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## Forward Enhanced Reserves Market

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# Agenda

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- Recap
  - Market Design Fundamentals
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- New Information
  - Resource Auction Offer Example
  - FERM Penalty Rate
  - Replacement Auctions
  - Cost Allocation
  - Estimate of FERM Costs
- Conclusion
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# Introduction

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- ISO New England has identified that due to New England's evolving resource mix and constrained natural gas delivery infrastructure generators with stored or firm fuel are not properly addressed or compensated under the existing market structure.
- Calpine suggests that there be a forward market design put in place that
  - that properly values the existing fuel secure resources and
  - that incentivizes fuel supply arrangements and investments, and
  - that recognizes the same timeframe for when a decision to retire or retain a resource would occur.

***The Forward Enhanced Reserves Market (FERM) allows resources to compete and markets to produce cost efficient solutions for winter fuel security.***

# Market Design Fundamentals

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- The Forward Enhanced Reserves Market (FERM) procures fuel secure MWh for winter period December 1<sup>st</sup> - March 15<sup>th</sup> three years prior to the obligation year.
- ISO qualifies resources based on their ability to contract for stored fuel or readily use stored energy<sup>1</sup>.
- Suppliers submit offers into the auction for a maximum amount of MWh they will commit over the winter months to offer on stored fuel upon alert of an Operating Procedure-21 Energy Emergency Event.
- Suppliers with a FERM obligation will be required to offer on the qualifying fuel source in the Day-Ahead and Real-Time Energy Markets during an Energy Emergency or will be subject to penalty.
- If under the Energy Emergency a resource is dispatched for a FERM commitment, the MWh provided in the Energy Emergency will count towards its total FERM obligation.
- ISO will track the MWh for a FERM commitment.

1. Stored fuel is used throughout the presentation, but is meant to imply stored fuel or energy.

# Performance Obligations

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- A FERM resource is obligated to offer sold MWh upon ISO declaration of a forecasted Operating Procedure-21 Energy Emergency Event, but it is not necessary that all FERM resources be committed to produce energy.
- A resource is not selling the energy, only the assured capability to generate the offered energy with stored fuel or from a stored source.
  - The ISO will continue to pay energy at the LMP.
- If a resource's offer is in merit during an emergency event, and the ISO wants to utilize it from the pool of FERM resources it has procured, then it will be committed to run on the stored fuel.
  - A FERM designation is only for settlement/ tracking of obligation. It does not interfere with proper energy price formation.
  - ISO may also dispatch a resource within EcoMin or EcoMax limits.
  - For example, ISO may dispatch a resource at or down to min level to posture a resource in an effort to preserve inventory. This action is recognized as a commitment and total MWh used will count toward total MWh sold forward.
- ISO is responsible for tracking FERM MWh commitment and settlement.
  - Once a resource has been committed and run for total MWh sold forward, its obligation to FERM is over.
  - ISO will issue a weekly FERM report for resource's to track FERM obligation.
- Risk of penalty and opportunity cost bidding promotes the efficient use of fuel inventories and stored energy throughout the winter period.
  - A resource is responsible for fuel inventory management up until FERM obligation is over.
  - Resource can run on stored fuel during winter if economic to do so, but it will need to preserve or replenish inventory levels to support FERM obligation. Under an OP-21 event, a resource can utilize opportunity cost bidding to properly reflect cost to use inventory.
  - ISO is not responsible for fuel inventory management, but resource will be subject to penalty for not offering off of stored fuel during OP-21 event.
- As applies, all other obligations, e.g. CSO, are in place even after FERM obligation is over.

# Resource Auction Offer Example

## Qualification and Verification

A	What is your resource Type	Oil Only	
B	Do you plan to participate in FERM	Yes	
C	Generator Capacity (MW)	300	
D	What is your maximum amount of RT energy inventory in days	3	
E	How many days of RT energy inventory do you want to sell into FERM	4.5	
F	How large is your storage tank (bbl)	28,200	
G	What is your assumed fuel heat content (mmbtu/bbl)	5.8	
H	What is your unit heat rate (mmbtu/MWh)	7.5	
I	Calculated maximum amount of inventoried energy (MWh)	21,808	= F*(G/H)
J	Max amount of RT energy inventory in Days	4.5	= I/(C*K)
K	Peak hours required each day for FERM (hr)	16	
L	Capacity allowed to offer into FERM (MW)	300	= MIN(J,D,E)/3,* C

## Internal Calculation by Resource

M	Set Rate (\$/bbl)	\$13.30	
N	Total storage	28,200	
O	Carrying Costs	\$375,025	= M*N
P	Tank Lease + Maintenance	\$600,000	
Q	Risk Adder	\$56,254	= 15%*O
R	Cost per MWh	\$47	= (O+P+Q)/I

## FERM Offer in \$/MWh, Total \$, \$/kW-month

S	Capacity allowed to offer into FERM (MW)	300	
T	Real-Time Inventory MWh	21,808	
U	FERM Offer (\$/MWh)	\$47	
V	Revenue (\$)	\$1,031,279	= T*U
W	Revenue (\$/kW-month)	\$0.98	= V/L/3.5/1000

# Performance Obligations Q&A

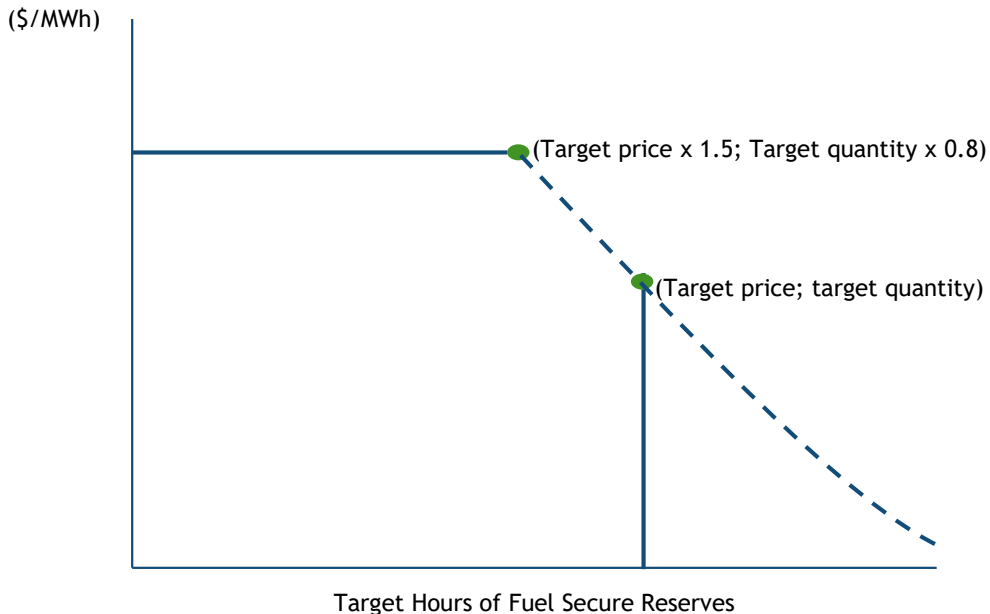
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Questions around the performance obligations of the Oil-fired resource from the Resource Auction Offer Example in a previous slide:

1. How would they offer into the market under 'normal' conditions?
  - Same as today. If a resource has sold FERM MWh and has a CSO obligation, it is up to the resource to manage offers and inventory under normal conditions.
2. How they would offer into the market under 'OP-21' conditions?
  - For example, ISO will declare an OP-21 event for the next three days. A resource must offer its energy cost curve from fuel secure or stored energy MWh. These offers can be informed of the opportunity cost to use limited inventory.
3. What happens when the OP-21 condition happens for 4.5 days and the resource is committed for a FERM run for everyday?
  - Resource has met its FERM obligation for the winter. All other obligations, e.g. CSO, remains in place.
4. What happens when the OP-21 condition happens for two days and they are designated for a FERM run for one of the two days?
  - Resource is obligated to offer oil-backed MWh for both days. ISO will inform resource of the MWh left in obligation after first day.
  - If resource does not have enough fuel or stored energy to offer on second day it is required to pay penalty.
5. What happens when the OP-21 condition happens for seven days in a row (and they run out after 4.5 days, even though they put in a high LOC)
  - Resource has met its obligation. ISO must use other MWhs in FERM pool.
  - Resource can still be dispatched to run but, it is no longer subject to FERM penalty.
6. What happens if their tank collapses just before October, how will they 'shed' this obligation?
  - Resource is subject to the uncontracted penalty. It will pay the 2<sup>nd</sup> FERM Replacement Auction clearing price back to load.

# Penalty rate

- Penalty rate is set prior to the auction and is not based off of the clearing price.
- Variable penalties could have high and low swings in risk for a resource, whereas, a set penalty rate allows risk to be known upfront which makes it easier to formulate an informed offer.
- Penalty rate is set at 105% of the auction price cap.
  - Penalty rate should be high enough so that people bid above zero and make preparations for the obligation, but low enough that resources can manage it.
  - No stop loss provision for penalties because penalties are limited to number of MWh sold.



Reference Rate for Price Cap	\$/MWh
Interim Solution	\$82.49/MWh
Price Cap at 150%	\$123.74/MWh
Penalty Rate at 105% of Price Cap	\$130/MWh



# Replacement Auction

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- Purpose of FERM Replacement Auctions

- Risk of meeting obligation has increased since primary auction; risk of meeting obligation has lowered for uncleared FERM resources now that obligation is closer than 3 years out.
- Allow ISO to force a resource out of FERM obligation for violation of contract verification; becomes the penalty for not contracting.

- Timing of FERM Replacement Auctions

- 1<sup>st</sup> FERM Replacement Auction is one year prior to the obligation start.
- 2<sup>nd</sup> FERM Replacement Auction is after the contract verification period of Oct. 1<sup>st</sup> in the prompt delivery year.

- Structure of FERM Replacement Auctions

- Auction is a static double auction format similar to the FERM Primary Auction
- All previously cleared Obligations are entered into the Auction at a price of \$0 (similar to how FCM ARAs work)
- Since there is a demand curve, it is likely that the price will be set on a curve. This also means that the marginal resource may not clear all of their supply offer/demand bid.
  - Social surplus maximization for resources to take on the obligation similar to the primary auction
- A MW vertical requirement with a penalty factor will continue to ensure that there are enough MW and MWh to meet any level of OP-21 energy emergency.

# Cost Allocation

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- Costs will be allocated on a regional basis to Real-Time Load Obligation.
- The total costs will be evenly distributed across each day of December 1<sup>st</sup> - March 15<sup>th</sup> delivery period.
- Charge to load is the clearing price of FERM for total MWh purchase.
- Credit to load is the sum of
  1. Penalties of FERM resources not offering or delivering on stored fuel or energy under OP-21 energy emergency
  2. Clearing price of the 2<sup>nd</sup> FERM replacement auction for a FERM resource's failure to verify contracts
- Cost of FERM will be known three years prior to obligation period and the spot settlement can only result in a credit.
- Costs to FERM resources and load are known well in advance giving a clear price signal to make arrangements for the obligation and financially prepare for the costs.

# Estimate of FERM Costs (2024-2025 inputs)

		Inputs from Impact Analysis
Gas Supply Assumptions from PP10 w/o Dstrigas		
Pipeline Gas	+	3.59
Modeled LNG	+	0.83
Satellite LNG	+	1.46
Total Supply	=	5.88
LDC Demand	-	5.76
Pipeline gas remaining	=	0.12
Pipeline gas required	/	1.65
Gas %	=	7%
Analysis Group Key Inputs and Assumptions 7/29/2019		
Total Storage Capability (Million gallons)		246
2018 Starting Inventory (Million gallons)		127
Oil in 2018 (Total Storage/2018 Starting Inventory)		52%
December 2018 COO Report		

# Estimate of FERM Costs (2024-2025)

			Source		
NICR (90/10 load)		24,707	*2019 CELT		
Reserves	+	2,921	*Latest FRM Req.		
BTM PV + Energy Efficiency	-	4,527	*2019 CELT		
Imports	-	1,143	*2019 CELT		
Intermittents	-	3,872	*Impact Analysis		
Run of River Hydro	-	749	*Impact Analysis		
<b>Total</b>	<b>=</b>	<b>17,336</b>			
Resources	Impact Analysis 2024-2025 Resource Mix	Adjusted for EFORd	No Fuel Program	2024-2025 Resource Mix after FERM Auction	Notes
Natural Gas with Oil Dual Fuel	8,320	7,255	3,745	4,925	*Adjusted for WRP levels (68% Storage Capability)
Natural Gas Only	8,582	7,939	593	5,419	*Some FT, better import capability, etc.
Natural Gas with LNG			0	2,520	*Adjusted for Excelerate
Natural Gas Fuel Cell	27	24	24	24	
Oil Only	6,601	5,756	2,972	3,908	*Adjusted for WRP levels (68% Storage Capability)
Coal	549	510	510	510	
Nuclear	3,472	3,332	3,332	3,332	
Hydro: Pondage	1,241	1,166	1,166	1,166	
Hydro: Run-of-River	749	687	0	0	
Pumped Storage	1,778	1,671	1,671	1,671	
Onshore Wind	1,401	1,284	0	0	
Offshore Wind	800	733	0	0	
Solar	1,671	1,532	0	0	
Biomass/Refuse	785	720	720	720	
Battery Storage	458	420	420	420	
Price Responsive Demand Response	167	167	167	167	
<b>Total Supply</b>	<b>36,601</b>	<b>33,196</b>	<b>15,320</b>	<b>24,782</b>	
Supply/Demand			-2,016	7,446	

*Program costs are  
dependent on ISO-NE OP-21  
forecast of MWh need*

Assuming 4.5 days and 16 peak hours of OP-21	1,248,224
Price Cap at 150% of Interim Program Rate	123.74
Total Program Costs	\$ 154,449,007
\$/kW-mo (3.5 months)	\$ 2.55

Assuming 4.5 days and 16 peak hours of OP-21	1,248,224
Marginal LNG	85.00
Total Program Costs	\$ 106,099,047
\$/kW-mo (3.5 months)	1.75

# In Conclusion

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- The Forward Enhanced Reserves Market is run three years forward to align with the decision to retain resources at risk of retirement.
- FERM procures a diverse pool of MWh and ties the obligation to offering the stored energy under OP-21 energy emergencies.
- FERM strives to bridge a missing gap in today's existing products by providing:
  - The ISO-NE operations group with the appropriate in-market tools to manage the grid reliably around forecasted fuel system constraints.
  - The evolving resource mix a forward price signal to properly invest and manage risk around fuel supply arrangements.



# APPENDIX

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Slides from previous presentations for reference

# Qualifying Resources

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- Resource must be under dispatch control of the ISO, and can follow dispatch instructions up and down within their physical limits.
- Resource must have the ability to contract for fuel or ability to readily use stored fuel/energy.
- Intermittent resources are not eligible.
- Imports are not eligible.

Resource Technology	FERM Eligibility
Nuclear	Yes
Pumped/Battery Storage (dispatchable)	Yes
Biomass/Refuse	Yes
Coal	Yes
Hydro	If on-site or upstream reservoir/pondage controlled by participant
Natural Gas	Yes, with LNG and/or firm transportation and gas supply.
Oil	Yes
Active Demand Response	Yes



# Qualification and Verification

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- Resource offers are reviewed by ISO prior to running of the auction for
  - Resource's rated generation
    - Winter capacity in MWs
  - Known or planned storage capacity
    - Minimum MWhs based off of MW rating
      - Current thinking is to prorate MW rating based on a starting inventory level
    - Maximum MWhs offered by resource owner
  - Credibility of quantity offered
    - Officer Certification
    - Inventory levels and replenishment plans for oil
  - Planned outages
    - Not allowed during winter period or must be deducted from offered FERM quantity
- Contract eligible resources must provide Officer Certification of intent to contract prior to FERM auction. These resources will be subject to contract review by the ISO.
- Contract verification must be completed prior to October 1<sup>st</sup> of the Obligation Year.
- Resources that do not meet Contract Verification upon ISO review will pay 2<sup>nd</sup> FERM Replacement Auction clearing price.

# Auction Timing and Clearing

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- Auction is held three years prior to the winter obligation year.
  - For example, the FERM Auction for Dec. 1 - Mar. 15, 2026 is run Spring 2022.
  - FERM aligns with the planning horizon for ISO operations group to retain a fuel secure resource.
- FERM Auction is run separately and after the Forward Capacity Auction.
  - This way fuel secure attributes are kept out of the capacity market although, a fuel security constraint is a simple solution to solve for a target amount of capacity.
  - ISO will sunset Fuel Security RMR tariff language after FCA 15. It will not be able to retain a resource in the capacity market for its stored fuel/energy attributes.
- FERM allows ISO to pay resources for fuel security attributes for only the winter months needed.
  - For example, going forward a resource that static de-lists from the FCA could clear in FERM.
    - As a result, FERM may clear a little higher than typical, providing an investment price signal to some resources and allowing for a timely transition as resource exits the market.
    - Conversely, if fuel secure resources are plenty then FERM will clear primarily to provide payment for forward fuel arrangements.
- Resources will submit sealed-bid offers for FERM after the results of its Capacity Supply Obligation are known.

*Participation in FERM is voluntary.*

# Auction Demand Curve

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- ISO will leverage its fuel security reliability review set out in Planning Procedure 10 in Appendix I to solve for an amount of MWs and MWhs needed to avoid violations of trigger criteria across multiple scenarios.
- A sloped demand curve is set for a total MWh portfolio requirement over the winter with a soft constraint on total MWs per event.
  - “Soft Constraints” are those that can be violated in the optimization (if needed) in order to reach a solution with a penalty factor to allow the optimization to try and comply with the constraint.
  - Each MWh of stored fuel/energy enhances fuel security, but after a certain point at a declining rate- similar to the MRI curve.
- The market price is set by the intersection of the demand curve and supply stack.
- All suppliers to clear the auction are paid the auction clearing price, subject to penalties for non-performance.