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INCREASING DEMAND RESPONSE and RENEWABLE ENERGY RESOURCES:

How ISOs and RTOs are helping meet important public policy objectives

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OVERVIEW

For most of the past decade, the 10 Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs) in North America have been operating centralized wholesale electricity markets serving two-thirds of electricity consumers in the United States and more than half of Canada's population.[1] These ISOs and RTOs have overseen the transformation of a monopolistic industry structure, in which vertically integrated utilities operated in their own territories, into vibrant wholesale electricity markets that are delivering value to consumers.

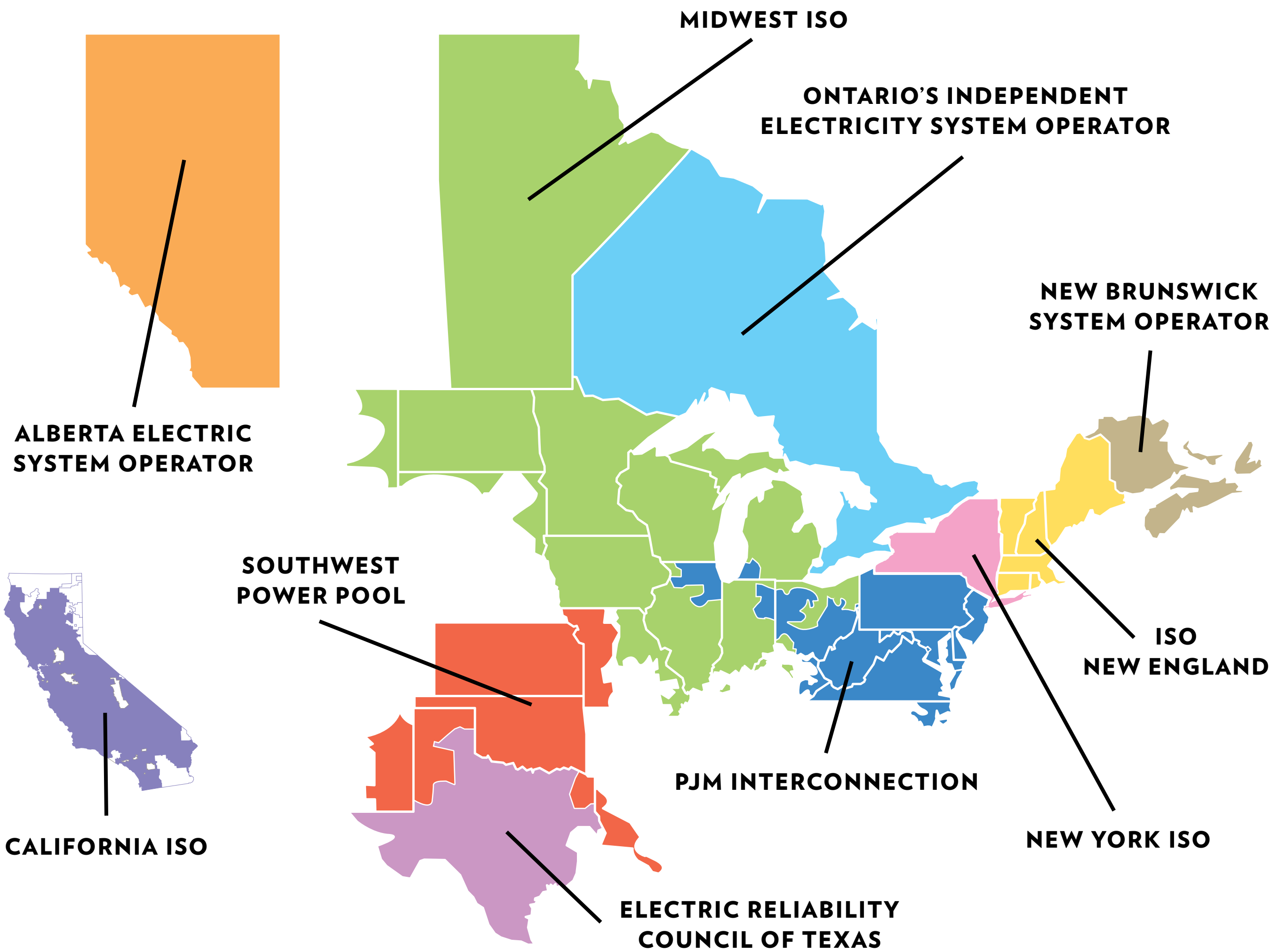

FIGURE 1: FOOTPRINT OF THE NORTH AMERICAN ISOs AND RTOs.

[1] As of 2007, the North American ISOs and RTOs include the Alberta Electric System Operator (AESO); California Independent System Operator Corporation (CAISO); Electricity Reliability Council of Texas (ERCOT); Ontario's Independent Electricity System Operator (IESO); Midwest Independent System Operator (MISO), ISO New England (ISO-NE); New Brunswick System Operator (NBSO); New York Independent System Operator (NYISO); PJM Interconnection (PJM); and Southwest Power Pool (SPP).

A review of how these markets performed in 2006 shows the following:

- Regional bulk electric power systems operated reliably despite of the strain of record-breaking demand.
- Wholesale prices dropped in virtually every region as fuel costs, which have been the major factor in price increases, eased.
- Markets are providing price signals that support investment in new generation and encourage the development of demand resources.
- Coordinated regional planning led by ISOs and RTOs is stimulating new transmission investments, which is reducing congestion costs by moving electricity more efficiently within and between regions.

TABLE 1
CHANGE IN AVERAGE ANNUAL LOAD-WEIGHTED WHOLESALE ELECTRICITY PRICES ($/megawatt-hour)[(a), (b), (c)]

Region	2005	2006	Price Change (%)
AESO ($Can)	$70.36	$80.79	14.8%
CAISO	$57.83	$47.55	(17.8%)
ERCOT	$77.22	$55.23	(28.5%)
IESO ($Can)	$72.14	$48.75	(32.4%)
ISO-NE	$79.96	$62.74	(21.5%)
MISO	$34.91	$29.98	(14.1%)
NYISO	$88.81	$71.32	(19.7%)
PJM	$63.46	$53.35	(15.9%)

(a) Electricity prices can be expressed in a number of ways, including nominal average compared with time-specific, weighted by load levels, and fuel-adjusted (because electricity prices are strongly driven by fuel prices, which vary widely over time). These prices are nominal averages without fuel-price normalization, but they have been weighted to reflect the number of megawatt hours (MWh) consumed at different price levels over the course of the year.

(b) No central organized wholesale market exists within SPP or NBSO, thus these figures are not available for these regions. However, SPP and NBSO operate balancing markets.

(c) In Alberta, wholesale prices increased in 2006 due to a decrease in the reserve margin, from 40% to 20%, resulting from the retirement of generation in the 2004 to 2006 timeframe. The numbers for Alberta are not load weighted.

The role of ISOs and RTOs continues to evolve. In addition to the day-to-day coordination of electric generation and transmission across a wide geographic area and continuous management of competitive wholesale electricity markets, ISOs and RTOs provide nondiscriminatory transmission access, facilitate competition among wholesale electricity suppliers, and conduct regional planning to ensure a reliable grid for the future. As challenges have presented themselves, ISOs and RTOs have seized them as opportunities to adapt their markets, programs, and practices to enhance the reliability and efficiency of their systems.

One of the major challenges currently facing each of the 10 regions is the continued growth in electricity demand. Peak demand levels within the ISO and RTO regions have grown consistently, reaching record levels in 2006. This growth in peak demand has created a need for a significant quantity of new resources.

TABLE 2
PEAK HOURLY LOADS IN ORGANIZED MARKETS (MEGAWATTS)[a]

Region	2005	2006	% Change
AESO	9,236	9,661	4.6%
CAISO	45,431	50,270	10.7%
ERCOT	60,274	62,339	3.4%
IESO	26,160	27,005	3.2%
ISO-NE	26,885	28,130	4.6%
MISO	112,078	116,030	3.5%
NBSO[b]	3,154	2,807	-11.0%
NYISO	32,075	33,393	5.8%
PJM	133,763	144,644	8.1%
SPP	40,187	42,284	5.2%

(a) These are actual loads that are not weather-normalized. Although actual peak loads are what challenge grid performance and reliability, analysts use weather-normalized peak loads for long-term comparisons because the weather-normalization betters reflects underlying population and economic growth rates in a region.

(b) The New Brunswick system peaks in winter because of high electric heating load (and minimal air-conditioning load in summer).

This growing demand must be met while meeting new environmental policy initiatives that have been adopted by individual states or are under consideration at the national level. These initiatives have established, or could establish, aggressive goals to reduce overall greenhouse gas emissions from power plants.

ISOs and RTOs are tackling this challenge by developing new market initiatives and programs that reduce peak demand and enable the development of renewable energy sources with little or no emissions.

The ISO/RTO Council (IRC), an industry organization comprised of the 10 North American ISOs and RTOs, commissioned two reports to describe the role they play in fulfilling the public policy objective of reliably serving future electric demand in a low-cost and environmentally sound manner.

The reports describe how ISOs and RTOs have used organized markets and coordinated regional planning to harness the power of demand response and enable the development of renewable energy resources. The studies show that both demand response and renewable energy are expanding rapidly in the ISO and RTO regions, providing economic and environmental benefits for consumers, and improving the efficiency of regional power systems.

ISO AND RTO INTEGRATION OF DEMAND RESPONSE INTO WHOLESALE ELECTRICITY MARKETS

Demand response is becoming an increasingly important part of the overall solution to address rising electricity demand, increasing fuel prices, and concerns over global warming. Policymakers recognized its value as far back as 1976—during the last energy crisis—when Congress directed state public service commissions and local utilities to consider adopting retail rates that would better reflect the highly variable nature of wholesale electricity prices.

BENEFITS OF DEMAND RESPONSE FOR ELECTRICITY CONSUMERS

Demand response in the 10 North American ISO and RTO markets serves several critical roles in the management of the regional power grids. In real time, it lowers peak demand, helping system operators manage power flows and use electricity sector resources more efficiently. Because it "shaves the peak," demand response also mitigates peak prices and limits supplier market power. In the long term, it reduces the need for new generation resources and improves system reliability.

The potential benefits of demand response are substantial:

- PARTICIPANTS in demand-response programs receive incentive payments to reduce electricity consumption or lower electricity costs by moving consumption from high-priced to lower-priced hours.
- OTHER ELECTRICITY CONSUMERS benefit, even if they do not engage in demand response, because lower overall demand can result in lower wholesale prices that translate into lower electricity costs for all consumers. In addition, demand response helps keep the lights on, which benefits anyone who depends on electricity in their daily lives.
- SOCIETY AS A WHOLE benefits from demand response, because it results in fewer generating plants operating, which reduces emissions and conserves fuel. The reduction in peak demand also slows down the need to build costly additional transmission and generation infrastructure.
- COMMUNICATION AND CONTROL TECHNOLOGY FIRMS benefit because of the increased demand for information and control technologies.

Over the past several years, as policymakers have grappled with rising electricity prices and established aggressive environmental goals, the regional grid operators in the United States and Canada have successfully encouraged the growth of demand response through innovative market designs and demand-response programs.

More than 23,000 megawatts (MW) of demand response are now participating in North American ISO and RTO markets, representing 4.5% of their combined electricity demand. Researchers have found that demand response of about 5% to 15% of peak demand should result in an efficient balance between building new supply resources and reducing demand. Several of the North American markets operate within that range: New York ISO, New Brunswick, the Midwest ISO, Ontario, and Alberta. The other regions are nearing that range. As more intermittent resources such as wind power are added to the grid, the need for demand-response resources and the balancing capabilities of regional grid operators will become even greater.

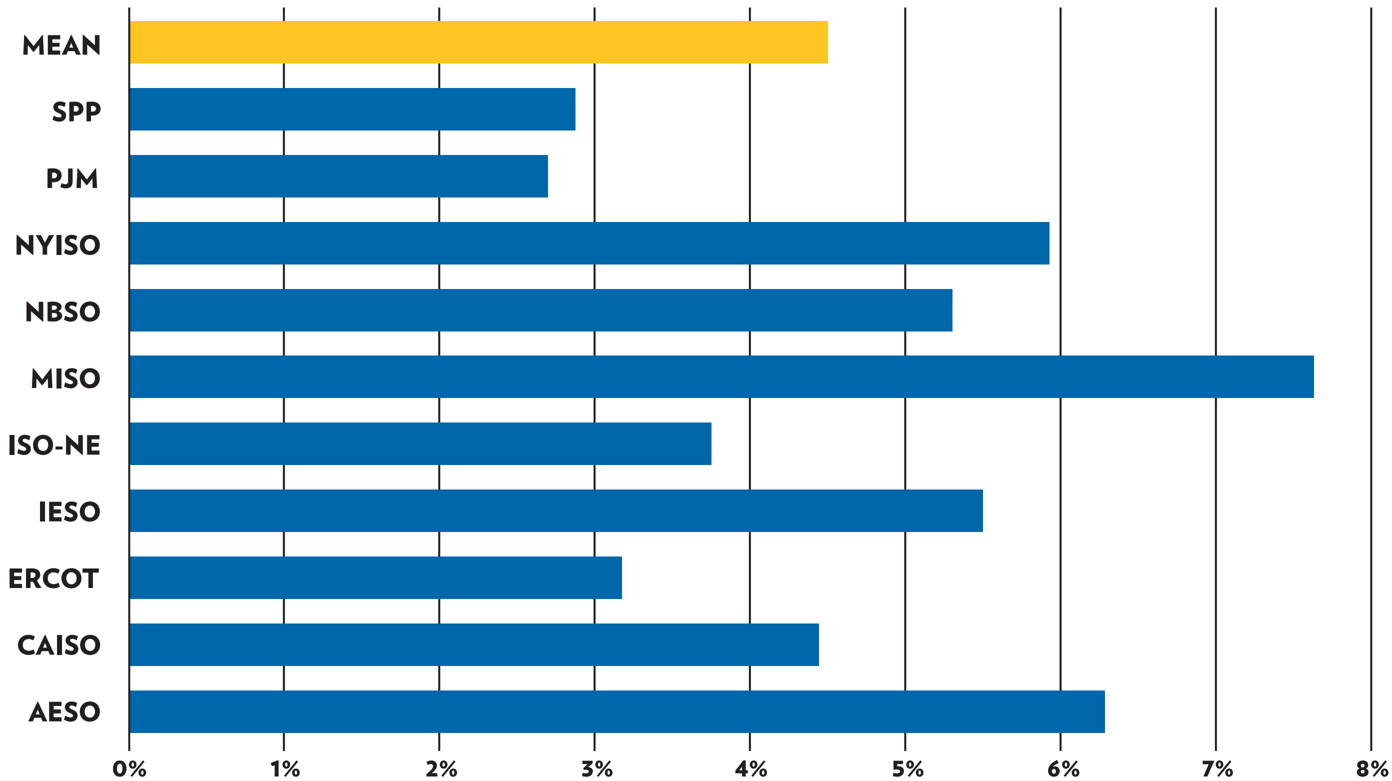

FIGURE 2: ISO AND RTO DEMAND RESPONSE AS PERCENTAGE OF SYSTEM PEAK.

ISOs and RTOs have created opportunities for demand response to participate directly in wholesale electricity markets or through programs that provide “out-of-market” payments to demand-response resources. These resources can participate in energy, ancillary services, and capacity markets operated by ISOs and RTOs. A review of currently enrolled demand-response resources shows the following:

- Sixty-eight percent (15,705 MW) are categorized as capacity resources, which equate to the power produced by as many as 30 commercial-sized power plants.

- Seventeen percent (3,855 MW) participate as ancillary services resources, which replenish operating reserves to preserve system reliability during emergency situations.

- Twelve percent (2,736 MW) are considered *energy-price resources*, which allow their energy providers to cut-off their power supply during shortages in return for a payment that reflects the price of electricity they did not use.

- Four percent are *energy-voluntary resources*, which enroll in programs that provide payments to reduce their electricity use voluntarily.

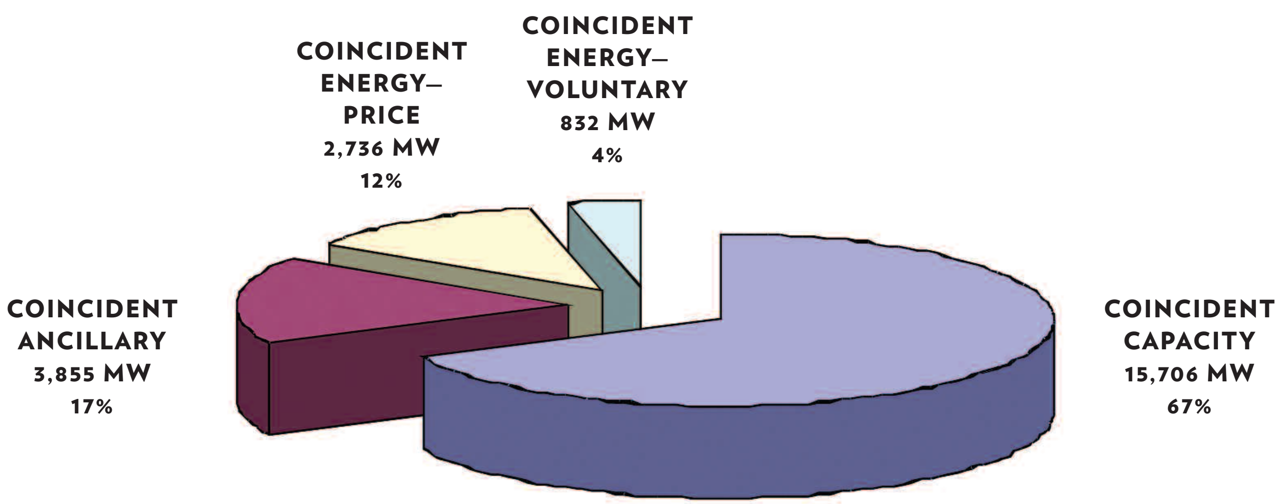

FIGURE 3: DEMAND RESOURCES BY MARKET PRODUCT FOR ISOs AND RTOs OF THE UNITED STATES AND CANADA, AS OF SPRING 2007, TOTALING 23,129 MW.

Note: The term “coincident” represents the total amount of resources available at a given time and assumes that all enrolled customers respond to the extent they had committed.

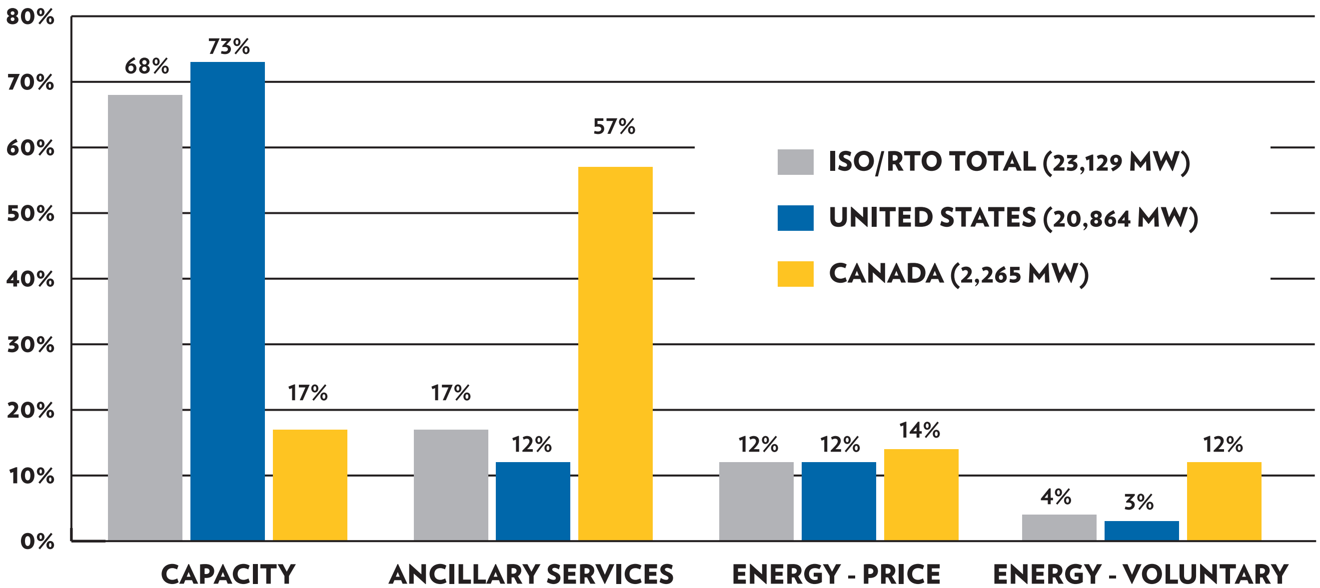

FIGURE 4: DISTRIBUTION OF ISO AND RTO DEMAND-RESPONSE RESOURCES BY CATEGORY.

Alberta, New England, New York, Ontario, PJM, and ERCOT support demand response by enabling consumers to directly compete in the markets against generating resources and by managing programs that provide economic incentives for participants to shift their electricity consumption to off-peak hours. California, the Midwest, the Southwest, and New Brunswick support significant state- and province-funded and utility-implemented demand-response programs.

ISO AND RTO FRAMEWORK FOR ENCOURAGING DEMAND RESPONSE

ISOs and RTOs provide the framework for demand-response resources to participate and thrive through the following actions:

- Managing large, liquid markets that can accommodate a significant amount and variety of demand-response resources
- Allowing a diverse group of demand-response resources to participate, including individual customers, utilities, demand-response providers or aggregators
- Developing well-defined demand-response products, standardized rules, and common communication protocols, which reduce barriers to market entry and lower transaction costs
- Providing transparent market prices making it easier for customers and demand-response providers to calculate the potential value of their demand-response resources and make informed investment decisions

As the wholesale markets mature and technology improves, the markets run by ISOs and RTOs will continue to enable significant growth in demand response.

FUTURE ACTIONS

ISOs and RTOs have been at the forefront in fostering demand response to improve the performance of both the wholesale markets they operate and the retail markets that critically rely on price transparency and resource coordination to achieve optimal resource utilization. They have developed vehicles permitting consumers to participate directly in wholesale markets on terms equivalent to generation resources. In addition, they have worked with utilities and competitive retailers to ensure that demand-response initiatives serve customer needs and are aligned with how wholesale markets value resources. The result of ISO and RTO demand-response initiatives is a more vibrant and flexible wholesale market and infrastructure that benefits all consumers and all sectors of the economy.

Much has been accomplished, but more must be done to ensure that the full force of customer demand for electricity is exerted consistently and in a sustainable manner on electricity markets, at both the wholesale and retail levels. Accordingly, ISOs and RTOs are continuing efforts to increase demand participation in the market. They have identified key barriers to expanded demand response and are pursuing several initiatives to break them down as described below.

COMMUNICATION AND METERING STANDARDS AND INFRASTRUCTURE

Barriers

The telemetry and communication requirements put in place by ISOs and RTOs for large generation resources providing ancillary services are likely to be cost-prohibitive for small and geographically-dispersed demand resources, which in the aggregate are a potentially large and valuable resource. In addition, the lack of standards in existing metering and associated information management systems for data exchange limits the scope and scale economies that are possible with demand response. Because utilities have developed their metering and consumption data-retrieval systems independently and over different time spans and generations of technologies, the sector's devices and systems cannot communicate with one another and are not readily amenable to communicating with new, more robust systems, such as those that are Internet-based. In addition, ISOs and RTOs operate their own data-collection and communication systems. To fully integrate demand response into ISO and RTO market operations, inbound and outbound data retrieval is required, in some cases very frequently.

The lack of uniformity in metering and communication standards requires service providers and customers to develop different systems to participate in multiple markets. This raises the cost of business and reduces the amount of cost-effective demand response.

ISO and RTO Initiatives

The ISOs and RTOs are working together to develop standards for lower-cost open architecture technology for measuring demand response to enable more small demand-response resources to participate in ISO and RTO markets.

STANDARDIZATION OF PERFORMANCE-VALIDATION PROTOCOLS AND TERMINOLOGY TO ENHANCE THE NATIONWIDE DEVELOPMENT OF DEMAND RESPONSE

Barriers

Demand response involves change in electricity usage over relatively short time periods, such as hours and in some cases minutes. Conventional metering only measures total consumption. Clearly, new technology is required. Even with the proper interval metering, protocols are required to measure demand response.

Demand response is manifested by a reduction in usage during a specified time. What is metered and readily available is the consumer's actual usage after it has undertaken its demand-response actions. However, measuring the amount of load that was reduced requires ascertaining the level of energy usage the consumer would have otherwise consumed, often referred to as the customer baseline load (CBL). Currently, ISOs, RTOs, and utilities use somewhat varying CBL methodologies to measure and verify the load impacts of demand-response resources participating in wholesale markets (e.g., capacity, electric energy, ancillary services). Similar to the issues associated with metering and communications, a lack of uniformity in CBL protocols hampers the realization of the economies of scale and scope that characterize demand-response resources. A number of retail suppliers, curtailment service providers, and some large customers whose facilities or plants have a national or regional footprint (e.g., national chain accounts, very large industrial customers) have argued that more standardized methods to measure and verify the load impacts of demand-response resources would lower transaction costs and reduce barriers to participation by end users in wholesale markets. Moreover, the North American Energy Standards Board (NAESB) has embarked on a process to develop wholesale (and retail) market standards for the measurement and verification (M&V) of the contributions of demand resources.[2] The Federal Energy Regulatory Commission (FERC) has been supportive of the NAESB effort.

Establishing common M&V standards as well as demand-response product specifications among the ISOs and RTOs would better enable third parties and load aggregators to serve multiple markets. It would enable firms that operate facilities in multiple markets and geographic locations to devise and carry out standardized demand-response behaviors. These efforts also would facilitate the full integration of demand-response transactions into ISO and RTO market systems, which will ensure that demand-response resources are paid promptly for the actual value they deliver.

ISO and RTO Initiatives

The ISOs and RTOs are working collaboratively with other stakeholders and NAESB to define more standardized M&V approaches that build on the body of existing experiences and recognize the diverse nature of demand-response resources and the consumers that provide them, with the goal of making demand response attractive to all electricity consumers.

[2] See http://www.naesb.org/dsm-ee.asp.

ISO AND RTO SUPPORT OF POLICIES THAT ENCOURAGE RENEWABLE ENERGY

Renewable resources provide energy with little or no emissions, reduce dependence on fossil fuels, and strengthen local economies. Renewable generation currently provides about 8.6% of the energy produced in regions operated by ISOs and RTOs, with 6.2% coming from large hydro, 1.2% from wind, and the remaining 1.3% supplied by geothermal, biomass, and solar.

To encourage renewable resources, policymakers have implemented favorable tax policies at the federal and state levels, and 25 states (and the District of Columbia) have implemented Renewable Portfolio Standards (RPSs) that require utilities to supply a targeted percentage of their electric energy from renewable resources. The combination of Renewable Portfolio Standards and tax policies have helped make renewable energy financially viable in many areas. These Renewable Portfolio Standards include many types of renewable resources but generally exclude large hydro resources.

The markets run by ISOs and RTOs are proving to be effective in encouraging the development of renewable resources. Nearly half (44%) the 300,000 MW of proposed new generation are renewable-energy projects. Wind energy is the largest single technology in the ISO and RTO interconnection queues, exceeding natural gas, more than doubling coal, and tripling nuclear.[3] Wind proposals represent 10 times the amount of wind generation currently installed. Proposed additions for solar, hydro, geothermal, and biomass are also impressive at a total of nearly 17,000 MW. Solar in particular is making a strong showing in California.

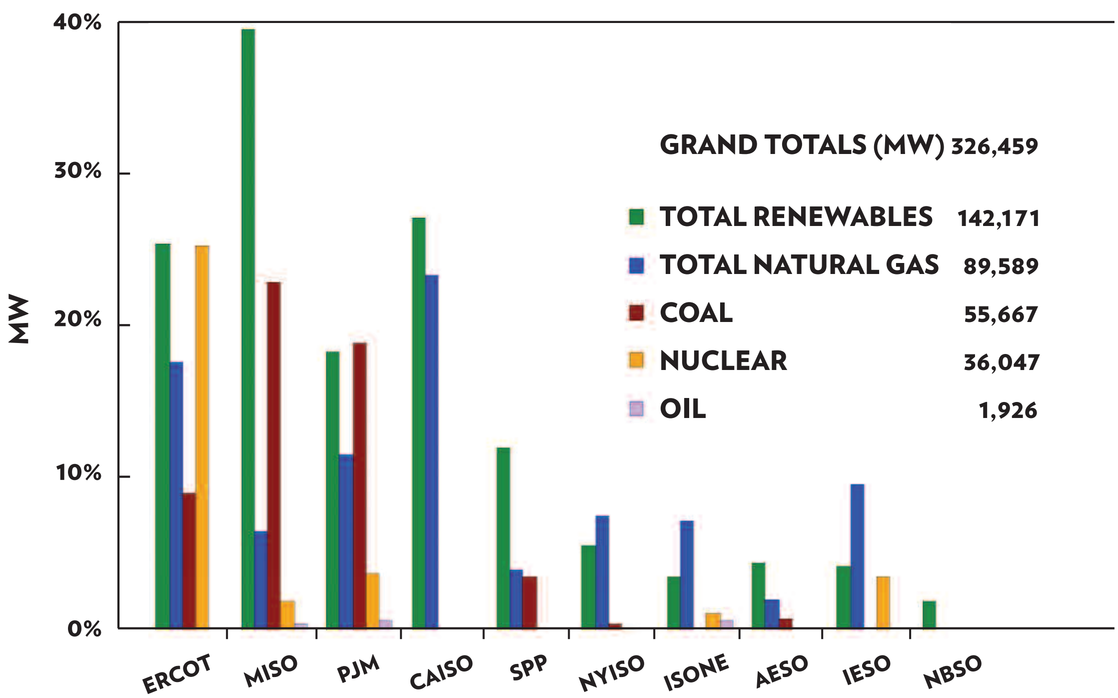

FIGURE 5: PROPOSED SUPPLY RESOURCES IN THE 10 NORTH AMERICAN REGIONS BY FUEL SOURCE.

[3] The interconnection queue determines the transmission improvements necessary to interconnect a project to the power system. Being in the generation queue does not guarantee that a project will actually be built, but it is a necessary step for all projects.

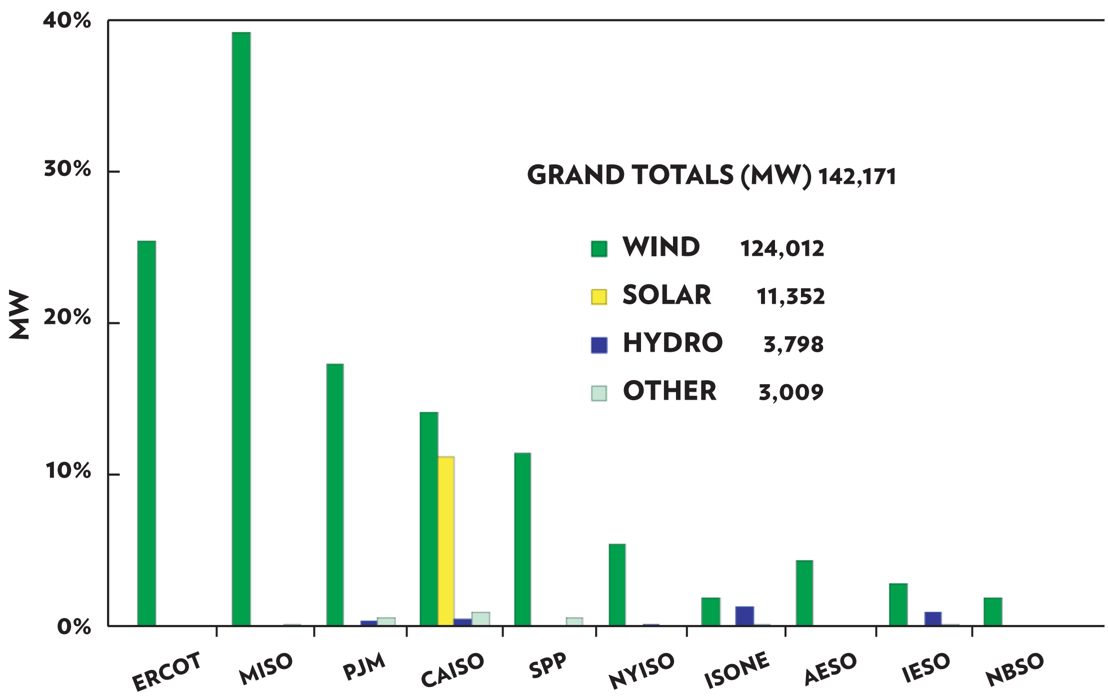

FIGURE 6: PROPOSED RENEWABLE GENERATION IN ISOs AND RTOs.

ISO AND RTO ACTIONS TO ENABLE THE DEVELOPMENT OF RENEWABLES

Several features of existing ISO and RTO wholesale electricity markets play an especially critical role in the development of renewable resources:

- ISO and RTO wholesale markets are open to all who wish to invest in and develop new resources.
- Prices are transparent, which allow developers to make intelligent decisions about whether to invest and what type of plants to build.
- The large size of the wholesale markets reduces the cost of integrating wind into the power system, while the flexible and quick-response capabilities of conventional generators allow system operators to adjust quickly to maintain system reliability should wind plants suddenly become unavailable because of wind patterns.
- Incorporation of wind forecasting into existing regional planning processes helps facilitate the growth of renewable energy generation.
- Coordination of regional transmission planning makes it possible to build the transmission needed to bring renewable energy to market.
- Extensive stakeholder input into establishing market rules is responsive to the needs of new technologies.

Several ISOs and RTOs have developed important transmission planning initiatives especially designed to support renewable resources. Because renewable generators are often located far from demand centers, additional transmission lines will be required to interconnect the large increase in renewable generation expected over the next several years.

The Midwest ISO was among the first to proactively include wind in its transmission planning process.

Texas has initiated a process to designate Competitive Renewable Energy Zones (CREZs) to facilitate the development of thousands of megawatts of new wind generation.

CAISO has created a new framework to build transmission to areas of the state where generation is constrained and significant renewable potential has been identified. Transmission to the region is designed and built prior to the full development of the renewable generation. Costs are allocated to end users until the renewable generation is built, at which point generation owners assume the costs.

Southwest Power Pool, which includes portions of Texas, Kansas, Oklahoma, and Arkansas, has proposed the “X Plan,” a $419 million transmission project that spans western Kansas, Nebraska, Oklahoma, and into the Texas panhandle. The project would enable the region to tap the tremendous potential for wind power.

In 2006, ISO New England, state regulators, and other stakeholders launched the New England Electricity Scenario Analysis Initiative, an effort to examine how various ways to meet the region’s future electricity needs might affect system reliability, the cost of electricity, and the environment. The objective was to arm the region with information to help make decisions about how to address the challenges of the need for new resources, a desire for lower prices, and stronger environmental mandates. The results of the analysis showed that adding an additional 1,500 MW of import transfer capability from New Brunswick into Maine produced positive emissions impacts and contributions to RGGI's goals under the assumption that the sources of power had low emissions (e.g., energy efficiency, wind, certain types of hydro imports and nuclear).

RENEWABLE PORTFOLIO STANDARDS

The role of ISOs and RTOs in implementing renewable policies is not limited to operating markets that encourage the development of renewable generation. ISOs and RTOs also play an important role in RPS implementation. Of the 25 states (including the District of Columbia) that have enacted Renewable Portfolio Standards, 17 are served at least partially by an ISO or RTO. The RPSs all differ in key respects: flexibility, resource eligibility, size of target, treatment of existing versus new renewables, whether Renewable Energy Credits (RECs) are used or not, and how RPS noncompliance is treated.

ISOs and RTOs possess much of the market data that states need for tracking compliance. Two ISOs and RTOs, PJM, and ERCOT, administer tracking systems for RPS implementation and compliance.[4] ISO New England provides all of the operational data needed to run New England’s Generation Information System, and New York is in the process of designing and implementing a tracking system. In addition, the Western Renewable Energy Generation Information System (WREGIS), encompassing 14 western states and two Canadian provinces, began operating in July 2007.

[4] PJM Environmental Information Systems, a subsidiary of PJM, administers the Generator Attribute Tracking System for PJM.

The combination of policy initiatives and open wholesale electricity markets are resulting in significant progress toward meeting renewable energy goals. The renewable generation projects in the queues would produce sufficient energy to exceed the RPS requirements in ERCOT, Midwest ISO, New Brunswick System Operator, and California ISO. Proposed renewable generation projects do not yet fully meet the RPS requirements in PJM, ISO New England, and New York ISO.

TABLE 3
CURRENT RENEWABLE ENERGY AND FUTURE RPS REQUIREMENTS IN ISOs AND RTOs

ISO/RTO	2006 % Energy From Renewables Non-Hydro	2015 RPS Requirements
AESO	3%	N/A
CAISO	11%	20%
ERCOT	3%	5%[(a)]
IESO	1%	N/A[(b)]
ISO-NE[(c)]	3%	11.7%
MISO	1%	3.8%[(d)]
NBSO	1%	10%
NYISO	1%	25%[(e)]
PJM	1%	11.8%[(f)]
SPP	2%	N/A
Total ISO/RTO	2%	N/A

(a) Texas' RPS calls for 5,880 MW of renewables by 2015, which is equivalent to roughly 5% of demand.

(b) Ontario's long-term supply plan shows 6% energy from renewables (excluding large hydroelectric) by 2015.

(c) For 2006, total renewable resources provide almost 12% of New England's electric energy. However, this amount includes large hydro resources, which are not counted toward RPS requirements. For 2015, 11.7% represents the weighted average of RPS policies in Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island.

(d) Represents the weighted average of RPS policies in Iowa, Minnesota, and Wisconsin.

(e) New York's RPS calls for an increase in renewables from a 2004 base level of 19% (18% of which is large hydropower) to 25% by the year 2013. Centralized procurement aims to provide about 24% and a voluntary green market would provide at least the other 1%.

(f) Represents the weighted average of RPS policies in the District of Columbia, Delaware, Maryland, New Jersey, and Pennsylvania.

CONCLUSIONS

The success of markets in enabling renewable resources is evidenced by the fact that ISOs and RTOs host 79% of today's installed wind generation, which is well above their 44% share of wind energy potential and 53% share of total North American electricity demand.[5] The facilitation of Renewable Portfolio Standards and innovative transmission development policies promises to keep ISOs and RTOs in the forefront of renewable generation growth for the foreseeable future.

[5] Michael Skelly. Comments, FERC Docket No. AD07-7-000. February 27, 2007.

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