California ISO

Storage Design and Modeling

Straw Proposal on Default Energy Bids, Uplift, and State-of-Charge Management Topic Groups

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Table of Contents

1. Executive Summary

In this paper, the ISO proposes a sequenced approach to address storage bid cost recovery, default energy bids, and modeling. Bid cost recovery, also framed as uplift, refers to additional payment to resources to ensure compensation for applicable costs when the revenues from following market dispatch are insufficient. In this paper, the ISO outlines a path for reforming bid cost recovery for storage resources. Because there is broad recognition that uplift must be reassessed but cannot be fixed in isolation, the ISO proposes to focus near-term discussions on improvements to default energy bids and bidding structures and then using those results to inform a more comprehensive uplift redesign.

As such, the ISO is proposing a sequenced approach. Near-term efforts will focus on improving default energy bids and introducing new bidding concepts, while longer-term work will address uplift in a more integrated way. The goal is to ensure that all elements of the market – including bids, pricing, dispatch, and cost recovery – work together effectively as storage continues to grow in importance. The ISO has therefore structured this initiative to culminate in a draft final proposal on default energy bids, bidding enhancements, and uplift considerations by the end of 2026.

In this paper, the ISO puts forth two approaches to enhance the default energy bid for storage resources. Today, the ISO may replace a resource's bid with a previously agreed upon default energy bid to limit the ability of local market power to affect market outcomes. This default energy bid is meant to reflect the resource's marginal costs. The current default energy bid for storage resources has limitations because it relies on outputs from prior market processes and does not fully reflect changing conditions throughout the day. To address this, the ISO details two approaches: a time-of-day approach and a static approach. After comparing both approaches to the status quo, the ISO concludes that the time-of-day approach can meet the principles for enhancement while remaining implementable.

The ISO also proposes a way to extend default energy bid rules to hybrid resources. Hybrid resources combine multiple technologies under a single resource, such as a solar component paired with a battery component. Because hybrid resources combine different technologies, setting a single default bid is more complex. In this paper, the ISO evaluates three approaches to derive a hybrid default energy bid by considering the default energy bids applicable to the underlying components. Ultimately, the ISO proposes to move forward with a "greater-of" method, where the default bid is based on the highest cost component, with guardrails.

Finally, the paper introduces a potential new way to frame storage bidding into the ISO markets for additional discussion. Today, storage operators must submit hourly bids and forecast prices to manage how much energy they store, which can be complex and inefficient. The ISO is exploring an alternative reframing where storage resources would instead submit a single bid reflecting the value of ending a given period with more or less energy stored than what the resource began the day with. This approach would allow the market system to manage charging and discharging decisions more effectively while improving alignment between market outcomes and resource incentives.

2. Introduction

Since 2020, utility-scale battery storage deployments, have grown rapidly across the California Independent System Operator's (the ISO's) footprint and the Western United States. In the ISO, storage capacity has skyrocketed from about 500 MW in 2020 to 16,531 MW as of June 1, 2026. In the multistate Western Energy Imbalance Market (WEIM), battery capacity was 8,500 MW at the end of 2025, an increase of 69% percent compared to late 2024.[1] As storage assets have quickly become a significant share of the resource mix, the ISO, its market participants, and other stakeholders have identified opportunities to enhance current rules and frameworks to better leverage these flexible assets. In this paper, the ISO discusses three issues: the next steps regarding uplift discussions, default energy bids for storage and hybrid resources, and a concept for discussion regarding the reframing storage bidding.

First, this paper provides clarity on the next steps regarding uplift discussions. Recent discussion within the Storage Design and Modeling initiative highlights a central design question: how to appropriately sequence reforms to storage bidding, default energy bids, and uplift. While stakeholder views vary, a meaningful portion of feedback supports prioritizing default energy bid enhancements as a near-term step, with the understanding that these elements form a critical foundation for any subsequent changes to the uplift framework. Others note improvements to bidding structures or modeling alone will not resolve underlying issues in bid cost recovery design and therefore should not be viewed as substitutes for broader uplift reform.

In response, the ISO proposes a structured path forward that emphasizes issue sequencing. This paper focuses on advancing default energy bid and bidding framework enhancements, with the intent that these near-term efforts will inform and enable a more coherent and internally consistent uplift paradigm. This approach reflects the view that storage bidding behavior, mitigation constructs, and modeling assumptions are tightly interconnected. Prematurely modifying uplift without clarity in these areas could lead to misaligned incentives or unintended outcomes.

Looking ahead, the ISO plans to use the outcomes of these near-term efforts and data from recently implemented real-time bid cost recovery changes to support a more comprehensive evaluation of uplift design. The Storage Design and Modeling initiative is therefore structured to release a draft final proposal integrating default energy bids, bidding enhancements, and uplift considerations by the end of 2026, ensuring that any changes to the uplift paradigm are compatible with, and informed by, the broader evolution of storage market design.

The second issue addressed in this paper relates to default energy bids. Today, the ISO mitigates the potential exercise of local market power through a framework that replaces certain resource bids with pre-approved default energy bid values under defined conditions. These default energy bids are intended to approximate a resource's marginal costs, ensuring cost recovery under mitigation while preserving efficient market outcomes. Within this framework, the storage default energy bid has become increasingly important as the fleet of storage resources has significantly grown across the ISO's markets. While this approach has provided a workable foundation, evolving market conditions have

[1] Department of Market Monitoring (DMM), "Department of Market Monitoring Report", February 2026, at 9.

shown limitations of the current methodology given its reliance on prior market outputs and its static real-time formulation.

In response to these challenges, the ISO, in collaboration with stakeholders, has developed a set of problem statements and guiding principles to inform potential enhancements to the storage default energy bid. These guiding principles emphasize the need to:

(1) Reflect changing real-time opportunity costs and minimize the use of “stale” cost proxies.
(2) Ensure that all storage assets, regardless of location, can access a viable default energy bid option.
(3) Maintain appropriate bid stack positioning even under mitigation.
(4) Minimize charging-side mitigation that could impair state-of-charge management.

Building on these principles and extensive stakeholder engagement, this paper presents two approaches to enhance the storage default energy bid methodology: a time-of-day approach and a static approach. Of these, the ISO’s preferred approach is the time-of-day framework, which incorporates scaling of inputs leveraged from prior market processes and limited temporal differentiation to better capture intraday opportunity costs while minimizing administrative burden.

Parallel to these efforts, the ISO continues to explore how default energy bid frameworks should be extended to hybrid resources, an issue deferred from the 2020 Hybrid Resources initiative. Stakeholder engagement over the past year reflects broad interest in developing a methodology that appropriately captures the operational and economic characteristics of hybrid resources, including component-level costs and interactions between technologies. Stakeholders have identified the need for an approach that both reflects marginal cost drivers and supports effective market power mitigation, while remaining practical for near-term implementation.

In evaluating potential pathways, the ISO considered three paradigms for hybrid resources. The ISO currently favors further development of the greater-of approach, which uses the default energy bid value of the largest component as the default energy bid of the hybrid resource. This approach would be paired with a minimum share requirement to ensure that only components representing a meaningful portion of installed capacity influence the resource’s default energy bid. This direction seeks to preserve alignment with marginal cost principles, maintain consistency with existing frameworks, and mitigate risks associated with disproportionate influence from small, high-cost components.

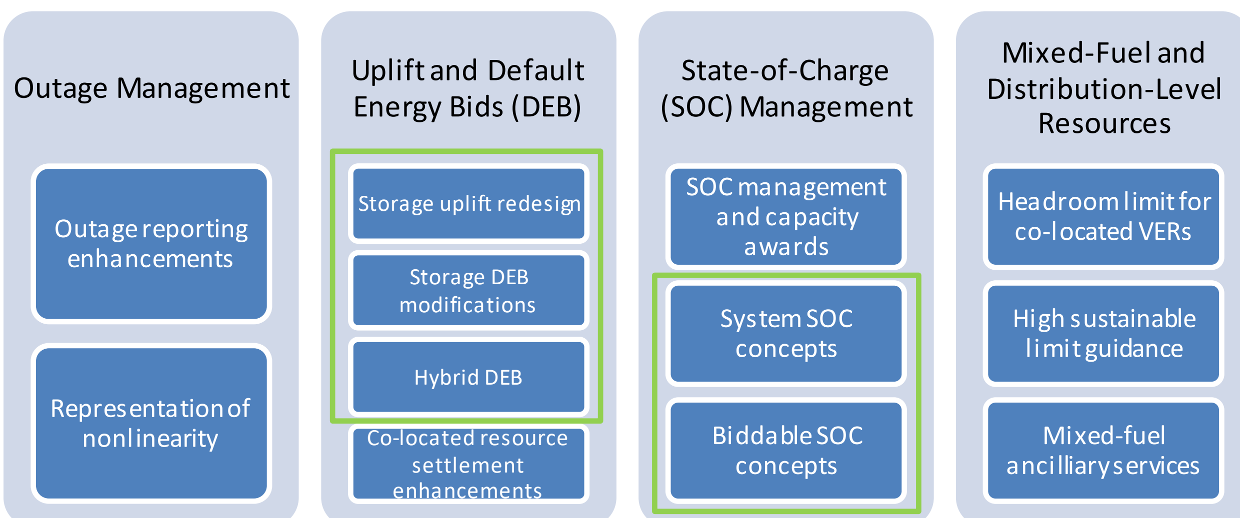
The final section of this paper relates to storage bidding and state-of-charge management. Here, the ISO details a concept for discussion: a broader reframing of non-generator resource bidding to address persistent challenges in storage state-of-charge management and real-time dispatch efficiency. Under the current paradigm, storage resources rely on interval-by-interval bid curves and implicit bid spreads to guide dispatch, requiring market participants to forecast near-term prices and actively manage state-of-charge through hourly bidding. The current paradigm introduces challenges for efficient market design, including potential difficulty forecasting uncertainty, misalignment between day-ahead schedules and real-time outcomes, and inconsistencies between bid structures and underlying operational costs.

To address these limitations, the ISO is evaluating a conceptual shift in how storage resources express their economic preferences in the market. Building on prior Market Surveillance Committee (MSC) feedback and recent academic work, this reframing centers on allowing storage resources to submit one bid reflecting their willingness to deviate their end-of-horizon state-of-charge from their initial or reference state-of-charge. This structure would enable the market optimization to directly incorporate both variable operating costs and the forward-looking value of stored energy, improving alignment between dispatch decisions and resource incentives. By embedding opportunity costs beyond the optimization horizon into a single terminal value, the approach strengthens the connection between day-ahead and real-time outcomes and provides a more internally consistent framework for managing state-of-charge. Following initial stakeholder discussions, the ISO notes that, while open questions remain, there is merit in the bidding reframing concept to warrant continued development. Accordingly, the ISO seeks additional stakeholder feedback on this concept to inform what additional information can ease evaluation of whether and how this concept should advance as part of broader storage market enhancements.

3. Stakeholder Process

To address the aforementioned challenges and other elements related to energy storage participation, the ISO launched the Storage Design and Modeling initiative. Given the complexity, broad scope, and interrelated nature of some items, the ISO created four topic groups to facilitate parallel development, efficient stakeholder engagement, and phased resolution. Figure 1 shows these topics as grouped. The solid green boxes show topics discussed in this paper. Workstreams may span groupings as needed.

Figure 1. Topic Groups



This paper incorporates feedback from working group meetings and the rounds of written comments received after the issue paper for the topic group, as well as ISO implementation assessments. Figure 2 shows the typical process from a stakeholder initiative. The ISO is at the “develop” stage regarding the Uplift and Default Energy Bid topic group within the Storage Design and Modeling initiative.

Figure 2: Stakeholder Process Milestones

4. Further enhancements to the storage uplift paradigm

Following the publication of the December 2025 Updated Discussion and Issue Paper on Uplift and Default Energy Bids, several stakeholders provided feedback on whether the questions surrounding storage bid cost recovery and the efforts to create a new uplift framework were ripe for a straw proposal. In those comments, three camps emerged.

The first camp believes that bid cost recovery and uplift discussions should be a top priority. For example, the California Public Utility Commission's Energy Division (CPUC ED) advocated for urgency, highlighting that the current framework results in distorted incentives and unwarranted uplift payments and urging the ISO to move quickly to adopt near-term reforms. Cal Advocates similarly supported near-term implementation of a more restrictive bid cost recovery regime, signaling a preference to act now rather than prolong design discussions. The Six Cities stressed procedural urgency, noting that stakeholders have been engaged in this issue for a long period of time and encouraging the ISO to move toward decisions even without full consensus, rather than delaying for future market developments. Finally, DMM explicitly identified bid cost recovery as its top priority while also calling for immediate incremental improvements regarding storage default energy bids.

The second camp, while recognizing the importance of addressing bid cost recovery challenges, advocated for these to be addressed through a holistic, properly sequenced redesign rather than incremental fixes. AES advocated for the ISO to refrain from implementing bid cost recovery reforms in isolation. Instead, AES called for the ISO to improve storage default energy bids, develop real-time make-whole mechanisms, and then address day-ahead bid cost recovery. AES explicitly supported pausing day-ahead bid cost recovery changes until this broader framework is established. California Energy Storage Alliance (CESA) emphasized that real-time uplift redesign should be of higher priority relative to day-ahead uplift but agreed that more foundational reforms regarding storage modeling and default energy bids should be completed ahead of those conversations.

Western Power Trading Forum (WPTF) and Vistra also fall within this camp. WPTF argued that a holistic discussion of the uplift framework must occur before making changes to either day-ahead or real-time bid cost recovery. In addition, WPTF stressed that focusing on incremental fixes within the current framework risks optimizing a design that may not be appropriate for storage. WPTF urged the ISO to defer changes to bid cost recovery until default energy bid improvements are agreed to and a holistic uplift framework discussion takes place. Vistra, while pushing for faster progress on the initiative as a whole, argued against incremental changes to the existing bid cost recovery framework. Instead, Vistra advocated for discussions to integrate state-of-charge management, mitigation, price formation, and uplift in a cohesive manner.

The third camp placed an even lower priority on bid cost recovery enhancements, saying the ISO should avoid rushing any modifications at this time. American Clean Power – California (ACP-CA) represented bid cost recovery as a lower in priority relative to other initiative elements, including the enhancement of default energy bids. The California Community Choice Association (CalCCA) cautioned against premature elimination of day-ahead bid cost recovery, recommending monitoring and reporting to evaluate impacts over time. Pacific Gas & Electric (PG&E) similarly stressed the need for additional policy development and analysis, pointing to uncertainty around new market products (e.g., EDAM/DAME) and their interaction with uplift outcomes. San Diego Gas & Electric (SDG&E) echoed these concerns, opposing early elimination of day-ahead uplift and emphasizing continued analysis and monitoring, along with prioritization of default energy bid improvements first.

Overall, there is a tension regarding what kind of enhancements should be explored and defined first. Some stakeholders favor immediate structural reforms regarding bid cost recovery while others urge the ISO to pivot to deeper, foundational redesign discussions, even if that means pausing incremental changes to the current framework. In this context, during the May 2026 stakeholder meeting, the ISO indicated that it would focus this paper on developing straw proposals for default energy bid and bidding enhancements. Relatedly, the ISO noted that following discussion of those changes, the initiative would explore whether additional bid cost recovery modifications are needed. This was informed by prior stakeholder feedback and a desire for more information on how recently implemented changes to real-time bid cost recovery for storage resources has impacted payments.

After the May 2026 meeting, DMM offered comments cautioning against delaying bid cost recovery discussions in favor of other design enhancements. DMM disagreed with the sequencing detailed at the May 2026 stakeholder meeting and recommended that the ISO advance comprehensive bid cost recovery independently and ahead of other market changes. DMM argued that while other enhancements discussed in this initiative such as end-of-horizon state-of-charge bidding may improve dispatch efficiency, these changes do not address the underlying issues in bid cost recovery design. In that context, DMM underscored that improvements to bidding structures, default energy bids, and modeling should not be viewed as substitutes for bid cost recovery reform.

The ISO has identified that a plurality of commenters have explicitly prioritized default energy bid enhancements as a near-term or first step, with many recommending that this work proceed before or in parallel with broader uplift reforms. Even DMM supported expedited consideration of default energy bid enhancements, including the development of a readily-available default energy bid option for WEIM-only storage assets. As such the ISO seeks to sequence discussions and development of proposals for these issues in a holistic manner. Critically, this does not mean that improvements to bidding structures, default energy bids, and modeling are being considered as substitutes for bid cost recovery reform, but that the ISO would like to discuss the future of storage bidding, mitigation, and modeling so as to ensure that any eventual uplift policy modifications are consistent with it.

As such, the ISO proposes to use the present paper to (1) expedite the finalization of a direction regarding default energy bid enhancements and (2) move forward the discussions regarding bidding modifications. These items, in turn, will inform discussions through the remainder of 2026 so as to allow for a draft final proposal on default energy bids, bidding, and uplift by the end of 2026. Such discussions and subsequent papers will also be informed by data on the impact of recent changes to real-time bid cost recovery for storage resources. Once more, the ISO is not replacing discussions on bid cost recovery but seeking to finalize related discussions to ensure any future uplift paradigm is compatible with other potential modifications.

5. Default Energy Bids

The ISO mitigates the exercise of market power through its local market power mitigation process. Through this process, the ISO identifies conditions in which scheduling coordinators could exercise market power and mitigates their bids to the default energy bid option selected by the asset or the competitive locational marginal price, whichever is greater.[2] As such, default energy bids seek to approximate a generator's variable costs to ensure assets can at least recover them if mitigation lowers their bids. The energy storage default energy bid methodology is one among many methods discussed in the Market Instruments Business Practice Manual.

In the following subsections, the ISO first provides an overview of the current storage default energy bid and the problem statements, guiding principles, and concepts for enhancement developed through the working group process. The paper then offers a summary of the discussions following the publication of the December 2025 Updated Discussion and Issue Paper on Uplift and Default Energy Bids. Later, the paper includes a description of the time-of-day draft straw proposal shared during the May 2026 stakeholder meeting, as well as a summary of stakeholder feedback on it and ISO responses to said feedback. Finally, the paper details two approaches meant to modify the storage default energy bid calculation in a manner aligned with the problem statements and guiding principles derived from the working group process, stakeholder feedback, and the MSC: the time-of-day approach and the static approach.

5.1. The current storage default energy bid

Today, the storage default energy bid includes three cost components and accounts for batteries' round-trip efficiency and duration. The first cost component relates to energy costs. This seeks to

[2] Methodology for bid mitigation can be found for the day-ahead market in Tariff Section 31.2.3 and for market power mitigation in the real-time market in Tariff Section 34.1.5 and Market Operations Business Practice Manual Section 7.4.

estimate the average cost of energy needed to charge the storage resource. For the day-ahead default energy bid, the energy costs are sourced from the day-ahead locational marginal price from the market power mitigation run at the relevant pricing node for the same trading day. For the real-time default energy bid, the energy costs are sourced from day-ahead locational marginal prices from the integrated forward market run at the relevant pricing node for the same trading day. The energy cost component considers the duration of charging adjusted by the round-trip efficiency to accurately estimate charging costs.

The second cost component relates to opportunity costs. Price-based opportunity costs attempt to estimate the market opportunity cost when determining whether to discharge stored energy at various hours during the day. For the day-ahead storage default energy bid, the price-based opportunity cost uses advisory prices from the market power mitigation process. For the real-time storage default energy bid, the price-based opportunity cost is set at the value of the highest day-ahead locational marginal price corresponding to the discharge duration of the resource. Therefore, the price-based opportunity cost component considers the discharge duration to determine which price should be leveraged in the calculation.

The final cost component seeks to capture the asset's variable operations costs. This component is used to represent cycling and other variable operational costs. Currently, scheduling coordinators can submit a ticket to discuss the variable operations cost value for their storage resources. If no value is established, a $0/MWh value is applied. In the 2026 Variable Operations and Maintenance Cost Review stakeholder process, the ISO proposes establishing a default variable operations cost for storage resources to reduce the administrative burden associated with negotiating resource-specific values. Stakeholders are encouraged to participate in discussions on what methodology to use to establish the default variable operations cost value. [3] The charging default energy bid’s formulation is identical to the discharge default energy bid’s, with the sole difference being that the charging default energy bid does not consider the variable operations cost component. As a result, if the price-based opportunity cost component is the one setting the default energy bid’s value, both the charge and discharge default energy bid result in the same value.

[3] See: [California ISO - 2026 Variable operations and maintenance cost review]() for more details

Storage Default Energy Bid Calculation

$$Discharge\ Default\ Energy\ Bid = Max\left\{\left[Max\left(En_{\delta/\eta}\ ,0\right) +\ \rho\right], PB\_OC_{\gamma}\right\} * Multiplier$$

$$Charge\ Default\ Energy\ Bid = Max\left\{\left[Max\left(En_{\delta/\eta}\ ,0\right)\right], PB\_OC_{\gamma}\right\} * Multiplier$$

Where:

- *En*: Energy Cost
- η: Round-trip efficiency
- δ: Energy charging duration
- γ: Energy discharge duration
- ρ: Variable operations cost
- *PB_OC*: Price-based opportunity cost
- *Multiplier*: 110% multiplier

Because some of the storage default energy bid components rely on day-ahead outputs, today, WEIM-only storage resources (those not participating in EDAM) are not able to use the storage default energy bid option. Today, such storage resources must pursue a negotiated default energy bid or pick any of the other default energy bid methodologies for which they are eligible.

The only difference between the discharge and charge default energy bid is the consideration of the variable operations cost. Because the default variable operations cost is zero, the charge and discharge default energy bids could have the same value.[4] This result could be of concern if the resource was trying to discharge or charge to prepare for intervals that are later than what the market can optimize for. For example, a lowered charging bid makes the battery susceptible to receiving market dispatches that leave the resource with less state of charge than desired. This lack of ability to control state of charge during local market power mitigation events could make it harder for the battery to prepare for awards or schedules past the 65-minute real-time optimization window. These challenges are directly related to the bidding concept explored in Section 6 of this paper.

The mitigation of charging bids is the result of this design and the need for bid curves that never decrease as the amount of energy offered increases, also known as monotonically non-decreasing bid curves. When a resource is subject to mitigation, any segment of the bid curve that falls above the default energy bid and the competitive locational marginal price will be mitigated to the higher of either of those values. As a result, for storage resources, the axiomatic need for monotonically non-decreasing bid curves means that charging bid curve segments that are higher than either the default energy bid or the competitive locational marginal price may be mitigated to the higher of those values.

[4] Note that this could also occur with a non-zero variable operations cost if the price-based opportunity cost is the determinant factor in setting the default energy bid value.

5.2. Problem statements, guiding principles, and concepts for enhancement

In the issue paper published in December 2025, the ISO, considering stakeholder feedback, presented a problem statement regarding default energy bids. Since that posting, discussions with stakeholders have continued evolving the problem statement. The latest iteration of the problem statement reads:

- The storage default energy bid's dependence on outputs from prior market runs creates challenges because:
  - Those values may be "stale" in the market where the default energy bid is used.
  - With an expanding footprint, some resources that are not part of the day-ahead market cannot readily leverage the storage default energy bid option.
- A static real-time storage default energy bid has the potential to over- or under-estimate opportunity costs at different hours of the day.

The December 2025 issue paper also included a set of guiding principles to address the problem statement. Similarly to the problem statement itself, the guiding principles have continued to evolve as stakeholder discussions continued. The latest iteration of the guiding principles reads:

- The storage default energy bid should be designed in a way that allows for the reflection of changing real-time opportunity costs, ensuring the correct placement of storage within the bid stack, even under mitigation.
- The storage default energy bid should be calculated in a way that all storage resources, regardless of location, should be able to readily leverage a default energy bid option.
- The storage default energy bid should be designed in a way that minimizes the risks of charging-side mitigation.

As part of the December 2025 paper, the ISO provided a general overview of four ideas that had been advanced in the working group process to address the limits of the current storage default energy bid. The first idea involved modifying the storage default energy bid's energy cost and price-based opportunity cost components to incorporate data beyond day-ahead market outputs for resources that do not participate in those markets, such as their respective default generation aggregation point (DGAP). The paper noted that this concept is viable and could enable the development of a default energy bid option for WEIM-only storage resources with the DGAP as the cost proxy. Nevertheless, a methodology based on DGAP values would still result in a static value that does not capture changing opportunity costs.

The second idea calls for a time-sensitive default energy bid. This could be achieved by either allowing for the issuance of an updated value in real-time under certain circumstances or by implementing a time-of-day default energy bid structure. The December 2025 paper underscored that the issuance of an updated real-time default energy bid under certain circumstances could prove useful. Nevertheless, because default energy bids are calculated once daily, implementing a means to issue updated default energy bid values would require new processes, representing significant implementation and ISO operational effort. Conversely, the implementation of a "time-of-day" default energy bid structure for storage resources appeared to be less burdensome, but its complexity is directly proportional to its granularity.

The third concept would be to develop an hourly default energy bid for storage resources in real time. This option was described as the most complex, requiring new data inputs, systems, and processes and representing a material design and implementation lift. The fourth concept presented an alternative path where, rather than focusing on enhancing the storage default energy bid methodology, the ISO would consider exempting storage resources from local market power mitigation. Since it would be a significant departure from current policy, the paper noted that this concept would introduce significant regulatory and feasibility risks and may be an oversized solution to the issue at hand.

In the December 2025 paper, the ISO noted that a majority of stakeholders generally agreed that enhancing the accuracy of storage default energy bids would reduce reliance on real-time bid cost recovery and improve dispatch efficiency. Beyond that, stakeholders appeared generally divided on the options put forth. While some stakeholders emphasized the importance of hourly default energy bid values, others cautioned against their complexity and instead supported time-of-day default energy bids. Despite these differences, a clear majority of commenters noted that enhancements to the storage default energy bid should be preferred over eliminating market power mitigation for storage resources.

5.3. Discussions following the publication of the Updated Discussion and Issue Paper

Following publication of the December 2025 paper, the ISO held three stakeholder calls to gather feedback on the paper and further discussions related to the future default energy bid enhancements. In comments, CalCCA, Cal Advocates, Portland General Electric (Portland), PG&E, Southern California Edison (SCE), Terra-Gen, and others generally leaned towards a multiplier-based time-of-day approach. AES, CalCCA, NV Energy, SCE, and Portland generally supported development of a readily available WEIM-only storage default energy bid. In contrast, CESA, Terra-Gen, and Vistra argued that all storage resources should be subject to a single, consistent default energy bid framework.

Moreover, some stakeholders have advocated for the incorporation of elements of the default energy bid applicable to hydro resources. WPTF and Vistra opposed time-of-day default energy bids altogether, instead supporting modifying the existing hydro default energy bid methodology as a starting point, thus creating a methodology focused on short-term opportunity costs and the gas floor components.[5] These stakeholders have argued that inclusion of the hydro default energy bid elements such as the gas floor is essential to ensure storage preserves the correct position in the bid stack, even under mitigation.

Given commenter feedback, the ISO worked on developing a default energy bid draft straw proposal that would leverage the time-of-day concept for both EDAM and WEIM-only storage resources, with

[5] The hydro default energy bid reflects the opportunity costs a hydroelectric generator faces due to their limited water supply. The calculation has three components: 1) long-term and geographic component, 2) short-term component, and 3) gas price floor. These components represent the opportunity costs for the hydroelectric generator to substitute energy from a gas resource and opportunities to sell energy in geographic areas outside of the resource's local area in future time horizons. Hydroelectric generators are mapped to a default electric pricing hub based on the resource's location.

minimal differences between each paradigm. The draft straw proposal built on the commenter feedback detailed above, including calls for further alignment with the hydro default energy bid and recommendations from the MSC to eliminate certain elements of the storage default energy bid's design.[6]

5.4. The May 2026 Time-of-Day Draft Straw Proposal

In May 2026, the ISO presented a draft proposal to modify the storage default energy bid calculation in a manner consistent with the time-of-day concept, incorporating elements of the hydro default energy bid paradigm, and providing a consistent framework that can be leveraged across EDAM and WEIM, with minimal methodological differences. At a high level, the proposal takes the current storage default energy bid calculation and makes four critical modifications.

First, for both day-ahead and real-time (EDAM and WEIM-only resources), the calculation is modified to eliminate consideration of the energy costs and include the gas floor. Second, for both day-ahead and real-time (EDAM and WEIM-only resources), the calculation is modified to include a step that would scale the price proxies used to calculate the opportunity cost component.

Third, for both day-ahead and real-time (EDAM and WEIM-only resources), the currently applicable 1.1 default energy bid multiplier is modified. For the day-ahead default energy bid calculation, the 1.1 multiplier is used within the maximum function in conjunction with the gas floor component and the variable operations cost component, respectively. In addition, a 1.4 multiplier is included within the maximum function to affect the price-based opportunity cost component, which has been informed by the scaling step. The modification of these multipliers in the day-ahead default energy bid calculation is intended to provide consistency with the hydro default energy bid. For the real-time default energy bid calculation, for both EDAM and WEIM-only resources, the 1.1 multiplier's value is modified, but it continues to be leveraged outside of the maximum function. In real-time, the multiplier is leveraged to achieve the time-of-day concept, which seeks to shape the resultant default energy bid in a manner that captures changing opportunity costs. The multiplier used in the real-time default energy bid calculation would be a value between 0.6 and 1.4.

Finally, under this approach, the charging default energy bid would be calculated in a manner that minimizes the risk of charging-side mitigation. To accomplish this, the charge default energy bid would be set to be defined as the discharge default energy bid minus the variable operating costs. This would

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[6] In September 2020, the MSC offered an opinion in response to the ISO's storage default energy bid design. The MSC argued that energy costs are generally unnecessary within default energy bid calculations because these are implicitly included in the optimization in day-ahead and are sunken costs in real-time. In contrast, the variable operation costs would always be a legitimate part of bids and should therefore be included in the default energy bid calculations. Regarding opportunity costs, the MSC argued that, while these may not be necessary to include in the day-ahead timeframe, they are relevant in real-time bids to manage state-of-charge and should be included in the default energy bid calculation.

ensure the preservation of monotonically non-decreasing bid curves under mitigation while minimizing the risks mitigation may pose with regard to state-of-charge management.

5.5. Stakeholder feedback on the May 2026 Time-of-Day Draft Straw Proposal

Following the May 2026 stakeholder meeting, commenters expressed broad agreement on the need to reform the current storage default energy bid framework, particularly to address the limitations of static, day-ahead-based values. A majority of stakeholders, including CalCCA, CESA, Cal Advocates, NV Energy, Portland, Rev Renewables, SCE, and Terra-Gen, expressed support for the incorporation of a scaling process to address "stale" values, the addition of the gas floor, and the improvement of how storage would be positioned in the bid stack under mitigation. This section provides an overview of commenter feedback.

Most stakeholders support the incorporation of a scaling process for the price proxies used to estimate the opportunity cost component. CESA agreed with the principle of scaling the price proxies used to estimate the price-based opportunity cost component of the storage default energy bid. To achieve this scaling, CESA recommended the ISO perform a similar analysis as the analysis performed when the hydro default energy bid was developed to calculate an appropriate scalar using historical data.

On a related topic, some stakeholders offered comments regarding the appropriate price proxy to leverage for the estimation of opportunity costs. As part of the approach presented during the May 2026 stakeholder meeting, the ISO indicated that it would continue to leverage day-ahead locational marginal prices to estimate the real-time price-based opportunity cost component for EDAM resources, albeit with the addition of a scaling multiplier. Given the fact that WEIM-only resources are not part of day-ahead processes, the ISO indicated that the scaling step is not applied to day-ahead locational marginal prices but to the default generation aggregation point prices. This is the sole difference between the default energy bid paradigm for EDAM and WEIM-only resources under the time-of-day approach, and it is solely driven by the difference in data availability in the WEIM and EDAM.

ACP-CA, CESA, and Vistra encouraged the ISO to explore the use of trading hubs rather than locational marginal prices for the estimation of opportunity costs for EDAM storage resources. CESA argued in favor of using the resource trading hub for EDAM resources and the relevant DGAP for EDAM resources to improve alignment between EDAM and WEIM-only storage resources. Vistra supported this approach by positing that all storage resources, regardless of location, face the same fundamental challenge of managing limited energy against dynamic real-time opportunity costs. As a result, Vistra notes, EDAM and WEIM-only storage assets should be evaluated consistently to each other and to all other daily use-limited resources, such as hydro. In this context and considering that the hydro default energy bid methodology incorporates the applicable electric region to inform opportunity costs, Vistra urged the ISO to avoid any difference in the default energy bid constructs for storage resources participating in the same real-time market beyond those adopted in the hydro default energy bid.

Moreover, Vistra noted that the price-based opportunity cost component used in the storage default energy bid should be essentially equivalent to the short-term component used to value daily hydro's uses, thus rejecting the notion of including a scaling multiplier for this piece in the storage default energy bid. While the exclusion of a scaling factor could bring the storage and hydro default energy bids closer in terms of alignment, it could create material differences relative to existing negotiated default energy bids for WEIM-only storage resources, an issue that is explored more later in this paper.

Most commenters, including CESA, NV Energy, REV Renewables, SCE, and Vistra, were supportive of the inclusion of the gas floor into the storage default energy bid. CESA and NV Energy posited that the inclusion of the gas floor in both the day-ahead and real-time storage default energy bid, in alignment with the hydro methodology, will help correctly position storage resources in the bid stack even if mitigated. Vistra added that the inclusion of the gas floor is also an appropriate representation of replacement cost for stored energy in lieu of sunk costs for charging. REV, while supportive, questioned the source of the 11,068 MMBTu/MWh value used in the ISO's May 2026 materials, asking if this price could be updated.

Conversely, DMM and Cal Advocates opposed the inclusion of the gas floor. DMM argued that the gas floor is not directly tied to storage marginal costs and that locational marginal prices already capture these dynamics more accurately. Similarly, Cal Advocates asked the ISO to reconsider whether the inclusion of the gas floor is appropriate in all hours as opposed to only during hours in which gas resources are most likely to be marginal. Cal Advocates argued that this reassessment is needed since storage should be able to maintain its position in the bid stack without unduly inflating the default energy bid in hours when gas is not on the margin.

Comments also highlighted significant questions and differences around implementation, particularly regarding the time-of-day multiplier. A majority of stakeholders (ACP-CA, CESA, PG&E, NV Energy, and Terra-Gen) did not oppose the time-of-day multiplier concept but rejected the notion that multipliers should be set below 1 at any point of the trade date. CESA, while recognizing that the opportunity cost of a storage resource could differ over the course of the day, noted that it could not support a multiplier below 1 as it would penalize storage resources in real-time relative to their day-ahead position. CESA also expressed general concerns about the implementation of the time-of-day multiplier, noting that this approach assumes that real-time conditions are predictable enough so that an accurate multiplier can be calculated. Terra-Gen and ACP-CA also expressed concerns about use of multipliers below 1, noting that these could result in problematic instances of storage resources being discharged prematurely. NV Energy argued that a time-of-day multiplier that is below 1 counteracts other efforts by the presented approach to ensure that the storage default energy bid placed batteries correctly in the bid stack under mitigation. Finally, PG&E also recommended that time-of-day multipliers be set at or above 1 to ensure that storage resources are not required to bid to discharge at prices below their expected marginal discharge value prior to net peak hours.

Representing the opposing position, Cal Advocates argued that there is a material economic rationale for multipliers above and below zero. These commenters see multipliers reflecting higher real-time opportunity costs in hours before the peak and lower real-time opportunity cost in high load, high-price hours. Similarly to Cal Advocates, DMM also supported multipliers both above and below 1, stating that values above 1 are needed to avoid understating opportunity costs in some hours, while values below 1 are necessary to reflect lower opportunity costs in peak hours.

DMM emphasized that even a simple time-of-day multiplier can yield meaningful efficiency improvements, highlighting recent analyses submitted as part of their prior comments.[7] In this context, DMM recommended the ISO continue refining the current storage default energy bid with a simple time-of-day multiplier, rather than introducing more complex design changes. As a result, DMM supports a time-of-day multiplier similar to the illustrative example discussed during the May 2026 stakeholder meeting but encourages the ISO to perform additional analyses to ground the multiplier values. Moreover, DMM also recommended a framework that allows for seasonal and long-term changes to the assignment of multiplier values across different hours.

Regarding the multipliers used within the day-ahead default energy bid presented at the May 2026 meeting, few stakeholders provided specific feedback. Cal Advocates noted that the 1.4 multiplier used in the hydro default energy bid was developed empirically by the ISO by calculating the default energy bid for each day without a scalar and comparing it to real-time 15-minute market prices in the resource's balancing area over a year. Cal Advocates asked the ISO to consider conducting a similar study for storage resources to ensure the multiplier does not unnecessarily inflate these resource's day-ahead default energy bid.

CESA, on the other hand, advocated for the inclusion of the 1.4 multiplier for opportunity costs within the real-time storage default energy bid, just as it is included in the day-ahead default energy bid. CESA stated that the 1.4 multiplier for the hydro default energy bid was based on analysis to ensure the hydro resource was not dispatched more than four hours per day in a range of 95-99%. This value constitutes a viable proxy for storage resources to ensure that the estimate of opportunity costs does not result in excessive real-time dispatch of a four-hour storage asset. While recognizing that the time-of-day approach presented during the May 2026 stakeholder meeting does include a time-of-day multiplier which attempts to replace the need for the opportunity-cost multiplier, CESA urged the ISO to treat these as independent because they serve unique purposes. The opportunity cost multiplier ensures that the estimate of opportunity costs does not result in excessive real-time dispatch whereas the time-of-day multiplier attempts to address changes in opportunity costs across the operating day.

In contrast to most feedback, a subset of commenters including NV Energy, WPTF, and Vistra questioned whether the added complexity of the time-of-day approach is justified. These stakeholders were skeptical of the time-of-day components of the proposed framework, describing it as overly complex. Vistra, while recognizing that the ISO modified the time-of-day concept to better align it with the hydro default energy bid in response to stakeholder concerns, posited that those revisions do not resolve the core problem of how to mitigate daily use-limited storage resources in a manner consistent with technology-neutral mitigation principles and real-time opportunity costs. Noting that the time-of-day

[7] In prior comments, DMM analyzed CAISO battery resources in August 2025 using counterfactual fifteen-minute market schedules under unmitigated bids, the current storage DEB, and several simple time-of-day DEB formulations. DMM found that time-varying DEBs increased modeled net revenues relative to the current DEB and better reflected differences in opportunity costs across the day.

paradigm could offer a false sense of precision, these stakeholders have favored eliminating the time-of-day multiplier and instead consider a static default energy bid alternative based on the hydro methodology. More details of this alternative static approach are included in subsequent subsections.

Finally, several commenters asked for greater detail into what each of the proposed multipliers would seek to address and how their values would be derived. Some stakeholders additionally asked for analyses for empirical grounding on how multipliers and scalars should be derived, how frequently they should be updated, and what data should underpin them. ACP-CA supported a process to update the time-of-day multiplier more than yearly so as to appropriately capture seasonal shifts in solar and wind patterns. CPUC ED also requested clarification on how the time-of-day multiplier would accurately reflect seasonal changes and differences throughout the year. REV, NV Energy, and SCE made similar comments.

5.6. ISO Responses to Stakeholder Feedback

While reviewing comments, the ISO identified five areas of debate among stakeholders. In this subsection, the ISO offers responses to these five areas. Subsequent subsections present two alternatives — the time-of-day approach and the static approach — for enhancing the energy storage default energy bid based on stakeholder feedback and ISO responses.

The first area of debate relates to whether all storage resources, regardless of location, should leverage the same values for their price proxies. Stakeholders who advocate for trading hubs or DGAP values highlight the ISO's identified limitation that reliance on day-ahead locational marginal prices can exclude certain resources, particularly WEIM-only storage, from effectively using the default energy bid. At the same time, it is reasonable to recognize that different price proxies may be appropriate for resources in different geographies, since imposing a single proxy across all regions could diminish the accuracy of the current default energy bid design for EDAM storage resources that already rely on nodal pricing.

Allowing differentiated proxies —DGAP values for WEIM-only resources and locational marginal prices for EDAM assets — can better reflect localized market conditions while still addressing gaps for resources without access to day-ahead prices. This approach balances the need for improved inclusivity and alignment across markets with the preservation of accurate location-specific signals, ultimately supporting the ISO's guiding principle of enabling all storage resources to leverage a default energy bid without undermining the fidelity of the existing EDAM default energy bid construct.

The second area of debate relates to the incorporation of the gas floor. The inclusion of the gas floor is consistent with the guiding principle of better positioning storage in the bid stack under mitigation. The ISO does not believe that the inclusion of the gas floor would result in an undue overstatement of the storage default energy bid. DMM expressed concerns about the inclusion of the gas floor as it does not relate directly to storage marginal costs. DMM also argued that the need for the gas floor may be limited since some of the dynamics implied by it are captured via the storage default energy bid's use of other price proxies such as locational marginal prices. The ISO acknowledges that the gas floor does not directly inform a storage asset's marginal costs and that some of the impacts the gas floor may capture could be reflected by locational marginal prices. Nevertheless, the inclusion of the gas floor is intended to enhance alignment among the default energy bids used by energy-limited resources that may face daily use-limitations, such as hydro. In that sense, the pertinence of this component is directly related to the intended outcome of positioning energy storage assets in a similar manner as other similar resources when mitigated.

Concerns from Cal Advocates about applying the gas floor in all hours are also less material, since the maximum function in the design ensures the gas floor only binds when it is the highest relevant value. Once more, this is desirable because, if the gas floor were to be the binding component of the hydro default energy bid, but it was not considered within the storage default energy bid, then the market may discharge storage resources ahead of hydro assets if both are mitigated. Finally, regarding REV's question, the 11,068 MMBtu/MWh value is drawn from the hydro default energy bid as defined in the ISO's Market Instruments Business Practice Manual, supporting consistency between both the hydro and storage methodologies.

The third area of debate relates to how the scaling multiplier and the time-of-day multiplier should be estimated. Incorporating a scaling process for price proxies used to estimate the price-based opportunity cost aligns with the broader goal of minimizing the risks associated with leveraging "stale" values within the storage default energy bid. While CESA's recommendation to base the scaling factor on historical analysis would be consistent with how the hydro short-term component's multiplier was developed, the ISO believes that the methodology used by DMM within existing negotiated default energy bids for WEIM-only storage assets can be leveraged as part of the time-of-use approach. Today, DMM includes an upward adjustment based on recent real-time prices for the DGAP prices leveraged in negotiated storage default energy bid for WEIM-only resources. This adjustment scales up hourly DGAP prices based on the ratio of (1) the average hourly 15-minute real-time price for the WEIM area over the past three days, and (2) the hourly DGAP price from the ISO's day-ahead model in the corresponding hours. The same could be done as part of the time-of-day approach, as detailed in the following subsections.

Having a scaling step within the storage default energy bid methodology will ensure alignment with already existing negotiated default energy bids. Without the inclusion of a scaling step similar to the one used in existing WEIM-only storage negotiated default energy bids, the new resources seeking to use the readily available default energy bid methodology may find themselves at a slight disadvantage relative to their WEIM-only storage homologues. In this context, the inclusion of a scaling step is aligned with the goal of ensuring all storage resources are placed consistently in the bid stack, even when mitigated. As such, the ISO is leaning toward the inclusion of a scaling factor as it aligns with the guiding principles. This said, if with stakeholder feedback the ISO were to develop a default energy bid methodology that could be readily leveraged by all WEIM-only resources and did not include a scaling step, it may be prudent to transition all assets with negotiated default energy bids with a scaling factor to the new readily-available methodology. Negotiated default energy bids exist to reflect unique cost characteristics. With the creation of a new default energy bid, WEIM-only resources' unique cost characteristics may be properly represented in a storage default energy bid.

Stakeholder disagreement on time-of-day multipliers below 1 reflects a tradeoff between accurately reflecting real-time opportunity costs and preserving consistent bid stack positioning under mitigation. Commenter's concerns are grounded on the risk that multipliers below 1 could suppress the default energy bid, potentially leading to premature discharge or misalignment with day-ahead expectations, which runs counter to the ISO's goal of ensuring proper placement in the bid stack. The ISO agrees that, while allowing multipliers below 1 is conceptually reasonable because opportunity costs are not static and may legitimately decline in certain hours, such reductions must be carefully calibrated to avoid undermining other elements of the design that aim to maintain efficient dispatch and mitigate state-of-charge risks. Taken together, these considerations suggest there is a compelling basis to limit the multiplier to values no lower than 1 to preserve appropriate bid-stack positioning and avoid unintended dispatch distortions. At the same time, opportunity cost variation can still be effectively captured by increasing the multiplier in hours leading up to peak, allowing the design to reflect changing system conditions without introducing the downsides associated with values below 1.

The use of 1.4 as the upper bound for a multiplier within the storage default energy bid is reasonable because it is consistent with the hydro default energy bid and it is based on the premise of guaranteeing that an energy-limited resource was not dispatched more than four hours per day 95-99% of the time. For these reasons, it is pertinent to include a 1.4 multiplier for the price-based opportunity cost component of the day-ahead storage default energy bid, consistent with its use for the short-term component within hydro's methodology. With regards to the real-time default energy bid methodology, it is pertinent to use 1.4 as the upper bound of the time-of-day multiplier.

Finally, with regard to the shape of the time-of-day multiplier, a significant share of stakeholders asked for clarity regarding the methodology to define and shape the time-of-day multiplier. Moreover, some commenters expressed a desire for a method that could reflect seasonal and long-term changes to the grid's resource mix. To minimize complexity while relating to system conditions, the time-of-day multiplier could be developed so it creates two periods. The first period would use a 1.4 multiplier for all hours before the hour that sets the price-based opportunity cost component (i.e., the fourth-highest priced hour determined based on the price proxies used in the case of a four-hour energy storage resource). The second period would cover the hour that set the price-based opportunity cost component and all hours thereafter. For those hours, a multiplier of 1 would be used to capture the change in opportunity costs. This is an implementable approach that relates to system conditions already considered within the storage default energy bid method and does not create meaningful administrative or maintenance burdens.

The fourth area of debate relates to the use of the variable operations costs to establish a hurdle between the charge and discharge default energy bids. The ISO agrees with this goal. To achieve this, the ISO could leverage the values registered in the Master File by scheduling coordinators. While it is the case today that resources that have not elected to register a value would receive a $0/MWh value, the ISO is currently in the process of defining a new default value methodology that will leverage the roughly six years of registered data. Stakeholders interested in the development of a new default variable operation cost value should refer to the 2026 Variable Operations and Maintenance Cost

Review stakeholder process. Stakeholders are encouraged to participate in initiative discussions on what methodology to use to establish the default variable operations cost value.

The fifth and final area of debate relates to whether the time-of-day element is valuable given its complexity. While several stakeholders support a time-of-day approach because it more accurately reflects intraday variation in opportunity costs, others caution that increasing temporal granularity may significantly increase implementation complexity and create a false sense of precision. The ISO recognizes that an alternative without scaling or time-of-day multipliers would be more aligned with the existing hydro default energy bid and potentially less burdensome from an implementation perspective. While static approach based on the

hydro methodology would not address the challenges posed by "stale" values, nor does it allow for the reflection of changing opportunity costs within the real-time market, this is by design because it seeks to mimic the hydro default energy bid and lessen both implementation and maintenance burdens.

5.7. Straw Proposal for storage default energy bids

In the following subsections, the ISO details two alternatives to enhance the energy storage default energy bid: the time-of-day approach and the static approach. These subsections detail both approaches and offer a comparison example to guide stakeholder feedback.

5.7.1. The Time-of-Day Approach

The time-of-day approach seeks to modify the storage default energy bid calculation in a manner aligned with feedback provided by a large share of stakeholders and the MSC. The proposal, mostly consistent with what the ISO shared during the May 2026 stakeholder meeting, has minimal differences between how the storage default energy bid is calculated for EDAM storage and WEIM-only storage. It also includes elements of the hydro default energy bid given stakeholder feedback and can be readily used under today's bidding and modeling approach.

Time-of-Day Approach Formulation

$$DA\ Discharge\ DEB = Max(Variable\ Operations\ Cost * 1.1, PB\_OC * 1.4, Gas\ Floor * 1.1)$$

$$DA\ Charge\ DEB = (DA\ Discharge\ DEB - Variable\ Operations\ Cost)$$

$$RT\ Discharge\ DEB = Max(Variable\ Operations\ Cost * 1.1, PB\_OC * 1.4, Gas\ Floor * 1.1) * TOD\ Multiplier$$

$$RT\ Charge\ DEB = (RT\ Discharge\ DEB - Variable\ Operations\ Cost)$$

Where:

$Variable\ Operations\ Cost$: Represents cycling and other operational costs

PB_OC: Price-based Opportunity Cost

- In DA for EDAM, calculated by scaling the MPM outputs based on differences relative to DA LMPs
- In RT for EDAM, calculated by scaling DA LMPs based on differences relative to RT LMPs
- In RT for WEIM, calculated by scaling DGAP based on differences relative to RT LMPs

$TOD\ Multiplier$: A value of 1.4 before the hour that set the price-based opportunity cost and 1 after the hour that set the price-based opportunity cost (only in real-time)

$Gas\ Floor$: 11,068 MMBtu/MWh * Fuel region gas price

The time-of-day approach would take today's storage discharge default energy bid and make four modifications to it. First, for both day-ahead and real-time — for both EDAM and WEIM-only resources —the calculation is modified to eliminate consideration of the energy costs and include the gas floor. This modification is related to the feedback provided by the MSC and Vistra and WPTF, respectively. The elimination of energy costs is consistent with the MSC observation that energy costs are sunken costs, and default energy bids should generally be determined by forward-looking opportunity costs. The inclusion of the gas floor is intended to conform with the hydro default energy bid and, as a result, ensure that storage resources preserve the correct position in the bid stack, even under mitigation. The gas floor included is the exact same as the one within the hydro default energy bid.

Second, for both day-ahead and real-time (EDAM and WEIM-Only resources), the calculation is modified to include a step that would scale the price proxies used to calculate the opportunity cost component. This step would only scale price proxies upwards, never downwards. The way this scaling would work varies by market and timeframe. For EDAM resources, the day-ahead default energy bid calculation would include a step to scale the outputs of the market power mitigation run based on their difference relative to day-ahead locational marginal prices. For the day-ahead default energy bid, the scaling would use the ratio of the hourly day-ahead locational marginal price over the past three days at that pricing node and the hourly locational marginal price derived from the local market power mitigation pass.

For the real-time default energy bid applicable to EDAM resources, the scaling would use the ratio of the average hourly 15-minute real-time price for the applicable pricing node over the past three days and the hourly day-ahead locational marginal price at the corresponding pricing node. For the real-time default energy bid applicable to WEIM-only resources, the adjustment scales up hourly DGAP prices based on the ratio of the average hourly 15-minute real-time price for the WEIM area over the past three days and the hourly DGAP price from the ISO's day-ahead model in the corresponding hours. Under all circumstances, the scaling is only done upwards, meaning that only if the aforementioned ratios result in a value above 1 would the scaling take place.

Third, for both day-ahead and real-time (EDAM and WEIM-Only resources), the currently applicable 1.1 default energy bid multiplier is modified. For the day-ahead default energy bid calculation, the 1.1 multiplier is used within the maximum function in conjunction with the gas floor component and the variable operations cost component, respectively. In addition, a 1.4 multiplier is included within the maximum function to affect the price-based opportunity cost component, which has been informed by the previously explained scaling. The modification of these multipliers in the day-ahead default energy bid calculation is intended to provide consistency with the hydro default energy bid. By leveraging the same multipliers to the homologue components in both the hydro and storage default energy bids, this formulation seeks to ensure that storage resources preserve the correct position in the bid stack, even under mitigation.

For the real-time default energy bid calculation, for both EDAM and WEIM-only resources, the 1.1 multiplier's value is modified similarly to the day-ahead formulation. In addition, the real-time calculation also includes a multiplier outside the maximum function to achieve the time-of-day concept, which seeks to shape the resultant default energy bid in a manner that captures changing opportunity costs. The multiplier used in the real-time default energy bid calculation would be a value of either 1 or 1.4. This range is desirable because it conforms with the default energy bid calculations applicable to other energy-limited resources, such as hydro, it aligns with observations made by DMM,[8] and it eliminates concerns regarding the use of multipliers below 1 while still capturing changing opportunity costs.

Finally, for both day-ahead and real-time (EDAM and WEIM-only resources), the charge default energy bid is defined as the discharge default energy bid minus the variable operating costs. This would ensure the preservation of monotonicity under mitigation while minimizing the risk that mitigation may both charge and discharge a resource at the same price, not accounting for cycling and other operating costs. The variable operations cost would be sourced from the registered value provided by scheduling coordinators, or the new default value being proposed in the 2026 Variable operations and maintenance cost review initiative.

[8] In its April 2026 comments, DMM supported using a time-of-day multiplier to increase the storage default energy bid during hours when intraday opportunity costs are higher and decrease the default energy bid when opportunity costs are lower. DMM also observed that the incremental benefit of higher multipliers diminished after about 1.3 or 1.4, and recommended that any multiplier be shaped around intraday opportunity costs rather than day-ahead/real-time price spreads.

5.7.2. The Static Approach

The static approach seeks to modify the storage default energy bid calculation in a manner aligned with feedback provided by stakeholders that cautioned against the complexity of the time-of-day approach. The commenters that favor the alternative approach note its value is to ensure consistency across all energy-limited resources and geographies. As such, the static approach is largely consistent hydro default energy bid.

Under the static approach, the ISO would calculate the charge and discharge default energy bids using a hydro-like framework that considers the registered limitations of storage resources and incorporates the variable operation costs. Like the hydro default energy bid, this index would use on peak prices only. In contrast to the hydro default energy bid, the static approach's discharge default energy bid would exclude the long-term component. This is because the only registered limitation for most energy storage resources is the daily use limitation. As a result, the static approach would only consider the short-term component, the gas floor, and the variable operations cost.

The discharge default energy bid would be calculated by identifying the greater of either the gas floor times a 1.1 multiplier or the short-term component times a 1.4 multiplier. The gas floor is defined in the same way as under the hydro default energy bid and the time-of-day approach. The short-term component is different to the price-based opportunity cost used in today's storage default energy bid and the time-of-day approach. Namely, the short-term component is not trying to estimate the opportunity cost at a specific node given an asset's duration, but to represent the opportunity cost of sales at the local wholesale electric pricing hub. It is defined as the day-ahead power price index at the local default electric pricing hub. The static approach, just as the hydro default energy bid, leverages the same calculation for the day-ahead and real-time values.

Finally, the charge default energy bid would be defined as the discharge default energy bid minus the variable operations cost in both day-ahead and real-time. The variable operations cost would be sourced from the values provided by scheduling coordinators and registered in the Master File. Like the time-of-day approach, this would create a clear hurdle for moving from charge to discharge modes across markets.

As mentioned above, the static approach is largely consistent with the time-of-day approach, with three critical differences. First, unlike the time-of-day option, the static approach leverages the same price proxy for both EDAM and WEIM-only storage resources: the power price index at the local default electric pricing hub. Second, unlike the time-of-day option, the static approach does not include a scaling step to address the "stale values" issue. Third, unlike the time-of-day option, the static approach does not include a time-of-day multiplier in real-time.

Static Approach Formulation

$$Discharge\ Default\ Energy\ Bid = Max(Gas\ Floor * 1.1, STC * 1.4) + Variable\ Operations\ Cost$$

$$Charge\ Default\ Energy\ Bid = (Discharge\ Default\ Energy\ Bid - Variable\ Operations\ Cost)$$

Where:

$Variable\ Operations\ Cost$: Represents cycling and other operational costs

$Gas\ Floor$: 11,068 MMBtu/MWh * Fuel region gas price

STC: Day-ahead power price index at local default electric pricing hub

5.7.3. Approach comparison

The time-of-day approach addresses the problem statements in alignment with the guiding principles. This approach allows for the reflection of changing real-time opportunity costs by incorporating a time-of-day multiplier. By virtue of its scaling process, the time-of-day approach would address the challenges posed by using "stale" values. Having a scaling step within the storage default energy bid methodology will ensure alignment with already existing negotiated default energy bids, ensuring the correct placement of all storage assets within the bid stack in case of mitigation.

The time-of-day approach also offers a formulation that allows all storage resources, regardless of location, to readily leverage a default energy bid option with minimal differences. The only material differences between the formulations applicable to EDAM and WEIM-only resources relate to the price proxies used to estimate the price-based opportunity cost component. The ISO holds that such differences are reasonable as they would allow the novel design to preserve the accuracy offered by the current storage default energy bid calculation. Finally, the time-of-day approach also minimizes the risks of charging-side mitigation by defining the charge default energy bid as the discharge default energy bid minus the variable operating costs.

In contrast, the static approach does not address the challenges posed by using "stale" values within the storage default energy bid formulae. Moreover, the static approach does not allow for the reflection of changing opportunity costs within the real-time market. Instead, the static approach boosts alignment between the storage and hydro default energy bids. The static approach also has fewer administrative, implementation, and maintenance burdens than the time-of-day approach.

The static approach creates a default energy bid methodology that can be used by all storage resources regardless of location by eliminating the nodal accuracy of the current storage default energy bid paradigm. By relying solely on hub prices, the static approach ensures a single paradigm is applied across all storage assets at the expense of the current method's accuracy. Without the inclusion of a scaling step similar to the one used in existing WEIM-only storage negotiated default energy bids, the new resources seeking to leverage the readily available default energy bid methodology may find themselves at a slight disadvantage relative to their non-EDAM homologues. Currently, the ISO leans towards the inclusion of a scaling factor as it aligns with the guiding principles, but if the ISO were to opt for a default energy bid methodology that could be readily leveraged by all WEIM-only resources and did not include a scaling step, it may be prudent to transition all assets with negotiated default energy bids with a scaling factor to the new readily-available methodology.

Finally, the static approach partially ensures the correct placement of storage within the bid stack, even under mitigation. This is because of two reasons. First, is the lack of a scaling step which, as explained above, could be obviated if the ISO transitioned all assets with negotiated default energy bids with a scaling factor to the new readily available methodology. Second is the lack of a mechanism to recognize changing opportunity costs within the same trade date, particularly in real-time. By preserving a static discharge default energy bid value in real-time, the static approach is likely to overestimate the opportunity costs faced by storage resources, at least for part of the day.

Figure 3: Comparison of the approaches

	Time-of-Day	Static
Addresses the “stale” value issue	Yes	No
Creates a default energy bid that WEIM-only storage can readily leverage	Yes, albeit with different cost proxies being leveraged	Yes
Allows for the reflection of changing opportunity costs	Yes	No
Ensures the correct placement of storage within the bid stack when mitigated	Yes	Partially since it does not reflect changing opportunity costs in real-time
Minimizes the risk of charging-side mitigation	Yes	Yes

To better understand the time-of-day and static concepts, the ISO has created an example that compares the status quo to each of the approaches for both day-ahead and real-time charging and discharging default energy bids. First, consider an energy storage resource that has a duration of four hours, a round-trip efficiency of 90%, and a registered variable operations cost of $10/MWh. This resource will be the basis for the comparative example below.

Figure 4: Assumed Energy Storage Characteristics for this Example

Variable	Value
Duration	Four hours
Round-trip efficiency	90%
Variable operations cost	$10/MWh

Under today’s storage default energy bid methodology, the day-ahead default energy bid would be calculated considering the energy costs and the price-based opportunity costs based on the day-ahead locational marginal price from the market power mitigation run at the relevant pricing node for the same trading day. These two costs, in combination with the assumed variable operations, the duration of the asset, and the efficiency of the asset, will determine the default energy bid value. Assuming the prices below, this methodology would yield a day-ahead default energy bid of $46.2/MWh for both charge and discharge.

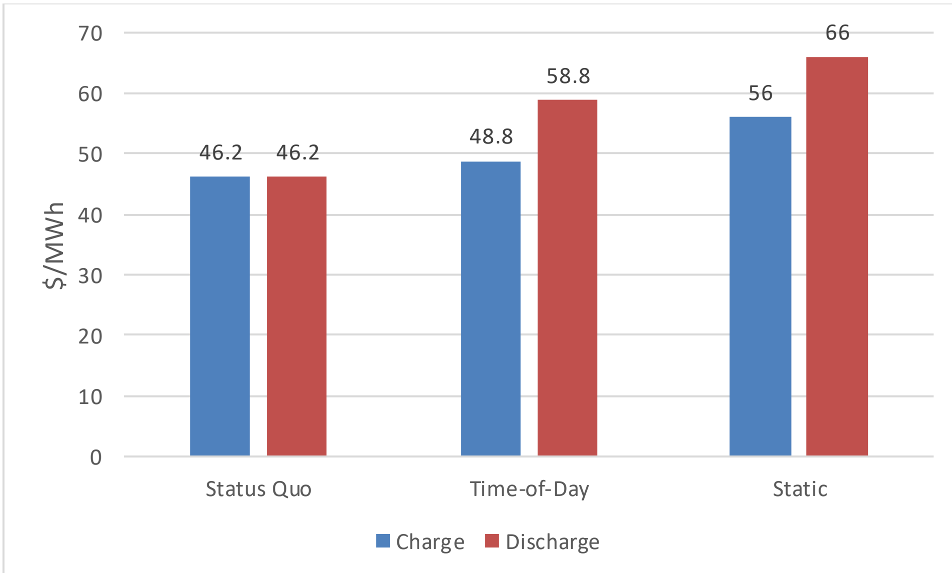
Figure 5: Assumed day-ahead locational marginal price from the market power mitigation run at the relevant pricing node for this example

Hour	Price	Hour	Price
HE1	32	**HE13**	11
HE2	34	**HE14**	13
HE3	33	**HE15**	15
HE4	34	**HE16**	16
HE5	35	**HE17**	18
HE6	39	**HE18**	29
HE7	36	**HE19**	42
HE8	17	**HE20**	55
HE9	10	**HE21**	51
HE10	4	**HE22**	45
HE11	8	**HE23**	41
HE12	9	**HE24**	40

Under the time-of-day approach, the day-ahead default energy bid would be set by the greater of either (1) the variable operations cost times a 1.1 multiplier, (2) the price-based opportunity cost component times a 1.4 multiplier, and (3) the gas floor times a 1.1 multiplier. Assuming no scaling was needed in this trade date and using the same assumptions applicable to the current default energy bid calculation and additionally assuming a fuel region price of $1.5/MMBtu, this methodology would yield a day-ahead default energy bid of $58.8/MWh. Since the charge default energy bid under the time-of-day approach would be defined as the discharge default energy bid minus the variable operations cost, the time-of-day approach would yield a day-ahead charge default energy bid of $48.8/MWh.

Finally, under the static approach, the day-ahead default energy bid would be calculated by identifying the greater of either the gas floor times a 1.1 multiplier or the short-term component times a 1.4 multiplier, and then adding the variable operations cost. Using the same assumptions applicable to the aforementioned approaches, and assuming a day-ahead power price index of $40/MWh, this methodology would yield a day-ahead default energy bid of $66/MWh for discharge and $56/MWh for charge.

Figure 6: Comparison of Day-Ahead Charge and Discharge Default Energy Bids



Under today's storage default energy bid methodology, the real-time default energy bid would be a static value calculated similarly to the day-ahead value, but with updated price proxies. Assuming the day-ahead locational marginal prices below, this methodology would yield a real-time default energy bid of $45.1 for both charge and discharge.

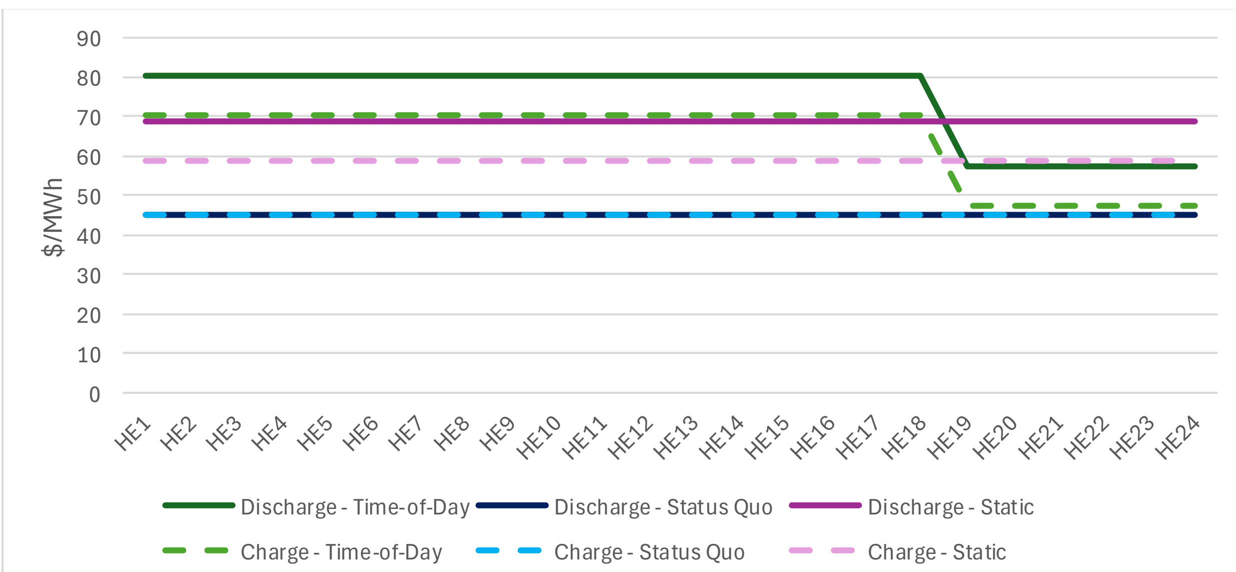
Under the time-of-day approach, the real-time default energy bid would be calculated similarly to the day-ahead default energy bid, with the addition of a time-of-day multiplier outside the maximum function. Assuming no scaling was needed for this trade date and using a time-of-day multiplier of 1.4 for every hour before the hour that set the price-based opportunity cost, HE 19, and multiplier of 1 for HE 19 and every hour thereafter, this methodology would yield real-time default energy bids of $80.36/MWh and $57.4/MWh for discharge and $70.36/MWh and $47.4/MWh for charge, respectively.

Finally, under the static approach, the real-time default energy bid would be a static value calculated by identifying the greater of either the gas floor times a 1.1 multiplier or the short-term component times a 1.4 multiplier, and then adding the variable operations cost. Using the same assumptions applicable to the aforementioned approaches and assuming an updated day-ahead power price index of $42/MWh, this methodology would yield a day-ahead default energy bid of $68.8/MWh for discharge and $58.8/MWh for charge.

Figure 7: Assumed day-ahead locational marginal price from the integrated forward market run at the relevant pricing node for this example

Hour	Price	Hour	Price
HE1	30	**HE13**	10
HE2	31	**HE14**	11
HE3	32	**HE15**	12
HE4	33	**HE16**	13
HE5	34	**HE17**	14
HE6	37	**HE18**	28
HE7	35	**HE19**	41
HE8	18	**HE20**	54
HE9	7	**HE21**	50
HE10	4	**HE22**	42
HE11	8	**HE23**	40
HE12	9	**HE24**	37

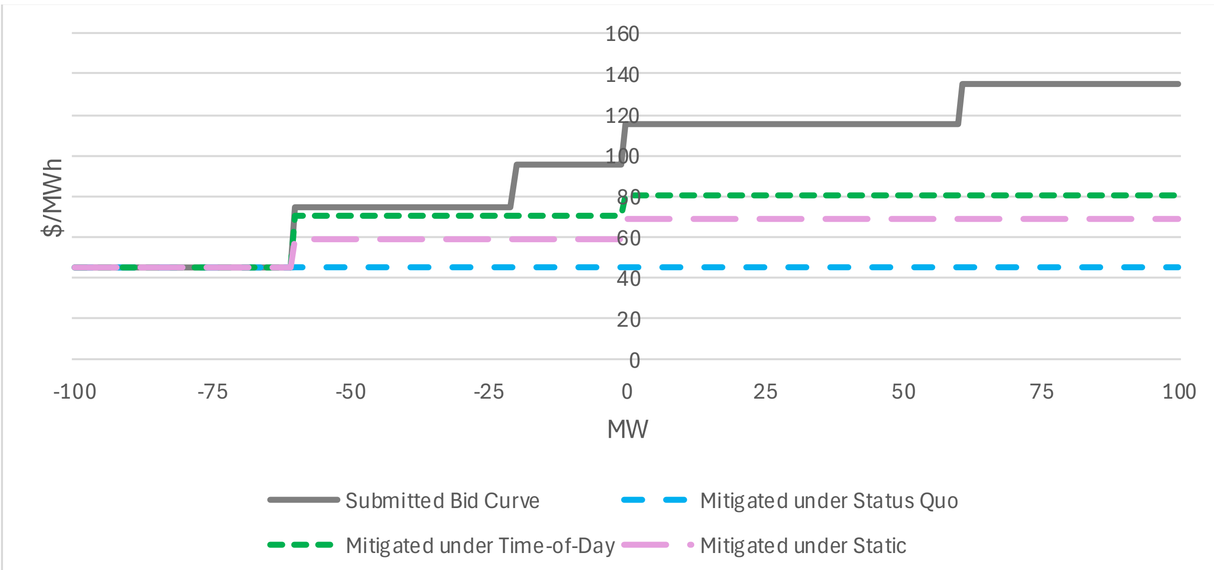
Figure 8: Comparison of Real-Time Charge and Discharge Default Energy Bids



To better understand the value of the modifications proposed for the charging default energy bid, consider a circumstance in which a storage resource that has submitted the real-time bid curve below for HE 5 is subject to mitigation. In this example, all discharge bid segments and the last charging bid segment would be subject to mitigation. Using the values from Figure 8 for HE 5, under today's storage default energy bid, there would be no difference between the discharge and charge default energy bid value, resulting in a bid curve that uses the same $/MWh value for the majority of the bid range and does not include a bid spread between the highest charging segment and the lowest discharging segment. This may create issues as the bid curve no longer sees a hurdle to go from charging to discharging along some of the dispatch range despite the inherent inefficiencies of battery assets.

Under the time-of-day and static approaches, on the other hand, the charging bids subject to mitigation are always mitigated to a value below the discharge default energy bid. This ensures a bid spread that at least respects the registered variable operations costs, eliminating the aforementioned challenges related to the status quo.

Figure 9: Comparison of Approaches Relative to Charging Mitigation



Overall, the time-of-day approach is the most effective at addressing the identified problem statements while remaining consistent with the guiding principles. By incorporating a scaling step and a time-of-day multiplier, this approach avoids reliance on potentially stale values and reflects changing real-time opportunity costs. These elements, in turn, ensure the appropriate placement of storage resources within the bid stack even under mitigation.

While the ISO sees merit in the reduced complexity of the static approach, the time-of-day approach's additional elements can be implemented in a manner that minimizes administrative and maintenance burden. First, the scaling step can be set to automatically consider conditions at the relevant geography over the last three days. Second, the time-of-day multiplier can be implemented to simply establish two daily values for the discharge default energy bid based on the hour leveraged to determine the price-based opportunity cost. These implementation decisions would allow for a "set-it-and-forget-it" approach that eliminates the need for seasonal modifications or periodical updates.

While the static approach offers administrative and implementation efficiencies, it does so at the expense of accurately capturing dynamic opportunity costs and addressing the "stale" vales issue. In addition, its lack of a scaling step would put it at odds with some negotiated default energy bids for WEIM-only storage assets. As a result, pursuit of the static approach may require transitioning all assets with negotiated default energy bids that include a scaling factor to the new readily available methodology. Doing so would ensure market participants bid and receive schedules on a level playing field. Using a standard default energy bid will also enable the ISO to better reflect and adjust default energy bids in pre-market and integrated forward market processes. The ISO welcomes stakeholder feedback on both approaches to better understand whether there are merits to further exploring the static option. Nevertheless, based on the current assessment, the ISO believes that the time-of-day approach is the most effective at addressing the identified problem statements while remaining consistent with the guiding principles.

5.8. Straw proposal regarding hybrid default energy bids

In the 2020 Hybrid Resources initiative, the ISO decided not to design and implement a default energy bid methodology for hybrid resources, noting that this issue would be addressed in a future initiative. As part of the Storage Design and Modeling initiative, eight stakeholders (CalCCA, DMM, CESA, PG&E, Portland, SDG&E, Terra-Gen, and WPTF) provided input on this topic in early 2025. DMM and PG&E supported the use of the storage default energy bid as a proxy for hybrid resources in the near term. CalCCA, CESA, and PGE encouraged further discussion, while SDG&E suggested addressing hybrid default energy bids after other initiative topics.

In June 2025, the ISO posted a Discussion Paper on Mixed-Fuels and Distribution-Level Resources. This paper provided an overview of the topic and guiding principles for problem statement development. In response, twelve stakeholders (AES, CalCCA, CESA, DMM, CPUC ED, Cal Advocates, Next Era Energy Resources, PG&E, SDG&E, Six Cities, Terra-Gen, and Vistra) provided feedback regarding hybrid default energy bids. Nine stakeholders (AES, CalCCA, DMM, CPUC ED, Cal Advocates, Next Era Energy Resources, PG&E, SDG&E, and Six Cities) supported further exploration in developing a default energy bid for hybrid resources. AES, CalCCA, and Six Cities highlighted that hybrid default energy bid formulation should reflect component characteristics. Offering a contrasting view, Vistra argued that hybrid resources should be exempt from market power mitigation, and that hybrid resources should be allowed to reflect opportunity costs and risks in their offers. In exchange, Vistra supported eliminating bid cost recovery.

During the September 2025 stakeholder meeting, Wellhead Power Services (Wellhead) presented an approach in which the hybrid default energy bid would be determined by the greater of the default energy bids applicable to its underlaying components. Wellhead argued that this approach offered a sensible and straightforward way to represent the variable costs of a hybrid asset within the local market power mitigation process. CESA, DMM, Vistra, and WPTF provided supportive comments in response to Wellhead's presentation. DMM underscored that the greater-of approach would achieve the goal of subjecting hybrid resources to market power mitigation in the near-term and could be further enhanced in the future if necessary. CESA noted that Wellhead's proposal was valuable as it would position hybrid resources with a storage component in the bid stack in a manner similar to standalone storage assets, thus minimizing the risk of dispatch inconsistent with real-time system conditions.

In the June 2026 Issue Paper and Straw Proposal on Mixed-Fuel topics, the ISO shared that the development of a hybrid default energy bid would be considered after expedited discussions regarding the storage default energy bid. In that paper, the ISO noted that it has envisioned hybrid default energy bid development and storage default energy bid enhancements as related but distinct topics and has monitored whether feedback overlaps between the two. Given stakeholder feedback to prioritize consideration of storage default energy bid enhancements and the development of a storage default energy bid alternative that can be readily leveraged by WEIM-only storage resources, the ISO expressed plans to expedite discussions regarding the storage default energy bid within this initiative's Uplift & Default Energy Bids topic group and continue discussions on the hybrid default energy bid thereafter.

In this paper, the ISO provides an overview of three different approaches to estimate a default energy bid applicable to hybrid resources: the greater-of approach, the largest component approach, and the weighted average approach. After detailing each approach and its relative strengths, the ISO favors further development of the greater-of approach with a minimum share requirement. As explained hereafter, this requirement would make it so that a component must constitute at least N% of all installed capacity that is part of the hybrid resource for its default energy bid to be considered as part of the greater-of approach. At this time, the ISO seeks feedback on the percentage at which the minimum share requirement should be set. Under the ISO's proposed path forward, if a component were to fail the greater-of approach's minimum share requirement, the largest component's default energy bid would be leveraged for the hybrid resource.

The Greater-Of Approach.

Under the greater-of approach, a hybrid resource's default energy bid would be equal to the greater of the default energy bid values applicable to each of the components that make up that hybrid resource. For example, a hybrid resource made up of a battery component and a solar component would be calculated as follows. First, calculate each component's default energy bid. Since most storage resources leverage the storage default energy bid and most solar resources leverage the locational marginal price default energy bid, this example uses those methodologies. Next, compare the two component default energy bids and whichever is greater becomes the default energy bid for the whole resource.

In the Storage Design and Modeling initiative, this idea was presented by Wellhead. Wellhead believed this idea would offer a viable near-term hybrid default energy bid that could be further developed and enhanced as needed over a longer-term. CESA, DMM, Vistra, and WPTF provided support for this approach in written comments.

The ISO believes this idea is viable and achieves the goal of subjecting hybrid resources to market power mitigation. However, the ISO has concerns about whether this methodology would properly mitigate the exercise of market power for some hybrid configurations under certain circumstances. For example, consider the edge case of a 100 MW hybrid resource made up of 99 MW of solar and 1 MW of battery storage. Under this approach, if the storage default energy bid is higher than the locational marginal price default energy bid, the storage default energy bid would be used for all 100 MW of its capacity.

Given this potential for misuse, the ISO believes that any application of the greater-of approach should include a minimum share requirement. This requirement would make it so that a component must constitute at least N% of all installed capacity that is part of the hybrid resource for its default energy bid to be considered as part of the greater-of approach.

The Largest Component Approach

Under the largest component approach, the default energy bid for the entire hybrid resource would be equal to the default energy bid of its largest component. For example, a hybrid resource made up of a battery component and a solar component would be calculated by identifying the largest component and then using that component's default energy bid for the entire hybrid resource.

While this approach would obviate the concerns associated with the greater-of approach, it presents its own challenges. For example, consider a 100 MW hybrid resource made up of 60 MW of solar and 40 MW of battery storage. Because the solar component is the largest, this approach would use the locational marginal price default energy bid for the entire hybrid resource. This would mean that, when the storage component is the one injecting power to the grid, this hybrid's default energy bid will be completely different than the default energy bid applicable to standalone storage resources. This difference could potentially lead to a mitigated solar-plus-storage hybrid to be placed lower in the bid stack relative to a standalone storage resource under mitigation. Such an outcome is generally undesirable because a standalone storage asset faces similar opportunity costs relative to the battery component of a hybrid asset.

The Weighted Average Approach

Under the weighted average approach, the default energy bid for the entire hybrid resource would be the weighted average of its components' default energy bids. For example, a hybrid resource made up of a battery component and a solar component would be calculated as follows: First, calculate the default energy bids applicable to each component independently. Then, average those default energy bids based on the relative sizing of each of the components. Finally, use that weighted average default energy bid for the entire resource.

The rationale behind this approach is the recognition that a hybrid resource is intended to be a blend of its underlying components.[9] In this context, while a hybrid resource's most expensive component may have higher costs in comparison to the weighted default energy bid, the hybrid resource's least expensive component technology will have lower costs in comparison to the resource's default energy bid. This approach is viable but has some material drawbacks.

First, this approach, just like the largest component approach, fails to address the bid-stack positioning challenge for hybridized storage relative to standalone storage. Second, and more broadly, the approach breaks the link between true component-level costs and the default energy bid by introducing a difference relative to the original default energy bid applicable to the components. This can lead to

[9] This is in contrast to a co-located configuration where each of the resources comprising it bid separately and thus can be dispatched and mitigated independently and consistently to their non-co-located homologues.

under-mitigation when actual costs are below the default energy bid, potentially artificially increasing prices if those components are in the margin. Conversely, when actual costs exceed the default energy bid, it can discourage operators from offering higher-cost component output, thereby reducing efficient dispatch.

Comparison of Approaches

To better understand these three approaches, the ISO presents two example scenarios below. Scenario 1 assumes a hybrid made up of solar and battery components of different sizes. Scenario 2 assumes a hybrid made up of battery and conventional thermal components of different sizes. For simplicity, all scenarios assume that the variable cost default energy bid is greater than the storage default energy bid, and that the storage default energy bid is greater than the locational marginal price default energy bid.

Figure 10: Comparison of Hybrid DEB Approaches

Assumed values for Scenarios:

Storage DEB	**$25/MWh**
LMP Option	**$5/MWh**
Variable Cost	**$35/MWh**

Scenario 1: Solar + Battery

Storage MW	Solar MW	Current	1: Max of	2: Majority	3: Weighted Average
20	80	NA	Storage DEB = 25	LMP Option = 5	0.2*Storage DEB + 0.8 *LMP Option = 9
40	60	NA	Storage DEB = 25	LMP Option = 5	0.4*Storage DEB + 0.6 *LMP Option = 13
80	20	NA	Storage DEB = 25	Storage DEB = 25	0.8*Storage DEB + 0.2 *LMP Option = 21

Scenario 2: Battery + Thermal

Storage MW	Thermal MW	Current	1: Max of	2: Majority	3: Weighted Average
20	80	NA	Variable Cost = 35	Variable Cost = 35	0.2*Storage DEB + 0.8 *Variable Cost = 33
40	60	NA	Variable Cost = 35	Variable Cost = 35	0.4*Storage DEB + 0.6 *Variable Cost = 31
80	20	NA	Variable Cost = 35	Storage DEB = 25	0.8*Storage DEB + 0.2 *Variable Cost = 27

Given the risks posed by each alternative, the ISO currently favors further development of the greater-of approach with a minimum share requirement. This requirement would make it so that a component must constitute at least N% of all installed capacity that is part of the hybrid resource for its default energy bid to be considered as part of the greater-of approach. The ISO seeks feedback on the percentage at which the minimum share requirement should be set. If a component were to fail the greater-of approach's minimum share requirement, the largest component's default energy bid would be leveraged for the hybrid resource.

6. Reframing of non-generator resource bidding

While the aforementioned default energy bid concept can be readily leveraged under today's bidding approach, it could also be leveraged under a "reframing" of non-generator resource bidding that could bolster the efficiency of storage state-of-charge management and dispatch. During the May 2026 stakeholder call, the ISO presented a concept to reframe storage bidding based on a prior MSC opinion and the work of new MSC member, Ross Baldick.[10]

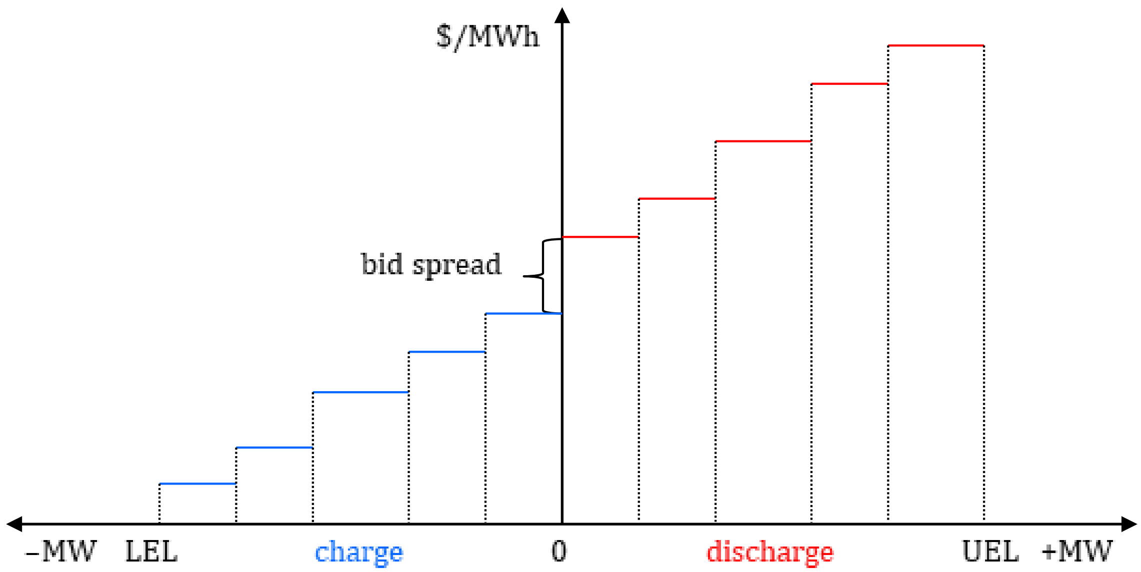
In this section, the ISO first provides an overview of non-generator resource bidding today. The paper then offers an overview of the optional end-of-hour state-of-charge biddable parameter and the feedback the MSC provided on it during its development. Next, the paper includes a discussion of how prior MSC feedback and work from current MSC members informed discussions during the May 2026 stakeholder meeting. The paper then details the stakeholder feedback following the May 2026 stakeholder meeting. Finally, the ISO provides a more detailed articulation of the bidding reframing concept with the intent of clarifying its structure, scope, and potential market implications. The ISO recognizes that several open questions remain and seeks additional stakeholder feedback and discussion of this concept. This feedback will help determine what additional information would be needed in initiative materials to evaluate whether and how this concept should advance as part of broader storage market enhancements.

6.1. Non-Generator Resource Bidding Today

Today, non-generator resources submit a monotonically nondecreasing bid curve with up to ten MW and $/MWh pairings to indicate their willingness to charge or discharge. As discussed in the December 2025 paper, currently, the specific $/MWh values are not the sole drivers of dispatch.[11] Within the optimization horizon, if state-of-charge constraints are binding, the market is able to schedule storage assets based mainly on the difference between the highest offer to charge and the lowest bid to discharge, the bid spread. Conversely, if state-of-charge constraints are not binding, the market considers the entirety of the bid curve to determine dispatch.

[10] [10] *See* Baldick, Ross. "A state-of-charge based formulation for storage participation in electricity markets: Technical Reference." *arXiv preprint arXiv:2606.14993* (2026).
[11] See "Uplift and Default Energy Bid Working Group Updated Discussion and Issue Paper", December 2025, p.12.

Figure 11: Illustrative Non-Generator Resource Bid Curve



In the day-ahead market under today's bidding approach, storage resources submit a bid curve for their charging and discharging range. Within the optimization horizon, which is the 24-hours considered for the trade date, the implied bid spread enables the market to optimally schedule the storage resource. The market will schedule the asset to charge in hours with the lowest prices and discharge in hours with the highest prices, treating the bid spread as the arbitrage minimum bid value. This is generally beneficial and based on the principle that, if we understand the bid spread as the minimum price difference that makes charging for later discharge profitable, maximizing the bid spread is generally consistent with maximizing the asset's profitability. This being said, it is important to note that, because storage resources are not 100% efficient and they experience degradation costs, this relationship is not exactly equivalent.

In real-time, under today's bidding approach, storage resources manage their state-of-charge by submitting hourly bid curves for their charging and discharging range. Just like in the day-ahead market, the implied bid spread enables the market to optimally schedule the storage resource within the optimization horizon. Nevertheless, unlike the day-ahead market, the real-time market's optimization horizon is much shorter. As a result, the bid spread influences dispatch only when the market recognizes that the asset would hit a state-of-charge constraint within the optimization horizon. Such constraints include the physical limits of the asset, but also constraints associated with the preservation of awarded ancillary services, for example.

The current bidding paradigm presents some challenges for market participants and the ISO, particularly in real-time. First, because bidding should be the primary means of state-of-charge management and real-time bids must be finalized 75 minutes before the trade hour, market participants are tasked with engaging in near-term price forecasting to shepherd their state-of-charge through the day in the desired trajectory. This is complicated by exogenous factors that are asymmetrically known, including underlying random events and overall system conditions.[12] Moreover, price forecasting by scheduling coordinators will always be prone to endogeneity issues since the prices being forecast by a storage asset need to incorporate the effect of forecasting by other storage assets.

The underlying challenges of near-term price forecasting for the purposes of hourly bidding may cause resources to submit unnecessarily high bids to manage their state of charge. Moreover, since the bid spread becomes the relevant driver of dispatch when the market recognizes a state-of-charge constraint within the horizon, the efforts to forecast prices in order to submit meaningful bids to manage state-of-charge can be nullified if an ancillary service constraint were to materialize in the horizon. The bid submission timeframe of the real-time market also complicates this dynamic as scheduling coordinators must submit their bids while both forecasting where prices and the state-of-charge of their asset will be 75 minutes into the future. All of these issues are connected to some of the drivers of uplift described in the ISO's December 2025 paper.

Second, the current framework assumes that the bid spread reflects the resource's minimum arbitrage value. This assumption may not hold if the bid spread is not informed by the resource's variable operating costs and efficiency losses. For instance, a scheduling coordinator could submit a bid curve with an implied bid spread that is lower than the resource's true cost of cycling. Even so, the market would continue to interpret that spread as the minimum arbitrage value. Although maximizing the bid spread could mitigate this concern, reliance on the bid curve during intervals when state-of-charge constraints are not binding across the optimization horizon may still lead to dispatch outcomes that are uneconomic for the resource and detrimental to the market participant's revenues.

Third, while the day-ahead and real-time markets are settled incrementally, real-time bidding is not linked or related to the financial position that results from the day-ahead optimization. As such, once more, storage resources must rely on hour-by-hour bid curves to achieve the dispatch outcomes that are consistent with their day-ahead positions. This, paired with the aforementioned challenges inherent to hour-by-hour storage bidding in real-time, could lead to a significant disconnect between the day-ahead state-of-charge trajectory and the real-time telemetered state-of-charge. This issue has been previously described as both an uplift issue and a potential area for market enhancements as part of the ISO's December 2025 paper.[13]

6.2. The End-of-Hour State-of-Charge Parameter and the 2020 MSC Opinion

In 2020, to address some of the state-of-charge management challenges detailed above, the ISO developed the end-of-hour state-of-charge parameter. This optional biddable parameter allows storage resources to specify a desired state-of-charge range or value they wish to achieve by the end of a given

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[12] Baldick, Ross. "A state-of-charge based formulation for storage participation in electricity markets: Technical Reference." *arXiv preprint arXiv:2606.14993* (2026).

[13] See "Uplift and Default Energy Bid Working Group Updated Discussion and Issue Paper", December 2025, p.27-36.

trading hour. This parameter informs market optimization and allows the market to dispatch storage resources economically or uneconomically to achieve the scheduling coordinator's preferred end-of-hour state-of-charge, when specified. Since any end-of-hour state-of-charge will take precedence over economic outcomes in the market optimization, a non-generator resource that submits an end-of-hour state-of-charge bid is ineligible to receive bid cost recovery for the hour with said biddable parameter and the hour preceding it.

During the discussions ahead of the approval of the end-of-hour state-of-charge parameter, the MSC produced an opinion in which it weighed in on both the default energy bid and the aforementioned biddable parameter. In that opinion, MSC members underscored that the end-of-hour state-of-charge parameter could ease some of the challenges associated with state-of-charge management. The MSC portrayed the end-of-hour state-of-charge parameter as "primal" approach to solve the "end effects" problem: the challenges associated with limited lookaheads within its optimization processes. Today's end-of-hour state-of-charge parameter seeks to address end effects by fixing a state-of-charge level at the end of a given horizon. The end-of-hour state-of-charge biddable parameter effectively communicates to the market that the scheduling coordinator would like to save a given amount of energy for later use.

The MSC underscored that the end-of-hour state-of-charge parameter's "primal" approach could be bolstered with a "dual" approach. Under a "dual" approach, scheduling coordinators could both fix a state-of-charge level at the end of a given horizon; and assign a $/MWh to the energy at the end of that horizon. The assignment of a $/MWh value to the energy at the end of the horizon communicates to the market the future economic value of the stored energy, as determined by the asset's private assessment of opportunity costs beyond the optimization horizon. This $/MWh could be understood within the implementation as the penalty price for violating the desired end-of-hour state-of-charge range or value.

Following the publication of the MSC's opinion, the ISO implemented the end-of-hour state-of-charge parameter as described above in its "primal" form in 2021. This optional biddable parameter takes precedence over economic outcomes in the market optimization. Resources that use this parameter are ineligible to receive bid cost recovery for the hour with said biddable parameter and in the preceding hour.

6.3. Ross Baldick's Work and the May 2026 Stakeholder Meeting

During the May 2026 stakeholder meeting, the ISO presented a bidding paradigm based on the MSC opinion and the ongoing academic work of new MSC member, Ross Baldick. As part of his research, Baldick has developed a bidding paradigm under which storage scheduling coordinators would no longer submit interval-by-interval charge and discharge bids. Instead, these assets would submit a single bid/offer for deviating end-of-horizon state-of-charge from its reference state-of-charge value. The reference state-of-charge value in the day-ahead market would be its initial state-of-charge value. In real time, the reference state-of-charge value would be the day-ahead resultant day-ahead state-of-charge trajectory. This bid/offer, together with the asset's physical parameters (state-of-charge limits, efficiency) and the asset's variable operations cost would inform the optimization.

The ISO identified similarities between Baldick's concept and the feedback provided by the MSC in 2020, with one crucial difference between the two. Under the MSC's "dual" approach, the bid/offer that seeks to represent the value of the stored energy beyond the optimization horizon is used as a penalty price for the end-of-hour state-of-charge parameter and does not supplant hour-by-hour bid curves for charge and discharge. Under Baldick's bidding concept, on the other hand, the single bid/offer replaces the current bidding structure and thus reframes the storage bid as a willingness-to-pay or willingness-to-be-paid for finishing a given optimization horizon (a 24-hour period in the case of the day-ahead market and a 1-hour period in the case of the real-time market) with a higher or lower state-of-charge, relative to the reference value.

In this context, the ISO presented a bidding paradigm informed by both these positions during the May 2026 stakeholder meeting. Under said concept, storage scheduling coordinators would submit a single bid/offer to deviate the end-of-horizon value from the reference value, reflecting the expected value of energy after the market horizon. To achieve this, the ISO would first continue to model, as it does today, the technical characteristics of storage, including round-trip efficiency and state-of-charge. Then, the asset would submit a bid/offer reflecting its willingness to pay to increase its end-of-horizon state-of-charge or its willingness to accept compensation for reducing end-of-horizon state-of-charge. This would replace the current ten-segment monotonically nondecreasing bid curve.

6.4. Stakeholder Feedback Following the May 2026 Meeting

Following the May 2026 stakeholder meeting, stakeholder feedback reflected broad interest in improving storage bidding frameworks, but varying levels of support, caution, and an emphasis on implementation considerations. Several stakeholders, including ACP-CA and Portland, expressed general support for refining the non-generator resource paradigm and better capturing intertemporal opportunity costs, while underscoring the importance of maintaining operational simplicity and aligning any bidding reforms with accurate market modeling of storage behavior. Similarly, SCE and Vistra found value in the concept's ability to incorporate end-of-horizon state-of-charge considerations, noting its potential to better align dispatch with resource incentives, though both emphasized the need to preserve existing interval bidding structures and ensure robust price formation.

Other stakeholders adopted a more neutral or exploratory stance. CalCCA supported continued evaluation of the reframing approach alongside alternatives, while CESA acknowledged its ability to capture opportunity costs beyond the market horizon but recommended deferring further development until higher-priority storage default energy bid reforms are addressed. REV also viewed the concept as lower priority and raised concerns about added complexity, requesting further clarification on scope, implementation details, and interactions with existing market constructs before offering stronger support.

At the same time, several commenters highlighted important design and market implications. PG&E and WPTF raised more significant concerns, cautioning that the reframing could oversimplify storage behavior, fail to account for intra-horizon constraints and ancillary service interactions, and introduce risks related to price formation and strategic bidding. They emphasized the need for additional analysis, clearer design specifications, and a more comprehensive assessment of potential unintended consequences.

Finally, the Cal Advocates supported continued development of the concept as part of a broader, long-term reform effort, recognizing its potential to improve dispatch efficiency by explicitly valuing end-of-horizon state-of-charge. However, Cal Advocates stressed the importance of maintaining appropriate safeguards, particularly around bid cost recovery eligibility, to prevent strategic behavior. Overall, stakeholder feedback suggests cautious support for continued exploration, with a strong emphasis on careful design, transparency, and integration with broader market reforms.

6.5. Reframed Bidding Concept for Discussion

Given stakeholder feedback, the ISO agrees that, while open questions remain, there is merit in the bidding reframing concept to warrant continued development. In particular, stakeholder comments highlight both the potential value of more explicitly capturing end-of-horizon opportunity costs and the importance of addressing design, implementation, and market interaction challenges in a deliberate manner. Accordingly, the ISO provides a more detailed articulation of the concept below, with the intent of clarifying its structure, scope, and potential market implications. The ISO recognizes that several open questions remain and seeks additional stakeholder feedback on this topic to inform what additional information can ease evaluation of whether and how this concept should advance as part of broader storage market enhancements.

The bidding reframing concept seeks to directly value the energy remaining after the optimization horizon, easing state-of-charge management and bidding. This concept would reframe storage bidding so that these assets would no longer submit interval-by-interval charge/discharge bids and would instead submit a single bid/offer to deviate the end-of-horizon value from the reference state-of-charge value. The reference state-of-charge value in the day-ahead market would be its initial state-of-charge value. In real-time, the reference state-of-charge value would be the resultant day-ahead state-of-charge trajectory.

This offer/bid, in combination with the asset's physical parameters (state-of-charge limits, efficiency) and the asset’s variable operations cost would guide dispatch optimization. The concept would thus reframe the storage bid as a willingness-to-pay or willingness-to-be-paid for finishing a given optimization horizon (a 24-hour period in the case of the day-ahead market and a 1-hour period in the case of the real-time market) with a higher or lower state-of-charge, relative to the reference value.

Under this paradigm, the market optimizes the resource by endogenously considering two distinct inputs: (1) the resource's variable operating costs and efficiency losses, and (2) the participant's bid or offer to deviate from a desired terminal state of charge, which serves as a terminal energy value. The first component ensures that the resource is never dispatched in a manner that ignores its underlying cost of cycling. The second component allows the market to account for the economic value of energy that remains in the battery at the end of the optimization horizon.

Conceptually, this reframes the optimization problem. Today, when the market recognizes that state of charge is constrained within the optimization horizon, it seeks to maximize the bid spread associated within the market horizon. That spread effectively propagates forward through the optimization and influences subsequent charging and discharging decisions. Under the reframed bidding framework, the market instead starts with the value assigned to the terminal state of charge and propagates that value backward through the optimization horizon. In other words, rather than asking "what charge-discharge spread should the resource earn?", the market asks "how valuable is it to preserve energy for later use?" and incorporates that value into dispatch decisions throughout the horizon. This allows the resource to be optimized against an economically meaningful terminal condition while continuing to respect its operating costs and physical limitations.

This approach more directly reflects storage operators' sense of the changing value of energy over time, specifically how the value may change from one optimization period to the next. Rather than expressing specific price quantity pairs that position the resource based on anticipated market prices and letting the terminal state of charge be a consequence of that, participants explicitly indicate the value of ending the horizon with energy in the battery. The market can then determine the economically efficient charging and discharging pattern that balances near-term opportunities against that future value.

Utilizing the bid/offer as a terminal value allows for storage to be paid and charged only for energy injected or withdrawn, not for state-of-charge itself. This means that the end-of-horizon state-of-charge bid influences dispatch decisions but that bid itself is not used directly in settlement, simplifying the implementation burden of this paradigm. Locational marginal prices will continue to emerge naturally from this optimization and storage earns arbitrage value without forecasting prices since the arbitrage is embedded in centralized optimization. Moreover, this bidding approach reflects the goal of having storage bids represent the asset's private assessment of opportunity costs beyond the optimization horizon. This philosophy is consistent with the default energy bid enhancements discussed earlier in this paper, which recognize that the bids submitted by energy storage resources should be determined by the opportunity costs of these assets, which vary throughout the day as expected market conditions evolve. By allowing resources to express the value of preserving energy beyond the optimization horizon through a terminal value, the reframed framework extends this same time-dependent valuation concept to the resource's future operating opportunities.

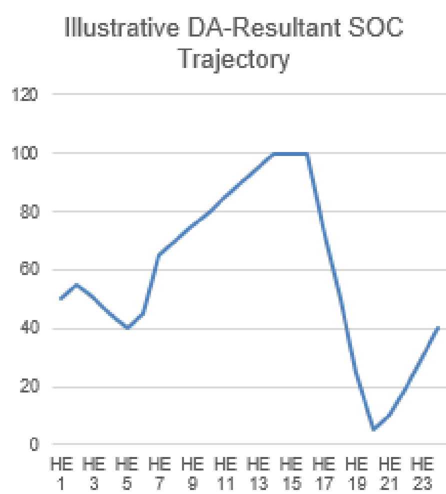
To better understand this concept's intuition, the ISO includes two simplified examples that focus on energy bids in the day-ahead and real-time markets. These examples are meant to be illustrative and seek to convey the intuition of this paradigm in a graphical manner. In day-ahead, state-of-charge is explicitly tracked across the full horizon so storage scheduling coordinators can submit a bid/offer that represents the willingness-to-pay (or be paid) for deviating end-of-day state-of-charge from initial state-of-charge. This bid would reflect the expectations about prices after the day-ahead horizon, such as the next trade date. It would also allow scheduling coordinators to represent their long-term operational strategy on wear, fuel substitution, and risk appetite via their bids.

In the example below, consider an asset that submits an initial day-ahead state-of-charge of 50 MWh, the equivalent to 50% state-of-charge for this hypothetical asset. This resource included that their willingness to end the day with a lower state-of-charge is $25 per MWh. Finally, the resource has three characteristics in the Master File. The efficiency limits dictate how much energy is preserved in a charge and discharge cycle by the battery. The state-of-charge limits provide bounds for the maximum and minimum state-of-charge for the resource. Here, the battery is full at 100 MWh and empty at 0 MWh. Finally, the variable operation cost is $10/MWh.

The day-ahead optimization uses these constraints and factors to model out what trajectory would result in the most efficient dispatch, as shown in the sample charts on the right. The market finds that the most efficient dispatch leaves the battery with a lower state of charge (40 MWh) than what the battery started with (50 MWh).

Figure 12: Illustrative Day-Ahead Example of Reframed Bidding Concept

Element	Source	Value
Initial DA SOC	SC (Bid)	50 MWh (50%)
Bid to end day with lower SOC	SC (Bid)	$25/MWh
Efficiency	Master File	85%
SOC limits	Master File	0-100 MWh
VOC	Master File	$10/MWh



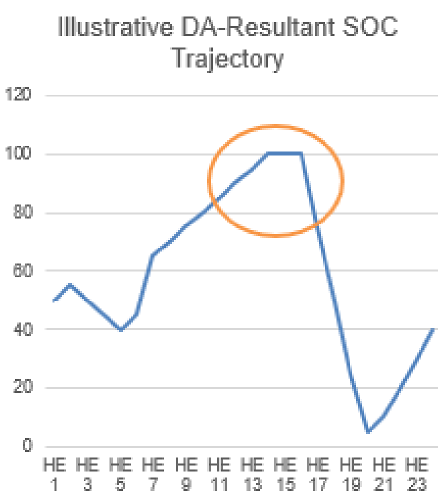
In real-time, due to the short look-ahead horizon, the real-time end-of-horizon state-of-charge is defined relative to the day-ahead state-of-charge trajectory. If the real-time horizon ends at a day-ahead boundary (end-of-hour), the real-time reference state-of-charge equals the day-ahead state-of-charge at that hour. If the real-time horizon ends inside a day-ahead hour, the real-time reference state-of-charge is interpolated from the day-ahead state-of-charge trajectory. Across the real-time market, the storage resource would submit one real-time deviation bid per hour to capture its willingness-to-pay or its willingness-to-be-paid for deviating its real-time end-of-horizon state-of-charge from the day-ahead-implied state-of-charge.[14]

[14] For resources without a day-ahead schedule, this could relate to the base schedules. This would allow for a means to offer economic deviation from base schedules.

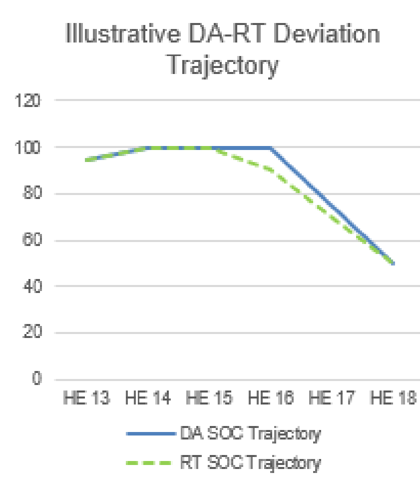
In the example below, consider the same asset. This asset has bid that its willingness to have a lower state-of-charge than its day-ahead trajectory is $50 per MWh. From hour ending 14 through hour ending 17, the market determines that it is efficient to discharge the battery earlier than planned and pay the bid price for ending the hours with lower state of charge relative to the day-ahead trajectory. The chart in the bottom right shows the comparison between the day-ahead results and the real-time results.

Figure 13: Illustrative Real-Time Example of Reframed Bidding Concept

Element (HE 16)	Source	Value
Bid to end **the hour** with lower **SOC relative to DA trajectory**	SC (Bid)	$50/MWh
Optional: EOH SOC	SC (Bid)	NA
Efficiency	Master File	85%
SOC limits	Master File	0-100 MWh
VOC	Master File	$10/MWh



Element (HE 16)	Source	Value
Bid to end **the hour** with lower **SOC relative to DA trajectory**	SC (Bid)	$50/MWh
Optional: EOH SOC	SC (Bid)	NA
Efficiency	Master File	85%
SOC limits	Master File	0-100 MWh
VOC	Master File	$10/MWh



This bidding concept addresses some challenges posed by today's approach. First, this approach would mitigate the task of engaging in near-term price forecasting to shepherd their state-of-charge through the day in the desired trajectory. This is because within the optimization horizon, the market is able to leverage the variable operations cost as the minimum spread needed and the bid/offer to deviate propagates backwards into the optimization horizon to inform dispatch instructions. As a result, this bidding approach lessens the importance of near-term interval-by-interval price forecasts since the bid is capturing the asset's private assessment of future value beyond the horizon, such as next-day prices in the case of the day-ahead market or prices beyond the real-time optimization horizon in the case of the real-time market. This is notably consistent with the default energy bid paradigms discussed earlier in this paper which focus on forward-looking opportunity costs.

Second, this approach would make it so that energy dispatch instructions always consider the registered variable operations cost as a hurdle rate for charging and later discharging energy. This would eliminate the aforementioned issue where a scheduling coordinator could submit a bid curve with a bid spread that is less than the asset's variable operations cost. Under the reframed bidding approach, the market can optimize the resource within the optimization horizon by endogenously considering (1) the variable operations cost, and (2) the bid/offer to deviate as a terminal value. As a result, the variable storage energy costs are always respected and the bid/offer to deviate acts as both a terminal value that propagates backwards in the optimization and a representation of the asset's private assessment of opportunity costs beyond the optimization horizon.

Third, this bidding approach creates a linkage between real-time bidding and the financial position resultant from the day-ahead optimization. This is desirable as it could allow for a more effective way to manage deviation from the scheduled state-of-charge relative to the status quo. This is because today, deviations from the market dispatch resulting from prior market runs comes from adjusting bids and offers, which may be complicated by underlying random events, overall system conditions and endogeneity issues. In contrast, under the reframed bidding approach, deviations from the scheduled state-of-charge are handled via the offer/bid submitted. This is viable because the market optimization already internalizes charging costs and opportunity costs if state-of-charge and energy value are specified. This is also desirable as it gets to a key issue this initiative has identified regarding storage bid cost recovery: unlike other resources, batteries are not exposed to real-time prices when they fail to meet their day-ahead schedules.[15] As a result, and considering the stakeholder feedback to evaluate modeling and uplift conversations in a holistic manner, the ISO is interested in gathering feedback on this concept and any implications to inform uplift discussions.

7. Governance Classification

This proposal discusses changes to default energy bid calculations, uplift, and storage bidding. Because these changes would apply to WEIM/EDAM Entity balancing authority areas, rather than solely the ISO balancing authority area, they fall under the WEM Governing Body's primary authority.

The WEM Governing Body has primary authority over any proposal to change or establish a tariff rule applicable to the WEIM/EDAM Entity balancing authority areas, WEIM/EDAM Entities, or other market participants within the WEIM/EDAM Entity balancing authority areas, in their capacity as participants in WEIM/EDAM. The scope of this primary authority excludes, without limitation, any other proposals to

[15] See "Uplift and Default Energy Bid Working Group Updated Discussion and Issue Paper", December 2025, p.6.

change or establish tariff rule(s) applicable only to the ISO balancing authority area or to the CAISO-controlled grid.[16] The proposed tariff changes would be "applicable to WEIM/EDAM Entity balancing authority areas, WEIM/EDAM Entities, or other market participants within WEIM/EDAM Entity balancing authority areas, in their capacity as participants in WEIM/EDAM."

The changes proposed are not limited to the ISO balancing authority area or to the CAISO-controlled grid. Accordingly, the proposed changes fall within the scope of the WEM Governing Body's primary authority. Stakeholders are encouraged to submit a response in their written comments to the proposed classification of as described above, particularly if they have concerns or questions.

8. Next Steps

This paper will be discussed at a stakeholder meeting scheduled for July 22, 2026. Comments on the paper and the stakeholder meeting will be due August 5, 2026.

[16] Charter for WEIM and EDAM Governance § 2.2.1.