# Price Formation Enhancements

*Fast-Start Pricing*

Policy Development Working Group

December 5, 2024

# Reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.

- The meeting is structured to stimulate dialogue and engage different perspectives.

- Please keep comments professional and respectful.

- Please try to be brief and refrain from repeating what has already been said so that we can manage this time efficiently.

# Instructions for raising your hand to ask a question

- Open the Participant and Chat panels from the bottom right.

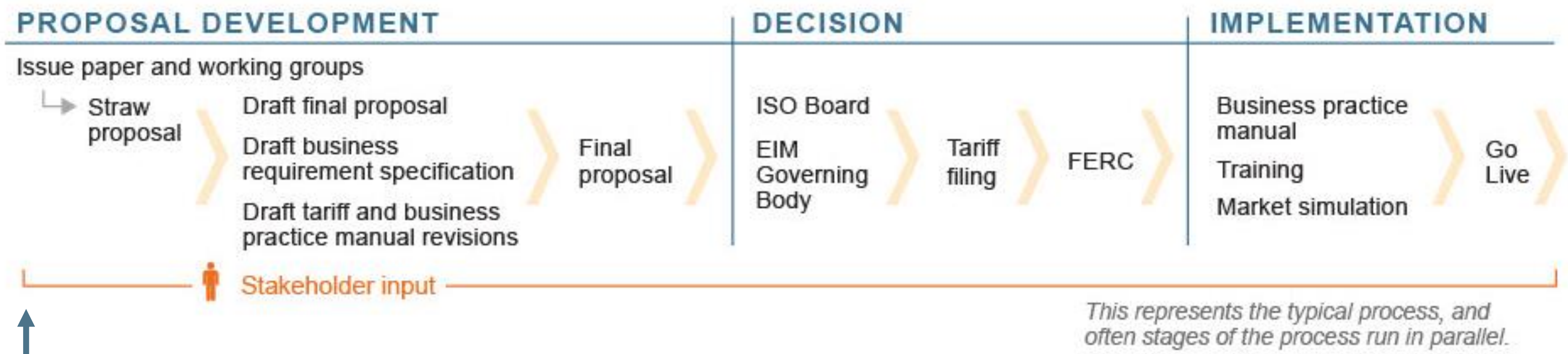
- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon located on the bottom of your screen.
  - **Note**: *3 only works if you dialed into the meeting.

- Please remember to state your name and affiliation before making your comment.

- You may also send your question via chat to either **Brenda Marquez** or to all panelists.

- If you need technical assistance during the meeting, please send a chat to the event producer.

# CAISO Policy Initiative Stakeholder Process




We are here

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Stakeholders Meetings:

12/16 - BAA level MPM

12/19 - Fast- Start Pricing

# Meeting Objectives

By the end of this working group meeting, participants will discuss:

- How to amortize fixed commitment costs across different time periods
- Implications of implementing fast-start pricing in the day-ahead market
- How different ISOs/RTOs have approached these implementation decisions
- The guidance from FERC's NOPR on these implementation decisions

# Timeline of Fast-Start Pricing Working Group Discussions

| Date | Topic |
| --- | --- |
| **November 14, 2024** | Explore initial design concepts; defining a fast-start resource and review modified offer curve method to amortize commitment costs into market prices |
| **December 5, 2024** | **Explore initial design concepts (continued); how long to amortize costs and whether to apply fast-start pricing in the day-ahead market.** |
| **December 19, 2024** | CONFIRMED: MISO and MISO IMM perspectives on fast-start pricing, featuring:<br>Shu Xu, Principal Engineer, Market Evaluation, MISO<br>Carrie Milton, VP, Potomac Economics (MISO IMM) |
| **January 16, 2025** | CONFIRMED: PJM and PJM IMM perspectives on fast-start pricing, featuring:<br>Vijay Shah and Keyur Patel, PJM<br>Catherine Tyler, Deputy Market Monitor, Monitoring Analytics (PJM IMM) |
| **January 30, 2025** | Discuss interactions with flexible ramping product |
| **February 13, 2025** | Discuss interactions with multi-interval optimization and impacts to storage resources |
| **February 27, 2025** | Discuss interactions with DAM / HASP / FMM, including interactions with EDAM / WEIM transfers and WEIM base scheduling practices |
| **March 13, 2025** | Discuss interactions with GHG constraints and design |
| **March 27, 2025** | Discuss interactions between scarcity pricing and fast-start pricing |
| **April 3, 2025** | Discuss needed changes to scheduling run / pricing run and interactions with pricing run penalty prices |

# Workshop Agenda

| Topic | Presenter | Time |
|---|---|---|
| Welcome and Introductions | Brenda Marquez | 10 minutes |
| Review of Previous Working Group | James Friedrich | 30 minutes |
| Continue to Discuss Core Design Features<br>• Amortization period<br>• Fast-start pricing in the day-ahead market | James Friedrich<br>Mike Cadwalader | 80 minutes |
| Open Discussion and Q&A | All | 60 minutes |

Fast-Start Pricing

# REVIEW OF PREVIOUS WORKING GROUP MEETING

California ISO

# Meeting summary

- The working group discussed three different methods for incorporating commitment costs into LMPs for fast-start resources:
  - simple constant adder approach
  - adjusted constant adder approach
  - minimum average cost approach.

- We discussed each method's calculations, advantages, disadvantages, and stakeholder opinions, focusing on how each approach incorporates start-up and minimum load costs into market prices.

# Major questions

**Q: Should fast-start pricing apply to all block-loaded or inflexible resources, not just fast-start units, since the pricing issues are similar? Similarly, must fast-start resources be block-loaded (on/off)?**

A: Fast-start pricing targets resources with fast-start capability and short runtime patterns because they rely more on uplift to recover costs. Also, it is more difficult to determine the time period over which commitment costs should be allocated for units with longer MUTs. Resources do not need to be block-loaded to qualify as fast-start, and not all resources with inflexible operating ranges meet the criteria for fast-start treatment.

**Q: Does fast-start pricing apply to self-schedules?**

A: No. In fact, all types of non-economic commitments would be excluded from fast-start pricing, for example, WEIM base schedules, minimum online constraints, reliability must run commitments, exceptional dispatches, etc. The general principle being: any commitment decision driven by non-economic factors makes a unit ineligible for FSP, since the commitment costs in those cases are not part of the economic optimization.

# Major questions

**Q: Should fast-start pricing apply to MSG transitions?**

A: MSG transitions were included in CAISO’s fast-start pricing analysis but their inclusion in any proposal remains an open question that requires further discussion.  MSG transitions do have characteristics that make fast-start pricing relevant.

**Q: Would battery storage resources qualify as fast-start resources?**

A: No.  Storage resources are "always committed“ in the CAISO market.  They don't have a traditional unit commitment process like conventional generators. Also, storage resources don't have commitment costs in the same way conventional generators do.  Since fast-start pricing is about incorporating commitment costs into LMPs, there aren't relevant costs to incorporate for storage.

# Major questions

**Q: What is the relationship between eligibility thresholds and expected LMP impacts?**

A: Generally speaking, more generous thresholds would lead to higher LMP impacts.

**Q: Would we be potentially "double counting" costs if generators are internalizing commitment costs in their incremental energy bids and then getting the fast-start adder?**

A: Preserving incentives for generators to bid their marginal costs in the absence of market power should be one of the criteria used to select an amortization method. Bid cost recovery payments should reduce the need for generators to inflate their energy market bids to cover fixed costs.

# Major questions

**Q: Questions about how fast-start pricing would interact with: imbalance reserves, multi-interval optimization and advisory interval pricing, CRRs, Price Inconsistency Market Enhancements (PIME) policy, general price inconsistencies between markets.**

A: All of these we will explore in future sessions.

**Q: How does fast-start pricing affect bid mitigation?**

A: We can learn from other MMUs about their experience. It seems reasonable to run the normal MPM process and apply the adder to mitigated bids when applicable. Implementing fast-start pricing in a manner that gives generators an incentive to submit bids that reflect their actual cost structure should facilitate market monitoring.

# Major questions

**Q: Should fast-start pricing logic apply to offline units that could be started but aren't currently running?**

A: No decision has been made either way.  MISO has made changes to their rules for offline resources over time so we can learn from their experience.  NYISO has implemented changes to its procedures for setting prices when there are transmission constraint violations and now plans to eliminate offline fast-start pricing, although it won't do so in the near future due to other priorities.  The original FERC NOPR did not require markets to allow offline fast-start resources to set prices.  The NOPR said offline fast-start resources could only be used to set prices during transmission constraint violations, energy shortage conditions, or ancillary service shortage conditions.

Fast-Start Pricing

# AMORTIZATION PERIOD

# What is amortization?

- **Amortization** involves spreading the fixed commitment cost of a fast-start resource across a defined period to derive a per-megawatt-hour adder to its energy bid curve.
  - Incorporates fixed costs into variable cost bids

- Without amortization, markets rely on uplift or out-of-market payments to compensate fast-start units if they cannot recover their commitment costs when they operate for short durations.

# Understanding commitment costs in CAISO market

- **Start-up cost ($/start):** a one-time fixed cost incurred each time a generating unit is started. It occurs at a discrete point in time when the unit transitions from offline to online.
  - **Transition cost:** a type of startup cost specific to multi-stage generators. These costs reflect the expenses associated with moving between different operating configurations while the unit is online.

- **Minimum load cost ($/hour):** the cost incurred when the unit is online but operating at its minimum output level. It accrues continuously for every hour the unit remains online.

*No-load costs and minimum load costs are related but distinct concepts that are often confused. Minimum load costs include both the fixed costs (no-load) and variable costs of producing at minimum output.

# Key question: how long should fixed costs be amortized?

- The commitment cost is equal to the sum of:
  - The start-up cost and
  - The minimum load cost multiplied by the MUT.

- Markets need to establish the manner that will be used to spread these costs, both over the unit's output (discussed during the last meeting) and over time.

# Guidance from the FERC NOPR (RM17-3)

- The NOPR states that these costs should only be included in prices “during the resource's minimum run time”.

- **For start-up costs:** The NOPR proposed to "amortize a fast-start resource's start-up cost over the resource's minimum run time and its economic maximum operating limit"

- **For no-load costs:** The NOPR proposed to "divide a fast-start resource's no-load cost by the resource's economic maximum operating limit"

# Guidance from the FERC NOPR

- The NOPR stated that while "it could be argued that commitment costs for fast-start resources are still marginal costs of operating the system even beyond a fast-start resource's minimum run time, attempting to amortize start-up costs beyond the minimum run time is problematic from a practical standpoint, specifically in the real-time market." This is because after the minimum run time, "the unit commitment algorithm may de-commit the fast-start resource if it is no longer economic, making the total run time unknown."

- The NOPR concluded that "Given that the resource must operate for no less than its minimum run time, we believe that amortizing a fast-start resource's commitment costs during this period represents a reasonable approach," but remained open to "better or alternative timeframes over which commitment costs for fast-start resources should be amortized".

# Comparisons in other markets

| Market | Start-Up Cost | No-Load Cost |
|---|---|---|
| ISO-NE | Start-up cost is amortized across the resources maximum output and minimum run time. | No-load cost is amortized across the resources maximum output for the duration the unit is online and running. |
| MISO | Start-up cost is amortized across the resources maximum output and its minimum run time. | No-load cost is amortized across the resources maximum output for the duration the unit is online and running. |
| NYISO | The adjusted cost for output levels that are less than or equal to the output level that minimizes average cost is equal to that minimum average cost. Start-up costs are included in the calculation of minimum average cost for the first 15 minutes (in the RTM) after the scheduled start of a fast-start generator. | |
| PJM | Start-up cost is amortized across the resources maximum output and minimum run time. | No-load cost is amortized across the resources maximum output for the duration the unit is online and running. |
| SPP | Start-up cost is amortized across the resources maximum output and minimum run time. | No-load cost is amortized across the resources maximum output for minimum run time. |

# Assumptions for Examples

- With this in mind, consider a fast-start generator with:
  - Pmin of 50 MW.
  - Minimum load cost of $2000/hour (which is $40/MWh), and a start-up cost of $500.
  - MUT of 1 hour (which simplifies the math).
    - For this example, assume that such a generator is eligible for fast-start pricing.
  - Therefore, its commitment cost is $500 + $2000/hr. × 1 hr. = $2500.
- Also assume that this generator has two incremental output segments.
  - Its cost to increase output from 50 MW to 75 MW is $30/MWh.
  - Its cost to increase output from 75 MW to 100 MW is $70/MWh.

# Allocating all commitment costs evenly over the MUT (1/3)

- How should the $2500 in commitment costs for this generator be allocated?
- One approach is to allocate all commitment costs evenly over the one-hour MUT, which produces an adder of:
  - $2500 / 100 MWh = $25/MWh using the constant adder approach.
  - ($2500 – $30/MWh × 50 MWh) / 100 MWh = $10/MWh using the adjusted constant adder approach.
- Under the minimum average cost approach, the commitment cost would be included in the calculation of average cost during the MUT. Thus, the average cost would be:
  - $2500 / 50 MWh = $50/MWh at Pmin.
  - ($2500 + $30/MWh × 25 MWh) / 75 MWh = $43.33/MWh at 75 MW.
  - More than $43.33/MWh if output increases above 75 MW, since the actual offer to increase output above 75 MW exceeds $43.33/MWh.
  - So its FSP offer to produce up to 75 MW would be $43.33/MWh.

# Allocating all commitment costs evenly over the MUT (2/3)

- If this fast-start generator continues to operate after the conclusion of the MUT, its FSP offers would not include the $500 start-up cost. Thus, the adders would be:
  - $2000 / 100 MWh = $20/MWh using the constant adder approach.
  - ($2000 – $30/MWh × 50 MWh) / 100 MWh = $5/MWh using the adjusted constant adder approach.
- Under the minimum average cost approach, its cost—excluding the start-up cost—is still minimized at 75 MW.
  - Thus, its FSP offer to produce up to 75 MW would be ($2000 + $30/MWh × 25 MWh) / 75 MWh = $36.67/MWh.

# Allocating all commitment costs evenly over the MUT (3/3)

- Thus, if all commitment costs are allocated evenly over the one-hour MUT, we obtain the following FSP offers using the different amortization methods:

| | | | | FSP Offers During First Hour Using: | | | FSP Offers After First Hour Using: | | |
|---|---|---|---|---|---|---|---|---|---|
| Block | Capacity (MW) | Actual Offer ($/MWh) | Start-Up Cost Offer | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) |
| Pmin | 50 | $ 40.00 | $ 500 | $ 55.00 | $ 40.00 | $ 43.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| Inc 1 | 25 | $ 30.00 | | $ 55.00 | $ 40.00 | $ 43.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| inc 2 | 25 | $ 70.00 | | $ 95.00 | $ 80.00 | $ 70.00 | $ 90.00 | $ 75.00 | $ 70.00 |

# Allocating start-up costs to a portion of the MUT (1/3)

- However, just because this generator's MUT is one hour does not mean that it was committed to meet load in the next hour.
  - The NYISO and its IMM found that in New York, "the majority of fast-start gas turbine commitments are to satisfy immediate energy needs, i.e., within 15 minutes of the resource's scheduled start."
- Consequently, in the Real Time Market NYISO allocates start-up costs to that 15-minute period, to increase the likelihood that costs incurred to meet load at a given point in time are allocated to that point in time, which should improve incentives to increase supply and decrease demand at that time.
- How would that approach affect this example?

# Allocating start-up costs to a portion of the MUT (2/3)

- The portion of commitment costs that is allocated to the first 15 minutes is the $500 start-up cost plus the minimum generation cost for 15 minutes, which is $2000/hr. × ¼ hr. = $500, for a total of $1000.
  - The remaining $1500 in commitment costs are allocated to the last 45 minutes needed to complete the one-hour MUT.
- For the first 15 minutes, this produces an adder of:
  - $1000 / (100 MW × ¼ hr.) = $40/MWh using the constant adder approach.
  - ($1000 – $30/MWh × 50 MW × ¼ hr.) / (100 MW × ¼ hr.) = $25/MWh using the adjusted constant adder approach.
- For the last 45 minutes needed to complete the one-hour MUT, this produces an adder of:
  - $1500 / (100 MW × ¾ hr.) = $20/MWh using the constant adder approach.
  - ($1500 – $30/MWh × 50 MW × ¾ hr.) / (100 MW × ¾ hr.) = $5/MWh using the adjusted constant adder approach.
  - These are the same adders that would apply after the conclusion of the one-hour MUT (which were calculated previously).

# Allocating start-up costs to a portion of the MUT (3/3)

- Under the minimum average cost approach, $1000 of the commitment cost would be included in the calculation of average cost during the first 15 minutes. Thus, the average cost during the first 15 minutes would be:
  - $1000 / (50 MW × ¼ hr.) = $80/MWh at Pmin.
  - ($1000 + $30/MWh × 25 MW × ¼ hr.) / (75 MW × ¼ hr.) = $63.33/MWh at 75 MW.
  - More than $63.33/MWh if output increases above 75 MW, since the actual offer to increase output above 75 MW exceeds $63.33/MWh.
  - So, for the first 15 minutes, the FSP offer would be $63.33/MWh for up to 75 MW.
- As for the other amortization methods, FSP offers for the last 45 minutes needed to complete the one-hour MUT would be the same as the FSP offers that would apply after the conclusion of the MUT.

# Comparing the results

- If all commitment costs are allocated equally over the one-hour MUT, we obtain the following FSP offers:

| | | | | FSP Offers During First Hour Using: | | | FSP Offers After First Hour Using: | | |
|---|---|---|---|---|---|---|---|---|---|
| Block | Capacity (MW) | Actual Offer ($/MWh) | Start-Up Cost Offer | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) |
| Pmin | 50 | $ 40.00 | $ 500 | $ 55.00 | $ 40.00 | $ 43.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| Inc 1 | 25 | $ 30.00 | | $ 55.00 | $ 40.00 | $ 43.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| inc 2 | 25 | $ 70.00 | | $ 95.00 | $ 80.00 | $ 70.00 | $ 90.00 | $ 75.00 | $ 70.00 |

- And if start-up costs are allocated to the first 15 minutes, we obtain the following FSP offers:

| | | | | FSP Offers During the First 15 Min. Using: | | | FSP Offers After the First 15 Min. Using: | | |
|---|---|---|---|---|---|---|---|---|---|
| Block | Capacity (MW) | Actual Offer ($/MWh) | Start-Up Cost Offer | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) | Constant Adder ($/MWh) | Adj. Constant Adder ($/MWh) | Min. Avg. Cost ($/MWh) |
| Pmin | 50 | $ 40.00 | $ 500 | $ 70.00 | $ 55.00 | $ 63.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| Inc 1 | 25 | $ 30.00 | | $ 70.00 | $ 55.00 | $ 63.33 | $ 50.00 | $ 35.00 | $ 36.67 |
| inc 2 | 25 | $ 70.00 | | $ 110.00 | $ 95.00 | $ 70.00 | $ 90.00 | $ 75.00 | $ 70.00 |

# Allocating other commitment costs to a portion of the MUT

- In principle, there is no reason why minimum load costs also couldn't also be allocated unevenly over the MUT.
  - Suppose that the fast-start generator was committed to meet load in the next 15 minutes, and the expected LMP in the remaining 45 minutes of the hour was \$25/MWh.
  - Then the expected value of the energy produced when operating at Pmin for 45 minutes is \$25/MWh × 50 MW × ¾ hr. = \$937.50.
  - Therefore, there is an argument for allocating \$2500 – \$937.50 = \$1562.50 of this generator's commitment costs to the first 15 minutes, instead of just \$1000.
- However, this would produce situations when the FSP offer for the last 45 minutes needed to complete the MUT was lower than the FSP offer used after the MUT was completed.
  - And it makes the calculation more complex, as it's based on the expected LMP.

Fast-Start Pricing

# FAST-START PRICING IN THE DAY-AHEAD MARKET

# Guidance from FERC NOPR

- FERC proposed to require RTOs/ISOs to incorporate fast-start pricing in both markets and maintain consistency between them because it would:
  - Provide more accurate price signals in the day-ahead market
  - Support better price convergence between day-ahead and real-time markets

# Comparisons in other markets

| Market | FSP in DAM? |
|---|---|
| ISO-NE | No |
| MISO | Yes |
| NYISO | Yes |
| PJM | Yes |
| SPP | Yes |

# ISO-NE response to FERC

- ISO-NE stated that implementing fast-start pricing in the day-ahead market would have limited benefits because most fast-start resources are committed in real-time
  - Argued it would be a “complex and time-consuming endeavor” with significant software changes and costs that were not worth the benefit

- Unresolved market design issues:
  - Whether lost opportunity cost payments are appropriate in the DAM
  - How to apply amortization for resources with sub-hourly minimum run-times when the day-ahead market clears hourly

# Impact on day-ahead market

- The practical impact of incorporating fast-start pricing in the day-ahead market may be minimal.
  - There are generally more options available in the day-ahead market to meet load, which may significantly reduce the likelihood that fast-start generators would be scheduled to operate in the day-ahead market.

- Even if fast-start pricing is not explicitly included in the day-ahead market, it would affect day-ahead market outcomes through virtual bidding.
  - If the use of fast-start pricing is expected to affect real-time prices, it will also affect the prices at which market participants are willing to take positions in the day-ahead market.

# Evidence from market monitors

- **PJM IMM (2023): "**The real-time load-weighted average PLMP was $31.08 per MWh in 2023, which is **6.8 percent**, $1.97 per MWh, higher than the real-time load-weighted average DLMP of $29.11 per MWh. The day-ahead load-weighted average PLMP was $31.93 per MWh in 2023, which is **0.1 percent**, $0.04 per MWh, higher than the day-ahead load-weighted average DLMP of $31.89 per MWh."

- **MISO IMM (2023): "**ELMP had almost no effect in the day-ahead market because the supply is far more flexible and includes virtual transactions."

- **SPP MMU (2023): "**SPP has seen a large percentage of the fast-start resources clearing in the day-ahead market"

# Next Steps

# Next Steps

- Visit the Price Formation Enhancements - Working Group Phase 2 - Schedule 2024 -2025: https://stakeholdercenter.caiso.com/InitiativeDocuments/Price-Formation-Enhancements-Working-Group-Phase-2-Schedule-2024-2025.pdf
- Visit initiative webpage for more information:
- https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements
- If you have any questions, please contact isostakeholderaffairs@caiso.com

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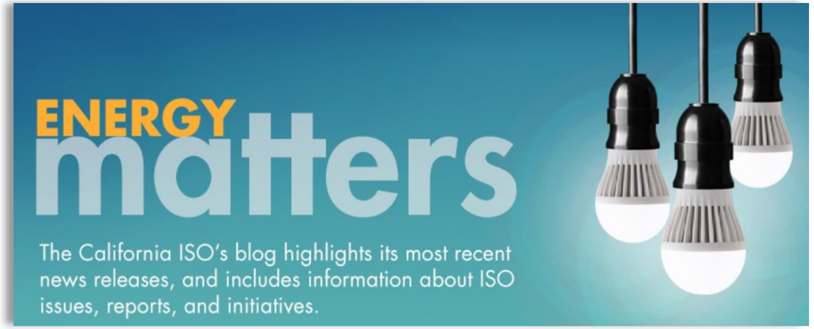
Stakeholders Meetings:

12/16 - BAA level MPM

12/19 - Fast- Start Pricing

# Upcoming Meetings this Month

- Dec 11 – Storage Design and Modeling Working Group
- Dec 12 – Market Performance and Planning Forum
- Dec 12 - Winter Readiness Training for Scheduling Coordinators
- Dec 12 - Tariff Clarification Draft Tariff for After-Market Fuel Cost Recovery
- Dec 12 - Comments due - Congestion Revenue Rights Enhancements Working Group
- Dec 13 - Comments due - Price Formation Enhancements Policy Development Working Group Sessions 1 and 3, BAA-Level MPM
- Dec 13- Resource Adequacy Modeling and Program Design Workshop
- Dec 16 - Price Formation Enhancements Policy Development Working Group
- Dec 19- Price Formation Enhancements Policy Development Working Group

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