Price Formation Enhancements

Working Group Session #6

10/12/2023

Housekeeping reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Note: The ISO encourages any verbal or written agreements to comments made during this working group session.
- You may also send your question via chat to either Brenda Corona or to all panelists.

Instructions for WebEx

- The “raise hand” icon is located in the lower tool bar. You will hear a beep tone when you are un-muted; at that time please state your name, and question. Attendees dialed in on the phone only press #2 will hear a notification when you are un-muted; at that time please state your name and question.
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- Polling App: *Slido* you can select the answer to the question.

- Virtual Attendees will see questions on right screen above the chat window.

Today's Working Group Agenda

Time	Topic	Presenter
1:00 – 1:05	Welcome, Today's Agenda, Stakeholder Process Overview	Brenda Corona
1:05 – 1:15	Today's Goals / Next Session	Juan Buitrago
1:15 – 2:00	Revisiting Fast-Start Pricing	Sylvie Spewak
2:00 – 2:30	Analysis on Fast-Start Pricing	Guillermo Bautista-Alderete
2:30 – 3:55	Open Discussion : Feedback on FSP Analysis	Juan Buitrago
3:55 – 4:00	Next Steps	Brenda Corona

ISO Policy Initiative Stakeholder Process

We are here

Stakeholder meetings, working groups and workshops may occur throughout the stakeholder process.

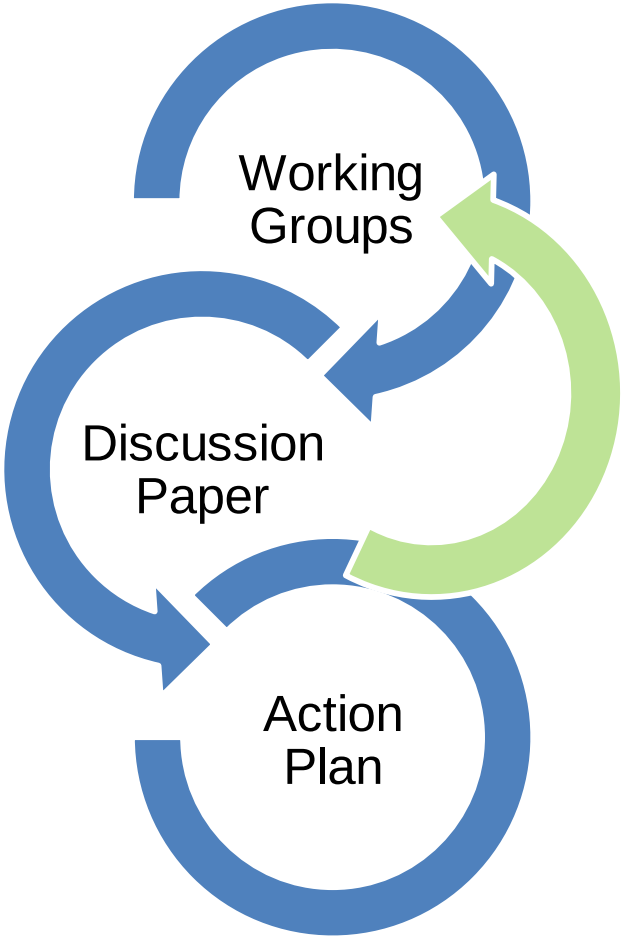
- Working groups will inform the Phase 1 straw proposal
- The ISO will take notes and produce reports of each of our working group meetings.

Working Group Deliverables

Fast Start Pricing Analysis: seeking Stakeholder feedback in developing a scope for analysis on Fast Start Pricing to allow for robust discussion in subsequent phases on its inclusion to the ISO markets

The FSP Analysis will take an iterative approach, coming back to stakeholders for multiple rounds of feedback and fine tuning

You will have an opportunity to provide written comment on the scope of FSP Analysis



Goals of Today's Working Group Session

The Working Group structure is meant to embrace flexibility to allow organic and robust conversation on the topics at hand – it is still key for us to drive towards solutions collaboratively

- **Provide the history and context of Fast-Start Pricing at the ISO**
  - Level set to frame discussion on potentially incorporating Fast Start Pricing along with Flex Ramp Product
  - Provide information necessary for development of a scope for analysis
- **Analysis Scoping**
  - ISO approach to the FSP Analysis
  - Illustrative examples of potential analysis
  - Stakeholder feedback on analysis to allow for robust discussion in subsequent phases of PFE on FSP inclusion into ISO

Revisiting Fast Start Pricing

Sylvie Spewak
Senior Policy Developer

October 12, 2023

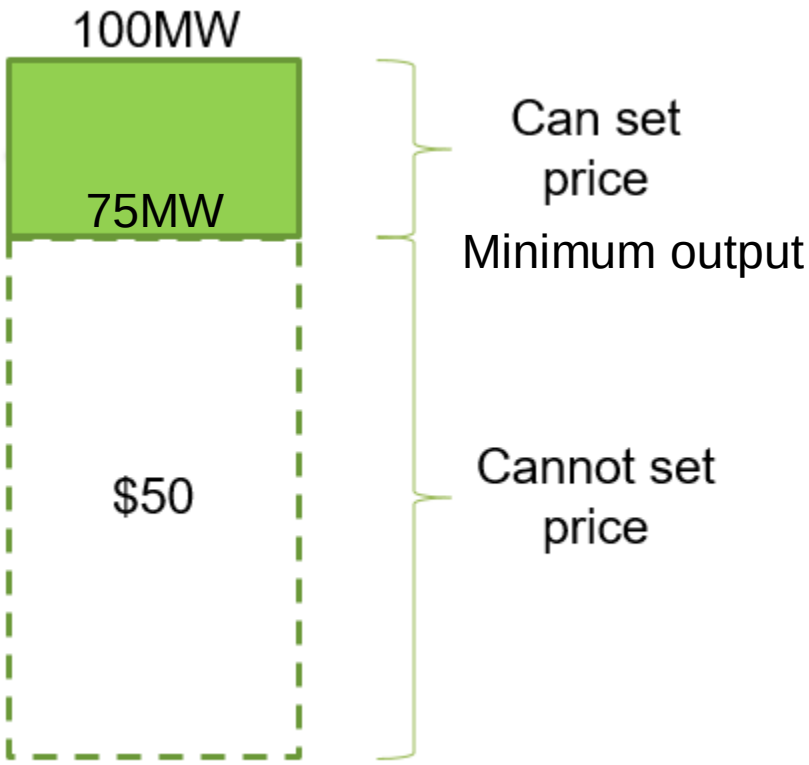
Why revisit fast start pricing?

- Price formation must be tailored to the unique characteristics of the market it serves
  - Different system conditions impact dispatch and pricing

- The CAISO is open to the possibility that some form of Fast Start Pricing could better meet the needs of a broad regional market
  - The benefit of fast start pricing depends on the resource fleet, system conditions, and existing market rules

Characteristics of a resource with ‘lumpy costs’

- The LMP is set by the resource that can be incremented up or down in response to changes in demand
- Inflexible operational limits like min load do not set the LMP
  - Commitment costs do not change with a change in demand
- Real-time pre-dispatch (RTPD) ensures efficiency by taking all costs into account
  - Make whole payments ensure cost recovery where necessary

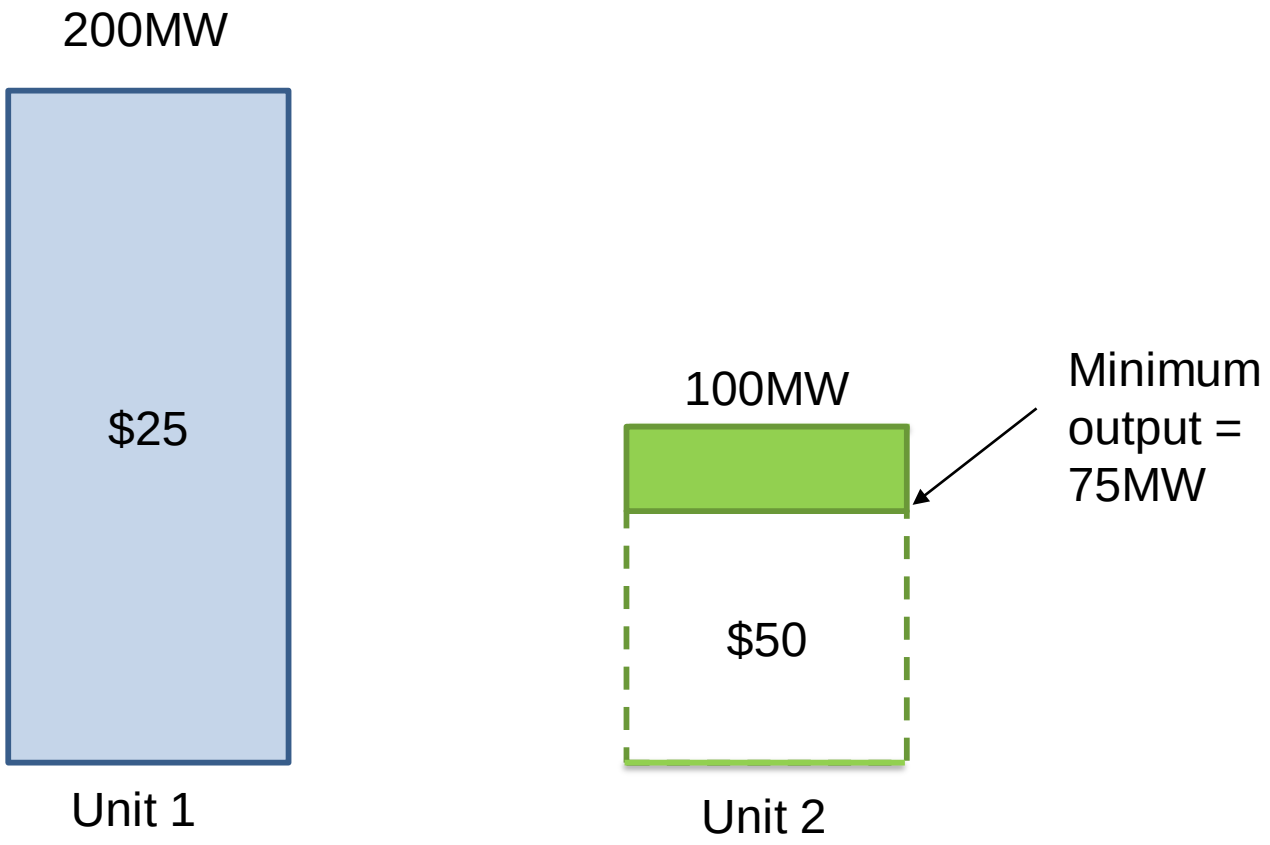


Characteristics of a fast start resource + pricing

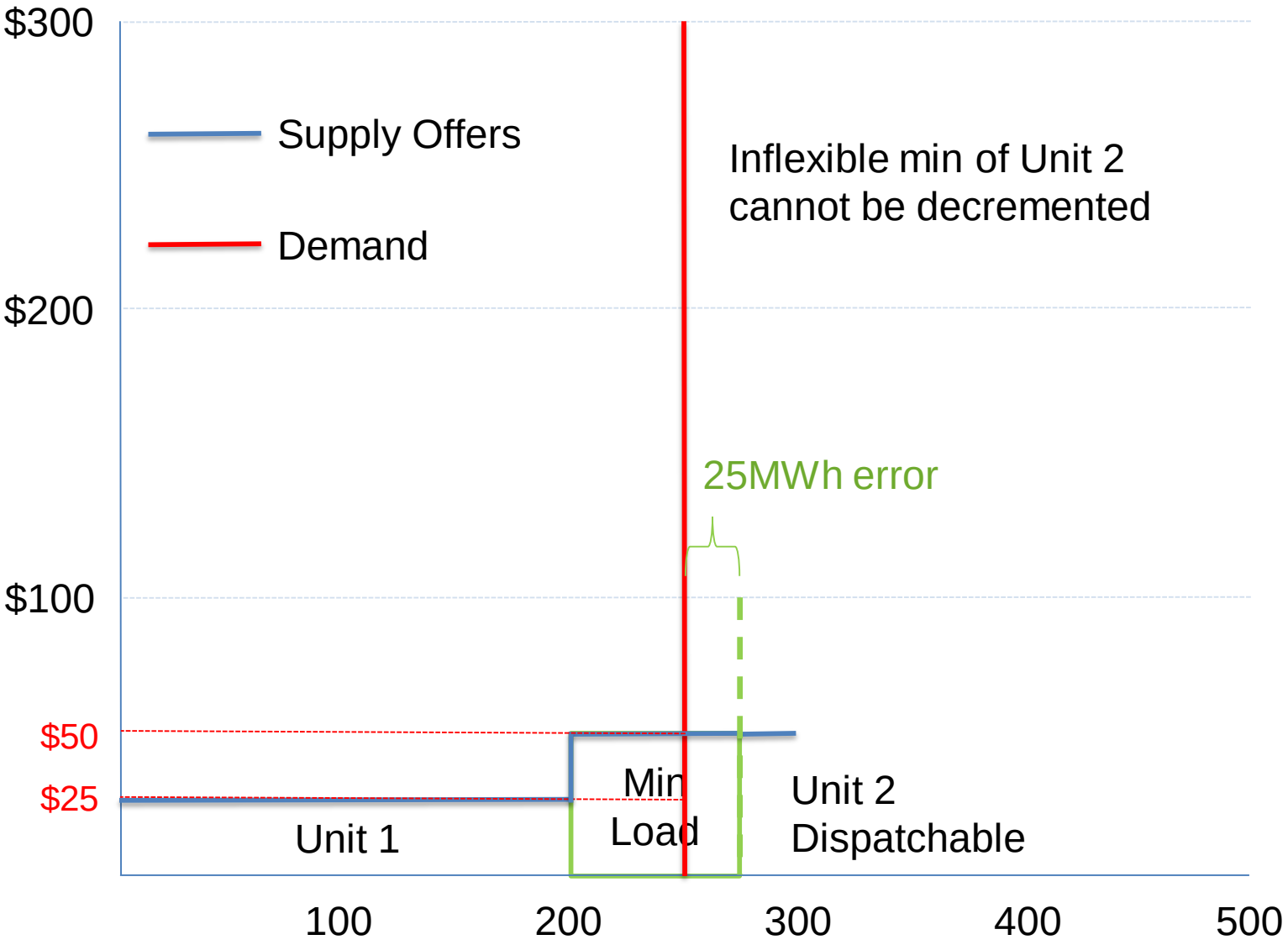
- ‘Fast start’ resources can be dispatched quickly in response to sudden changes in load to support reliability
- Fast start pricing addresses ‘lumpy costs’ that are not traditionally included in the LMP by shifting them into the LMP

Characteristics of a fast start

How should we dispatch these units to serve 250MW of demand while minimizing production costs?



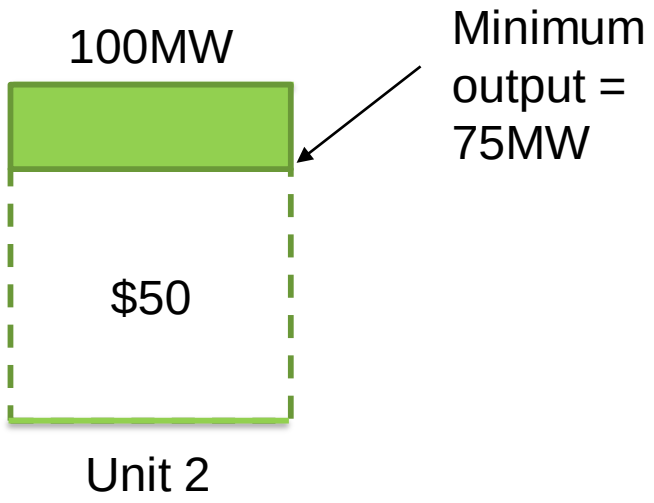
Merit order results in a power balance violation



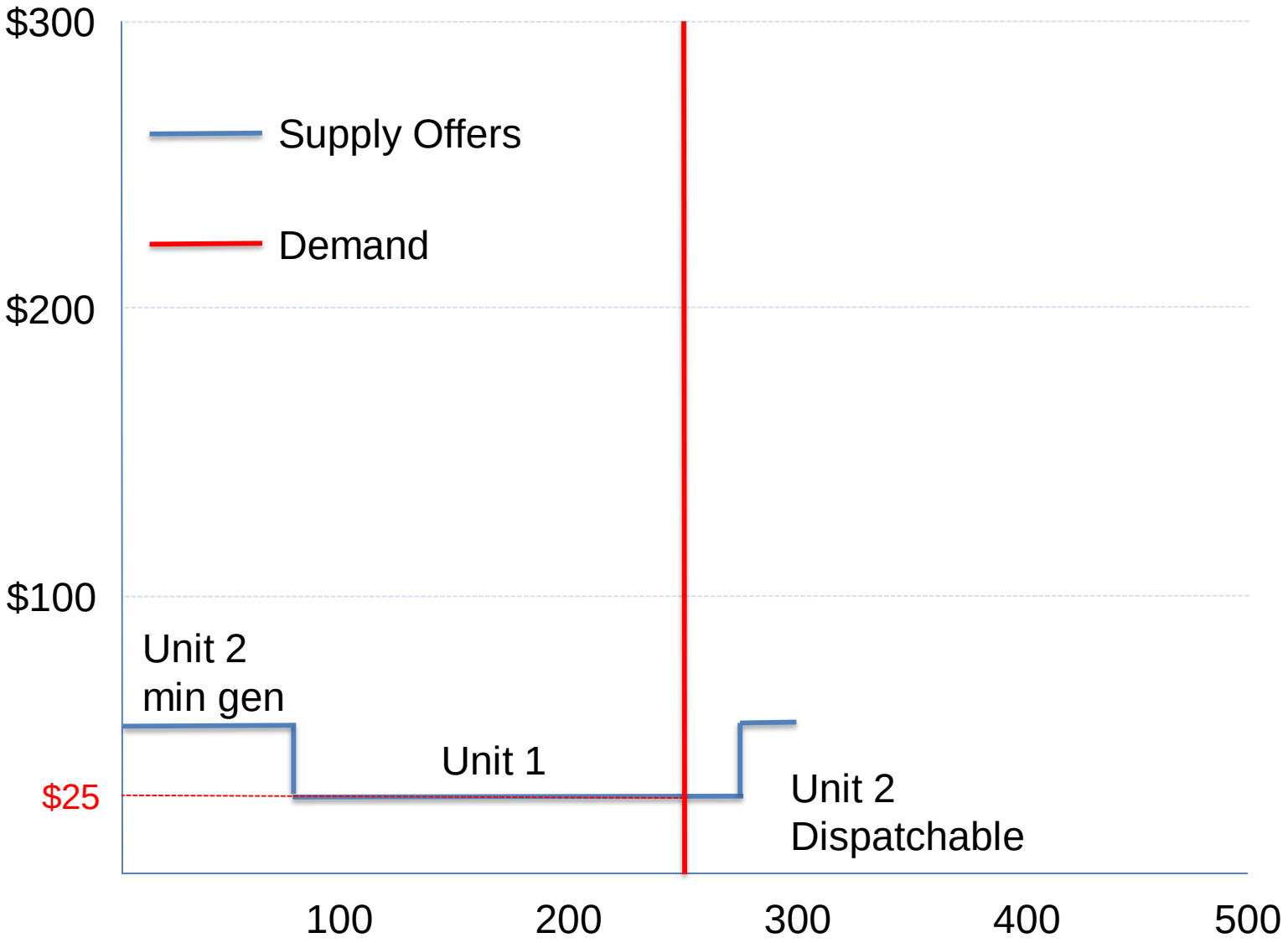
Characteristics of a fast start

How should we dispatch these units to serve 250MW of demand while minimizing production costs?

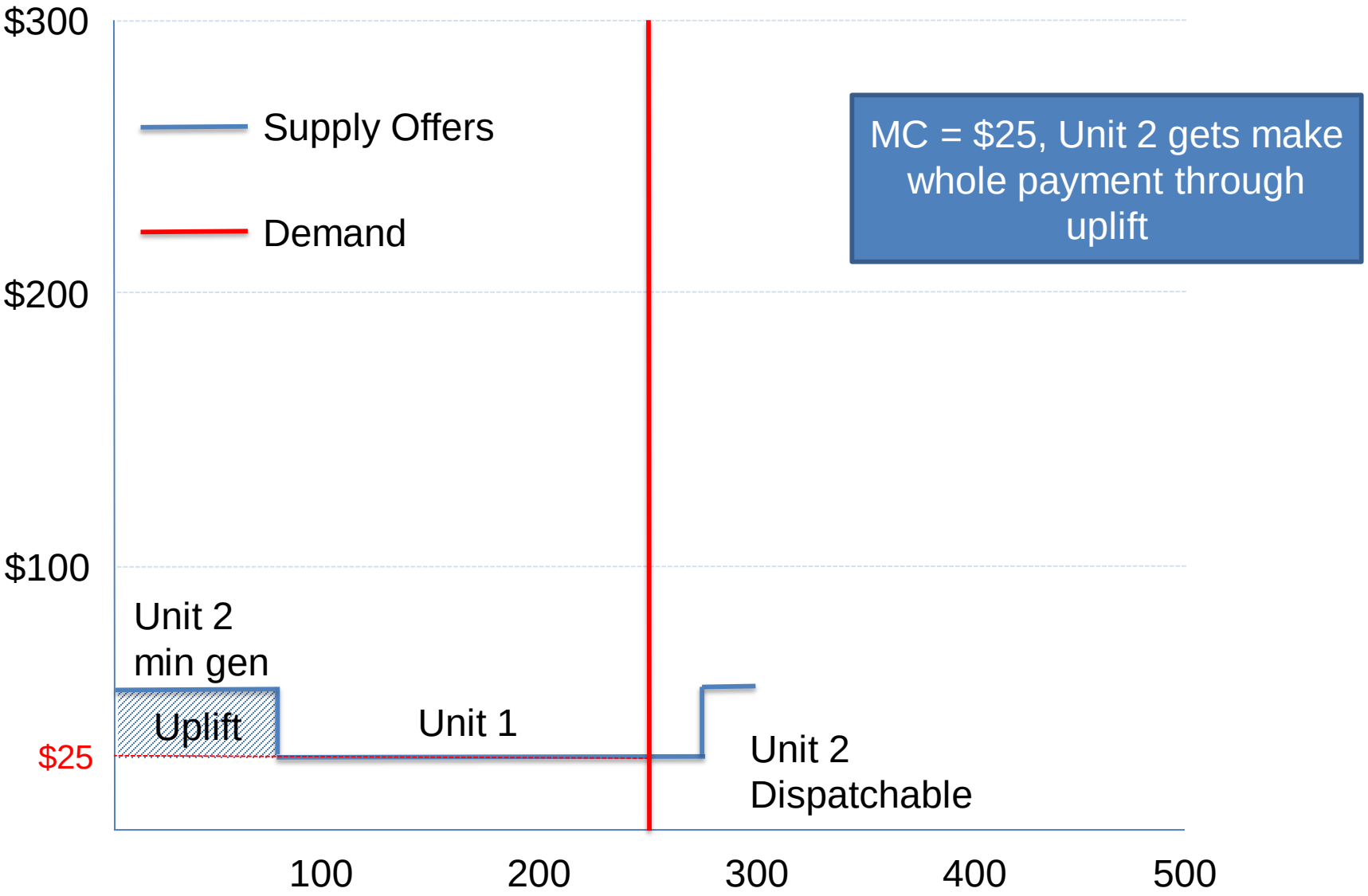
Unit	Energy Award	Offer Price	Production Cost
1	175MW	$25	$4,375
2	75MW	$50	$3,750
	250MW		**$8,125**



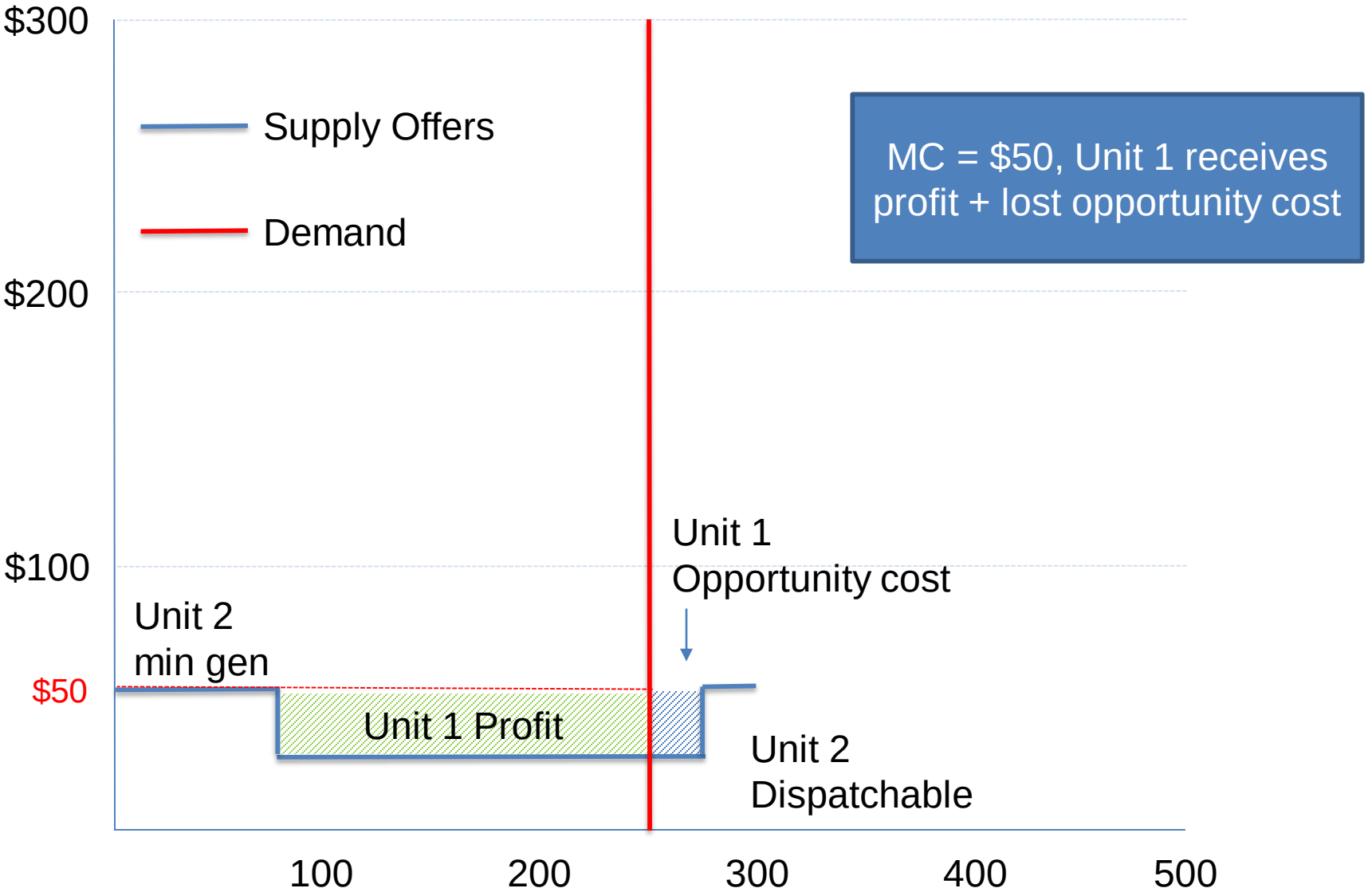
What is the marginal price?



What is the marginal price? Unit 1 sets the LMP



What's the marginal price? Unit 2 sets the LMP



Fast start pricing methodology

- Minimum output limit relaxation
  - Prices are set as though fast-start resources can be dispatched across their entire capacity range by reducing their minimum operating limits (Pmin) to 0. This makes it easier or possible for the resource to become the marginal generator and set the price.
- Inclusion of commitment costs in pricing
  - Marginal prices incorporate start-up and minimum load costs.

Logic and methodology vary regionally

ISO/RTO	Start up time <=	DA/RT
MISO	1 hour	DA and RT
ISO-NE	30 min	RT only
NYISO	30 min	DA and RT
SPP	10 min	DA and RT
PJM	1 hour	DA and RT

FERC did not issue a final rule because of regional variations

- FERC NOPR RM17-3 (December 15, 2016) addressed fast start price formation, noting:
  - Commitment costs are incurred close to the same time as incremental energy costs
  - Reflecting commitment costs in the LMP would reduce uplift and support efficient investments in ramping capacity

- FERC found that a generic rulemaking was not appropriate for all RTOs/ISOs
  - CAISO already had experience operating a market with large ramping capacity requirements
  - Other RTO/ISOs face different problem statements and underlying market design

CAISO's previous experience met intended goals

Intended benefit	CAISO market solution
Reduce reliance on uplift	Use of bid cost recovery was deemed a reasonable and efficient method to allocate costs to consumers
Ensure sufficient ramping capability is committed	Multi-interval optimization takes ramp rates into account, and ensures dispatch is consistent with bids over the market horizon
Increase transparency of price signals to support dispatch	Flexible ramping product increases transparency through separate energy and ramping prices
Increase transparency of price signals to support investments	Separate capacity payments

Potential impacts of FSP in CAISO markets

- FSP would increase LMPs in the market pricing run it applies to
  - In RT, higher LMPs do not just impact load

- Impact on uplift is uncertain
  - FSP may require make-whole and opportunity cost payments

Analysis of Fast Start Pricing

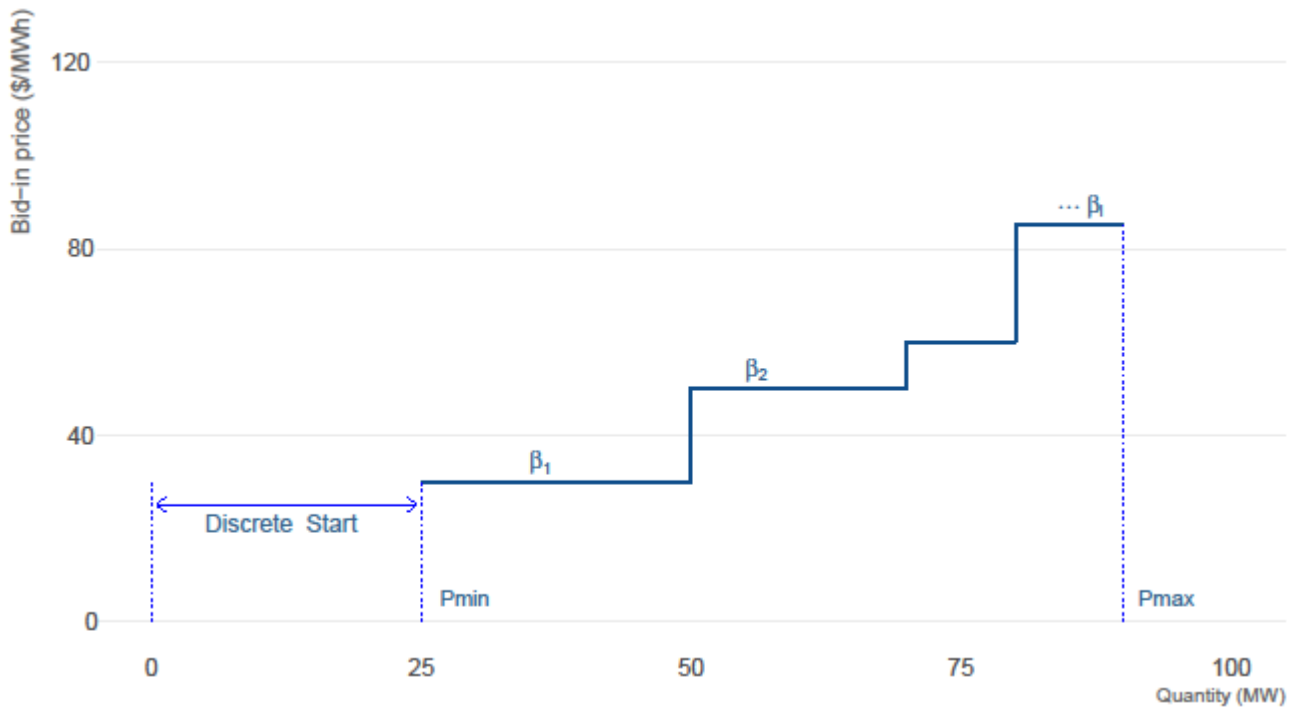
Kun Zhao, Ph.D.
Lead Market Engineering Specialist

Guillermo Bautista Alderete, Ph.D.
Director, Market Performance and Advanced Analytics

CAISO is committed to assess the impact of Fast Start Pricing

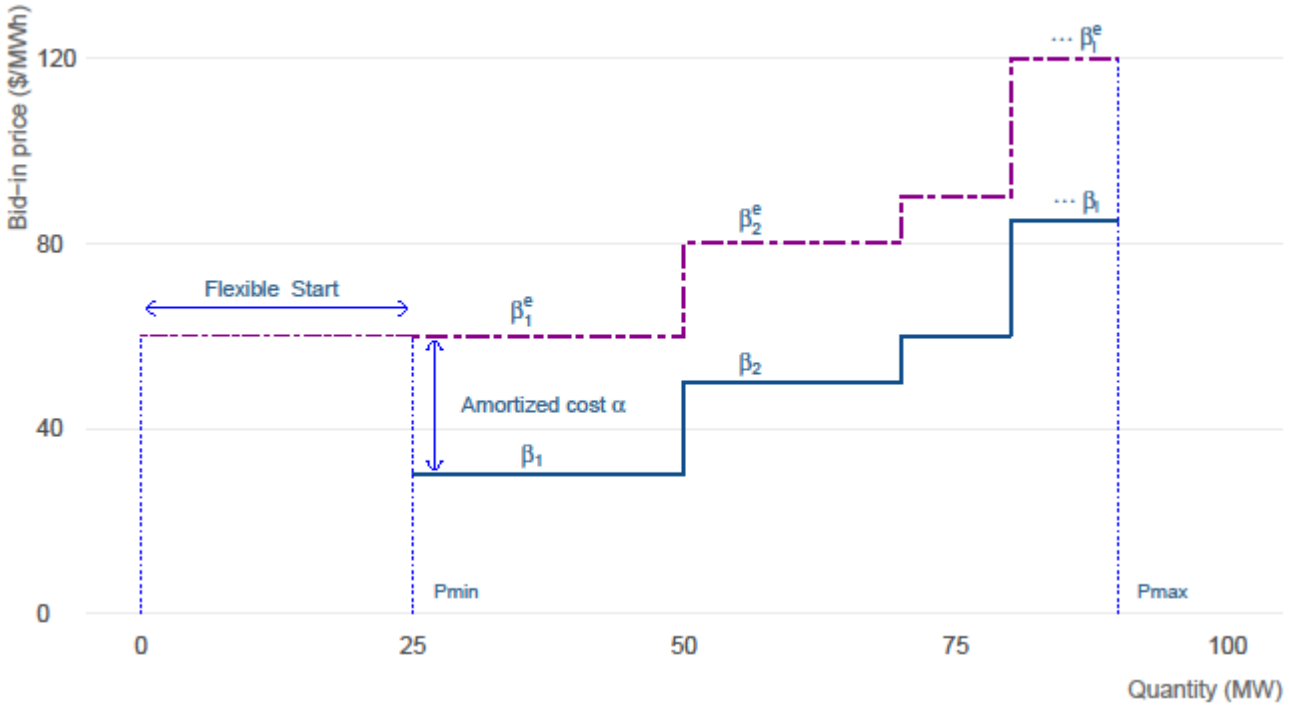
- This effort is to explore potential impacts of FSP and help guiding subsequent FSP discussions
- First stage:
  - Start with some basic analysis of FSP implications
  - Consider participants feedback to shape its scope
  - Provide analysis and opportunity for discussion of the first stage of analysis. December 2023
- Second Stage:
  - Consider additional feedback from market participants
  - Define final scope of analysis
  - Provide analysis and opportunity for discussion of final analysis. March 2024

Analysis on Fast Start pricing



- Lumpy and discrete commitment costs for range $[0\ ,\ P_{min}]$.
  - Minimum Load Costs
  - Startup cost
- Variable bid-in cost defined between $Pmin$ and $Pmax$.

Fast Start Pricing factors in commitment costs into the variable bid-in cost



Adjusted bid $\beta_i^e = \beta_i + \gamma + \delta \quad \forall i$

where $\gamma = \frac{MLC - P_{min}\beta_1}{P_{max}}$ $\delta = \frac{STUC}{max(0.25, \frac{MUT}{60})P_{max}}$

How can we estimate the impact of FSP?

Sandbox with detailed formulation

X

- Need to define specific formulation
- Develop the sandbox
- Derive input data set
- Account for market conditions (fuel prices, resource characteristics, bidding behavior)
- Account for intertemporal constraints, FRP, congestion and detailed resource characteristics
- Onerous effort and time to implement

Counterfactual estimate

- Use a back-of-the-envelop estimate
- Rely on historical data as input data set (WEIM BAAs historical resource and bid information)
- Define assumptions (interval by interval approximation, no FRP)
- Set the boundaries based on actual market schedules
- It does not replicate a full optimization
- System-wide energy price, no congestion
- Area by area *vs.* EIM system wide area *vs.* WEIM areas (accounting for transfers)
- DA versus RT? No info available to derive a DA counterfactual
- CAISO will use this approach to assess FSP

Analysis: 1. Basic statistics about current supply mix

Supply classification by
- startup time,
- minimum up time,
- minimum load cost and
- start-up costs

Historical bid cost recovery by supply classification

Definition of sensitivity scenarios

Analysis: 2. Develop a set of sensitivity scenarios for different alternatives

Scenario	Type of Startup	Start -up time	Minimum-up time
Benchamark	Discrete	All times	All times
1	Discrete	≤ 15 minutes	≤ 1 hour
2	Flexible	≤ 15 minutes	≤ 1 hour
3	Flexible	≤ 1 hour	≤ 1 hour
:	:	:	:
n	Flexible	All times	All times

What resources are subject to FSP?

- Based on Start up time and/or minimum up time definitions
  - <15 minutes,
  - <1hour,
  - all resources?

How are the discrete costs factor in?

- Horizon to amortize costs, based on MUT or something else
- How to amortize cost over the operational bid range?
- Amortize only MLC or both MLC and STUC?

Benchmark FSP relative to standard pricing for the chosen sensitivity scenarios

- Prices stratified by month, area and hour
- Bid cost recovery changes
- Cost changes
- Volume of imbalance created by FSP
- Marginal resources under FSP

Prototype using CAISO area only

It uses real-time data from 2021

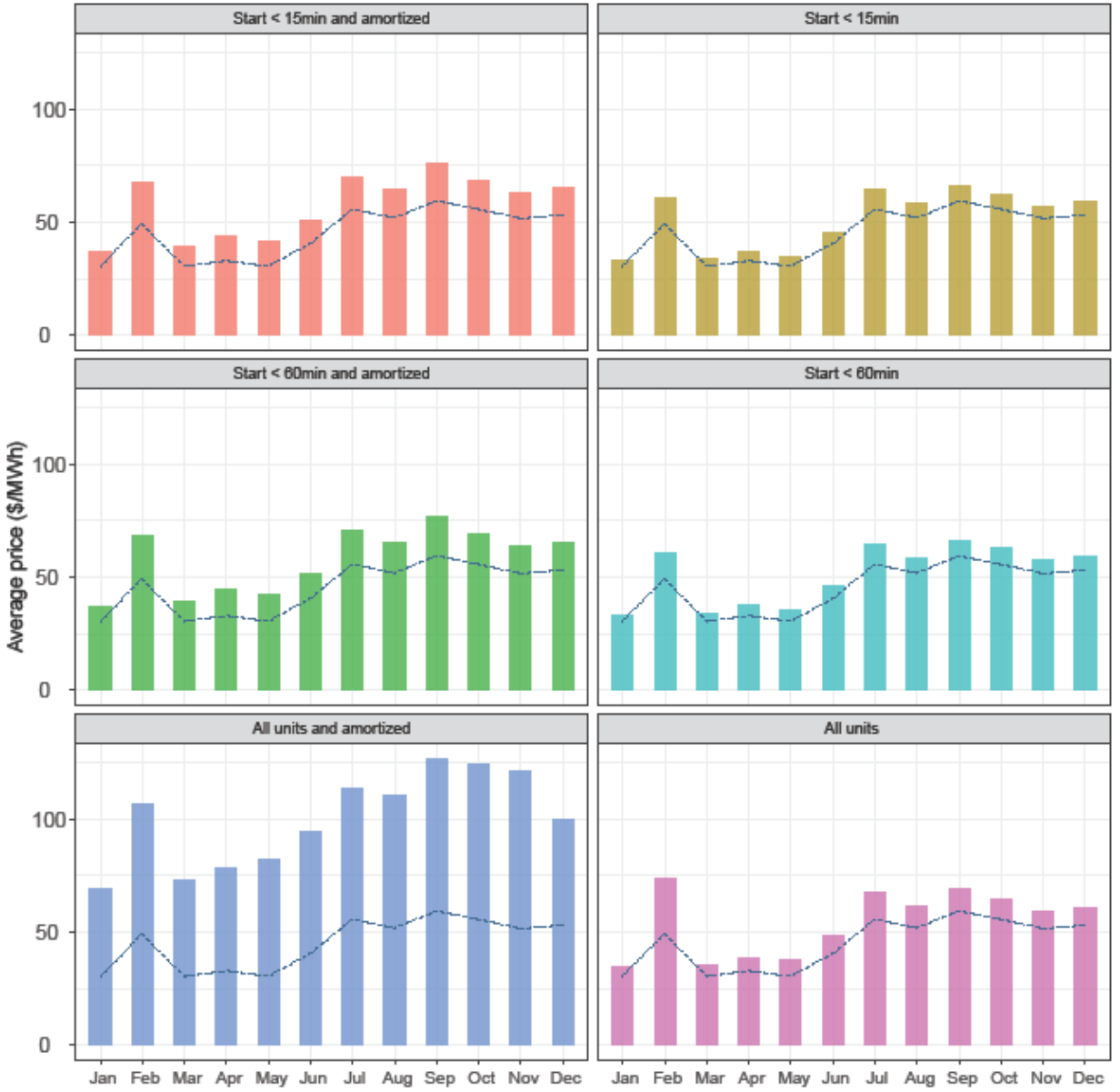
Scenario	Bid	Type of Startup	Units Startup time
Benchmark	β_i	Discrete	All times
1	β_i^e	Flexible	$\leq$ 15 minute
2	β_i^e	Flexible	$\leq$ 60 minute
3	β_i^e	Flexible	All times
4	β_i	Flexible	$\leq$ 15 minute
5	β_i	Flexible	$\leq$ 60 minute
6	β_i	Flexible	All times

Benchmark of price changes

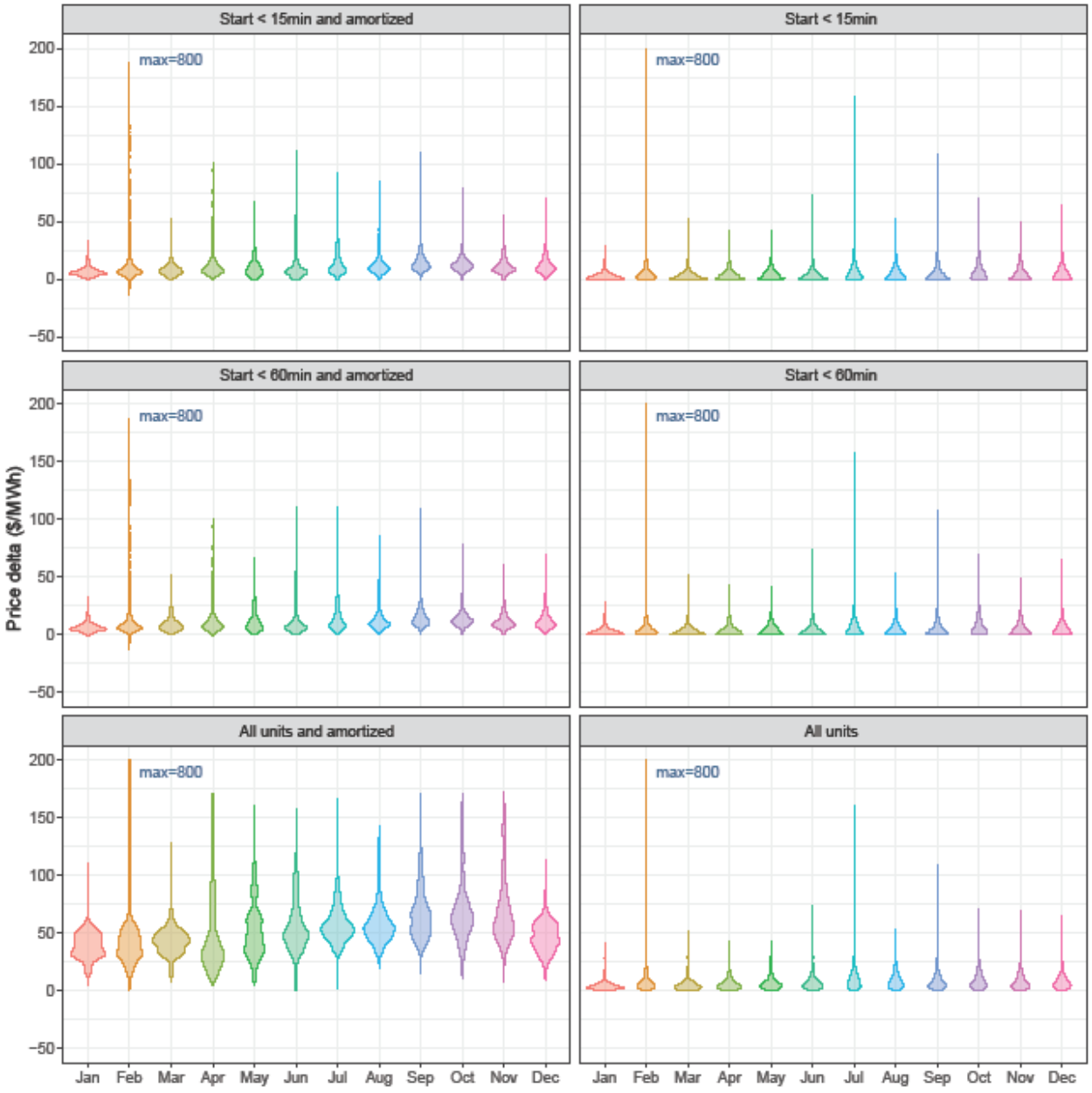
Bars: FSP prices

Dotted line: Standard pricing

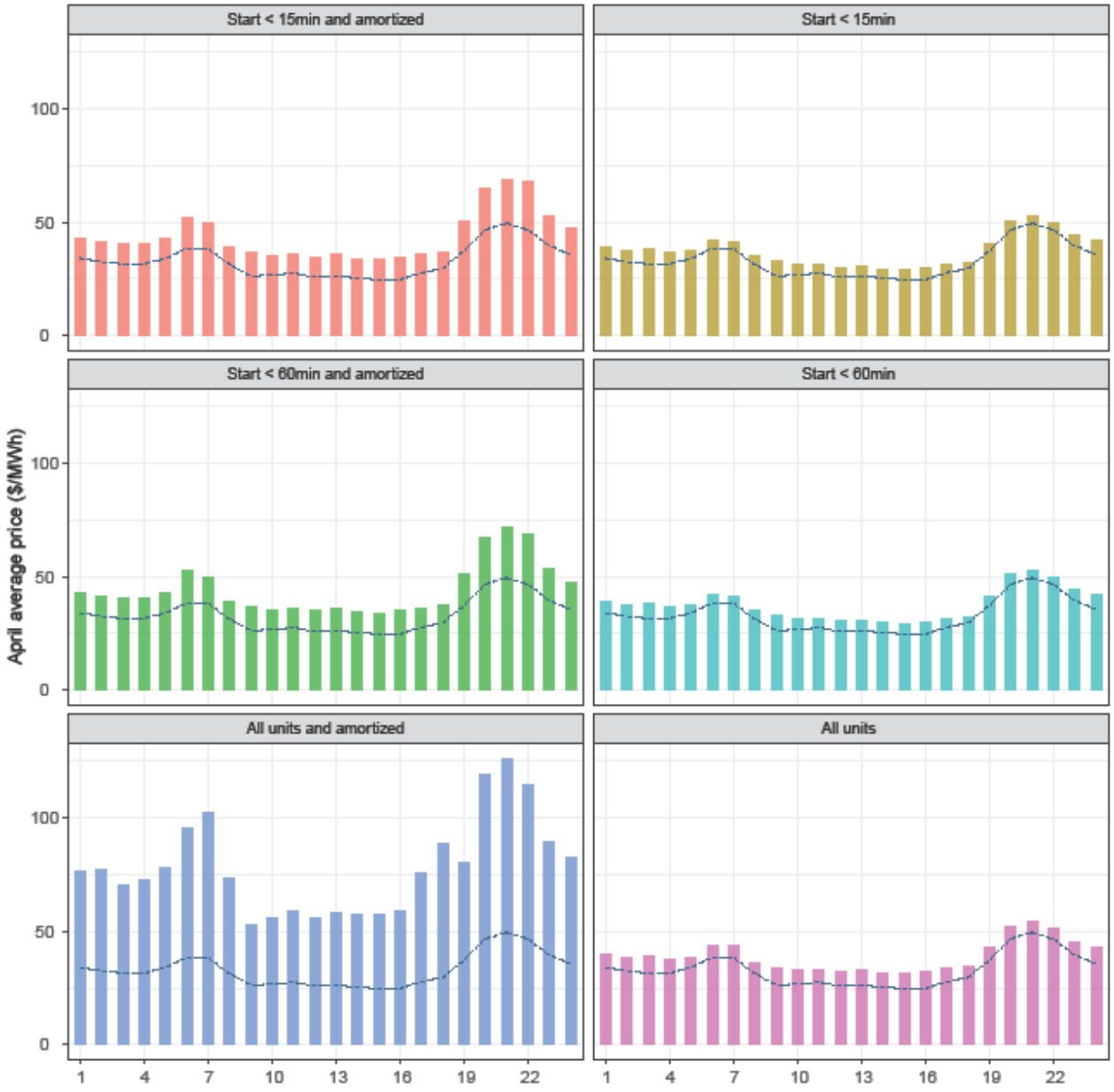
Scenario	1	2	3	4	5	6
Avg price ($/MWh$)	57	57.7	100	50.85	51.13	54.1
Increase ($/MWh$)	12.08	12.78	55.08	5.93	6.21	9.18
Increase (%)	27	28.5	122.6	13.2	13.8	20.4



Price differences between standard and FSP approaches



Sample of hourly prices
April 2021



Sample of hourly prices
August 2021

Open Discussion : Scope for FSP Analysis

Please provide your feedback on the information needed in the analysis.

Next steps

Revised Discussion Paper

- Please provide feedback via comment tool
- Incorporating feedback from this session and comments

PFE Working Group Session #7

- Tentatively October, 25th, 2023
- Return to Scarcity and BAA-Level MPM conversation

For reference

- Visit initiative webpage for more information: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements
- If you have any questions, please contact Brenda Corona at bcorona@caiso.com or isostakeholderaffairs@caiso.com

- *Energy Matters* blog provides timely insights into ISO grid and market operations as well as other industry-related news http://www.caiso.com/about/Pages/Blog/default.aspx.

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