Price Formation Enhancements

Stakeholder Workshop

July 12, 2022

Reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO permission.
- Calls are structured to stimulate open dialogue and engage different perspectives with the understanding that stakeholders have read the proposal.
- In the interest of time, please refrain from repeating or reiterating what has already been said.
- If you need technical assistance during the meeting, please send a chat to the event producer.

Instructions for raising your hand to ask a question

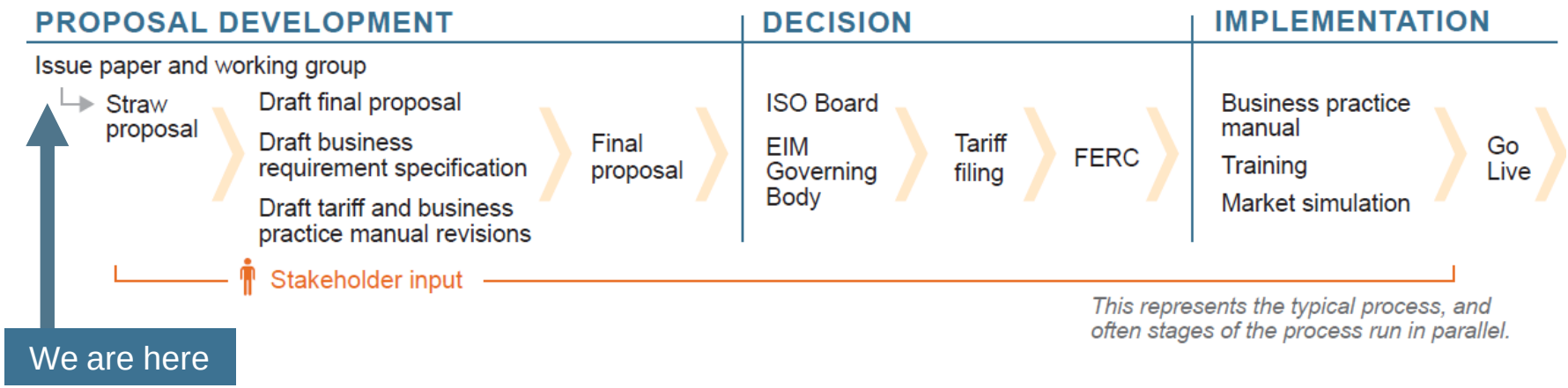
- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon  located on the top right above the chat window. **Note**: #2 only works if you dialed into the meeting.
  - Please remember to state your name and affiliation before making your comment.

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

Agenda

Time:	Topic:	Presenter:
1:00 – 1:05	Welcome	Brenda Corona
1:05 – 3:55	Price Formation Enhancements • Scarcity Pricing • Fast-Start Pricing • Multi-Interval Optimization • BAA-Level Market Power Mitigation	James Friedrich Gabe Murtaugh
3:55 – 4:00	Next steps	Brenda Corona

Stakeholder Process



Price Formation Enhancements

INTRODUCTION

Initiative Scope

- The ISO plans to consider the following topics in this *Price Formation Enhancements* initiative:
  - Scarcity pricing enhancements
  - Fast-start pricing
  - The real-time market's multi-interval optimization, focusing on interaction with energy storage resources, and related changes to real-time bid cost recovery
  - Market power mitigation grouping methodology
  - Other price formation issues as prioritized by the ISO or stakeholders.

June 9, 2022 Workshop

- CAISO solicited stakeholders to prepare materials and present their organization's perspective on the topics scoped for this initiative.
- Five entities made presentations:
  - CAISO
  - Powerex*
  - Calpine*
  - Rev Renewables
  - WPTF

*Also provided associated reports

Issues Raised – Not in Scope

- Although the CAISO seeks feedback on scope of this initiative, stakeholders raised the following issues at the workshop and the CAISO has preliminarily proposed to not include these items in the scope:
  - Integrated BAA pricing
  - Decremental market power mitigation
  - Pumped storage modeling enhancements
  - Changes to commitment cost bid caps
  - Reliability demand response resource (RDRR) pricing

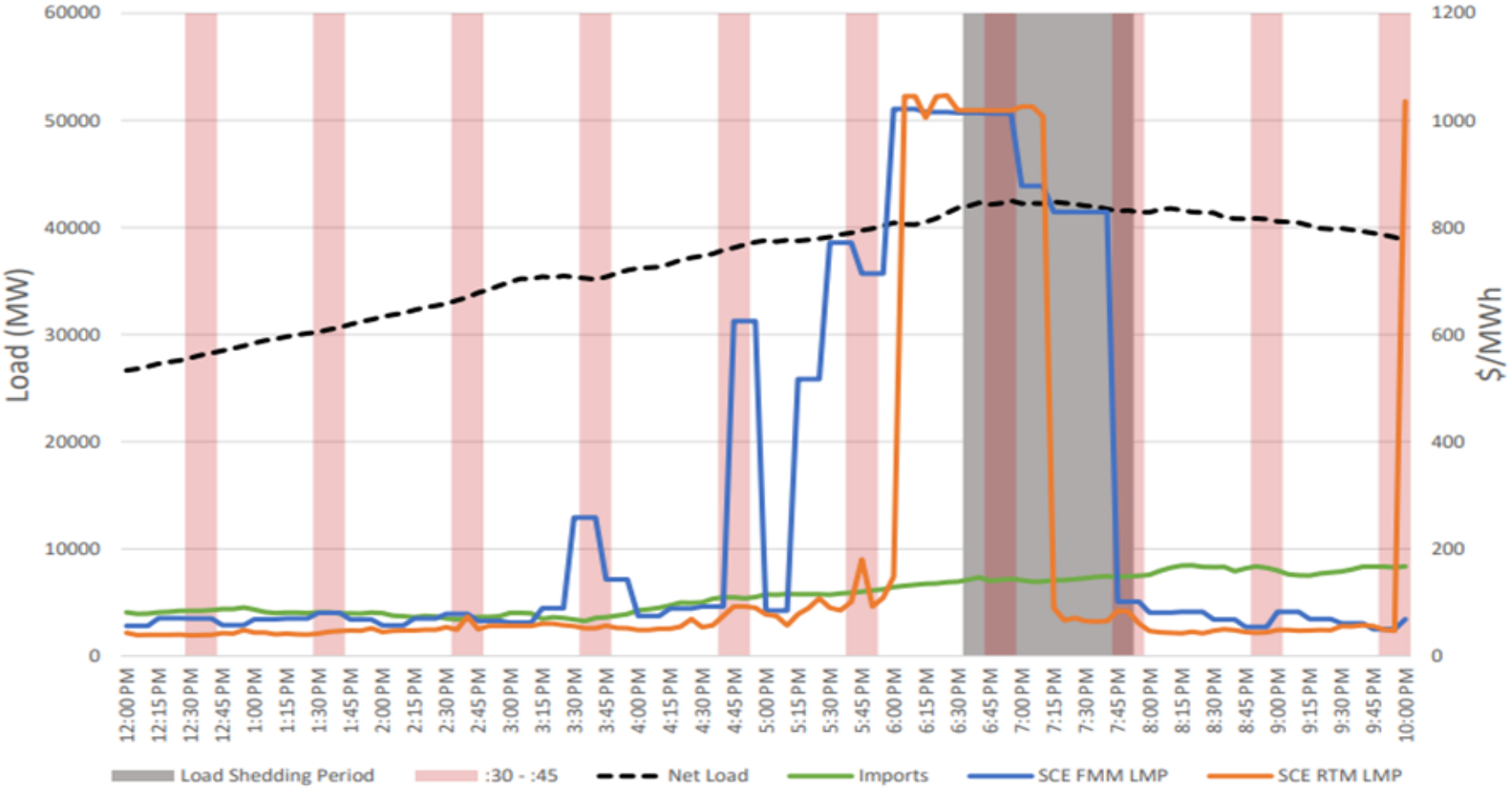
Price Formation Enhancements

SCARCITY PRICING

Scarcity Pricing Enhancements

- **Scarcity pricing** establishes and sets market prices when there is insufficient supply to cover energy, ancillary service, ramping product, and other reserve requirements
- CAISO uses administrative values in conjunction with supply bids to set prices under scarcity
- Accurate scarcity pricing is important to maintain system reliability by incenting resource offers, penalizing non-performance, and aligning price signals with consumers willingness to avoid load curtailment
- August 2020 heat wave and outages prompted CAISO to review its scarcity pricing market design

Market Pricing during Load Shedding Event – August 14, 2020



Existing Scarcity Pricing Measures
Energy

- When there is insufficient supply of energy offers or ramping capability, set energy prices at penalty price for violating power balance constraint.
- Recent changes:
  - FERC 831 increased the bid cap and PBC penalty price under certain conditions
  - Summer 2021 initiative priced at the bid cap the energy released from contingency reserves when arming load

Existing Scarcity Pricing Measures
Ancillary Services

- Ancillary service requirements are:
  - Met 100% in day-ahead market, incremental only in HASP and FMM, none in RTD
  - Procured in zones
  - Procured in cascading fashion (higher quality AS can substitute for lower quality)
- If there is insufficient supply to meet ancillary service requirements, the CAISO uses a tiered demand curve to set ancillary service prices.

Existing Scarcity Pricing Measures
Ancillary Services

Reserve	Demand Curve Value ($/MWh)					
	Percent of Max Energy Bid Price		Max Energy Bid Price = $750/MWh		Max Energy Bid Price = $1000/MWh	
	Expanded System Region	System Region and Sub-Region	Expanded System Region	System Region and Sub-Region	Expanded System Region	System Region and Sub-Region
Regulation Up	20%	20%	$150	$150	$200	$200
Spinning	10%	10%	$75	$75	$100	$100
Non-Spinning						
Shortage > 210 MW	70%	70%	$525	$525	$700	$700
Shortage > 70 & < = 210 MW	60%	60%	$450	$450	$600	$600
Shortage □ 70 MW	50%	50%	$375	$375	$500	$500
Upward Sum	**100%**	**100%**	**$750**	**$750**	**$1,000**	**$1,000**
Regulation Down						
Shortage > 84 MW	70%	70%	$525	$525	$700	$700
Shortage > 32 & < □ 84 MW	60%	60%	$450	$450	$600	$600
Shortage □ 32 MW	50%	50%	$375	$375	$500	$500

Existing Scarcity Pricing Measures
Ancillary Services

- Ancillary service scarcity may or may not affect energy prices
  - Lack of combined EN + AS offers to meet EN + AS demand → AS opportunity cost incorporated into EN price
  - Only lack of AS offers to meet AS demand → AS opportunity cost not incorporated into EN price

Existing Scarcity Pricing Measures
Flexible Ramping Product

- The real-time market procures flexible ramping product up and down using a demand curve that establishes the price of not fulfilling the requirement.
- The ISO calculates the demand curve based on the probability of violating the power balance constraint if the market did not procure additional flexible ramping product.
- The price cap for the flexible ramp up demand curve is set to $247/MWh

Current energy bid caps may not provide appropriate incentives for market participants during tight system conditions

- Day-ahead and real-time offer and price caps are typically the same
- Market participants face little downside price risk when prices are near the cap
  - Low financial risk for under-scheduling load
  - Low financial risk for unavailable supply
  - Low financial risk for storage to deviate from its day-ahead schedule
  - Perverse incentives for convergence bids

Ancillary service scarcity pricing is not fully effective in setting scarcity prices

- CAISO does not re-optimize ancillary services in RT and does not procure incremental reserves in RTD
- Deliverable ancillary services to enable co-optimization is longer-term item considered on policy roadmap
- Could consider increasing penalty prices of AS and FRP
  - Would allow prices to gradually rise as the ISO approaches scarcity conditions
  - E.g., if FRU was relaxed at $100/MWh and the last economic bid was $200/MWh, then energy price would be $300/MWh
  - May need to align with imbalance reserve penalty price

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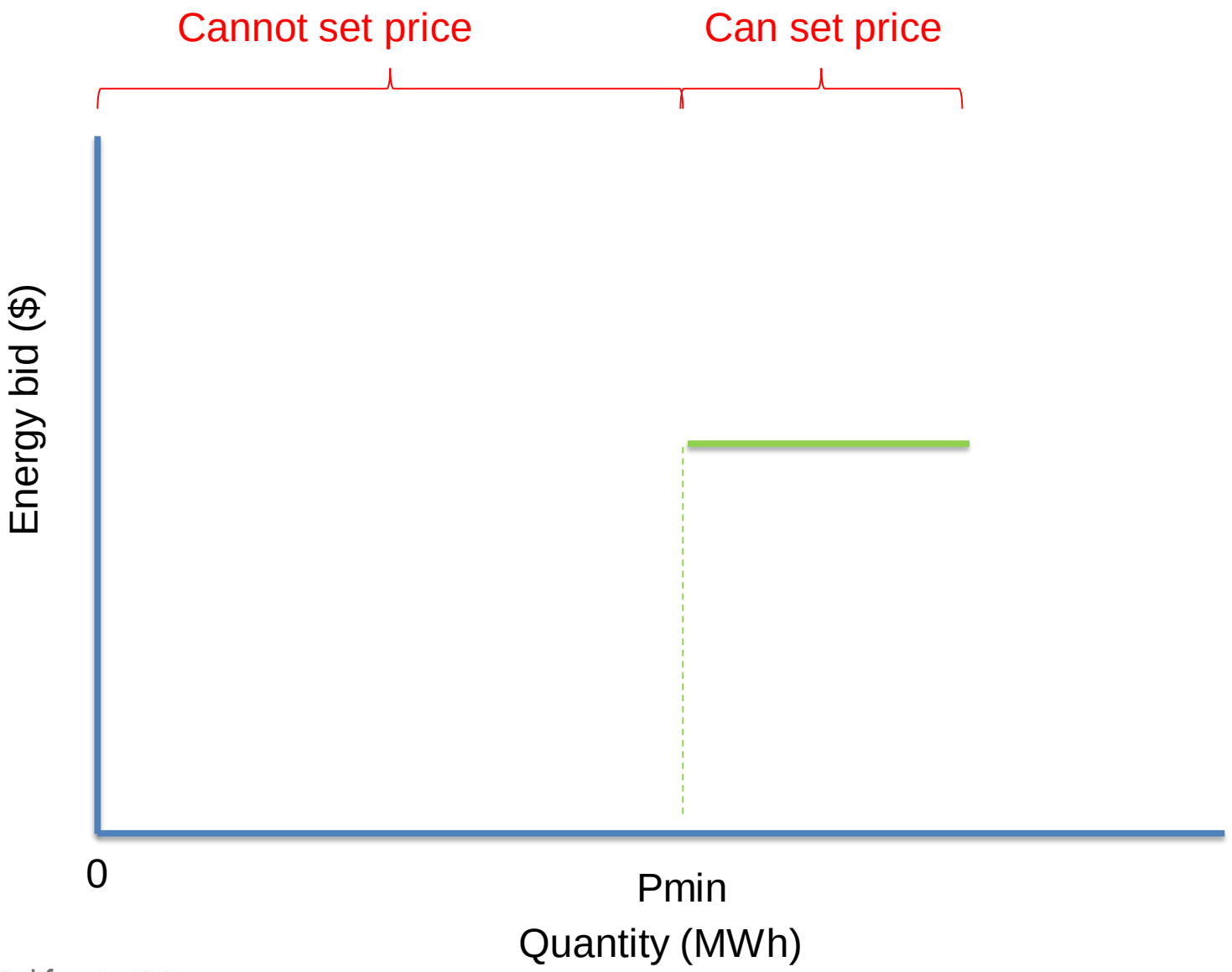
FAST-START PRICING

Fast-Start Pricing

- CAISO is reassessing its initial position on fast-start pricing in pursuit of a regional day-ahead market with a different generation fleet
- While initial concerns remain, CAISO is open to possibility that fast-start pricing could more accurately reflect system costs in regional context


Cannot set price
Can set price
Energy bid ($)
0
Pmin
Quantity (MWh)

FERC NOPR on Fast-Start Pricing

- Fast-start pricing methods vary but intend to “recognize that fast-start resources are…the marginal resource used to meet the next increment of energy or operating reserves demand.”
- Two common features:
  - Minimum output relaxation in the pricing run
  - Inclusion of commitment costs in price

CAISO response to FERC NOPR

- CAISO felt that fast-start pricing would undermine its efforts to incentivize and compensate flexible resources in real-time
- Fast-start pricing may not dispatch units in a way that secures the ramp needed to meet the net load or the net load uncertainty in a future interval
- As a result, the market would not price the opportunity cost of ramp

Numerical examples can be found here:
https://www.caiso.com/Documents/Aug18_2017_SupplementalComments-Fast-StartPricingNOPR_RM17-3.pdf

Fast-Start Pricing Practices of Other ISO/RTOs

- Each ISO/RTO real-time market optimization algorithms are different
  - Similar system conditions can result in different dispatch and pricing
- Other major distinguishing characteristics:
  - The definition of a “fast-start resource”
  - The methods for incorporating commitment costs into price
  - Whether and how offline resources are included in fast-start pricing
  - Whether fast-start pricing logic is included in both day-ahead and real-time markets, or just the real-time market;
  - Whether to impose opportunity costs payments or financial penalties to incentivize generators not to deviate from their dispatch

Constrained Output Generators

- A Constrained Output Generator is a resource with a zero or very small operating range between its minimum load (Pmin) and maximum capacity (Pmax)
- The market treats COGs as fully dispatchable from 0 to their Pmax in both the day-ahead and real-time, which allows COGs to set the price
- COGs energy bid calculated by dividing its minimum load cost by the Pmax MW quantity

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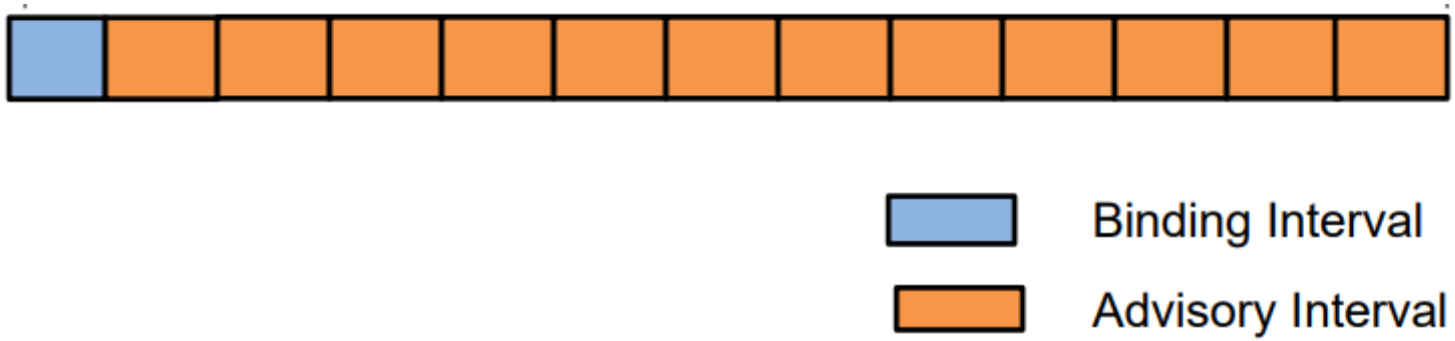
MULTI-INTERVAL OPTIMIZATION

Multi-Interval Optimization



- Multi-interval optimization enables the real-time market to position resources to handle changes in future horizon
- Stakeholders have noted that multi-interval optimization in the real-time market could result in uneconomic dispatch for energy storage resources

Issues to Consider

- Removing the multi-interval optimization
- Removing storage resources from the multi-interval optimization
- Weighting early advisory intervals higher than later advisory intervals
- All solutions would need to be carefully considered as not to detriment efficient operation of the grid and ability for the market to optimally position resources to meet anticipated grid conditions.

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BID COST RECOVERY

Bid Cost Recovery

- Changes to real-time bid cost recovery may improve compensation for storage resources that are uneconomically dispatched
- Real-time bid cost recovery could consider a counterfactual dispatch based on energy awarded strictly based on bids and binding interval prices
- Could consider changing the net recovery period from 24-hours to a shorter period
- Would have to make case that storage resources are differently situated or else BCR changes would have to be assessed for and applied to all resources

Storage Performance Incentives

- Day-ahead and real-time BCR considered separately
- Resources could be infra-marginal in the day-ahead market but may have schedules in the real-time market that that include losses from buying back infeasible day-ahead schedules.
  - RT BCR protects these infra-marginal revenues
- This may prohibit scarcity pricing from providing sufficient incentives for storage

Price Formation Enhancements

BAA-LEVEL MARKET POWER MITIGATION

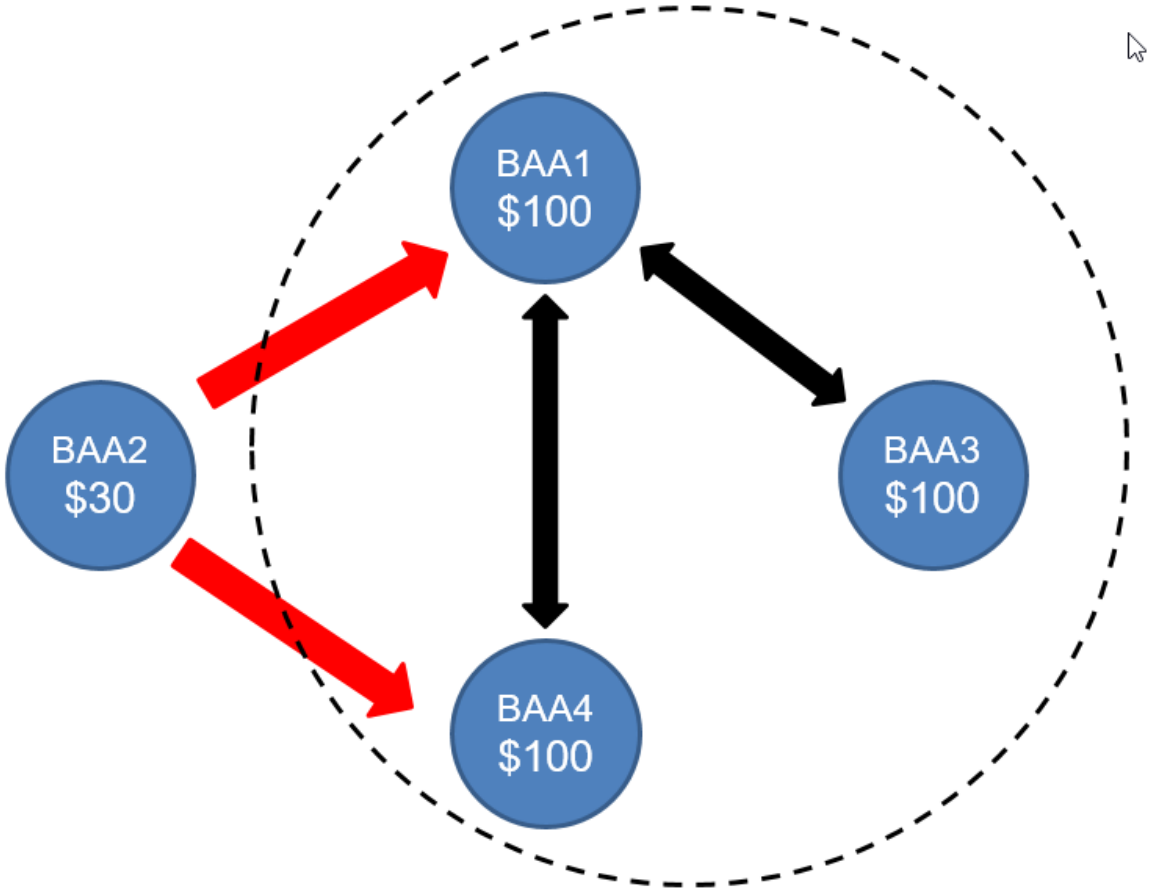
EDAM Market Power Mitigation

- WEIM has local market power mitigation and BAA-level mitigation
- CAISO proposed to extend the WEIM BAA-level mitigation framework to EDAM as a starting point
- CAISO seeks feedback whether to revise the MPM methodology to group together all resources (across multiple EDAM BAAs) that contribute to congestion relief, as opposed to testing individual BAAs
  - Doing so may require CAISO to similarly enhance the WEIM MPM framework

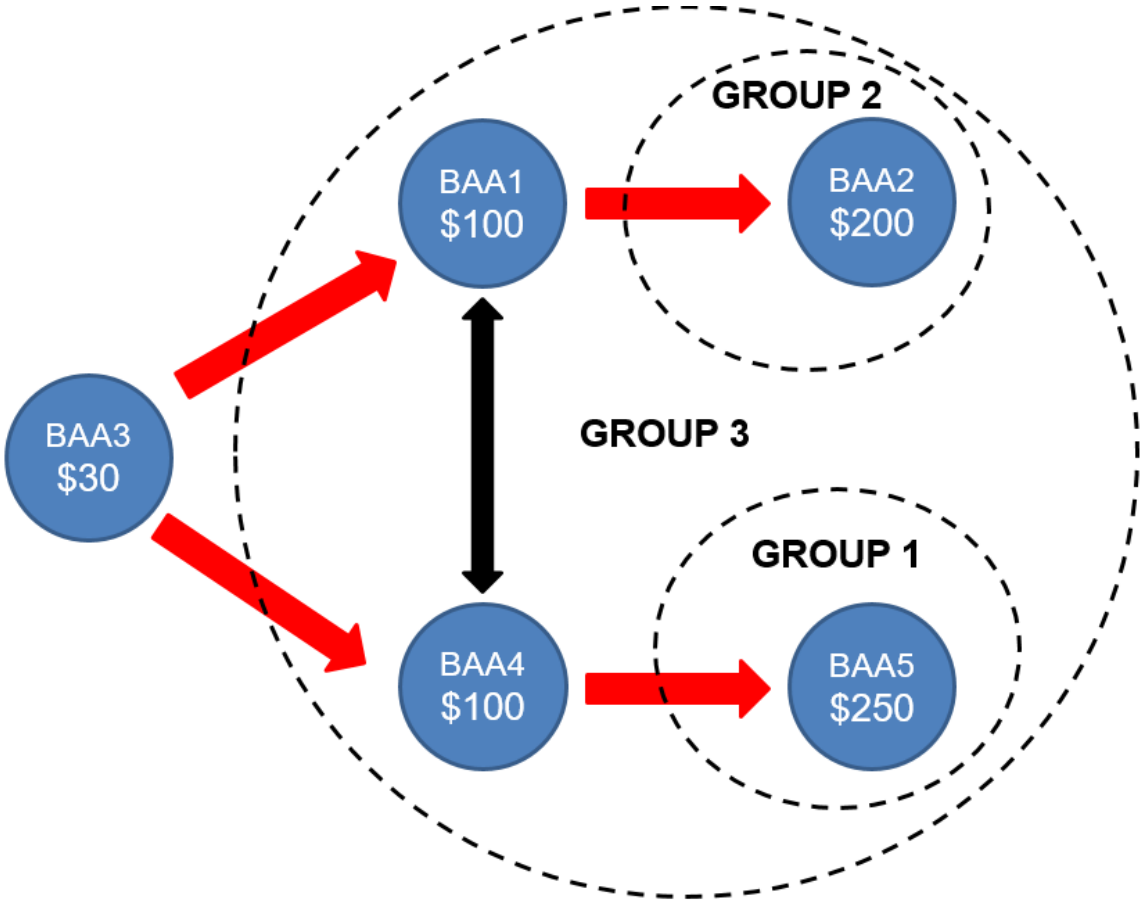
BAA-level Market Power Mitigation

- Similar principles to LMPM
- Applies DCPA and 3-pivotal supplier test to the power balance for each EIM BAA
- DCPA is triggered when the PBC shadow price is higher than the CAISO PBC shadow price due to import transfer congestion
  - CAISO is considered competitive
- RSI may pass for the BAA group but fail for a BAA member of that group

Simple Grouping Scenario



Complex Grouping Scenario



Next Steps

- All related information for the Price Formation Enhancements initiative is available at: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements
- Please submit stakeholder written comments on today's discussion and the issue paper by August 9, 2022, through the ISO's commenting tool
  - The commenting tool is located on the Stakeholder Initiatives landing page (click on the "commenting tool" icon): https://stakeholdercenter.caiso.com/StakeholderInitiatives

- The ISO is pleased to be hosting the Stakeholder Symposium in-person at the Safe Credit Union Convention Center in downtown Sacramento on Nov. 9 – 10, 2022

- Registration now on the Stakeholder Symposium page at: https://californiaiso.swoogo.com/2022StakeholderSymposium

- Please direct questions to symposiumreg@caiso.com