicates that policymakers, regulators, and others may be less concerned with fuel diversity *per se* than they are with some other factors, such as the extent to which electricity prices — or, rather, changes in electricity prices — are driven by conditions affecting a particular fuel and/or power plant technology.

Some non-economic factors that might strengthen the case for greater diversity in an electric system are:

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[1] These states are: Maryland (50%); Alabama (54%); Pennsylvania (55%); Michigan (59%); Minnesota (60%); Nebraska (60%); North Carolina (61%); Georgia (62%); Wisconsin (63%); Tennessee (64%); Montana (64%); Delaware (66%); Colorado (68%); Kansas (73%); Iowa (77%); and New Mexico (77%).

- A vulnerability with respect to extreme weather events (e.g., extreme drought causing a shift from significant hydropower to other fuels, or a hurricane disrupting oil and gas production capacity)
- Exposure of existing facilities to public policy measures (e.g., a carbon tax that speeds retirements and/or requires extensive capital outlays)
- A supply portfolio with a high percentage of power produced by a few large generating units that may be exposed to simultaneous outages (e.g., an extended outage of multiple large units at a nuclear generating station)
- A single clearing price market with a single fuel dominating the marginal power production curve in a high percentage of hours and where the dominant marginal fuel (e.g., natural gas) experiences high, volatile and/or increasing prices
- An electrical zone within a larger region in which the zone (a) is constrained in its ability to import power from other generators outside the zone and (b) has one or more of the aforementioned attributes

These examples illustrate that the issues affecting the interactions of generation and electricity prices are not only a function of fuel and/or technology diversity, but also market design, technological developments, locational issues, and other factors. What might seem like a relatively diverse electrical mix during one set of conditions may shift rapidly to looking like a region with fuel and/or other types of diversity challenges.

3. Snapshot of New York's Fuel Diversity by Region

Previously, this paper characterized New York State's overall electric system as being relatively diverse compared to its neighboring control areas and considerably more diverse than most states. No fuel is used to generate more than a third of the state's power;[8] and together, four separate fuels each produce over 15% of the power generation.

The statewide characteristics however are not shared by the regions of New York's power market. There are important differences between the generating capacity, technology and fuel mix, and transmission systems in the upstate and downstate regions. These features have different implications for the economics, reliability and other attributes of power supply for electricity customers in different parts of New York.

As shown in Figure 3-1, there are multiple "zones" in New York's electric system. There are several upstate zones (A-I), the New York City zone (J), and the Long Island zone (K). These zones are interconnected electrically by the high-voltage transmission system. Power can move between the zones to the extent allowed by capacity of the transmission network and electrical conditions in various parts of the system at any point in time. That said, there are significant constraints on the ability of power to move from upstate zones to downstate zones, which is the normal direction of flows on the system.

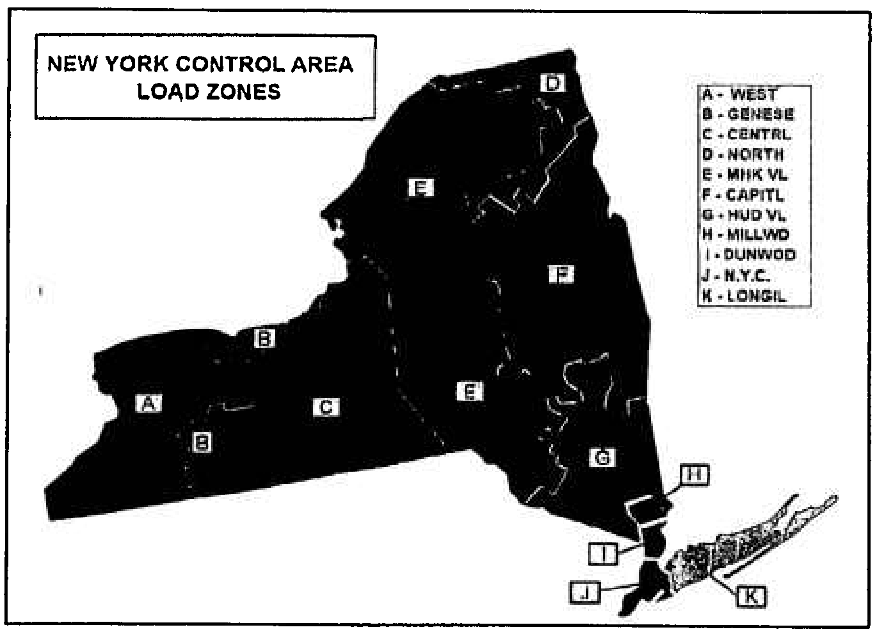


Figure 3-1: New York Control Area Load Zones

These patterns result from well-known realities within the state:

- Most of the population and electrical load is downstate (in the New York City and Long Island zones).
- Much of the state's lower-cost electrical supplies (hydroelectric, wind, relatively efficient gas plants) are located in the upstate zones.
- Typically, the NYISO cannot fully dispatch all low-priced power production facilities in the upstate region to meet downstate loads because of electrical overloading of the transmission system that would occur with the north-to-south flows on the system. As a result, more expensive plants (gas-fired peaking plants, oil plants) located downstate must be turned on to keep the lights on in New York City and Long Island.
- The downstate areas (Zones J and K) tend to be faster growing in terms of electricity use. These are also areas where it has been difficult and expensive to site any types of power plants besides gas-fired power plants. Hence, the heavy reliance on natural gas, exposure to risk of sudden fuel price increases, and considerably higher electricity prices — as compared to the rest of the state. While off-shore wind could be used for renewable generation, developing such projects remains a challenge.
- In contrast, the rest of state (the upstate zones, A-I) has had slower load-growth. Historically, it has been easier to site relatively large and diverse power plants (including hydroelectric, nuclear, coal, and natural gas projects, as shown in Figures 3-2 and 3-3). Some of the upstate areas have significant indigenous resources for power generation (e.g., wind and hydroelectric resources). Electricity prices in the upstate zones are much lower on average than in New York City and Long Island.

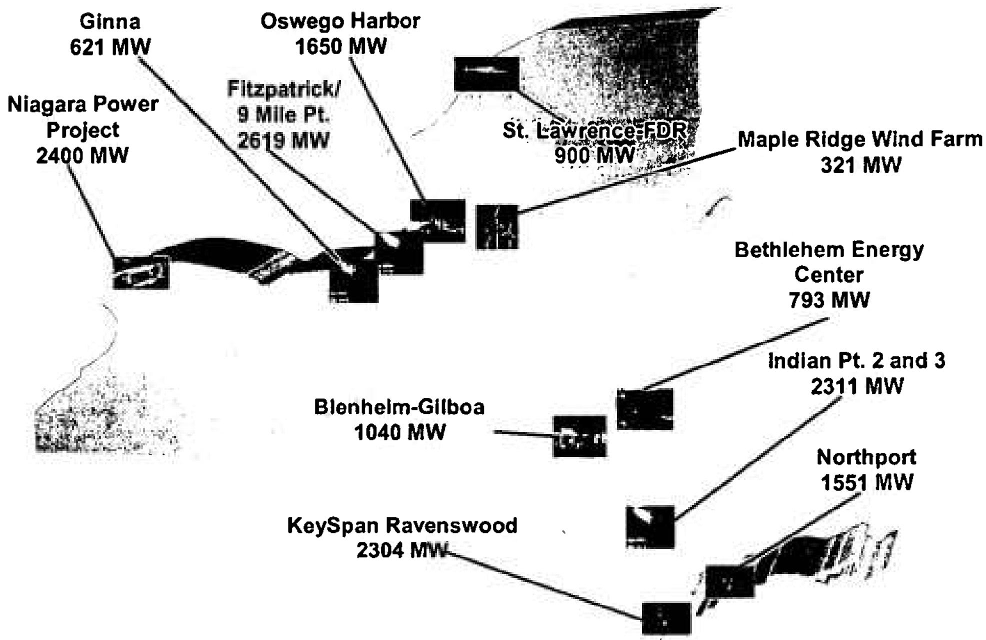


Figure 3-2: Key Generation Facilities in New York State

These differing conditions have significant fuel diversity implications for the upstate and downstate areas of New York. For example, as shown in Figure 3-3, the power plants located in New York City and Long Island are significantly dependent on natural gas and oil. Single-fuel plants using natural gas alone and dual-fuel plants that mainly use natural gas (i.e., dual fuel with air-permit limitations on the amount of generation that can come from oil) make up 95% of New York City's generating capacity and 79% of Long Island's capacity. By contrast, natural gas-only plants make up 15% of the capacity in the rest of New York State, where there are also significant amounts of generating capacity that use lower-cost fuels like nuclear, hydroelectric, and coal.

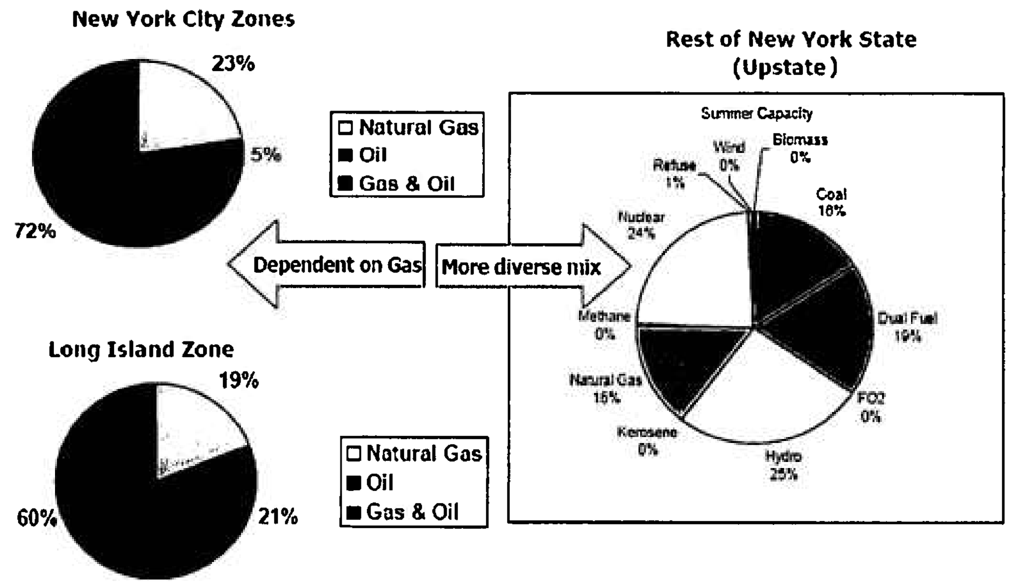


Figure 3-3. Fuel Mix (Capacity) by New York Region

As shown in Figure 3-4, in New York State as a whole, low-cost fuels (i.e., coal or hydro) set the day-ahead clearing price in the wholesale electric energy markets administered by the NYISO in approximately one-sixth of the hours of the year. By contrast, in NYC, in-zone natural gas and oil facilities are setting the price in virtually all of the hours of the year (as shown in Figure 3-5).

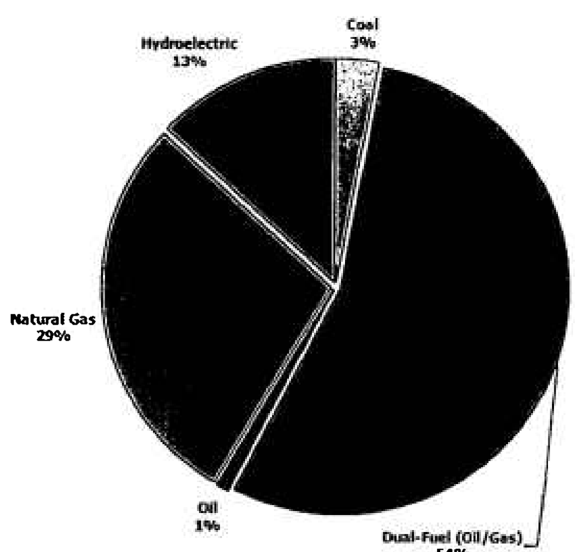


Figure 3-4: Percentage of Hours in Which Energy Clearing Price is Set by Fuel Type – New York (2007)

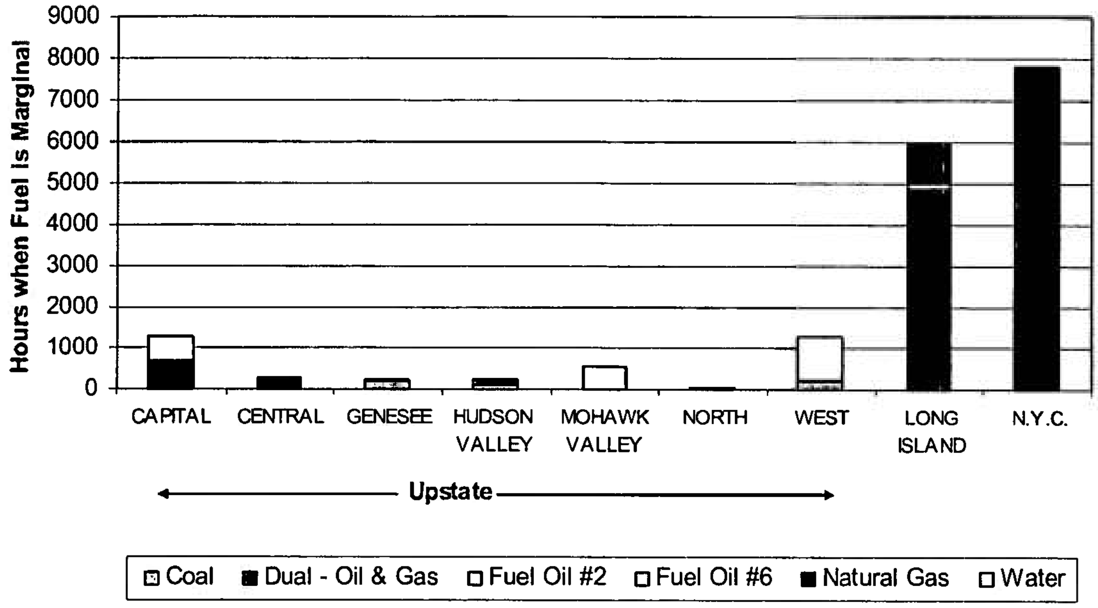
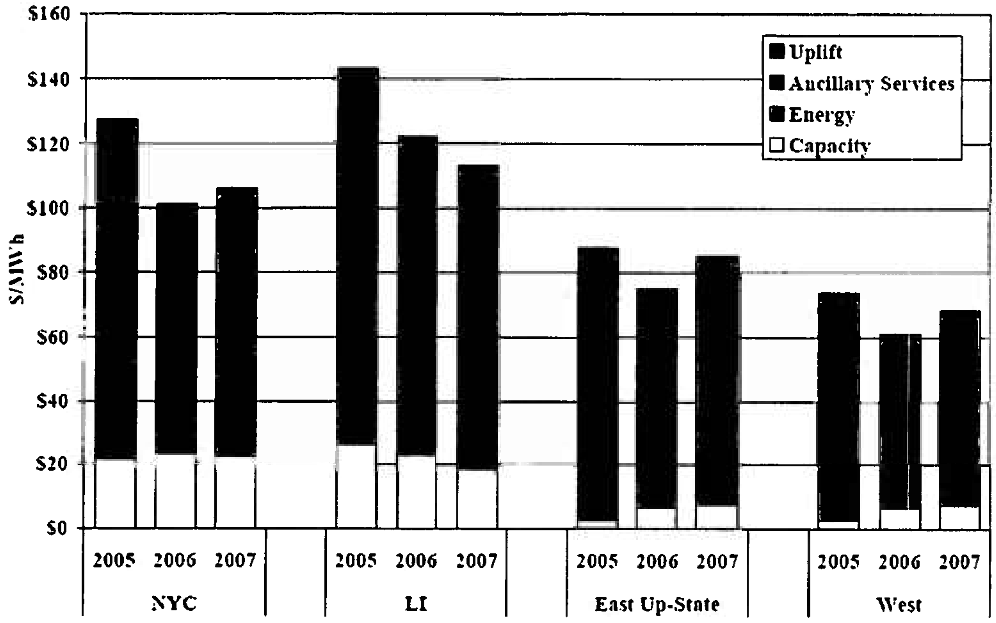


Figure 3-5: Fuel of Marginal Unit by Zone

Transmission constraints prevent "surplus" low-cost power from upstate New York from satisfying demand in downstate areas. That is, while some economic generation that is dispatched in upstate New York goes toward meeting part of the demand in New York City, other low-cost generation cannot be dispatched because transmission lines cannot carry the power downstate. Relatively low-cost power is thus bottled up, and more expensive plants located in the New York City and Long Island zones are needed to meet local loads located in those areas. This keeps wholesale electricity prices higher downstate than upstate. Figure 3-6 below shows the yearly average "all-in" wholesale electricity prices by region in New York State, indicating that prices in New York City and Long Island were higher than in the rest of the state (Eastern Upstate and Western New York)

Notably, relatively new transmission capacity into Long Island — from Connecticut, through the Cross Sound Cable, and from New Jersey through the Neptune cable — has provided some relief, as compared to New York City, in recent years.



Source: "2007 State of the Market Report," NYISO Independent Market Advisor, May 2008.

Figure 3-6: Average All-In Price by Sub-Region of New York – 2005 – 2007

Factors Posing Risks and Affording Resiliency Related to Fuel Diversity

The comparatively limited downstate fuel diversity poses certain risks for the New York City and Long Island areas. For obvious reasons, the wholesale prices in these areas are inextricably tied in the short run to price conditions in the natural gas market. Without changes in the transmission infrastructure allowing power from other fuel technologies to become available to the downstate regions, prices will continue to be shaped by relatively expensive fossil fuels in the downstate area.

As described previously, New York has evaluated the impact of an early shut-down of nuclear capacity at the Indian Point nuclear station north of New York City. The National Academy of Sciences Committee's assessment of the impacts of closing Indian Point concluded that natural-gas fired power plants were the most likely type of generating unit that could be added to replace the nuclear station. Thus, a closure could exacerbate New York City's existing dependence on natural gas for power production.

In spite of these challenges in the near term, there is promise and opportunity for New York to make its electric system more resilient. For example, the New York metropolitan port area has the ability to move energy products in and out of the locality; New York's off-shore wind and tidal resources could be developed, providing some indigenous sources of power; the state's significant municipal solid waste and demolition streams might provide gasified fuel for combustion in power plants.[9]

Finally, New York's state-owned power utility — New York Power Authority (NYPA) — has certain financial and legal capabilities that have enabled the agency to take actions that have met various evolving electricity needs over time in the state.[10]

Implications of New York's Fuel Diversity Profile

Like investment and development patterns in other parts of the U.S., those that have occurred in the electrical infrastructure in New York over the years are outcomes of countless decisions by public and private decision makers. The resulting fuel mix, then, reflects how policy makers and private entities have responded to the conditions, opportunities, and risks and reward structure confronting them.

The resulting blend of fuel mix, delivery structure, and use patterns in New York are given to various risks and/or unanticipated market outcomes, especially those associated with volatile fuel prices.[11]

Given the fact that the operation of New York's electrical system is heavily influenced by market forces and industry structure, this paper studies the options available to address fuel diversity and assesses the implications of taking the steps to achieve it. This paper also examines the variety of ways in which public policy makers and the market in New York has contributed to fuel diversity.

Section 4 of this paper focuses on the types of options that might be available (and in some cases, are being used elsewhere) to address fuel diversity issues in electrical systems. Where appropriate, the discussion will point out where a given approach has been used elsewhere and who might be the right entities to consider whether such an option might be appropriate to pursue. Presumably, since most of these options involve either a change in public policy and/or a change in market rules, the appropriate way to consider them is through stakeholder processes informed by more in-depth analysis of the trade-offs, and potential benefits and costs of adopting one or another strategy.

4. Fuel Diversity Options

In theory, there are many options available to address fuel diversity. Some are more or less intrusive into markets, some are nearer- or longer-term in nature, and some can be more or less well aligned with the structure of wholesale markets in New York. Some of the options focus on allowing greater diversity to withstand reliability effects of supply curtailments, but may address only moderating (if at all) the price impacts of doing so. Many involve trade-offs of one sort or another: Increasing downstate New York's access to some of the more diverse supplies in the upstate area may improve prices and reduce vulnerability of downstate consumers with either no benefits, perceived costs or actual transfers of impacts to the upstate region.

Historical Solutions in New York

Over the years, New York has directly undertaken a number of actions to ensure that New Yorkers have reliable supplies, in the face of potential fuel supply and/or delivery problems. While the list is too long to mention here, there have been a few notable examples in recent years.

For example, in order to address concerns about the impacts of a possible disruption in fuel supply in the New York City and Long Island areas (such as occurred after the 1989 gas line explosion affecting Consolidated Edison's Hellgate power plant), the New York State Reliability Council (NYSRC) has adopted "local reliability rules." They address operational requirements so that the system deals appropriately with "unique circumstances and complexities related to the maintenance of reliable transmission service, and the dire consequences that would result from failure to provide uninterrupted service."[12] Such operating standards, and cost-allocation requirements associated with them, are another way to mitigate the impacts of reliance on single critical fuels – and New York, through actions of the New York State Public Service Commission (NYSPSC) and the NYISO, has responded to the need to address them in the past.[13]

The NYISO has a number of market rules designed to address reliability concerns that might arise as a result of fuel dependency.[14] For example, in recent years steps have been taken to better align the timelines for submission and clearing of the NYISO's day-ahead energy and ancillary service markets, on the one hand, and the scheduling of natural gas into the Northeast, on the other. Similarly, various RTOs in the Northeast, including the NYISO, coordinate and share information about conditions on the natural gas system to help each other respond to abnormal events.

Less directly, but still important, the energy markets have responded to economic conditions in recent years in ways that have resulted in diversifying natural gas supplies and delivery systems into the Northeast. For example, natural gas pipeline companies continue to reinforce the delivery infrastructure into the Northeast in ways that support the resiliency of flows into the region. In the past two years, new pipeline delivery capacity totaling 1.7 billion cubic feet/day was added into the Northeast, with significant plans for further construction activity in upcoming years.[15] Additionally, the Northeast Gateway LNG project, located offshore of Gloucester, MA, went into commercial operation in 2007, along with the pipeline lateral to deliver gas into the Northeast natural gas pipeline system.

Also, while supplies of natural gas from conventional sources in North America have suffered declines in recent years, attention has turned to unconventional supply basins in many parts of North America.[16] One of the interesting prospects for development, for example, is the "Marcellus Shale" basin in the Appalachian region of West Virginia, Pennsylvania and New York — which is closer to Northeast gas demand locations than many other sources of unconventional gas supply. While there are challenges to developing this basin for production, there are indications of market interest, such as recent announcements by several interstate gas transmission companies of their plans to build connections to bring natural gas from the Marcellus Shale basin to the Northeast market.[17]

Together these many delivery and supply projects, along with the Maritimes and Northeast pipeline expansion that deliver gas from the Eastern Canadian provinces into the Northeast gas market, have helped to bolster the availability of supplies available to users in New York.

Short Term Options

In the near term, there is a limited set of options for modifying the fuel-mix profile of downstate New York or for mitigating the risk of price increases. Here are some of the options potentially available to address fuel diversity issues.

Enhance the ability to allow for fuel substitution

One option is adjusting the operating permit conditions for dual-fuel gas facilities located in downstate New York. As shown in Figure 3-3, much of Long Island's and New York City's power plant capacity is made up of units that can only burn natural gas. In the New York City area, the natural gas capacity is 23%, while it is 19% on Long Island. Much larger percentages of the generating fleets in those regions are capable of burning either gas or oil. Moreover, in the New York City area, gas-only power plants set the marginal clearing price in over 40% of the hours (as shown in Figure 3-5); on Long Island, they are on the margin 16% of the time.

Having the ability to switch between two different fuels adds greater operational flexibility for individual generators and for the system as a whole because facilities are less captive to price and/or supply/deliverability conditions in a particular fuel market. In principle, fuel substitution provides hedging against pricing power by suppliers of a fuel that would otherwise be essential to the reliability of the system.

After ISO-NE, for example, found itself in an electricity supply crunch when gas-only generating units sold off or lost their gas supplies during the cold snap of 2004, its grid operators, various market participants, and state energy and environmental officials focused attention on mitigating this risk in the future. After analysis, they adopted the following approaches: relicensing gas-only power plants located in New England so that they would also be capable of running on oil; expanding the size of on-site storage of oil at facilities; extending the number of hours of allowable operations on oil (under a facility's air permit) to enable it to be run during system emergencies called by the grid operator; and requiring power plant owners to retain gas supply for their own use in order to qualify for capacity credits. These actions led to a significant increase (an additional 2,270 MW) in the dual fuel capability of the New England fleet of generators.

In practice, to the extent that natural gas and oil prices are tightly correlated, in times when events in natural gas markets would prompt a desire to switch fuels, steps such as these may have minor benefits — in terms of both economics and reliability. Reliability is critically important in times when a failure to receive deliveries of gas supply into a region could threaten the electric system's ability to keep the lights on. But it may not do much to dampen the effects of fuel price volatility and price increases at those times.

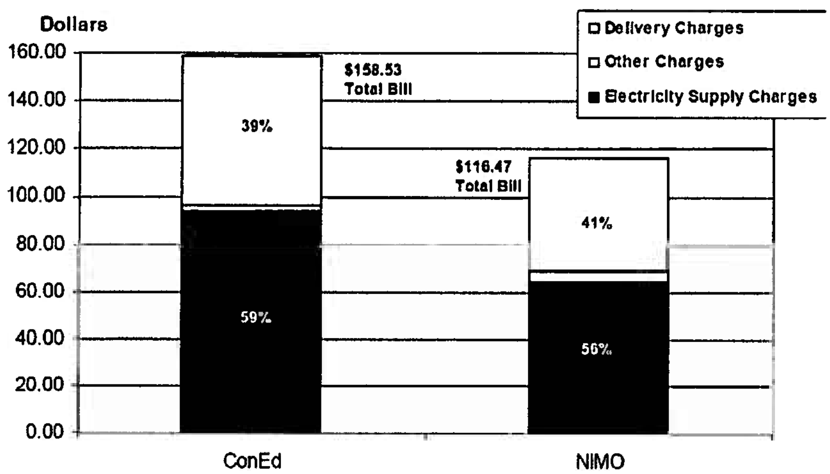
Energy efficiency, other demand-side measures and customer renewable energy

There is already renewed interest in New York in pursuing a variety of programs to induce greater efficiency in electricity use, greater response of demand to changes in supply and price conditions, and greater reliance on efficiency measures on the customer side of the meter.

For example, the Governor of New York State has established a "15x15" energy strategy aimed to achieve a reduction in statewide electricity usage by 15% by 2015. On June 23, 2008, the NYSPSC issued an order formalizing the Energy Efficiency Portfolio Standard (EEPS)[18]. The NYSPSC is requiring the state's investor-owned utilities to collect additional funds from electric and gas consumers to support the deployment of more energy efficiency measures than have been funded in recent years through the state's System Benefit Charge for programs implemented by the New York State Research and Development Administration (NYSERDA).[19] And the NYSPSC has adopted financial incentives to align the utilities' actions with the state's goal for adoption of much more aggressive energy efficiency programs than in the past. The new targets and funding sources are designed to "kick–start" the penetration and savings from efficiency programs.[20] Additionally, the Renewable Energy Task Force to then-Lieutenant Governor Paterson recommended that the state focus increasingly on a number of strategies to support "customer-side applications of solar photovoltaic (PV), solar thermal, sustainable biomass, anaerobic digesters, geothermal, small wind, small hydro (including kinetic power), and fuel cells."[21] Further, in the NYISO-administered demand-response programs, 2,125 MW of demand response capability has been enrolled.[22]

As noted in the documents establishing the value of energy efficiency and demand response programs to consumers in the state, customer-side measures are important in helping them mitigate the price impact of changes in fuel prices. The development of consumer-driven tools and programs makes it possible for consumers to make their own choices with respect to reducing energy use and/or obtaining energy from renewable sources on its own premises. The net result is that customers could have a direct role in mitigating the impact of fuel prices on their electricity bills.

For example, for a residential customer in New York City using 750 kWh per month, the average bill would have been $158.53 in January 2008.[23] (See Figure 4-1, which compares a Consolidated Edison (Con Edison) customer with a Niagara Mohawk customer.) For every kWh the Con Edison residential customer avoided consuming in January 2008 as a result of energy efficiency, the customer would have saved over 19½ cents (12.6 cents/kWh for supply; 6.8 cent/kWh for delivery charges; and 0.2 cents/kWh for other charges). (The comparable amounts for a Niagara Mohawk customer were 13.4 cents/kWh (total), with 8.6 cents/kWh for supply, 4.1 cents/kWh for delivery, and 0.6 cents/kWh for other.) Thus, saving 10% of a bill would have saved a New York City residential customer $15.85 per month (assuming 750 kWh original use and the rates in effect in January 2008). These savings are not insignificant for many households.



Source: New York Department of Public Service, http/www.dps.state.ny.us/typical_bills/util_elec_res_bills_Jan_2008.pdf

Figure 4-1: Total Residential Customer Bill – Con Edison and Niagara Mohawk (@750 kWh/month – January 2008)

That said, the adoption of these programs may not greatly affect the actual prices New York faces in its electric energy markets, at least without seeing energy efficiency, demand response and customer-side renewable applications greatly reduce demand in a large number of hours of the year. Since gas or dual-fuel oil/gas capacity is the marginal fuel in almost 90% of the hours of the year in the New York City area, then the addition of demand-side resources are unlikely to have a significant effect on de-linking electricity clearing prices from natural gas, even though such resources may provide value to consumers in the form of lower electricity bills (from lower power use). Unless demand-side measures dig quite deeply into the load curve in periods when the marginal fuel can shift away from gas, this particular approach does not particularly address fuel diversity issues *per se*.

Bring non-gas resources into downstate New York –strategies to expand transfer capacity from north to south

The principal factor that splits New York State into two separate upstate and downstate electrical areas is the limitation on the ability of the high-voltage transmission system to transfer power produced upstate to loads in the downstate (New York City and

Long Island) areas. Currently, the transmission system is rated higher than its actual ability to move power to Load Zones I-K (New York City metropolitan area and Long Island), due to a variety of reliability constraints that require the NYISO to operate the system below its full capability. Were these operating limitations able to be modified so that more low-cost power supplies could be dispatched in upstate New York for downstate customer requirements, then the NYISO would be able to forego dispatching some of the more expensive power generators located in downstate zones. In turn, this would have the potential to reduce locational marginal prices for electrical energy downstate, as the NYISO could avoid dispatching less efficient generators with higher energy bid prices.

The NYISO has analyzed the cost and benefits of having various hardware measures, such as capacitor banks in key locations, installed by market participants so as to enable the grid operator to move more power over the north-to-south transmission grid. According to a recent NYISO study, an investment of $80 million in capacitor banks could increase power flows and lower line losses, amounting to approximately $60 million per year in wholesale energy savings for the state's system as a whole. Measures like this have the ability to moderate the downstate region's lack of fuel diversity and its exposure to high and volatile natural gas prices.

Enhance hedging strategies and practices

Since one of the principal consequences of downstate New York's dependence on natural gas is the risk of fuel price volatility and price increases, one way to mitigate the impact of this lack of fuel diversity is to ensure that there is an efficient and optimal amount of hedging being carried out by electricity providers.

New York is a state with retail choice; so, many customers and competitive retail suppliers are making their own arrangements for commodity supply and pricing. This is reflected in the fact that, as of December 2007, almost nine out of ten large customer accounts (and 95% of their load) on Con Edison's time-of-use rates had "migrated" away from basic service provided by Con Edison, with 20% of medium commercial and industrial customers having migrated (with 47.5% of their load).[24] By contrast, just under 15% of residential customers and loads had migrated away to competitive retail suppliers.[25] This means that Con Edison was in the position of arranging and providing electricity for about five out of every six residential customers, and about four out of five medium-sized non-residential customers. As such, Con Edison — like other investor-owned utilities with responsibility to arrange commodity supply for its non-migrating customers — is responsible for any and all hedging activities, subject to oversight from the NYSPSC.

In 2007, the NYSPSC issued an order[26] (the "Supply Portfolio Order") which found that most mass market customers generally find beneficial the restraints on electric commodity price volatility that utilities are able to achieve, because those customers are generally risk-averse. The NYSPSC's Supply Portfolio Order therefore required utilities to set standards for measuring volatility, and to set goals for constraining price volatility "to levels that are acceptable." The NYSPSC decided "that electric utilities should engage in hedging practices intended to reduce the volatility of the commodity prices they charge customers electing to take commodity supply from them instead of from alternative providers. The Supply Portfolio Order also requires electric utilities to participate in collaborative discussions for the purpose of developing electric price volatility metrics; establish goals for reducing volatility as measured by those metrics; and recommend requirements for reporting electric utility supply price information."[27]

In this and prior orders, the NYSPSC actively involved stakeholders in commenting on the question of the extent to which utilities should undertake hedging strategies on a voluntary or mandatory basis. As recently as December 2007, the NYSPSC determined that it would continue to "encourage the use of voluntary forward contracts of all durations by all parties, together with all other instruments legitimately used in any competitive market. If the wholesale markets have a reasonable balance of spot purchases together with short-, medium-, and long-term contracts, retail price volatility and the opportunities to exercise market power at the wholesale level could be reduced, as could the investment risks of both new and existing generation."[28]

New York is continuing to examine the appropriateness of the role of hedging in commodity supply to basic service customers in the state, as one of the important ways in which electricity providers can address and mitigate the impacts of fuel dependence in the state.

Emergency actions

There are examples in other regions where disruptions in fuel supply or delivery or unexpected outages of power plants critical to system reliability have led to an array of emergency actions being taken by public officials, utilities and grid operators. During such events in recent years the grid operator and other players took steps to heighten large and small customers' awareness of reliability challenges and to encourage voluntary and aggressive energy conservation. Additionally, steps were taken to move into the region mobile generators and other emergency equipment to assure that the lights would stay on.

The industry has a long and effective history of instituting procedures outlining actions to take in the event of a capacity or energy emergency. These steps involve long-standing agreements among utilities to assist each other in restoring service and other forms of aid in the event of emergencies. Such actions were widespread, for example, when utility crews from all around the East Coast traveled to the Gulf Coast areas to assist in restoring power and other energy services in the wake of Hurricanes Katrina and Rita, and after Hurricane Ike hit parts of Texas in 2008. The outages caused by the effects of these natural disasters were massive and lengthy. Moreover, the nation's dependence on natural gas and oil supplies emanating from the Gulf States did have impacts on various energy markets affected by price increases caused by lack of production in the aftermath of the hurricanes.

There are examples in the industry of how a system has responded in the face of extraordinary electricity supply shortages and price increases. The actions taken during the "California electricity crisis," over the period from the summer of 2000 through late 2001, are examples of what grid operators, utilities and state officials can do on an emergency basis to address rising prices and looming power shortages over some sustained period of time. Starting in the spring of 2000, the California ISO (CAISO) instituted its "Power Alert" program, with a series of mechanisms to provide cues to the public about the real-time operating conditions of the grid. Over the course of the next year and a half, as a "perfect storm" of conditions collided to raise prices and tighten electricity supplies, CAISO, the utilities, the state and others adopted measures that included: instituting new siting procedures to expedite the consideration and approvals of new power plant projects; implementing aggressive energy efficiency programs; issuing urgent appeals for conservation; and redesigning the retail price of electricity so that customers would pay dramatically higher marginal prices if their usage levels were above some "basic service" threshold established by the public utility commission. The point of this brief discussion is primarily to highlight the role crises play in shaping market rules and policies.

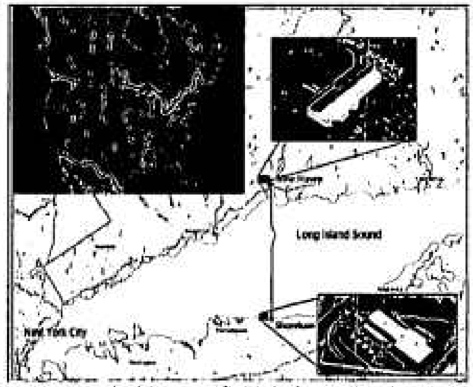
One thing to note when considering how emergency responses could be deployed in the event of a crisis: A fundamental plank of most emergency programs to deal with capacity or energy shortages, or periods of volatile or high prices, is to issue calls to the public for voluntary conservation. As the region proceeds to implement more and more energy efficiency over time and becomes more reliant on a routine and systematic basis on demand-side strategies (e.g., price-responsive demand and demand-response programs, whether run by the NYISO or others), it will be important for grid operators, utilities and the government to gauge how much incremental reduction in load can be counted on in an emergency.

Longer Term Options

Some of the strategies described above — energy efficiency and demand-side measures, hedging approaches, and fuel-substitution measures — are also applicable to the longer term as well. But an additional set of tools may present themselves for consideration if the time line is many years into the future.

Incentives for investment in transmission into downstate New York

As described above, one principal way to diversify the fuel mix of the New York City and Long Island areas would be to enhance the capacity of the transmission system to move in power from other areas. Two examples of recent steps taken by merchant transmission developers to do just that are the Cross Sound Cable, connecting Long Island to Connecticut which entered service in 2003, and the Neptune Cable, connecting Long Island to New Jersey, which entered service in 2007. (Interestingly, disputes over environmental impacts of the Cross Sound Cable kept it from going into operation upon completion of construction; it was only after reliability concerns following the Northeast Blackout of 2003 that the facility was allowed to enter into operation.[29]) The locations of the Neptune Cable and the Cross Sound Cable are shown below in Figures 4-2 and 4-3.



Source : http ://www.neptunerts.com/, http ://www.crosssoundcable.com/CableInfonew.html, http://www.lipower.org/company/powering/neptune.html

Figure 4-2: Neptune Cable
Sayerville, NJ to Newbridge, NY

Figure 4-3: Cross Sound Cable
Shoreham, NY to New Haven, CT

The NYISO has an active planning process to examine reliability and economic upgrades to the transmission system. The most recent addition to the NYISO's Comprehensive Reliability Planning Process (CRP Process) is the Congestion Assessment and Resource Integration Study (CARIS) process to examine the benefits and costs to the system of economic upgrades to the transmission system. Given the market rules and industry structure in the state's electric system, there is a strong preference for looking for market-based means to add transmission (or generation or demand-side solutions), with the NYISO providing information to market participants about the trade-offs (in terms of congestion impacts, reliability improvements, production cost savings, and other impacts) associated with transmission capacity additions in various locations on the grid.

Additionally, New York State has begun a new round of state-wide energy planning that will certainly inform decisions in the future by potential investors in electric infrastructure, including NYPA.

One of the approaches being used in New York to diversity its fuel mix (and address economic and environmental issues at the same time) is to facilitate the development of wind resources located in the state. Figure 4-4 shows the existing and proposed wind projects in New York State by county.

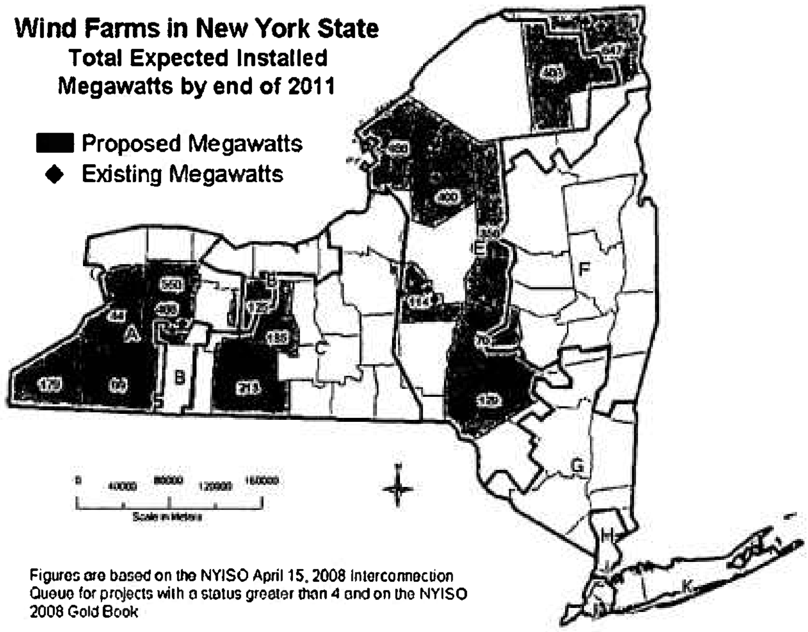


Figure 4-4: Wind Farms in New York State

New York is third among the states in wind capacity under construction. As of June 30, 2008, only Texas and Iowa had more wind capacity under construction.[30] At that time, New York State had 706.8 MW of wind power, with 588.5 MW more under construction. And, as shown in Figure 4-4, above, thousands more MWs of wind capacity have been proposed in the state.

Wind projects support fuel diversity in New York's power market, since most other new generating capacity added in the past decade and currently proposed is from power plants that use natural gas – a fossil fuel whose price has tripled since 2000. The price of wind remains the same over the same period: zero cents per kWh.

As indicated in Figure 4-4, most of the wind developments are in the upstate area. Therefore, without enhancements to the transmission grid in the state that will allow greater transfers of power from north to south, the wind resources may do little to reduce energy prices and diversify the downstate mix. Moreover, without transmission enhancements enabling greater delivery of wind, wind turbines may be required to dispatch down even when the wind is blowing because the grid would otherwise become overloaded with too much power for the local region to absorb.[31]

Like New York, other regions are actively engaged in analyzing the interactions between transmission expansion plans and the development of renewable resources and exploring ways to enhance incentives for transmission investment for moving renewable power. One example is the "Joint Coordinated System Plan," being prepared by various regional transmission organizations and other transmission providers in the Eastern Interconnection: NYISO, PJM, ISO-NE, MAPP, MISO, and TVA. This long-term, interregional planning initiative is examining the implications for transmission of a nationwide 20-percent renewables mandate by 2024.[32]

Among the various issues that must be addressed is how best to analyze benefits and costs of "strategic" investments in transmission, designed for strategic purposes such as supporting wind development for fuel diversity, environmental and energy security reasons. A recent analysis[33] by Lawrence Berkeley National Laboratory (LBNL)[34] for California's Public Interest Energy Research (PIER) program observed that our tools for analyzing strategic transmission investments may need to evolve in order to capture fully the benefits of facilities providing not only the traditional transmission system functionalities (e.g., helping to meet reliability standards, lowering costs of congestion and losses, enabling inter-regional trading), but also indirect strategic benefits and "insurance" benefits (including such things as renewable resource development and integration, fuel diversity, emissions reduction, market power mitigation, insurance against contingencies, hedging against market volatility, and insurance against extreme event impacts). The study encourages broadening the array of variables examined to include certain impacts beyond those internalized in electricity markets alone.[35]

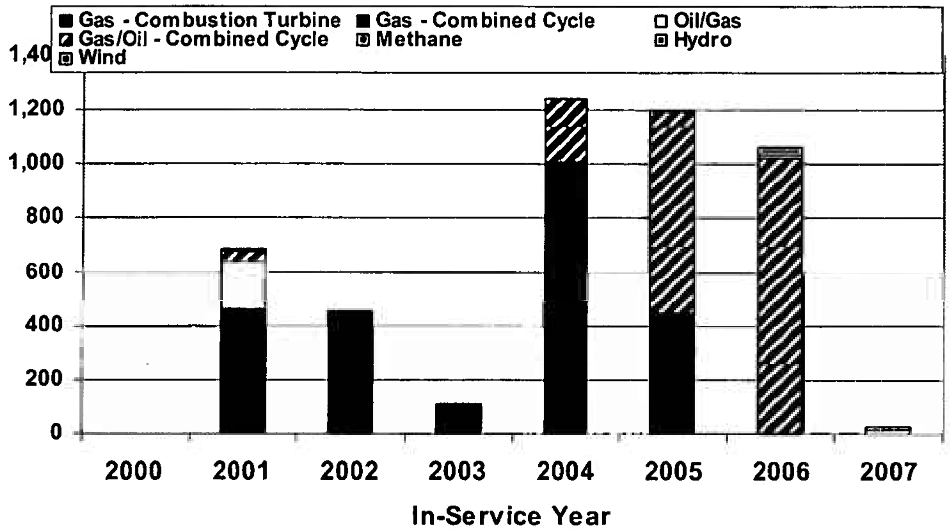
Other incentives for investment in non-gas-fired power generation facilities

The work underway in New York to stimulate further development of wind resources (described briefly above) is aimed, among other things, at diversifying the fuel mix in the state. The wind capacity additions are notable for the fact that they are different than the typical generating capacity additions built in New York in recent years. Since the NYISO opened its markets in 1999, much generating capacity has been added, but as shown in Figure 4-5, most of it has been gas-fired generating capacity. While generation has been successfully located in relatively close proximity to load (in part in response to signals from the market design in New York), it has nonetheless been the case that virtually all new generating capacity (besides recent wind projects) consists of plants that burn natural gas.

Were New York to decide that it valued other types of generating resources besides natural gas (and wind), state policy could be adjusted accordingly. These adjustments might include:

- Establishing a "fuel diversity portfolio standard"
- Implementing measures (such as special purpose zones) to facilitate the siting of facilities other than natural gas
- Assisting with long-term contracting for capital-intensive facilities

Some of these, such as the latter, are indirectly the subject of the New York NYSPSC's Supply Portfolio Order, discussed previously. Others are the object of continued stakeholder appeals (e.g., the need for New York to reinstate its Article X power plant siting process). That said, many observers note that even were such policies to be adopted by the state, it may remain difficult — if not impossible — politically to site and construct any conventional central-station power plants in the downstate area that use any fuel besides natural gas.



Data include capacity additions through March 2008. Source: NYISO Generator List, 2008[2]

Figure 4-5: Power Plant Capacity Added in New York (since 1999)
(MW – summer capacity)

The "energy zone" concept is what has been used to support the development of energy resources that are bound to a particular location (such as wind), and which benefit from particular planning studies designed to focus on impediments to resource development. In theory, this latter concept could be used to analyze the potential for development of other types of electric generating facilities — such as those that might use as their fuel a portion of the municipal waste streams and demolition debris (to be gasified, for example, rather than incinerated) from locations in urbanized areas of downstate New York. These other "fuel zones" might be a way to organize analyses and focus attention on issues that need to be addressed to stimulate the development of additional, non-natural-gas-fired facilities in the downstate area.

The "fuel diversity standard" is a notion borrowed directly from the conceptual underpinnings of the state's "Renewable Portfolio Standard" (RPS). New York, like almost half of the states in the U.S.,[3] [36] has an RPS — a state policy requirement that electricity providers obtain a certain percentage of their power from eligible renewable resources. New York's RPS allows support for the following eligible renewable and other resources: photovoltaics (solar), landfill gas, wind, biomass, hydroelectric, fuel cells, anaerobic digestion, tidal energy, wave energy, ocean thermal, ethanol, methanol,

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[2] Available at www.nyiso.com/public/webdocs/services/planning/planning_data_reference_documents/2008_NYCA_Generators.xls

[3] Currently there are 24 states plus the District of Columbia that have RPS policies in place. These represent more than half of the electricity sales in the United States.

and biodiesel.[37] This policy is a market-based mechanism to support demand for renewable power. Renewable attributes of power produced by such projects become a commodity capable of being unbundled from the "regular" electric energy and capacity related products associated with a particular plant. The producer of energy from qualifying facilities creates a "renewable energy credit" for every unit of electric energy produced by the facility. The facility can fully and efficiently participate in "regular" ISO-administered energy markets, and when dispatched can produce renewable energy credits, which can be bought and sold together with or separately from the underlying power production itself. This would provide an incremental revenue stream to support investment in and operation of the facility.

While this approach has been primarily for renewable resource procurement and development, there are some examples where it has been used for other energy resources as well. Pennsylvania, for example, has an "Alternative Energy Portfolio Standard," for which not only renewables but also other resources such as municipal solid waste, cogeneration, waste coal, coal mine methane, coal gasification, anaerobic digestion, and other distributed generation technologies are eligible.[38]

If a state determined that it was in the public interest to support development of a particular type of electric resource (besides renewables) that was not otherwise coming forth from the decisions of private investors in the power market, the "portfolio standard" might be an approach to use to encourage development. This could be more compatible with the market designs that exist in New York's wholesale and retail electricity markets. As described in a prior white paper (by Tierney) prepared for the NYISO:

> "In theory, this approach could be applicable to other types of attributes that are currently undervalued in current markets (e.g., fuel diversity). Demand for the attribute of interest could be created through state-imposed content-requirement mandates (such as those established for renewable attributes by Renewable Portfolio Standards), or through other means (e.g., through the centralized purchase of attribute credits by a centralized entity with funding provided to do so). Continuing the analogy to renewable energy credit markets, some states impose the requirement on all load-serving entities to procure through decentralized markets the requisite amount of attribute credits; in other states, a central purchasing agent issues requests-for-proposals for attribute credits, that are paid for by a source of funding available to the centralized purchasing agent (i.e., New York State Energy Research and Development Authority in New York State). Suppliers of the attribute are still expected to participate in the region's regular energy markets, as all other producers of power are required to do.[39]"

Incentives for investment in fuel deliverability and storage

Similarly, the state may want to put in place incentives for improving the reliability of fuel delivery and storage. If one of the problems experienced in regions dependent on particular fuels is that they fall prey to economic, technical or strategic disruptions in the fuel distribution networks, then one way to mitigate this impact is to reinforce the strength of the delivery systems themselves. This reinforcement can come in the form of creating incentives for stronger commitments between the buyer of the fuel and its transporter. For example, New England does not permit generators that seek to qualify for payments in the capacity market to take an "economic outage" in that same capacity period. (An economic outage is one where a generator requests to be allowed to be out of service for purely economic reasons associated with fuel market conditions.)

There are other ways to shore up supplies and transportation of fuels. Some states require a demonstration by certain regulated energy entities (typically gas distribution utilities) that they have firm transportation and storage arrangements for fuel delivery during the winter heating season at a sufficient level to meet requirements during "design winter" conditions. In theory, state policy could address delivery arrangements for other types of energy entities if the state considered this a matter of high public interest and worth the costs that would be imposed on consumers through the markets for power and other energy resources.

Additionally, a state could support and/or facilitate the siting and development of other local fuel delivery or storage infrastructure, such as natural gas pipelines, satellite or centralized storage facilities for LNG or petroleum, and centralized terminals for gasification and liquefaction of LNG. While there are potential issues of federal/state jurisdiction over the siting of some of these facilities, it is nonetheless possible for a state to decide it wanted to support the development of such local infrastructure in particular locales or sites, if it determined that there was a compelling state interest in doing so. (Note here again that in recent years, several new interstate natural gas infrastructure projects have been completed in New York State and neighboring regions that support the interstate pipeline system's deliveries into New York State.[4],[40])

Policy information and advocacy

There are several additional options through which New York could assist in addressing fuel diversity. One would be to take an active position on national policies affecting energy resource availability or cost to the state.

For example, when discussions begin to become more active in Washington, D.C. with regard to the shape of the national carbon-control program, an important issue that will affect the comparative impacts on New York State energy consumers will be the design of the greenhouse gas emissions allowances program. New York State has already stepped into the policy arena on greenhouse gases through its participation in the Regional Greenhouse Gas Initiative (RGGI) which will require certain generators in New York and other states in the Northeast to begin to control their emissions of carbon. For example, the ways in which the national program might intersect and interact with RGGI (e.g., through the possibility of federal preemption, through overlays of state and federal programs), and allocate allowances to generators based on historical emissions of carbon, will directly impact New York's electric industry participants (especially consumers.) But the national policy will likely also have indirect impacts as well, given the potential impact on electricity prices in neighboring states.

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[4] Among the natural gas pipeline projects listed as completed in 2007 by the EIA are: Tenneco's Northeast ConneXion compression project, and Transco's Leidy-to-Long Island Expansion project.

Another option for policy advocacy, adoption and implementation would be to support particular directions in energy research — either directly, through the NYSERDA research program, or more indirectly, through cooperation and advocacy before other energy research and development organizations. This could include the U.S. Department of Energy, its national laboratories (one of which, Brookhaven, is located within New York State), the Electric Power Research Institute, and other research and development forums. There are important options that may affect New York's interests in fuel and technology diversity that may be advanced by the direction of research programs in the future.

Another option for New York's future fuel and technology diversity path is to support the development of certain "game-changing" or disruptive technologies. Prime examples are plug-in hybrid electric vehicles (PHEV). They not only plug into the grid to draw power to fuel a battery, but also are capable of reversing the flow of power from the vehicle to the grid, so that the vehicle becomes a micro distributed generator. This is a technology about which much has been written in recent years, but which still will require substantial analysis and information to explore the manner in which such vehicles integrate with the power system.[41],[42]

Finally, there are myriad ways in which the evolution of a "smart grid" system in New York State might affect the impacts on consumers of the state's dependency of single fuels. This is a topic of enormous breadth, with possible implications ranging from enabling customers to better manage their own electricity use in the face of price signals and other information from the market, to integration of new technologies (such as PHEV) with the potential to reshape the nature of electricity demand, storage, delivery and supply in untold ways.

5. Conclusion

While there is no industry standard for determining what exactly constitutes "fuel diversity" in comparison to most states the electric supply fuel mix in New York State can be called diverse. The New York electric utility system relies on supply from numerous fuel sources, including water, wind, nuclear and natural gas, as well as interconnections with its neighbors and demand-response resources to meet the needs of the 19 million residents in the state.

The New York fuel diversity picture changes when viewed from an upstate vs. downstate perspective. In this context the diversity of the upstate region is much greater than that of the downstate region where except for the Indian Point nuclear plant the fuel mix is dominated by natural gas and dual fuel (gas and oil) powered generators. This relative lack of downstate diversity is partially mitigated by transmission connecting the downstate region to the more diverse upstate region of New York. The ability of the existing transmission system to transfer power from north to south has limits, and the continued growth in downstate demand for electricity will mainly rely on natural gas and oil fueled local resources until the transmission system is expanded or unless the right incentives are in place attract alternate resources. These local solutions could include more demand response, energy efficiency, new technologies that can optimize the existing transmission infrastructure and alternate fuel sources such as renewable energy and LNG.

Maintaining and improving fuel diversity in New York will likely to lead to less volatile electric prices, improved reliability and positive environmental impacts. It is essential that public policy makers and the NYISO confront the risks that are posed by inadequate fuel diversity. Market forces should be harnessed and planning principles should be utilized to encourage signals that will lead to support for the protocols and technologies necessary to move New York towards an optimum fuel diversity profile.

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