Price Formation Enhancements

Fast-Start Pricing

Policy Development Working Group

February 13, 2025

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- 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.

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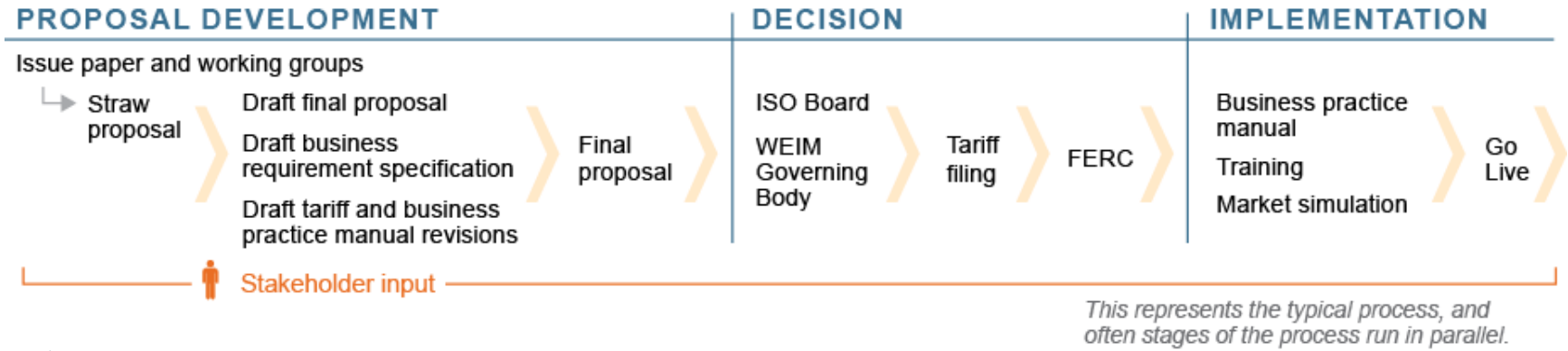
CAISO Policy Initiative Stakeholder Process



We are here

Workshop Goal

- Present a high-level summary of the key takeaways the working group should glean from the MISO, PJM, and their respective IMM presentations on fast-start pricing.
- Revisit CAISO's analysis and relate to the experiences of MISO and PJM.
- Present Mike Cadwalader's comments to the MISO/PJM discussions.

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	MISO and MISO IMM perspectives on fast-start pricing, featuring: Shu Xu, Principal Engineer, Market Evaluation, MISO Carrie Milton, VP, Potomac Economics (MISO IMM)
January 16, 2025	PJM and PJM IMM perspectives on fast-start pricing, featuring: Vijay Shah and Keyur Patel, PJM Catherine Tyler, Deputy Market Monitor, Monitoring Analytics (PJM IMM)
February 13, 2025	Key takeaways from MISO, PJM, and their respective market monitors.
Future sessions	Discuss fast-start pricing interactions with existing market features such as flexible ramping product, multi-interval dispatch, etc.

Workshop Agenda

Topic	Presenter	Time
Welcome and Introductions	Brenda Marquez (CAISO)	10 minutes
Key Takeaways from MISO and PJM	James Friedrich (CAISO)	50 minutes
Comments on Fast-Start Pricing Presentations by MISO and PJM Staff and Their Independent Market Monitors	Mike Cadwalader (Atlantic Economics)	90 minutes
Open Discussion and Q&A	All	30 minutes

Fast-Start Pricing

KEY TAKEAWAYS

Key Takeaways

Fast-Start Pricing (FSP) is Complex, with Tradeoffs

- FSP is not simple. It is a sophisticated mechanism designed to address specific pricing issues, but it introduces new complexities and potential unintended consequences.

- The implementation of fast-start pricing has been an iterative process.

- FSP designs must account for each market's unique issues, resource characteristics, and design features.

Key Takeaways

The Core Problem FSP Addresses: Non-Convexities

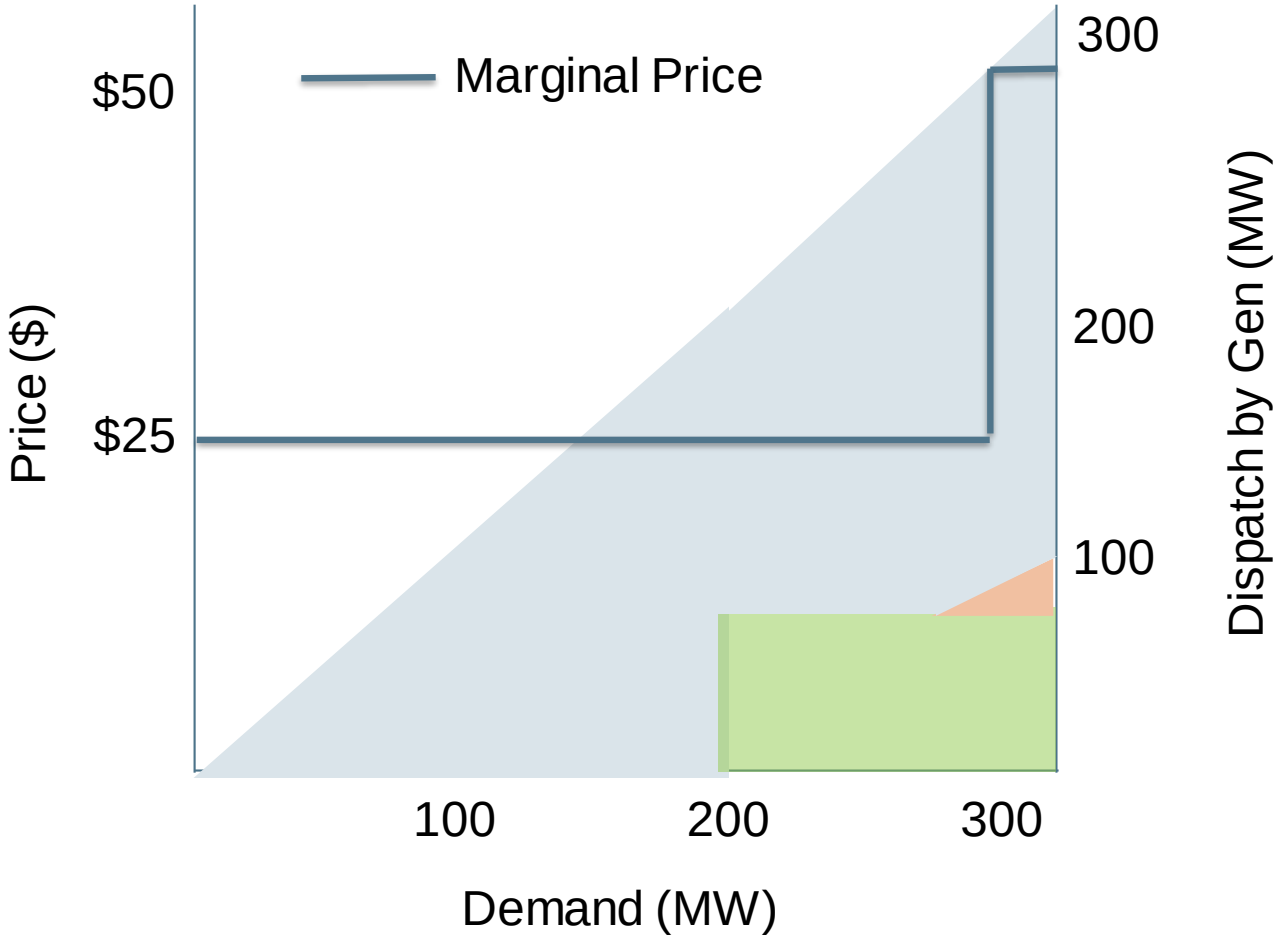
- A producer has convex costs when its marginal cost (the cost of producing one more unit) increases as output increases. A market has convex costs when all participating producers exhibit convex costs.

- In markets with convex total costs there is a clear and well-defined marginal cost at each level of production that under perfect competition ensures allocative efficiency.

Key Takeaways
The Core Problem FSP Addresses: Non-Convexities

- Some electricity producers have start-up and no-load costs and operational constraints like minimum output levels. These characteristics make their total cost functions **non-convex**. Therefore, electricity markets exhibit non-convex costs.

- The non-convex nature of electricity markets creates theoretical challenges in determining the "right price".
  - The aggregate market supply curve will not be smooth and continuously increasing with output. In other words, an increase in supply could lead to a decrease in marginal cost.
  - Market prices may fail to recover the full cost, which is why electricity markets often require additional mechanisms (like uplift payments).

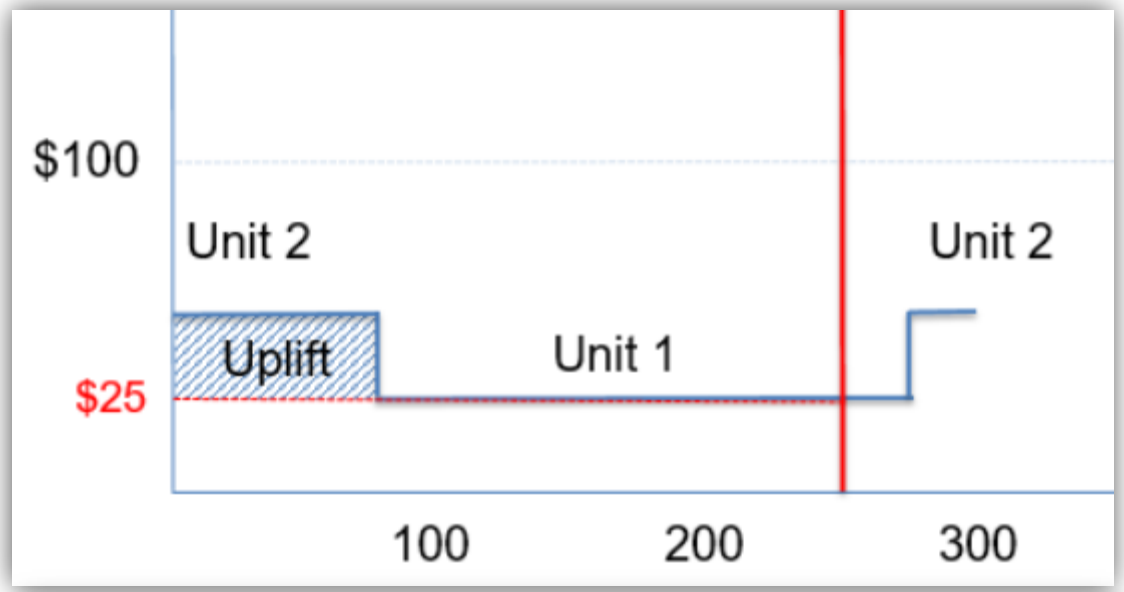


Unit 1 is $25/MWh
200 MW capacity

200MW

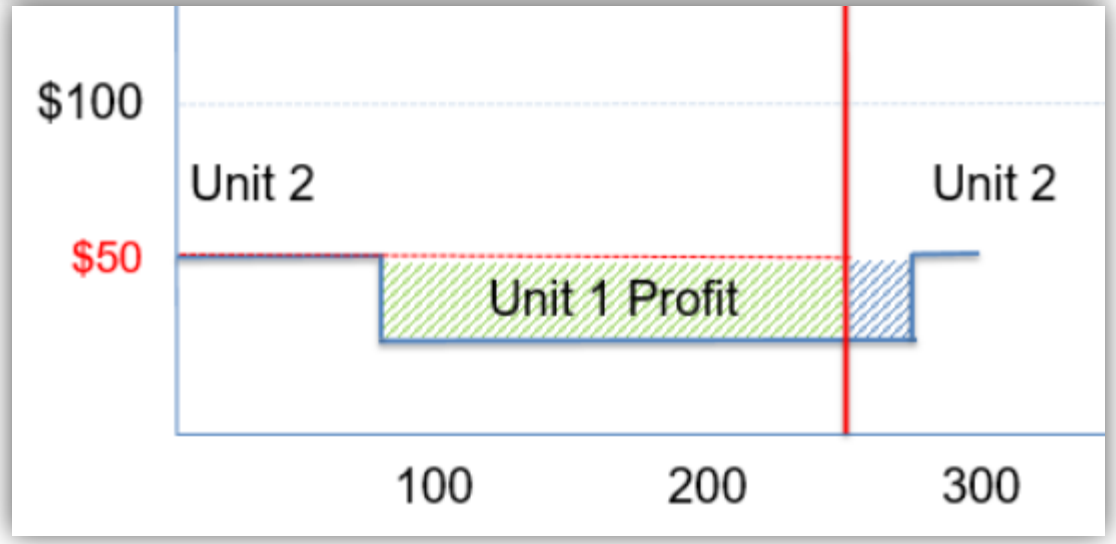
Unit 2 is $50/MWh
100 MW capacity
75 MW are fixed

75MW = 100MW



Traditional LMP
Price = $25

Unit 2 needs to cover it's costs through uplift



Fast start pricing
Price = $50

Unit 1 faces a lost opportunity and requires uplift

Key Takeaways

The Core Problem FSP Addresses: Non-Convexities

- When inflexible, high-cost units are needed but aren't marginal (because of their minimum output levels), LMPs don't reflect the full cost of serving load. The market operator makes "out-of-market" payments (uplift) to cover the full costs of these units.

- This is why some ISOs/RTOs have implemented fast-start pricing or similar mechanisms that allow certain qualifying units' costs to be reflected in prices even when they're not technically marginal due to their operational constraints.

- Reduced uplift is not the primary goal of FSP but an auxiliary benefit of improved price signals.

Key Takeaways
How FSP Works

- There are two main ways of implementing fast-start pricing:
  - **Modified offer curves** - start-up and no-load costs are spread across time and over the unit's output into $/MWh adders and incorporated into the price calculation.
  - **Integer relaxation** - instead of treating commitment as a binary (on/off) decision, FSP allows for "fractional" commitment in the pricing run. A unit might be "0.5 committed," meaning half its output is needed. Start-up and no-load costs are automatically incorporated into the price calculation.

- FSP requires two market runs:
  - **Dispatch run** - determines the actual physical commitment and dispatch of units.
  - **Pricing run** - determines the market-clearing prices using integer relaxation or modified offer curves.

Key Takeaways
Key Design Choices and Challenges

- **Eligibility** - Which units qualify as "fast-start"? MISO initially used a more restrictive definition (10-minute startup, 1-hour minimum run), then expanded it. MISO has expanded eligibility in emergency conditions to include resources with a 4-hour start up time. PJM uses a 1-hour startup and minimum run time. The broader the definition, the more units can set prices, but the less "fast" they are.

- **Cost Amortization -** Both MISO and PJM amortize startup costs over the minimum run time of the resource and no load costs for the duration the unit is online and running.

- **Offline FSRs** – MISO allows offline FSRs to set prices to avoid an energy/reserve deficit or transmission constraint violation. MISO restricted offline participation over time. PJM does not allow offline fast-start resources to set prices.

- **Ramp Constraints -** MISO initially had a rule that prevented units from setting prices if they were constrained by their ramp-down limit. This significantly reduced the number of eligible units. They later relaxed this.

- **Offer Verification** - PJM discussed their offer verification process for fast-start resources with composite offers above $1000/MWh.

Key Takeaways
MISO IMM Perspectives

- Fundamentally supports FSP.

- They argue when inflexible high-cost resources like fast-start units are needed but not allowed to set prices, it creates several market inefficiencies including:
  - The need for uplift payments to cover units' full costs
  - Understated real-time prices that provide inefficient incentives for day-ahead scheduling
  - Poor incentives for imports/exports that could help displace higher-cost peaking resources

- They demonstrated FSP effectiveness in addressing these inefficiencies through increased LMPs when FSRs are economic, reduced uplift, improved DA/RT price convergence, and preserved emergency price signals.

Key Takeaways
PJM IMM Perspectives

- Fundamentally opposes FSP.

- They argue that fast-start pricing removes efficient market outcomes by:
  - Changing prices from the efficient level, which can create incentives for market participants to deviate from efficient behavior
  - Requiring additional uplift payments to correct these incentive distortions

- They highlight several issues with fast-start pricing in PJM:
  - It creates artificial reserve shortages by removing reserves from the pricing run that actually exist in the dispatch
  - It has not achieved a stated goal of incentivizing more fast-start units (the number of CTs and diesels has actually decreased)
  - It creates pricing inconsistencies for virtual traders and FTR holders

Key Takeaways
Impact on Prices (MISO)

Phase I: MISO implemented Fast Start Pricing in real-time and day-ahead markets, allowing online resources with a 10-minute startup and 1-hour minimum run time to set prices.
Phase II: MISO expanded online Fast Start Resource eligibility to include units with a 60-minute startup time.
Phase III: MISO included day-ahead committed Fast Start Resources in real-time pricing and relaxed ramp-down limits.

FSR Type	Market	Impact
Online	RTM	Generally increased prices especially during ramp/peak periods reflecting commitment costs. Phase 1 ~$1/MWh average increase; Phase 2 ~$3/MWh average increase (due to expanded eligibility); Phase 3 further price increases (including DA-committed FSRs)
Online	DAM	Minimal impact ($0.02/MWh); Phase 3 improved DA/RT convergence
Offline	RTM	Generally decreased prices during scarcity/constraints by mitigating price spikes
Offline	DAM	No direct impact; potential for slight indirect improvement in DA scheduling

Key Takeaways
Impact on Prices (PJM)

- **Real-Time:** Monthly load-weighted average real-time prices at major hubs were on average 8% higher with fast-start pricing ($2.58/MWh), with peak ramping hours in the $4 - $6/MWh range.

- **Day-Ahead:** The impact on monthly load-weighted average day-ahead prices has been minimal, with differences between 0.0 and 0.5%.

Key Takeaways
Impact on Uplift (MISO)

- **Phase I**: Uplift costs decreased modestly, with RSG (Revenue Sufficiency Guarantee) costs dropping by about 1% during expected periods.

- **Phase II (Expanded Eligibility)**: Uplift costs decreased more significantly, with RSG costs dropping by approximately 9% during expected periods.

Key Takeaways
Impact on Uplift (PJM)

- Fast-start pricing introduced a new form of uplift called "Dispatch Differential Lost Opportunity Cost" (DD LOC). This represents the difference between what a resource would have earned if operating at the pricing run's MW level and what it actually earned following the dispatch run's instructions.
  - DD LOC was introduced in 2021 and has been relatively small compared to other uplift categories ($0.1 - $3.6M per year).

- The net change in uplift in PJM due to FSP is an open empirical question but the IMM believes that it has not lead to a decrease.

Revisiting CAISO's Analysis
Focus

- CAISO's analysis was a preliminary assessment of the potential impacts of FSP on the Western Energy Imbalance Market (WEIM). It was not a final policy proposal, but rather an exploration of design choices and their likely effects.

- Our goal here is to reflect on CAISO's analysis and findings in light of the discussions with MISO and PJM.

Revisiting CAISO's Analysis
Key Design Elements Explored

- **Eligibility** - focused on start-up time and minimum up-time thresholds of 30- and 60-minutes.

- **Amortization Methods**
  - **Constant Adder:** Spreads commitment costs evenly across the entire operating range.
  - **Adjusted Constant Adder:** Same as above, but subtracts the first bid segment's cost.
  - **Minimum Average Cost Adder:** Calculates the average cost at each point in the bid curve and uses the minimum.

- **Commitment Time -** The analysis amortized costs over the minimum up time

- **Market Configuration -** BAA Level and System Level bookends

Revisiting CAISO's Analysis
Key Design Elements Explored

- Only economic commitments count towards pricing (excludes base schedules, minimum online constraints and self-schedules).

- CAISO analysis excludes offline units and includes multi-stage generator transitions.

Revisiting CAISO's Analysis
Key Findings

- The overall impact of FSP on WEIM prices is projected to be "generally moderate," with system monthly average price increases ranging from $0.2 to $2/MWh depending on the scenario and ranging from $0/MWh to $8.70/MWh depending on the region.

- A 60-minute STUT/MUT definition qualifies about 19% of WEIM gas capacity
  - Same for 30-minute definition; 13% for 10-minute

- Price increases are higher during summer months (peak demand).

- Price increases are concentrated in morning and evening peak hours (when units are starting up or transitioning).

Revisiting CAISO's Analysis
Key Findings

- Impacts are larger in the Southwest and CAISO, and minimal in the Pacific Northwest, because of a higher concentration of fast-start gas in those areas.

- Constant amortization has a larger impact than the other two methods.
  - Mike will discuss later how integer relaxation and modified offer curves (specifically using the minimum average cost approach) generally produce the same results in energy-only examples.

Revisiting CAISO's Analysis
Key Findings

- The analysis did not directly estimate the impact of FSP on BCR payments.

- FSP should lead to a reduction in BCR payments but the overall reduction in total BCR may be moderate. The analysis shows that fast-start gas units make up a small share of overall BCR payments, and DMM estimates that economic commitments account for less than half of BCR payments to fast-start units in CAISO.

- While BCR payments likely decrease under FSP (because the LMP is now covering some of those costs), this decrease is likely to be less than the increase in total costs paid through the higher LMP.

For reference

- All meeting material and notices are available on the Price Formation Enhancements Initiative webpage: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements
- If you have any questions, please contact Brenda Marquez bmarquez@caiso.com, or ISOStakeholderAffairs@caiso.com

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