RTOs, ISOs and Wholesale Electricity Markets

Jacqulynn Huguee
Associate General Counsel
PJM Interconnection, L.L.C.

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Topics for Discussion

Purpose and function of RTO/ISO

Why become member of RTO/ISO

How becoming member of RTO/ISO affect utility decisions to construct or decommission facilities

Role of wholesale electricity markets operated by RTOs/ISOs
Topics for Discussion

Purpose and function of RTO/ISO
What is an Independent System Operator (ISO)?

- An independent entity that is responsible for:
  - Facilitating open access to transmission
  - Operating the transmission system independently of wholesale market participants
  - Fostering competition for electricity generation among wholesale market participants
  - Ensures reliability of high-voltage electric power system
What is a Regional Transmission Organization (RTO)?

• An independent entity that is responsible for:
  – Operating competitive wholesale electricity markets
  – Administering transmission tariff
  – Safe and reliable operation of regional power grid
  – Ensuring competitive open access to transmission where no member or member group has undue influence
  – Plans regional transmission expansion improvements
Electric industry historically traded electricity through bilateral transactions and power pool agreements.

FERC Order No. 888 issued in 1996 required mandatory open transmission access by all transmitting utilities and promoted the concept of ISOs.

In 2000, FERC in Order No. 2000, encouraged utilities to join RTOs, to operate the transmission systems and develop innovative procedures to manage transmission equitably.

Orders Nos. 888 and 2000, along with the efforts of the states and the industry, led to the voluntary organization of ISOs and RTOs.
Organization of RTOs and ISOs

Several groups of transmission owners formed ISOs, some from existing power pools.

Each ISO and RTO subsequently developed full scale energy and ancillary service markets in which buyers and sellers bid for or offer generation.

ISOs and RTOs used bid-based markets to determine economic dispatch.

While two-thirds of the nation's electricity load is served in RTO regions, major parts of the United States operate under more traditional market structures, notably the West (excluding California) and the Southeast.
Nine ISOs and RTOs in North America

There Are Nine ISOs and RTOs in North America


- California ISO
- Alberta Electric System Operator
- Electricity Reliability Council of Texas
- Southwest Power Pool
- Midcontinent ISO
- Ontario Independent Electricity System Operator
- PJM Interconnection
- New York ISO
- ISO New England
Regulatory Implications

Planning
- Rolls-up regional plans
- Coordinates with Canada, Western Interconnect and Texas
- Receives stakeholder input and holds public meetings
- Performs studies of various transmission alternatives against national, regional and state energy/economic/environmental objectives
- Identifies gaps for further study

Annual interconnection analysis

Review/directs
- Order adjustments
- Cost recovery

Regional plans

Regional/compliant state plans provided as input

ISO/RTOs & Order 890 Entities

Regional

States

DOE / FERC

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<table>
<thead>
<tr>
<th>Functions - Demand</th>
<th>Load Serving Entity</th>
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<tr>
<td>Forecast for reliability analysis</td>
<td>Load forecast for commercial position</td>
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<tr>
<td>Ensure adequate generation scheduled and dispatched to satisfy load</td>
<td>Manage energy supply requirements</td>
</tr>
<tr>
<td>Accept demand bids in Day-Ahead Market</td>
<td>Manage generation adequacy contracts</td>
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<tr>
<td>Administer demand response</td>
<td>Enter into hedging contracts</td>
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<tr>
<td>Operate reserve requirements</td>
<td>Enter into contracts with wholesale / retail customers</td>
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<td>Administer capacity requirements</td>
<td>Interaction with state regulators</td>
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<tr>
<th>Functions - Supply</th>
<th>Generation Owner</th>
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<tr>
<td>Perform real-time generation dispatch</td>
<td>Schedule generation outages</td>
</tr>
<tr>
<td>Accept generation offers in Day-Ahead and Real-Time markets</td>
<td>Manage generator offer information</td>
</tr>
<tr>
<td>Commitment, generation scheduling</td>
<td>Bilateral Contracts</td>
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<td>Generation control signals</td>
<td>Operate generating plants, Maintain plants, etc.</td>
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<tr>
<td>Load following</td>
<td>Offer various products (energy, capacity, regulation, spin, etc.)</td>
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<tr>
<td>Frequency control</td>
<td>Manage generation portfolio w/ three alternatives:</td>
</tr>
<tr>
<td>Ancillary services</td>
<td>Self-schedule</td>
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How Is RTO/ISO Different from a Local Utility?
Why become member of RTO/ISO
Why ISOs/RTOs are Good for North America

Cooperation + Competition = Measurable Benefits for All

1. Reliability: keeping the lights on
2. Efficiency: leading the way to tomorrow’s grid operations and diverse energy network
3. Transparent, open markets: dispelling the mystery of electricity, while promoting innovation, wise investment and least cost for consumers
4. Fostering innovation: moving forward with advanced grid technologies

http://www.isorto.org/about/topreasons
Locational prices (Prices signal system needs; participants respond)

Information (RTOs/ISOs exchange information)

Grid management (RTOs use best practices)
Efficiency

Ability to share resources reduces required reserve margins

RTO/ISO's breadth increases access to lower-priced, diverse supply resources

Prices are lower than they would have been under regulation
Increased market efficiency

- Information transparency increases confidence
- “Pancaked” transmission charges have been eliminated
- Central dispatch has increased trading volumes
Fostering Innovation

- Demand-response programs
- Encouragement for renewable generation, storage
- Track environmental/emissions
One RTO/ISO’s Value Proposition – PJM 2015

- Grid Services: $100 million savings
- Reliability: $475 million savings
- Integrating More Efficient Resources: $600 million savings
- Energy Production Costs: $525 million savings
- Generation Investment: Savings of $1.1 to $1.4 billion

Total Annual PJM Value: $2.8 to 3.1 billion

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How becoming member of RTO/ISO affect utility decisions to construct or decommission facilities
Factors

RTO/ISO requirements to build a resource and interconnect with regional transmission system

RTO/ISO requirements to meet before retire resource and disconnect from system

Financial implications
  - Cost to retire
  - Impact on ability to participate in wholesale electric markets

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PJM Queued Interconnection Requests
(Requested Capacity Rights)

- Gas, 74,000 MW
- Nuclear, 1,663 MW
- Other, 163 MW
- Solar, 2,203 MW, Nameplate Capacity, 3,766 MW
- Wind, 2,352 MW, Nameplate Capacity, 14,923 MW
- Biomass, 45 MW
- Wood, 66 MW
- Coal, 1,863 MW
- Methane, 97 MW
- Hydro, 209 MW
- Storage, 0 MW, Nameplate Capacity, 8,994 MW

December 31, 2015

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PJM Cumulative Generator Capacity Additions

- **Combined Cycle**: 23,368.7 MW
- **Combustion Turbine/Gas Turbine**: 6,909.7 MW
- **Steam**: 4,794.5 MW
- **Nuclear**: 1,402.3 MW
- **Wind**: 1,287.5 MW
- **Hydro**: 877.0 MW
- **Diesel**: 493.3 MW
- **Solar**: 205.7 MW
- **Fuel Cell**: 30.0 MW

**Total**: 39,369 MW

Gas = 75%
Role of wholesale electricity markets operated by RTOs/ISOs
Energy Supply Must be Balanced Against the Demand for Power
RTO Markets and Features

- Day-ahead energy market
- Real-time energy market (balancing market)
- Capacity market
- Ancillary services market
- Financial transmission rights
- Virtual trading
- Demand-side response
Organized Competitive Wholesale Markets

- Lower costs
- Broaden access to diverse power technology
- Increase reliability

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Day-ahead Energy Market

- Schedules electricity production and consumption before the operating day
- Produces financially binding schedules for the production and consumption of electricity one day before its production and use (the operating day)
- Purpose is to give generators and load-serving entities a means for scheduling their activities sufficiently prior to their operations, based on a forecast of their needs and consistent with their business strategies

Real-time Energy Market (Balancing Market)

Reconciles any differences between the schedule in day-ahead market and the real-time load while observing reliability criteria, forced or unplanned outages and the electricity flow limits on transmission lines.

Used to balance the differences between the day-ahead scheduled amounts of electricity based on day-ahead forecast and the actual real-time load.

Run hourly and in 5-minute intervals and clears a much smaller volume of energy and ancillary services than the day-ahead market.

For generators, it provides additional opportunities for offering energy into the market.


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RTOs, like other electric systems, are required to maintain adequate generation reserves to ensure that sufficient generation and demand-resource capacity are available to meet load and reliability requirements.

Some RTOs use a capacity market to obtain capacity commitments.

These markets cover short-term capacity, such as a month, season or year.

PJM and ISO-NE run capacity auctions up to three years prior to when the capacity is needed. The near-term focus is consistent with providing payments to existing generation, or generation such as combustion turbines that can be sited and built within three years.

Ancillary services are functions performed by electric generating, transmission and system-control equipment to support transmission of electric power from generating resources to load while maintaining the reliability of the transmission system.

RTOs procure or direct the supply of ancillary services.

Ancillary Services procured in market:
- Spinning reserve
- Supplemental (Non-spinning) reserve
- Regulation and frequency response service
- Day-ahead scheduling reserve

Ancillary Services not procured in market, but through cost-based rates:
- Voltage support/control
- Black-start service
- Reactive service
Financial Transmission Rights (FTRs)

FTRs are contracts that give market participants an offset, or hedge, against transmission congestion costs in day-ahead market, and vary by RTO.

Protect holder from costs arising from transmission congestion over a specific path on the grid.

Originally developed in part to give native load-serving entities (LSEs) in the nascent RTOs price certainty similar to that available to traditional vertically integrated utilities operating in non-RTO markets.

Practice continues, as FTRs are allocated to LSEs, transmission owners or TR holders based on historical usage, and to entities that fund the construction of specific new transmission facilities.

Virtual Trading

Virtual bids and offers are used by traders to profit from differences between day-ahead and real-time prices.

Quantity of MW purchased or sold by trader in day-ahead market is exactly offset by sale or purchase of an identical quantity of MW in real-time, so the net effect on the market quantity traded is zero.

Primary benefits of virtual transactions are achieved through their financial impact on the markets -- they result in convergence bidding because they theoretically cause day-ahead and real-time prices to converge each hour.

The convergence of day-ahead and real-time prices within the RTOs is intended to mitigate market power and improve the efficiency of serving load.
Demand Response

Electricity demand is generally insensitive to price, meaning that demand does not typically fall when wholesale prices rise because most end use consumers of electricity are not exposed to real-time electricity prices.

Some utilities and grid operators are developing ways to stimulate a response from consumers through demand-response programs.

Demand response (DR) is the reduction in consumption of electricity by customers from their expected consumption in response to either reliability or price triggers where the customer forgoes power use for short periods, shifts some high energy use activities to other times, or uses onsite generation.
Demand Response

DR programs use price signals or incentives to prompt customers to reduce their electricity consumption to respond to electric power system needs or high market prices.

Lowers system-wide power costs and assist in maintaining reliability.

Can be used instead of running power plants or to relieve transmission congestion. There can also be environmental benefits because peaking units tend to be costly - and dirty - to run.

Demand response rewards consumers for reducing load during certain market conditions and at specific times.


http://www.isorto.org/Pages/Home
Questions?