



California ISO

Analysis of battery bid cost recovery and bid mitigation issues

Department of Market Monitoring

Storage Bid Cost Recovery and Default Energy Bids Enhancements

Meeting on Revised Straw Proposal

September 11, 2024

Overview of DMM analysis

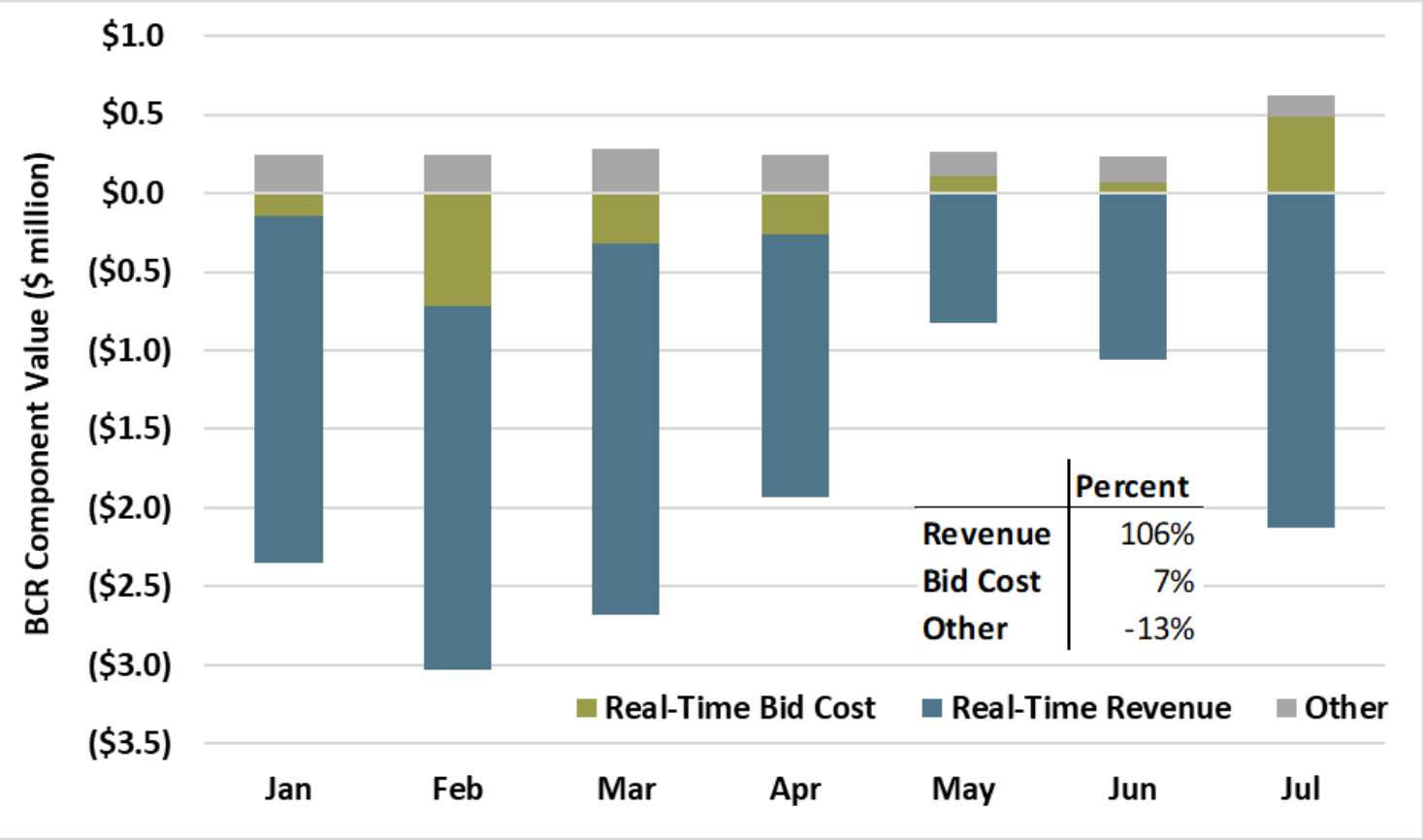
- **Bid cost recovery for batteries**

- In first half of 2024, real-time BCR for battery state-of-charge (SOC) induced buy/sell backs of day-ahead schedules have been primarily driven by negative revenues – not bid costs.
- The ISO's initial proposal to disallow BCR when SOC induces day-ahead schedule buy/sell backs addresses both sources of BCR; not just the bid cost.

- **Mitigation of batteries on critical days**

- Mitigation of batteries has had minimal impact on dispatch of batteries prior to peak net load hours.
- Analysis shows that even if batteries bid high (i.e., \$1,000+/MWh), mitigation would likely have had minimal impact on dispatch prior to the peak net load hours on critical days.
- This indicates that more efficient bidding incentives created under ISO's initial proposal would not have been undermined by local market power bid mitigation.

Real-time BCR from state-of-charge induced buy/sell backs has been primarily driven by negative revenues – not bid prices



This chart shows BCR payments from Jan to July 2024 from buy-backs of day-ahead schedules due to insufficient state-of-charge.

Negative revenues are the primary driver of the BCR, not bid costs.

The ISO’s initial proposal addressed both the revenue and bid cost portions of BCR

Analysis of local market power mitigation on battery dispatch

- Sample includes the 9 days in summer 2023 when Restricted Maintenance Operations (RMO) in effect
- Historical analysis
 - Calculates total increase in battery dispatches due to bid mitigation
- Counterfactual analysis
 - Assumes batteries bid at the \$1,000/MWh bid cap during all hours due to changes in BCR rules
 - Assumes all batteries select the storage default energy bid option (for a 4-hour battery, includes opportunity cost based on 4th highest price in day-ahead market)
 - Calculates potential impact of mitigation with higher bid prices

Local market power mitigation procedures

- Mitigation triggered when positive net marginal congestion cost from constraints found to be structurally non-competitive is positive
 - 3 pivotal supplier test used to determine structural competitiveness of constraints
- When subject to mitigation, bids are capped to the maximum of:
 - Default energy bid for unit (DEB)
 - Competitive locational marginal price (competitive LMP)

$$\text{CLMP} = \text{system marginal energy cost (SMEC)}^* + \text{congestion on } \underline{\text{competitive}} \text{ constraints} + \text{loss component}$$

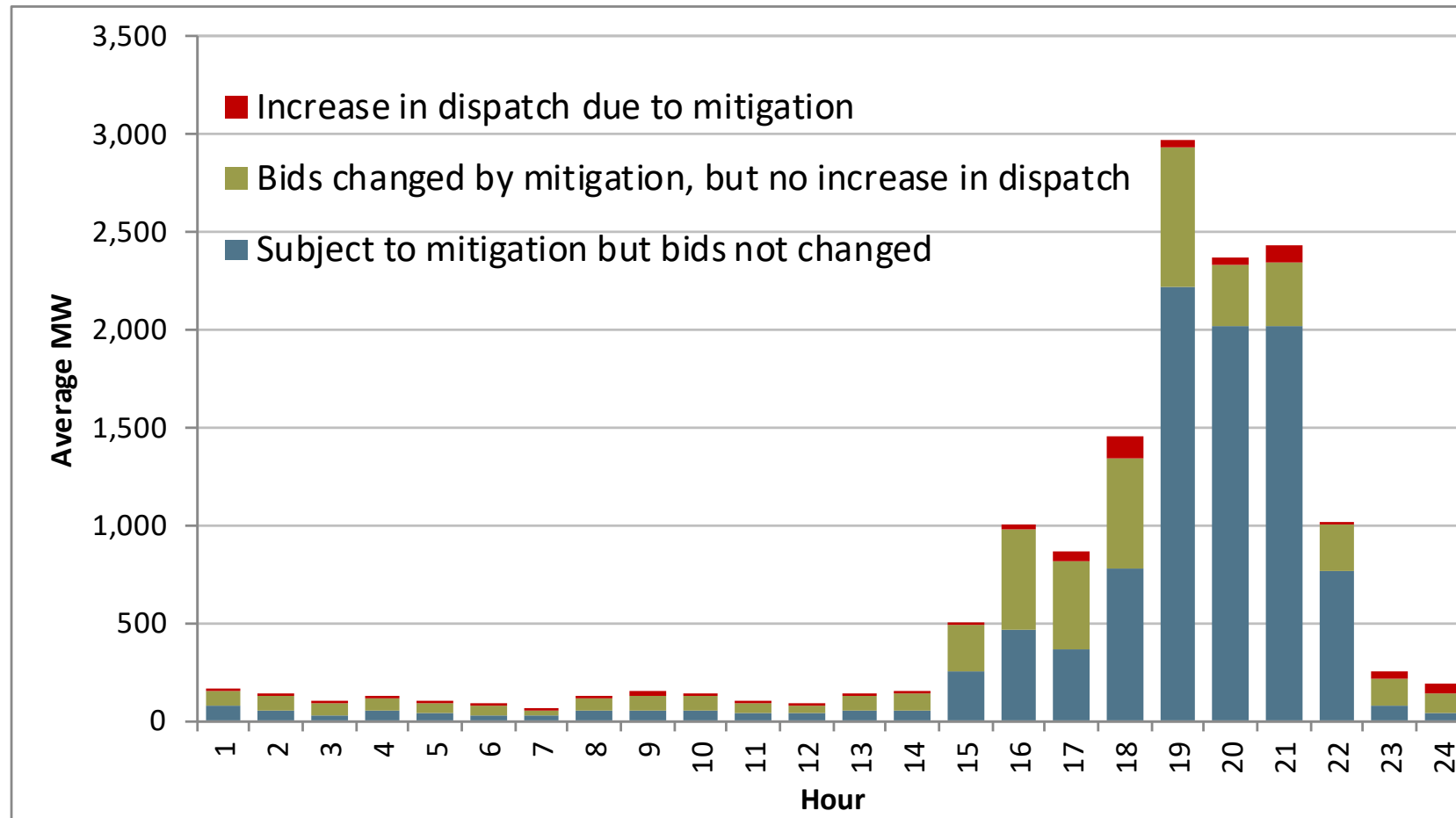
*components calculated from the LMPM reference bus rather than load distributed reference bus

Default energy bids (DEBs) for batteries

- Storage DEB for batteries includes projected intra-day opportunity cost
 - For a 4-hour battery in real-time, 4th highest LMP in day-ahead market
 - Also includes charging cost, variable O&M component and 10% adder
- A significant portion of batteries (~1,200 MW) have chosen very low *cost-based* DEB option instead of storage DEB designed for batteries
 - Cost based option for storage = \$0.39/MWh
 - Average storage DEB = \$146/MWh (August 2023)
 - DMM's analysis of potential impacts of mitigation after BCR changes assumes that all batteries switch to the storage DEB option

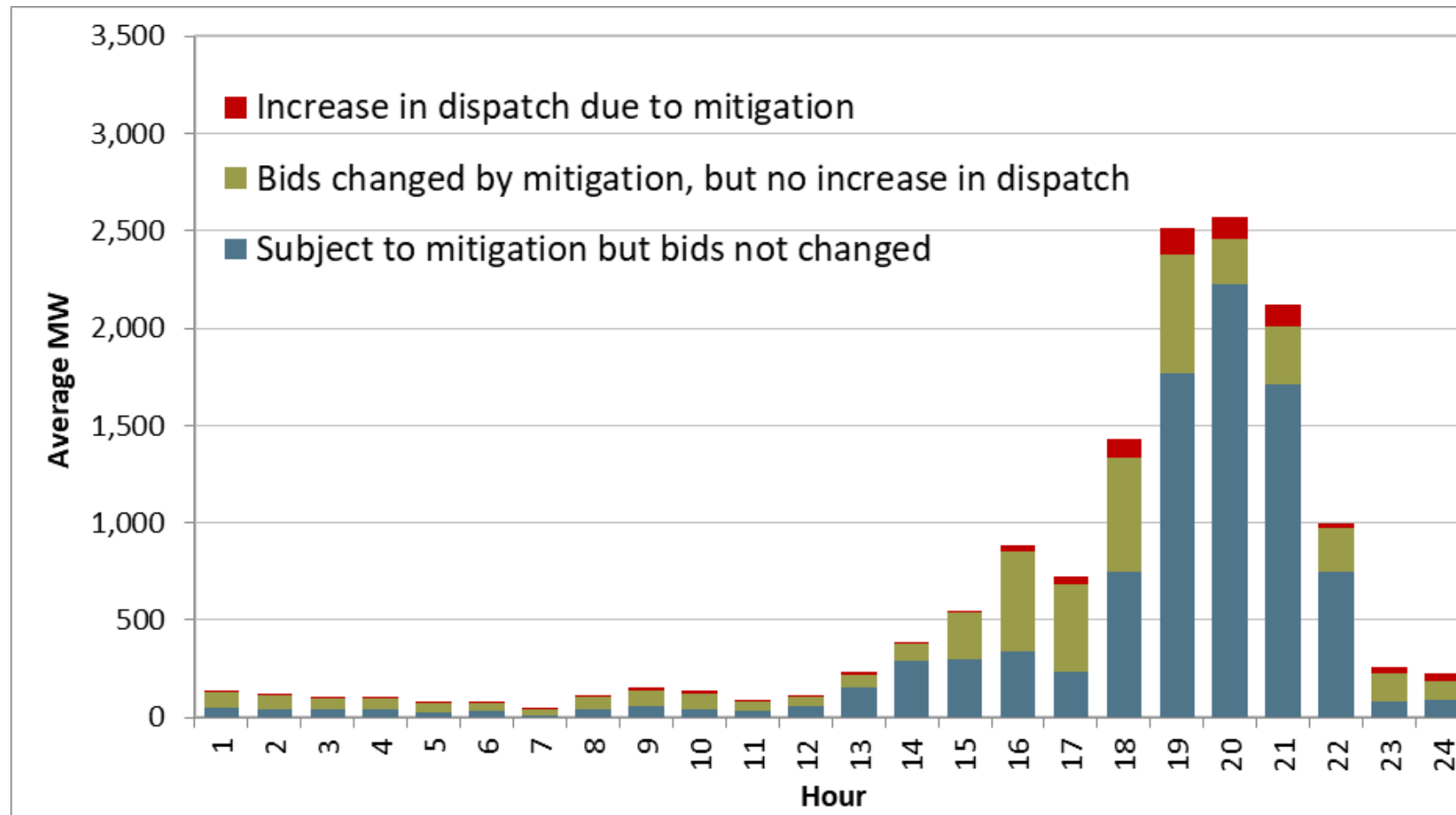
Actual impact of bid mitigation on dispatch of batteries

Hourly averages for all 9 RMO days in summer 2023 - FMM



Actual impact of bid mitigation on dispatch of batteries

Hourly averages for all 9 RMO days in summer 2023 - RTD

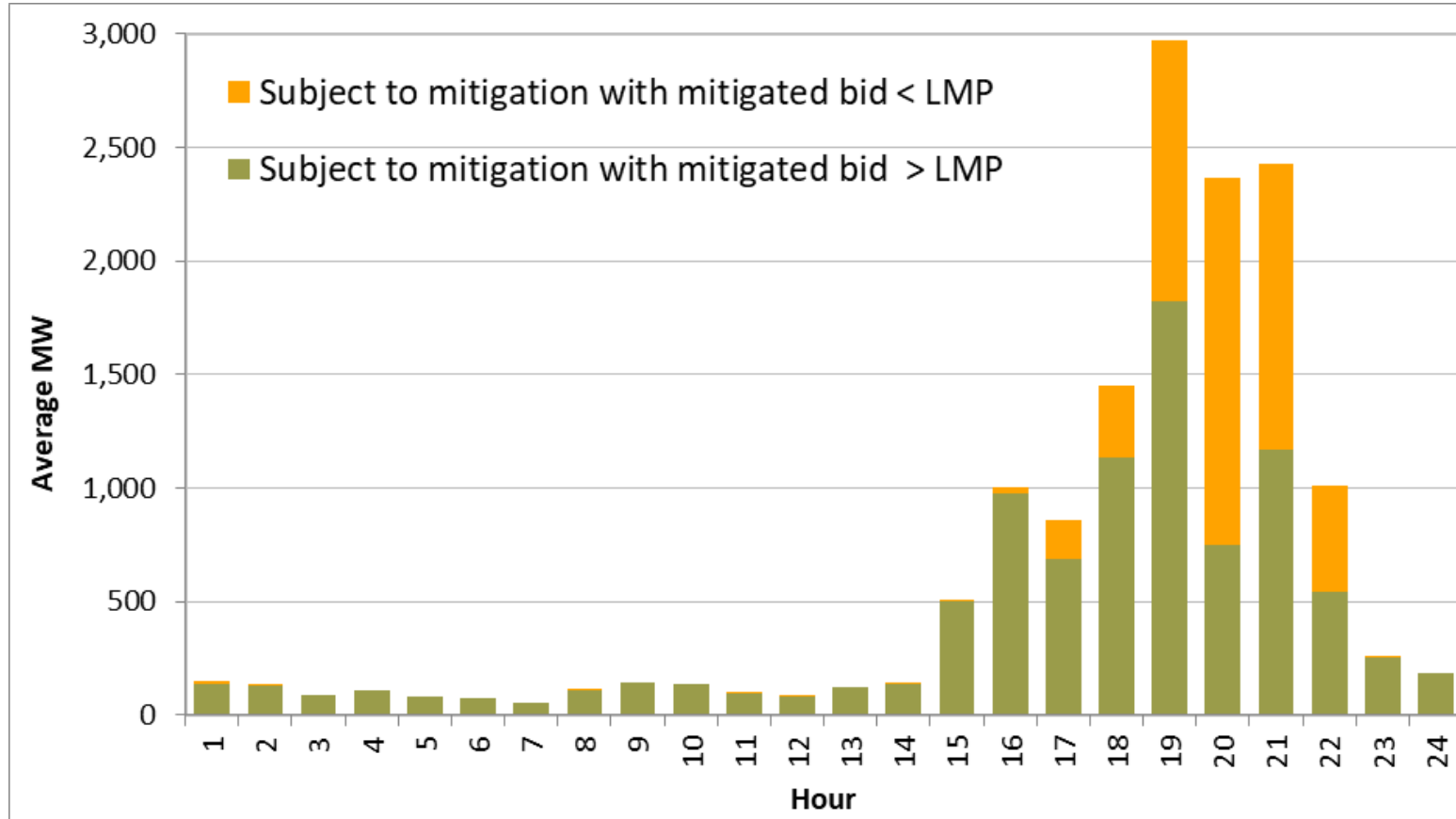


Analyzing potential impacts of mitigation with BCR changes

- ISO proposal provides incentive for batteries to bid their best estimate of actual real-time opportunity costs in hours prior to the peak net load hours
 - This could lead to higher priced bids in hours prior to the peak net load hours
 - For this study, batteries are assumed to bid higher than mitigated bid (e.g., \$1,000) in all hours
 - Assumes all batteries choose opportunity cost storage DEB option
- Under this scenario, potential impact of mitigation can be assessed as follows:
 - Calculate each unit's mitigated bid (Max of DEB or CLMP)
 - If mitigated bid > unit's LMP, then mitigation has no impact
 - If mitigated bid < unit's LMP, then mitigation can cause unit to be dispatched

Potential impact of bid mitigation with higher energy bids

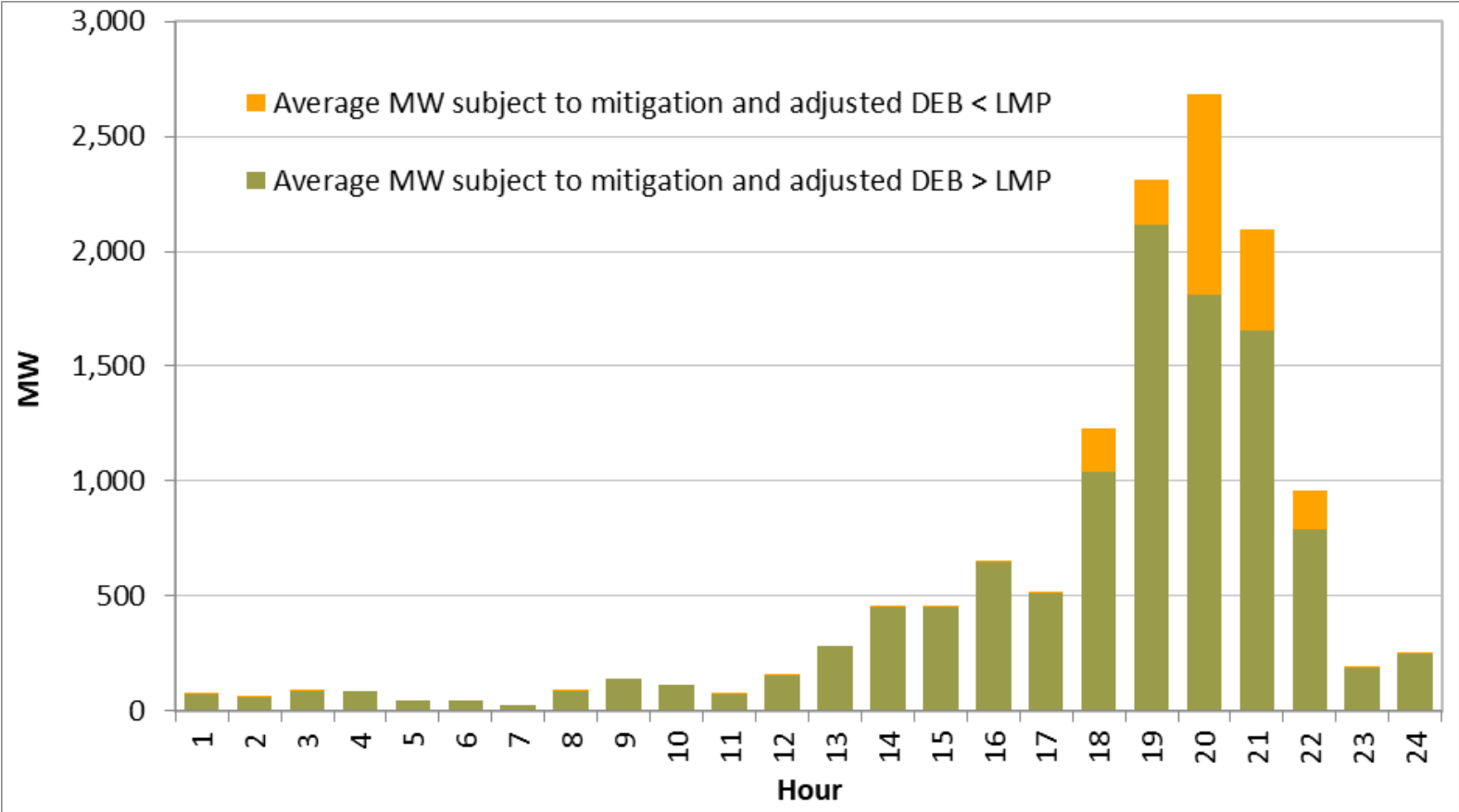
Hourly averages for all 9 RMO days in summer 2023 - FMM



Bid mitigation would not have been likely to cause significant capacity to be dispatched prior to peak net load hours (19-22) on critical reliability days.

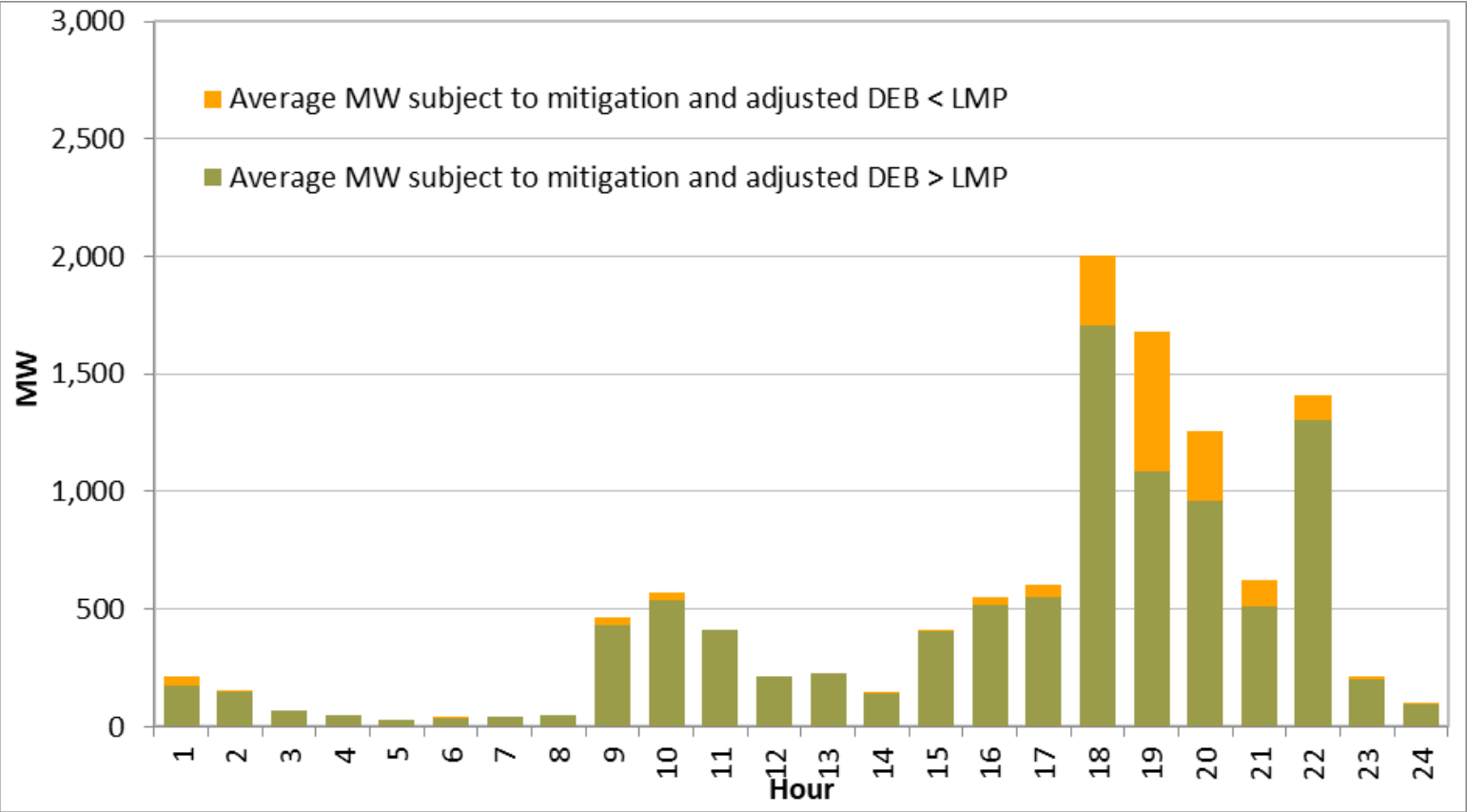
Potential impact of bid mitigation with higher energy bids

Hourly averages for all 9 RMO days in summer 2023 - RTD



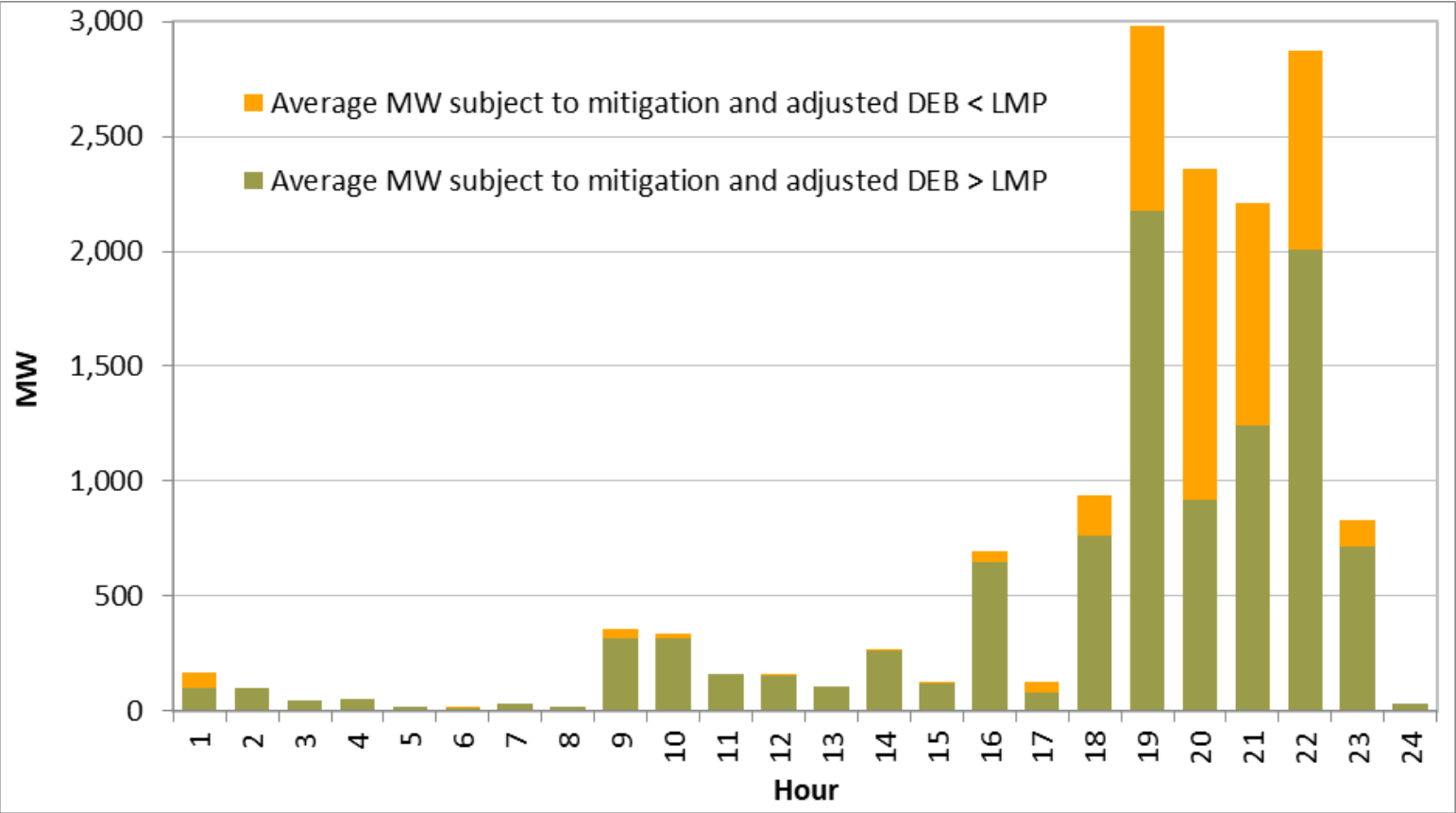
Potential impact of bid mitigation with higher energy bids

Hourly averages for all 9 RMO days in summer 2024 - FMM



Potential impact of bid mitigation with higher energy bids

Hourly averages for all 9 RMO days in summer 2024 - RTD



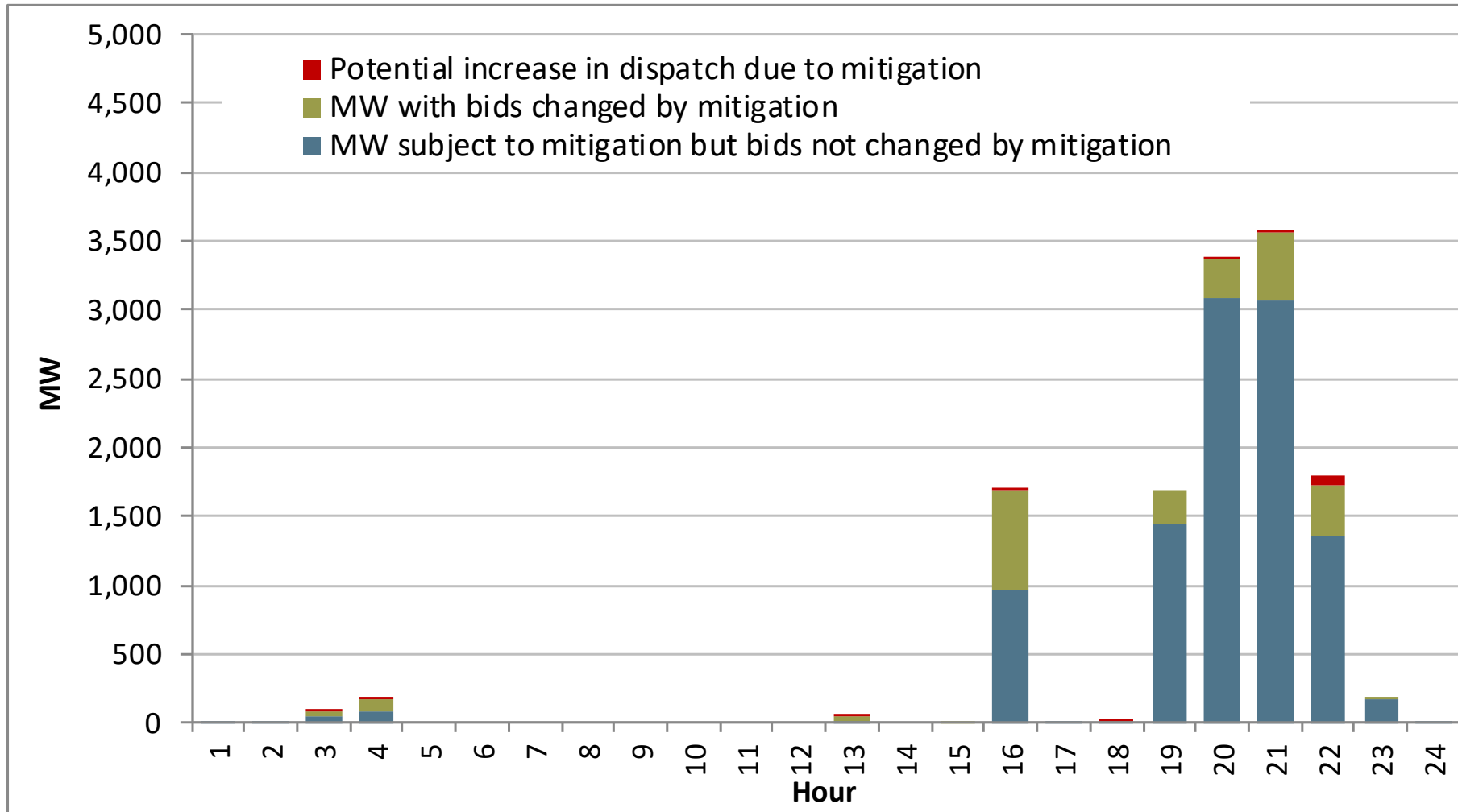
Default energy bid enhancements

- Current storage DEB should be enhanced to reflect hourly intra-day opportunity costs in real-time, but current storage DEB for batteries appears to be an infrequent driver changes in real-time dispatch in the sample.
- DEB enhancements not needed prior to implementing ISO's BCR proposal.
- Additional *ex post* settlement enhancements can effectively address instances where resources incur losses associated with day-ahead schedule buy-back when mitigation leads to depleted SOC.

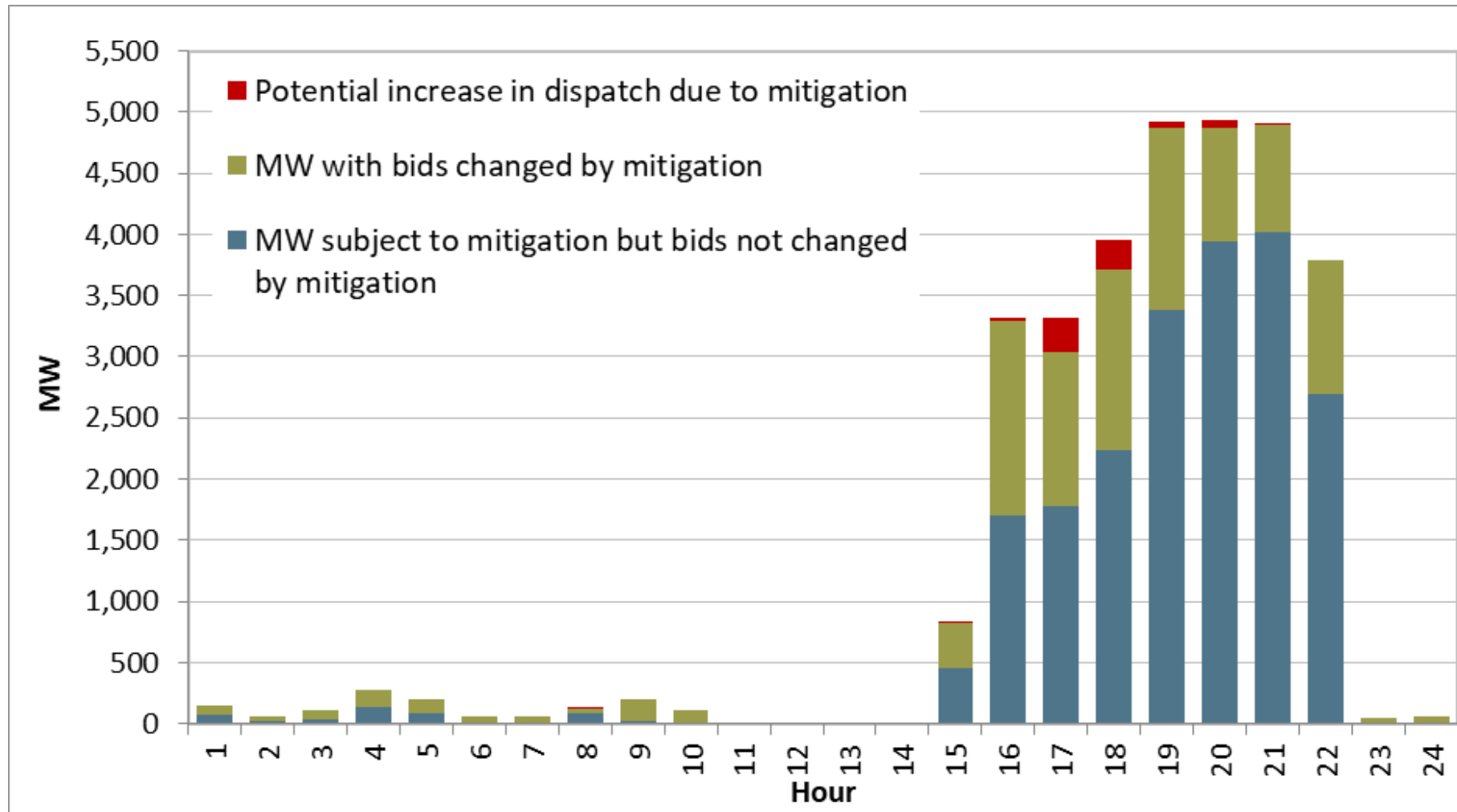
Appendix

Daily results for all 9 Restricted Maintenance Operations (RMO) days in 2023 (FMM)

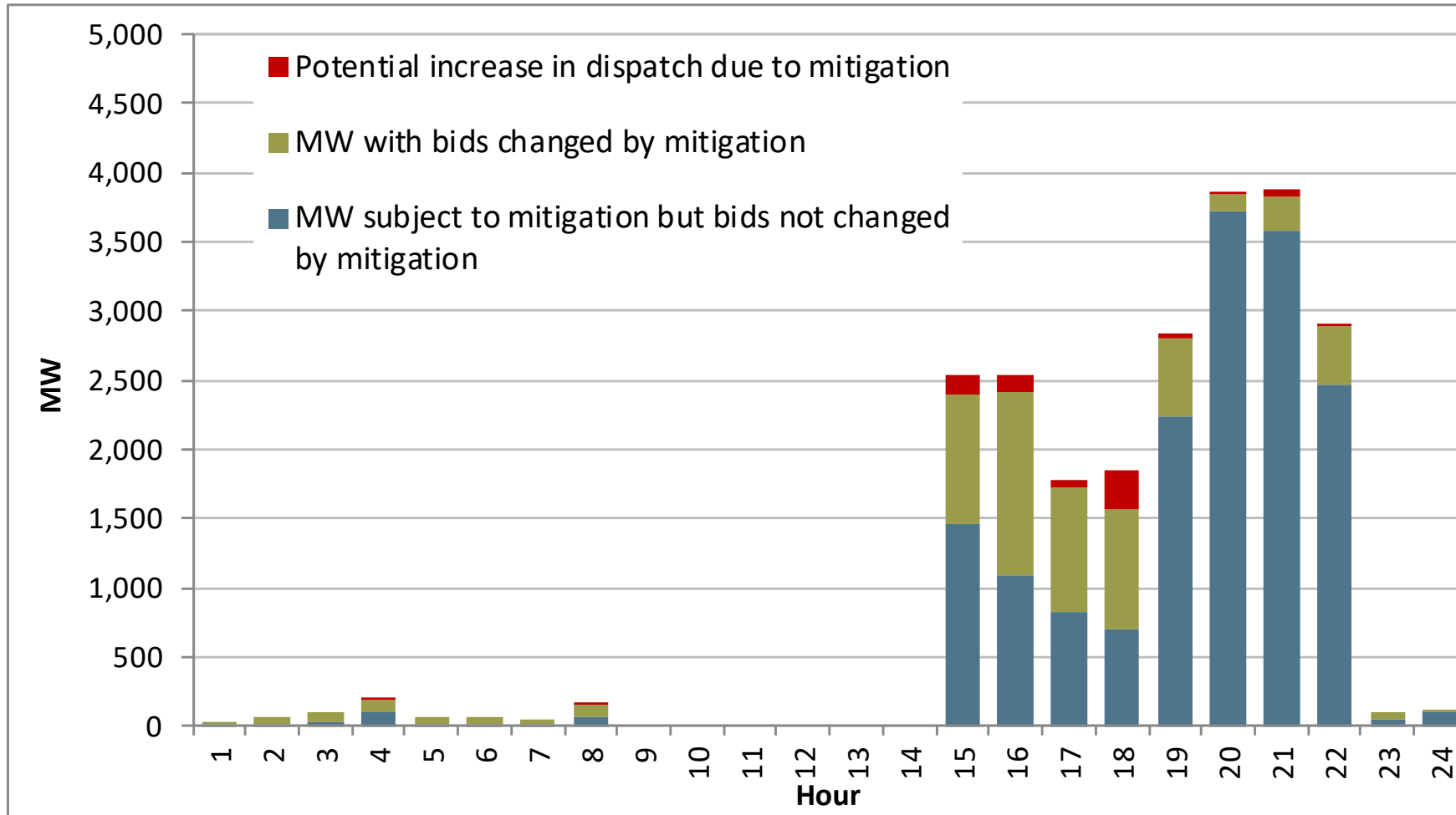
Impact of battery bid mitigation - July 20, 2023



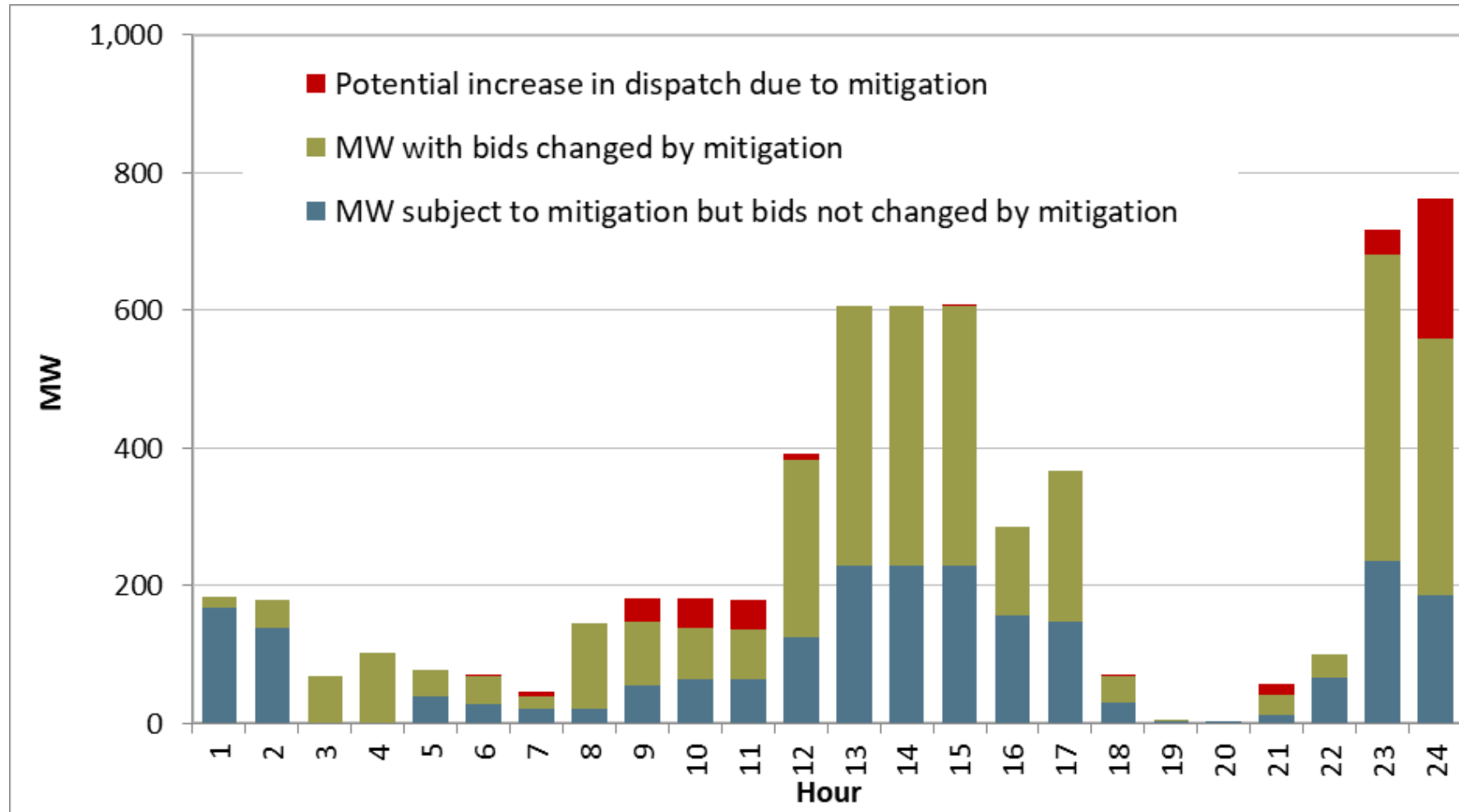
Impact of battery bid mitigation - July 25, 2023



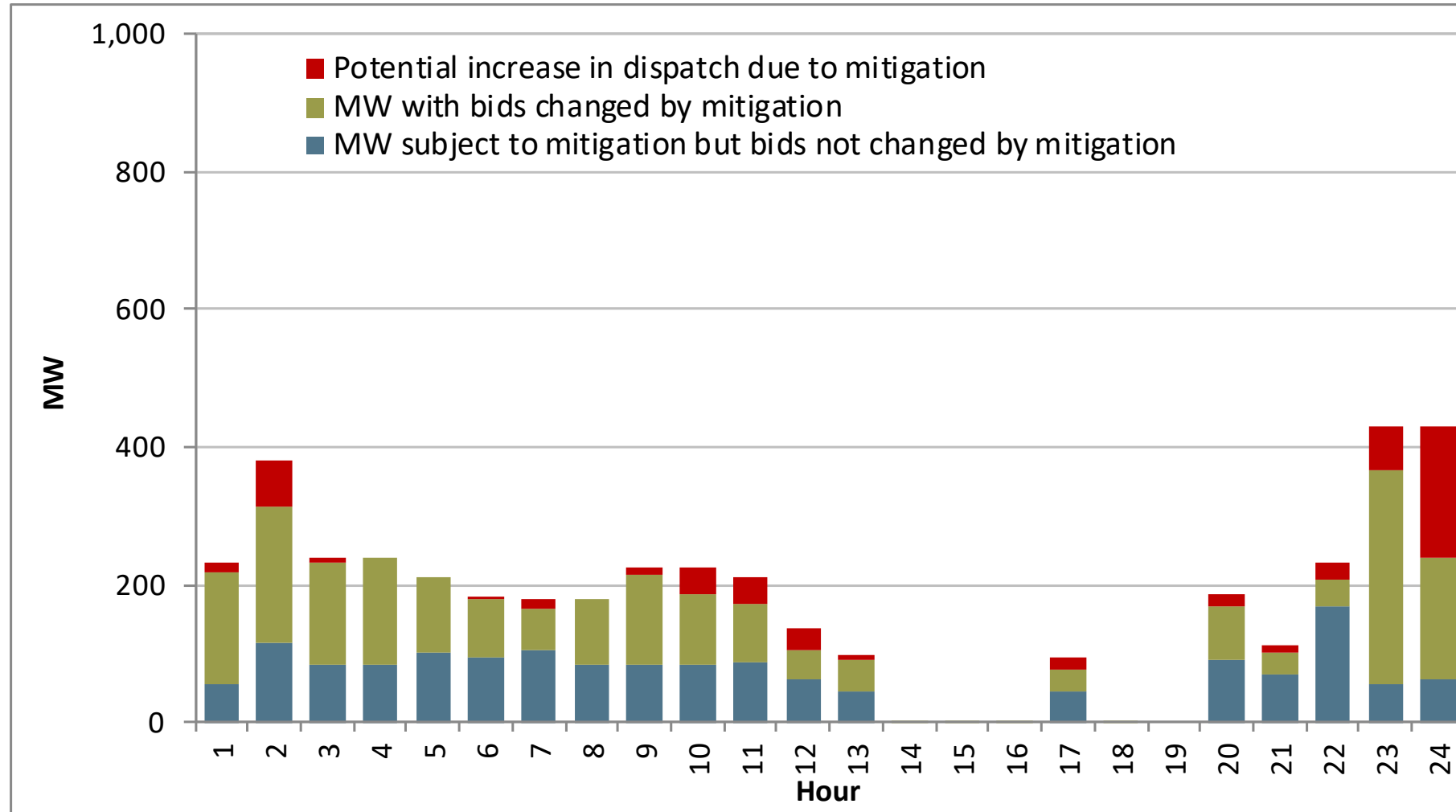
Impact of battery bid mitigation - July 26, 2023



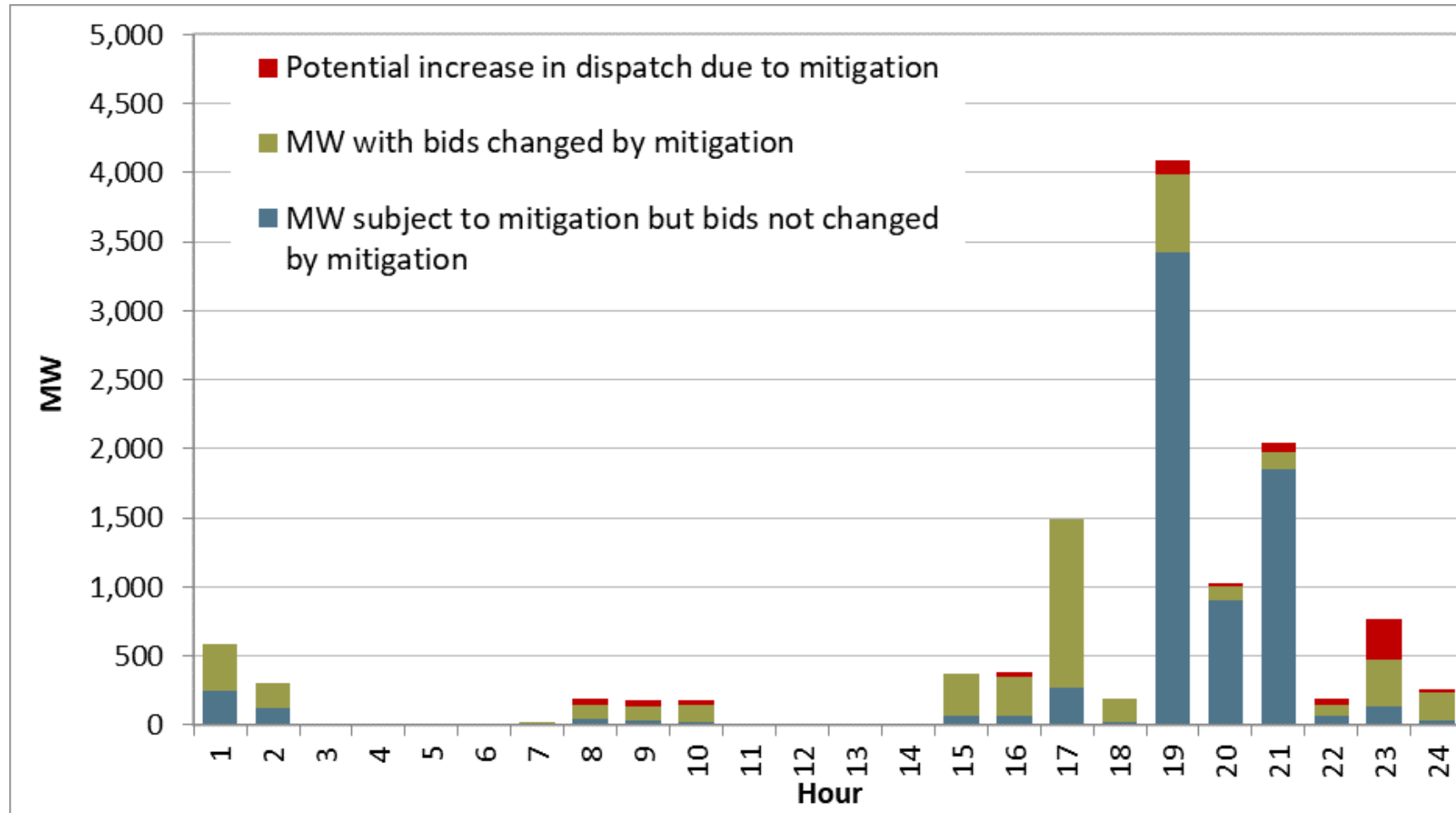
Impact of battery bid mitigation – August 15, 2023



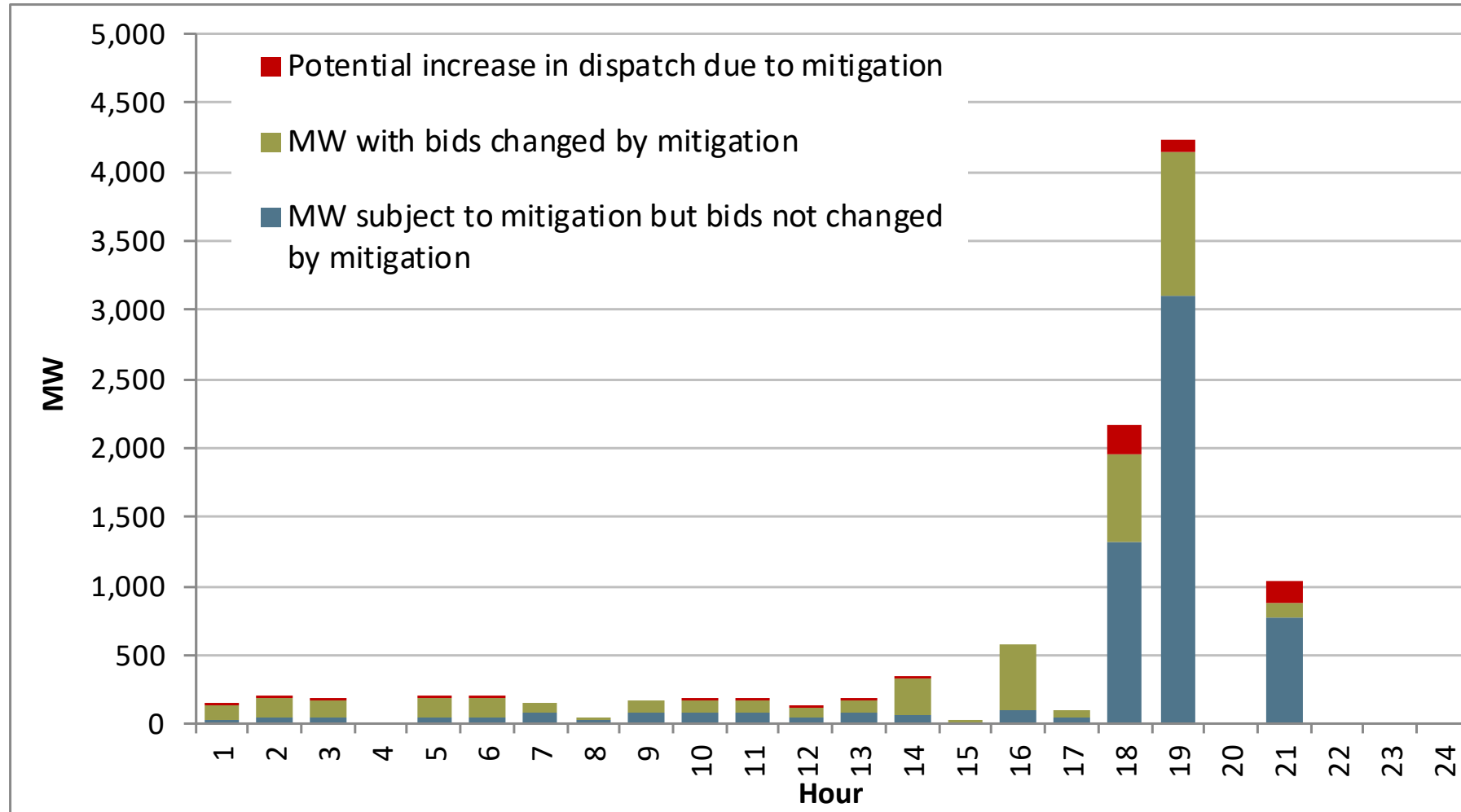
Impact of battery bid mitigation – August 16, 2023



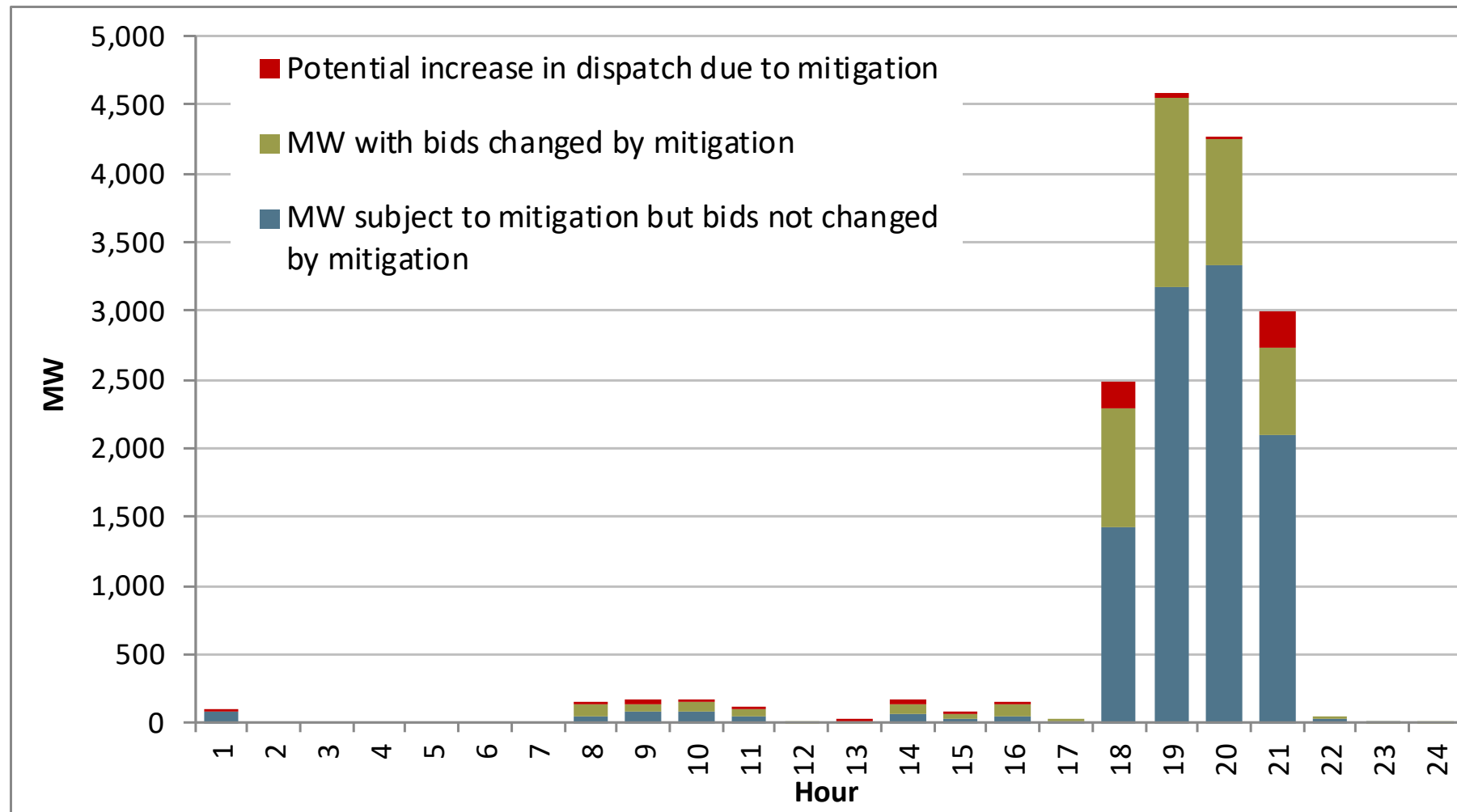
Impact of battery bid mitigation – August 17, 2023



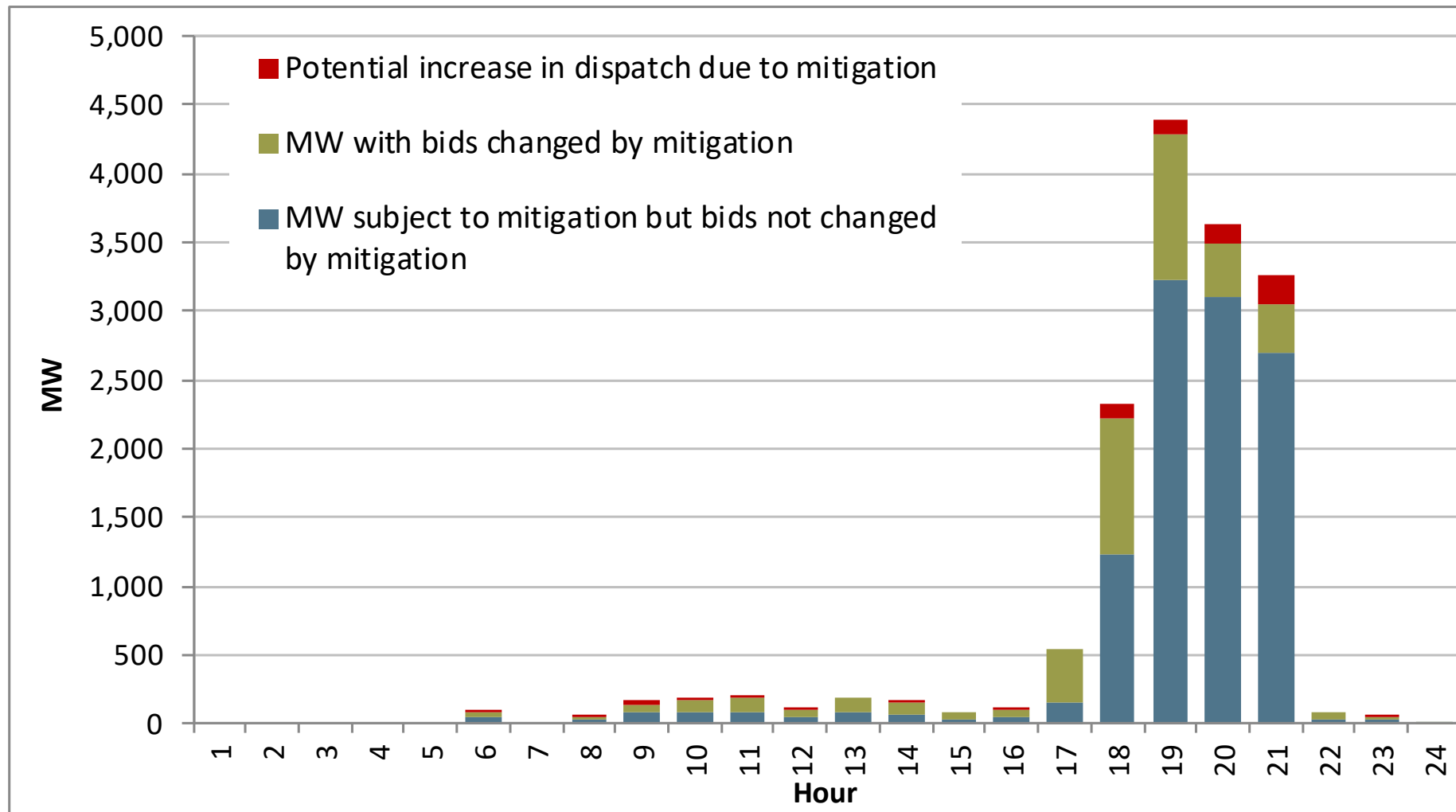
Impact of battery bid mitigation – August 28, 2023



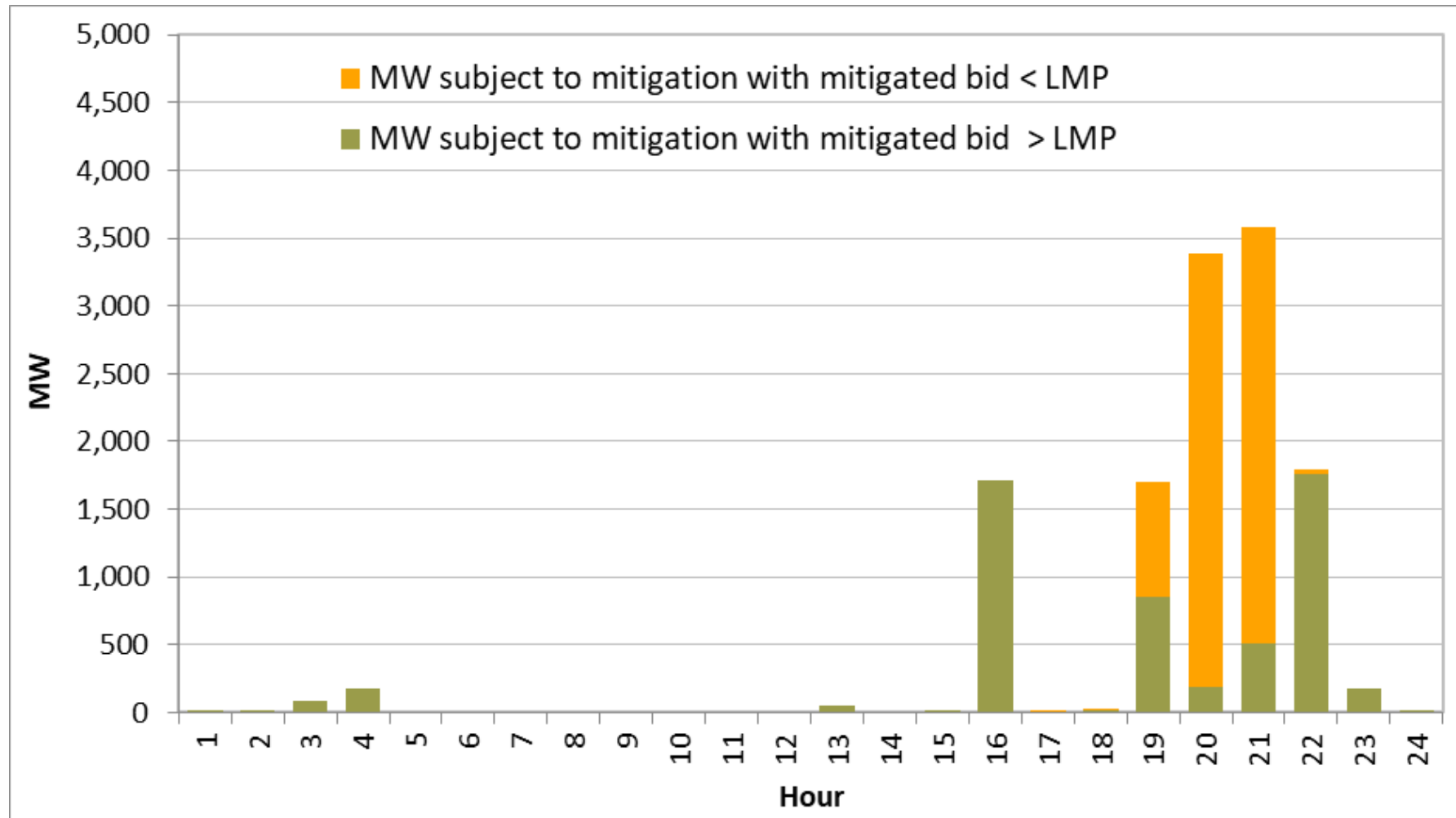
Impact of battery bid mitigation – August 29, 2023



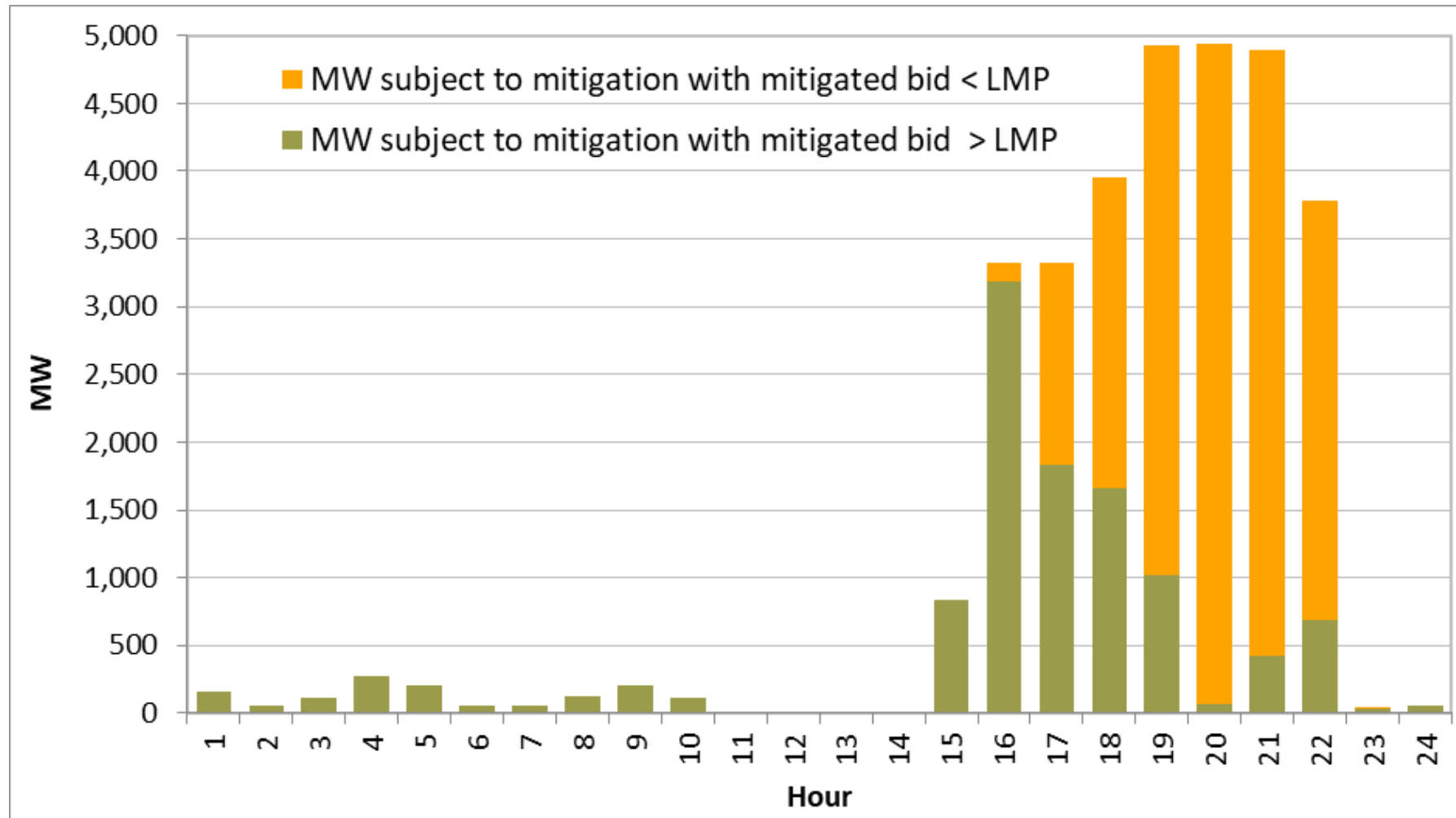
Impact of battery bid mitigation – August 30, 2023



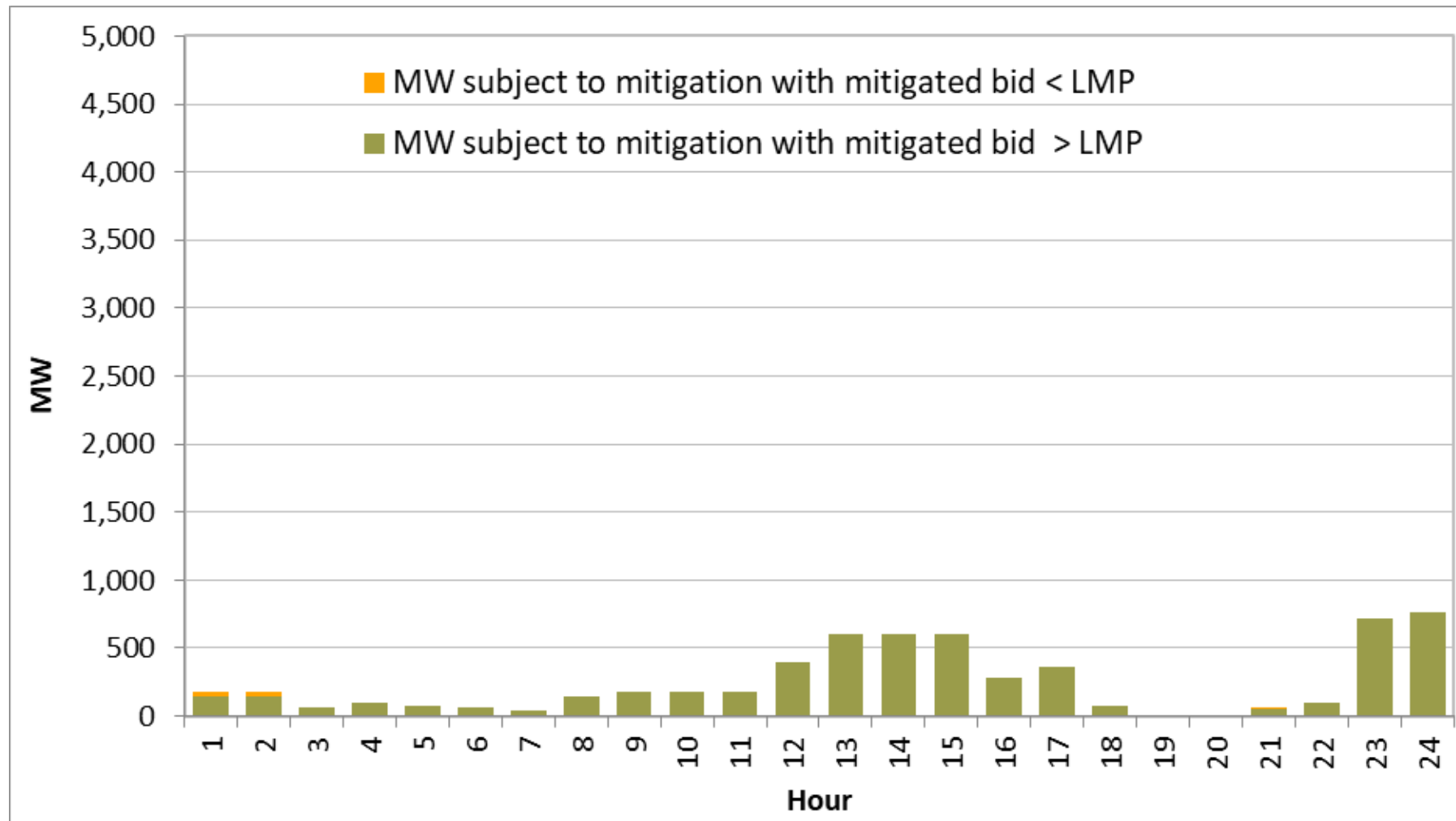
Potential impact of bid mitigation with higher bids – July 20, 2023



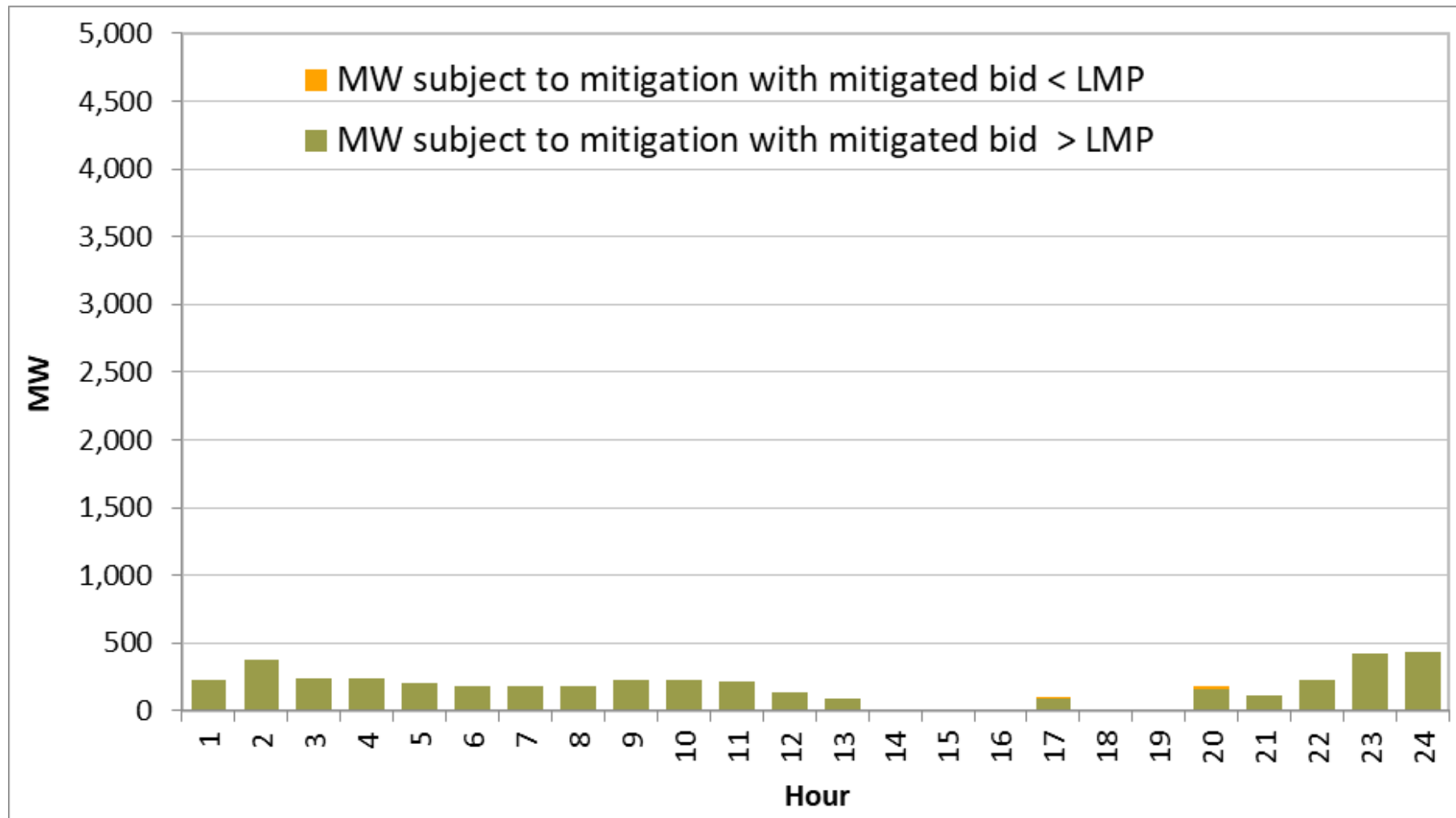
Potential impact of bid mitigation with higher bids – July 25, 2023



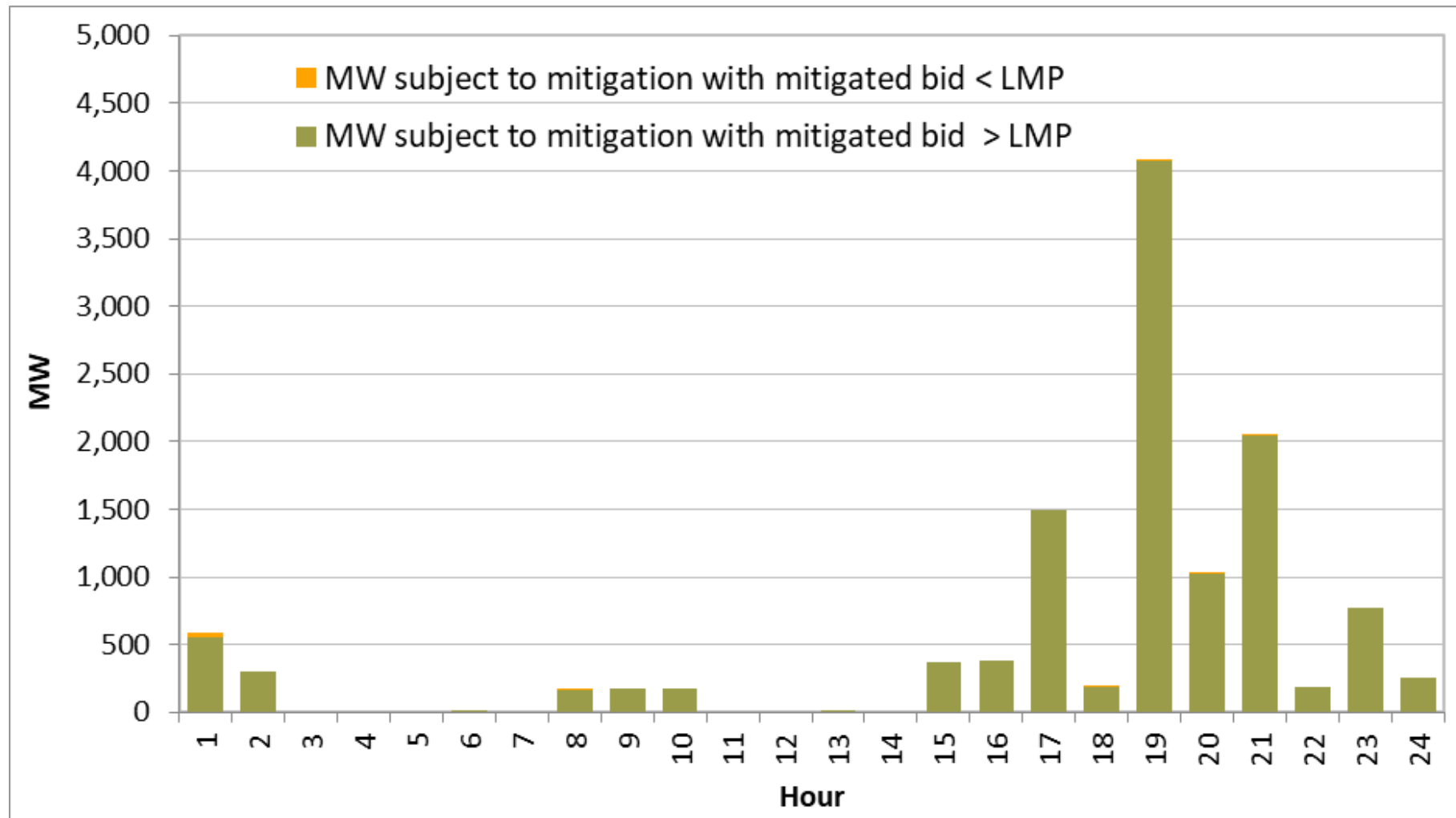
Potential impact of bid mitigation with higher bids – August 15, 2023



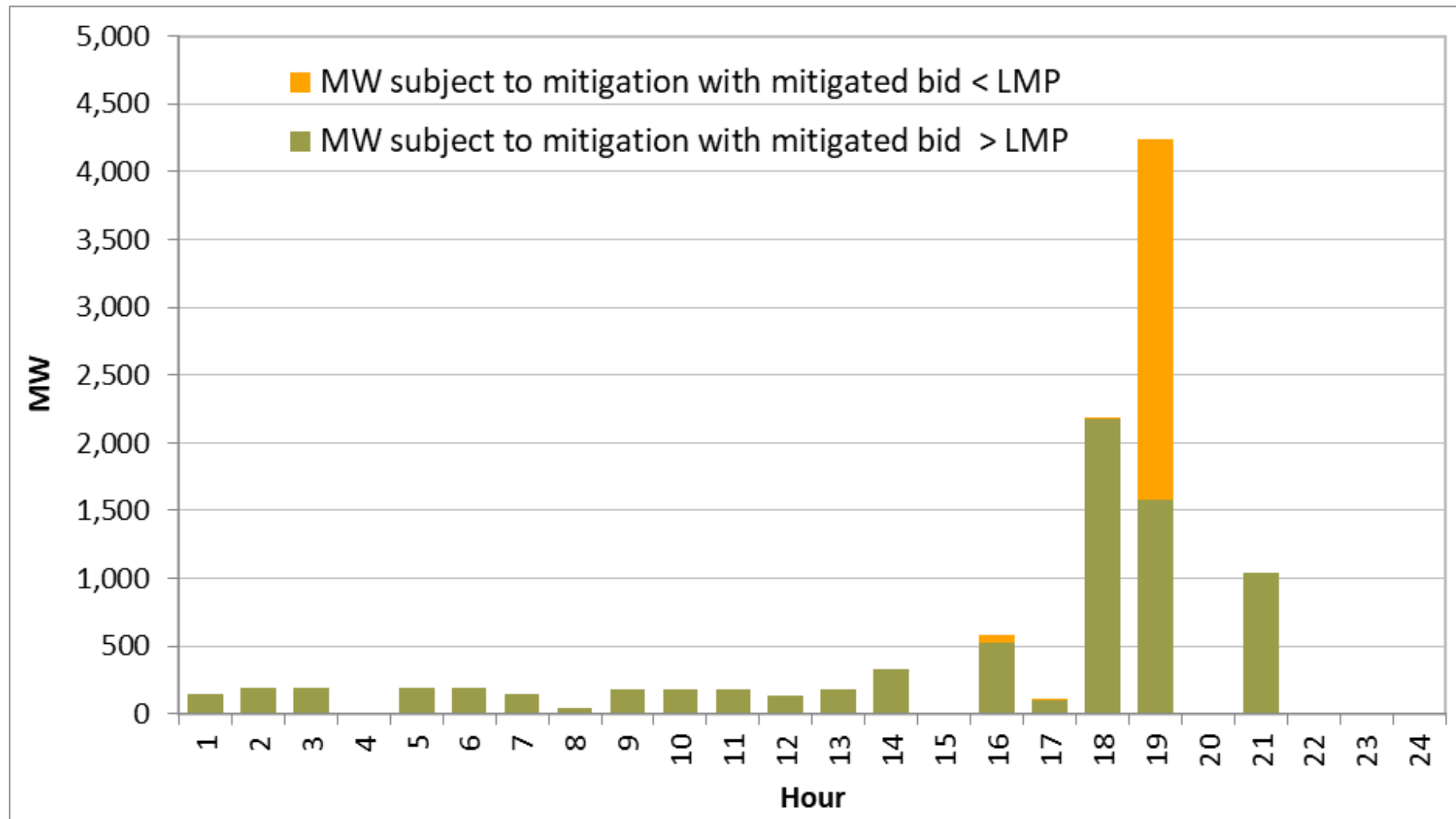
Potential impact of bid mitigation with higher bids – August 16, 2023



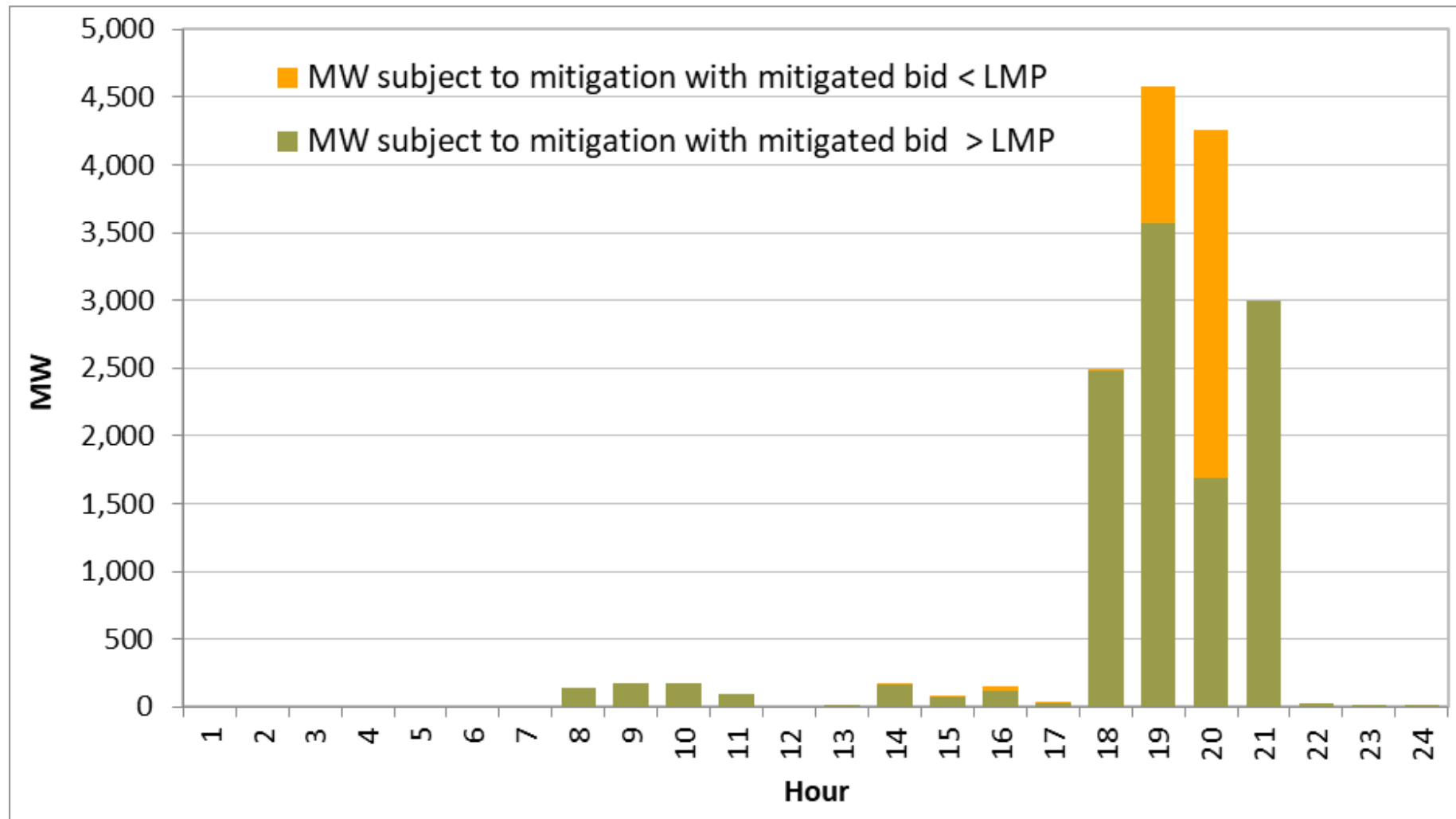
Potential impact of bid mitigation with higher bids – August 17, 2023



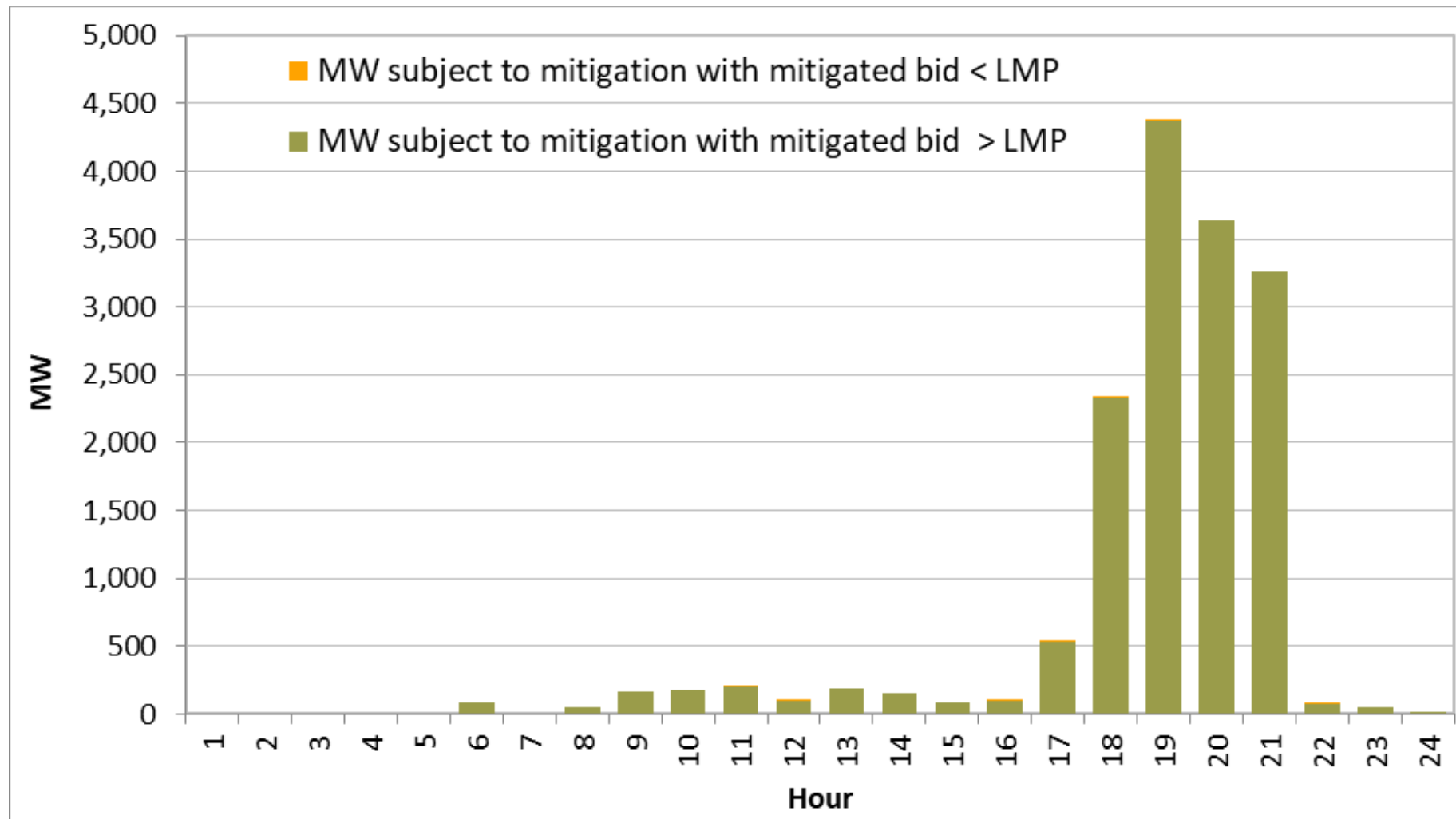
Potential impact of bid mitigation with higher bids – August 28, 2023



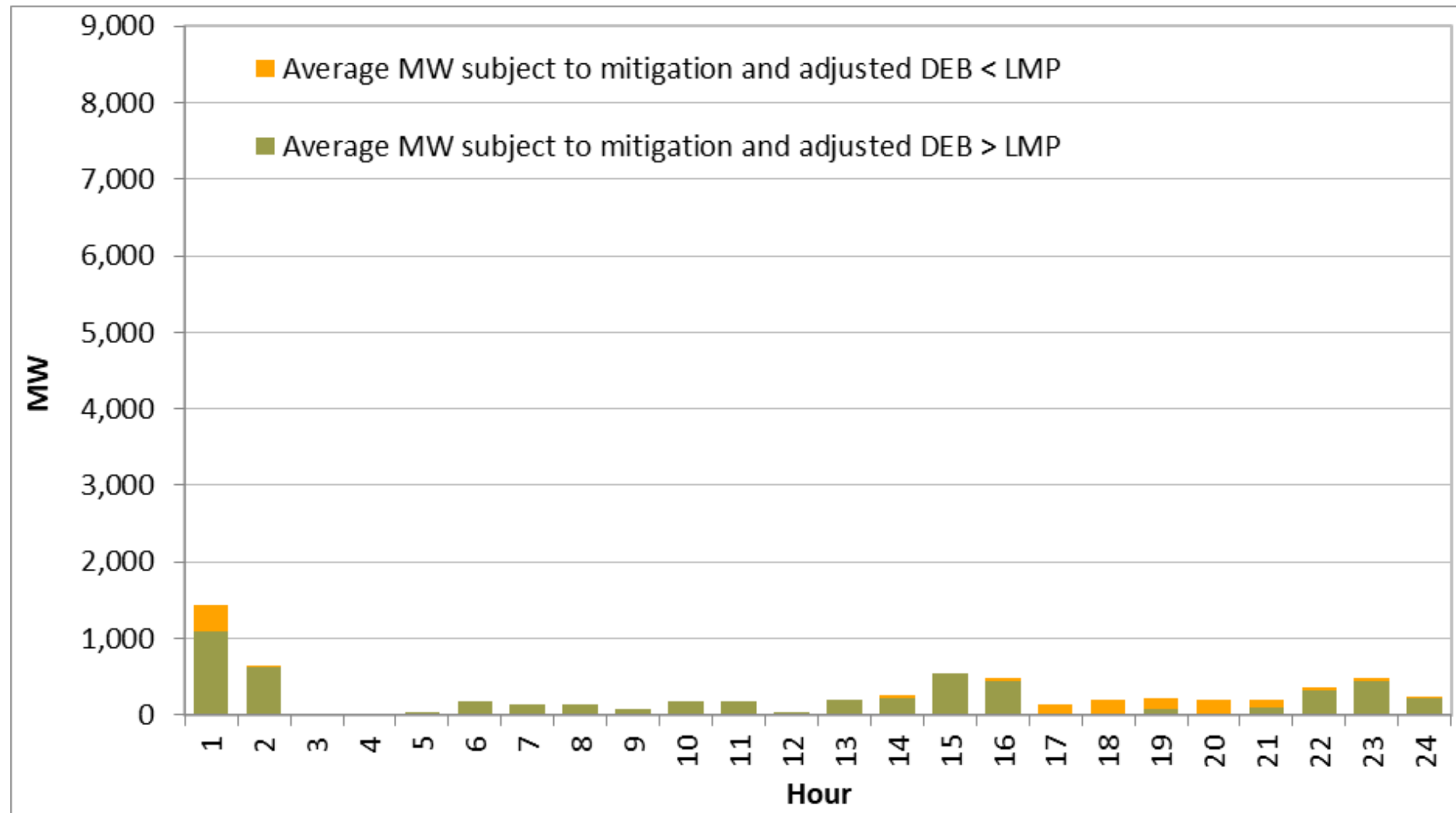
Potential impact of bid mitigation with higher bids – August 29, 2023



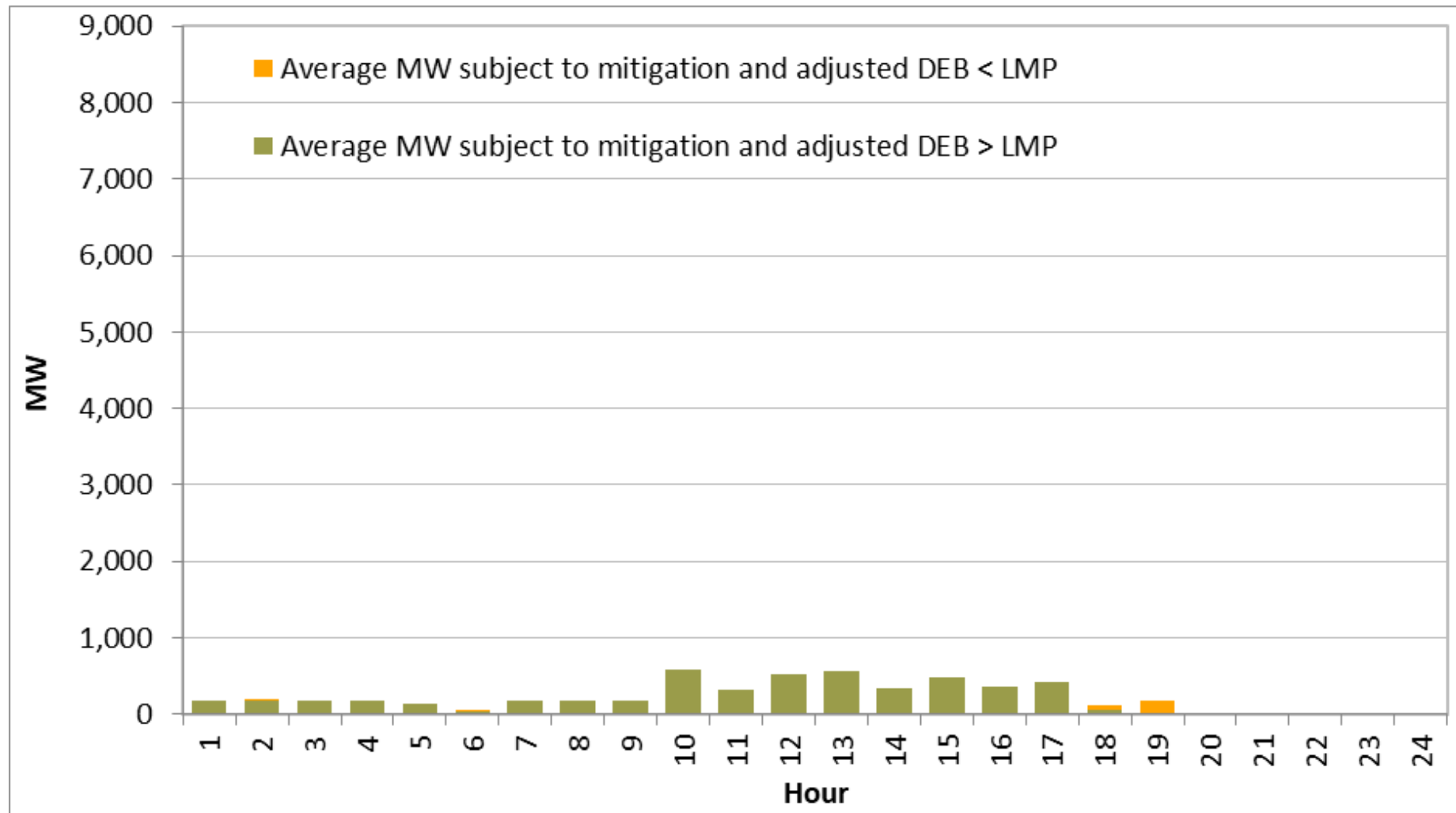
Potential impact of bid mitigation with higher bids – August 30, 2023



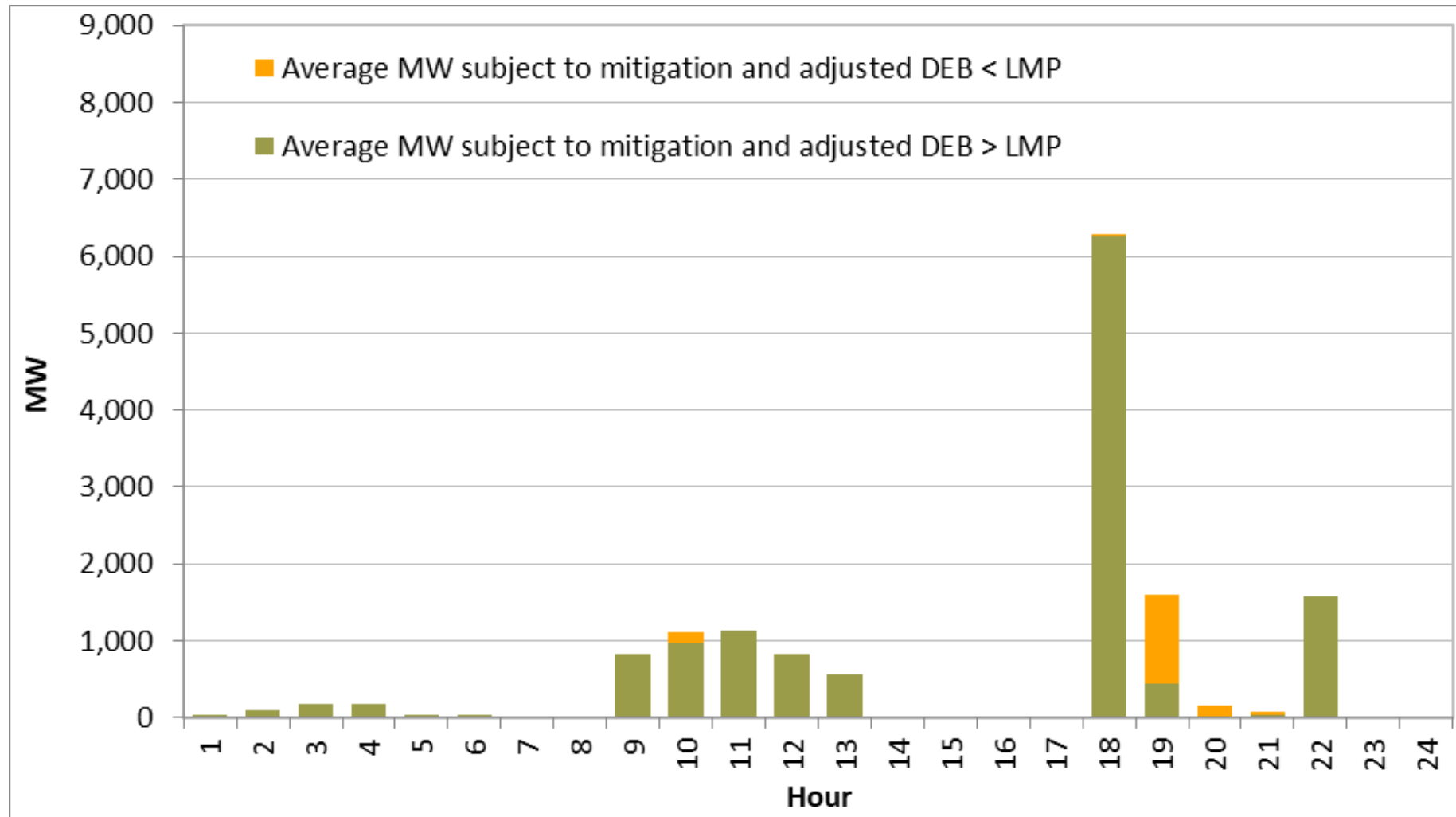
Potential impact of bid mitigation with higher bids – July 3, 2024



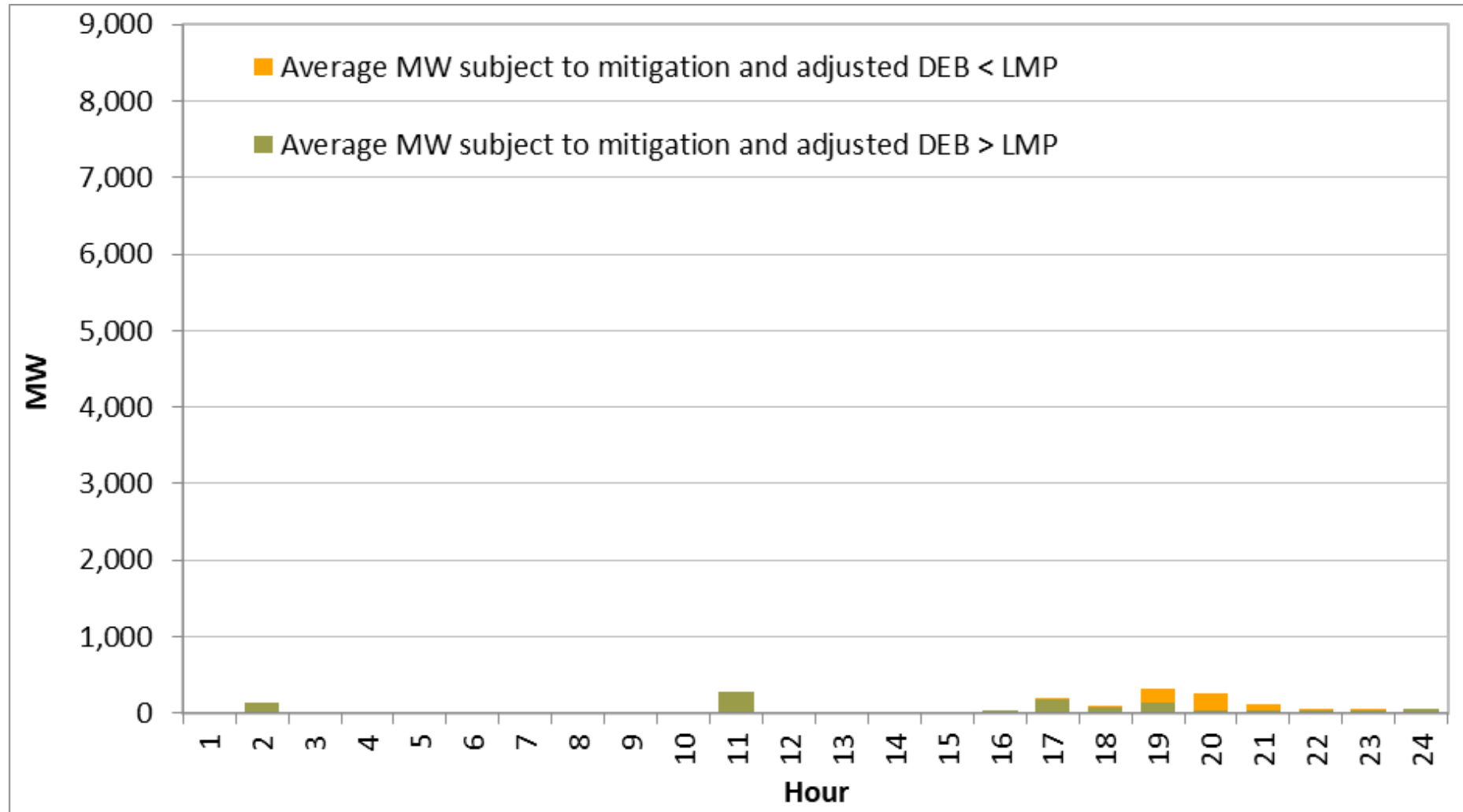
Potential impact of bid mitigation with higher bids – July 8, 2024



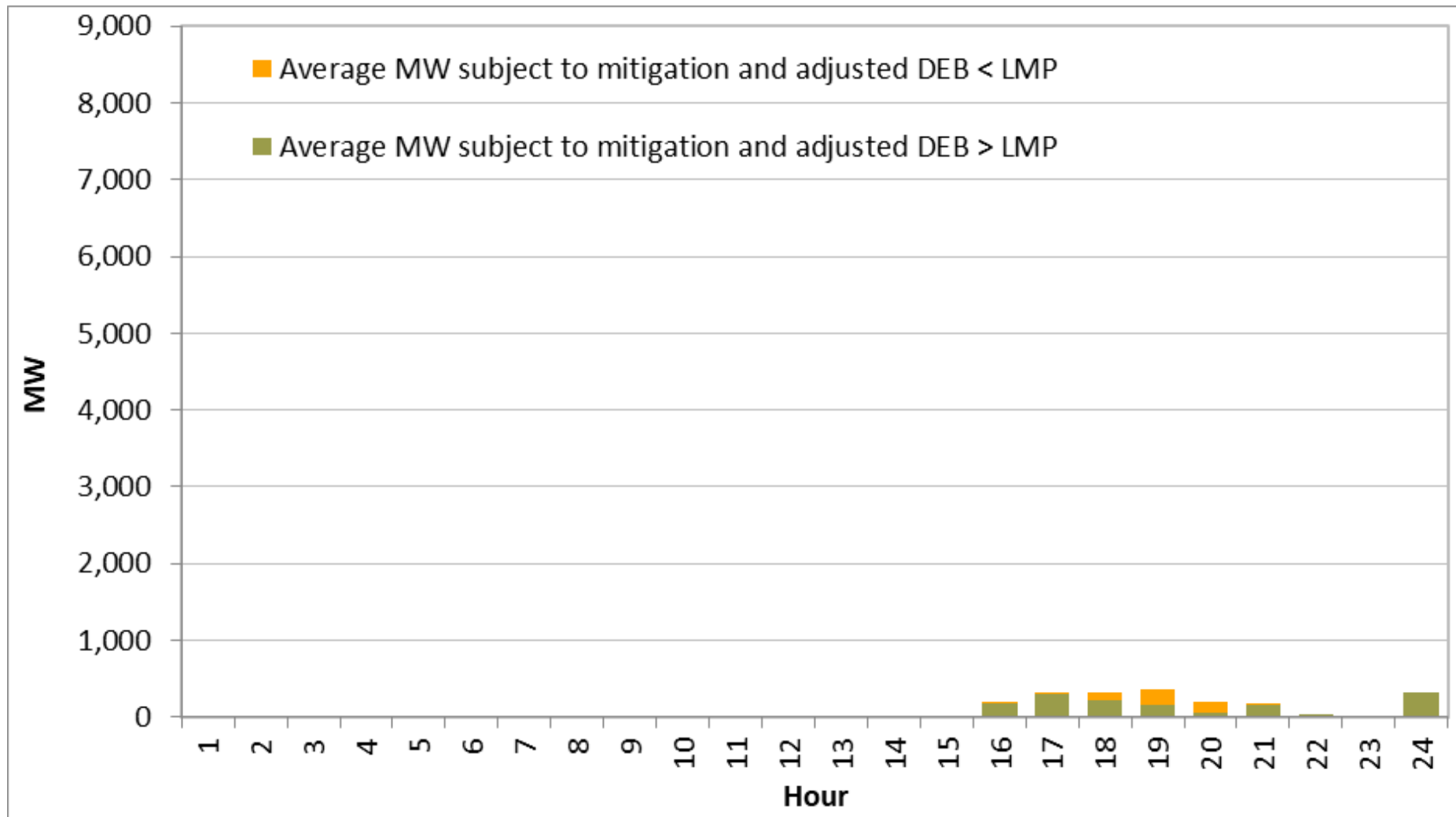
Potential impact of bid mitigation with higher bids – July 9, 2024



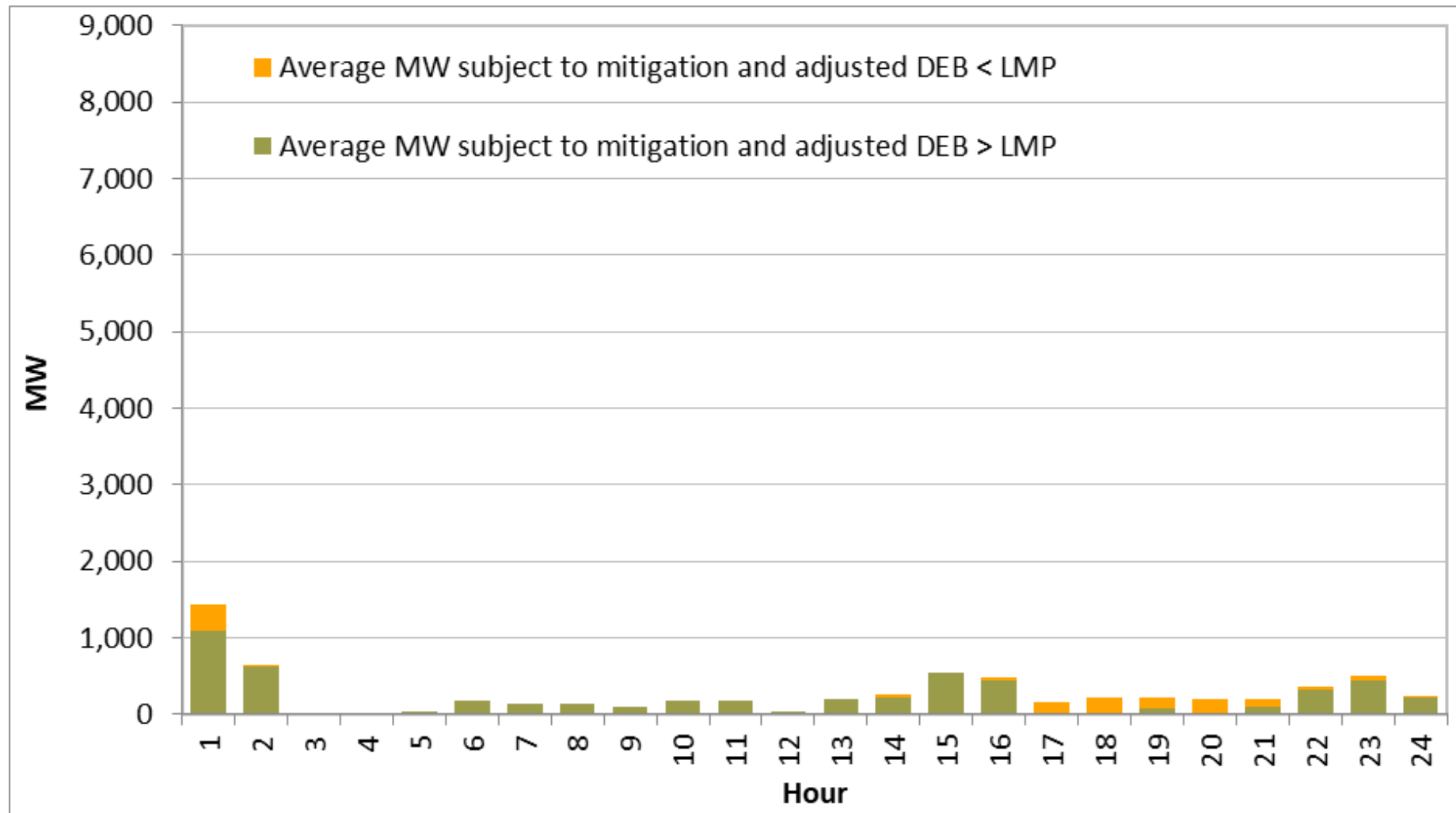
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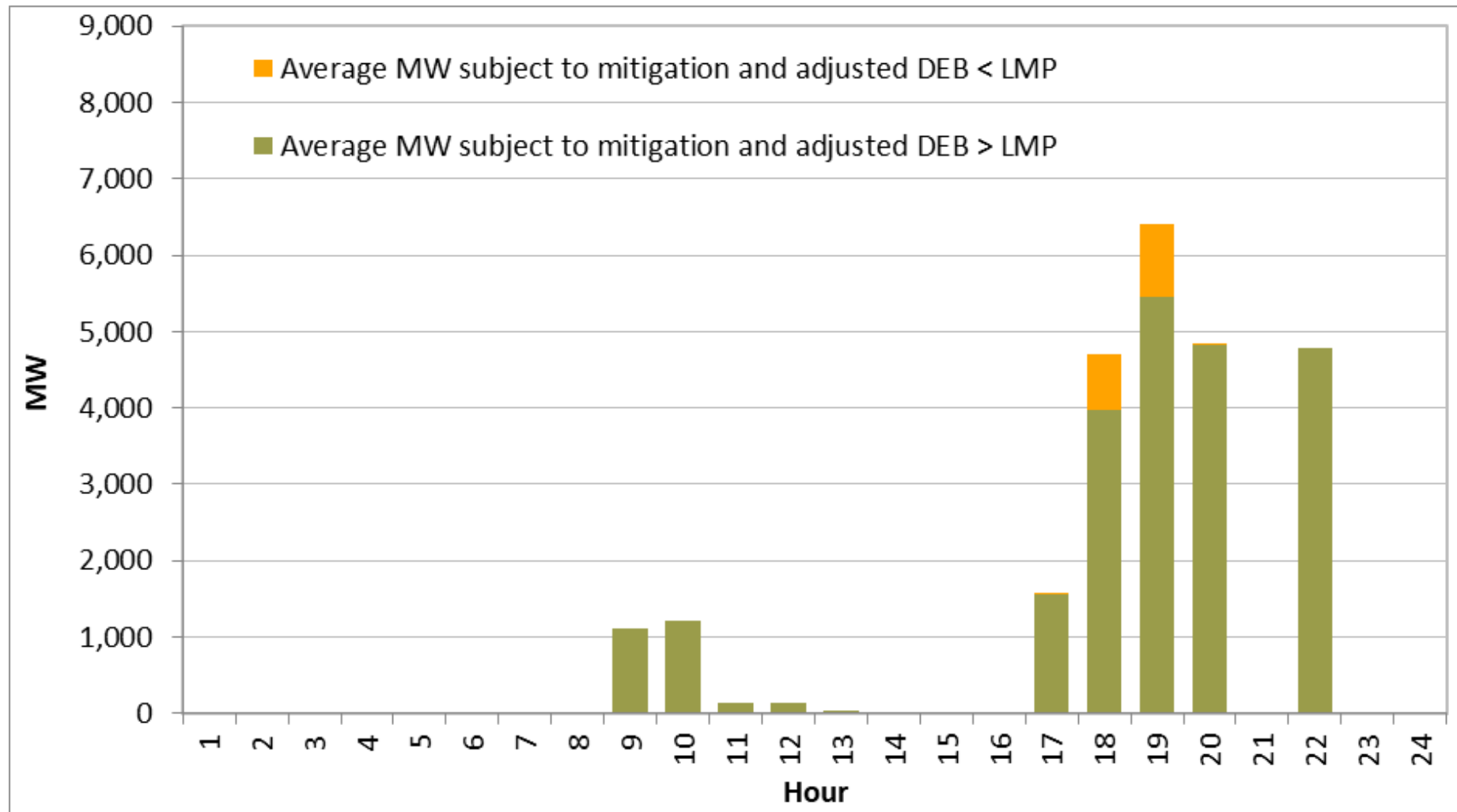
Potential impact of bid mitigation with higher bids – July 11, 2024



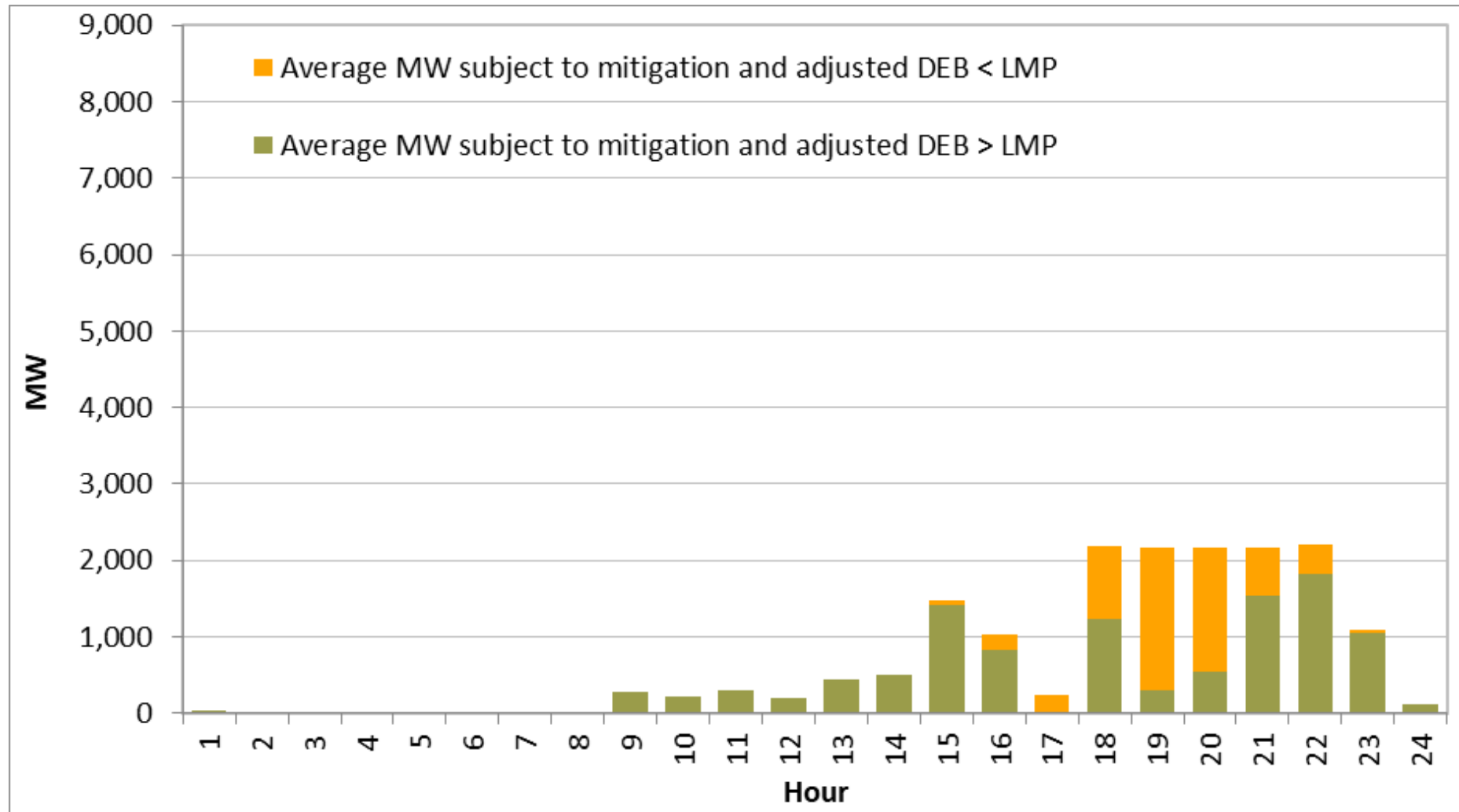
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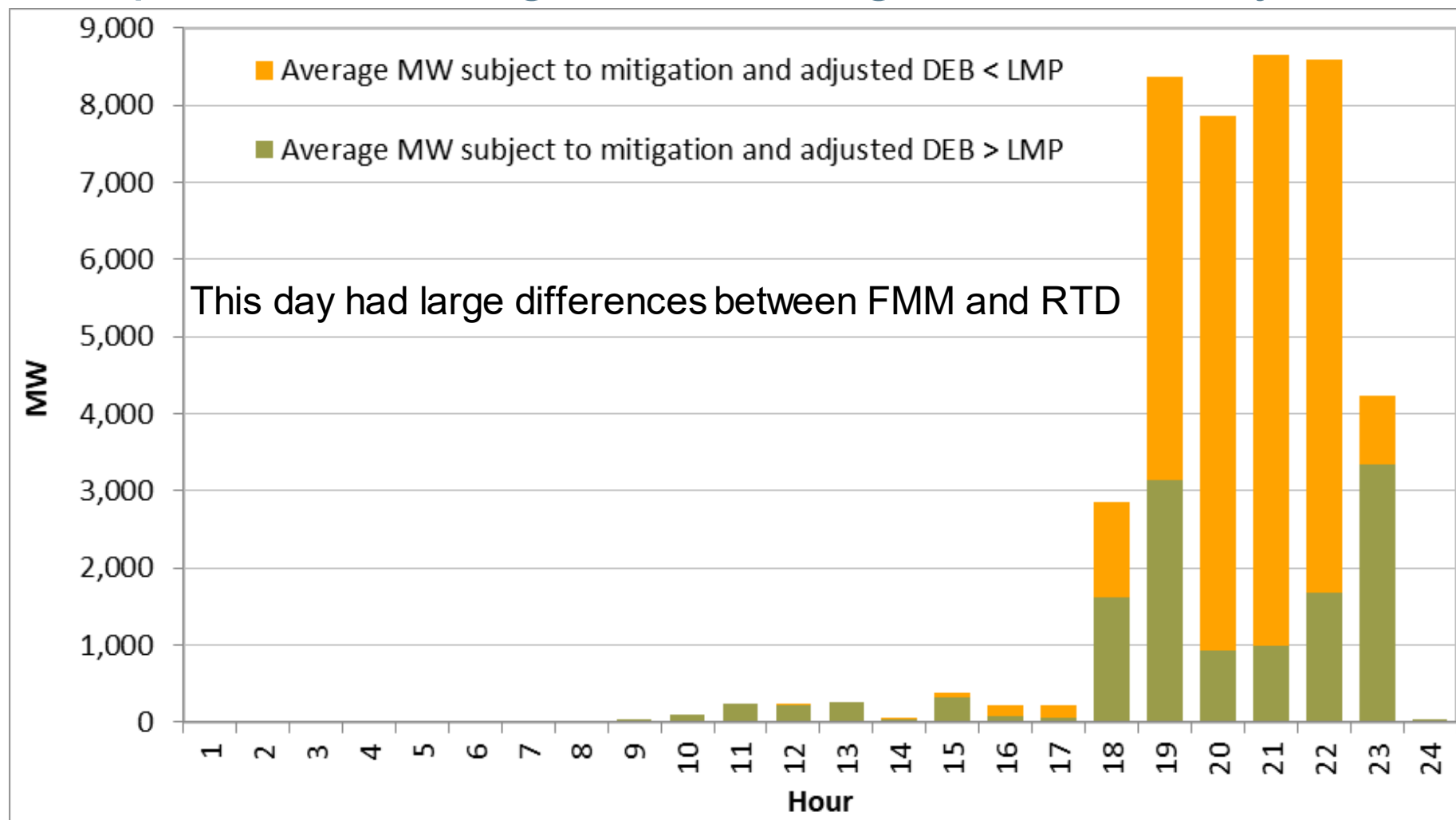
Potential impact of bid mitigation with higher bids – July 15, 2024



Potential impact of bid mitigation with higher bids – July 24, 2024



Potential impact of bid mitigation with higher bids – July 24, 2024 RTD



Potential impact of bid mitigation with higher bids – July 25, 2024

