



Memorandum

To: ISO Board of Governors and WEIM Governing Body
From: Eric Hildebrandt, Executive Director, Market Monitoring
Date: May 9, 2023
Re: Department of Market Monitoring report

This memorandum does not require ISO Board of Governors or WEIM Governing Body action.

EXECUTIVE SUMMARY

This memo provides comments by the Department of Market Monitoring (DMM) on Management's day-ahead market enhancements proposal. Adding a day-ahead market to the Western Energy Imbalance Market (WEIM) has the potential to provide significant efficiency and greenhouse gas reduction benefits by facilitating trade between diverse areas and resource types.¹ The current extended day-ahead market (EDAM) design requires the development of an imbalance reserve product in the day-ahead market to establish a real-time must offer obligation for resources in EDAM balancing areas. Therefore, further delaying implementation of Management's current day-ahead market enhancements (DAME) proposal could jeopardize the launch of the extended day-ahead market. Given the large potential long-term benefits of a west-wide day-ahead market and the enormous challenges in initiating such a market, DMM supports approval of the DAME proposal, while recommending that the ISO continue working with stakeholders on enhancements to the design that could be implemented before and after EDAM's initial implementation.

The ISO's revised final proposal recognizes that further details of both EDAM and DAME design will need to be developed and adapted based on testing the full software model prior to implementation and based on operational experience after implementation. The revised final proposal also includes a set of specific configurable software parameters, which can be adjusted before and after implementation in consultation with stakeholders. This approach reflects a conservative and prudent approach for dealing with the uncertainty and complexity of initiating the type of regional day-ahead ahead market being proposed. DMM supports this approach and looks forward to collaborating with the ISO and stakeholders on the next steps of developing and implementing a regional day-ahead market.

The remainder of this memo provides more detailed comments on key elements of Management's final proposal and how these may be further refined as the ISO proceeds with development and implementation of a regional day-ahead market.

¹ Department of Market Monitoring Report to ISO Board of Governors and WEIM Governing Body, January 25, 2023, p. 2: <https://www.caiso.com/Documents/DepartmentofMarketMonitoringReport-Feb2023.pdf>

DAY-AHEAD MARKET RESERVE PRODUCT

Demand curve for the day-ahead imbalance reserve product

Management proposes to introduce a new reserve capacity product, imbalance reserves, into the integrated forward market (IFM) in order to address net load uncertainty that may materialize between the close of the day-ahead market and the next day's real-time markets. The quantity of imbalance reserve procured will depend on the values of the product's downward sloping demand curve and the cost of procuring the capacity.

The demand curve will be based on the same theory as the real-time flexible ramping product demand curve: For each potential net load realization, the probability of that net load realization is multiplied by the presumed cost to the real-time market from not having procured the last increment of capacity in the day-ahead market necessary to meet that particular level of net load.

DMM agrees with the Market Surveillance Committee's observation that determining an accurate value for the demand curve will be extremely difficult because capacity that does not receive an imbalance reserve or other day-ahead market award is still likely to bid into the real-time market.² The ISO's proposals have assumed that failing to give an imbalance reserve award to the last MW necessary to meet any given net load realization would result in a \$1,000/MWh power shortage or a \$247/MWh flexible ramping product shortage. However, because other capacity that did not receive a day-ahead market award would be likely to bid into real-time to prevent such supply shortages, these assumptions would likely significantly over estimate the value of procuring imbalance reserves in most scenarios.

The proposal addresses the risks associated with an overvalued imbalance reserve demand curve by capping the demand curve at \$55/MWh. This is a substantial improvement over prior proposals that allowed the value to exceed the \$1,000/MWh bid cap. Given the long-term opportunity cost of further delaying the extended day-ahead market implementation, DMM believes this cap constitutes a reasonable initial safeguard against the costs of an overvalued demand curve during the initial EDAM implementation phase. However, this \$55/MWh demand curve cap may still significantly exceed the actual value of procuring imbalance reserve capacity in the IFM in many scenarios.

DMM's prior stakeholder comments explain how an overvalued imbalance reserve demand curve in the integrated forward market could increase day-ahead energy costs while providing limited benefit relative to procuring the necessary reserve capacity in the residual unit commitment market.³ This is because virtual supply in the integrated

² *Final Opinion on Day-Ahead Market Enhancements*, Market Surveillance Committee, May 3, 2023, p. 16: <http://www.aiso.com/Documents/MarketSurveillanceCommitteeFinalOpiniononDay-AheadMarketEnhancements.pdf>

³ *Comments on Day-Ahead Market Enhancements - March 2023 Workshops*, Department of Market Monitoring, March 31, 2023, pp. 3 and 6: <https://www.aiso.com/Documents/DMMComments-DAMEMarch2023Workshops3-31-2023.pdf>

forward market will tend to converge IFM prices toward expected real-time prices and outcomes. If the demand curve overvalues extra capacity over the range of potential net load realizations, virtual supply would be able to profitably displace the more expensive physical supply in the IFM that would need to be dispatched up to address the less likely net load realizations. As a result, the residual unit commitment market will still need to procure capacity that needs to be available to address these less likely net load realizations.

Under this scenario, average day-ahead prices would remain inflated above real-time average prices. This is because in even a competitive virtual supply market, virtual supply bidders will include a risk premium above their estimate of expected real-time market costs. This would allow virtual supply to systematically profit at the expense of load over the long run.

Due to the potentially significant increase in day-ahead market energy prices from an overvalued imbalance reserve demand curve, DMM recommends that the ISO continue to work on developing more accurate methods for determining demand curve values and prepare to potentially reduce the \$55/MWh cap during enhancements after the initial EDAM implementation. Given the complexity in developing an accurate estimate of the actual value of this reserve capacity, the ISO and stakeholders should also consider removing imbalance reserves from the IFM and instead procuring the necessary day-ahead reserve capacity as part of the residual unit commitment market as a future market design enhancement.

Ramping capability requirement for imbalance reserve product

The ISO proposes to limit the amount of a resource's unloaded capacity that can count as imbalance reserve supply to the amount the resource can ramp to within 30 minutes. This is a significant improvement to prior proposals, which defined imbalance reserve as a 15-minute product.

The imbalance reserve product is intended to meet the demand for capacity needed to address net load uncertainty that materializes between the day-ahead and real-time markets. DMM's analysis in past stakeholder comments demonstrated that the entire forecast error between the day-ahead and real-time market for a given hour or interval would not be realized over only fifteen minutes.⁴ Rather, some of the errors are realized thirty minutes, one hour, or longer before the real-time interval.

DMM analysis looked at the correlation of hourly errors between cleared day-ahead market net load and fifteen-minute market net load. There was significant correlation between errors in the hours shown and at least the previous three hours. This suggests that portions of the errors for a given hour are realized in previous hours. DMM also analyzed an example day that demonstrated that net load errors are similar across multiple intervals. This analysis showed that restricting all imbalance reserves to being

⁴ *Comments on Day-Market Enhancements - Second Revised Straw Proposal*, Department of Market Monitoring, August 18, 2021: <http://www.aiso.com/Documents/DMM-Comments-on-Day-Ahead-Market-Enhancements-Revised-Straw-Proposal-Aug-18-2021.pdf>

rampable within fifteen minutes is overly restrictive. The Market Surveillance Committee has also demonstrated that if a net load error is positive in one hour it is likely to be positive in several subsequent hours.⁵

DMM agrees with the Market Surveillance Committee that limiting the supply to capacity that is dispatchable within 30 minutes may still be overly restrictive. DMM continues to recommend that the ISO consider as a future enhancement allowing capacity that is dispatchable within 60 minutes or longer, including hourly block intertie resources, to meet demand for reserves needed to address uncertainty between the day-ahead and real-time markets. As a much smaller quantity of reserves would be needed to meet 15-minute ramping requirements, the day-ahead uncertainty product could require only a subset of the reserves needed to address day-ahead to real-time market uncertainty to be 15-minute dispatchable.⁶

Real-time market resettlement and performance incentives for imbalance reserve and reliability capacity products

The ISO proposes that day-ahead imbalance reserves that do not receive real-time flexible ramping product awards buy back a portion of their imbalance reserves at the 15-minute market flexible ramping product price. If day-ahead imbalance reserve capacity is not available in real-time, it will have to buy back its entire imbalance reserve award at the higher of the imbalance reserve price or 15-minute market flexible ramping product price. If a reliability capacity award is not available in real-time, it simply must pay back the award at the reliability capacity price.

DMM believes it is important that the EDAM design include appropriate incentive mechanisms for capacity receiving imbalance reserve and reliability capacity awards to be available and capable of performing in real-time. DMM therefore supports the proposal to require imbalance reserves unavailable in real-time to have to buy back the imbalance reserve award at a potentially high real-time flexible ramping product price. This should provide some incentive for resources receiving imbalance reserve awards to maintain their availability in real-time.

DMM recommends that the ISO reconsider other aspects of its real-time market resettlement and performance incentive design in an initiative to enhance the initial EDAM implementation. DMM agrees with the Market Surveillance Committee that unavailable reliability capacity be subject to an incentive penalty rather than simply not receiving payment of its day-ahead award.⁷ This penalty could be determined in part by the fifteen-minute market flexible ramping price.

DMM continues to question the appropriateness of resettling imbalance reserves against the fifteen-minute market flexible ramping price when the imbalance reserves

⁵ MSC final DAME opinion, p. 7

⁶ *Comments on Day-Ahead Market Enhancements – 4th Revised Straw Proposal*, Department of Market Monitoring, November 18, 2022, p. 4: <https://www.caiso.com/Documents/DMM-Comments-Day-Ahead-Market-Enhancements-Fourth-Revised-Straw-Proposal-2022-11-18.pdf>

⁷ MSC final DAME opinion, p. 24.

are available in real-time but do not receive flexible ramping product awards.⁸ As currently proposed, imbalance reserves will likely be procured in much greater quantities than flexible ramping product. This is because the reserves are intended to address uncertainty between the day-ahead and real-time markets in addition to real-time 15-minute ramping needs. Imbalance reserve capacity converted to real-time energy could be forced to operate at a loss in real-time if the energy price is at or near its marginal cost of production and there is a positive flexible ramping product price at which it must buy back its imbalance reserves. This is because the real-time energy price is not ensured to exceed the sum of a resource's marginal energy cost and flexible ramping product price.

As part of its process for enhancing the initial EDAM design, the ISO should consider not resettling against the real-time flexible ramping product price the portion of imbalance reserves procured and available for addressing day-ahead uncertainty. As described above, DMM recommends the ISO consider a 60-minute uncertainty product procured in the residual unit commitment process. A 60-minute uncertainty product that maintains real-time availability should not resettle against the fifteen-minute market flexible ramping product price. If the ISO designs a product for the IFM that only procures the 15-minute flexible ramping capacity needed in real-time, it may be appropriate to consider resettling this product against the 15-minute market flexible ramping product price.

Local market power mitigation

The supply of the proposed imbalance reserve and reliability capacity up products will be constrained by transmission elements. As a result, local market power could clearly exist for these products. Imbalance reserve bids could be used to exercise market power for reserves as well as for energy. Therefore, local market power tests and mitigation for both imbalance reserve and reliability capacity up are an important component of the proposal.

The ISO proposes to establish a uniform default availability bid floor of \$55/MWh calculated using historical ancillary service prices. DMM believes this is a reasonable initial approach. The ISO proposes to cap the demand curve for the imbalance reserve product at this initial \$55/MWh default availability bid floor. DMM agrees with the Market Surveillance Committee that this demand curve cap should effectively mitigate the exercise of local market power by imbalance reserve up bids.⁹ As a result, DMM supports the proposal to build the functionality to apply market power mitigation to both imbalance reserve and reliability capacity up, but to only initially implement the functionality for reliability capacity up. If the ISO decides in the future to increase the imbalance reserve demand curve cap or to lower the default availability bid floor, the ISO will need the ability to implement market power mitigation for imbalance reserves. It is therefore prudent to develop the functionality now.

⁸ *Comments on Day-Ahead Market Enhancements – Revised Draft Final Proposal*, Department of Market Monitoring, April 24, 2023, p. 3: <https://www.caiso.com/Documents/DMMComments-DAMERevisedDraftFinalProposal.pdf>

⁹ MSC final DAME opinion, p. 19.

Consider procuring imbalance reserve in the residual unit commitment process

DMM supports the development of an imbalance reserve product to procure reserves to address net load uncertainty between the day-ahead and real-time markets. Under the current EDAM design, such a product is necessary for creating the requisite real-time must offer obligation for generation in EDAM balancing areas. However, DMM has suggested that it may be preferable to procure this product as part of the residual unit commitment process instead of in the integrated forward energy market.

If the IFM demand curve places a value on imbalance reserve above its actual probabilistic value for reducing real-time market costs, energy market inefficiencies may arise. As previously described, in this scenario DMM expects the imbalance reserve product to raise day-ahead energy prices, while still requiring the residual unit commitment market to assign the real-time must offer obligations to the more expensive physical supply that would be needed in case net load uncertainty materializes. However, if the IFM demand curve places an accurate value on imbalance reserves, the IFM may not always assign real-time must offer obligations to the additional physical supply that would be needed in case net load uncertainty materializes. In this scenario, the residual unit commitment market would still need to address uncertainty between the day-ahead and real-time markets.

Procuring imbalance reserves in the IFM rather than the residual unit commitment market has the potential advantage of allowing the market to co-optimize energy and reserve awards. However, virtual supply in the IFM may undo much of this potential benefit by displacing the more expensive and slower ramping physical supply. This would require the residual unit commitment market to continue to serve its current role of procuring excess capacity to address net load uncertainty after the IFM has issued energy awards. Therefore, in the event this scenario frequently occurs, DMM recommends that the ISO and stakeholders more carefully consider whether it would ultimately be more efficient to procure imbalance reserves in the residual unit commitment market.¹⁰

Designing real-time market product to hold and access capacity reserves procured in the day-ahead market

DMM also continues to recommend that the ISO develop mechanisms to allow the real-time market to efficiently determine whether or not to preserve imbalance reserves procured in the day-ahead market.¹¹ If the real-time market does not have a mechanism

¹⁰ This could include a more nuanced approach if the ISO adopts DMM's ongoing recommendation described above to separate imbalance reserves into a 60-minute product for addressing net load uncertainty and a 15-minute product for addressing the smaller requirement for fast ramping resources. Because the demand for the 15-minute ramping product would presumably remain in the real-time market in the form of the flexible ramping product, the ISO could consider including the 15-minute ramping product in the integrated forward market and moving the 60-minute uncertainty product to the residual unit commitment market.

¹¹ *Comments on day-ahead market enhancements - August 13, 2019 Working Group*, Department of Market Monitoring, September 6, 2019, pp. 1-3: <http://www.aiso.com/Documents/DMMCommentsDay-AheadMarketEnhancements-Aug13-Aug19Meetings.pdf>

to maintain these reserves, the value of procuring them in the day-ahead market could be significantly reduced. Extending the real-time flexible ramping product and real-time market lookout horizons would help the real-time market manage this capacity.

DMM continues to recommend that the ISO consider extending the uncertainty horizon of the real-time flexible ramping product so that the markets can procure and compensate the capacity required to address net load uncertainty that exists over the real-time market's four-hour time horizon. If these changes are not considered, the ISO should at least consider adding simpler products to the real-time markets in order to procure and compensate the ramping capacity and energy required to meet expected net load uncertainty over a multi-hour horizon (e.g. 1, 2, 4, and potentially even 8 hours out from the current market run).

These new products could resemble more traditional reserve products. Therefore, they may be much easier to implement in the near-term than a more complicated approach that incorporates net load uncertainty directly into advisory intervals of the multi-interval optimization. To help incorporate energy storage resources and the energy required to meet net load demand overnight when there is no solar production, it will be important for these new reserve products to consider energy requirements in addition to just rampable capacity several hours out from each real-time market run.

BATTERY STORAGE ISSUES

Including storage resources in the residual unit commitment process

Management's proposal includes provisions for energy storage resources to participate in the residual unit commitment process. DMM supports the inclusion of storage resources in the residual unit commitment process. However, because residual unit commitment awards will be constrained by the resource's state of charge from its IFM schedules, the proposal may lead to limited additional battery capacity awards in the residual unit commitment process. Further, real-time exceptional dispatch may be necessary to ensure the availability of RUC capacity awarded to storage resources in real-time.

Accounting for ancillary services and reliability products in day-ahead market state of charge constraints

In order to support feasible awards of all market products (energy, ancillary services, and reliability products), the ISO proposes to modify existing constraints and implement new constraints on state of charge in the IFM and residual unit commitment processes.

These constraints are important to help ensure that day-ahead awards for ancillary services and capacity products could be feasible over the 24-hour horizon. The feasibility of awards is required by the ISO tariff for ancillary services.

Enhancing the flexible ramping product to better address net load uncertainty, Department of Market Monitoring presentation to Western EIM Body of State Regulators, June 12, 2020:
<http://www.caiso.com/Documents/Presentation-Real-TimeFlexRampProductEnhancementsWesternEIMBodyofStateRegulators-June122020.pdf>

The ISO’s proposed “envelope constraints” appear to be a reasonable approach to ensure that the impacts of capacity awards in opposite directions do not cancel out, and that the impacts of day-ahead energy and capacity awards would not exceed the limitations of the resource. This may be important since, as the ISO notes, when day-ahead capacity awards are deployed as energy in real-time, this is likely to occur in a single direction even when awards may exist in both directions.¹²

In general, the use of multipliers and constraints in the day-ahead market processes to estimate state of charge impacts of day-ahead ancillary service and capacity awards may improve — but will not guarantee — the real-time deliverability of day-ahead storage awards of any product. Estimating multipliers specific to each product and hour seems likely to provide the best estimate of real-time availability. However, as with reliability capacity awards, the availability of imbalance reserve capacity in real-time may ultimately rely on real-time exceptional dispatch to ensure real-time deliverability.

Finally, as with the implementation of any new or modified market constraint, the addition of new or modified state of charge constraints has potential to interact in unexpected ways with existing constraints. DMM recommends the ISO carefully monitor the implementation of the newly proposed state of charge constraints, and be prepared to quickly modify the implementation as needed to address any unexpected market outcomes.

¹² *Day-Ahead Market Enhancements: Draft Revised Final Proposal*, California ISO, April 6, 2023, p.56: <http://www.caiso.com/InitiativeDocuments/DraftRevisedFinalProposal-Day-AheadMarketEnhancements.pdf>