Memorandum

To: ISO Board of Governors and WEIM Governing Body

From: Eric Hildebrandt, Executive Director, Market Monitoring

Date: February 1, 2024

Re: **Department of Market Monitoring report**

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

EXECUTIVE SUMMARY

This memo provides a review of upward adjustments made by grid operators to the load forecasts for the ISO balancing area during 2023. These adjustments are important aspects of the day-ahead and real-time markets that are needed to help ensure reliability. While these adjustments can have significant impact on market outcomes, prices, and costs, these adjustments are often not very transparent to market participants and stakeholders.

Over the course of 2023, ISO operators made significant changes in their methods for setting the load adjustments in these markets. These changes were designed to help ensure reliability within the ISO system and to avoid the need to curtail non-firm exports to other balancing areas under tight systems conditions. How the ISO determines these load adjustments will be even more important with implementation of the extended day-ahead market. Therefore, the Department of Market Monitoring (DMM) recommends that the ISO continue to engage with stakeholders on developing methods for determining optimal load adjustments, taking into consideration the tradeoff between increased costs and increased reliability benefits.

RESIDUAL UNIT COMMITMENT LOAD ADJUSTMENT

Background

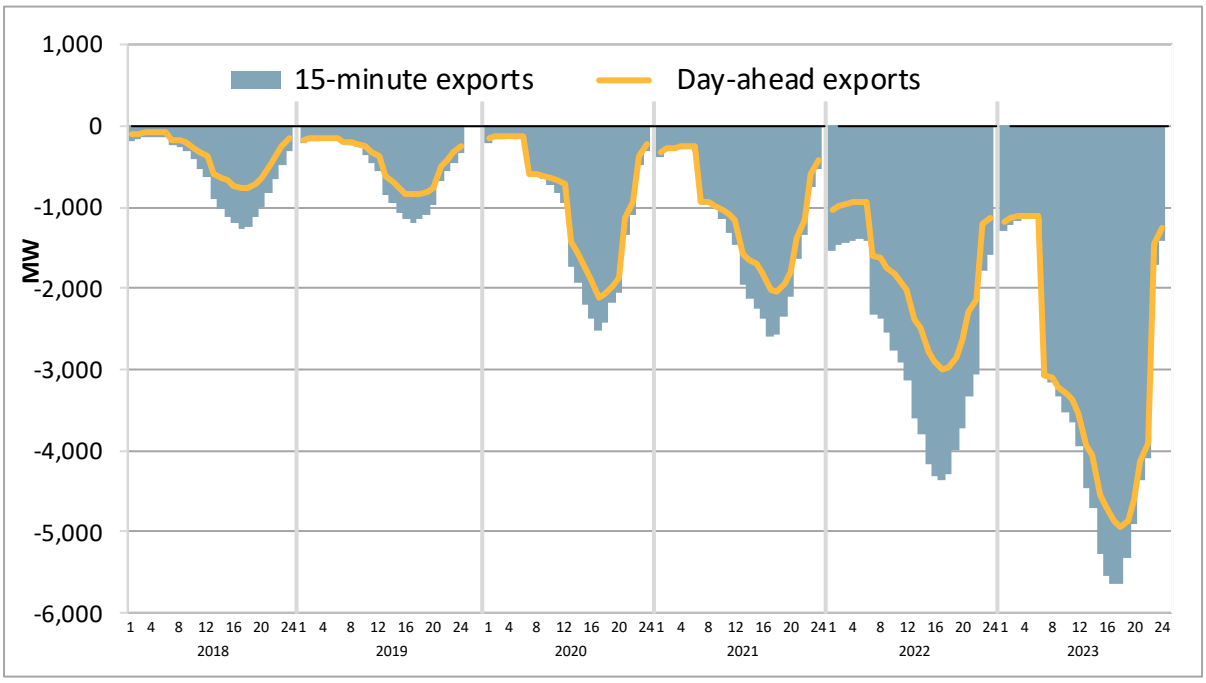
The residual unit commitment process runs immediately after the day-ahead market and procures capacity sufficient to bridge the gap between the amount of supply cleared in the day-ahead market and the amount needed to meet export schedules and real-time load. The day-ahead forecast for renewable resources may be higher than the actual renewable production. Similarly, the day-ahead load forecast may be significantly lower than the actual real-time load. In the absence of any load adjustment, the residual unit commitment capacity requirement would only be the day-ahead load forecast. Therefore, to ensure sufficient capacity in real-time to address the supply and demand uncertainty that may materialize, operators need to adjust hourly residual unit commitment capacity requirements to levels above the day-ahead load forecast.

The ISO resource adequacy requirements are set based on the amount of capacity needed to meet the balancing area's load and ancillary service requirements, plus some supply and load uncertainty. However, exports scheduled out of the day-ahead market are not included in resource adequacy requirements and must be met by supply offered into the market under tight system conditions. Over the last few years, the ISO has begun to take a variety of measures to ensure that firm exports scheduled in the day-ahead and real-time markets can be met by non-resource adequacy capacity under tight system conditions.

Analysis

Figure 1 shows average gross export schedules in the day-ahead and 15-minute markets for each hour of the third quarters for 2018 through 2023. Exports during these critical summer months have been increasing significantly over the last several years. As a result, more of the excess resource adequacy capacity intended to be available to address uncertainty is instead scheduled to support exports in the day-ahead market. This has made the residual unit commitment load adjustment a critical component of ISO balancing area reliability during tight supply conditions in the West. The load adjustment is necessary to reduce the amount of exports receiving day-ahead market awards if there is not sufficient capacity to meet ISO area load, uncertainty, and export awards.

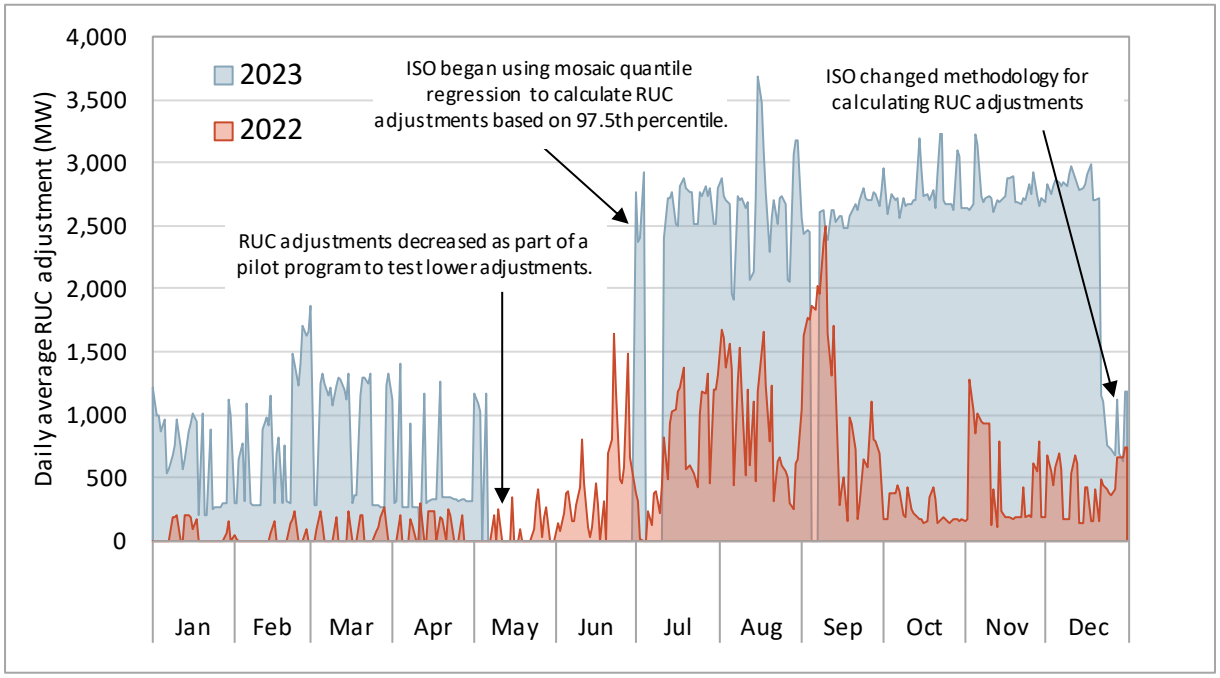
Figure 1. Exports out of California ISO balancing area, Q3 2018-2023



While a sufficiently large load adjustment is critical for balancing area reliability, high load adjustments increase market costs. DMM's December 2023 report to the WEIM Governing Body and ISO Board of Governors described increasing residual unit commitment costs through October driven by increasing load adjustments.[1]

Figure 2 compares daily average residual unit commitment load adjustments during 2022 (in red) to average daily adjustments made during 2023 (in blue). In 2022, load adjustments tended to be low during low load periods and high during tight summer conditions. In 2023, the ISO balancing area made significant changes to the methods used to determine the load adjustment at several points in the year.

Figure 2. Daily average residual unit commitment load adjustments, 2022-2023



As highlighted in Figure 2, the load adjustments dropped at the beginning of May as part of a pilot program to assess the use of much lower load adjustment. At the end of June 2023, the adjustments rose to very high levels when the ISO began using the mosaic quantile regression based on the 97.5th percentile of net load error between day-ahead and real-time. On December 21, operators again adjusted their method for determining the load adjustment so that adjustments were much lower.

[1] DMM memo to the ISO Board of Governors, December 6, 2023: https://www.caiso.com/Documents/DepartmentofMarketMonitoringUpdate-Dec2023.pdf

DMM understands that the ISO has been trying out different methods of determining the residual unit commitment load adjustments in an effort to improve this process and rely less on operator judgement. However, DMM has released a comprehensive report on the mosaic quantile regression model of net load uncertainty, questioning the efficacy of the method for several ISO market applications.[2] Preliminary data suggest that with the application of this method to residual unit commitment load adjustments, costs in that market will be substantially higher in the fourth quarter of 2023 than in the same quarter of 2022.

Under the extended day-ahead market, the imbalance reserve product is designed to attempt capacity procurement to address some uncertainty between the day-ahead and real-time markets. However, the ISO will continue needing to estimate uncertainty and incorporate this into the demand curve for the imbalance reserve product procurement. In addition, since supply clearing the extended day-ahead market will include virtual supply, the ISO will continue needing to make upward load adjustments in the residual unit commitment market to ensure the reliability of all balancing areas in the extended day-ahead market.[3]

Therefore, DMM recommends the ISO continue working with stakeholders on evaluating current load adjustment methods and on developing future enhancements.

REAL-TIME MARKET LOAD ADJUSTMENT

Background

Load adjustments are also made by the ISO in the real-time market to address load and resource uncertainty between the hour-ahead market and actual real-time conditions. Beginning in the hour-ahead market, ISO balancing area operators adjust the hour-ahead market load forecast upward during the evening net load ramps in order to procure sufficient capacity to meet demand and supply uncertainty that may materialize.

The extra capacity is usually from hourly block imports and extra internal resources committed or ramped up. However, during tight supply conditions, the hour-ahead market load adjustment is also a critical tool for preventing low priority exports from utilizing ISO balancing area supply that may be needed to meet load and ancillary service requirements.

Load adjustments are used in a similar manner in the 15-minute market to address supply and demand uncertainty that may materialize between the start of each 15-minute market run and real-time. Operators usually set the 15-minute market load adjustment to be almost identical to the adjustment that they used for the corresponding hour-ahead market's load adjustment. Therefore, for visual clarity, the graphs below show the load adjustments from either the hour-ahead or15-minute market.

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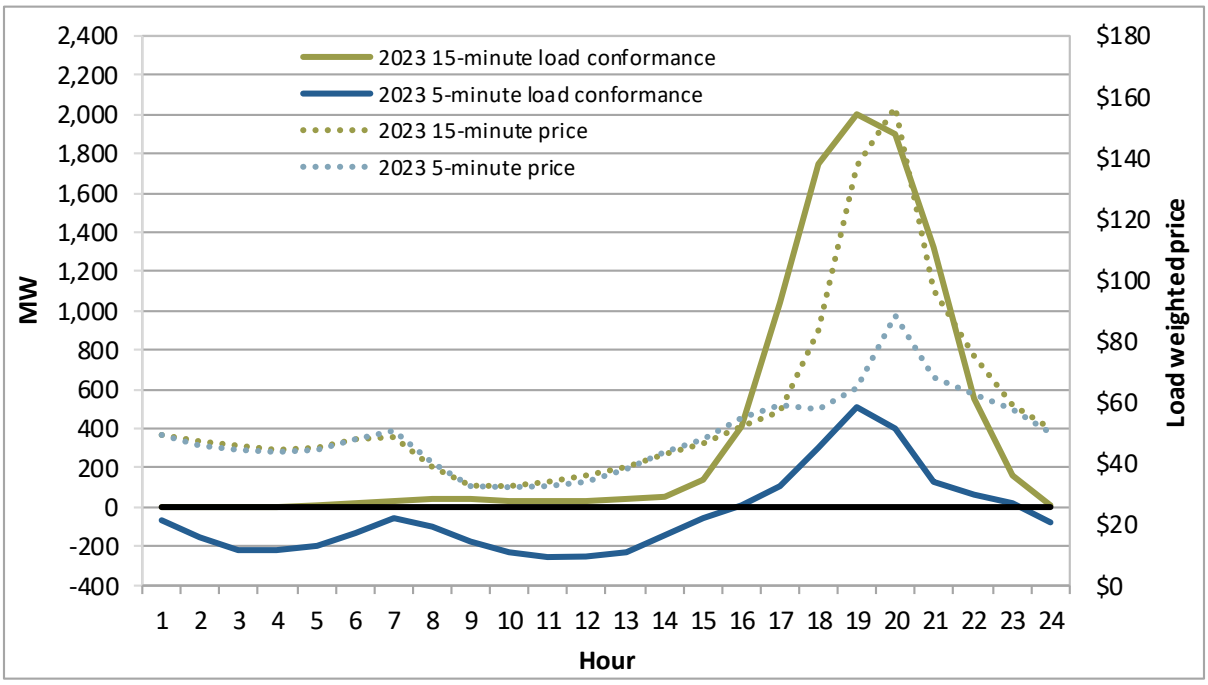
[2] *Review of mosaic quantile regression for estimating net load uncertainty*, Department of Market Monitoring, November 20, 2023: https://www.caiso.com/Documents/Review-of-the-Mosaic-Quantile-Regression-Nov-20-2023.pdf

[3] For a more detailed discussion of these issues, see DMM's May 9, 2023 memo to the ISO Board and WEIM Governing Body, pp 2-3 and p 6: https://www.caiso.com/Documents/DepartmentofMarketMonitoringReport-May2023.pdf

Analysis

Hour-ahead and 15-minute market load adjustments play a critical role in the ISO balancing area reliability, but they also significantly impact market costs. Figure 3 shows hourly average load adjustments for the 15-minute market (solid green line) and 5-minute market (solid blue line) in the third quarter of 2023. The dotted green and blue lines in Figure 2 show hourly average prices for these two markets during this period.

Figure 3. 15-minute and 5-minute market prices and load adjustments, Q3 2023

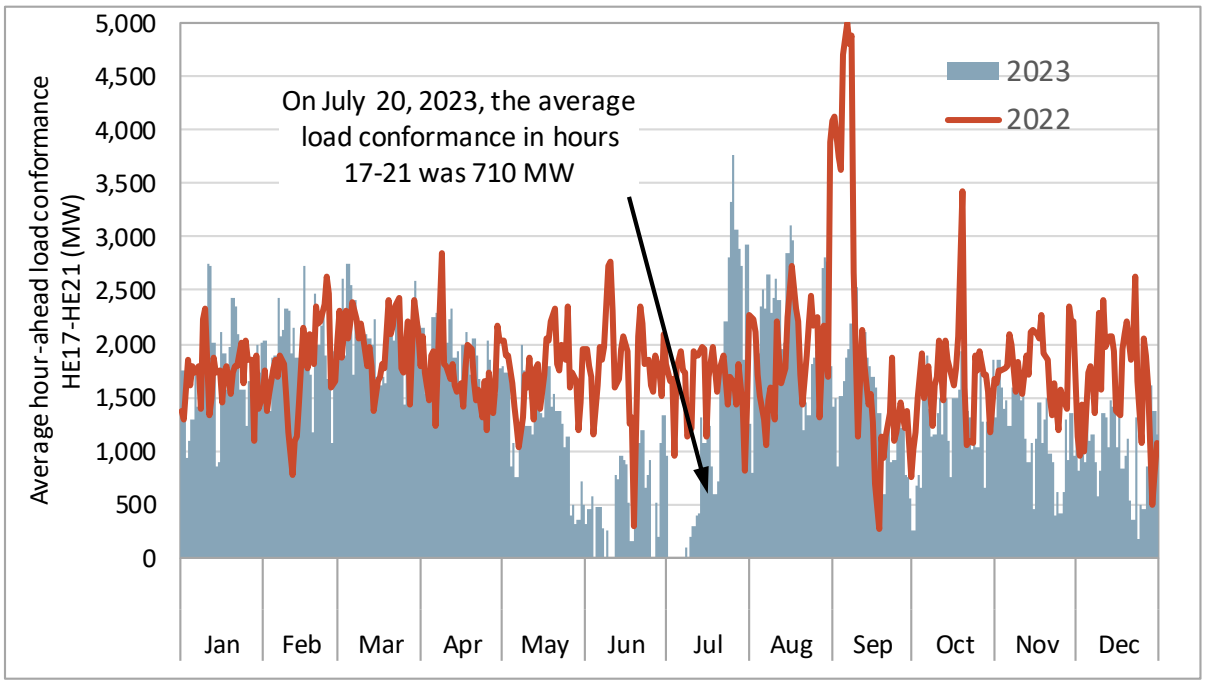


As shown in Figure 3, the 15-minute market load adjustment is significantly higher than the 5-minute market load adjustment during the evening peak net load hours. These are the same hours in which the 15-minute market price is significantly higher than the 5-minute market price. When the 15-minute market load is higher than the 5-minute market load, load-serving entities buy this extra load at the higher 15-minute market price and then sell it back at the lower 5-minute market price. Therefore, the high 15-minute market load

adjustment during the hours when those 15-minute prices are much higher than 5-minute market prices creates an extra cost that is allocated to load.[4]

The ISO balancing area made significant adjustments to its methods for determining these important hour-ahead and 15-minute market load adjustments during the summer of 2023. Figure 4 compares the daily average hour-ahead market load adjustments for hours-ending 17 to 21 during 2022 (in red) and 2023 (in blue). These load adjustments appeared similar over the first few months of 2022 and 2023.

Figure 4. Average daily hour-ahead market load adjustments
Hours-ending 17-21, 2022-2023



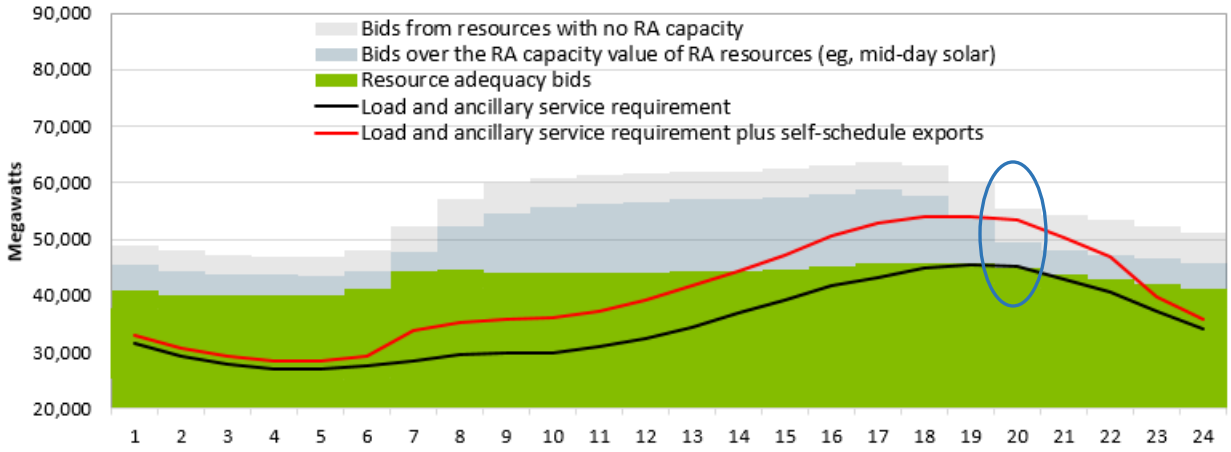
[4] The larger load adjustment in the 15-minute market will contribute to causing higher prices in the 15-minute market than in the 5-minute market. For the third quarter of 2023, another major contributor to price differences between these two markets during peak net load hours in balancing areas across the WEIM was the ISO balancing area limiting almost all WEIM transfers into its area in the hour-ahead and 15-minute markets. The ISO balancing area did not limit its import WEIM transfers in the 5-minute market.

DMM will publish a more detailed analysis of this WEIM transfer limitation and its significant market impacts across the WEIM throughout most of the third quarter in the upcoming quarterly report for Q3 2023. See also DMM's December presentation to the Body of State Regulators on significant July 2023 market issues impacting the WEIM at: https://www.caiso.com/Documents/Presentation-for-WEIM-Body-of-State-Regulators-July-2023-Market-Issues-Dec-8-2023.pdf

In late May 2023, the ISO balancing area began a period of substantially lower peak period load adjustments. This continued through July 20, 2023, when the average peak period load adjustment in the hour-ahead market was just 710 MW. On July 20, demand and supply conditions changed quickly after the hour-ahead market for hour-ending 20 awarded schedules to over 8,000 MW of self-scheduled exports out of the ISO balancing area.

As shown in Figure 5, despite the high realized uncertainty on July 20, there ended up being sufficient capacity from resource adequacy resources to meet the ISO balancing area load and ancillary service requirements during all hours. However, total capacity was almost insufficient for also supplying the more than 8,000 MW of exports that had received hour-ahead market awards for hour-ending 20.

Figure 5. Real-time market supply bids and demand requirements (July 20, 2023)



As a result, the ISO balancing area declared a level 1 Energy Emergency Alert (EEA 1) for this hour on July 20. A larger hour-ahead market load adjustment would likely have reduced the quantity of exports receiving market schedules, creating more headroom for comfortably serving load and export schedules. By the next day, load adjustment made in the ISO hour-ahead market increased significantly compared to the lower load adjustments used from late May through July 20. The trend of higher real-time load adjustments continued through the summer and the rest of 2023.

CONCLUSION

The modifications made by the ISO during 2023 highlight the importance of utilizing load adjustments to account for uncertainty, and how the ISO is still refining how to determine these adjustments in its different markets. DMM recognizes that it is extremely difficult to develop effective models for estimating load and supply uncertainty several hours into the future. However, improvements to these estimates could have major reliability and costs impacts. These benefits would go to the ISO as well as neighboring balancing areas hoping to schedule reliable exports. Therefore, DMM encourages the ISO to continue working to enhance its uncertainty estimates and to openly engage stakeholders in these efforts.