Day-Ahead Market Enhancements: Update on the configurable parameters working group progress

Scott Lehman
Lead Analyst, Market Performance & Advanced Analytics

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General Session
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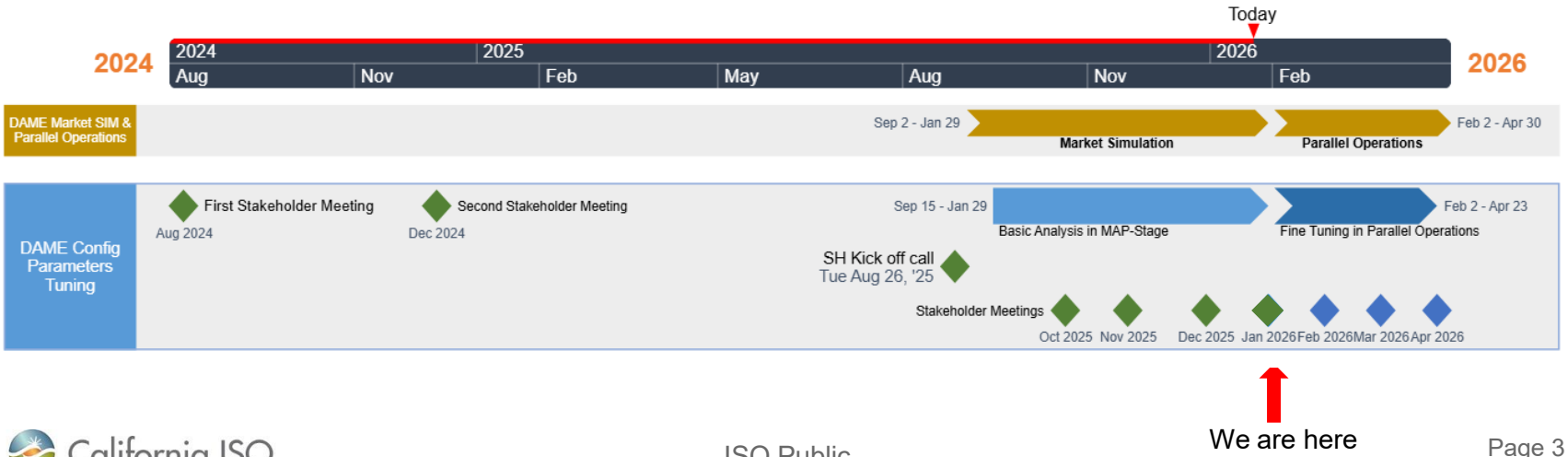
Agenda

- Timeline of working group effort
- Summary of first stage of analyses
- Plan for parallel operations
- Start of parallel operations and next steps

Implementation and working group schedule

- Although this working group effort is occurring concurrent to Market Simulation and Parallel Operations, it is an independent effort
- Market Simulation and Parallel Operations are not dependent on outcomes of the working group effort
- The working group leverages the Market Simulation and Parallel Operations efforts to set-up scenarios for analysis and tuning of the parameters
- Parallel operation period has been extended through April 30, providing the opportunity to include one additional working group session in April

DAME Configurable Parameters Tuning Timeline



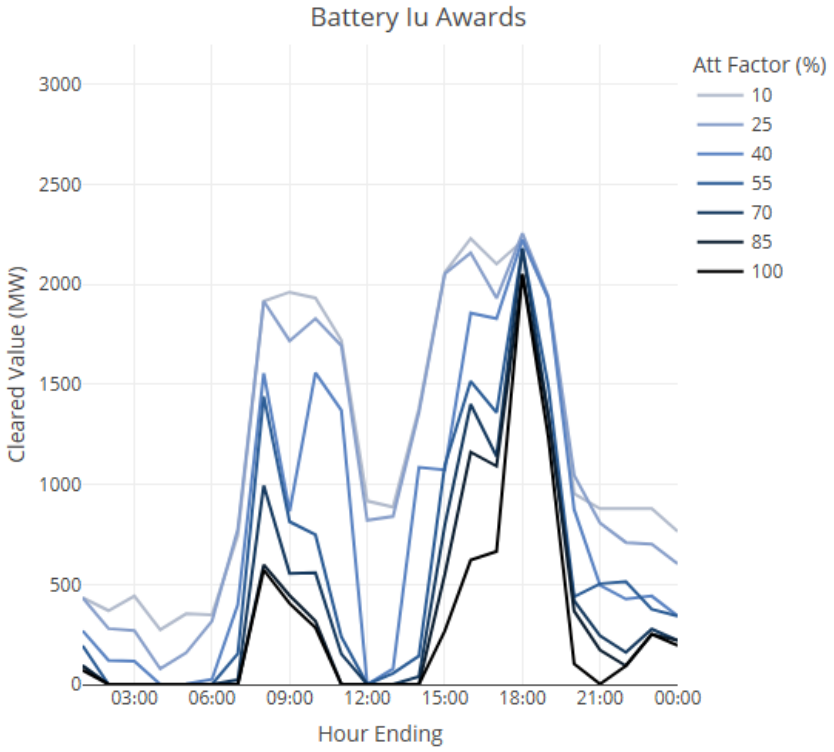
SUMMARY OF FIRST STAGE OF CONFIGURABLE PARAMETER ANALYSIS

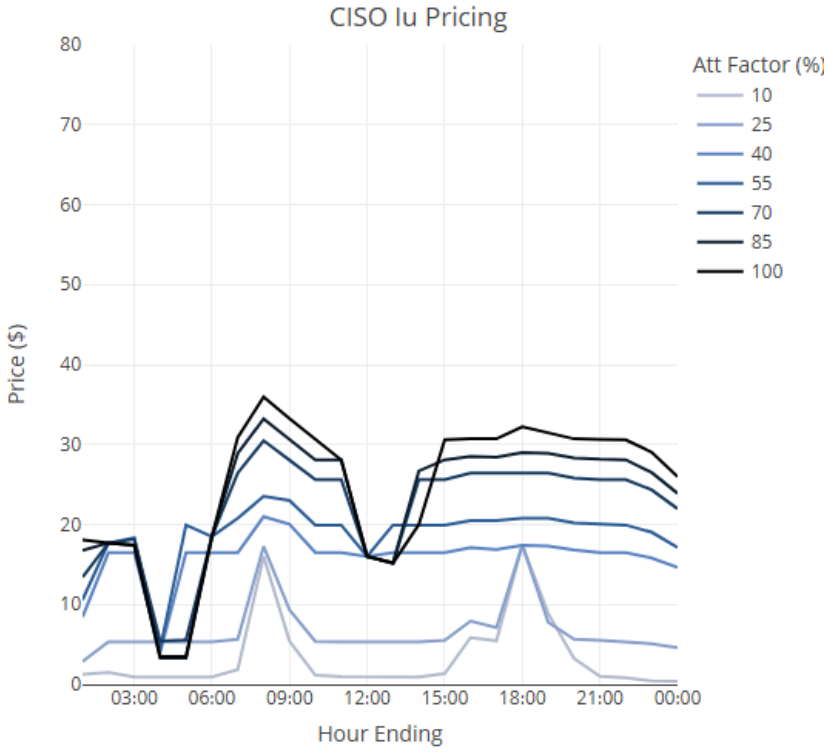
First stage of configurable parameter working group: sensitivity analyses

- The scope and goal of the working group is to evaluate the impact of five key DAME market parameters:
  1. Envelope constraint multiplier
  2. IR bid price cap
  3. IR and RC Default Availability Bids
  4. Deployed Imbalance Reserve Factor
  5. Set of enforced constraints

- Each parameter's impact was assessed with sensitivity analyses by holding all inputs constant except the parameter being tested in a benchmark case

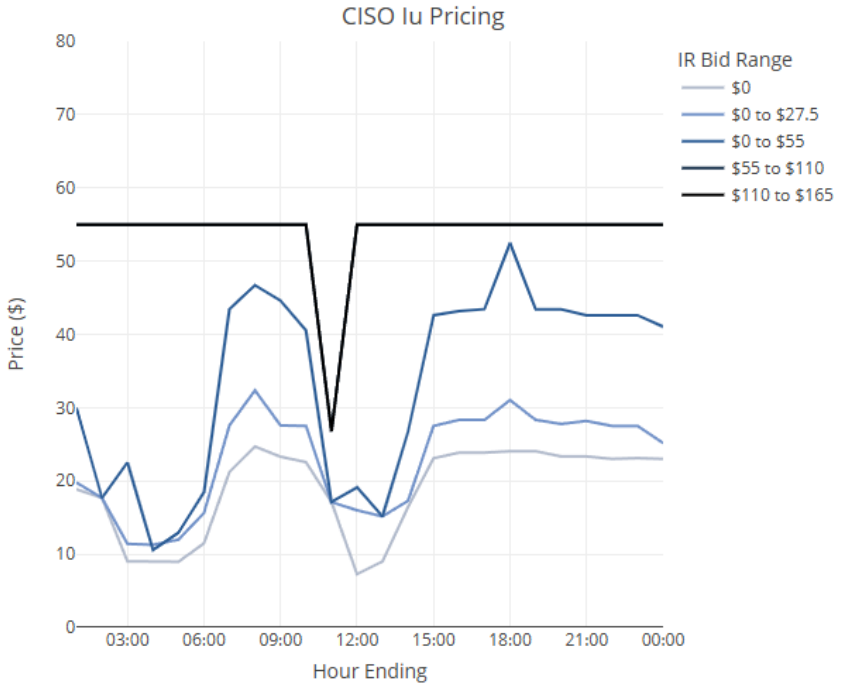
The analysis shows that the Envelope Constraint Multiplier can have a significant impact on battery IR awards and overall IR pricing

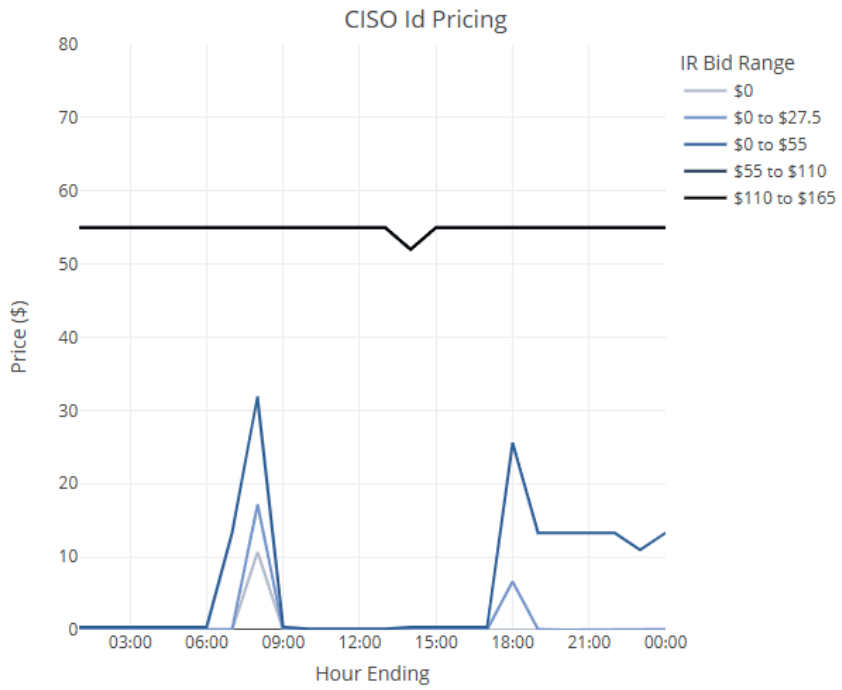




- Increasing the envelope constraint multiplier increases the opportunity costs of providing other products and increases overall IR prices
- Even with the large changes in IR pricing, impact to both energy and AS pricing was moderate

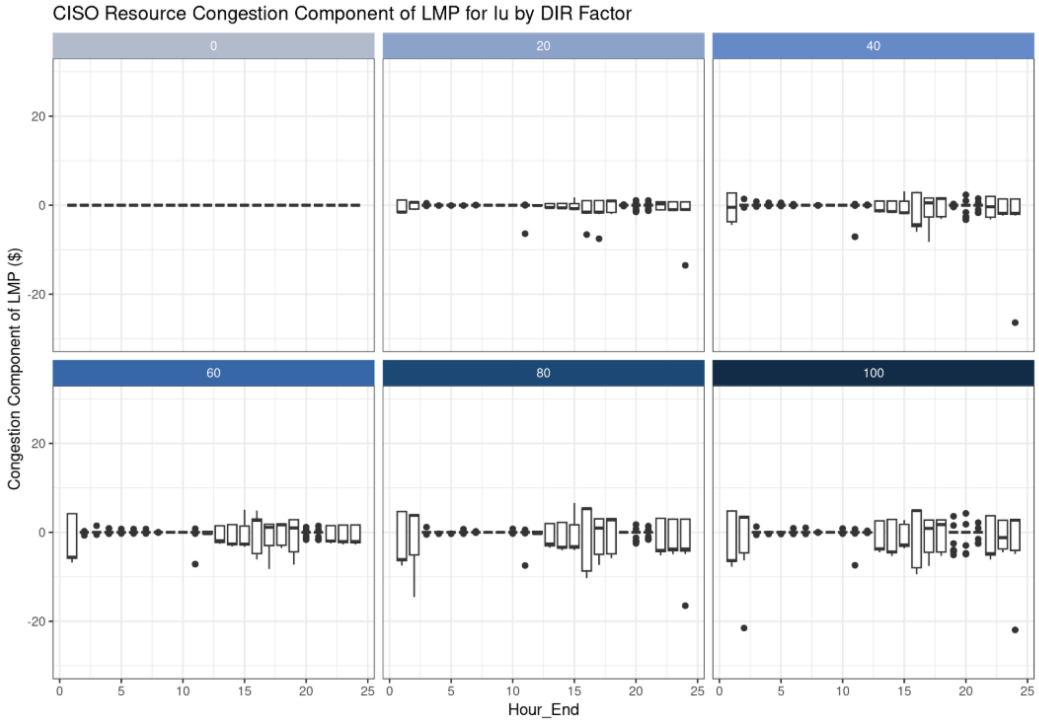
Imbalance reserve bid caps above $55 had moderate impact on IR pricing due to impact of demand curves and interaction with $55 DAB

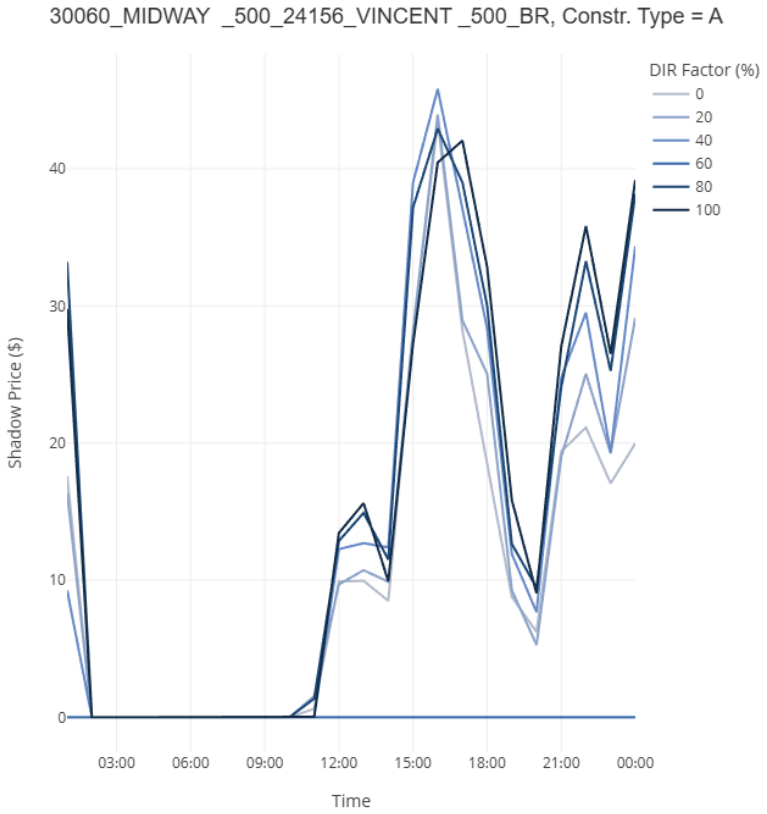




- The demand curve price caps were also raised to match the upper bid cap level, but the rest of the demand curve was left unchanged
- Mitigation brought some resources back down to $55 as DAB was unchanged
- Impact to the rest of the solution was minimal

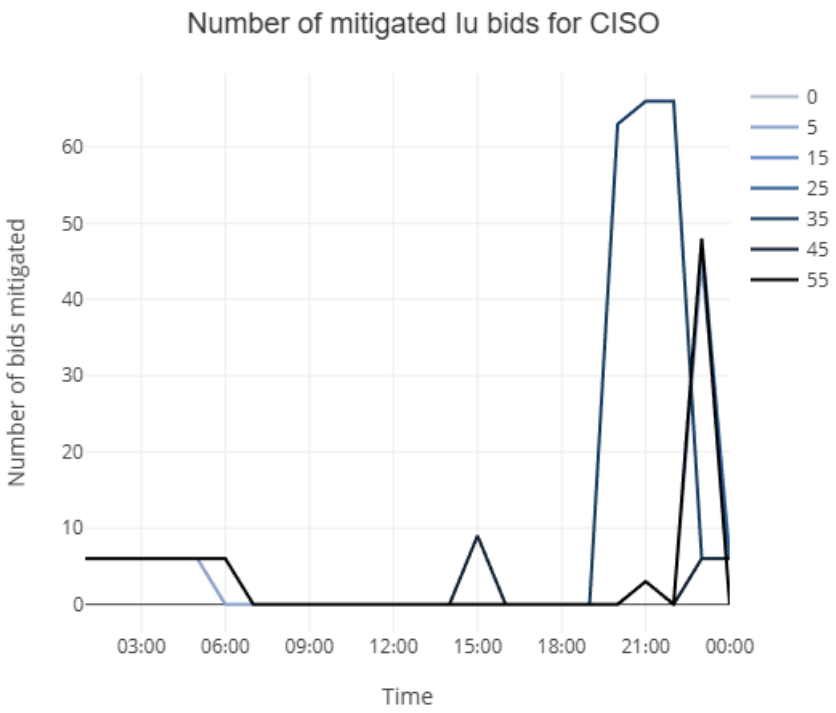
The Deployed Imbalance Reserve (DIR) factor had a modest impact on resource-level IR pricing

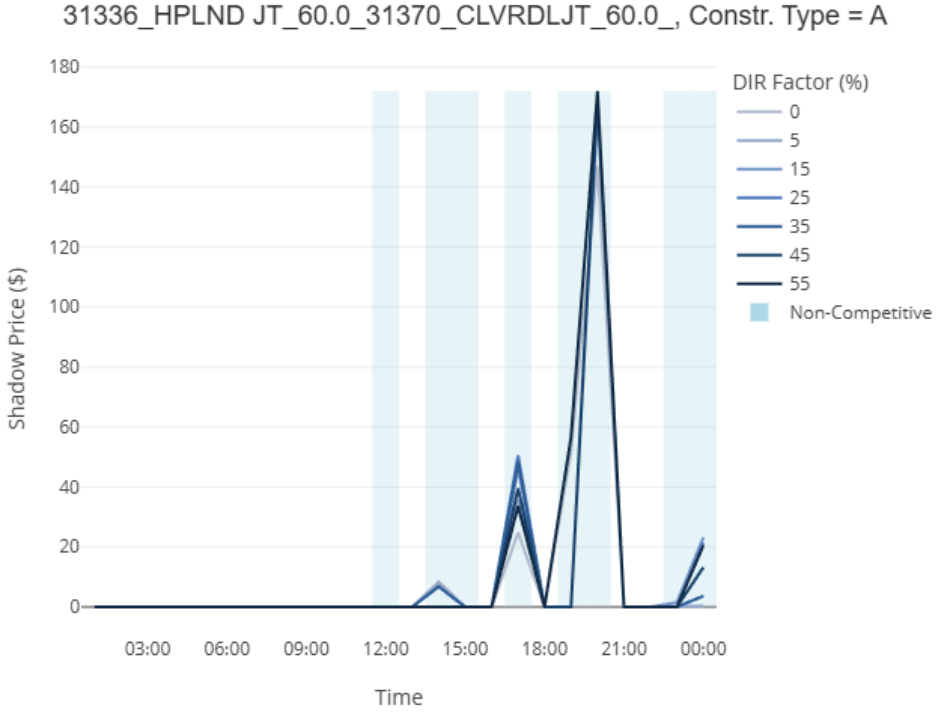




- The DIR factor impacts both energy and IR congestion by defining the impact of IR awards on congestion in the IR deployment scenarios
- Changes to the DIR factor resulted in increased IR resource level congestion, with minimal impacts to other market results

The Default Availability Bid (DAB) for IR and RC had modest market impacts





- The DAB sensitivity analysis showed very few changes in mitigated bids and modest impact on congestion prices for mitigated constraints
- The market application experienced complications to get a solution which led to certain outlier cases, as in the $35 DAB case showing increased mitigated IRU bids

The set of enforced constraints will be tested more thoroughly in Parallel Operations

- The term configurable parameter is a misnomer when referring to the set of enforced constraints. The choice of the constraints to enforce is not a parameter but rather a selection criteria
- An ideal set up is to have a consistent enforcement of transmission constraints between day-ahead IR and real-time FRP markets, and between energy and IR
- If this is not feasible, then we will leverage on the approach used for FRP: enforce flowgates, then nomograms and then assess feasibility of contingencies
- This is not a decision based only on the quality of market solution, it is a decision also to achieve a feasible and optimal solution within reasonable running times

Parameter Interactions – Transmission Constraint Enforcement

- Enforcing all transmission constraints leads to an array of different interactions with each parameter:
  - More constraints ensure better deliverability of IR
  - This leads to increased IR prices, which can lead to less overall IR procurement (more from demand curve) as resources become more expensive due to congestion
  - The bid cap will temper the clearing price. Higher caps can compensate for the effect of more congestion but may also lead to more demand curve procurement
  - Lower deployable factor can offset the benefits of enforcing all constraints since less capacity of IR will be tested for congestion

Parameter Interactions – Bid cap and DAB price for IR

- Lower bid cap and/or DAB results in lower IR bids used in IFM, which makes resources more competitive compared to procuring energy and increases the amount of IR procured by resources instead of the demand curve
- When the bid cap and the DAB are equal, as is the case for IR, market power mitigation becomes moot as there can be no bids above the DAB
- Higher DIR factors would result in an increase in mitigated bids by
  - increasing the number of binding constraints and
  - by increasing congestion pricing
- This would increase the number of constraints tested for market power and increase the overall non-competitive LMP components. This will impact energy mitigation and could impact IRU mitigation if the DAB was lower than the bid cap

Parameter Interactions – DIR Factor and Envelope Constraint Multiplier

- The DIR factor directly impacts the enforced transmission constraints by setting the impact of IR on congested constraints
- There is an inverse correlation of envelope constraint multipliers and DIR factors for storage resources
  - A higher envelope constraint multiplier results in lower IR procurement from storage resources and an increase in overall IR pricing
  - A lower DIR factor reduces the impact of IR congestion on all resources, including storage, resulting in a lower overall IR pricing
- The IR bid cap may interact with the envelope constraint multiplier by capping the price differentials that batteries can bid in across the day, as the envelope constraint multiplier impacts the opportunity cost of SOC across the day

Summary of results from first stage of analysis

Battery Envelope Multipliers for IR	• Significant impacts to market outcomes. Higher multipliers lead to higher IR prices and lower battery procurement. Metric specified only in BPM, may support reducing it from current 85%
Proportion of deployed reserves in congestion scenarios	• Moderate impact to overall congestion pricing. Metric specified only in BPM, merits to consider lower values from original 100%
Set of enforced constraints	• Determined mainly by computational considerations. Assessment during Parallel OPS and Production
$55 bid cap for IR	• Moderate impact on IR prices, tempered by demand curve. Value set in the Tariff
$55 default availability bid	• Limited impact to market solutions. Value set in the Tariff

There are several limitations that are important to keep in mind while assessing the results of this effort

- The analyses focused only on the day-ahead market results, no real-time market simulations were assessed

- The IR bids used in the analysis may not accurately reflect what we will see in production
  - Bids were generated using a blend of participant bids submitted to early market environments and random bid generation

- Imputed cost estimates and overall market efficiency claims from the limited set of results in these scenarios may not be accurate

PLAN FOR PARALLEL OPERATIONS

Working group commitments prior to go live

- The Market Simulation phase, which has just been completed, was focused largely on evaluating the functionality of each parameter
- The Parallel Operations phase, which has just begun, will be focused more on evaluating the market outcomes for the parameters that are not set in the Tariff
- The expectation for the scope of working group effort was defined in a matrix during the last stage of the policy stakeholder process*
- After go-live, the ISO will continue to assess how the parameters are performing with actual market results

* The ISO mapped the goal and scope of the assessment of each parameter towards the end of the stakeholder process. Matrix publicly available at https://stakeholdercenter.caiso.com/initiativedocuments/flexibleparametermatrix-day-aheadmarketenhancements.pdf

Plan for working group effort during Parallel Operations

Start	Assess	Use	Keep	Adjust	Assess	Propose
Start PO with proposed values	Assess market results using cases produced by PO. No mocked-up scenarios will be used	Use PO cases as benchmark, run sensitivity scenarios for •Set of enforced constraints •Envelope multiplier factors •Deployable factor	Keep the Bid cap and Default bid fixed at $55. No sensitivity analysis performed	Adjust either Envelope multipliers or Deployable factor in PO, and enforce contingencies	Assess results from PO. No additional sensitivity scenarios produced	Propose values for Go-live based on assesment during PO

Plan for Parallel Operations
1) Envelope constraint multipliers

- Sensitivity scenarios show that higher envelope constraint multipliers result in lower battery IR awards and increased IR pricing.

- Parallel operations plan:
  - Start parallel Operations with 85% and assess impact with sensitivity scenarios using lower values
  - Adjust value in Parallel Operations based on findings of first assessment

Plan for Parallel Operations
2) Proportion of deployed reserves

- Sensitivity scenarios show that impact on overall IR prices was modest, with a slight increase in most hours with higher DIR Factor.

- The DIR Factor impacts energy pricing locally due to the additional congestion impacts, the overall impact on system pricing was limited even on the high load day benchmark.

- Stakeholder feedback request reduction of this parameter to lower values.

- Parallel operations plan:
  - Start parallel Operations with 100% and assess impact with sensitivity scenarios using lower values
  - Adjust value in Parallel Operations based on findings first assessment

Plan for Parallel Operations
3) Set of enforced constraints

- Running times of the EDAM will determine the feasibility for full enforcement. This cannot be reasonably tested until Parallel Operations and actual Production

- If not feasible, leverage on approach used for FRP: enforce flowgates, then nomogram and then assess feasibility of contingencies.

- Parallel operations plan:
  - First step: Start PO with enforcing flowgates and nomograms and assess
  - Second step: Enforce all constraints in parallel Operations

Plan for Parallel Operations
4) IR bid cap of $55

- Sensitivity scenarios show that the IR bid cap of $55 has a moderate impact on clearing IR prices. Higher caps allowing higher bids lead to higher IR prices.

- The bids used in market simulation do not fully represent realistic trading behavior by participants.

- Parallel operations plan:
  - Keep value at $55 fixed as defined by the tariff while other parameters are subject to changes and further assessment

Plan for Parallel Operations
5) IR and RC default availability bid (DAB) cap of $55

- Sensitivity scenarios show that decreasing the IR/RC DAB bid cap of $55 to lower values have minimal impact on IR/RC prices on a system wide basis. They are highly dependent on the system congestion pattern and subsequent effects of local market power mitigation.

- The bids used in market simulation do not fully represent realistic trading behavior by participants.

- Parallel operations plan:
  - Keep value at $55 fixed as defined by the tariff while other parameters are subject to changes and further assessment

START OF PARALLEL OPERATIONS AND NEXT STEPS

Phases of Parallel Operations

- Parallel operations will be run in 3 phases:
  - Phase 1 will focus on DA with no economic transfer.
  - Phase 2 will focus on DA with economic transfer.
  - Phase 3 will include both DA run with results following RT.

https://www.caiso.com/documents/draft-parallel-operations-plan-edam-dame-2026.pdf

- This plan enables one additional working group session in April

First days of Parallel Operations focus is to get the system stable

- During Parallel Operations, the ISO generates day-ahead market results each day based on all available inputs and system processes
- Parallel Operations require all aspects of EDAM/DAME to function cohesively and in coordination
- The first days of parallel operations are focused on
  - ensuring that data flows,
  - no participants have access issues,
  - data merges from production and native data streams,
  - software patches are all verified, and
  - any issues are identified and resolved
- Market results from the first days reflect the transitional dynamics of setting up the systems and results should be taken with caution

Timeline

February and March

- Working group sessions to discuss and assess parameters from PO and sensitivity scenarios
- February 6. MSC discussion on configurable parameters
- Public Briefing to Board of Governors and WEM Governing Body
- Decision to adjust values in PO may not align with the date of working group session

April

- Final assessment from PO cases and recommendation of values for Go-Live. Phase 1.
- BPM language change to establish values to be used for Go-live

May and onwards

- Ongoing assessment of tunable parameters with operational data
- Recurrent market updates and reporting
- Adjust parameters. Phase 2. Time to be determined

Recommendation for Go-live

Analysis in PO provides quantitative supporting evidence for directional decision making

At this stage, and lacking ample sampling of operational data, parameter values cannot be solely determined with a quantitative analysis

Final recommendation will be based on qualitative assessment and directionally guided by analysis performed in this effort

Parameter tuning is part science but also part art

Plan for Recommendation for Go-live

With uncertainties that cannot be quantified due to the lack of sufficient and reliable data prior to Go-Live, the ISO is exploring a two-phased approach

First phase is for Go-live with a conservative setup to limit potential unintended impacts

This includes using parameter values and IR set up that impose less stringent conditions on the market

The ISO will closely assess the market performance and the parameters impacts using actual data from first months of operation

In a second phase, the ISO will adjust the parameters and use a standard set up for IR

The specifics of this two-phased approach will be introduced and discussed in the upcoming working groups prior to go-live

Questions or comments?