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New England Regional Energy Market and its Evolution

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New England's Electric Power Grid at a Glance



- 14 million residents
- 6.5 million meters
- 31,750+ megawatts (MW) of generating capacity and approximately 1,850 MW of demand resources
- 8,500 miles of high-voltage transmission
- 13 interconnections with neighbors
- 28,130 MW all-time peak demand
- \$8 billion total energy market (2013)



- Majority of electricity demand is in southern New England and on the coast
- In order to satisfy demand, region utilizes:
 - Generation
 - Transmission
 - Interconnections with neighbors
 - Energy Efficiency and Demand Response ₃

Source: www.nasa.gov/sites/default/files/images/712129main_8247975848_88635d38a1_o.jpg



Prior to the 1970s

- Utilities handled every aspect of providing electricity:
 - Generation
 - Transmission
 - Distribution to homes and businesses
- Utilities were regulated local monopolies that operated independently of each other.



The Great Northeast Blackout of 1965

- On Nov. 9, 1965, a blackout occurred as several Northeastern states and parts of Canada were hit by a series of power failures lasting as long as 13 hours.
- The blackout covered 80,000 miles and affected more than 30 million people.
- The blackout was caused by a faulty relay at a station in Ontario, Canada.



Response to the Northeast Blackout of 1965

- Concern about the system's reliability at the national and local levels.
- At the national/international level, the industry responded by creating a voluntary, utility-managed reliability organization, the North American Electric Reliability Council in 1968.
- At the regional and local level, the Northeast's power companies formed three "power pools" to ensure a dependable supply of electricity, including the New England Power Pool.

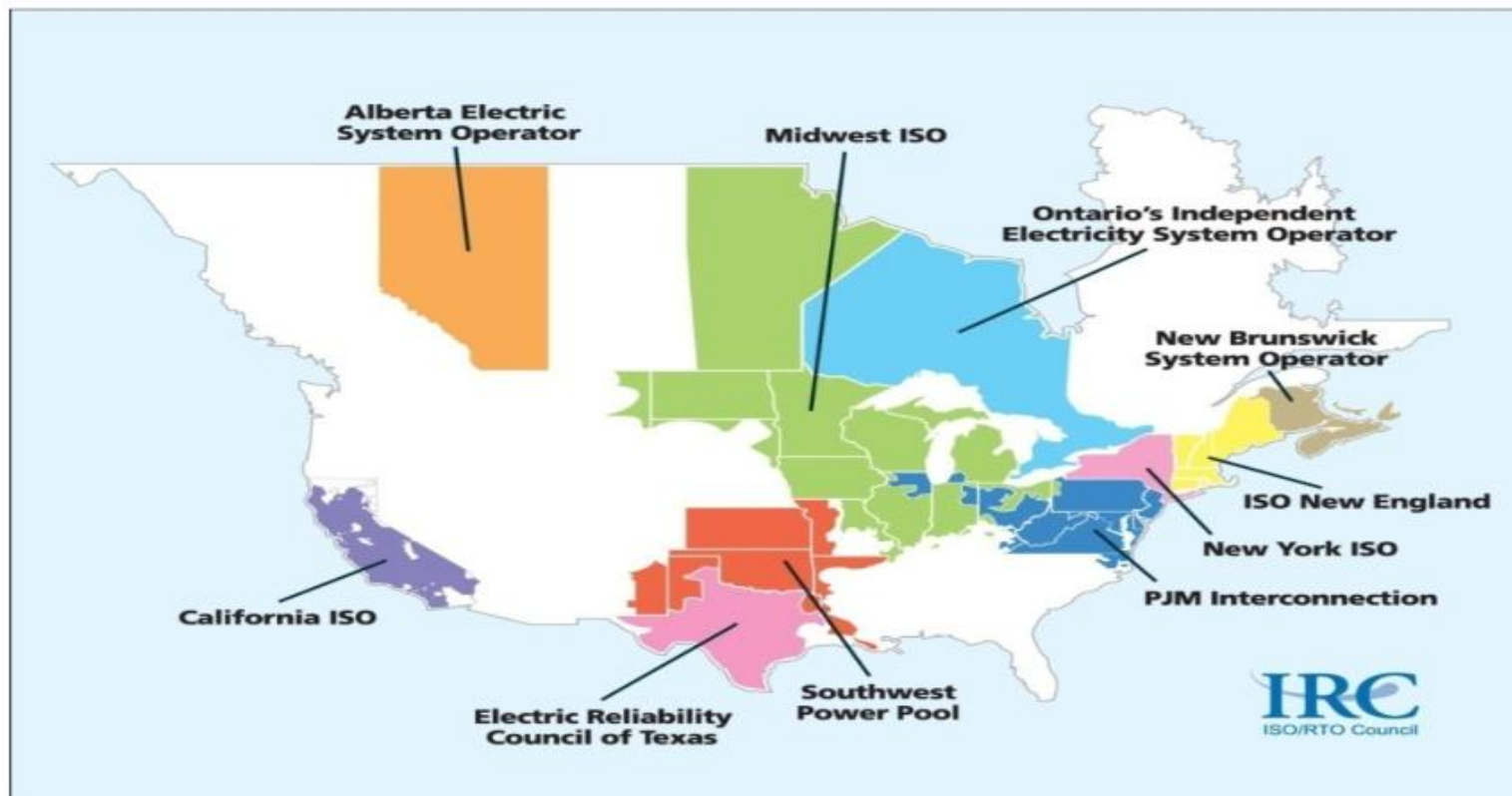


North American Electric Reliability Council (“NERC”)

- A non-governmental entity, governed by an independent board, whose mission is to ensure that the bulk electric system in North America is reliable, adequate and secure.
- Since its inception, NERC has operated as a voluntary organization, relying on reciprocity, peer pressure and the mutual self-interest of all those involved to ensure compliance with reliability requirements.
- NERC divided the nation into 10 reliability regions.



Each reliability council promulgates system planning and operating criteria that are intended to ensure that each utility with generation or transmission assets builds and operates them in a way that allows system controllers to preserve bulk power reliability.





New England Power Pool (“NEPOOL”)

- Formed in 1971 by the region's private and municipal utilities.
- Intended to foster cooperation and coordination among utilities in the six-state region.
- Now, it has expanded to be a group of generators, transmission owners, marketers, public power companies and end users.



1970s

- New England has limited fossil fuel resources, so the traditional fuels used in power generators (natural gas, oil and coal) all were imported into New England.
- The early 1970s' oil embargo resulted in rapid increases in the cost of fuel to operate power plants translated into equally large jumps in retail power prices.



1970s

- Continued increases in oil prices and unstable fuel supplies led electric utilities to construct new power plants that relied on domestic coal and nuclear power. These plants cost much more to build than simple oil or natural gas-fired generators.
- Consequently, the fixed costs of utility operations increased further increasing retail electricity prices.
- In 1979, the worst accident in the US commercial nuclear power plant history occurred at the Three Mile Island plant in Pennsylvania. While the accident was not in New England, it did have an impact on the completion of nuclear reactors in New England.



1990s

- By the 1990s, New England's electricity rates were among the nation's highest. The natural consequence was consumer complaints and increased regulatory oversight.
- Academics, companies and others began to talk to legislatures about the benefits of competition. With competition there would be incentive to improve service, minimize prices or invest in new facilities and technologies.



Restructuring of Wholesale Electric Power

- As early as the 1970s, the United States Congress and the Federal Energy Regulatory Commission (“FERC”)—which oversees the electricity industry nationally—began enabling the restructuring of wholesale electric power.
- By the mid-1990s some of the New England states began to open proceedings to examine restructuring how their utilities operated.



Legal Basis – Federal level

- FERC was created by Congress under federal law and is an independent agency.
 - Independent from political party influence because no more than 3 of the 5 Commissioners can be from one party.
 - Independent from President's/Congress' influence because FERC decisions are reviewed by a court.
 - Independent from parties' influence because private discussions in contested case- specific proceedings are prohibited by FERC's "ex parte" regulation (18 CFR 385.2201).
- Because FERC is a creature of statute, it can only do what a statute allows it do.



FERC Regulation

- FERC regulates the following:
 - Electric transmission and wholesale rates and services in interstate commerce
 - Monitors and investigates energy markets
 - Natural gas and oil pipeline transportation rates and services
 - Hydroelectric dam licensing and safety
 - Reliability of the high voltage interstate transmission system through mandatory reliability standards
- FERC has the ability to enforce its regulatory requirements through imposition of civil penalties and other means.



FERC-led Changes

- FERC created a level playing field for competitive markets, ensuring equal access to transmission grids.
- FERC encouraged states to require utilities to sell off power plants and gradually eliminate regulator-set rates in favor of prices determined by the markets.
- FERC also created independent system operators (“ISOs”) to oversee restructuring on a regional basis. These ISOs were given responsibility for ensuring reliability and establishing and overseeing competitive wholesale electricity markets.



Key Laws and FERC Orders

- The Public Utility Regulatory Policies Act of 1978 (“PURPA”) required all utilities engaged in the distribution of electricity to offer to purchase electricity produced by qualifying facilities.
- Competition in Wholesale Electric Markets (Order Nos. 719 and 719-A)
- Open Access Transmission (Order Nos. 888 and 888-A)
 - All public utilities that own, control or operate jurisdictional transmission facilities are required to have open access transmission tariffs (18 CFR 35.28(a) & (c)).
- Improvements in Open Access Transmission, e.g., Transmission Planning (Order Nos. 890 and 890-A)



Independent System Operator of New England (ISO-NE)

- Created by FERC in 1997.
- In 2005, FERC designated it the regional transmission organization for the area, which gives it broader authority over the day-to-day operation of the transmission system and greater independence to manage the power grid and wholesale markets.
- Three main responsibilities
 - Reliable operation of the electric grid.
 - Administration of the wholesale electricity markets.
 - Plan for future system needs.



Legal Basis – Regional level

- ISO-NE was created by FERC and must submit tariff changes to FERC for approval.
 - ISO-NE through a stakeholder process develops the rules that govern the markets, assesses the needs of the region, and plans for the future reliability of the grid and functioning of the markets.
 - State utility commissions have the right to participate in proceedings before FERC regarding any tariff changes.



Legal Basis – State level

- State public utility commissions have jurisdiction over the distribution functions of the utilities within their state (retail electricity sales) and approval for the physical construction of electric generation facilities.
- Five of the six New England states passed laws requiring utilities to divest themselves of their generation assets.

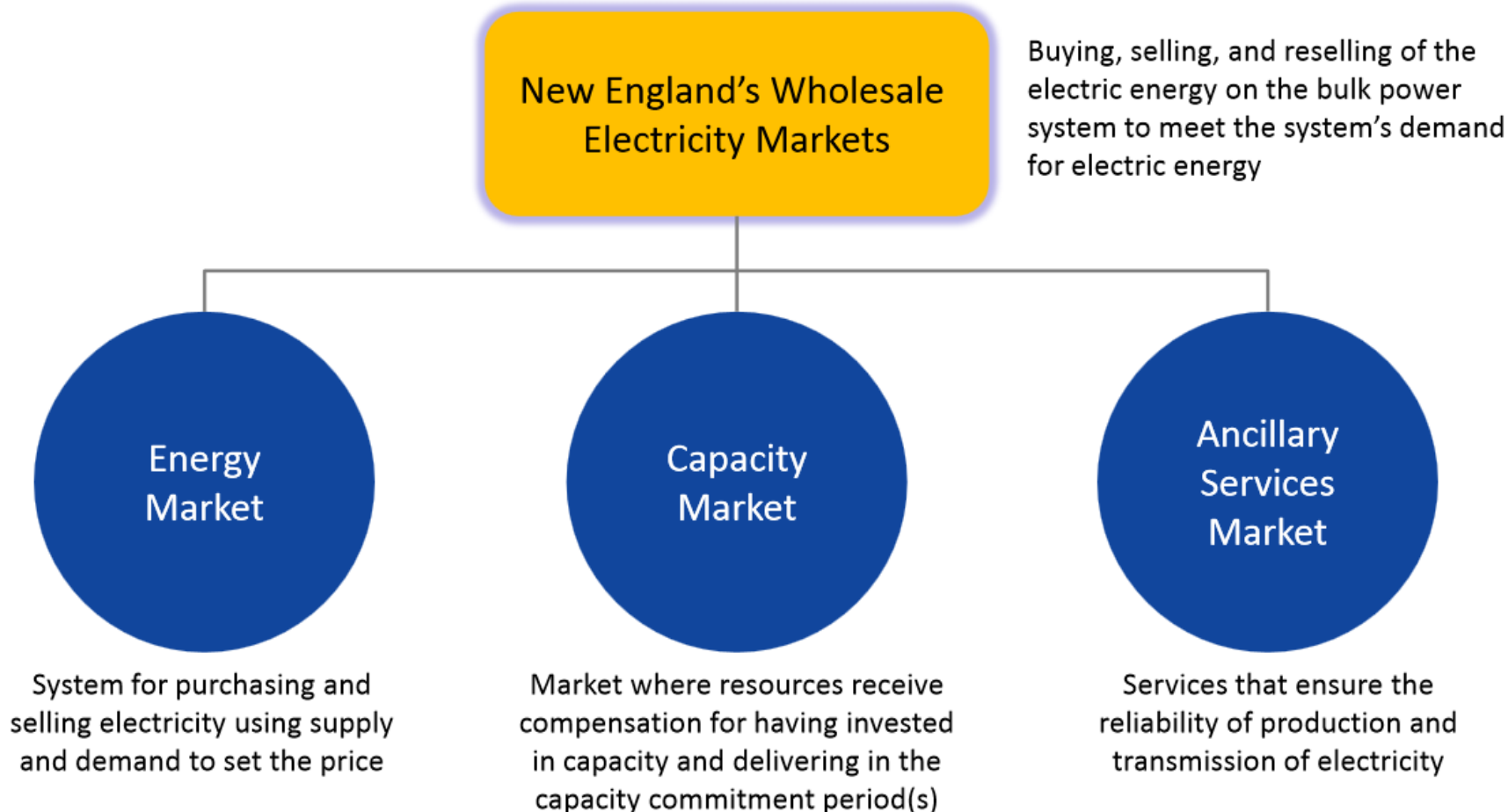


Creation of the Markets

- ISO-NE, NEPOOL and the states worked together to implement the wholesale markets in 1999.
 - Between 1999 and 2003, New England experienced a 34%, or about a 10,000 MW, increase in new plants, significantly improving reliability and making genuine competition possible.
- In 2003, the region adopted the Standard Market Design (“SMD”).
 - SMD added features such as a Day-Ahead Market to protect against price volatility.
- In 2008, ISO-NE held its first Forward Capacity Auction and the Forward Capacity Market was implemented in 2010.



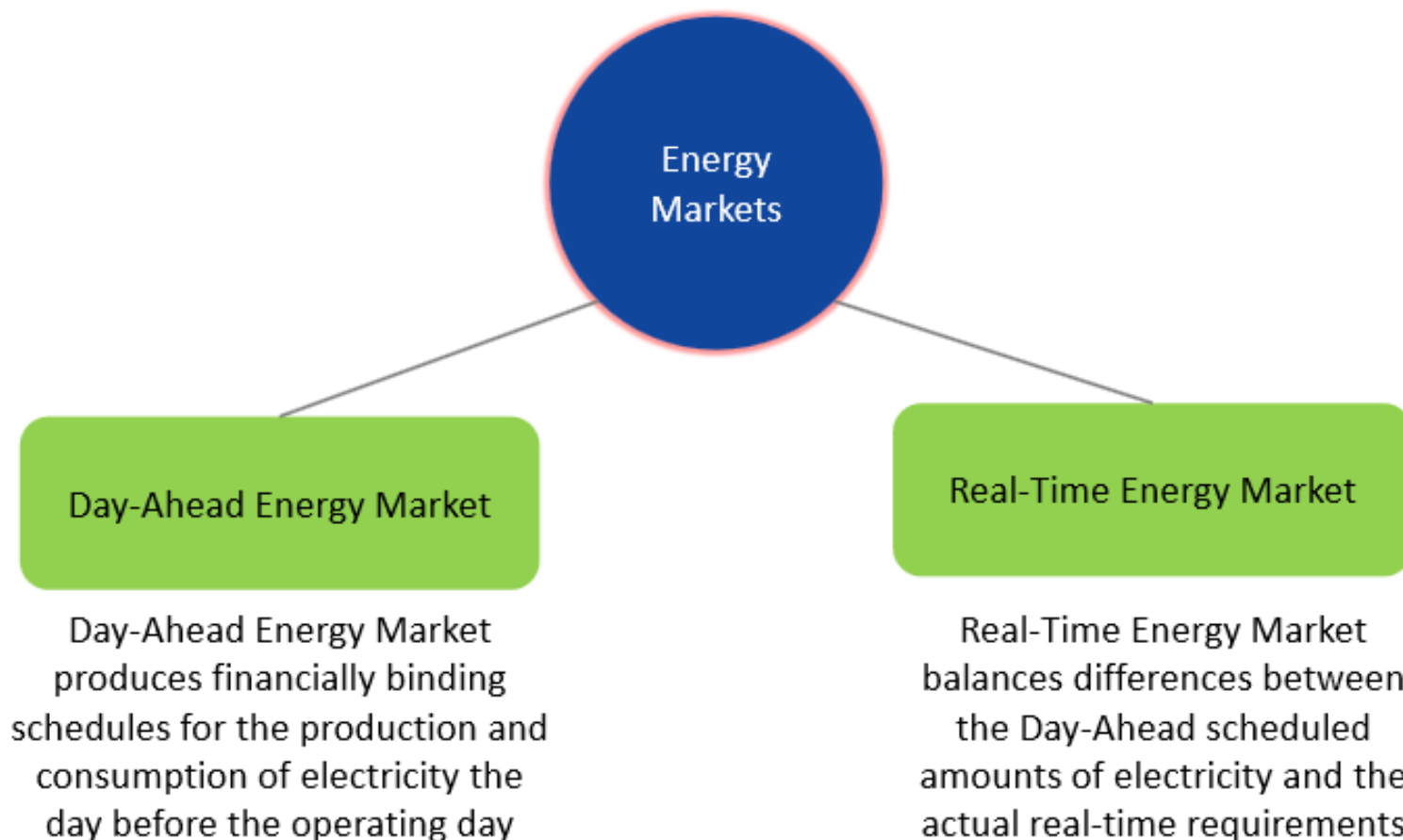
New England's Wholesale Electricity Markets





New England's Wholesale Electricity Markets

Electric Energy Markets





Electricity Auctions

- Daily Auctions for Electric Power
 - Day-ahead market
 - Real-time market
- Yearly Auctions for Capacity
 - Done on a three-year forward basis
 - Reconfiguration auctions are done closer to the delivery time for any over or under purchase of capacity
- Buyers and sellers are:
 - Large energy users (buyers)
 - Distribution utilities/retailers (buyers, serving homes/businesses)
 - Power plant owners (sellers)
 - Financial traders (buy and sell)



Locational Marginal Pricing

- The auctions (both forward and spot) determine prices that can vary by location.
 - Losses occur when you move power and vary based on how much transmission power must go over the lines.
 - There can be “congestion” (transmission limits) on the power grid that may limit the usage of the cheapest power sources at times.
- There are hundreds of distinct locations and distinct prices in our system.
 - Prices can change
 - Every few minutes during the spot market
 - Every hour in the Day-Ahead Market



<http://isoexpress.iso-ne.com/quest-hub?sessionid=CAB2E99A093B785AF3B6DBCBE73A547>

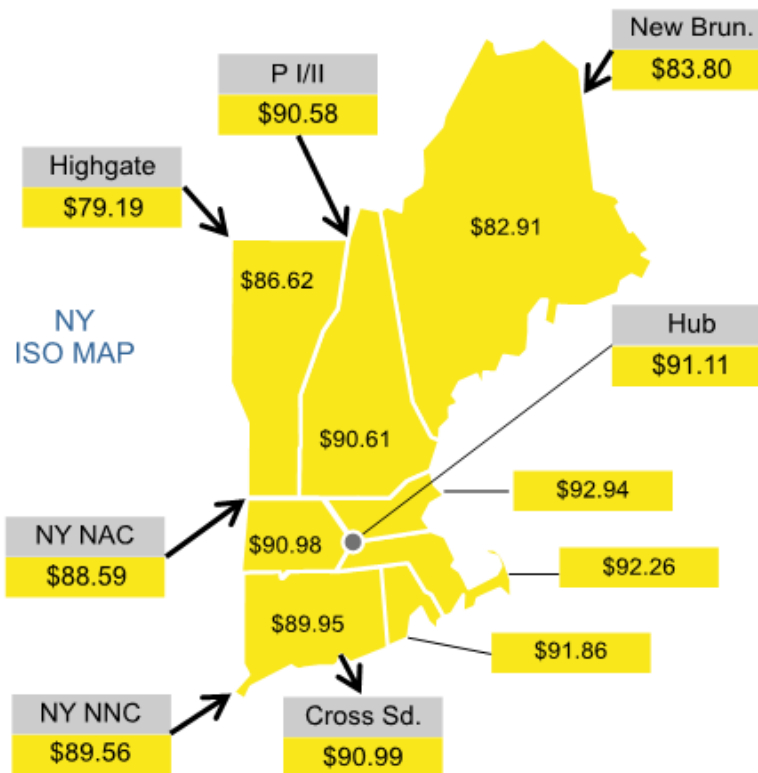
^ LMP MAP: REAL-TIME

Day-Ahead

Real-Time

NE Energy: \$90.31

System Demand: 14865 MW



Sampling Period: 04/23/2014 11:15 AM



<http://isoexpress.iso-ne.com/guest-hub;jsessionid=CAB2E99A093B785AF3B6DBCBE73A547>

FIVE-MINUTE REAL-TIME LMP LIST

All **Zones** Interfaces

Zone/Interface	Energy	Cong	Loss	LMP
.H.INTERNAL_HUB	\$77.61	\$0.26	\$0.38	\$78.25 ↑
.Z.MAINE	\$77.61	\$-2.31	\$-3.76	\$71.54 ↑
.Z.NEWHAMPSHIRE	\$77.61	\$0.26	\$-0.10	\$77.77 ↑
.Z.VERMONT	\$77.61	\$0.26	\$-3.25	\$74.62 ↑
.Z.CONNECTICUT	\$77.61	\$0.26	\$-0.57	\$77.30 ↑
.Z.RHODEISLAND	\$77.61	\$0.26	\$1.03	\$78.90 ↑
.Z.SEMASS	\$77.61	\$0.26	\$1.33	\$79.20 ↑
.Z.WCMASS	\$77.61	\$0.26	\$0.30	\$78.17 ↑
.Z.NEMASSBOST	\$77.61	\$0.26	\$1.90	\$79.77 ↑

New England Load (MW) 14865.31

Updated: 04/23/2014 11:30 AM



What are Financial Transmission Rights (FTRs)?

- A FTR is a financial instrument that may be purchased to insulate against congestion costs in the Day-Ahead Energy Market
 - Congestion is any condition that occurs when insufficient transmission capacity is available to support delivery of the least cost resources to serve the load
- FTRs do not represent a right for physical delivery of power
 - Entitles the holder to receive compensation (charge/credit) for congestion costs in the Day-Ahead Energy Market
 - Values are based on the difference in Locational Marginal Prices (LMPs) between the source and sink
- Participants acquire FTRs by auction



Congestion on the Transmission System

- When there is an element in the Transmission System that is at its limit, it means no more energy can flow across that element without potentially overloading the system.
- That means the next MW to serve some areas may come from different generators.
 - For instance if the transmission interface from Maine to the rest of the system was at its limit and no more cheap power available in Maine could be delivered to the system, Maine could be being served by \$40/MWh Generator, while the rest of the system still needs to dispatch a \$52/MWh Generator somewhere else in the system.
 - Some of that \$40/MWh Generation is serving the rest of the system, but the load that is using it is paying \$52/MWh. Where does the \$12/MWh difference go?
 - This difference is considered Congestion Revenue and is used to pay FTR holders.



Benefits of the market

- Enhanced reliability: the lights stayed on in almost all of New England during the August 2003 system failures that blacked out much of the Northeast, Midwest and Canada affecting about 50 million people.
- Encouraged new entry in the beginning of the process, which led to robust competition.
- New power plants typically use more efficient and cleaner-burning natural gas technology, which has reduced emissions of nitrogen oxides (NO_x), sulfur dioxides (SO_x) and carbon dioxide (CO₂).



Drawbacks of the market

- For many years, the system had more capacity than was needed and the clearing price in the Forward Capacity Market was set administratively at a floor price. The floor price had the effect of keeping some units in this market longer than would have been possible otherwise. This also had the effect of discouraging new entry.
- System planning is hampered in the non-vertically integrated states because the states cannot direct where the resources should be built.



Lessons Learned

- A market can have a combination of vertically integrated resources and non-vertically integrated resources.
- Key features are open access and non-discriminatory pricing.
- Market development can be done in stages.



Information Sources

- Federal Energy Regulatory Commission:
<http://www.ferc.gov/>
- ISO New England:
<http://www.iso-ne.com/>
- Massachusetts Department of Public Utilities:
<http://www.mass.gov/dpu>



Questions?

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