Resilience and Emerging Issues in Wholesale Electricity Markets

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What is Resilience?

- If you ask six people, your likely to get eight answers.
  - ✓ Proof: read the RTOs' comments on resilience filed at FERC.
  - ✓ Concern: ambiguous terms can be adopted opportunistically to support many agendas;
- In broad terms, resilience can address:
  - ✓ Network issues:
    - Hardening the system to be less vulnerable to catastrophic failures; and
    - Preparing to restore The system quickly after a catastrophic failure.
  - ✓ Reliability issues: having adequate available resources in the right locations to serve load.
- Examining and addressing network issues is a valuable focus for resilience.
  - ✓ Almost all serious blackouts are caused by transmission or distribution issues.
  - ✓ Unfortunately, very little of the discussion is focused on these issues.

Resilience and Reliability

- Addressing reliability issues in the name of resilience must be done carefully.
- RTO's are very good at reliability and most RTO systems are extraordinarily resilient from a reliability perspective
  - ✓ RTOs probabilistically evaluate system contingencies and establish planning requirements to satisfy a 1-day-in-10-year planning standard.
  - ✓ However, not all types of contingencies are planned for and evaluated (e.g.,, pipeline contingencies, extreme weather events, etc.)
- The RTO markets employ reliability and planning processes by:
  - ✓ Identifying the contingencies to plan for
  - ✓ Quantifying the resources needed to respond to the contingencies
  - ✓ Designing a market-based procurement to acquire the resources at least cost
- However, the energy markets are generally capable of maintaining reliability/resilience without relying on this planning process.

The Tension Between Planning and Energy Markets

- There are only a two fundamental products: energy and reactive power
  - ✓ Most other products are essentially options on energy in different timeframes (regulation, operating reserves);
  - ✓ Reliability and resilience are not products, they our expressions of demand for energy that exist only because the true demand cannot participate in the markets;
- How should reliability and resilience requirements ideally be established?
  - ✓ Ideally, they should be based on the fundamental value of the fundamental product: energy
  - ✓ What is energy worth to its consumers?

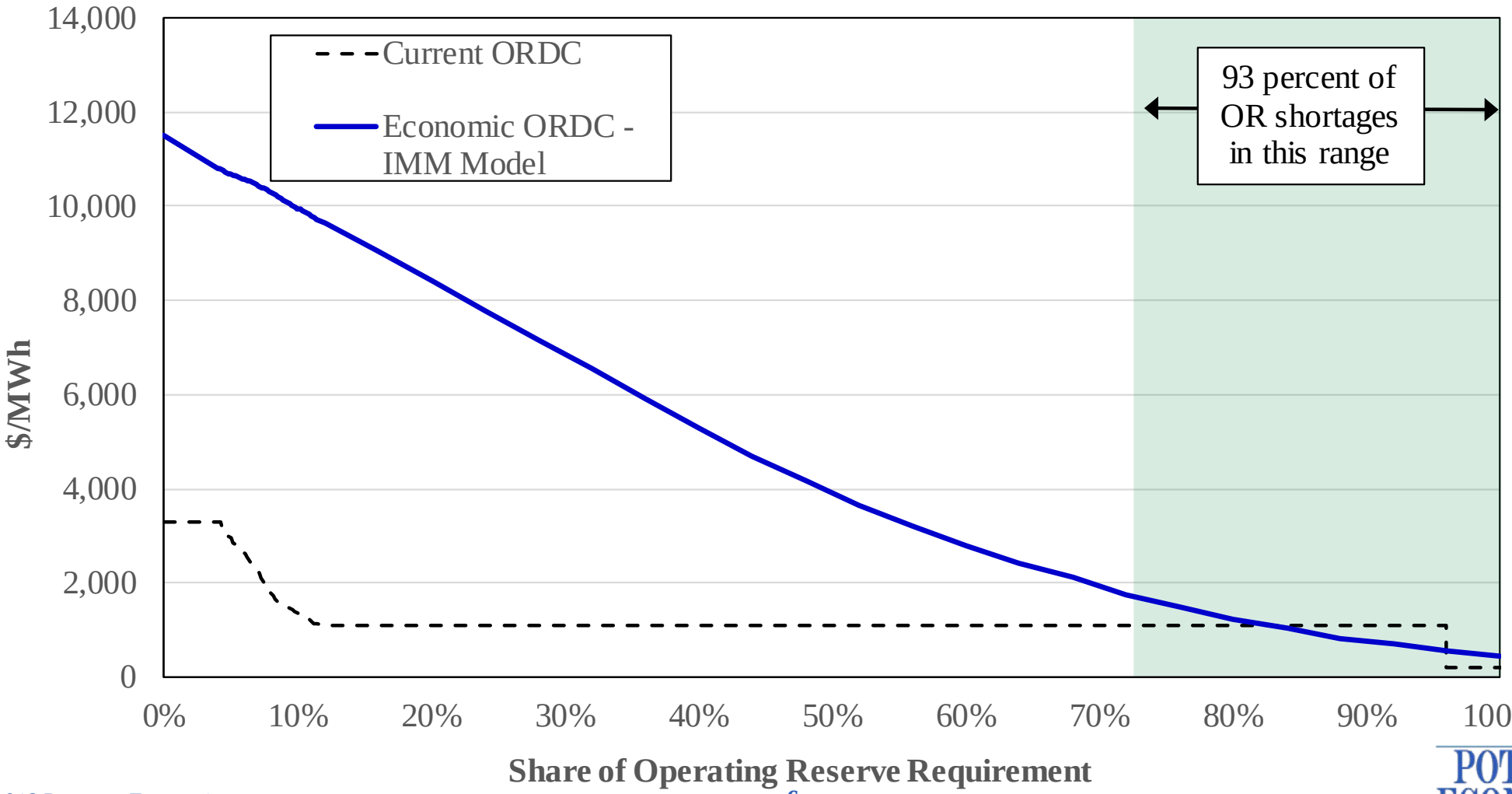
    "value of lost load" = $4000 to $25,000/MWh
  - ✓ Reliability requirements could be established that correspond to this value – stop requiring additional capacity when its costs exceed the reduction in expected value of loss load.
- RTOs do not do this, instead they plan to satisfy a 1-in-10 year planning standard.
  - ✓ **This standard implies a VOLL equal to $200,000 to $300,000/MWh.**

Achieving Resilience through Energy Markets

- So. . .*How can energy markets achieve reliability and resilience?*
  - ✓ Set VOLL to reflect the highest value load in the market and use it to price shortages by setting reserve demand curves =

    VOLL * Probability of Losing Load as reserve levels fall
  - ✓ When resources are not sufficient to satisfy all of the energy and reserve needs, the value of the foregone reserves will be reflected in energy and reserve prices
  - ✓ The expectations of the contingencies and other conditions that could lead to shortages (and associated shortage revenues) will motivate private investments to achieve an efficient level of reliability and resilience
- This approach is extremely robust and will address many issues, including:
  - ✓ The entry of large quantities of intermittent resources as increasing shortages from intermittency results in increasing revenues for flexible, fast-ramping resources.
  - ✓ Most fuel security issues associated with increasing dependence on natural gas; and

Example: MISO's ORDC Compared to an Economic ORDC



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When Do We Need Planning to Supplement Energy Markets?

- Energy markets can provide strong incentives to address conditions or contingencies whose probabilities can be estimated
- They will likely be less effective in facilitating the participant actions needed to address extremely low (or unknown) probability events that would be catastrophic
  - ✓ Participants are risk averse
  - ✓ The costs, if the contingency happens, would be to large for the system to bear (in reality or politically)
- For example, the analysis in our upcoming annual report for New England evaluates the recently announced retirement of a LNG terminal in Boston harbor, showing that:
  - ✓ A pipeline contingency could cause ISO-NE to fail to serve 10 to 15 percent of the load in New England during a cold two-week winter period
  - ✓ The economic and human costs of such an event are so large that making market-based procurements of a product that would insure against such an event is likely warranted

Conclusions

- Most of the RTO markets are extremely resilient
  - ✓ RTOs have been evaluating these issues for years and most concerns are overstated
  - ✓ Fuel security in New England is the exception
- To improve the resilience of the RTOs in other regions and prepare than to respond to change conditions and generation mix, improve real-time price formation:
  - ✓ Improve shortage pricing so it reflects VOLL and ensure that all shortages are priced
  - ✓ Price transmission shortages (when transmission flows cannot be managed)
  - ✓ Price high-cost emergency actions by operators that prevent shortages
  - ✓ Increase participation and price-setting by demand in the real-time market
  - ✓ **Then…trust that the markets will respond**
- Except in cases that energy markets cannot address, RTOs should avoid:
  - ✓ Creating new products, pricing attributes, or making other market changes to generate additional revenues streams outside of the current energy markets