New England States Committee on Electricity

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2011 RTO Metrics Report: NESCOE Data Summary

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ABSTRACT

Summary of comparative data across RTOS on selected metrics that may be of interest to New England

Introduction and Approach to Data Review

Background: The RTO Metrics Report originated with a review undertaken by the United States Government Accountability Office in 2008 at the request of the U.S. Senate Committee on Homeland Security and Governmental Affairs. To more effectively analyze ISO/RTO benefits and performance, the Government Accountability Office recommended that the FERC work with ISOs/RTOs, stakeholders and other interested parties to standardize measures that track the performance of ISO/RTO operations and markets, and to report the performance results to Congress and the public. The first Report released in December 2010 reflected data gathered in 2009. This is a summary of the second report produced in December of 2011 with data gathered and reported on in 2010.

The RTO Metrics Report provides information on various data points that are common to each of the transmission system operators, and was prepared at FERC's direction.[1] FERC held meetings with industry stakeholders for their input and established an open comment period on the proposed metrics. ISOs and RTOs compiled information and tracked certain data points relevant to performance in the areas of reliability, wholesale electricity market performance and organizational effectiveness.

A copy of the 2011 RTO/ISO Metrics Report is available at this link:
http://www.nyiso.com/public/webdocs/documents/regulatory/filings/2011/08/RTOs_ISOs_2011_Performance_Metrics_08_31_11.pdf

Data Summary Approach and Context: This data summary endeavors to present some comparative data across RTOs on some of the metrics that may be of interest to New England.[2] However, it is important to be mindful when considering such comparisons that RTO-specific processes and context are central to the data and thus, to any comparisons. Viewing the data outside of the context of each RTO may tell an incomplete story. The RTO to RTO comparisons presented in this memo are not intended to draw conclusions about ISO-NE performance but rather to help identify areas that may be worth exploring with ISO-NE. Over the long term RTO to RTO comparisons may be helpful to help identify best practices.[3]

The text passages in this memo are excerpts from the RTO Metrics Report that may be of interest; observations are presented in *italics*.

This memo provides data in the following subject matters: RTO Functions; Wholesale Power Markets; Price Convergence; Fuel Diversity; Wind Forecast Accuracy; Demand Response. The RTO Metrics Report contains data and observations from other market areas not addressed in this memo.

North American Electric Reliability Corporation: RTO Functional Models

The six RTO/ISOs differ in the components of the electricity markets they operate. The chart below describes the aspects each RTO controls. Data and information provided in this memo may vary based on the operations under management of each RTO.

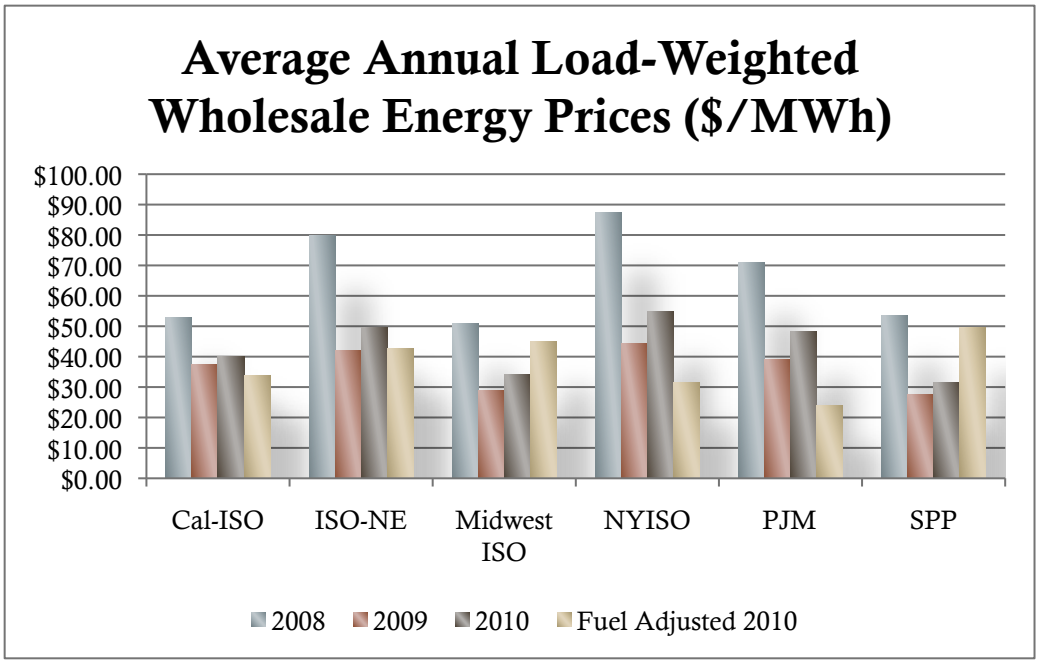
[1] The RTO Report may be accessed at this link: http://www.isorto.org/atf/cf/%7B5B4E85C6-7EAC-40A0-8DC3-003829518EBD%7D/2010%20ISO-RTO%20Metrics%20Report.pdf
[2] The RTO Report does not present RTO to RTO comparisons.
[3] The data in the 2011 RTO Report is consistent with that in the 2010 RTO Report. Changes to RTO metrics may be made in future years.

NERC Functional Models						
	Cal-ISO	ISO-NE	Midwest ISO	NYISO	PJM	SPP
Balancing Authority	x	x	x	x	x	
Interchange Authority		x	x	x	x	x
Planning Authority	x	x	x	x	x	x
Reliability Coordinator		x	x	x	x	x
Resource Planner		x		x	x	
Transmission Operator	x	x		x	x	
Transmission Planner		x		x	x	x
Transmission Service	x	x	x	x	x	x

Wholesale Power Markets

The average cost of electricity increased across every RTO in 2010. New England, New York and PJM saw the largest increase at around $10/MWh in each region. However, considering that in 2009 these regions saw steep price drops (nearly 50% from 2008) a slight increase is still well below 2008 prices.

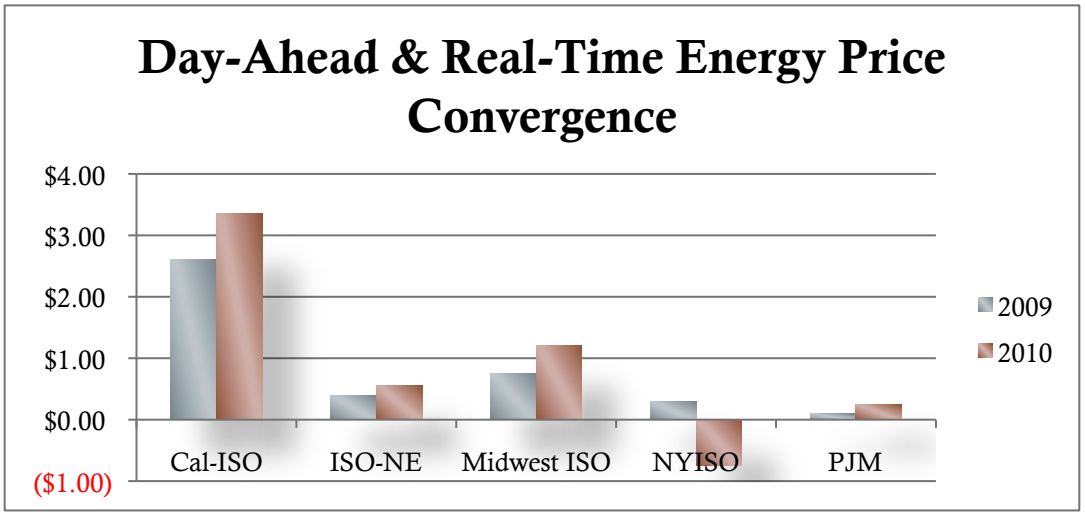
In New England the yearly average real-time LMP has trended downward for the past five years. Historically natural gas prices have influenced the LMP. In 2008 gas prices increased and drove prices up for on-peak hours. As a result the highest yearly average Hub LMP was $80.79/MWh, nearly twice as high as the 2009 price at $41.99/MWh. In 2010 the yearly average Hub LMP rose to $49.51/MWh. The same trend toward variability according to the price of gas followed in New York. NYISO points out that the annual average real-time wholesale energy prices have remained essentially flat over the past five years, once adjusted for the variation in natural gas prices. In 2010, average annual load-weighted energy prices rose to $54.83/MWh from the ten-year low price of $48.63/MWh set in 2009.



Price Convergence

Good price convergence with the real-time market helps ensure efficient day-ahead commitments that reflect real-time operating needs. Better convergence is indicated by a smaller dollar spread. Differences between ISO/RTO regions can be driven by several factors including differences in transmission congestion, market rules, virtual market participation and concentration of intermittent resources. In 2010, NYISO saw many more days than in

prior years (primarily during the summer) when Real-Time prices were substantially above the Day-Ahead prices and that caused a negative Energy Market Price Convergence metric.



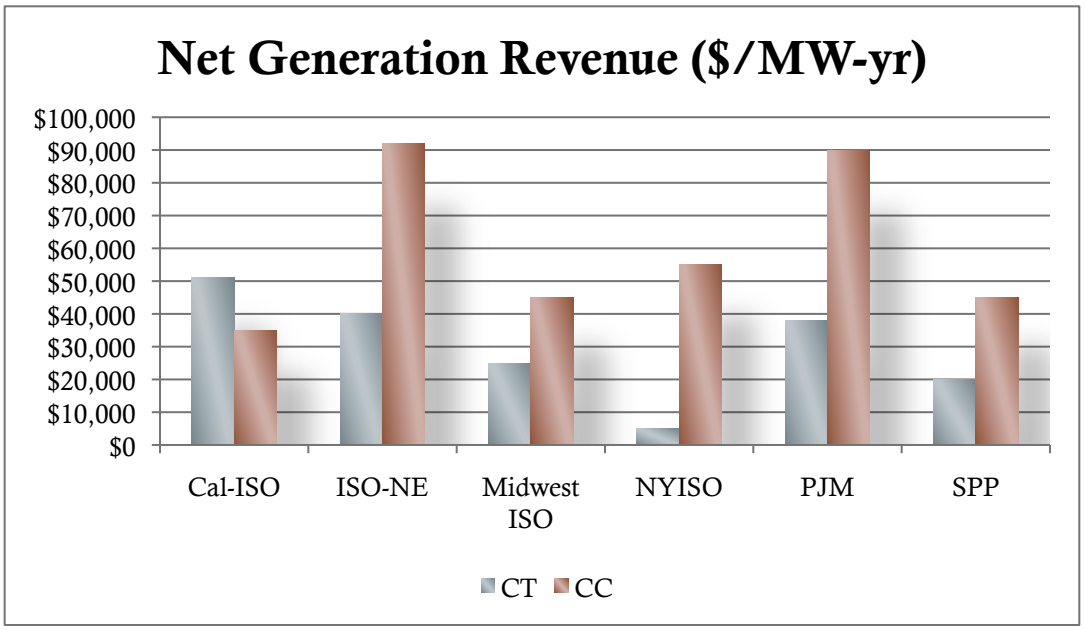
Net Generation Revenue

When compared to total fixed costs, net revenue is an indicator of generation investment profitability and thus is a measure of overall market performance as well as a measure of the incentive to invest in new generation and in existing generation to serve ISO/RTO markets. Net revenue quantifies the contribution to total fixed costs received by generators from all markets in an ISO/RTO.

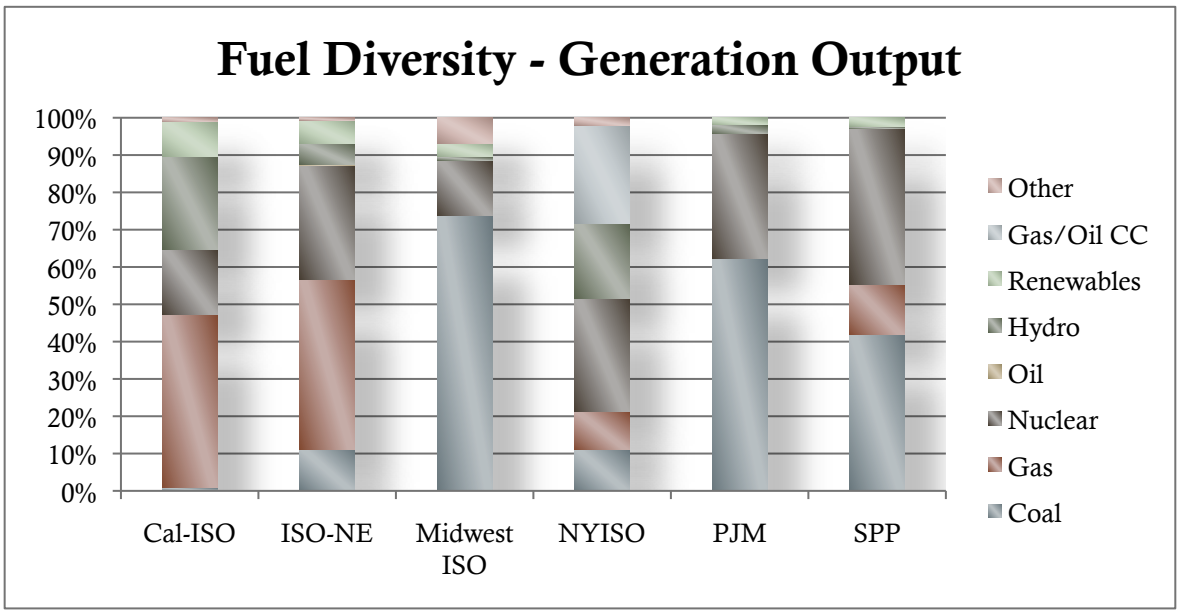
In 2010, net revenues for a typical new combined cycle unit increased compared to 2009 net revenues. Net Generation revenues trended upward from 2009 in ISO-NE and PJM, while staying relatively flat in Cal-ISO, NYISO, MISO, and SPP.

In 2009, net revenue estimates for a hypothetical combined cycle unit in California fell substantially below the $191/kW-yr annualized fixed cost estimated provided by the California Energy Commission. The decrease in spot market gas market prices and the resulting decrease in electric prices contribute to a corresponding decrease in net revenues for generators. It may seem counterintuitive that lower gas prices would decrease net revenues for a new gas resource. However, older less efficient gas units are often the marginal resources setting prices in the market. Lower gas prices allow these less efficient units to capture revenues that would otherwise be paid to newer, more efficient generation.[4]

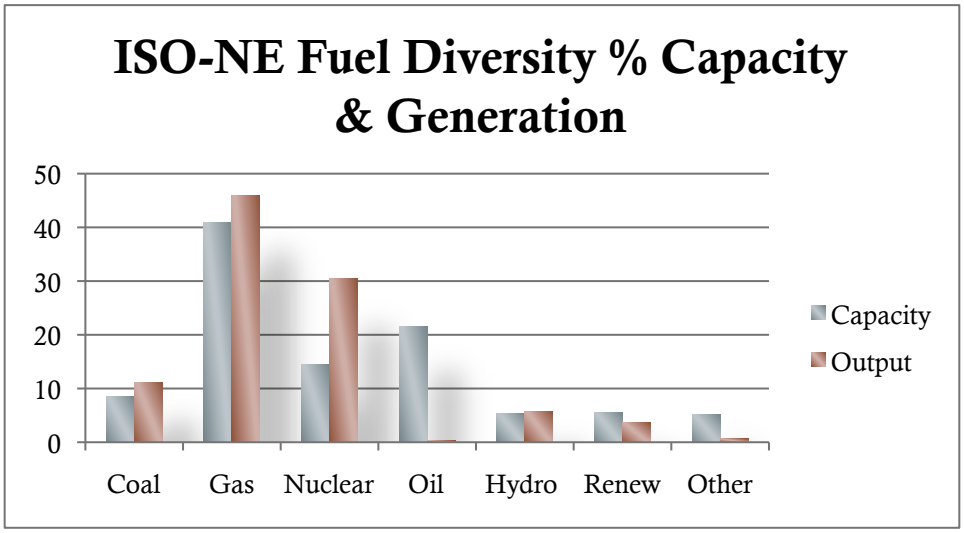
[4] 2011 ISO/RTO Markets Report, page 50.



Fuel Diversity



ISO-NE Generation



Renewable Resources

California ISO

California ISO is committed to assisting the state of California to reach its renewable energy goal of 33% of retail sales generation by 2020. The state goals increases from 20% of retail sales by December 31, 2013, to 25 % by the end of December 2016; and 33% by the end of 2020. California generated 10% renewable energy in 2010.

Midwest ISO

The Midwest ISO's renewable energy produced as a percentage of total energy rose from 0.5% in 2005 to 3.8% in 2010. In 2010, there were 2,117 curtailments of wind that were backed down due to local congestion issues, up from 1,141 curtailments in 2009. The total estimated curtailed energy amounts to 824,000 MWh over 19,951 duration hours, more than double the amount of energy curtailed in 2009. Interestingly, MISO has the highest wind forecasting accuracy of any RTO at over 90% accuracy in both 2009 and 2010.

NYISO

In 2009, the NYISO became the first grid operator to dispatch wind power fully balancing the reliability requirements of the power system with the use of the least costly power available. Including wind power in the economic dispatch allows more efficient management of the resources and minimizes the duration of wind-power curtailments. NYISO forecasted wind with 90% accuracy in 2010, down slightly from 2009. Energy from non-hydroelectric renewables has more than doubled since 2005. This may be attributable to the combined impact of NYISO markets providing economic incentives and public policy encouraging the development of renewable generation in New York State. New York's renewable portfolio standard goal is now 30% by 2015. Existing hydroelectric power counts toward the RPS goal, however going forward only power produced from units smaller than 30 MW will count.

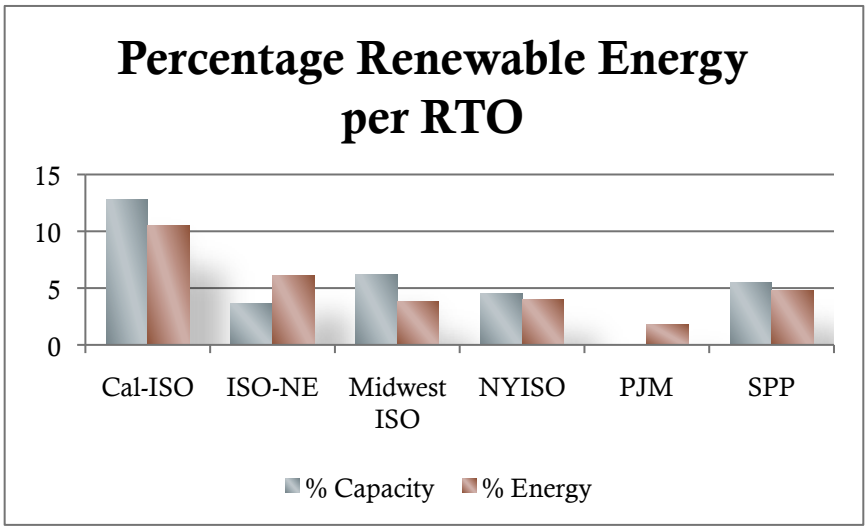
PJM

In 2010, PJM successfully integrated 1,032 MWs of new wind generation and 21 MWs of solar generation. PJM also noted it issued a whitepaper on wind farm communications and approved a wind farm communications standard in 2010.

As for potential new generating capacity, wind plants occupy two-thirds of PJM's year-end 2010 interconnection queue.

As of 2010, PJM had 4,491 MWs of operating wind generation. Solar generation grew from 5.5 MW in 2009 to 15 MW in 2010.

The Renewable Energy Dashboard at www.green.pjm.com illustrates a user-friendly snapshot of the amount and type of generation that currently provides power to the 51 million people in the PJM region.

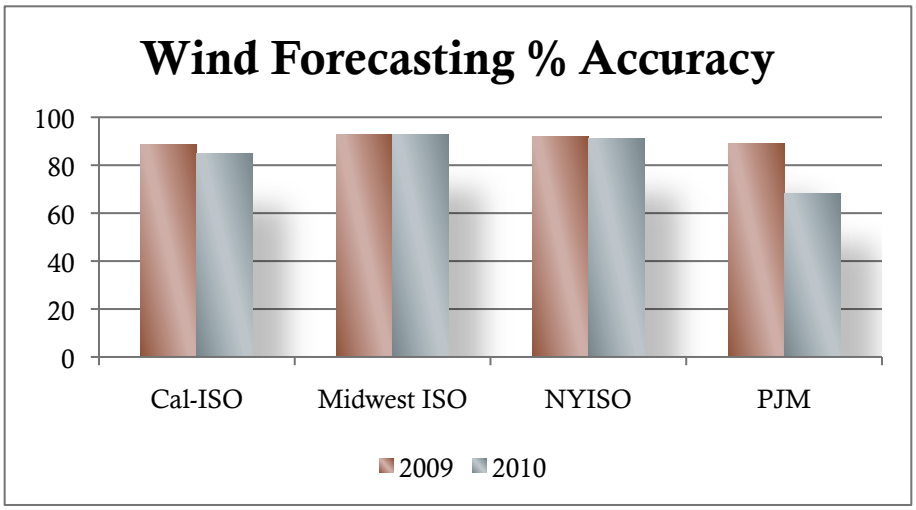


Wind Forecast Accuracy

In mid-2008, the NYISO instituted one of the first state-of-the-art wind forecasting systems in the United States incorporating wind power forecasts into Day-Ahead and Real-Time Market tools to improve commitment and scheduling of resources. The centralized system enables the NYISO to better utilize and accommodate wind energy by forecasting the availability and timing of wind-powered generation. The real-time forecasts are updated every 15-minutes and integrated into the NYISO's real-time Security Constrained Dispatch.[5]

Currently ISO-NE only has 270 MW of wind on the system and so does not do special wind forecasting. However, in 2012 ISO-NE plans to transition to a state-of-the-art forecasting system as variable energy resources (VERs) are expected to reach 500-750 MW. The new forecasting system will incorporate information from the New England Wind Integration Study (NEWIS), completed in December 2010. Such a system would produce a forecast for expected VER generation ideally for a range of timeframes (including next hours, next day, and the following week) to allow for optimizing short-term maintenance scheduling, unit commitment, and real-time unit dispatch.[6]

[5] 2011 ISO/RTO Markets Report, page 210.
[6] 2011 ISO/RTO Markets Report, page 80.



Demand Response

California ISO

The ISO Board approved the Proxy Demand Response proposal in late 2009 that set the conditions for aggregators and load-serving entities to bid demand reductions into the wholesale markets. In 2010, the Board approved the Reliability Demand Response product, which integrates emergency responsive demand into ISO markets and operations.[7] California ISO accounts for demand resources in the reserve margin and capacity markets with a value determined by the California Public Utilities Commission's methodology for capacity and expected performance.

ISO-NE

Every six months since February 2003, ISO-NE files status reports at FERC with information regarding participation in and the impact of demand response programs in New England. These status reports include information about the impact on real-time LMP as a result of demand response. In the period January 2008 through December 2010, the overall average impact of demand response on real-time LMPs in each observed period ranged from $0.04 to $1.72. The average impact over eleven reporting periods is $0.55. The median impact is $0.27 to $0.31. (114)

To achieve further benefits from the increase in demand resources, ISO-NE recently implemented improvements to the software and communications infrastructure used between demand resources and the ISO during real-time operations. New dispatch rules have been in place since June 2011 to allow operators to call on demand resources where, when, and in the amount they are needed.[8]

Midwest ISO

The Midwest ISO also allows demand response resources that meet specified requirements to participate in the following markets: energy, regulation, spinning reserves and non-spinning reserves. Demand response resources are actively participating in each of these areas. MISO is pursuing many improvements to evolve participation in the market. A sampling of the new features includes: Extended locational marginal pricing; Inclusion of Price Responsive Demand in it's real-time markets; allow aggregators of real-time customers; Demand Response Availability System (similar to GADS); incorporate DR and Energy efficiency into long-term planning process; and other changes to comply with Order 745.[9]

[7] 2011 RTO/ISO Metrics Report, Page 68.
[8] Id, pp. 94.
[9] Id, pp. 188-189.

NYISO

From 2005 to 2009, NYISO Day Ahead Demand Response program provided energy savings averaging $8.9 million annually, for a total of $42.7 million, with resources total nearly 2,400 MW in 2009.[10] When New York experienced its record peak load in August 2006, NYISO demand response programs shaved the peak by an average of 865 MW, providing estimated savings of $91 million. These savings are quantified by assessing the cost of providing a similar amount of capacity from peaking units.

In August 2010, two of the NYISO's major demand response programs, the Emergency Demand Response Program and the ICAP Special Case Resources program provided 2,498 MW of demand response capability, a 4.5 percent increase over the 2009 enrollment level. The demand response resources in NYISO reliability programs represent 7.5 percent of the 2010 Summer Capability Period peak demand of 33,452 MW, a nominal change from 2009.

The last report found that the overall average hourly wholesale LBMP reduction from scheduled DADRP load reductions was $0.27/MWh, On a monthly basis, the average hourly price reduction was most significant in the months of January 2009 ($0.93/MWh), November 2008 ($0.70/MWh) and September 2008 ($0.64/MWh). There were no price impacts for the summer months of May through August 2009, due to minimal load reduction offers and even fewer scheduled reductions.[11]

There were no emergency demand response deployments in NYISO in 2007, 2008, 2009 or 2010.

The savings associated with location of generation and demand-response resources are estimated at $500 million annually. This estimate is based on the transmission congestion costs that would have been incurred to transport power from other regions and the costs that would have been incurred to add new transmission capacity.[12]

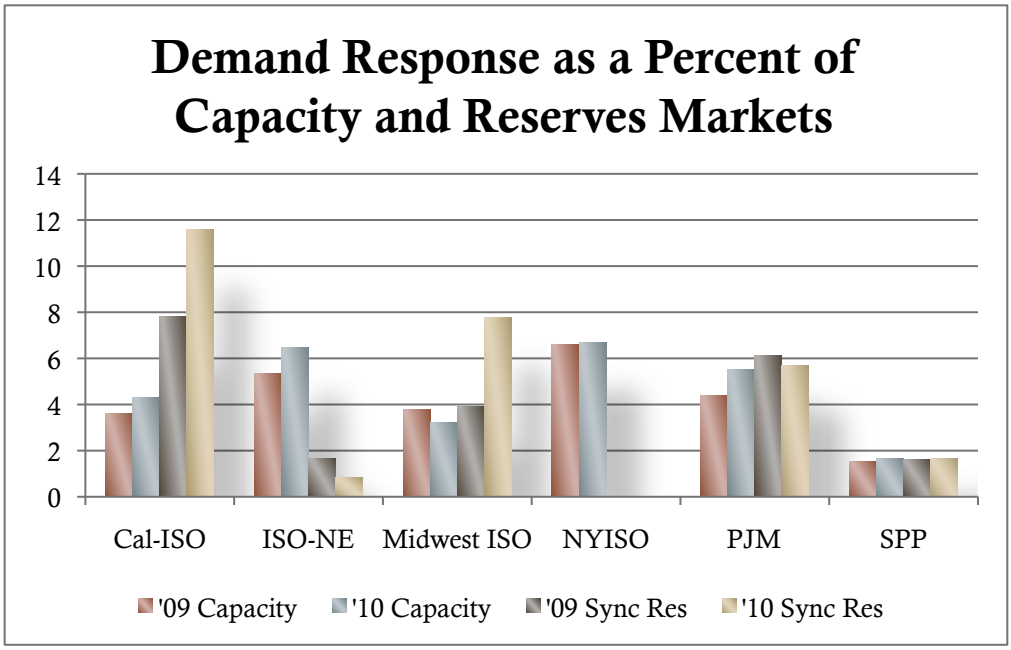
PJM

The PJM RPM provides a mechanism by which generation, demand response and transmission can compete on equal footing, thereby providing a transparent mechanism by which demand response can participate in the capacity market. Through this mechanism, the quantity of demand response that is providing capacity in the PJM footprint has increased by over 1,800 MW. The resulting avoidance of infrastructure development represents savings to the region of approximately $275 million per year.

In addition to the production cost benefit of operating the larger footprint, the transparent price signals produced by the operation of the *LMP energy market enable demand response to actively participate and compete directly with generation*. Because the value of energy is made transparent in real time, demand responders that otherwise would have no incentive to reduce demand can do so in response to real time prices, thereby competing directly with generation resources. This ability, although difficult to quantify as an annual average value, has the effect of reducing the cost to all load by reducing real-time prices, most particularly during times of high system demand.[13]

PJM estimates that total power costs were $175 million less during summer 2010 due to demand response. Voluntary curtailments through PJM's Demand Response program reduced wholesale energy prices by approximately $12 per megawatt hour during the highest usage hours in summer 2010 and by more than $300 per megawatt hour during the highest usage hours in early August 2006.

[10] Data on the Location Based Marginal Price impact of demand response resources participating in the NYISO's Day-Ahead Demand Response Program can be found in the NYISO's annual compliance file to the FERC, Docket No. ER01-3001. (p.227)
[11] 2011 ISO/RTO Markets Report, page 231.
[12] Id, page 257.
[13] Id, page 284.



DR Availability

ISO-NE
These data show that real-time demand-response resource availability was assessed at 76%, and real-time emergency-generation resource availability was assessed at 73%. Average active demand-resource availability was 75%. As highlighted in the following table, with passive demand resources assessed at 100% availability, overall demand-resource availability was estimated to be 84%.[14]

MISO
MISO has not experienced the need to deploy Load Modifying Resources (LMR) in an emergency (such as via Emergency Operating Procedures [EOP-002]) and thus does not have a record of LMR performance since the launch of the new Resource Adequacy construct in 2009. However, MISO continues to work with stakeholders and the NAESB to determine measurement and verification standards for Demand Response.[15]

PJM
The 2010 availability percentage reflects the aggregate actual demand response providers' performance for the six load management events during 2010. The aggregate load reductions of 4,652 MWs during these 2010 load management events resulted in approximately $175 million of savings in the energy costs that would have occurred absent the demand response providers' load reductions. Total revenues earned by demand response resources in 2010 from energy, capacity and ancillary service market participation exceeded $530 million, more than a 75 percent increase from 2009.

The 2009/2010 delivery year marks the first time PJM has required demand side resources to test their capability to deliver the reductions committed to meet capacity requirements. The test results for the 2009/2010 deliver year demonstrate that in aggregate, committed demand side resources performed at 118% of their committed capacity values.[16]

[14] 2011 ISO/RTO Markets Report, page 122.
[15] Id, page 187.
[16] Id, page 304.

Demand Response in Transmission Planning

ISO-NE may reflect demand resources in Needs Assessments as long as they have an obligation to serve through the Forward Capacity Market or other third party contract. To date, demand response has had varying impacts on the need for continued transmission infrastructure investment in New England. In many cases, demand resources are of insufficient quantity or granularity to address a specific reliability concern. In some cases, the addition of demand response aided deferring the need for some new transmission and contributed the need for more transmission in others.[17]

MISO
If demand-side resources are found to be significant and transfer capacity will not prevent their effectiveness, MISO includes demand resources as generation and energy efficiency as reduced demand in its transmission expansion plan. Demand response may also be provided as a solution to an identified transmission need, but must be evaluated through the transmission planning process and found to be the most cost-effective solution with a legally-binding obligation to implement the demand response solution.[18]

PJM began conducting sensitivity analysis in 2010 to complement traditional bright-line tests. The sensitivity analysis incorporate a number of factors not typically taken into account, including the potential impact of state renewable portfolio standards, demand response/energy efficiency efforts, and at-risk generation.[19]

The NYISO Congestion Assessment and Resource Integration Study (CARIS) issued January 12, 2010 provided an analysis of the types of projects (e.g. transmission, generation, or demand response) and costs of relieving constraints. The full report is available at the following link:
http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp

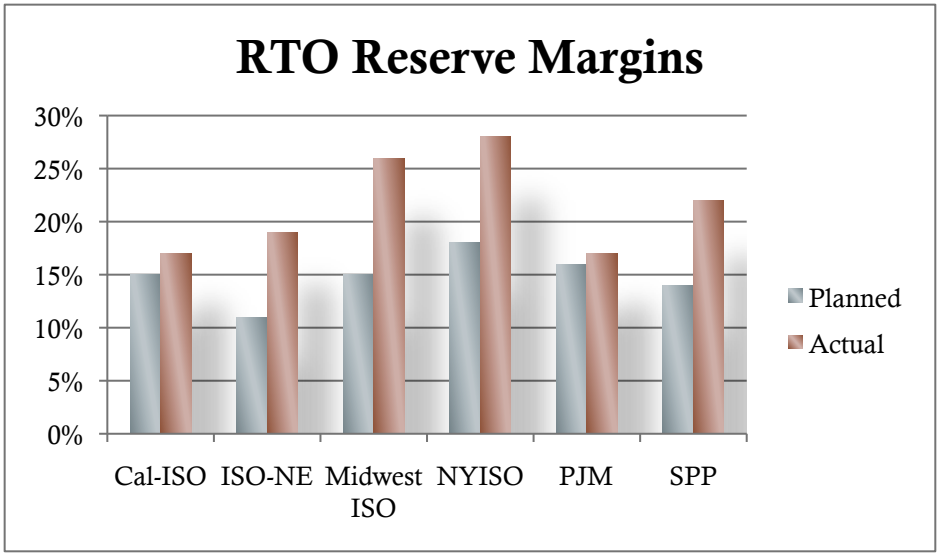
The NYISO will incorporate the provisions of Order 745 on demand response resource compensation into the market rules under development to integrate demand response participation in its Real-Time energy market.
At the state level, the NYISO is participating in proceeding of the New York State Public Service Commission (PSC) on advanced metering infrastructure. Detailed information is available from the NYISO filings on:

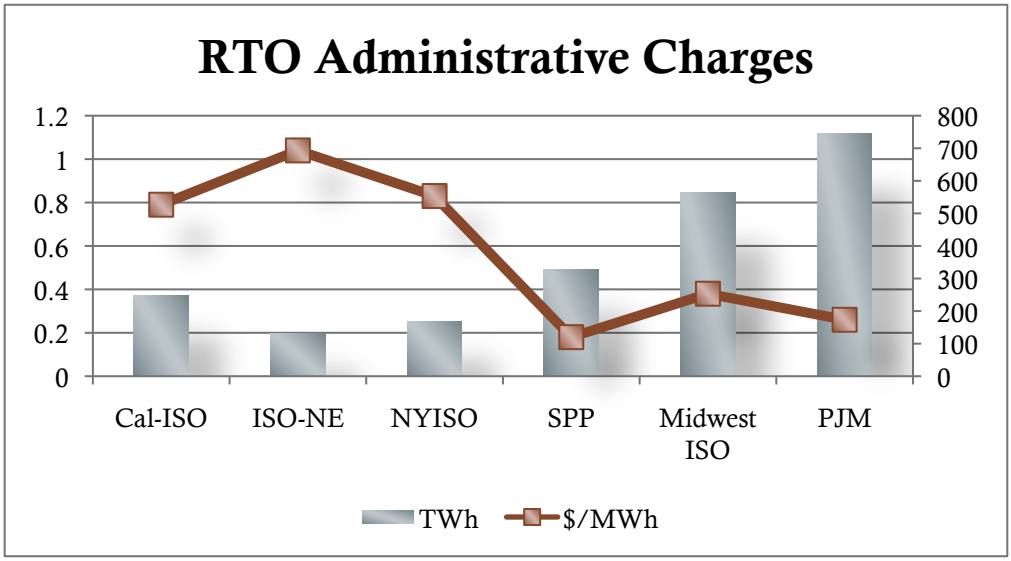
- Advanced metering (http://www.nyiso.com/public/webdocs/documents/regulatory/nypsc_filings/2009/NYISO_Comments_Staff_BC_Framework_6_15_09.pdf);
- Dynamic pricing (http://www.nyiso.com/public/webdocs/newsroom/white_papers/Dynamic_Pricing_NYISO_White_Paper_102709.pdf); and
- Smart grid (http://www.nyiso.com/public/webdocs/newsroom/white_papers/Envisioning_A_Smarter_Grid_NYISO_White_Paper_091710.pdf).

ISO Operations

From the chart it appears that ISO-NE's planned reserve margin stands out among its peers. The lowest Actual RM occurred in 2006 at 4,253 MW and 15.1%. The highest was in 2009 at 9,603 MW and 38.3%. The lowest Planned RM occurred in 2005 at 2,472 MW and 9.4%, and the highest was in 2008 at 2,990 MW and 10.7%.[20] ISO-NE believes that New England has one of the lowest installed reserve margins of all balancing authority areas and that it is reliant to a greater degree than other areas on tie-line benefits and emergency actions to meet its installed capacity requirement. The ISO currently is discussing these topics with its stakeholders. If the tie-line benefits and emergency actions are taken into consideration, the resultant PRM will be more comparable to other balancing authority areas.

[17] 2011 ISO/RTO Markets Report, page 88.
[18] Id, page 160.
[19] Id, page 277.
[20] Planned Reserve Margin MW = (NICR MW) – (Forecast Annual Peak Load MW).
The PRM also can be expressed as a percentage of forecasted annual peak load using the following formula: (PRM MW) / (forecasted annual peak load MW)] x 100. (p.91)





Generation RMR contract costs

The NYISO did not have any generating units under Reliability Must Run (RMR) contracts from 2005 through 2009. However, out of merit generation was dispatched in order to comply with reliability criteria. ISO-NE reduced RMR units to 1 in 2010 and is not expected to have any units under RMR contracts going forward.

Generator RMR Contracts 2009	# Units	MW	Cost ($millions)
Cal-ISO	12	1000	39.1
ISO-NE	1	162	1.97
PJM	1	383	

Special Initiatives

Each of the regions highlights several special initiatives having to do with market development, reducing congestion, developing demand resources and renewable resources, among other things. Each ISO characterizes Special Initiatives by benefits and cost savings to the system. A sampling of Special Initiatives from each RTO is listed below. Please see original RTO Metrics Report for a full report of Special Initiatives.

California ISO
Last year, the ISO released a 20 percent renewable portfolio standard integration report and commenced efforts to ensure it has sufficient tools to integrate renewable resources to satisfy the 33 percent renewable portfolio standard by 2020. The ISO adopted, and FERC approved, additional reforms to its transmission planning process in 2010 that allow approval of policy-driven transmission infrastructure projects. This authority will help the ISO plan for transmission expansions necessary to interconnect renewable resources.[21]

ISO-NE
Smart grid technologies represent the next stage in the evolution of the power system by improving data acquisition, analysis, control, and efficiency of the electric power grid. In 2010, the US Department of Energy approved an $8 million grant for ISO-NE and the New England transmission owners to add more than 35 new phasor measurement units (PMUs). The $18 million project to install these high-speed sensors at different points across the six-state transmission system will help ISO-NE system operators more accurately monitor system conditions by providing information on the system's status 30 times per second, rather than every four seconds as in the current configuration.[22]

Midwest ISO
Midwest ISO collaborated with stakeholders to develop Value Proposition metrics to measure the value of Midwest ISO. The benefits studied are: reliability, energy dispatch, unloaded capacity, regulation, spinning reserves, wind integration, diversity of resources in the footprint, generator availability, and two categories of demand response (dynamic pricing and interruptibles). Our 2010 Value Proposition shows realized annual benefits between $650 million to $875 million in annual net economic benefits to our region. Each of these is described in the following pages.[23]

NYISO
Locational price signals in the NYISO energy and capacity markets have driven investments in areas where the demand for electricity and, consequently, the prices are the highest. Such price signals drove investment in generation and demand technologies that allowed NYISO to defer transmission investments. The **savings associated with location of generation and demand response resources are estimated at $500 million annually**. This estimate is based on the transmission congestion costs that would have been incurred to transport power from other regions and the costs that would have been incurred to add new transmission capacity.[24]

PJM
PJM has partnered with the University of Delaware and the state to operate modified plug-in hybrid electric vehicle charging at PJM's direction. They receive payments depending on the hours they are plugged in and the hourly price paid for regulation service. PJM has also partnered with storage projects to gain direct experience as they participate in the Regulation Market. AES Corp.'s one-megawatt battery trailer has been providing regulation service to the PJM grid since 2009. New to storage testing on PJM's campus is a pilot to demonstrate how thermal storage can participate in PJM's Energy and Regulation markets. A 105-gallon electric water heater both provides hot water to the building and responds instantly to grid changes with a pricing and regulation signal from PJM dispatch.[25]

[21] 2011 ISO/RTO Markets Report, page 68.
[22] Id, page 142.
[23] Id, page 198.
[24] Id, page 257.
[25] Id, page 317.