California ISO | WESTERN ENERGY MARKETS

Memorandum

To: *ISO Board of Governors and Western Energy Markets Governing Body*

From: Anna McKenna, Vice President Market Design and Analysis

Date: October 31, 2024

Re: **Decision on Storage Bid Cost Recovery Enhancements**

This memorandum requires ISO Board of Governors and WEM Governing Body action.

EXECUTIVE SUMMARY

Management has identified the need to modify the application of the bid cost recovery rules to storage to address two concerns: 1) incentive issues unique to short-duration storage, and 2) potential exploitation of bid cost recovery payments through strategic bidding. The ISO proposes a near-term change in the calculation of real-time bid cost recovery payments for storage resources that would address the second concern and close a market design gap, while it continues to develop more fundamental changes to how storage resources are optimized and costs are recovered to more holistically address the first concern.

Management recommends that the ISO Board of Governors and Western Energy Markets Governing Body approve the proposed changes to storage bid cost recovery as described in this memorandum.

> ***Moved, that the ISO Board of Governors and WEM Governing Body approve the changes to bid cost recovery for storage as described in the memorandum dated October 31, 2024; and***
>
> ***Moved, that the ISO Board of Governors and WEM Governing Body authorize Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the changes proposed in this memorandum, including any filings that implement the overarching initiative policy but contain discrete revisions to incorporate Commission guidance in any initial ruling on the proposed tariff amendment.***

BACKGROUND

Grid-scale energy four-hour storage assets within the California Independent System Operator (CAISO) footprint have grown from about 500 MW in 2020 to approximately 10,000 MW by July 2024. Storage resources are defined by their unique operational characteristics: flexibility, responsiveness, and their energy-limited nature, as fuel availability is endogenous to the electric market.

The markets the CAISO operates ensure resources recover their costs for providing energy and ancillary services through the bid cost recovery mechanism, like all energy markets that are based on locational marginal pricing (LMP). Under these rules, the CAISO calculates a shortage or surplus of revenues earned in each interval as the difference between market revenue based on the market clearing price and bid costs, which include start-up, minimum load, transition, and energy costs. These market revenues shortage and surpluses are netted over the day, separately for the day-ahead and real-time markets, to determine whether a payment is necessary when market revenues for the day fall short of the resource's bid costs. The rationale for offering these payments is to incentivize efficient bidding by allowing for the recovery of commitment costs. Without these payments, resources would have an incentive to add a risk premium to their offers, leading to inefficient market outcomes, with higher overall costs for energy.

The current bid cost recovery rules were designed for conventional thermal assets. When storage resources started to enter the resource mix, these rules were extended to storage resources without modifications. At the time, storage resources were typically used for regulation, and, with only a small number of resources participating in the energy market, it was not immediately necessary to modify the bid cost recovery rules. Experience with increased participation of storage resources across the energy markets shows that the current bid cost recovery rules do not reflect the unique characteristics of grid-scale energy storage assets. Unlike thermal resources, storage resources do not have start-up or minimum load costs and generally have fast ramp rates, thereby lacking the conventional drivers for bid cost recovery. Although they may have other opportunity costs, they generally lack the intertemporal constraints that warrant bid cost recovery for conventional thermal resources.

The challenges associated with bid cost recovery for storage assets are further complicated by the nature of their bids in the real-time market. Energy storage resources' bids do not result merely from their costs to produce energy in a given interval; instead, they also reflect storage resources' desire to be dispatched at a given time based on their opportunity costs in future intervals. As a result, the bids submitted by storage resources are not equivalent to those submitted by conventional thermal assets as they are not solely a representation of the actual costs associated with injecting energy into the grid at a given interval, but also include an implied opportunity cost or simply indicate to the market a strong signal to hold state of charge for later dispatch that could fall outside the immediate optimization window. This means that current bid cost recovery payments to energy storage resources may make resources

whole to a higher value than their costs and may be unwarranted. This creates an incentive for storage resources to bid in an inefficient manner that jeopardizes their ability to meet their schedules in order to pursue outsized bid cost recovery payments, potentially hindering the reliability of the grid.

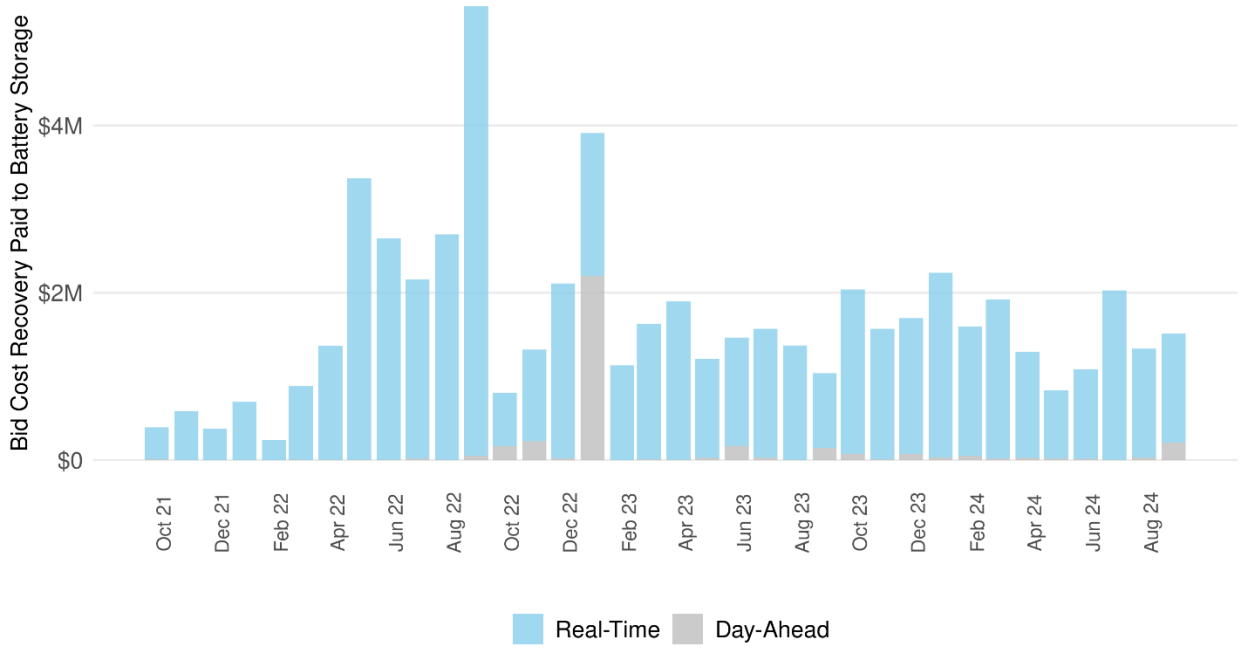
In addition, current bid cost recovery rules treat storage resources differently from conventional generators when they are unavailable to provide energy. Conventional resources are not eligible for bid cost recovery payments when unavailable due to a lack of fuel, but storage resources can experience fuel insufficiency in the form of state of charge limitations and still receive bid cost recovery payments under the current paradigm. This is particularly problematic since, given how shortfalls and surpluses are calculated today, storage resources can bid in a manner that inflates bid cost recovery payments.

In 2022, Management proposed and the ISO Board of Governors and WEIM Governing Body approved changes to the bid cost recovery rules for storage because the ISO observed that the then-applicable provisions related to bid cost recovery for energy storage did not align with the overall objectives and intent of bid cost recovery. Specifically, storage resources were receiving high bid costs recovery payments due to a combination of ancillary service awards or self-provision of regulation-down in the real-time market, coupled with relatively high energy bids.

FERC approved the tariff change noting that storage resources' high bids did not represent the resources' actual bid costs but rather reflected economic unwillingness to discharge, essentially avoiding energy dispatch in certain intervals. At that time, the ISO also committed to monitor the impacts of the bid cost recovery provisions to energy storage resource settlements and to continue to engage with stakeholders to examine whether any other longer-term enhancements might be made to the tariff to address this issue.

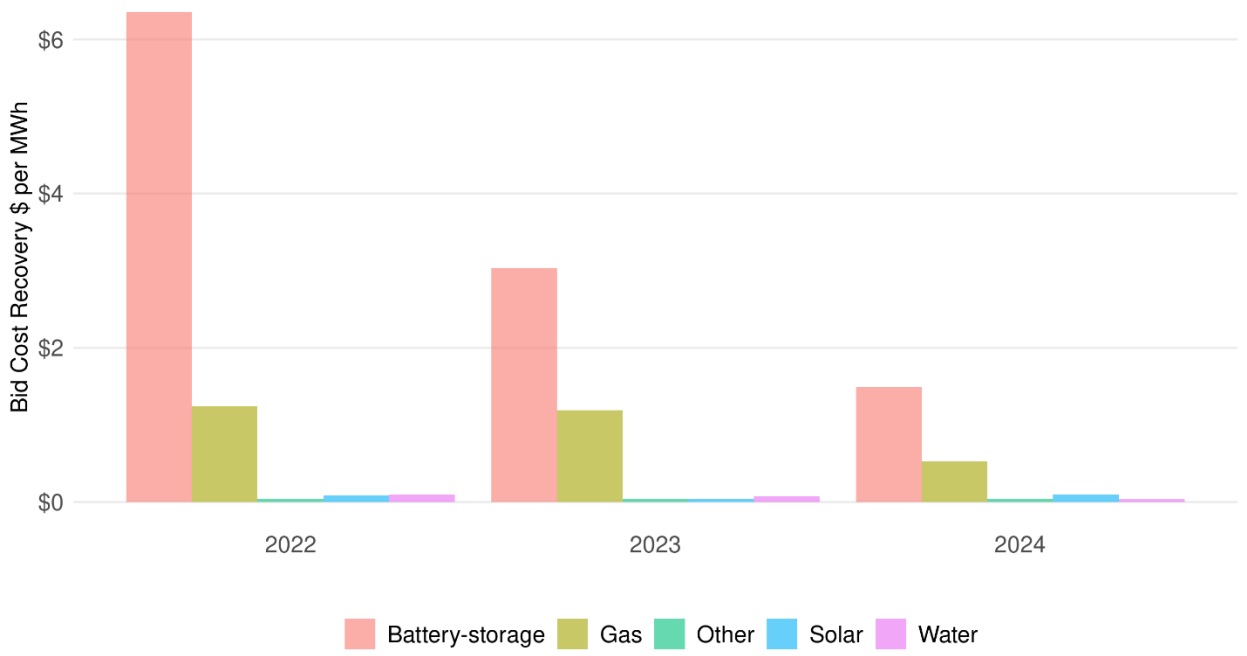
Figure 1 below shows the trend of bid cost recovery applicable to storage resources for the last three years organized by the market in which the cost was accrued. The majority of bid cost recovery for storage resources accrued in the real-time market.

Figure 1: Bid cost recovery for storage resources



Bid cost recovery paid to storage resources from January 2022 through September 2024 is about $58 million. While this represents a relative small share of the overall bid cost recovery paid in this period – about 8 percent – this is a disproportionate cost relative to the energy provided by storage resources. In 2024, storage resources have provided around 1.7 percent of energy, up from 0.5 percent in 2022, as more storage resources have integrated into the system. The disproportionate payment can be shown by the average cost estimated with the bid cost recovery paid divided by the energy they provided. These average costs are shown for the main technology categories in Figure 2.

Figure 2: Average cost per energy associated with bid cost recovery



While bid cost recovery for storage resources has been decreasing in aggregate on a per MWh basis, detailed analysis on the dynamics leading to specific instances of bid cost recovery paid to storage resources indicates that some of these payments may not be aligned with the purpose and intent of bid cost recovery. The current bid cost recovery calculation does not adequately consider attributes common among storage resources, such as state-of-charge constraints, which determine whether an asset can support its awards and schedules. This results in materially different treatment for storage from conventional generators, which are not eligible for bid cost recovery payment when unavailable due to fuel insufficiency. Significant bid cost recovery payments related to the buy- and sell-back of day-ahead schedules are driven by limited or insufficient state of charge.

This differentiated treatment of unavailable energy between conventional and storage assets creates two concerns:

- **Concern 1:** Storage assets are not exposed to real-time prices for deviating from day-ahead schedules, thereby lacking sufficient incentives to bid in such a way as to be available in times of greatest system needs.
- **Concern 2**: Storage assets are incentivized to bid strategically to maximize the combined bid cost recovery and market payment.

The concerns described above often materialize in the context of buy- and sell-backs of day-ahead schedules. The day-ahead market optimizes the storage asset over the full 24 hour horizon, whereas the 5-minute real-time market only optimizes over the next couple of hours. As a practical matter, the day-ahead schedules will position the resource to charge and discharge in the optimal hours considering the information available at the time. Because of that, day-ahead bid cost recovery payments are rarely if ever needed for storage resources. In contrast, the real-time market optimizes over a moving window of multi-interval optimization, and makes decisions to charge and discharge a storage resource without knowing the full set of binding prices in future intervals. Thus, there are scenarios where the real-time market optimization results in resources incurring greater costs to charge than earned through revenues for discharge. While there are benefits to having storage resources available to the real-time market throughout the day, as unanticipated conditions can and do occur in real-time, storage resources generally support reliability best by being available to deliver their day-ahead schedules, which have been optimized taking anticipated conditions the full day into account.

A buy-back of a discharge day-ahead schedule can occur when a storage asset's real-time state of charge is too low to support the day-ahead award. This can be due to the state of charge of the resource in the binding interval, but also in any of the advisory intervals considered in the multi-interval optimization. Conversely, a sell-back of a charge day-ahead schedule can occur when a storage asset's real-time state of charge is too high to support the day-ahead award. Similarly, this can be due to the state of charge of the resource in the binding interval, but also in any of the advisory intervals. When buy- and sell-backs materialize, a storage resource would receive a dispatch instruction in the fifteen-minute market that creates a differential relative to the day-ahead schedule. Likewise, in the real-time dispatch, a storage resource may receive a dispatch instruction in the five-minute market that creates a differential relative to the fifteen-minute schedule.

Since today's energy bid cost formulation for the purposes of bid cost recovery only uses the real-time bid as its sole proxy of costs, storage resources can bid in a manner that would unduly inflate bid cost recovery payments through buy-back or sell-back of the day-ahead schedule. This behavior can materially hinder reliability because grid operators rely largely on market dispatches and energy storage resources would be unavailable when needed in real-time. This construct also creates economic inefficiency, as it removes exposure to real-time prices, thus eliminating incentives to provide real-time offers that would drive the market to dispatch the resource in the highest value intervals. Finally, the current bid cost recovery paradigm can lead to undeliverable day-ahead market awards for storage, because scheduling coordinators may bid in a manner that would artificially inflate bid cost recovery payments precisely by not being available during times of anticipated highest value.

PROPOSAL

Replace the bid cost component of the calculation with an alternative value to eliminate incentives to bid strategically to expand bid cost recovery payments

The market design gap allowing strategic bidding behavior to unduly inflate bid cost recovery payments for storage assets must be closed in the near-term as it exposes market participants and ratepayers to adverse financial outcomes. Management proposes a near-term solution developed with stakeholders focused on modifying the real-time energy bid cost calculation in the real-time bid cost recovery settlement for storage resources for bid cost recovery payments accrued for energy dispatched between the fifteen-minute market and the day-ahead schedule as well as between the five-minute real-time dispatch and the fifteen-minute schedule.

To address strategic bidding concerns (Concern 2 noted above), Management proposes to replace the bid cost component of the bid cost recovery calculation with an alternative price dependent on the how the resource is dispatched in the fifteen-minute market and the five-minute real-time dispatch relative to their prior schedule.

The ISO's proposal would replace the real-time bid cost for storage resources in this calculation as follows:

For resources dispatched up, the alternative would be the minimum of the bid and the maximum of three alternatives:	For resources dispatched down, the alternative would be the maximum of the bid and the minimum of three alternatives:
1. Real-time default energy bid 2. Real-time market cleared price 3. Day-ahead market cleared price (only applicable to resources with a day-ahead award)	

- The phrase "dispatched up" or "dispatched down" is relative to the prior market.
    - A resource is dispatched up if the fifteen minute market dispatches a storage resource to increase its discharge or decrease its charge relative to its day-ahead schedule, or if the five-minute market dispatches a storage resource to increase its discharge or decrease its charge relative to its fifteen-minute market schedule.
    - A resource is dispatched down if the fifteen minute market dispatches the resource to decrease its discharge or increase its

charge relative to the day-ahead schedule, or if the five-minute market dispatches a storage resource to decrease its discharge or increase its charge relative to its fifteen-minute market schedule.

- In intervals without a day-ahead schedule, the day-ahead price is not applicable. Accordingly, Management proposes to exclude the day-ahead price term from the calculation applicable to storage resources that are in the Western Imbalance Energy Market but not in the CAISO/EDAM footprint, as it would for any resource without a day-ahead schedule.
- The alternative calculation will include the segment of the bid and default energy bid curves corresponding to the market dispatch. Prices included are the locational marginal prices at the resource's location.

This modified bid cost recovery calculation should be applied across all intervals of the day in real-time, as opposed to solely in a subset of intervals as proposed by some stakeholders. Management observes that implementation in all intervals is necessary to effectively eliminate the ability of resources to bid strategically in a manner that unduly inflates bid cost recovery. Moreover, this implementation is feasible to develop in the near-term and resettle as needed, thus curing the current design gap as soon as possible and it is a measured approach to solve some of the concerns described herein while allowing for the continued development of a new uplift mechanism for storage assets.

Stakeholder Feedback

Management's proposal is responsive to five rounds of verbal and written stakeholder feedback, which included seven public meetings and over 60 sets of written comments. The solution proposed by Management herein represents a modified version of the alternative bid cost recovery calculations put forth by stakeholders. Specifically, Management's proposal, as discussed since the September 11 meeting and further detailed in the October 9 meeting, is to apply the modified energy bid cost calculation for energy storage resources in all real-time intervals as opposed to in a subset of intervals as put forth by stakeholders.

Some stakeholders supported Management's proposal as a viable near-term compromise but urged the ISO to continue working on the remaining storage uplift issues so as to promptly address them. In contrast, other stakeholders opposed Management's proposal noting its application across all intervals could be overly conservative and may result in overly punitive outcomes. Regardless of their position on Management's proposal, all stakeholders have asked Management to continue working on a holistic redesign of optimization approach and uplift for storage resources as soon as possible.

The issues related to bid cost recovery are complex and merit a holistic revision of the uplift mechanism applicable to storage resources. This being said, it is also evident from the material discussed in this Memorandum that the current design gap that could allow for strategic bidding behavior to unduly inflate bid cost recovery payments for storage assets must be closed in the near-term as it exposes market participants and

ratepayers to adverse financial outcomes. Management reiterates its commitment to continue working on an uplift redesign for storage assets. If the present near-term solution is approved by the joint Board of Governors and WEM Governing Body, Management will commence a storage initiative to holistically redesign uplift for storage assets. Said initiative shall consider the interplay of storage bid cost recovery with other enhancements recommended by stakeholders to the ISO, such as modifications to the storage default energy bid formulation, consideration of the non-linearity of storage performance, optimization methodologies, and evaluation of the impacts of outages, bid parameters, and mitigation with relation to bid cost recovery.

CONCLUSION

Management proposes to modify the calculation of bid cost recovery for storage resources to limit the opportunity for strategic bidding to inflate bid cost recovery payments. Management proposes this near term solution as it appropriately eliminates the ability to bid strategically to inflate bid cost recovery payments and will continue to work with stakeholders to determine more appropriate optimization approaches and bids cost recovery rules for storage resources. The proposed changes can be implemented in a manner that would allow for resettlement to the effective date following the submittal of tariff changes to FERC, once approved by FERC.

Management recommends that the ISO Board of Governors and Western Energy Markets Governing Body approve the proposed changes to storage bid cost recovery as described in this memorandum.