WINTER ENERGY SECURITY IMPROVEMENTS: MARKET-BASED APPROACHES

Discussion of a market-based solution to improve energy security in the New England region

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Background

- In accordance with FERC's July 2, 218 order in EL18-182-000, ISO-NE must develop and file improvements to its market design to better address regional fuel security
- ISO-NE is targeting a filing to FERC for October 15, 2019
- Today's discussion
  - First we will discuss the problem more granularly;
    - What are the core problems, the implications, and root causes
    - How are the core problems interrelated
  - Second, we will share our current thinking on design concepts to address these interrelated problems

Problem Statement

- There may be insufficient energy available to the New England power system during extended cold winter weather conditions to satisfy electricity demand, given the system's evolving resource mix and fuel delivery infrastructure
  - While there has been no loss of load to date on the bulk power system attributable to these conditions, ISO-NE is concerned this emerging issue will worsen over time due to observed industry trends

Conceptual Design Components

- **Multi-day ahead market.** Expand the current one-day-ahead market into a multi-day ahead market, optimizing energy (including stored fuel/input energy) over a multi-day timeframe and producing multi-day clearing prices for market participants' energy obligations
- **New ancillary services in the day-ahead market.** Create several new, voluntary ancillary services in the day-ahead market that provide, and compensate for, the flexibility of energy 'on demand' to manage uncertainties each operating day
- **Seasonal forward market.** Conduct a voluntary, competitive forward auction that provides asset owners with both the incentive, and necessary compensation, to invest in supplemental supply arrangements for the coming winter

PROBLEM DISCUSSION

Three Interrelated Energy-Security Problems

1. **Incentives and Compensation**. Market participants whose resources face production uncertainty may have inefficiently low incentives to invest in additional energy supply arrangements, even though such arrangements would be cost-effective from society's standpoint as a means to reduce reliability risks
2. **Operational Uncertainty.** There may be insufficient energy available to the power system to withstand an unexpected, extended (multi-hour to multi-day) large generation or supply loss, particularly during cold weather conditions
3. **Inefficient Schedules.** The power system may experience premature (inefficient) depletion of energy inventories for electric generation, absent a mechanism to coordinate and reward efficient preservation of limited-energy supplies over multiple days

Context and Implications

These are inter-related problems. Fundamentally, Problem 1 is the contributing (and arguable the primary) cause of both Problem 2 and Problem 3

- **Uncertainty.** Problems 1 and 2 apply to resources that do *not* routinely clear in the day-ahead market, but that the ISO may need to call upon to operate above any day-ahead market award
  - Such resources face uncertainty over when/how often they may operate
  - Empirically, we have not observed problems with resources that routinely clear in the day-ahead market failing to procure sufficient fuel/energy to meet their day-ahead award
- **The Alignment Problem.** The ISO's single day-ahead market ("SDAM") is not well aligned with the multi-day horizon over which the ISO is forecasting and operating an increasingly energy-limited system

Problem 1. Incentives and Compensation

- It is financially prudent for resources to incur up-front costs of unit-specific fuel/energy supply procurement and replenishment arrangements based on their *expected* energy output
  - For example, the up-front cost to arrange trucking for a prompt oil replenishment, or up-front fees for an intra-day notice gas contract with an LNG terminal, or other fixed costs associated with arranging fuel/inputs in advance relevant to a resource's technology

The Problem

- A resource that faces uncertainty over whether or how often it will operate may not incur such fixed costs for any unexpected energy output
- Otherwise, these fixed costs become a loss if the resource does not operate

Problem 1. Incentives and Compensation
Adverse Consequences

- **Reliability risks.** In extreme cases, this can result in extended reserve and energy shortages
- **Not cost-effective.** Inefficiently low procurement incentives may produce higher than necessary total costs compared to efficient procurement outcomes

<u>Bottom line</u>: Robust procurement and replenishment arrangements may not be in a resource's commercial interest under the current market design, even when such arrangements would be beneficial and cost-effective for the system

Problem 1. Incentives and Compensation
Root Causes

- **Uncertainty** over whether or not the resource will be in demand
- **Fixed Costs** of resource-specific procurement and replenishment arrangements, which will be a financial loss to the generator if it does not operate
- **The decision to make fuel arrangements *matters*** *(i.e., impacts reliability and market outcomes)*
  - In the past, if a resource wasn't able to operate (for fuel or any other reason), there were sufficient energy stocks to dispatch up another resource in its place
  - This assumption may not be valid in an increasingly energy-limited system, especially during cold winter conditions
  - These decisions could dramatically impact the energy price, especially if demand turns out to be high (or cause a deficiency)

Problem 2. Operational Uncertainty

- Imagine a situation when, after the day-ahead market clears, we unexpectedly lose a large (non-gas) resource for an extended duration
  - The energy needed to replace the lost resource must come from a resource that did not clear in the day-ahead market

The Problem

- As a consequence of Problem 1, it is not certain that a replacement resource will have adequate fuel/energy supply arrangements (especially if the replacement resource does not routinely clear in the day-ahead market)
- Conceptually, this implies the need for an 'energy margin' to address uncertainty

Problem 2. Operational Uncertainty

What Supply Does the ISO Rely On Above Day-Ahead Market Awards

Three operational categories:

A. **Replacement Energy.** Energy needed if a day-ahead cleared resource is unable to perform for an extended (multi-hour or multi-day) duration

B. **Operating Reserves for Fast-Start/Fast-Ramping Contingency Response.** Energy from resources that the ISO relies upon for real-time operating reserves in the day-ahead current operating plan, including both off-line resources and ‘upper blocks’ of on-line (spinning/synchronized) resources

C. **Load-Balance Reserves.** Energy to supply the difference when forecast load exceeds day-ahead cleared physical supply

Problem 2. Operational Uncertainty
Implications

- **Quantity.** Depending on the day, there may be up to approximately 4-6 GW of resources in categories A, B, and C, for which Problem 1 is a concern
- **Not a fixed set of resources.** The most cost-effective set of resources to meet these needs can and does vary daily
- **The 'Margin' for uncertainty.** An additional 'margin' is needed to address operational uncertainties in an increasingly energy-limited system

Problem 2. Operational Uncertainty
Adverse Consequences

- **Reliability risks.** Absent a 'margin' for uncertainty, with stronger incentives for advance fuel/energy supply arrangements, this can in extreme cases result in extended reserve and energy shortages
- **Not cost-effective.** Inefficiently low procurement incentives may produce higher than necessary total costs compared to efficient procurement outcomes
- **Timing problems.** The system may not be well positioned for resources to start-up/ramp-up in a cost-effective way when real-time reserves must be converted back from energy to reserve status after a contingency

Problem 2. Operational Uncertainty
Root Causes

- **Limited energy.** There is an implicit assumption that there will be sufficient additional energy to cover demand after an unexpected, extended (multi-hour to multi-day) large generation/supply loss
  - The assumption that there will be sufficient energy from on-line unloaded resources and off-line resources to supplementally commit, post-contingency may not be valid in an increasingly energy-limited system, especially during cold winter conditions
- **Unpriced value of flexibility.** The optimal 'mix' of resources to cover the 'margin for uncertainty' isn't simply those resources that do not clear day-ahead *based on offer prices alone*
  - This ignores lead-times and resources' flexibility

Problem 3. Inefficient Schedules

- The single day-ahead market may "use up" limited stored energy inefficiently

The Problem

- The current construct does not efficiently coordinate the use of limited stored energy resources to meet the demand for energy tomorrow *and the demand for energy for day(s) after tomorrow*
- This can also result in (preventable) shortages
  - There may be enough stored energy to meet total energy demands over the next few days if it is used efficiently, but there may not be enough if it is used inefficiently (prematurely)

Problem 3. Inefficient Schedules

Adverse Consequences

- **Reliability risks.** In extreme cases, this can result in extended reserve and energy shortages
- **Not cost-effective.** In general, the status quo produces higher than necessary total costs by using limited stored energy resources prematurely (inefficiently)
- **Out-of-market posturing.** Neither efficient/cost-effective, nor transparently signals costs of actions taken

Problem 3. Inefficient Schedules

Root Causes

- **Market horizon is not aligned with the system's operating horizon.** ISO-NE administered single day-ahead market has no forward price signal to convey value of preserving limited energy for future days, instead of using it today
- **No external market can aggregate the relevant internal information about system-wide inventory limitations**

  For example, over-the-counter forward power markets:
  - Do not have access to the system-level supply information
  - Do not have the ability or means to price the value of *preserving* energy for future days
  - Do not have the ability or means to coordinate suppliers' production over multiple days in an efficient way

Why Are These Issues 'Problems' Now?

- **New England's power system is evolving into an ever-more energy-limited system**
  - Pipeline constraints, retiring generators with ample fuel storage, and growing 'just-in-time' generation from renewable technologies
- **The decision to make (or not make) advance fuel/energy supply arrangements *matters* more in an increasingly energy-limited power system**
  - In the past, if a resource was not able to operate (for fuel or any other reason), there was sufficient energy to dispatch up another resource in its place
  - The presumption that there will be sufficient energy may not be valid in an increasingly energy-limited system
  - If too many resources cannot operate the system may face:
    - Operating a much more expensive resource further up the supply stack, or
    - Scarcity prices, if there is a real-time deficiency in the system's energy plus reserves requirement

Why does the capacity market not address these concerns?

- Capacity market design in New England creates strong performance incentives during times of system scarcity (e.g., reserve deficiency)
- The capacity market design influences behaviors and actions in the market, but is not sufficient on its own to address problems 1, 2 and 3
  - The potential for scarcity impacts how resources acquire fuel stock and when they use the fuel stock, but these decisions are impacted based upon the probability of scarcity
- If there is a low expectation of scarcity, resources may not take sufficient actions to ensure they can operate in response to uncertainties (Problem 1 and 2)
- Further, the capacity market does not optimize the use of limited energy over a multi-day period (Problem 3)

CONCEPTUAL DESIGN ELEMENTS

High-Level Design Objectives

1. **Risk Reduction**. Minimize the heightened risk of unserved electricity demand during New England's cold winter conditions by solving Problems 1, 2, and 3
2. **Cost Effectiveness**. Efficiently use the region's existing resources and infrastructure to achieve this risk reduction in the most cost-effective way possible
3. **Innovation**. Provide clear incentives for all resources, including new resources and technologies that can reduce this risk effectively over the long term

Design Principles for a Market-Based Solution

1. **Product definitions should be specific, simple, and uniform.** The same well-defined product or service should be rewarded, regardless of the technology used to deliver it
2. **Transparently price the desired service.** A resource providing an essential reliability service (for instance, a call on its energy on short notice) should be compensated at a transparent price for that service
3. **Reward outputs, not inputs.** Paying for obligations to deliver the output that a reliable system requires creates a level playing field for competitors that deliver energy reliably through cold-weather conditions
4. **Sound forward markets require sound spot markets.** Forward-market procurements work well when they settle against a transparent spot price for delivering the same underlying service
5. **Compensate all resources that provide the desired service similarly.**

Overall Design Concept

- A comprehensive set of energy ancillary service products that ensure the system is well positioned and has sufficient energy to handle a variety of situations:
  - Reliability (consistent with existing NERC/NPCC criteria)
  - Done cost effectively
  - Reduce the likelihood of out-of-market supplemental commitments or posturing for:
    - Unavailability of gas for gas-fired generation
    - De-rates or underperformance of day-ahead cleared resources
    - Premature depletion of stored energy resources
    - Under-procurement of day-ahead cleared demand (*i.e.*, load balancing)

Design Concepts to Address Problems

Problem 1. Incentives and Compensation

Design Concept: Create several new, voluntary ancillary services in the day-ahead markets with stronger, financial-binding, obligations and settlements

Problem 2. Operational Uncertainty

Design Concept: Procure new ancillary services of such types and quantities to assure system reliability and procured cost effectively

Problem 3. Inefficient Schedules

Design Concept: Award energy and new ancillary service obligations through a multiple-day ahead market

Multiple-Day Ahead Market

Latest Thinking

The M-DAM alone addresses Problem 3, however:

- We have heard a number of questions and concerns about the length of the market horizon, primarily how this may not align with participants' hedging strategies conducted outside ISO-administered markets
- In practice it may not be necessary to procure new ancillary service products for the *entire* multiple-day market horizon
  - To be effective, the new ancillary service products should be acquired in/for the first two days of an M-DAM
  - This will allow the system to be positioned to handle any major contingency (*i.e.*, the deployment of RER resources) should an extended (multi-day) large energy loss occur shortly after the daily close of the M-DAM
- ISO-NE is still assessing the duration of the M-DAM

Three Categories of New Ancillary Services
(Procured in Day-Ahead Markets)

A multiple-day ahead market for energy, co-optimized with three new ancillary service products:

A. **Replacement Energy Reserves (RER)** – *New* product in the day-ahead markets, not in real-time
   - A 'call on energy' product from on-line or off-line gen
   - 1+ hour ramp-up/start-up capability
B. **Generation Contingency Reserves (GCR)** – Forward form of existing TMSR, TMNSR, and TMOR products
C. **Energy Imbalance Reserves (EIR)** – *New* product in day-ahead markets
   - A 'call on energy' product to cover the load forecast in excess of day-ahead cleared load (net virtual bids/offers)

Combined, these provide the 'margin for uncertainty' in an increasingly energy-limited system

New Ancillary Services

Current Thinking

<u>Participation</u>

- Resources (or portions thereof) that do not sell energy day-ahead may acquire a new day-ahead ancillary service obligation, and receive day-ahead compensation for that position
  - Similar to day-ahead energy, the new day-ahead ancillary services are financially settled in real-time
- This creates a financial incentive for awarded resources to be <u>capable</u> of delivering energy above any day-ahead scheduled amount – *i.e.*, actually provide energy 'on call' during the operating day, if and when the resource is needed

<u>Energy Sustainability</u>

- Achieved through the clearing process for the aggregate capability of all obligated 'on-call' resource as a whole, not through required energy sustainability limits on individual resources

Purpose of New Ancillary Services

- The new day-ahead ancillary service products address Problems 1 and 2
  - Problem 1 is addressed using products with a formal 'call on energy' option obligation that mirrors how this problem's root causes are normally solved in markets (*i.e.*, a real option on energy)
  - Problem 2 is addressed via the product definition and quantities procured for each of the new day-ahead ancillary service products
  - These mirror the capabilities (above day-ahead awards) the system relies upon for uncertainty today (Slide 12)
- The M-DAM alone addresses Problem 3

- *These new ancillary services will be procured cost-effectively in a co-optimized multiple day-ahead market*
- *Prices will transparently signal the costs of a more reliable energy-limited system*

Procuring New Ancillary Services

Why is it necessary to also procure new day-ahead ancillary services for Operating Reserves and to cover forecast load?

- **The 'cannibalization' problem.** If, for example, only Replacement Energy Reserves (RER) are procured day-ahead:
  - Many of the system's fast-start resources may clear as RER instead of Generation Contingency Reserve, GCR
  - During the operating day, the real-time reserve markets' co-optimization will 'cannibalize' that fast-start capability (designate it as operating reserves)
  - This will leave the system without the Replacement Energy Reserve capability we sought to acquire in the first place
- **Cost-effectiveness.** We need all these ancillary service capabilities to have a reliable operating plan each day
  - If they are not procured in a co-optimized process, we will not obtain the least-cost portfolio of resource capabilities going into each operating day

What About the Seasonal Forward Market?

- This is a longer-term forward concept, intended to facilitate investments in energy supply arrangements well in advance of the Multi-day Ahead Market (M-DAM) market horizon
  - A successful forward market requires a corresponding spot market *for the same good or service*
  - The new ancillary services procured in the M-DAM could be, in this context, the 'spot' market for this longer term forward market
- This component may entail a substantial re-vamping of the existing Forward Reserve Market, making it the longer term forward market for the suite of new ancillary services
- Stakeholder discussions on this topic will be held on a separate track (not for the October-2019 filing)

TODAY'S DISCUSSION TAKEAWAYS

Takeaways from Today's Discussion

Three problems have been identified that contribute to the energy security problem in New England:

1. **Incentives and Compensation**
2. **Operational Uncertainty**
3. **Inefficient Schedules**

ISO-NE is evaluating three solutions to address these issues:

- **Multi-day ahead market**
- **New ancillary services in the day-ahead market**
- **Seasonal forward market**

Conceptual Design Elements Summary

Problem 1. Incentives and Compensation

Concept: Provide compensation for new ancillary service obligations

Problem 2. Operational Uncertainty

Concept: Procure new ancillary services needed

A. Replacement Energy - for the balance of the day (or days)

New: Day-Ahead Replacement Energy Reserves **(RER)**

B. Operating Reserves for generator contingency response

New: Day-Ahead Generating Contingency Reserves **(GCR)**

C. Load-Balance Reserves to cover day-ahead forecast load

New: Day-Ahead Energy Imbalance Reserves **(EIR)**

Problem 3. Inefficient Schedules

Concept: Procure forward energy and new ancillary services in a multi-day ahead market

Modification:
Multi-Day Ahead Market
(M-DAM)

Questions

For More Information…

- Subscribe to the ***ISO Newswire***
  - *ISO Newswire* is your source for regular news about ISO New England and the wholesale electricity industry within the six-state region
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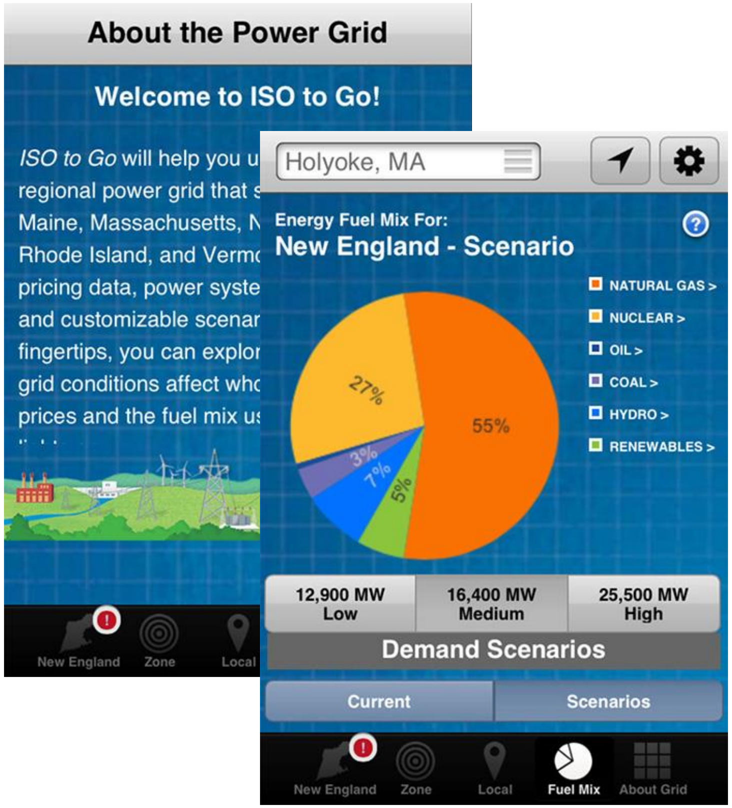
A Wholesale Electricity Industry Update



APPENDIX: ADDITIONAL INFORMATION

ISO-NE Material Provided to Stakeholders

Committee and Date	Material
April – Markets Committee	https://www.iso-ne.com/static-assets/documents/2019/04/a7c_presentation_energy_security_improvements_market_based_approaches.pptx
April – Discussion Paper	https://www.iso-ne.com/static-assets/documents/2019/04/a00_iso_discussion_paper_energy_security_improvements.pdf
March – Markets Committee	https://www.iso-ne.com/static-assets/documents/2019/03/a7_b_iso_presentation_winter_energy_security_improvements.pptx
December – Markets Committee	https://www.iso-ne.com/static-assets/documents/2018/12/a2a_iso_presentation_winter_energy_security_improvements.pptx
November – Markets Committee	https://www.iso-ne.com/static-assets/documents/2018/11/a2_presentation_winter_energy_security_improvements.pptx