Supplemental Comments on Storage Design and Modeling: Straw Proposal on Default Energy Bids, Uplift, and State-of-Charge Management

Department of Market Monitoring

August 17, 2026

Summary

The Department of Market Monitoring (DMM) appreciates the opportunity to submit these supplemental comments and analyses on the *Storage Design and Modeling: Straw Proposal on Default Energy Bids, Uplift, and State-of-Charge Management* issued July 15, 2026.[1] DMM submitted previous comments highlighting concerns regarding how the ISO's proposed storage default energy bid (DEB) would drastically over-estimate marginal costs across the day, but particularly during the peak hours when the opportunity to exercise local market power may be greatest and the danger of inflated default energy bids is most concerning.

In our prior comments, DMM identified numerous issues with the ISO's proposed storage DEB:

- The price-based opportunity cost multiplier being set at a value of 1.4 all day long
- The time-of-day multiplier not being set below 1 during peak net load hours when opportunity costs are lowest
- The time-of-day multiplier decreasing during the hour with the Nth highest day-ahead (DA) locational marginal price (LMP), which may result in inefficiently high DEBs when the Nth highest price is after peak hours, or inefficiently low DEBs when the Nth highest price is too far before ramping hours[2]
- Inclusion of the gas floor — which is not a determinant of marginal cost of storage resources

In these comments, DMM proposes an alternative DEB formulation that addresses these concerns by:

- Retaining the price-based opportunity cost value of 1.1
- Decreasing the time-of-day multiplier to 0.8 during peak net load hours
- Having a time-of-day multiplier that decreases in the later of: (1) the earliest of the Nth highest priced day-ahead LMPs, or (2) hour-ending 18 to ensure DEB does not decrease too early
- Removing the gas floor

These comments include analysis showing that the DEB proposed by DMM is a much more accurate estimate of marginal costs of storage resources, better protects from the exercise of market power during peak hours, and does not materially limit storage resources' ability to prevent dispatch prior to the highest priced hours of the day.

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[1] *Storage Design and Modeling: Straw Proposal on Default Energy Bids, Uplift, and State-of-Charge Management,* California ISO, July 15, 2026: https://stakeholdercenter.caiso.com/InitiativeDocuments/Straw-Proposal-Storage-Design-and-Modeling-Uplift-DEB-Outage-Management-State-of-Charge-Jul-15-2026.pdf

[2] Where N is determined by the discharge duration of the battery resource.

Background

For this analysis, DMM used data from CAISO storage resources from January 2024 to December 2025 to calculate the DEB values under both the CAISO and DMM proposals. Using this data, DMM developed several metrics to back cast how effectively each DEB proposal would have balanced the goals of protecting against potential local market power while maintaining the ability of batteries to remain available for dispatch during the highest-priced hours over this two-year period.

Equation (1) below shows CAISO's proposed RT Storage Discharge DEB:

$$(1)\ Max(1.1 * VOC,\ 1.4 * RT\_ADJ * PB\_OC,\ 1.1 * Gas\ Floor) * TOD\ Multiplier$$

Equation (2) below shows DMM's proposed RT Storage Discharge DEB:

$$(2)\ Max(1.1 * VOC,\ 1.1 * RT\_ADJ * PB\_OC) * TOD\ Multiplier$$

Where:

VOC = Variable Operations Cost

PB_OC = Price-Based Opportunity Cost

RT_ADJ = Real-Time Upward Adjustment Scalar

TOD Multiplier = Time-of-day Multiplier (varies by hour of day)

Table 1 provides a comparison of key inputs used in these two DEB proposals. As shown in Table 1, neither of the DEBs assessed were calculated with an upward real-time adjustment scalar or the variable operations cost component. Including either of these components would only increase the DEB values relative to those considered in this analysis. DMM continues to support incorporating a real-time adjustment scalar into the DEB calculation and notes that this component could help address instances where the DMM DEB is less than RTPD prices due to a divergence between day-ahead and real-time prices.

Table 1. Comparison of CAISO and DMM Storage DEB Proposals

	CAISO proposal	DMM proposal
Price-Based Opportunity Cost (PB_OC)	Nth highest DA LMP	Nth highest DA LMP
Price-Based Opportunity Cost Multiplier	1.4	1.1
Time-of-day (TOD) Multiplier	1.4 until Nth highest DA LMP hour, then 1	1.4 until max (18, Earliest of N highest DA LMPs), then 0.8
Gas floor	11,068 MMBtu/MWh * Fuel region gas price	Not included in proposal
Real-Time Upward Adjustment Scalar (RT_ADJ) and Variable Operations Cost (VOC)	Included in proposal, but not in this analysis	Included in proposal, but not in this analysis

Analysis

Comparison of average hourly DEBs

Figure 1 compares the average values of the DEBs proposed by the ISO and DMM across all hours of the day, along with the average 15-minute (RTPD) LMPs for battery resources.[3] This figure highlights how poorly the ISO's proposed DEB reflects the marginal costs of battery resources throughout the day, particularly during peak net load hours (HE 18-21). Prices during these hours are usually the highest of the day, so the opportunity cost of being available later in the day is low.

Figure 1 also highlights how DMM's DEB formulation is a better reflection of how marginal costs for storage resources change throughout the day. Under the DMM DEB, the estimated marginal cost decreases during the peak hours, when opportunity costs are lowest. If batteries discharge during these hours, they can be recharged in the early hours of the day prior to morning ramping hours and/or recharged during lowest priced solar hours of the following day.

During the peak net load hours, market power concerns are the greatest. As shown in Figure 1, the ISO-proposed DEB exceeds real-time LMP by an average of 74 percent during HE 18-21, allowing for significant exercise of local market power during the peak hours.

Figure 2 is similar to Figure 1 but only includes resource-intervals where resource was subject to mitigation and the CAISO DEB > RT LMP.[4] This figure focuses on the degree of local market power that could be exerted in cases where resources would be subject to mitigation under a DEB that is higher than LMP. During hours-ending 18-21, when resources are subject to mitigation and the CAISO DEB is higher than RT LMP, the ISO DEB is 72 percent higher than the RT LMP. This highlights the degree of market power exertion the proposed CAISO DEB would allow during peak hours. DMM's proposed DEB would provide significantly more protection against market power during the peak hours.

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[3] Both CAISO and DMM DEBs for each resource are calculated assuming the battery is four-hour duration for computational simplicity.

[4] Overall, batteries were subject to mitigation during only about 5.8 percent of intervals during the two-year period of this analysis.

Figure 1. Average DEBs and 15-minute LMPs (all hours)

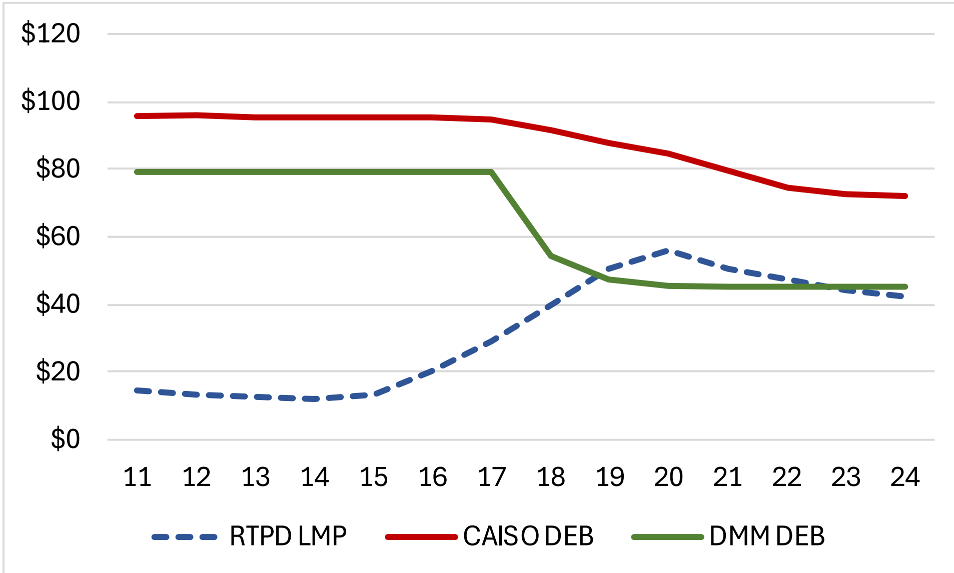
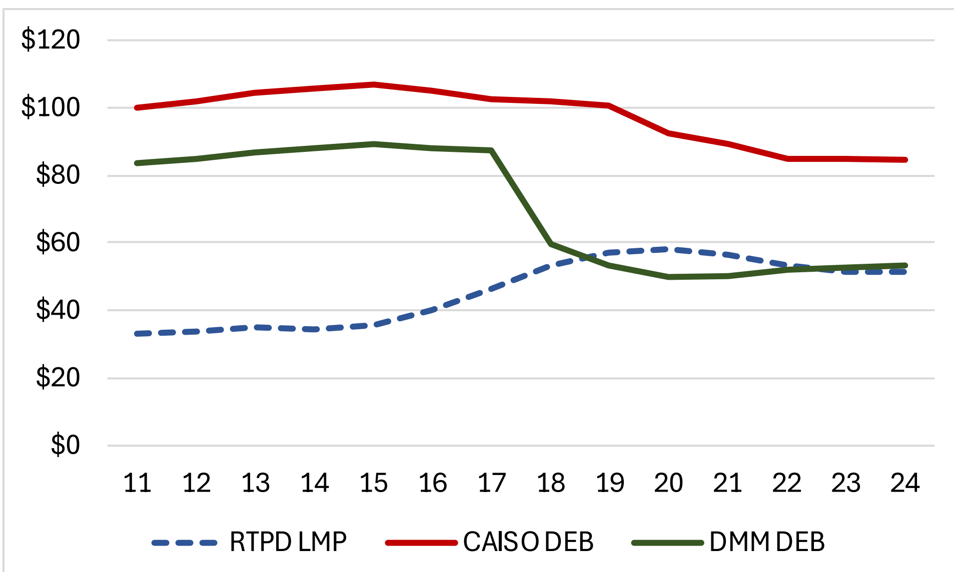


Figure 2. Average DEBs and 15-minute LMPs (intervals when resource subject to mitigation)



Intervals per day with DEBs less than LMP

Batteries with four hours of storage, which includes the majority of batteries participating in the CAISO market, aim to bid in a way that allows them to fully charge during the lowest priced solar hours, and then be optimally dispatched in the highest priced four hours (or 16 15-minute intervals) in the late afternoon and evening hours.[5] Thus, one very simple measure of a DEB is the number of 15-minute intervals during which the DEB is less than RTPD LMP during the afternoon and evening hours of each operating day. This provides some indication of the potential impact of the DEB on the dispatch of batteries due to mitigation.

Figures 3 and 4 show histograms of the daily values of this metric over the two-year period covered in this analysis.[6]

- Figure 3 includes all intervals during hours 11 through 24 with DEBs less than the RTPD LMP. This metric is equivalent to assuming that units are subject to mitigation in all hours. As shown in Figure 3, DMM's proposed DEB was less than the RTPD LMP four hours or less during 55 percent of days. Almost all other days, DMM's proposed DEB was less than the LMP during 5 to 7 hours, with the DEB being less than the LMP more than 7 hours on only 1 percent of days.
- Figure 4 only includes intervals in which units were subject to mitigation, and DEBs were less than the RTPD LMP, which provides a more realistic measure of the potential impact of DEBs. Based on this metric, the DEB proposed by DMM was less than the RTPD LMP four hours or less during more than 98 percent of days. Overall, batteries were subject to mitigation during only about 5.8 percent of intervals during the two-year period of this analysis.
- These two calculations are meant to provide a lower and upper-bound for how the DEBs might perform moving forward. While relying on historical mitigation patterns may underestimate how frequently resources may be subject to mitigation, assuming that resources are subject to mitigation during all intervals would drastically over-estimate the impact of DEBs.
- As shown in these figures, the DEB proposed by the ISO is less than the RTPD LMP four hours or less on more than 99 percent of days, reflecting the fact that the ISO's proposed DEB is set significantly above the resources' LMPs virtually all the time.

[5] Both CAISO and DMM DEBs for each resource are calculated assuming the battery is four-hour duration for computational simplicity.

[6] For these figures, the count of 15-minute intervals is shown in terms of hours (i.e., 4 intervals = 1 hour)

Figure 3. RTPD intervals per day with DEB < RTPD LMP (hours 11-24)

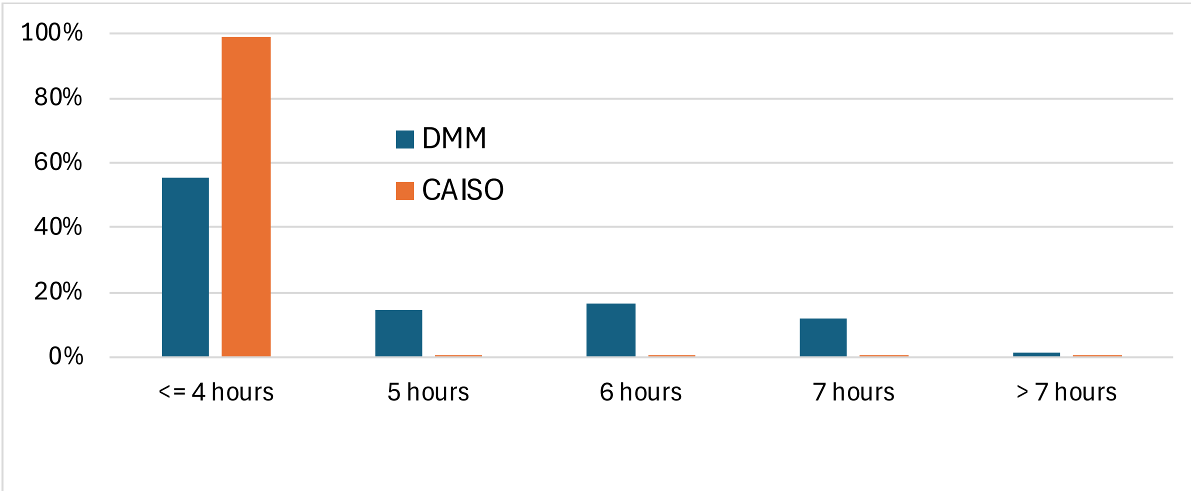
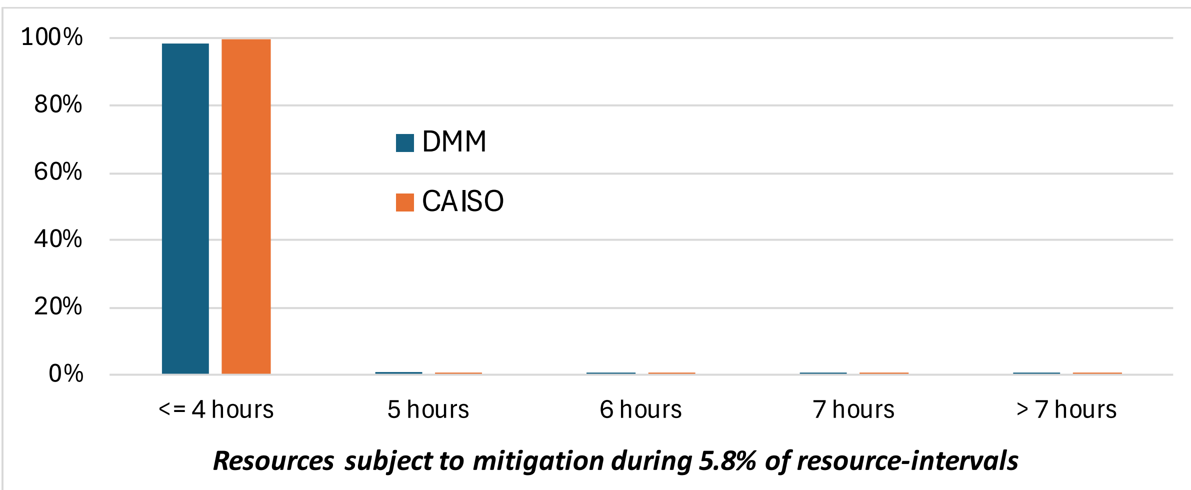


Figure 4. RTPD intervals per day DEB < RT LMP and resource subject to mitigation (hours 11-24)



Availability metric

In practice, a DEB being lower than RTPD LMP in more than four hours does not necessarily imply that a resource would be unavailable for dispatch during the highest-priced 16 RTPD intervals. Thus, a better metric for assessing DEBs for batteries with four hours of storage should reflect how well a DEB would allow resources to be available during the highest priced 16 RTPD intervals of the day (rather than simply limiting potential hours of dispatch to 16 RTPD intervals or less). While some batteries included in the sample have storage durations other than four hours, all resources are evaluated assuming four-hour duration for computational simplicity. This simplification is unlikely to materially affect the results, as the overwhelming majority of batteries participating in CAISO markets are four-hour duration.

This type of availability metric must account for the temporal sequence of intervals over the course of the day (e.g., hours 11 to 24) during which prices are higher than the DEB. The availability metric developed by DMM to assess DEBs in this manner can be calculated as follows:

- First, we identify the highest priced 16 RTPD intervals of each day between hours 11 to 24.
- We then calculate the percentage of these highest priced 16 RTPD intervals during which each battery resource would have sufficient charge to be available for dispatch if the resource was dispatched during the first 16 intervals when the resource's DEB was less than the LMP. This calculation tracks what each resource's state-of-charge would be if discharged based on its DEB each consecutive interval, assuming it was fully charged at hour-ending 11, and then assumes the resource is unavailable after being discharged in 16 RTPD intervals.

DMM calculates this availability metric in two ways:

- Scenario 1 assumes resources are subject to mitigation in every interval and therefore unable to ever bid above DEB
- Scenario 2 assumes resources are only unable to bid above their DEB during the intervals in which they were actually subject to mitigation

As with the simpler metric shown in Figures 3 and 4, DMM views these two scenarios as providing "bookends" for estimating the potential impact of different DEBs. Results of this analysis are shown in Table 2:

- Under the assumption that resources were always subject to mitigation, DMM's proposed DEB would allow resources to have a sufficient state-of-charge to be available 91.6 percent of the highest priced intervals.
- Based on intervals when resources were actually subject to mitigation in 2024 and 2025, DMM's proposed DEB would allow resources to have a sufficient state-of-charge to be available more than 99.6 percent of the highest priced intervals.
- The DEB proposed by the ISO would allow resources to have sufficient state-of-charge during almost all intervals (e.g., 99.8 percent) since the ISO's DEB would be significantly higher than the RTD LMP during virtually all intervals.

Table 2. Availability metric

	Scenario 1 **Assuming resources always subject to mitigation**	**Scenario 2** **Intervals when resources were subject to mitigation**
CAISO proposed DEB	99.8%	99.9%
DMM proposed DEB	91.6%	99.6%

Figures 5 and 6 provide additional hourly level data that provide additional insights from this availability metric. Figure 5 shows that the DEB proposed by DMM is frequently below the RTPD LMP during the seven-hour period from hour-ending 18 through 24. However, the availability metric shown in Table 2 indicates the DMM DEB rarely prevents storage resources from being available in the 16 highest-priced RTPD intervals. This reflects the fact that most of the highest 16 RTPD prices of the day tend to occur in hour 18 to 22, with a smaller portion of the 16 highest RTPD prices occurring in hours 23 to 24 (see black line in Figure 6).

This trend is further illustrated in Figure 6, which shows results of the availability metric summarized in Table 2 by hour. The green bars in Figure 6 show the availability metric (calculated under the assumption of mitigation during all intervals) for each hour, while the black line in Figure 6 shows the frequency that LMPs for each hour are among the highest 16 RTPD prices of the day. As shown in Figure 6:

- The green bars show that even under the assumption that mitigation occurs in all hours, the DEB proposed by DMM would not prevent batteries from being 100 percent available during the 16 highest RTPD prices occurring from hours 18 to 21.
- This availability metric drops to 84 percent of the highest priced hours occurring in hour 22, 69 percent in hour 23, and 45 percent in hour 24.
- The overall availability for all of these hourly values (weighted by the frequency of 16 highest priced RTPD intervals each hour) equals 91.6 percent, which corresponds to the availability value for Scenario 1 in Table 2.

As shown in Table 2, the overall availability metric is 99.6 percent for Scenario 2, which is based on intervals when resources were actually subject to mitigation. Thus, hourly results for Scenario 2 would show that the availability metric would remain at nearly 100 percent for all hours, including hours 22-24.

Figure 5. Frequency DEB < RTPD LMP by hour

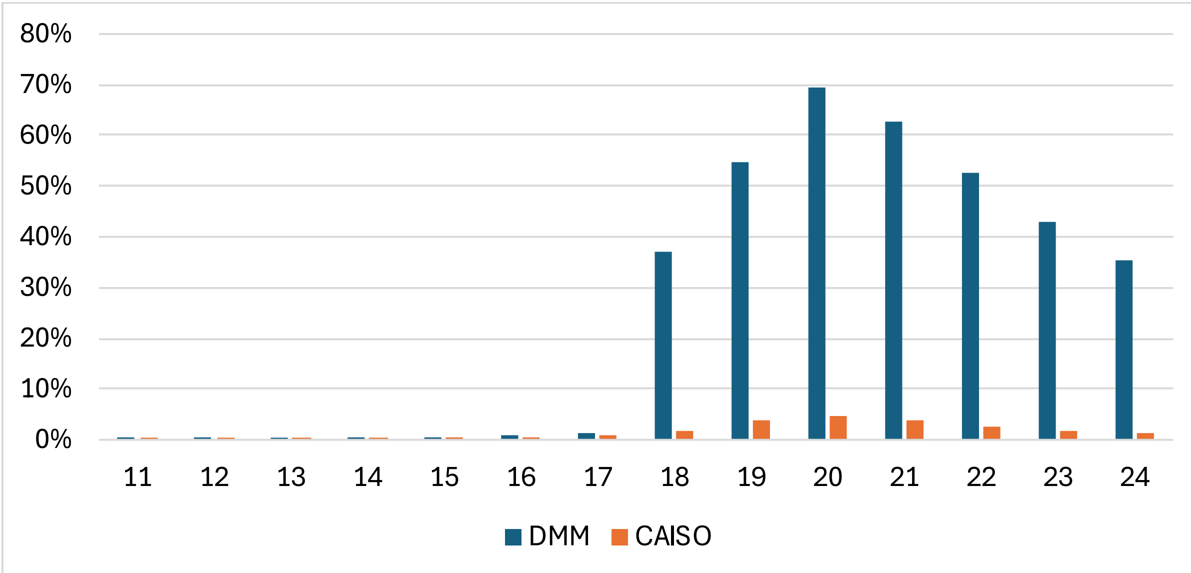
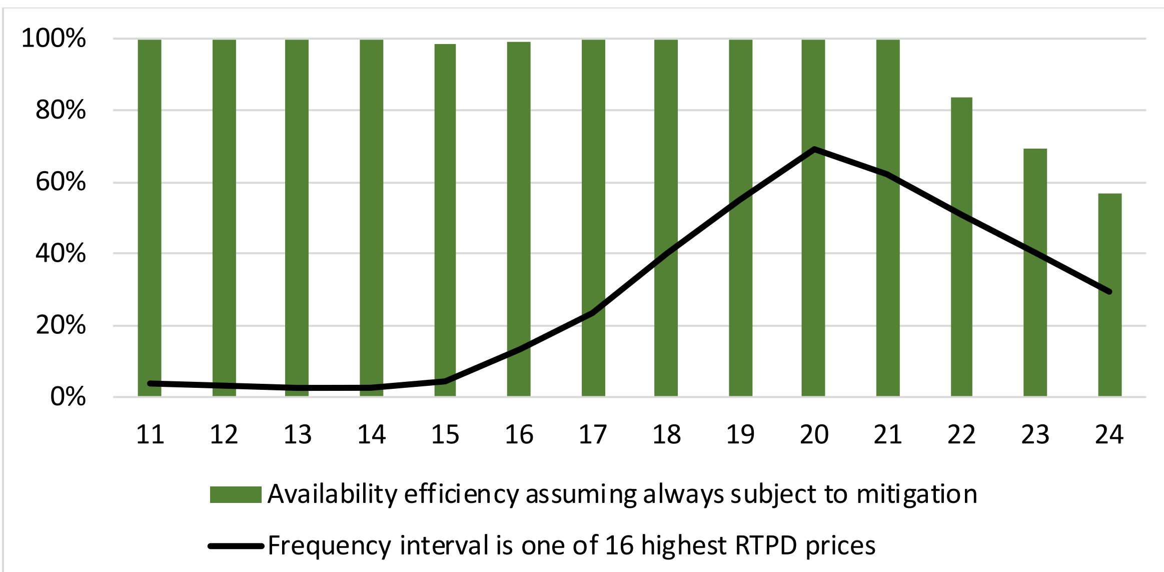


Figure 6. Hourly availability (assuming mitigation all intervals)



Revenue efficiency metric

The final metric calculated as part of this analysis measures the economic efficiency of the proposed DEBs based on the LMPs in each interval that batteries would be available for discharge if mitigated using each DEB. The initial steps of this calculation are the same as the availability metric summarized in the prior section of these comments. However, rather than simply counting the percentage of the highest price intervals that batteries would be available, this metric sums up the LMPs of each of the 16 highest priced intervals that batteries would be available under each DEB. The sum of these 16 RTPD prices is then compared to the sum of the highest 16 RTPD intervals of each day. The resulting metric represents the percentage of the maximum potential revenues that each resource could earn even when mitigated using the DEB.

For example, assume that a resource is being mitigated and its DEB is lower than the RTPD prices in hours 17 through 24, while all of the 16 highest priced RTPD prices on this day occurred in hours 18-21. This analysis would assume the battery is dispatched in hour 17 through 20, and then becomes unavailable for dispatch beginning in hour 21. The revenue efficiency metric would be calculated using the sum of LMPs for hours 17 to 20 (as the numerator), and the sum of LMPs for hours 18 to 21 (as the denominator).[7]

Since this metric is weighted by the LMP for each RTPD interval, DMM believes this metric most accurately captures the effectiveness of different DEBs in terms of both economic efficiency and system reliability. Results of this analysis are provided in Table 3.

As shown in Table 3, DMM's analysis shows that even under the assumption that resources are mitigated all intervals (Scenario 1), the DEB proposed by DMM would allow battery resources to be available to be dispatched for intervals accounting for 98.67 percent of the revenues that could be received if resources were optimally dispatched during the highest priced 16 RTPD intervals of each day.

Table 3. Revenue efficiency metric

	Scenario 1 **Assuming resources always subject to mitigation**	**Scenario 2** **Intervals when resources were subject to mitigation**
CAISO proposed DEB	99.85%	99.95%
DMM proposed DEB	98.67%	99.83%

[7] In this example, the only loss of the theoretically optimal dispatch of the resource due to mitigation would be the difference between the LMP in hour 17 compared to the higher LMP in hour 21.

Conclusion

DMM believes the various metrics provided in these comments demonstrate the DEB proposed by DMM is a much more accurate estimate of marginal costs of storage resources, better protects from the exertion of market power during peak hours, and does not materially limit storage resources' ability to prevent dispatch prior to the highest priced hours of the day.