POTOMAC ECONOMICS

Market Monitoring

Presented by:
Dr. Robert Sinclair

Presented to:

Georgian Energy Policy Delegation

April 30, 2012

Kentucky Public Service Commission

POTOMAC ECONOMICS

Potomac Economics

- Potomac Economics is a leading provider of independent market monitoring, expert analysis and advice, and litigation support services to the electricity and natural gas industries.
- Potomac Economics has extensive experience in the areas of market design, pricing, regulatory policy, antitrust and other competitive issues.
- Potomac Economics is a leader in the field of monitoring and competitive assessment of wholesale electricity markets in the U.S., serving as the Independent Market Monitor for
  - ✓MISO;
  - ✓ERCOT;
  - ✓New York ISO; and
  - ✓ISO New England.

POTOMAC ECONOMICS

Topics

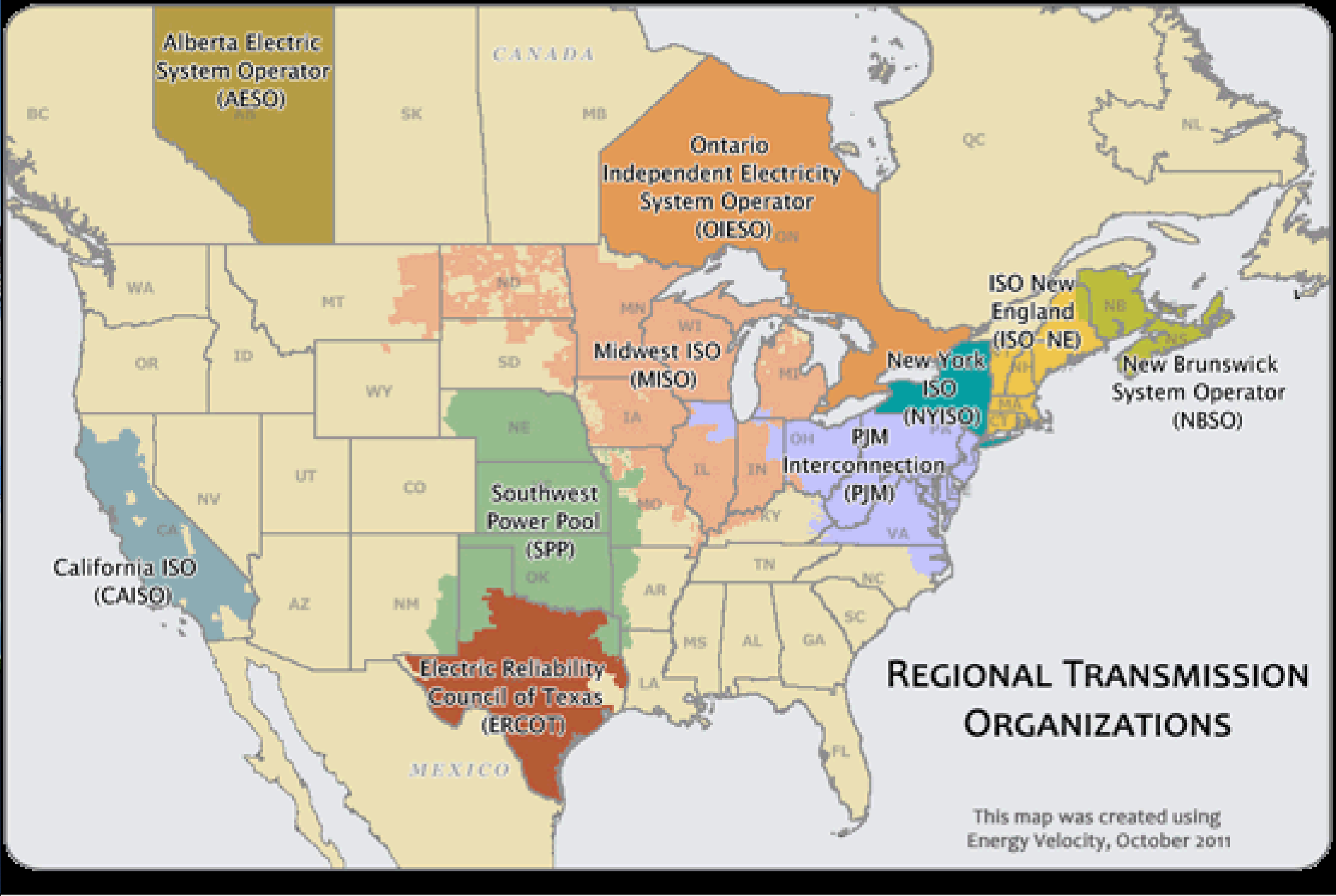
- RTOs and competitive power markets
  - ✓ Energy
  - ✓ Capacity
- RTOs cross-border energy trading
- RTO governance and stakeholder organization.
- Roles of key agencies in regional transmission expansion
- Ensuring open access to transmission and distribution systems.

Regional Transmission Organizations (RTOs)

POTOMAC ECONOMICS

Regional Transmission Organizations

- RTOs are an combination of utility transmission systems that had historically operated separately at the company level, e.g., Ameren, Illinois Power;
- Under an RTO, the individual companies operate jointly under an independent (RTO) management (assets still owned by individual utilities);
- This allows a sharing of economies of scale in transmission operations and planning without ownership consolidation;
- This allows development of regional markets that eliminate multiple transmission rates and allow increased liquidity;



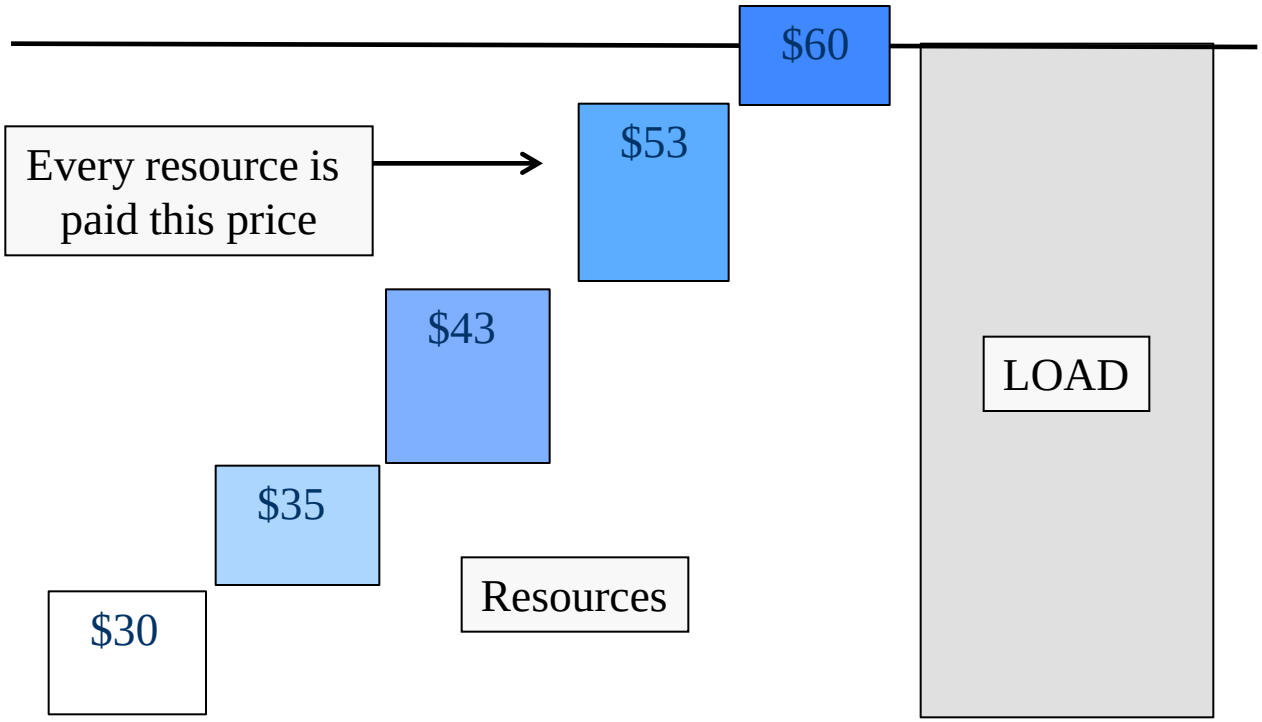
From FERC Website

RTO Markets

- The general approach to RTO markets is a two settlement system whereby:
  - ✓ First settlement is in a day-ahead market that establishes the day-ahead commitment;
    - – The market establishes which units will be started for the next day and at what MW level they will produce;
    - – The committed units must start-up and provide the offered output level in the real-time market
  - ✓ Second settlement is in real-time balancing that seeks to serve:
    - – Load not served by day-ahead contract (load under bid, under forecast)
    - – Supply not provided by day-ahead contracts

RTO Energy Markets

- In both markets, a "SECOND-PRICE Auction is used - Bids are stacked against the load and the second-highest-offered resource to clear load establishes the clearing price for all offers clearing the market



POTOMAC ECONOMICS

RTO Energy Markets

- When there is no market power (no dominance of a single supplier or group of suppliers), the second price auction causes participants to offer at their short-run marginal costs.
- The market clearing engine has information for all generators and loads and their associated "nodes",
  - ✓ which are the same (in general) as "electrical buses" on the network;
- Given the generation offers, the market clearing engine tries minimize overall production costs (including commitment costs) to serve the load at each node;

RTO Energy Markets

- If congestion occurs, prices may be different at different locations on the grid;
  - ✓ The model may not be able to dispatch a unit to its full output because of transmission limits.
  - ✓ This may cause a nodal prices to be different at different locations;
  - ✓ The difference between prices at two locations is the congestion cost, it is the shadow price indicating how much overall production cost will decline if the transmission limit were to be increased by a MW.
- Financial Transmission Rights
  - ✓ Allows buyers to hedge against congestion
  - ✓ The holder of the FTR is paid back the congestion costs it experienced between given locations
  - ✓ The rights were initially allocated to existing grid users;

RTO Capacity Market

POTOMAC ECONOMICS

RTO Capacity Markets

- In theory, the two-settlement system could provide the basis for investment decisions.
  - ✓ If capacity is short, the highest-cost unit will set the price and encourage new entrants.
  - ✓ However, this requires severe price spikes, which is undesirable from a policy perspective (California had an energy-only market prior to 2001);
- To avoid the price volatility from relying only on an energy market, RTOs have developed various capacity market mechanisms;
  - ✓ These are based on certain capacity adequacy requirements that each load serving entity has to meet;
  - ✓ The load-serving entity has a requirement to purchase capacity in a "capacity market"

RTO Capacity Markets

- Load Serving entity can meet capacity obligation through:
  - ✓ Self-supply,
  - ✓ Buying in bilateral contract, or
  - ✓ Buying monthly and annual capacity in centralized markets operated by RTOs
- The amount of capacity that the load-serving entity provides is established by RTO through stakeholder processes involving regulators.
- Any capacity supplier satisfying a capacity requirement is require to participate in the day-ahead market;
- In some markets, a capacity demand curve is established to stabilize prices;

Trading between RTOs

POTOMAC ECONOMICS

Trading between RTOs

- Trading between TSOs occurs through a scheduling process;
- This scheduling can be in the day-ahead or the real-time market
- In the day-ahead market scheduling allow sales into the day-ahead market (for import) or a purchase from the day-ahead market (for export)
  - ✓ For an import transaction, the scheduler must provide the import to the real-time market or buy it from the real-time market;
- Scheduling in the real-time market is on an hourly basis;
  - ✓ Real-time scheduling between RTOs is an attempt to arbitrage expected price difference:
  - ✓ If a trader in RTO A thinks the price in the next hour will be higher in RTO B, the trader may want to schedule from A to B;

Regional Governance

POTOMAC ECONOMICS

Transmission Expansion

- RTOs are responsible for identifying appropriate expansion of transmission within their system.
  - Reliability and economic additions are paid for on a system - wide basis;
  - Expansion required for new resources are paid for by the resource itself;
- FERC Order 890 called for coordinated, open, and transparent planning to facilitate customer participation in the planning and expansion of the transmission grid.
  - greater participation by transmission customers and other stakeholders in the planning process,
  - including providing these entities with greater information and access to planning data and models.

Open Access

- Open access is based on FERC Order 888, which required transmission owners to allow third-party access on a general basis.
  - ✓ A load-serving entity could purchase "network service, which allowed use of the entire transmission network to integrate loads and resources.
  - ✓ Other users could gains access through point-to-point-service (for imports or so-called "wheel-through" service).
  - ✓ Rates were based on average cost per MW of total transmission load. Network customers paid a load-ratio share of total costs (net of PTP revenue)
- RTOs adopted the network service for load serving entities in RTOs.

Market Monitoring

POTOMAC ECONOMICS

Rationale for Market Monitoring

- What is ***Market Monitoring***?
- ***Market Monitoring*** is to ensure competition in liberalized markets.
  - ✓ Competition itself may not be enough to endure efficient outcomes
  - ✓ Vertical Market Power (control of transmission)
  - ✓ Horizontal Market Power (control of generation)
- The role of ***market monitoring*** has been to advise and inform the regulator.
  - ✓ The structure of the market (concentration, vertical integration);
  - ✓ Compliance with market rules;
  - ✓ Behavior of individual market participants and the market as a whole;

Rationale for Market Monitoring

- ***Market Monitoring*** provides a focused observation of market activities, conduct, and outcome;
  - ✓ Experience in other regions has indicated that market monitoring should be in place before market opening;
  - ✓ Development of the monitoring approach should proceed in parallel coordination with the development of the market design;
- ***Market monitoring*** is conducted using screens and analyses that rely on both public data and data from market participants;

Rationale for Market Monitoring

- ***Market Monitoring*** seeks to identify solutions to market structure flaws;
  - ✓ solutions should lead to improved market outcomes;
- ***Market Monitoring*** seeks to identify potential anticompetitive conduct
  - ✓ often detecting activities is sufficient to cause change in conduct;
  - ✓ The mere presence of a monitoring system can deter anticompetitive conduct;
- ***Market Monitoring*** provides a path toward greater transparency, a goal that has been recognized as contributing toward development of efficient markets;

Market Monitoring Practices

- ***Market Monitoring*** is most noticed in centralized spot markets (RTOs, Midwest ISO, PJM ISO, New York ISO)
  - ✓ These markets have multi-lateral exchanges;
- Monitoring involves reporting and specific studies of outcomes
  - ✓ (Annual and quarterly reports
- Monitoring also employs market power ***mitigation***.
  - ✓ This activity monitors conduct on a continuous basis and can market generally employ offer caps when a supplier is inside a constrained area.
  - ✓ The offer cap is linked to estimates of the supplier's marginal cost
    - – This marginal cost is sometime based on historical behavior
- Mitigation is also applied to other behaviors;

Rationale for Market Monitoring
Non-RTO Markets

- Market monitoring is also conducted in non-RTO markets.
- In non-RTO markets, bilateral trading systems rely on open-access transmission tariffs to ensure non-discriminatory access to transmission service.
  - ✓ ***Market monitoring*** in these market focuses on the operation of the transmission network and the adherence to open-access policies.

Market Monitoring in South East Europe

POTOMAC ECONOMICS

Market Monitoring Indicators

- Market Monitoring in SEE is focused on individual ***Indicators***
- An indicator is focused on a market or operating variable (e.g., load level)
- The Indicator shows whether a certain variable is outside an ***established range***.
- If an Indicator is outside a range, then regulatory intervention is recommended.

Market Monitoring Indicators

Three-Step Monitoring Process

- Calculate Indicator
  - ✓ Based on some theory of market performance or outcome (e.g., TRM value)
- Establish Threshold Range
  - ✓ Based on an expected competitive value of the indicator (What to expect under competitive conditions)
- Regulatory Follow-up if Necessary
  - ✓ Regulator will attempt to "Mitigate" when Indicator exceeds threshold

SEE Monitoring

- Market Monitoring in SEE is focused on access to cross-border transmission capacity;
- Transmission capacity is established using Net Transfer Capacity (NTC) estimates;
- A key part of the market monitoring is monitoring assumptions of the Capacity Assessment;
  - ✓ Capacity Assessment is the process used to estimate the level of cross-border transmission capacity that can be used to transfer electricity between control areas.

Underlying Theory of SEE Market Monitoring Indicators

Network Model Base Case uses forecasts to estimate available cross-border capacity:

Base Case Assumptions

- Base Case Exchange (expected trades between control areas)
- Forecast Load
- Forecast Generation
- Transmission Topology

Error in Assumptions

→ Error in NTC

→ Restrict Cross-Border Trade

POTOMAC ECONOMICS

SEE Market Monitoring Indicators

Base Case Assumptions

- BCE →
- Forecast Load →
- Forecast Generation →
- Transmission Topology →

Market Monitoring Indicators ask: Are these assumptions accurate?

Base Case Exchange Indicator

Base Case Exchange (BCE) Indicator

- Monitors the accuracy of cross-border transactions forecasts in Network Model;
- BCE values are a forecast of cross-border commercial schedules.
- Therefore, the BCE Indicator is simple
  - ✓ Compute the ***forecast error*** and
  - ✓ Establish a ***threshold range***.

Base Case Exchange Indicator

BCE Indicator

Forecast Error:

(Forecast – Actual) / Actual

(BCE – Commercial Schedules) / Commercial Schedules

- Indicator 1- Indicator 6 are all focused on testing some aspect of a forecast;
- Hence, all six indicators use the forecast error formula;

Base Case Exchange Indicator

BCE Indicator

Two Elements to the Indicator

(1) Compute Forecast Error

(2) Threshold Range:

Threshold Range

Indicator Violation when

Forecast Error > Threshold ⟶ **?**

(BCE – Commercial Schedules) / Commercial Schedules

Base Case Exchange Indicator

BCE Indicator

Threshold Range:

- The threshold ranges used for the BCE Indicator as well as the other Indicators is based on Reference Values;
- Reference Values are used in market monitoring to establish "competitive benchmarks"
  - ✓ Basic idea of the Reference Value is to estimate what a supplier would do under competitive conditions.
  - ✓ One approach is to use suppliers historical behavior during periods deemed competitive.
    - (e.g., in centralized RTO markets, historical bid/offers are used that occur in low-priced periods)

Base Case Exchange Indicator

BCE Indicator

Reference Levels

- The reference levels used in the MMG Indicators are based on historical values of the Indicator itself.
  - ✓We consider the range of forecast errors across all participants and all interconnections.
  - ✓We consider outliers in this collections of forecast errors to be “non-competitive” or modeling errors.
  - ✓Outliers are considered to be top 15% and bottom 15% of all observations.

Base Case Exchange Indicator

BCE Indicator

Reference Levels

Process:

1. For the prior four months, collect all forecast errors for the Indicator on all interconnections for all data providers;
2. The 15th percentile value and the 85th percentile values are identified. (roughly equal to the 90 percent confidence interval for a normal distribution)
3. Example.
4. The values at the 15th and 85th percentile are the threshold ranges.
   - ✓ Thresholds may be one- or two-sided;
   - ✓ BCE Indicator in one-sided: Forecast Error>Threshold
   - ✓ Load Forecast Indicator is two-sided:

Base Case Exchange Indicator

BCE Indicator

Reference Levels

Process:

4. The values at the 15th and 85th percentile are the threshold ranges.
   - ✓ Thresholds may be one- or two-sided:

     BCE Indicator is two-sided:

     $Threshold_L < Forecast\ Error < Threshold_H$
   - ✓ Other Indicators may be one-sided: Forecast Error < Threshold

Other Monitoring Indicators

POTOMAC ECONOMICS

Market Monitoring Indicators

- **Indicator 1**: Base Case Exchange (BCE) Indicator –Monitors the accuracy of cross-border transactions forecasts in Network Model;
- **Indicator 2**: Already Allocated Capacity Indicator – Monitors the usage of cross-border reservation to detect any withholding (Hoarding);
- **Indicator 3**: Critical Facilities Indicator – Monitors the accuracy of Network Model outcomes on cross-border limiting facilities;
- **Indicator 4**: Load Forecast Indicator – Monitors the accuracy of load forecasts in Network Model;
- **Indicator 5**: Generation Output Indicator – Monitors the accuracy of generation forecasts in Network Model;
- **Indicator 6**: TRM Indicator – Monitors TRM calculations;
- **Auction Data Indicators** – Indicators the results of cross-border capacity auctions;

South East Europe Automated Market Monitoring System (SEEAMMS)

POTOMAC ECONOMICS

SEEAMMS

South East Europe Automated Market Monitoring System

SEEAMMS automates:

- ✓ Data Collection/upload
- ✓ Data Storage
- ✓ Indicator Calculation (forecast error)
- ✓ Threshold Calculations
- ✓ Indicator “Variances”
- ✓ Reporting and downloads;