Comments on Storage Design and Modeling Working Group Presentation on August 14, 2025

Department of Market Monitoring

September 5, 2025

Summary

The Department of Market Monitoring (DMM) appreciates the opportunity to comment on the *Storage Design and Modeling* working group presentation on August 14, 2025.[1] DMM supports the ISO addressing the storage bid cost recovery (BCR) issues as a top priority, and DMM appreciates the attention given to this issue in recent working group meetings. While DMM continues to recommend a bottom-up approach to redesigning uplift for storage resources, DMM supports eliminating most day-ahead BCR and does not oppose implementing rules that prevent storage resources from receiving BCR when operator behavior leads to inefficient real-time schedules.

DMM supports further analysis on the costs and benefits that may accrue to storage resources due to the multi-interval optimization prior to discussing any potential policy changes. DMM also recommends additional discussion before considering any changes to the current ancillary services state-of-charge constraint framework.

Lastly, DMM supports the Business Practice Manual clarifications for storage outages, and recommends addressing foldback in the clarifications. DMM continues to support the long-term solutions for outages and foldback discussed in previous working group meetings.

Comments

Storage BCR/uplift

DMM supports the ISO addressing storage bid cost recovery (BCR) issues as a top priority. DMM supports the ISO eliminating day-ahead BCR in most scenarios, as DMM has found the vast majority of day-ahead BCR for storage resources arises from uneconomic schedules due to parameter submissions by the scheduling coordinators.[2,3]

DMM does not oppose further discussion and development of stakeholder-suggested proposals to incentivize more efficient battery operator behavior by removing the eligibility for battery BCR under

[1] *Working Group on Outage Management, Uplift & DEB, and Mixed-Fuel & Distribution-Level Resources* presentation, California ISO, August 14, 2025: https://stakeholdercenter.caiso.com/InitiativeDocuments/Presentation-Storage-Design-and-Modeling-Aug14-2025.pdf

[2] *Comments on Storage Bid Cost Recovery and Default Energy Bids,* Department of Market Monitoring, July 18, 2024: https://www.caiso.com/documents/dmm-comments-on-storage-bcr-and-default-energy-bids-july-8-2024-workshop-jul-18-2024.pdf

[3] *Comments on Storage Design and Modeling Working Group Session 1,* Department of Market Monitoring, January 8, 2025: https://www.caiso.com/documents/dmm-comments-on-storage-design-and-modeling-working-group-session-dec-11-2024-jan-8-2025.pdf

certain bidding conditions. Early discussions of such proposals present the initial stages of a potentially workable approach to identify when uneconomic bidding may be the main driver of state-of-charge (SOC) limitations that prevent dispatch of storage resources.

As mentioned in previous comments, DMM's recommendation is to redesign storage BCR rules to assume no eligibility, and only add eligibility under specific situations where it is deemed appropriate.[4] However, if the ISO continues to address storage BCR issues by instead carving out scenarios where BCR is unwarranted, DMM agrees that storage operators bidding inefficiently and submitting inaccurate parameters are avenues for storage resources to receive unwarranted BCR.

The fundamental issue with applying the current BCR framework to storage resources is that storage resources are modeled with a number of constraints and parameters that are unique to batteries. The existing BCR rules do not consider the limitations these constraints may place on battery resources, and the control over market dispatches that these constraints provide for battery operators.[5] While conventional generators are ineligible to receive BCR when they are on outage, batteries are able to circumvent this rule in some instances because battery-specific constraints and parameters reflected in outage cards can make storage resources unavailable to the market without directly derating the resource. This allows these resources to receive BCR when they are effectively on outage.

While DMM continues to recommend the ISO address storage BCR from a bottom-up approach, if the ISO chooses to instead adjust the current BCR framework for each situation where storage resources could earn unwarranted BCR, then DMM agrees that the bidding behavior of storage resources should be considered. However, as mentioned previously, there are battery attributes unrelated to economic bids that can lead to unwarranted BCR under current market design. DMM recommends that all of these circumstances be accounted for when determining when storage resources are eligible to receive BCR.

Using DEBs as a benchmark for efficient bidding

A framework that utilizes default energy bids (DEBs) as a benchmark for whether battery operators are bidding efficiently inherently relies on a storage DEB that accurately reflects the intra-day opportunity cost for batteries. DMM has long recommended that the storage DEB vary hourly to reflect the changing real-time opportunity costs of dispatching in one hour versus another.[6] In general, storage DEBs should be higher prior to the net peak hours to reflect the opportunity cost of being unavailable in the highest priced hours. Alternatively, storage DEBs should be lower during the peak hours as the opportunity cost to dispatch at a later hour decreases during the highest priced hours. Storage DEBs should also be appropriately lower earlier in the day, to reflect the fact that if discharged many hours before the

[4] *Comments on Storage Design and Modeling May 28, 2025 Presentation,* Department of Market Monitoring, June 11, 2025: https://www.caiso.com/documents/dmm-comments-on-storage-design-and-modeling-may-28-2025-presentation-jun-11-2025.pdf

[5] *Comments on Storage Bid Cost Recovery and Default Energy Bids,* Department of Market Monitoring, July 18, 2024: https://www.caiso.com/documents/dmm-comments-on-storage-bcr-and-default-energy-bids-july-8-2024-workshop-jul-18-2024.pdf

[6] *Comments on Energy Storage Enhancements Final Proposal,* Department of Market Monitoring, November 15, 2022: https://www.caiso.com/documents/dmm-comments-energy-storage-enhancements-final-proposal-2022-11-15.pdf

highest priced hours, recharging opportunities exist and the opportunity of discharge in peak hours is not foregone.

While storage DEBs should vary hourly to ensure proper market power mitigation, storage DEBs will also need to vary hourly if bids will be compared to DEBs to determine BCR eligibility. In a framework such as the one proposed by California Energy Storage Alliance (CESA) and discussed in the August 14 working group meeting, accurate DEBs are necessary to determine when battery unavailability in the real-time is due to uneconomic bidding and inefficient state-of-charge management by the battery operator. A static DEB across the day will be too high in some hours and too low in others. Determining efficient bidding behavior by comparing bids to their DEBs will be dependent on the hour of the day and the resource's day-ahead schedule. Across the day, resources will face varying opportunity costs depending on expected prices in future hours.

Determining BCR eligibility using static storage DEBs can lead to unwarranted bid cost recovery (batteries bidding *inefficiently* and incorrectly being eligible for BCR) and loss of bid cost recovery that may be warranted (batteries bidding *efficiently* and incorrectly being ineligible for BCR). Either of these outcomes are possible with DEBs that are too high or too low, depending on the hour of the day and the day-ahead schedule of the battery resource.

In addition to reducing effective mitigation of market power, using DEBs that are too high to determine BCR eligibility may also make resources ineligible for BCR in hours where the static DEB far exceeds the intra-day opportunity cost. For example, assume a battery submits a charging bid in the morning when it has a day-ahead schedule to charge. If the battery is not dispatched to charge, then it will be ineligible for BCR in the highest shortfall interval if the charging bid in the morning hour is less than the static DEB. If the static DEB is based on the fourth highest price of the day, it is possible that the battery operator is submitting efficient bids based on expected prices, but the bid is still lower than the high static DEB. If the storage resource fails to receive a charging schedule for any reason, the resource will be ineligible for BCR if their bid is less than the DEB. This example highlights the importance of creating an hourly storage DEB if using the DEB to determine if the resource is bidding efficiently, rather than relying on a static DEB that reflects the highest intra-day opportunity cost of the day.

Regardless of whether this type of BCR rule is implemented, DMM continues to recommend that storage DEBs vary hourly to reflect the changing intra-day opportunity costs. However, if the DEBs are to be used for more than just mitigation, DMM recommends an even higher priority be placed on designing hourly DEBs that more accurately reflect the intra-day opportunity cost of storage resources.

Initial state-of-charge parameter

DMM has identified a number of cases where unwarranted BCR resulted from inaccurate estimation of the day-ahead initial state-of-charge (ISOC) parameter. In some cases, BCR accrues where the ISOC is simply a poor estimate of the realized real-time SOC. In other cases, this parameter may have been intentionally misused to generate surplus BCR payments. The day-ahead ISOC parameter may be inaccurate because battery operators submit estimates that do not materialize, or because battery operators fail to submit an estimate and the default of zero is different than the actual state-of-charge that arises. DMM supports providing incentives for battery operators to provide the best estimates of this parameter.

DMM conceptually supports the proposal suggested by stakeholders that market participants would be ineligible for BCR if their day-ahead ISOC is substantially different than their actual initial state-of-

charge. This proposal would better incentivize battery operators to submit accurate estimates of their day-ahead initial state-of-charge. However, additional details need to be developed before such an approach could be implemented, e.g., the definition of "substantially different", and over what time period in the day the resource would be ineligible for BCR.

DMM acknowledges that issues can arise from the default day-ahead ISOC being equal to zero if battery operators fail to submit an estimate. If the market is unable to properly incentivize battery operators to submit estimates of their day-ahead ISOC, it may be necessary to improve the default value to better estimate a likely initial real-time SOC, or require the submission of the day-ahead ISOC parameter rather than making it a voluntary parameter.

Analysis of multi-interval optimization

DMM supports the ISO further analyzing the benefits and costs of the multi-interval optimization (MIO) prior to considering changes that would provide uplift to storage resources for uneconomic dispatches that may occur as a result of the MIO. DMM continues to highlight that while there may be uneconomic dispatch of storage resources in some intervals, the discussion has yet to focus on the potential overall gains a resource may realize by being optimized in a manner that considers future intervals rather than solely considering the economics of the binding interval. Before discussing any potential policy changes to provide uplift to batteries due to MIO, there should be sufficient analysis provided on the total losses and benefits gained by storage resources through MIO. If the overall gains from MIO for batteries are significant, DMM does not believe that resources must be compensated for every instance in which MIO resulted in a dispatch that may have turned out to be sub-optimal based on *ex post* calculations that assume perfect information on future prices.

Ancillary service state-of-charge constraint

DMM recommends further discussion prior to any consideration of changes to the ancillary service state-of-charge (ASSOC) constraint framework. Ancillary services (AS) awarded to all resources, including awards from the day-ahead market, are assumed to be deliverable in real-time. Ancillary services are not re-optimized in real-time, with the real-time market only awarding ancillary services incremental to those awarded in the day-ahead. The real-time ASSOC constraint ensures ancillary services awarded to batteries are deliverable for the duration required by the CAISO tariff. Scheduling coordinators can also take proactive measures to manage state-of-charge in support of ancillary service deliverability. Costs associated with state-of-charge management to ensure deliverability of awarded ancillary services are costs of storage resources providing ancillary services, and like other operating costs, should be borne by the resource and factored into market bids.

DMM does not support providing bid cost recovery for uneconomic dispatches due to the ASSOC constraint.[7] By providing BCR for uneconomic dispatches of storage resources associated with maintaining ancillary services, storage resources do not face the full cost of their ancillary service

[7] *Motion to Intervene and Comments of The Department of Market Monitoring of the California Independent System Operator Corporation*, Federal Energy Regulatory Commission - Docket No. ER22-2881, Department of Market Monitoring, September 19, 2022: https://www.caiso.com/documents/motion-to-intervene-comments-er22-2881-energy-storage-bid-cost-recovery-sep-19-2022.pdf

provision.[8] Providing BCR associated with the ASSOC constraint binding may also incentivize dependence on the constraint instead of incentivizing resources to take actions to manage state-of-charge leading up to ancillary service awards.

Ensuring storage resources are properly incentivized to provide their ancillary service awards is necessary for market reliability.[9] DMM does not believe that subjecting storage resources to AS no-pay when ancillary service awards are undeliverable is sufficient incentive for storage resources to be available for their ancillary service awards. Additional constraints and market incentives are necessary to support reliability by ensuring deliverability of awarded ancillary services.[10]

Outage reporting and the representation of nonlinearity

DMM supports improvements to the outage management system (OMS) to better reflect limitations unique to storage resources. These improvements would improve transparency of resource availability and would support coordination of resource adequacy policy developments between the ISO and CPUC staff.[11] The ISO states that improvements to OMS are scoped for a longer-term initiative. In the interim, DMM supports the additional guidance for storage outages in the outage management Business Practice Manual (BPM).

Foldback is an operational limitation on the power output of a resource (MW), and not the stored energy (MWh). Due to the physical limitations of the resource's ability to provide power, DMM recommends the ISO continue to require scheduling coordinators to report the physical limitation as an outage that is not exempt from the resource adequacy availability incentive mechanism (RAAIM). Furthermore, DMM recommends the ISO include this clarification in the BPM.

For long-term improvements to represent foldback in the CAISO market, DMM continues to support the inclusion of foldback parameters through Master File, and the development of functionality to bid state-of-charge (SOC).[12] The inclusion of foldback parameters in the Master File would treat the resources as having a variable ramp rate that differs at the extremes of SOC.

Foldback prevents batteries from incurring damage and excess cost when operating at the minimum and maximum levels of the resource's SOC. DMM views allowing a resource to bid SOC as a significant

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[8] *Comments on Energy Storage Enhancements Second Revised Straw Proposal,* Department of Market Monitoring, August 4, 2022: https://www.caiso.com/Documents/DMM-Comments-Energy-Storage-Enhancements-Second-Revised-Straw-Proposal-Aug-4-2022.pdf

[9] *Comments on Energy Storage Enhancements State of Charge Formula- Workshop Paper,* Department of Market Monitoring, August 17, 2023: https://www.caiso.com/documents/dmm-comments-on-energy-storage-enhancements-workshop-paper-aug-17-2023.pdf

[10] Ibid.

[11] *Comments on Storage Design and Modeling Issue Paper and Straw Proposal on Outage Management, Nonlinearity, and SOC Clarification*, Department of Market Monitoring, May 23, 2025: https://www.caiso.com/documents/dmm-comments-on-storage-design-and-modeling-issue-paper-and-straw-proposal-on-outage-management-nonlinearity-and-soc-clarification-may-23-2025.pdf

[12] *Comments on Storage Design and Modeling Working Group Session 2 and 3*, Department of Market Monitoring, March 7, 2025: https://www.caiso.com/documents/dmm-comments-on-storage-design-and-modeling-working-group-sessions-2-and-3-mar-07-2025.pdf

improvement in the ability of storage resources to accurately reflect costs and resource limitations applicable to a particular market interval that can vary based on SOC, so that the cost of producing at a given megawatt output level can vary depending on SOC. To the extent that the degree of foldback may be relaxed at a given price, the ability to bid based on SOC may allow better reflection of this cost.