Market-Based Mechanisms for Winter Energy Security in NE

Presentation to the NEPOOL Markets Committee

PREPARED FOR

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December, 2018

THE Brattle GROUP

Outline

- Objectives
- Energy-Secure Reserve Product: An Alternative EIRC+ Approach
- Options for Coordinating EIRC+ and Energy over Multiple Forward Days
- Planning Time Horizon
- Takeaways

Objectives

Markets for Energy-Secure Supply

Addressing ISO-NE operator needs for energy-secure supply is a problem amenable to a market solution:

- A product could be defined to provide operators with the tools they need to maintain reliable operations despite energy security risks;
- A variety of resources could compete to provide this product, ensuring all resources capable of meeting the need are compensated;
- More complicated than other reserves due to multi-day nature of need.

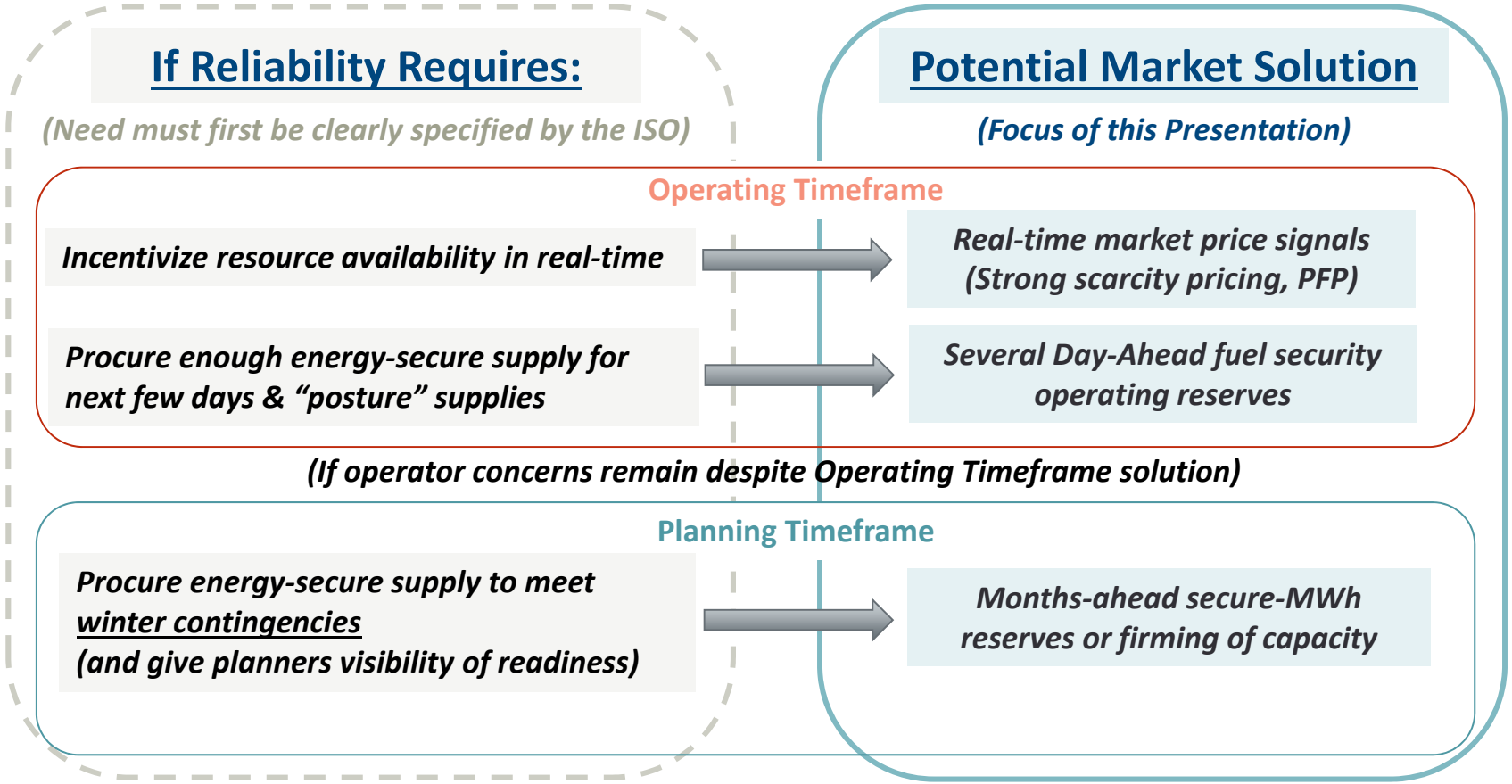
Guidelines for an effective market design:

- Clearly define the requirements: what do the planners and operators have to have in order not to intervene, and when do they have to see they have it?
- Need to express requirements as demand for products that the market can provide.
- Design procurement timing to fit when resources can efficiently act and when planners/operators would intervene if they did not see sufficient preparedness.
- Allow all capable resource types to participate, or else cost-effective existing resources may retire and new solutions may be excluded.
- Get the pricing right by considering interactions with all other wholesale markets, including energy and capacity (including performance incentives).

Objectives

Markets in Operating and Planning Timeframes

Markets for energy security should start by establishing effective price signals on the operating timeframe (days ahead). If operators still require additional visibility, a planning timeframe (months ahead) market could also be considered



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Operating Timeframe Energy-Secure Reserve

A new operating reserve should create a market for everything ISO-NE operators need (and might otherwise procure out-of-market).

- Procure enough energy-secure reserves to meet forecasted need demand.
- Provide the ISO with visibility and assurance that the reserves are there.
- Efficiently manage the usage of different resources with limited inventory, holding back those with one-day inventory for the peak day ("posturing"), but without out-of-market dispatch and uplift.
- Align prices with value, especially in shortages to incent sufficient and efficient entry, exit, fuel arrangements, and operations in ways that out-of-market solutions cannot.
- Reward all resources that contribute to preparedness, supporting optimal entry/exit decisions. This is critically important when all existing resources are at stake (LNG, nuclear, coal, oil) and to spur innovative solutions (e.g., LNG contracting, expanded fuel storage, better fuel delivery, new renewables and battery storage, electric and gas DR).
- Co-optimize or at least coordinate with energy and other reserves over multiple days to send a signal even for just-in-time resources without storage to help support the system's reserves, e.g., increase imports today when shortages of on-site fuel are anticipated by later in the week.

A fuel operating reserve differs from other reserves in that it has to prepare for a multi-period, shaped problem and to leverage resources with a range of durations; the design has to support:

- Rational substitution: a long duration resource can substitute for a short one; multiple short duration resources can jointly substitute for a long one.
- Rational value: preparedness will likely be limited by both capacity with secure fuel to meet peak demands, and the fleet-wide MWh of secure fuel to endure an extended cold snap. In that case, a long duration resource is more valuable per MW than a short duration resource but less valuable per MWh.

ISO's Energy Inventory Reserve Constraint (EIRC)

ISO-NE has proposed a reserve product (EIRC) designed to ensure sufficient fuel inventory to meet demand during fuel supply disruptions. As we understand it:

- EIRC establishes a target quantity of energy-secure inventory (measured in MWh) that would need to be available at the end of each operating day
- Resources with limited fuel supplies might be signaled not to produce energy in order to satisfy EIRC, with appropriate impacts on energy and reserve prices
- Pricing of the reserve would be co-optimized with the Multi-Day Ahead Energy Market, capturing the energy opportunity cost of providing reserves

While EIRC is directionally consistent with the design objectives, we have several questions about some of the details*

- How would EIRC provide operators with the resources needed to meet demand during high MW demand conditions?
- How would EIRC distinguish between and appropriately schedule a 1,000 MW resource with 1-day of secure energy (i.e., 1,000 MW-d) and a 100 MW resource with 10-days of secure energy (also 1,000 MW-d)?
- How would resources with longer-term inventories (e.g., nuclear resources) qualify to provide this reserve product?
- How would demand for the reserve product be determined?

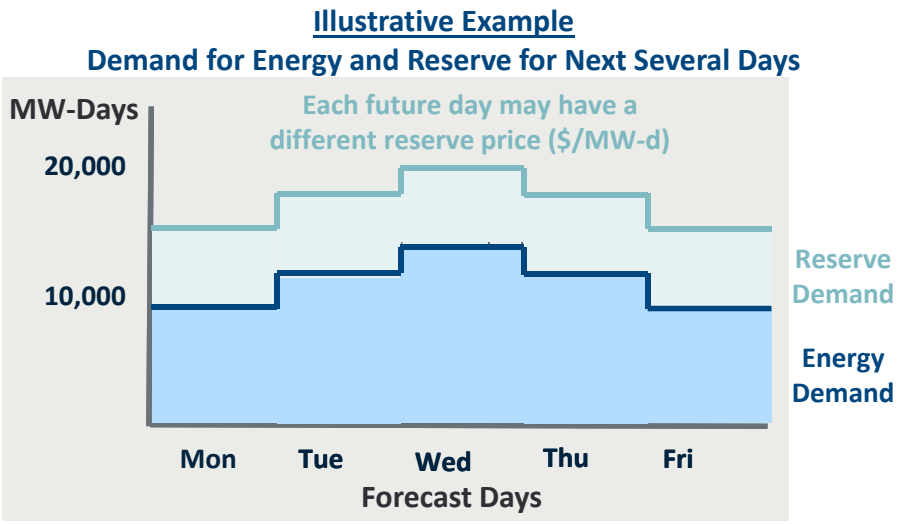
* We recognize that ISO's design is continuing to develop and ISO may have answered some of these questions by the time this presentation is delivered

Refined Energy-Secure Reserve Design (EIRC+)

We suggest a slightly refined reserve product accounting for both MW and MWh needs:

Demand

- ISO-NE would determine demand for secure MW and MWh on each of the next several days based on a forecast of load minus availability of non-firm pipeline gas and imports (analogous to tie-benefits).
- Demand could account for conservatisms regarding weather forecasts, resource outages, and availability of non-firm imports.



Product Definition

- ISO-NE purchases an option to receive delivery of 1 MW-day on a specified future date (with a different product for each of the next days).
- It could be a physical commitment, subject to ISO verification and steep penalties for turning out not to have the reserve.
- Resources selling the option may be held back from selling day-ahead energy to maintain their capability for the specified future date.
- "EIRC+" could be coordinated with energy through MDAM or options 2 and 3 discussed below

Resource Qualification

- All resources not subject to the unavailability of non-firm pipeline gas would be eligible to provide reserves, including nuclear, oil, LNG, firm gas, firm imports, and DR.
- Physical backing of commitments evaluated by ISO-NE a day before delivery based on supplier-submitted data on fuel stocks and delivery arrangements. Self-reporting subject to audit (and penalties) minimizes administrative burden for the ISO.
- Resources with multi-day secure fuel could sell multiple days of products.

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Link Between Reserves and Energy Market

A multi-day forward reserve market is inherently linked to multi-day forward energy prices through energy opportunity costs

- The economics of providing energy-secure inventory in several days depends on the energy market price today, but also on energy prices on future days
- Reserve commitments and pricing should reflect this

ISO's MDAM proposal would create a financially binding multi-day ahead energy market, which would price in energy opportunity costs

- By co-optimizing the multi-day forward reserve and energy markets, ISO's proposal could incorporate energy opportunity costs into the reserve price automatically, without requiring participants to determine their own opportunity costs
- ISO's approach would allow resources to offer at different prices on different future days, providing a mechanism to compensate for higher cost expedited fuel delivery options

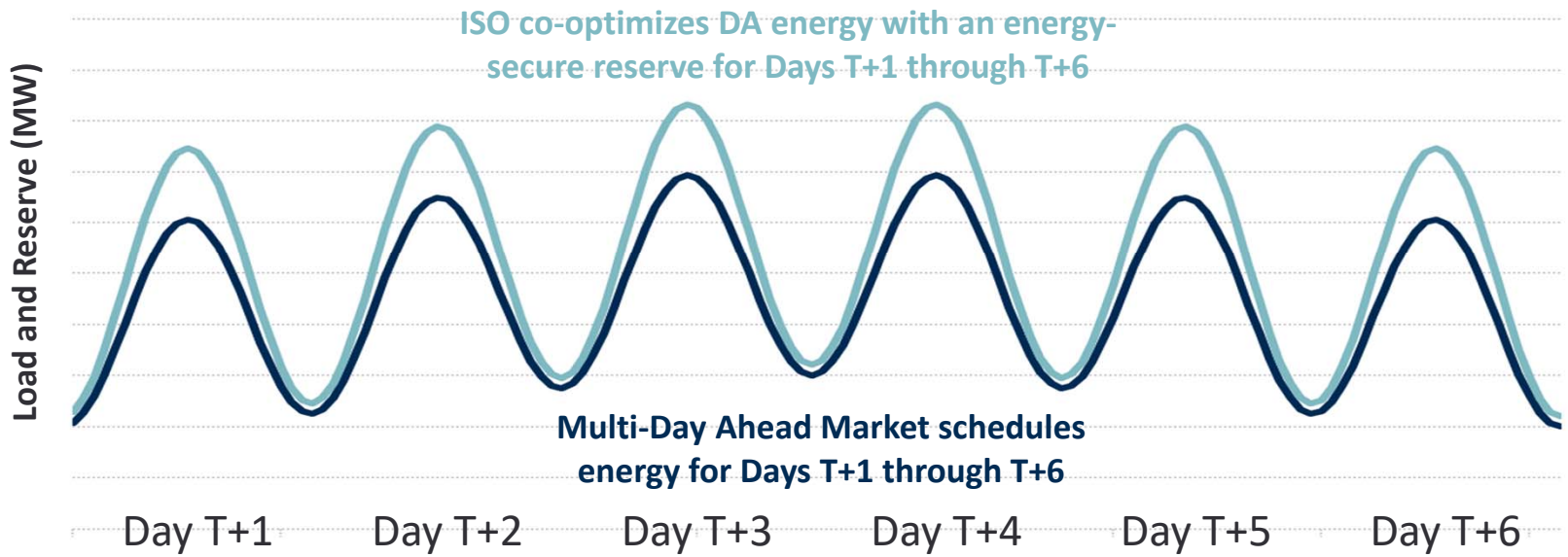
In the next few slides, we discuss ISO's MDAM proposal (Option 1) and compare to two alternative ways to incorporate energy opportunity costs in reserve prices (Options 2 and 3), with different advantages and drawbacks

All of these options are based on our proposed EIRC+ reserve construct, with different pricing options

Option 1: MDAM Proposal

Combines the energy-security reserve with a forward energy market for Days T+1 through T+6; co-optimization reflects energy opportunity costs in reserve prices

- **Advantages:** Solicits information from the market on costs and novel supply options ISO-NE might not otherwise know about; allows ISO to posture resources to meet both future *reserve* needs and future *energy* needs; suppliers need not add opportunity costs to offers
- **Disadvantages:** Potentially complex implementation and timeline; major change for energy markets; limited liquidity multiple days in the future for natural gas and (voluntary) market demand could limit the usefulness of MDAM in terms of providing additional information to the ISO

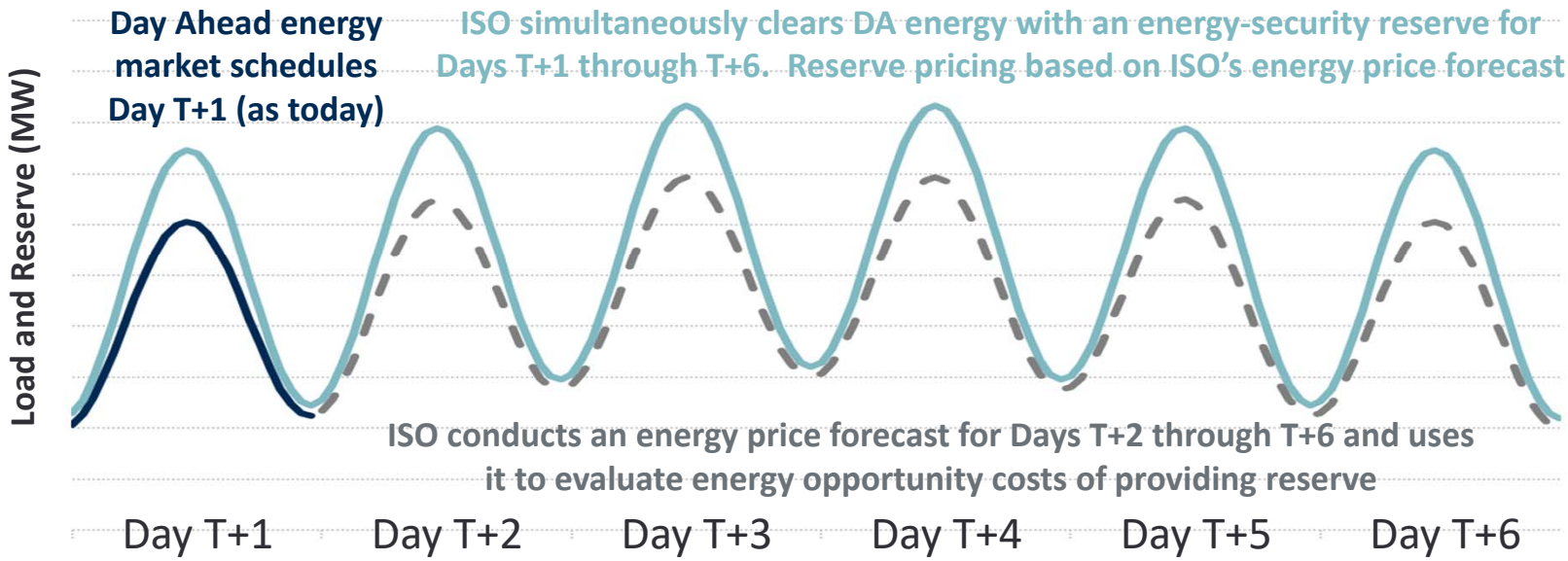


Options for Coordinating EIRC+ and Energy over Multiple Forward Days

Option 2: ISO Energy Price Forecast

Adds a multi-day energy-security reserve to the current DA market; ISO-NE forecasts multi-day-ahead energy prices to incorporate energy opportunity costs into the reserve price

- **Advantages:** Allows ISO to posture resources to meet future reserve needs; does not require opportunity cost offers to determine reserve pricing; likely simpler to implement than MDAM
- **Disadvantages:** ISO-NE uncomfortable forecasting prices with direct settlement implications; resources may not want to sell reserves priced using an ISO forecast rather than offers; ISO's forecast would not necessarily include all possible options (e.g., expensive short-term fuel delivery); posturing for future energy needs is not as straightforward as with MDAM (though it may be possible to increase the reserve requirement to account for this)

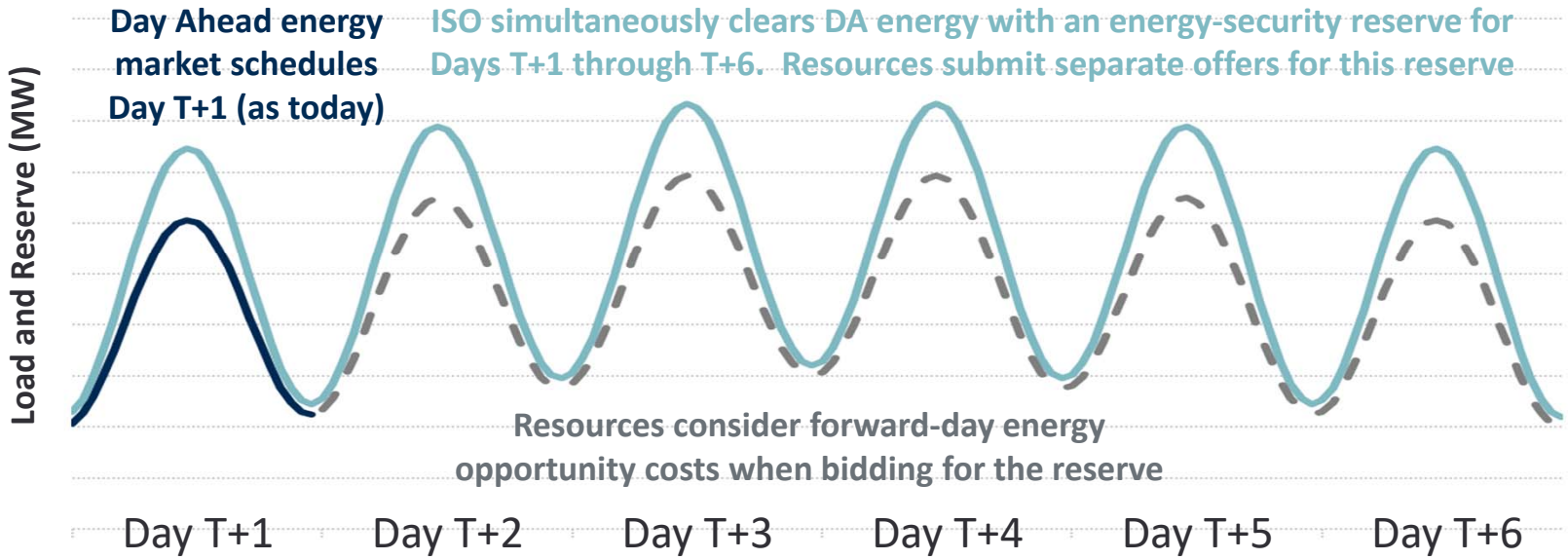


Options for Coordinating EIRC+ and Energy over Multiple Forward Days

Option 3: Suppliers Directly Offer for Reserves

Adds a multi-day energy-security reserve to current DA market structure, but relies on suppliers to determine how much to offer for reserves given their view of the costs and opportunity cost

- **Advantages:** Much simpler to implement and less disruptive to energy market than MDAM, and does not rely on ISO price forecast; supplier-determined offers could reflect a wide range of options for fuel delivery; resources cleared for reserves are naturally postured
- **Disadvantages:** Would still require opportunity cost energy-offers to posture energy (reserve pricing would also be based on opportunity cost offers, but this is less challenging due to fixed demand for reserves), management of resources and pricing does not reflect a global, centralized optimization based on comprehensive view of all options



Example of Posturing Under Each Option

Illustrative example: On Day 0, fossil generation resource with a 1 MWh hour tank postured out of the energy market for Day 1 to provide reserves for Day 5. Assumes resource is not setting either energy or reserves price. In each option, resource earns more profits ($30/MWh) when held back for reserves relative to what it would have earned if scheduled to provide energy on Day 1 ($10/MWh).

	Option 1			Option 2			Option 3		
Run	**MDAM** (co-optimized energy and reserve markets for Days 1 – 6)			**Day-Ahead Energy Market** + **Energy Price Forecast** for Days 2 – 6 + **Reserve Market** for Days 1 – 6			**Day-Ahead Energy Market** + **Reserve Market** for Days 1 – 6		
Offer	**Energy Offer** for Days 1 – 6 (subject to inventory constraint): $100/MWh			**Energy Offer** for Day 1 (subject to inventory constraint): $100/MWh			**Energy Offer** for Day 1 (subject to inventory constraint): $100/MWh **Reserve Offer** for All Days: $25/MWh		
Reserve Pricing Mechanism	Energy opportunity costs relative to MDAM clearing energy prices			Opportunity costs relative to energy price forecast (e.g., Day 5 energy price forecast of $125/MWh)			Direct opportunity cost offers from resources (e.g., based on energy opportunity cost of providing reserve on high-priced Day 5)		
Clearing Price	*$/MWh*	**Day 1**	**Day 5**	*$/MWh*	**Day 1**	**Day 5**	*$/MWh*	**Day 1**	**Day 5**
	Energy	$110	$125	**Energy**	$110	NA	**Energy**	$110	NA
	Reserve	$0	$30	**Reserve**	$0	$30	**Reserve**	$0	$30
Resource Clearing Result	**Energy**: No energy market clearing **Reserve**: Sells 1 MWh of reserve on Day 5, earning $30/MWh			**Energy**: No energy market clearing **Reserve**: Sells 1 MWh of reserve on Day 5, earning $30/MWh			**Energy**: No energy market clearing **Reserve**: Sells 1 MWh of reserve on Day 5, earning $30/MWh		

Options for Coordinating EIRC+ and Energy over Multiple Forward Days

Summary of Options

Commitment and pricing of reserves has to account for a multi-day-ahead view of both reserves needs and energy needs/opportunity costs (and all supply options for provision):

	Option 1 *MDAM + EIRC+*	**Option 2** *Day Ahead Market + EIRC+ Based on ISO Energy Price Forecast*	**Option 3** *Day Ahead Market + EIRC+ with Resource-Determined Offers*
Advantages	Solicits market information on novel supply options Facilitates posturing to meet both reserve and energy needs No need for opportunity cost offers (for energy or reserves)	Much simpler to implement than MDAM Facilitates posturing to meet future reserve needs	Much simpler to implement than MDAM Facilitates posturing to meet reserve needs Offers would reflect a range of options for fuel delivery
Disadvantages	Major change to energy markets with complex implementation Risk of limited liquidity on future days May not provide operator confidence given voluntary and financial nature	ISO and suppliers likely uncomfortable with a forecasted price with settlement implications Forecast would not reflect all possible options ISO does not schedule posturing for future energy needs Still requires opportunity cost offers for energy	Still requires opportunity cost offers for energy ISO does not schedule posturing for future energy needs Management of resources and pricing does not reflect a centrally optimized solution

In our view, Option 3 seems the most compatible with current markets without compromising the quality of information incorporated under an MDAM. Should be pursued alongside further consideration of MDAM's advantages and disadvantages.

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Planning Timeframe

The Potential Need for Forward Procurements

While an operating timeframe fuel security reserve is essential for securing and managing fuel for the next several days given the specific forecast at that time, the operators may also want to enter the winter ready to meet a range of conditions, including longer cold snaps and other conditions.

- Planning standards might be more conservative than the expected conditions that the market will prepare for based on expectations for prices of operating reserves.
- Even if not, having a several-month-forward procurement can coordinate suppliers' preparedness and give the ISO visibility and assurance, avoiding the need for OOM action.
- A several-month forward procurement could attract longer-lead time supplies (possibly winter LNG contracts) with lower risk than relying on uncertain prices for operating reserves.

Some Essential Elements of Forward Procurement

It must <u>complement, not substitute for, the operating timeframe fuel security operating reserve.</u>

- The operating reserve would still help meet any incremental needs, facilitate substitution of reserves, posture the fleet, and signal all resources to help, even just-in-time ones without storage, such as imports.
- Forward-procured resources "must-offer" into the operating reserve.
- The operating timeframe energy/operating reserve market would govern dispatch vs. hold decisions, and such dispatch would reduce resources' forward obligations for holding fuel (the obligation could then rise back to the base obligation under replenishment timing terms).
- Note: the forward likely cannot be a forward sale of the same product as in the operating timeframe, such that sellers take on a short position in the forward and then settle just incs and decs during operations. This is because the forward sale is for a limited number of days without specifying which days, whereas the operating timeframe product has to be day-specific. For example, if someone sold 3 MW-d forward then during the operating timeframe provided 4 MW-d of reserves for four different days over the following week, which date's price would apply to the incremental MW-d?
- Note: if forward procurement is very conservative and commits plentiful supply of fuel reserves, operating reserve prices will rarely exhibit shortage pricing; if less conservative, operating reserve prices may be higher, and anticipation of that may translate backward into lower prices for forward commitments.

As with the operating reserve, a forward procurement would define the entire need for fuel-secure MW/MWh and <u>reward all resources that contribute</u> to fuel security.

- Demand would not just specify the "gap" after taking certain resources (e.g., nuclear) for granted.
- This is essential both for securing enough commitments and for signaling sufficient and efficient entry/exit decisions of all types of resources.

Like the operating reserve, a forward procurement would have to be designed to efficiently match a range of resource capabilities to the demand.

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Takeaways

- **Winter energy security is a good problem for markets**
  - New England's energy security challenge can be converted into demand for clearly defined products that many, diverse resources can compete to provide at least cost
  - The opportunity for all resources to be compensated should foster efficient operation of existing resources, efficient investment/retirement, and innovation in technology, physical plant, contracting, and logistics
  - This should solve the problem and minimize customer costs
  - An operating timeframe (days ahead) solution is the first step – if operators still need additional visibility, a forward procurement could be added
- **Important to consider implementation details:** As the ISO finalizes further develops its design, it will be important to validate how it will function under specific cases and potentially trade off between a perfect market and a feasible one

Essential that any chosen solution will provide planners/operators with the certainty that winter reliability will be maintained, thus avoiding any need for out-of-market intervention

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