London Economics International LLC

Chapter 3 Preliminary Proposal

NEPOOL MC meeting - March 6, 2019

Prepared on behalf of MA AGO

March 6, 2019

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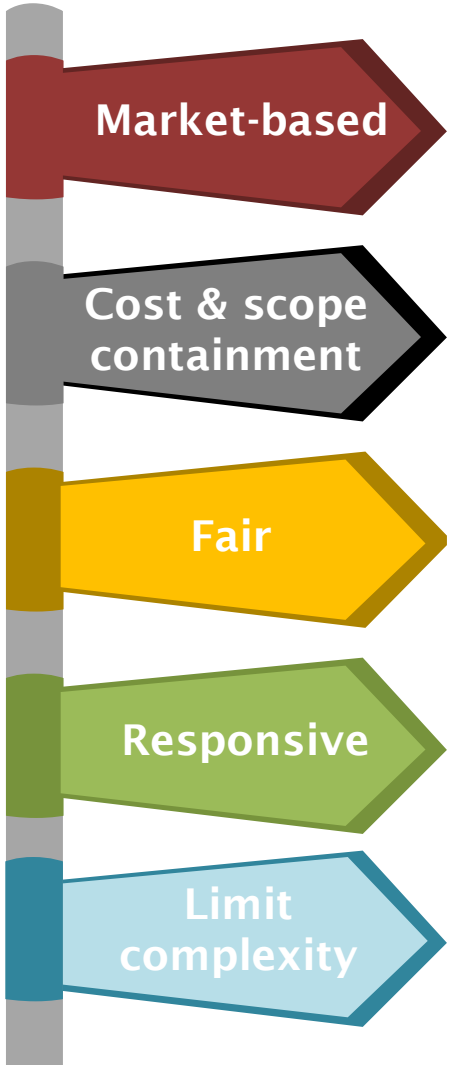
Agenda

AGO Chapter 3 objectives

A winter energy security solution should meet these objectives

AGO goals

- Rely on market-based mechanisms as feasible
- Have costs proportional to size of the problem
- Treat resources fairly
- Be responsive to changes in system resources
- Develop clear and complimentary market changes



ISO-NE's Chapter 3 objectives may not be met by current ISO-NE proposal

Market-based solution

- **Pro:** Proposal is market based; reduces out-of-market actions
- **Con:** Proposal is conceptually and operationally complex; Implementation will require substantial administrative costs

Operations: Multi-day visibility

- **Pro:** MDAM + EIRC could provide operators with multi-day visibility
- **Con:** The degree of participation in a voluntary MDAM is unknown, and low participation may mean low visibility

Planning: Preventing inefficient retirement

- **Pro:** Proposal might increase revenues for some power plants, preventing inefficient retirement
- **Con:** higher energy prices may lower net CONE, which would put downward pressure on capacity market prices, and potentially accelerate retirement

LEI's winter energy security proposal: Introduction

- **LEI proposal meets ISO-NE needs and AGO goals**
  - Incorporates market signals, supports operational visibility, and helps prevent inefficient retirement
- **Complete re-vamping of the Day Ahead Market (DAM) into MDAM would be complex, untested, and may not meet all ISO-NE's goals**
  - Existing mechanisms and others' proposals offer good ideas but do not address all goals
  - No data yet on size, frequency, or cost of potential problem; this points to an approach based on simple, minimal changes
- **New elements of LEI proposal**
  - Forward Stored Energy Reserve ("FSER") ancillary service
  - Update of technical methods which provide parameter values for the forward capacity market ("FCM")

LEI proposes an integrated solution that address ISO-NE and AGO objectives

Two new elements

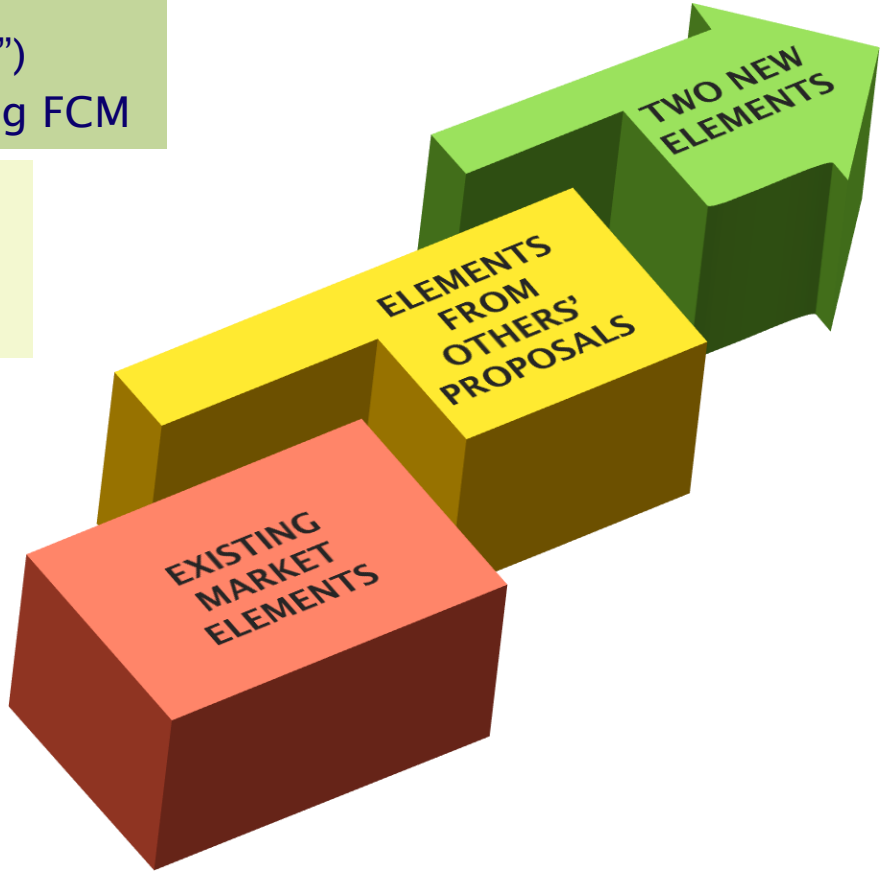
- Forward stored energy reserve ("FSER")
- Adjustments to parameters of existing FCM

Elements from others' proposals

- Constraint
- Reserve product

Existing market elements

- Bilateral contacts (provides a way to lock in opportunity cost, but no unit visibility to ISO-NE)
- DAM (market-based dispatch)
- Opportunity cost bidding (permitted by tariff; does not reflect all market information known by ISO-NE)



► **In LEI's solution, existing and new components are inter-related, and create a solid foundation for winter energy reliability**

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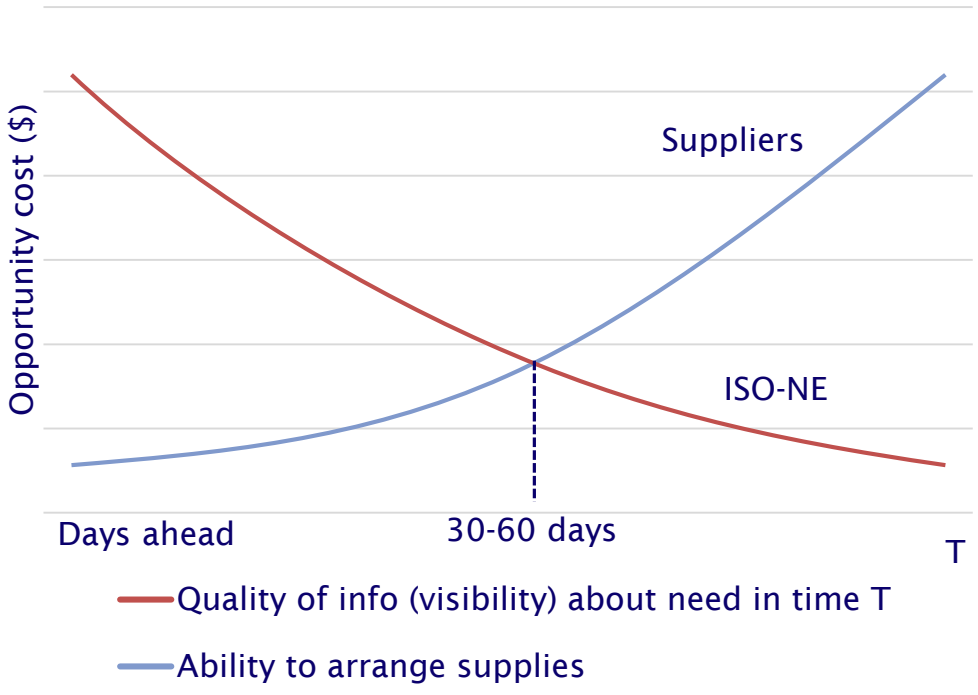
LE LONDON ECONOMICS

Forward stored energy reserve (FSER) purpose and concept

- **Purpose: Create an energy reserve product which will provide a known inventory available to be activated when system conditions are very tight**
  - Enhances operator visibility, reduces posturing, may help prevent inefficient retirement
- **Concept: FSER serves as a call option for ISO-NE to exercise**
  - Forward market allows time for resources to arrange energy supplies
  - ISO-NE decides the quantity of FSER to have on hand, then holds an auction a month or two before the delivery period
  - FSER resources are paid an option price for stored energy
  - If the resource is activated (i.e., called on to run), the stored energy will earn a strike price
- **FSER is an ancillary service which would be integrated into the DAM**
  - ISO-NE would use an information-rich, market-compatible trigger mechanism to know when and how much FSER to activate
  - ISO-NE would include a market true-up to LMPs (which raises LMPs for all market participants providing energy in that period) when activating FSER resources
  - The true-up helps preserve the market signal when supplies are tight

Details on following slides

FSER forward market timeframe should reflect planning and information needs



- Less than a week is probably not enough time to arrange fuel re-supply or other inputs
- More than a month or two is too far ahead for ISO-NE to know its wintertime needs
- No need to build new infrastructure, only to incentivize using what is already in place in New England

Forward time frame should balance ISO-NE's ability to forecast its need for reserves versus the time it takes to arrange fuel or other necessary inputs to stored energy

One to two months forward is probably the sweet spot

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FSER product definition: Visible reservoir of stored energy

- **Product:** American-style call option to activate a fixed quantity of MWh any time during the delivery term of the FSER
  - Bidders allowed to offer variety of time dimensions (i.e., 10 hours of 1200 MW per hour or 24 hours of 500 MW per hour)
  - Financial delivery, paired with hefty penalties for non-delivery
  - Option expires at the end of the delivery term
- **Eligibility:** Resources which (a) can set aside energy in storage and (b) have an opportunity cost for doing so
  - Includes oil, LNG, DR, pumped hydro, battery storage, etc.
- **Simple but rigorous verification**
- **Minimizes cost exposure**

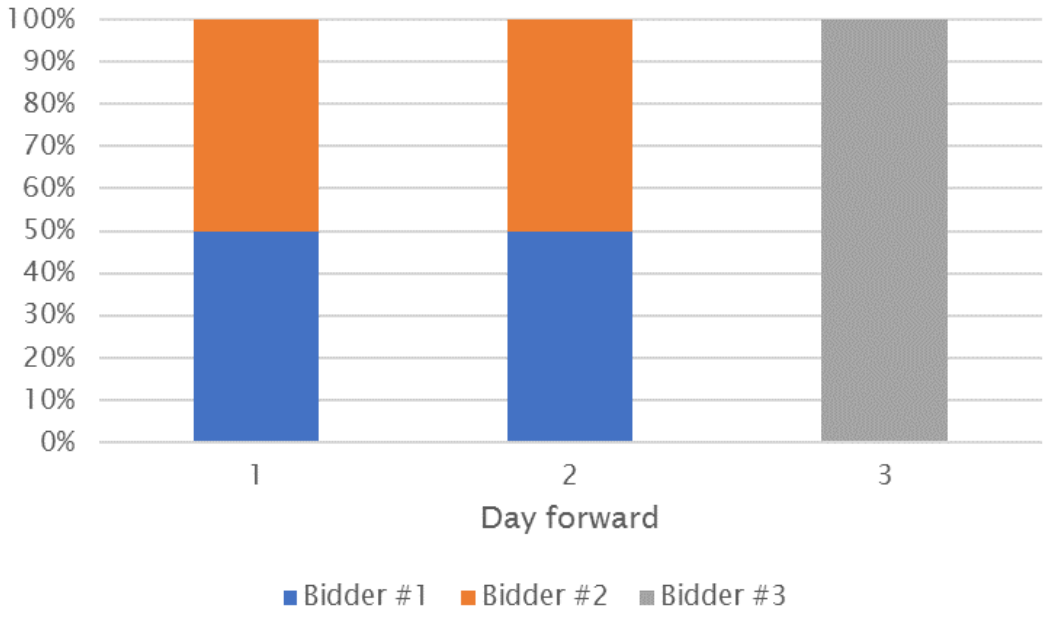
Call option FAQ

- Call options provide a buyer with the right, but not obligation, to procure an asset in a defined future period at a previously agreed upon price
- Two components
  - **Option price** is the price paid to secure the option, irrespective of whether it is called
  - **Strike price** is the price paid if the option is called
- **Gives ISO-NE maximum flexibility**
  - An American-style option can be exercised anytime during its life, and not only at its expiration
- **Provides cost containment**
  - The buyer of the option (ISO-NE, in this case) is only exposed to the option price

Hypothetical example of FSER procurement and activation

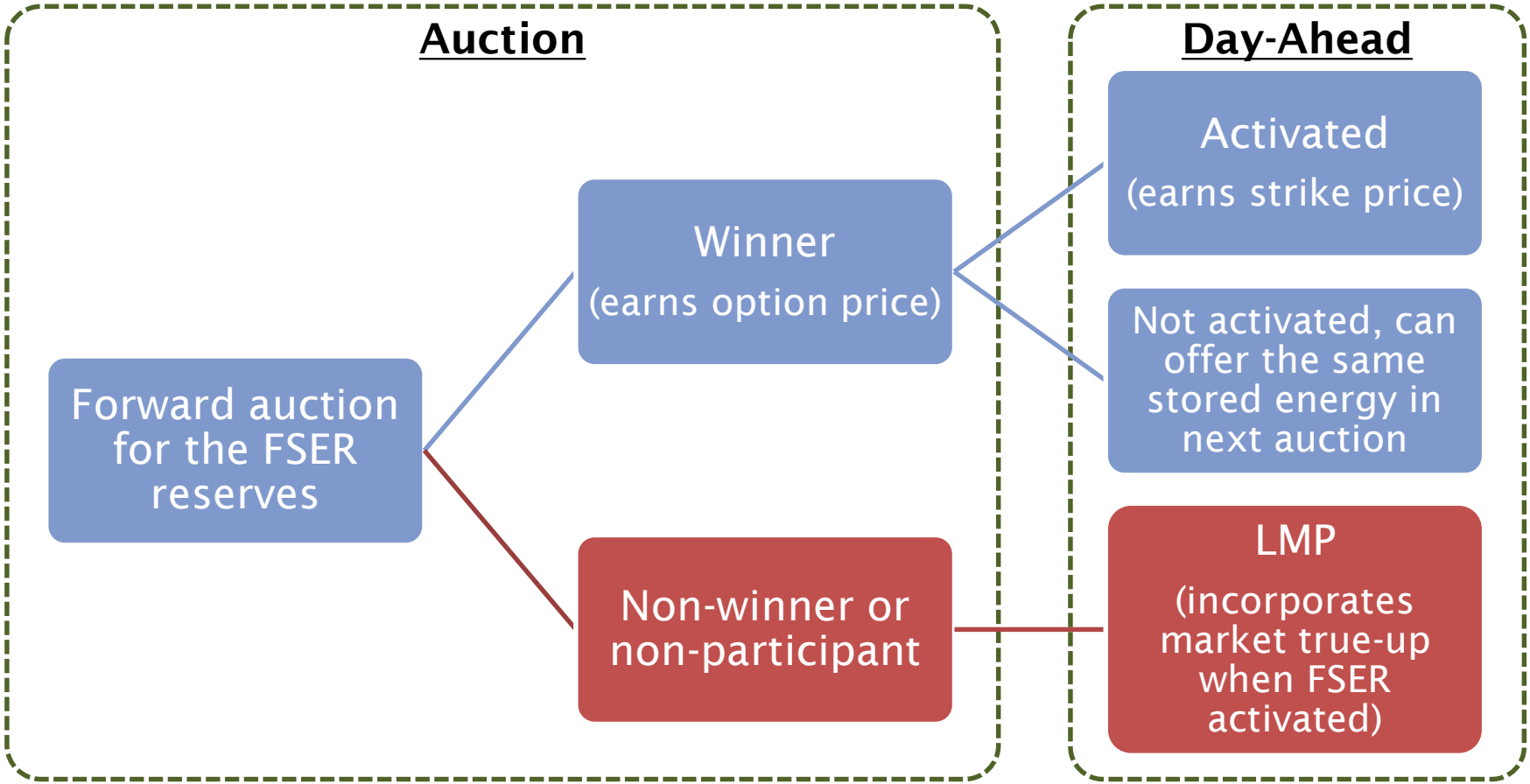
If bidders offer a flexible profile of reserves and their own strike prices, ISO-NE can shape its FSER procurement as needed

- **Assume ISO-NE wants 30,000 MWh for the coming month**
  - Bidder #1 offers a strike price of $400/MWh, for 5,000 MWh per day over two days
  - Bidder #2 offers $500/MWh for 5,000 MWh per day over two days
  - Bidder #3 offers $600/MWh for 10,000 MWh for one day
- **ISO-NE can decide when and how to activate the 30,000 MWh it has called in the day-ahead time-frame (e.g., 6 hours, 16 hours, 60 hours)**



- ISO-NE would not activate resource #3 until it depletes resources #1 and #2
- This saves costs, because the highest-cost resources are less likely to be activated

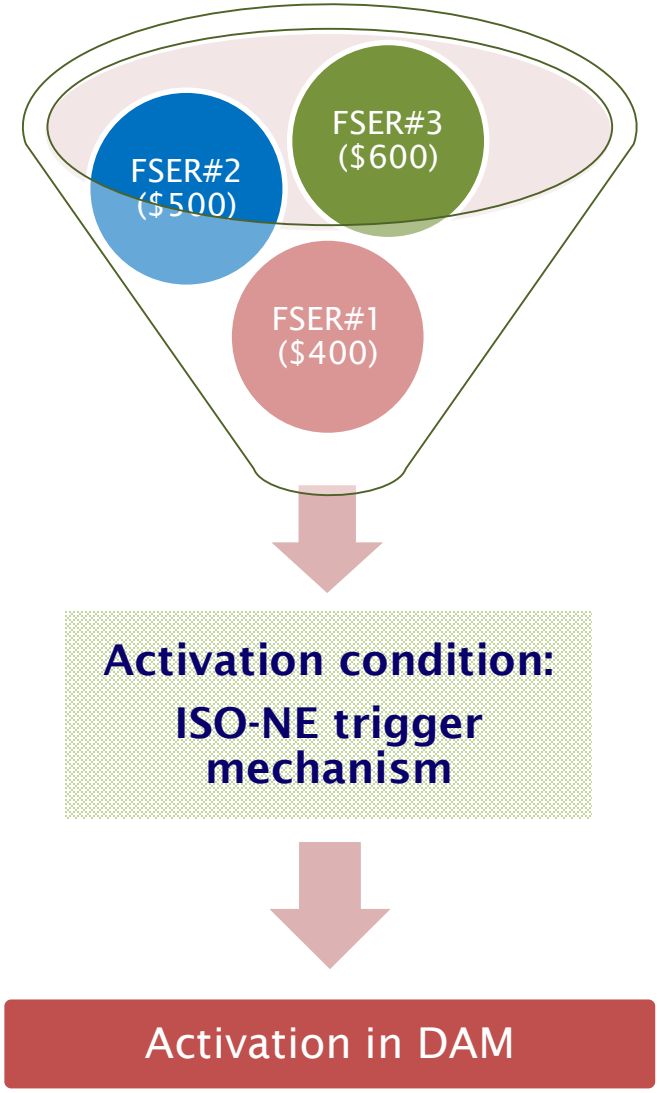
FSER auction provides two revenue streams for winners



- Non-winners compensated with market true-up component to LMP, if/when FSER is activated
- This preserves market scarcity signal

FSER activation condition would be a trigger mechanism established by ISO-NE

- **Trigger conditions established by ISO-NE links FSER activation to the DAM**
  - The trigger mechanism is a probability-adjusted factor created by ISO-NE. This trigger would consider BOTH the opportunity cost and the likelihood of needing the additional energy for later (not in the current DAM); this implies a >1-day opportunity cost horizon
  - When the trigger mechanism in DAM requires activation of energy, then the FSERs are activated and converted to energy
    - ISO-NE would activate the resources that bid the lowest strike price first
    - If the constraint is still binding, ISO-NE can activate the resource with the next-highest strike price



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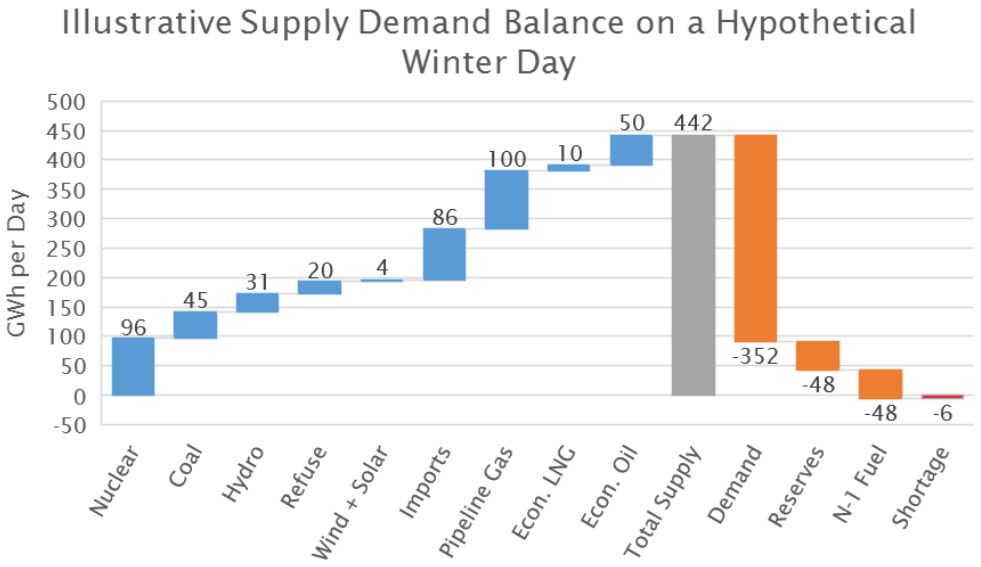
FSER activation should be paired with a true-up to LMP

- **When ISO-NE is activating stored energy, it is essentially running the system with out-of-merit stored supplies**
- **Introducing additional supply from the stored energy would ordinarily lower LMPs, which is not the correct market signal to signal scarcity and preserve reliability**
- **A market true-up will realign the DAM LMP**
  - For example: If a gas unit would have been the marginal resource on a given day (or hour) and LMP would have been $320/MWh, but instead a FSER resource was activated and LMPs fell to $300/MWh, then non-FSER resources would get the LMP of $300/MWh plus the $20/MWh market true-up
  - If FSER resources are not used, the market true-up = 0
  - FSER resources earn their strike price, but not the true-up
    - True-up is incorporated into LMP for non-FSERs only (but strike prices could still be different for different FSERs)
  - Note that the true-up is different than the trigger for activation

Demonstration of approach to defining monthly FSER quantity to procure

- **System operator would procure sufficient FSER quantities in each auction, such that in the event of an N-1 contingency in any period, there is sufficient supply available to the system to ensure continued reliable operation**
- **FSER quantity needs to reflect**
  a) short-term variability
  b) expectations about economic procurement of oil and LNG
  c) changes in system resource mix
- **FSER quantity to procure is based on a probabilistic analysis of daily supply and demand, aggregated into monthly demand for FSER**
  - Model system's actual resource mix along with uncertainty around delivery of oil, LNG, imports, etc.
  - ISO-NE already develops demand forecasts, has data on outage rates, and could extend this to expected margin after a contingency



- **Daily supply-demand balance depends on expectations of resource availability**
  - On sample day (above) the system demand > supply, so the 6 GWh shortage would factor into FSER procurement target
- **Auction procurement equals sum of expected shortages over the course of the month**
  - Does not net a surplus on Day D against a shortage on Day D+1. Assumes new supply, not posturing, is needed

FSER design helps meet most ISO-NE needs and AGO goals

ISO-NE needs

Market-based

FSER provides sufficient energy in DAM and reduces out-of-market actions

Operational forward visibility

FSER increases visibility to ISO by offering it a known quantity of reserve to help meet reliability when conditions are tight. If ISO buys a certain quantity of FSERs for a month, as it uses them, system operators will know how much stored energy is left for the remaining days in the month

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AGO goals

Cost containment

-- FSER only activated when needed
-- Buy only as much as you need
-- Options lower cost than underlying asset
-- Month-long delivery term is responsive to variability in conditions

Fair

Non-participating resources receive market true-up

Responsive to system changes

FSER quantity and use adapts to long-term changes in the resource mix of the market

Limit complexity

Simpler than MDAM + EIRC

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Technical methods used in FCM can be updated to help prevent inefficient retirement

- Changes will ensure retirement decisions reflect the value of resources to the system in winter as well as summer
- No new products or auctions
- These changes avoid the complications and unintended consequences of adding additional capacity products or running seasonal capacity auctions

ICR

- Installed capacity requirement ("ICR") currently considers only summer peak conditions in calculation of loss of load expectation ("LOLE")
- Other jurisdictions calculate LOLE based on year-round conditions
- If ISO-NE adopts this, it may not change the ultimate ICR value, but will at least reflect amount of capacity ISO-NE needs year-round

CSO

- A supply resource's capacity supply obligation ("CSO") is currently based on its summer capability
- The CSO definition can be refined to reflect year-round contribution to system reliability (e.g., electric load carrying capability ("ELCC"))
- Other jurisdictions use the ELCC approach

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Combining FSER design + FCM changes help meet all ISO-NE needs, and AGO goals

ISO-NE needs

Market-based
FSER provides sufficient energy in DAM and reduces out-of- market actions;
FCM outcomes are market-based

Operational forward visibility
FSER increases visibility to ISO by offering it a known quantity of reserve to help meet reliability when conditions are tight. If ISO buys a certain quantity of FSERs for a month, as it uses them, system operators will know how much stored energy is left for the remaining days in the month

Preventing premature retirement
FCM parameters adjusted to reflect reliability in winter as well as summer

AGO goals

Cost containment
-- FSER only activated when needed
-- Buy only as much as you need
-- Options lower cost than underlying asset
-- Month-long delivery term is responsive to variability in conditions
-- **Aligns capacity market products with year-round needs**

Fair
Non-participating resources receive market true-up

Responsive to system changes
FSER quantity and use adapts to long-term changes in the resource mix of the market

Limit complexity
Simpler than MDAM + EIRC
No new capacity markets

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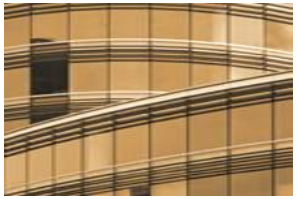

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Appendix: Vocabulary

Activation	· Converting energy reserve into energy
Market true-up	• Portion of LMP that reflects the difference in LMP when a FSER resource is activated compared to LMP if not activated
Trigger/constraint	· Condition set by ISO-NE based on calculations which reflect opportunity cost and probabilities of energy reserves needed to be activated > day ahead