



# Market design for extreme conditions

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# Market design for extreme conditions

- Planning: Building physical infrastructure to meet extreme forecast
  - Transmission upgrades
  - Interconnection rules
  - Procurement
  - Electrification
- Resource adequacy rules: contracting capacity
  - How to count capacity (renewables, demand response, storage, gas, ...)
  - New focus on net peak hours (HE 18-22) vs gross peak
- Regional integration
- Market processes:
  - Penalty prices and export/wheel prioritization
  - Higher bid caps and mitigation reference levels
  - New ramping products (real-time and day-ahead)
  - Manual actions (upward load bias, out-of-market dispatch)

# Do out-of-market operations during extreme system conditions inform market design changes?

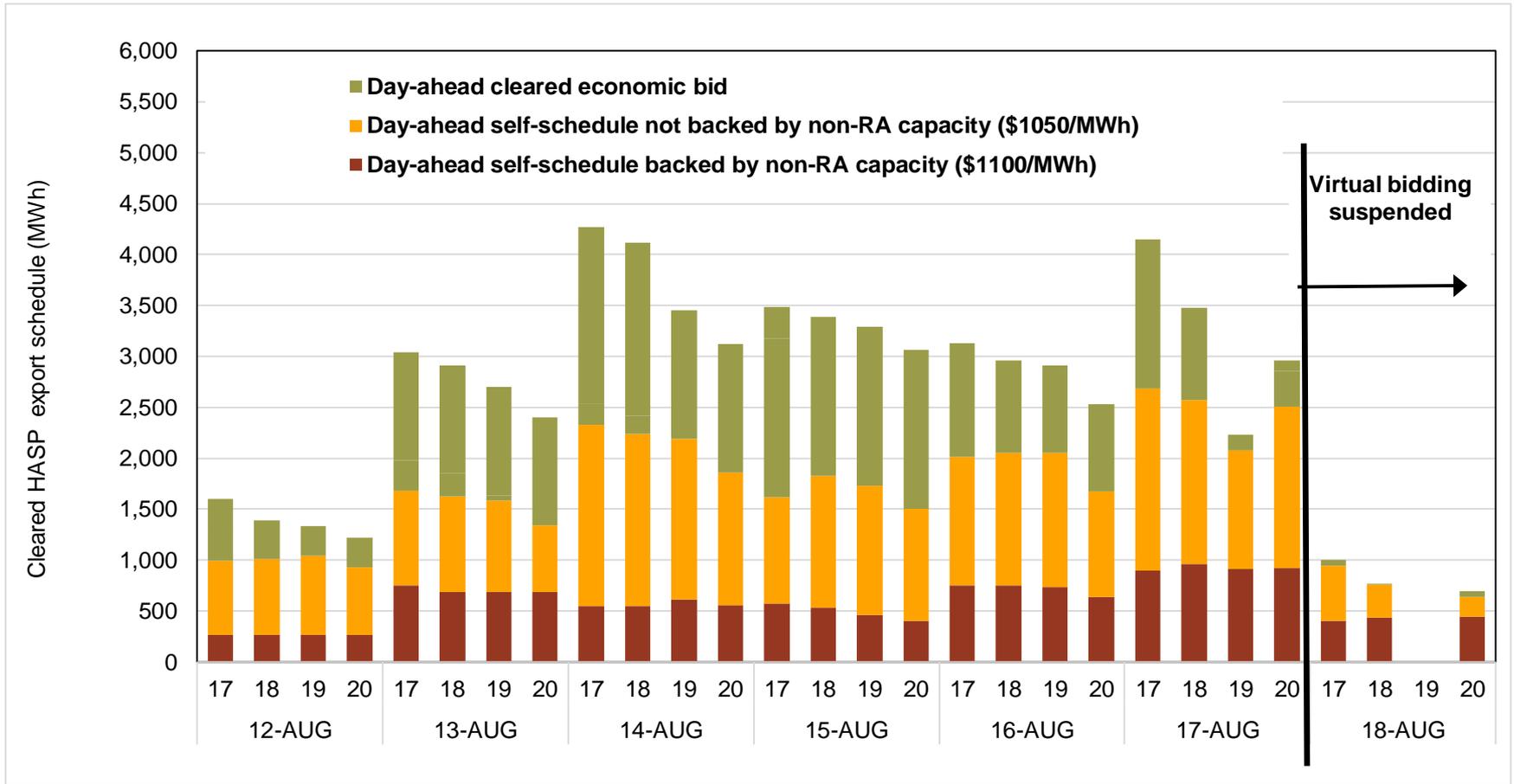
- **2020 (extreme demand, highest in California)**
  - Load bias
  - Virtual bidding suspended
  - Exceptional dispatch on the ties
  - Regional coordination and emergency assistance
  - Post event changes to export prioritization
- **2021 (fire threatens major intertie and winter storm Uri)**
  - Load bias
  - Exceptional dispatches on the ties
  - Manual congestion management
  - New higher bid caps and reference level adjustments
- **2022 (record high extended demand west-wide)**
  - Load bias
  - Operator process to reprioritize dispatches on the ties
  - Exceptional dispatch on the ties
  - Regional coordination and emergency assistance

## The ISO took steps to ensure exports were limited to physically feasible levels in 2020.

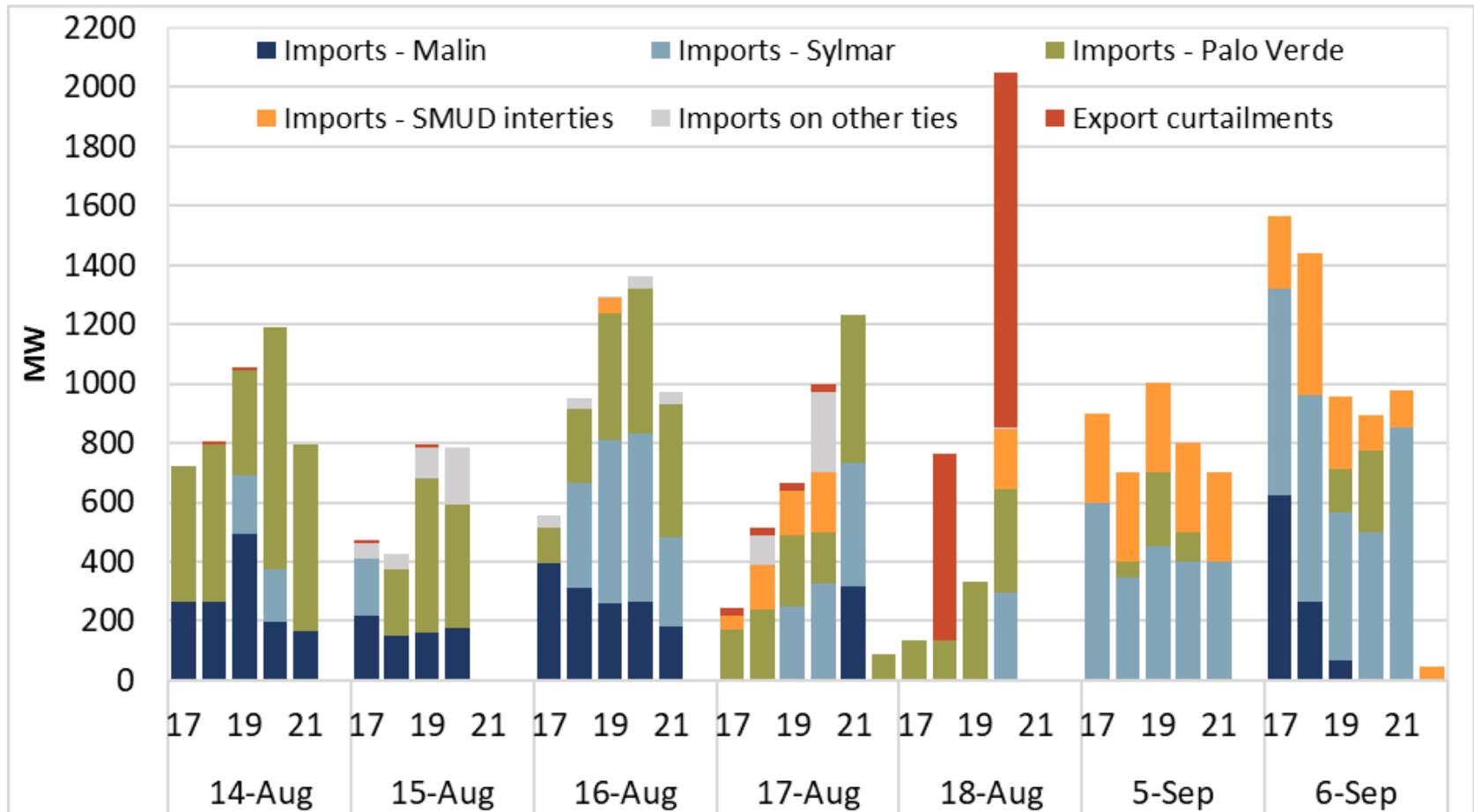
- Virtual bidding suspended effective August 18.
- Effective September 5, ISO made important enhancements to RUC (*day-ahead residual unit commitment*) and the real-time scheduling priority of day-ahead energy market export schedules that do not receive RUC awards.
- CAISO's current policy is still to prioritize exports that receive day-ahead RUC awards over native CAISO balancing area load in real-time.
- The rules and processes for limiting/curtailing exports used by the CAISO and other balancing areas should be reviewed, clarified, and potentially modified -- with a goal of establishing equal treatment and expectations of exports by all balancing areas.

# Exports increased demand above levels that could be supported by physical generation.

*Day-ahead export schedules clearing in HASP have real-time scheduling priority above real-time load curtailment (by HASP scheduling priority penalty price) in 2020*



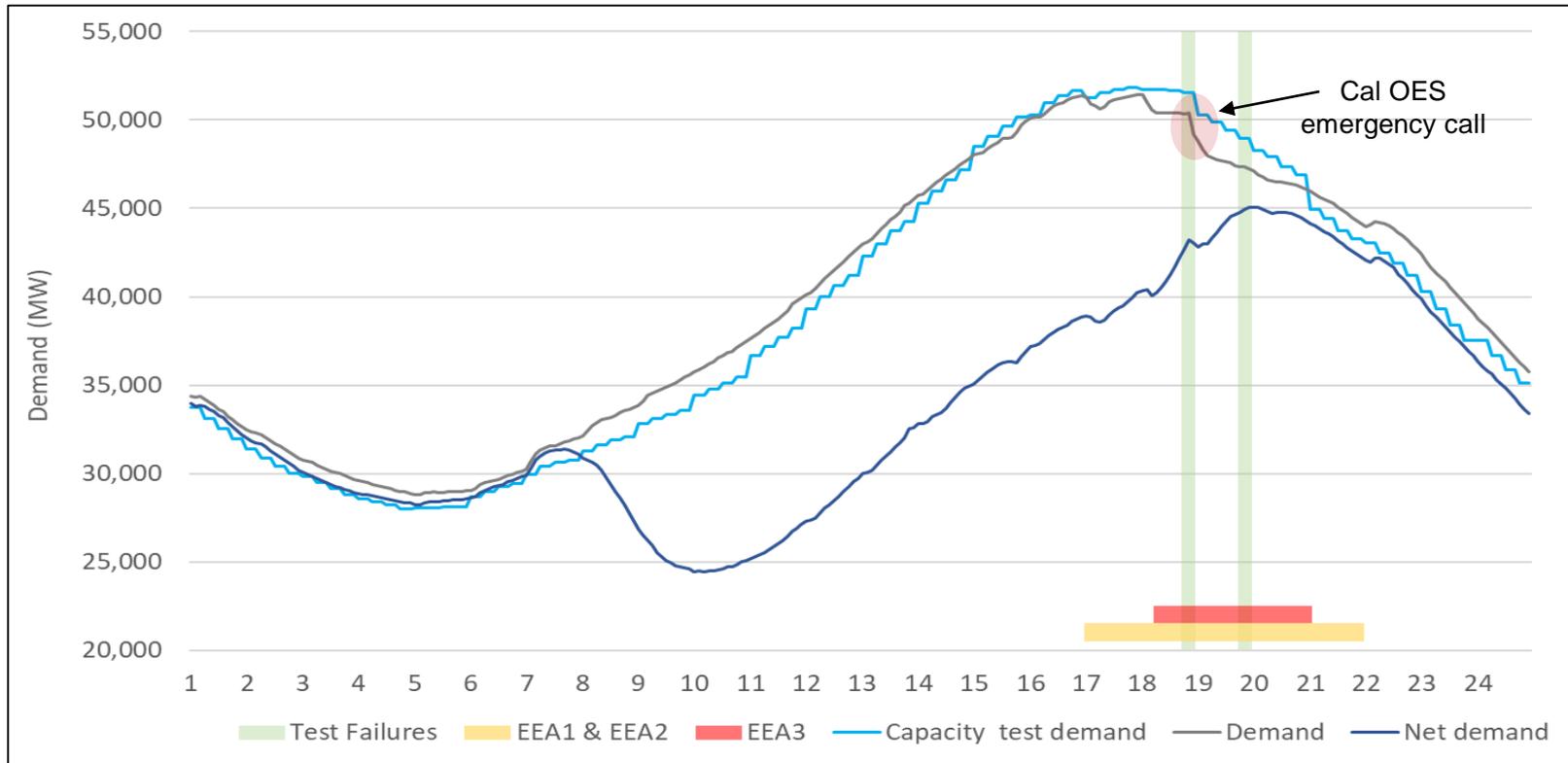
# 2020 hourly out-of-market imports, emergency assistance and market export curtailments (hours 17-22)



# Manual actions by grid operators remain very important for managing uncertainty and ramping needs in 2022

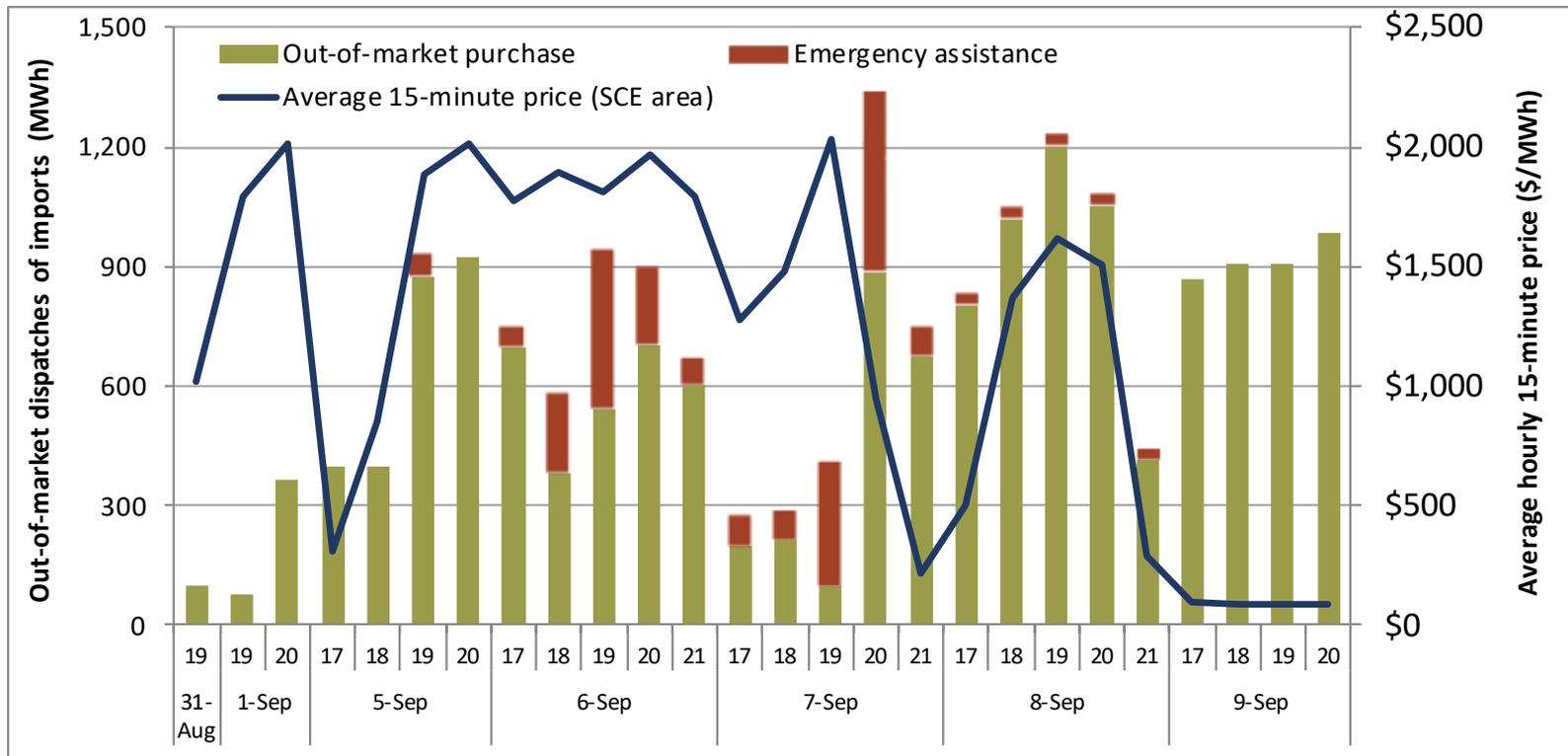
- Day-ahead residual unit commitment (RUC) process
  - Operators adjust load used in RUC process up significantly many hours/days.
  - This load adjustment can cause more units to be committed and fewer exports to clear in RUC process
- Direct manual dispatches
  - Commitment of gas-fired units
  - Ramp up gas-fired units up to higher operating level in late afternoon
  - Maintain state-of-charge of batteries in hours prior to net peak
- Upward adjustment (or bias) of load forecast used in hour-ahead and 15-minute real-time dispatch process
  - Helps position units to operate at higher levels in advance
  - Can cause more imports and fewer exports to clear hour-ahead scheduling process
- Battery capacity prevented from discharging before early evening hours by operators on very high load days

# In 2022, extraordinary levels of demand response and voluntary conservation caused CAISO load to drop well below forecast

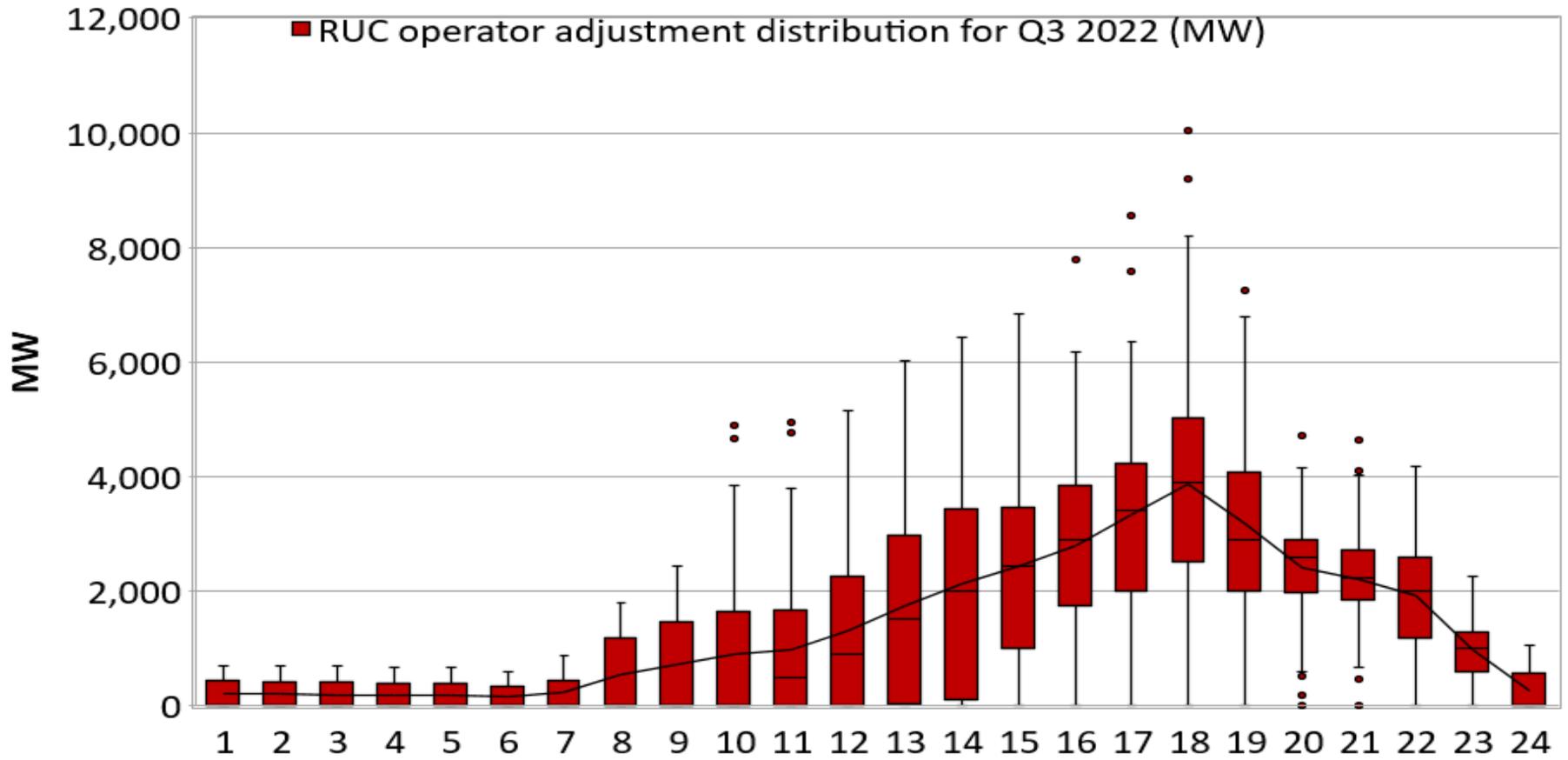


Source: CAISO Summer Market Performance Report Sept 2022

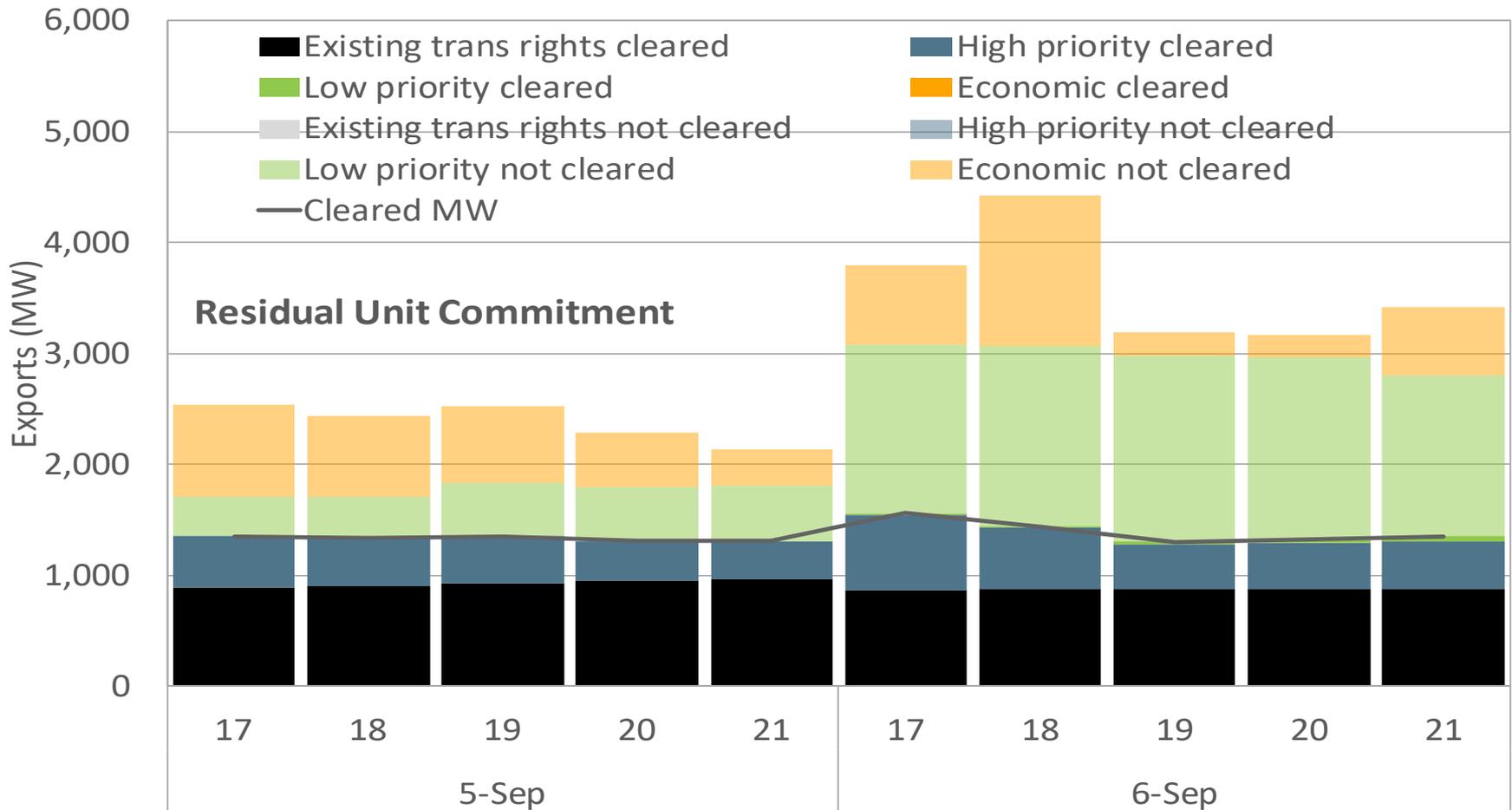
# CAISO scheduled additional real-time imports through out-of-market and emergency energy purchases in 2022



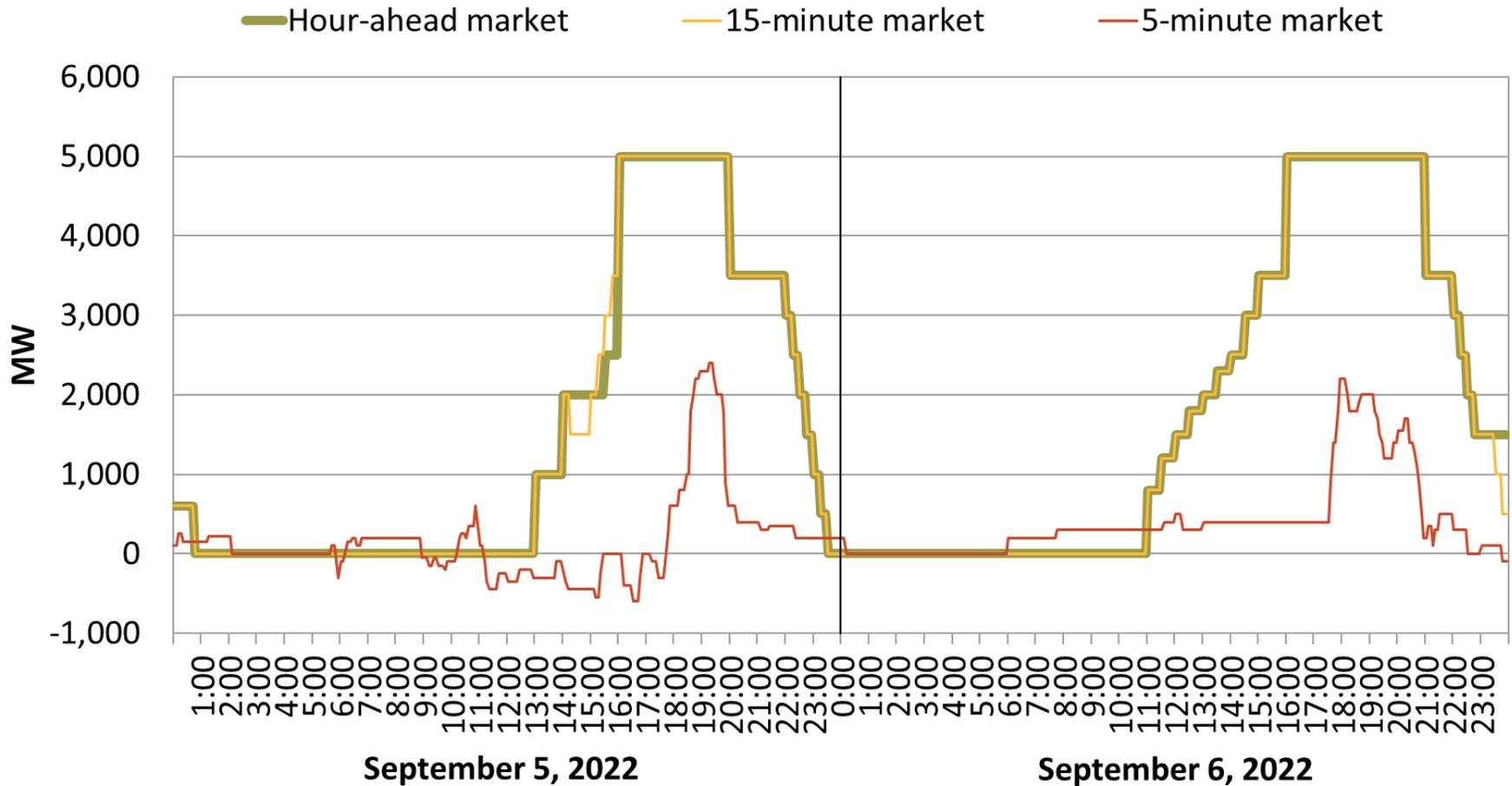
Operators increased RUC requirement significantly, causing some exports to clear the financial day-ahead market (IFM) but not the RUC process



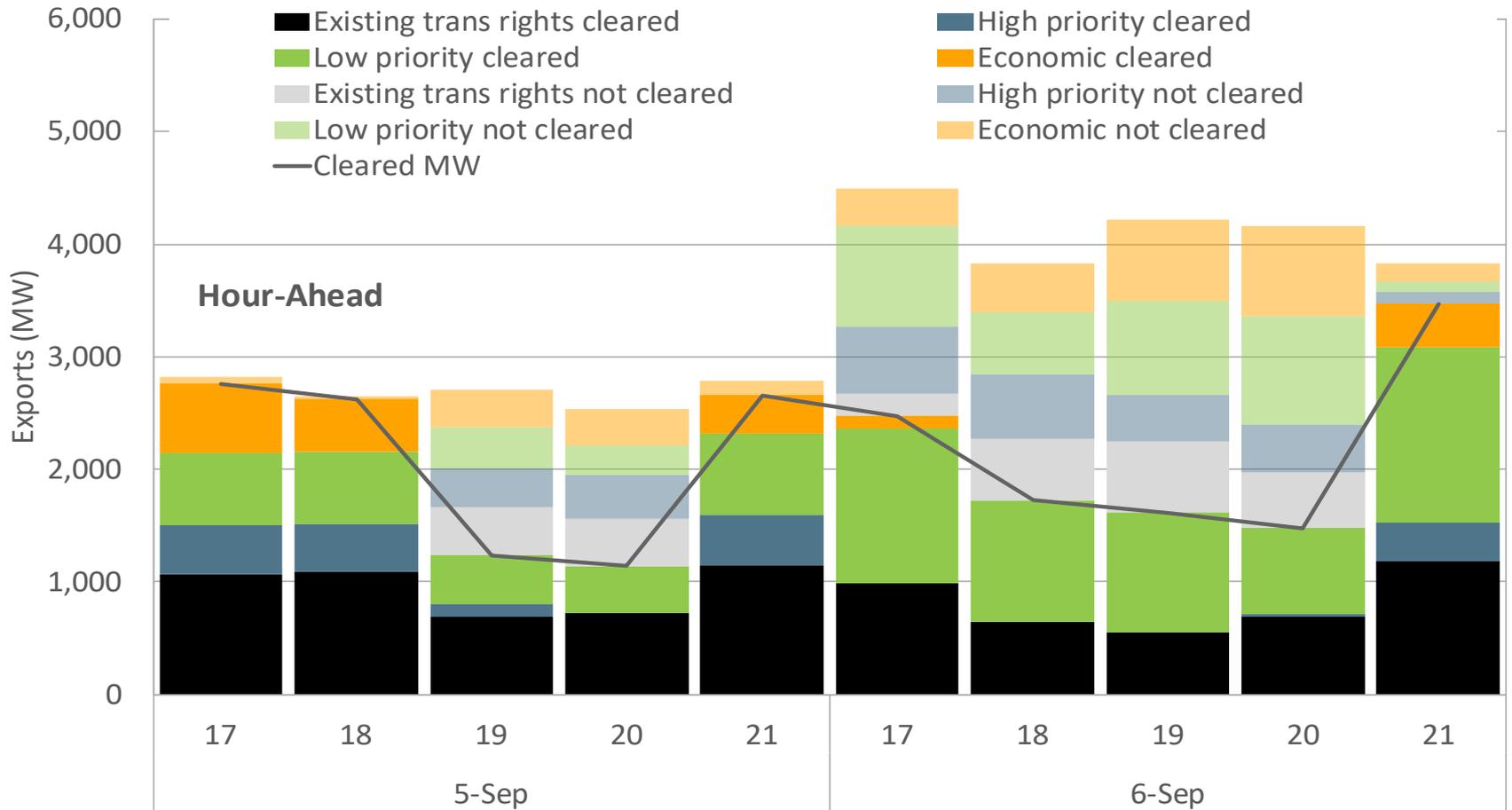
# IFM schedules that did not receive RUC awards were primarily low priority self schedules and economic bids that cleared in IFM



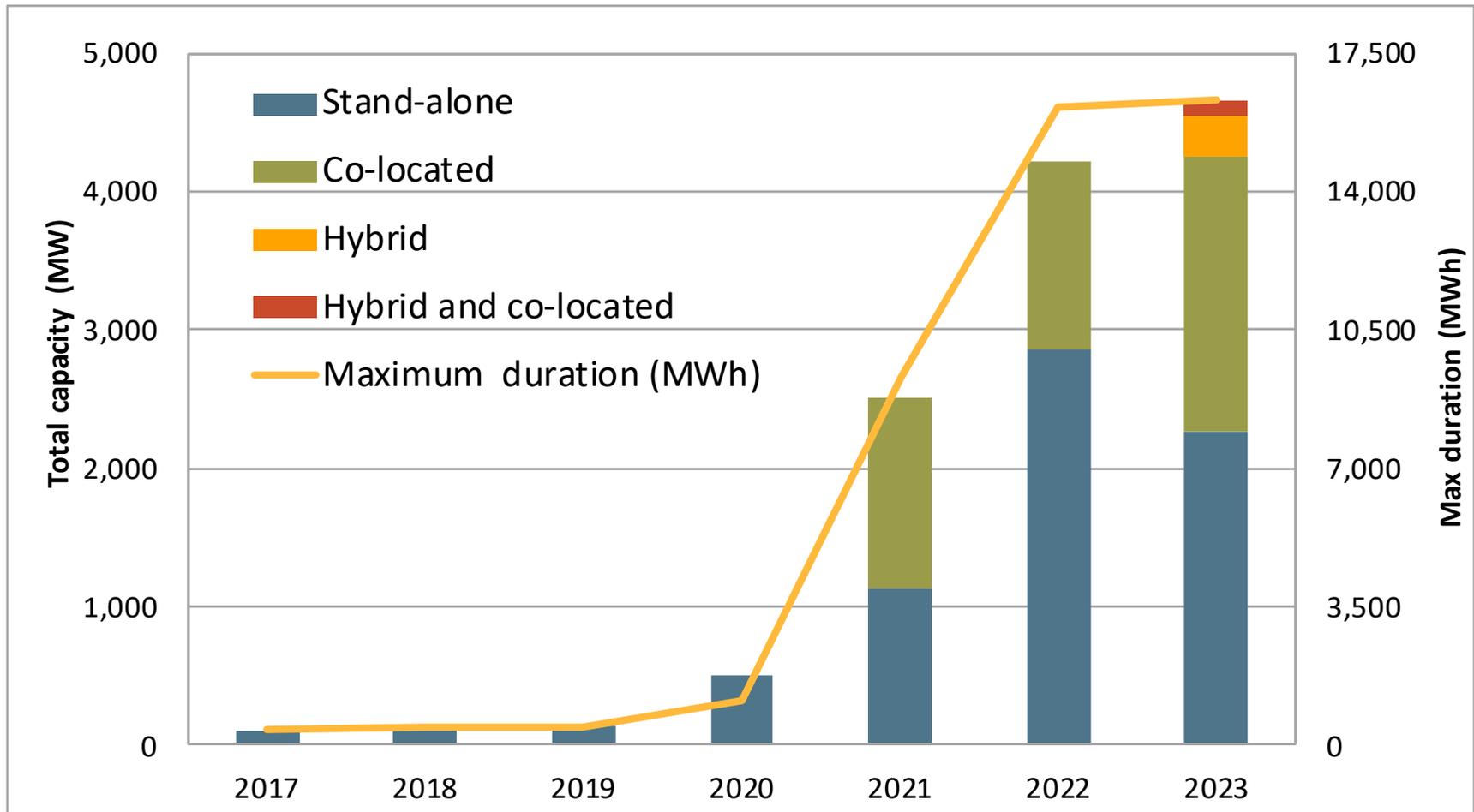
# Very high load bias in HASP and 15-minute market also prevented some exports from clearing in real-time market



# HASP curtailed high priority exports while scheduling low priority exports

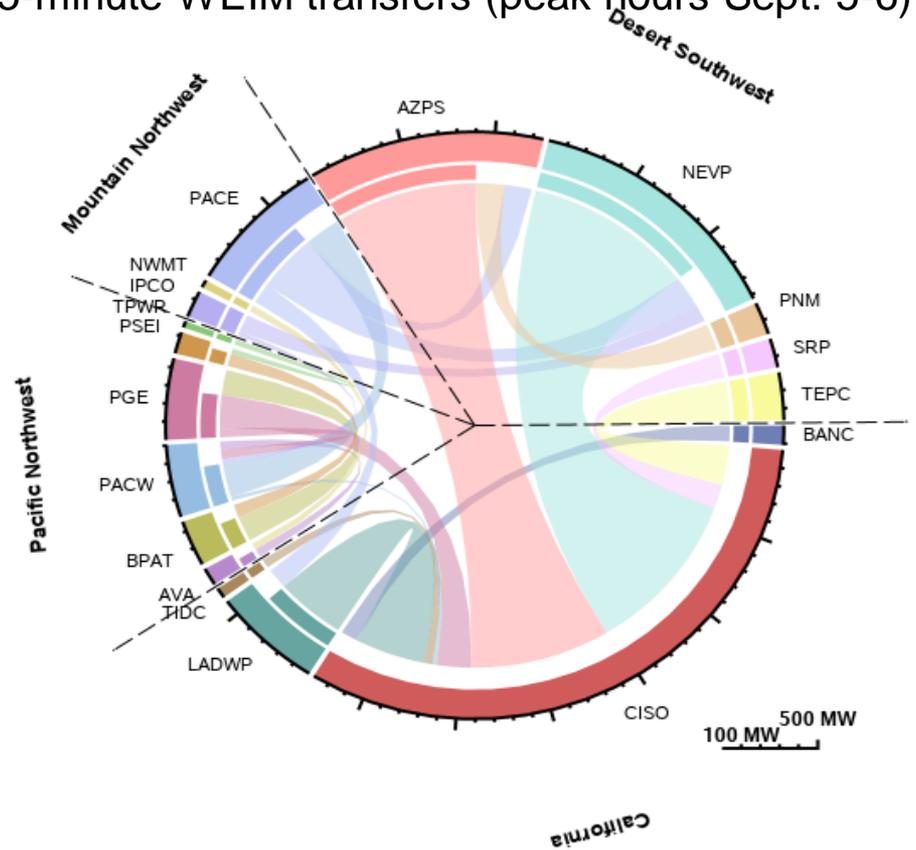
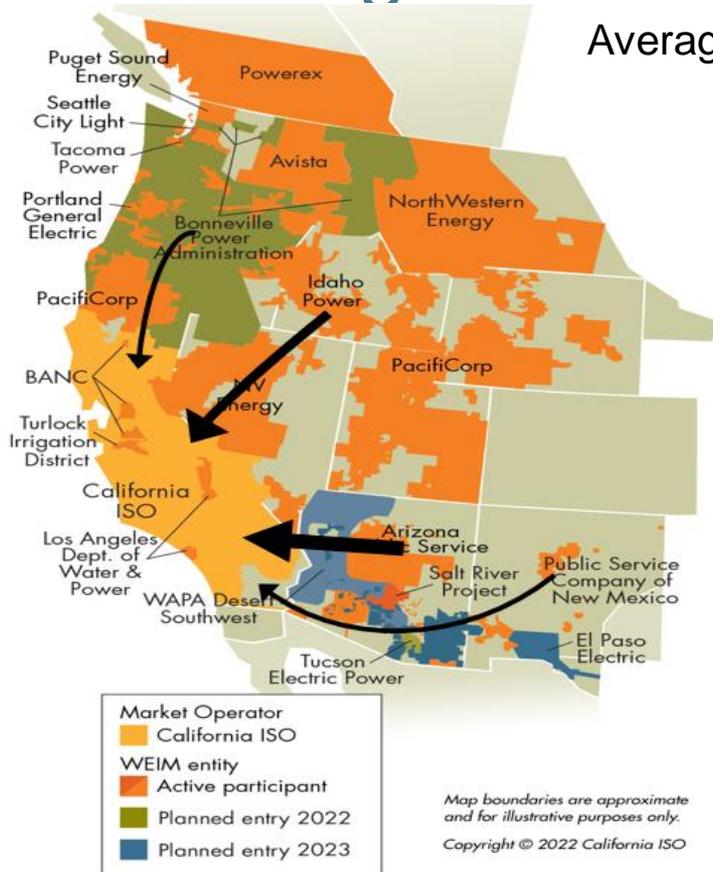


# Most batteries being designed so that they can discharge at maximum capacity for 4 hours



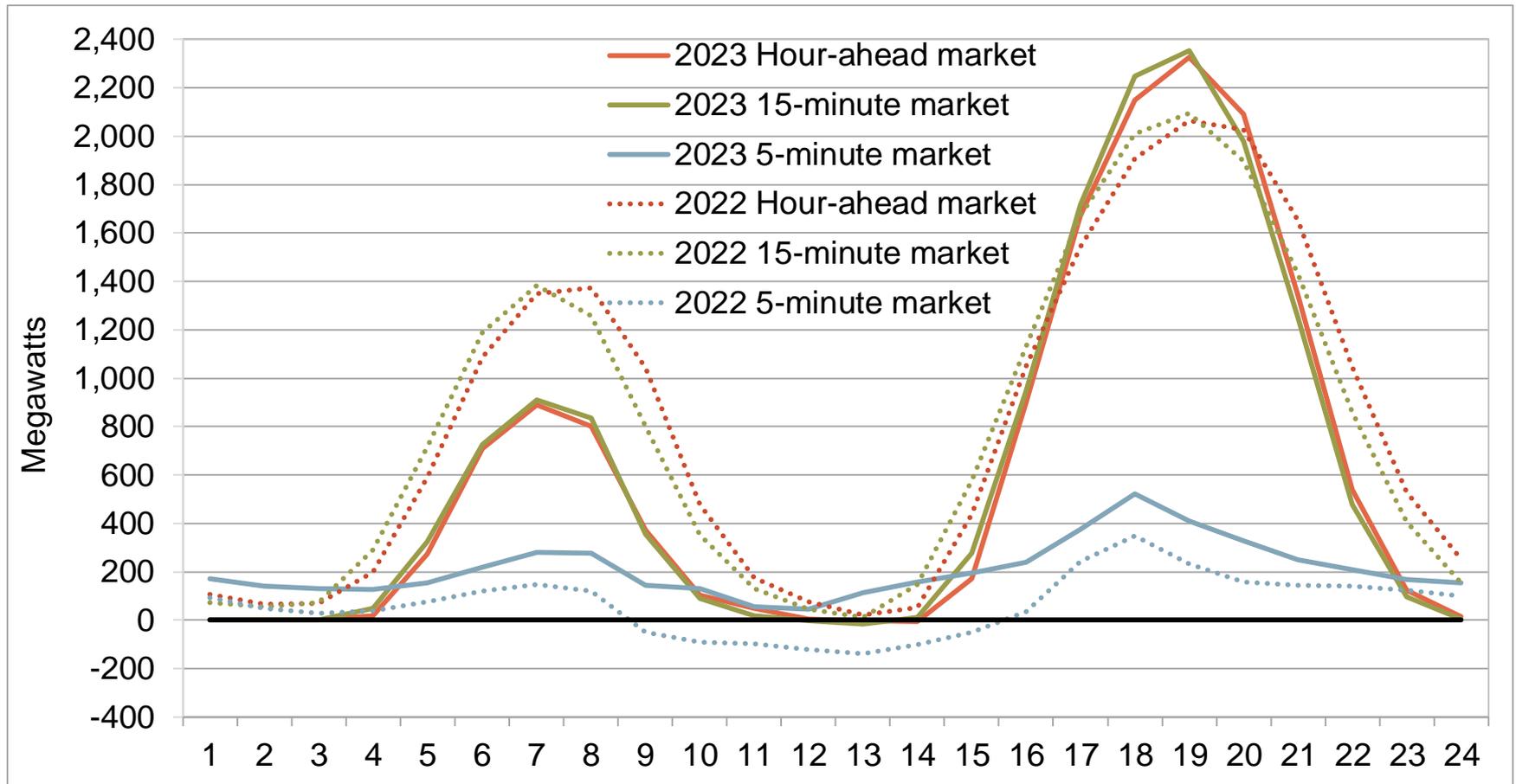
# Most WEIM areas were net exporters in net peak hours during heat wave -- with CAISO accounting for most imports

Average 15-minute WEIM transfers (peak hours Sept. 5-6)



# Use of load bias (out of market demand) in non-extreme conditions

Average hourly imbalance conformance adjustment (Q1 2022 – Q1 2023)



## Flexible ramping product

- Began as non-priced constraint in real-time market in 2011
- Evolved into flexible ramping product implemented in 2016
- Procures upward and downward ramping capacity to meet uncertainty between 15 minute and 5-minute market.
- Procured based on demand curve, with maximum demand based on forecast ramping needs plus uncertainty
- Rarely results in positive market price
- Continues to be “enhanced”
  - switched from system level procurement to locational procurement on Feb 1.

## Flexible ramping product (continued)

### Market Monitors opinion ...

- Product has not been effective at meeting ramping needs,
  - Operators have increasingly relied on other manual actions to create ramp and defend against uncertainty
- Recent changes to add locational procurement requirements may improve product effectiveness and prices.
- To be really effective, the product needs to be based on longer time horizon
  - e.g. 2 to 3 hours in advance vs 15 to 30 minutes