California ISO

Market Performance and Planning Forum

Q3

Oct 1, 2025

Forum Reminders:

- This quarterly forum that engages stakeholders in review of market performance issues and in high level dialogue on release planning, implementation and new market enhancements. This is intended to foster open dialogue and sharing of ideas and perspectives
- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- The meeting is structured to stimulate dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Please try to be brief and refrain from repeating what has already been said so that we can manage this time efficiently.

Instructions for raising your hand to ask a question

- Open the Participant and Chat panels from the bottom right.
- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon  located on the bottom of your screen.
  - **Note**: *3 only works if you dialed into the meeting.

- Please remember to **state your name** and **affiliation** before making your comment.

- You may also send your question via chat to **Brenda Marquez** or to all panelists.

- If you need technical assistance during the meeting, please send a chat to the event producer.

Objective: Enable dialogue on implementation planning and market performance issues

- Review key market performance topics
- Share updates to 2025-2026 release plans, resulting from stakeholders inputs

Market Performance and Planning Forum

Agenda – Oct 01, 2025

9 a.m. – 2 p.m. Pacific Time (PST)

Time:	Topic:	Presenter:
09:00 – 09:05	Introduction, Agenda	Brenda Marquez, Stakeholder Affairs
9:05 – 12:00*	Market Performance Update	Market Performance and Advanced Analytics Short Term Forecasting
1:00-1:45*	Policy Update	Market Strategy and Governance Market Policy Development
1:45-2:00	2025 MPPF Schedule	Brenda Marquez, Stakeholder Affairs

Market Performance Update

Agenda for Market Performance Update

1. Executive summary
2. Summer market performance
3. Storage enhancement and FRP performance
4. Enhancement to mitigate for market disruptions
5. Load conformance
6. Prices and market costs
7. Congestion and congestion revenue rights
8. Public reports on market performance
9. Market issues
10. CAISO BAA simulated IR requirements
11. Short-Term forecasting revised metrics

12. Appendix. General metrics

Executive Summary

Summer conditions were moderate with no major events

- CAISO demand peaked at 44,434 MW on August 21, significantly lower than the near record peak of 52,000 MW in 2022
- Summer prices were moderate in CAISO and the WEIM
- In CAISO, resource adequacy capacity exceeded relatively low demand to such an extent that CAISO was a net exporter on multiple days in August. CAISO supported over 9,000MW of exports
- CAISO market costs are on track to be the lowest in the past seven years, thanks to low natural gas prices and low load
- Congestion was similar to the last two summers, while congestion revenue rights auction resulted in a surplus payment to load

Market enhancements improve market efficiency

- Improvements to market processes have reduced CAISO's use of load conformance, lowering costs
- An enhancement to include flexible ramping product up awards in storage state of charge calculations has reduced the portion of flexible ramping product awarded to CAISO storage
- The ISO will implement an enhancement to mitigate real-time market disruptions caused by constraints that lead to infeasible solutions. This is an improvement to an existing process
- The assistance energy program was used this summer by 10 different entities. This program is set to expire by end of 2026. CAISO has filed at FERC to extend this program beyond 2026

Transparency efforts help the market stay informed

- CAISO is providing a reference of published reports where market participants can learn about market performance and operator actions
- CAISO is notifying the market of additional material posted about estimation of Imbalance reserve requirements for CAISO. This information provides more detailed data about the pattern and level of requirements
- The MPPF material has been expanded with enhanced tracking metrics to provide added context around forecast performance over time
- The MPPF is also reporting on a market issue: the requirements for flexible ramping product were calculated using the wrong sample from 8/14/2024 to 3/12/2025. This issue led to slightly lower coverage during that time period

Summer Market Performance

Market Performance and Advanced Analytics

Summer Performance Key indicators

Operational conditions this summer were stable and smoother than in previous years. CAISO exhibited moderate demand with a peak of 44,434 MW on August 21

The system was well positioned with sufficient resource-adequacy capacity to easily meet all load.

- July had the highest monthly capacity showing at 60,000MW while peak demand was about 40,000 MW

ISO market prices reflected the substantial margin of system supply over demand during summer, with daily average prices peaking at $70/MWh during days with the peak demand

CAISO supported other balancing areas, clearing large volume of exports, in excess of 9,000 MW at times. On multiple days in August, CAISO exported more than it imported, becoming a net exporter.

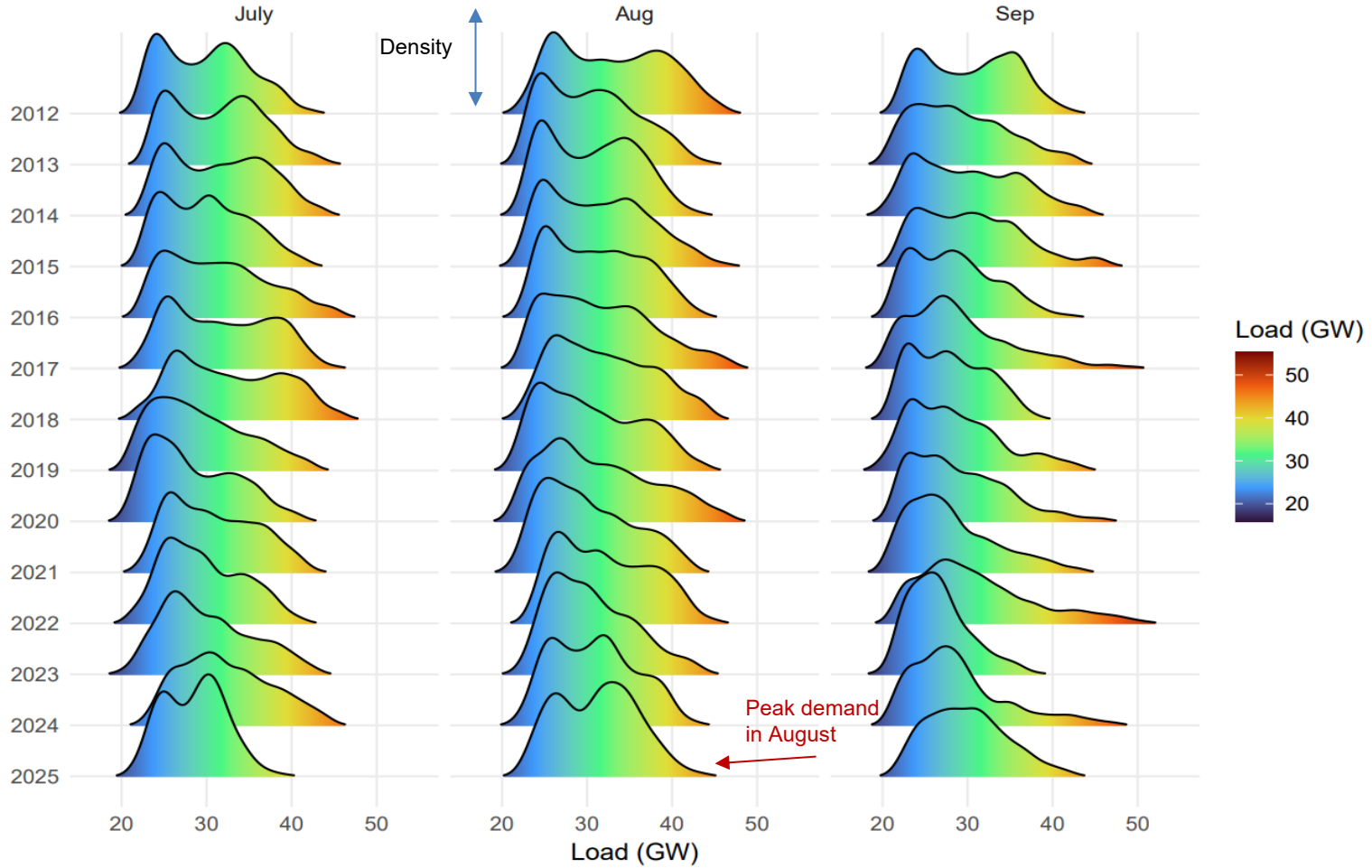
Summer Performance Key indicators

Most exports were self-scheduled in the day-ahead market. These exports cleared, except for four days when up to 700 MW were reduced

The maximum volume of high-priority wheel-through registered in the CAISO market was 344 MW, significantly lower than volumes observed in previous years. The maximum wheel bid in the market was 75 MW

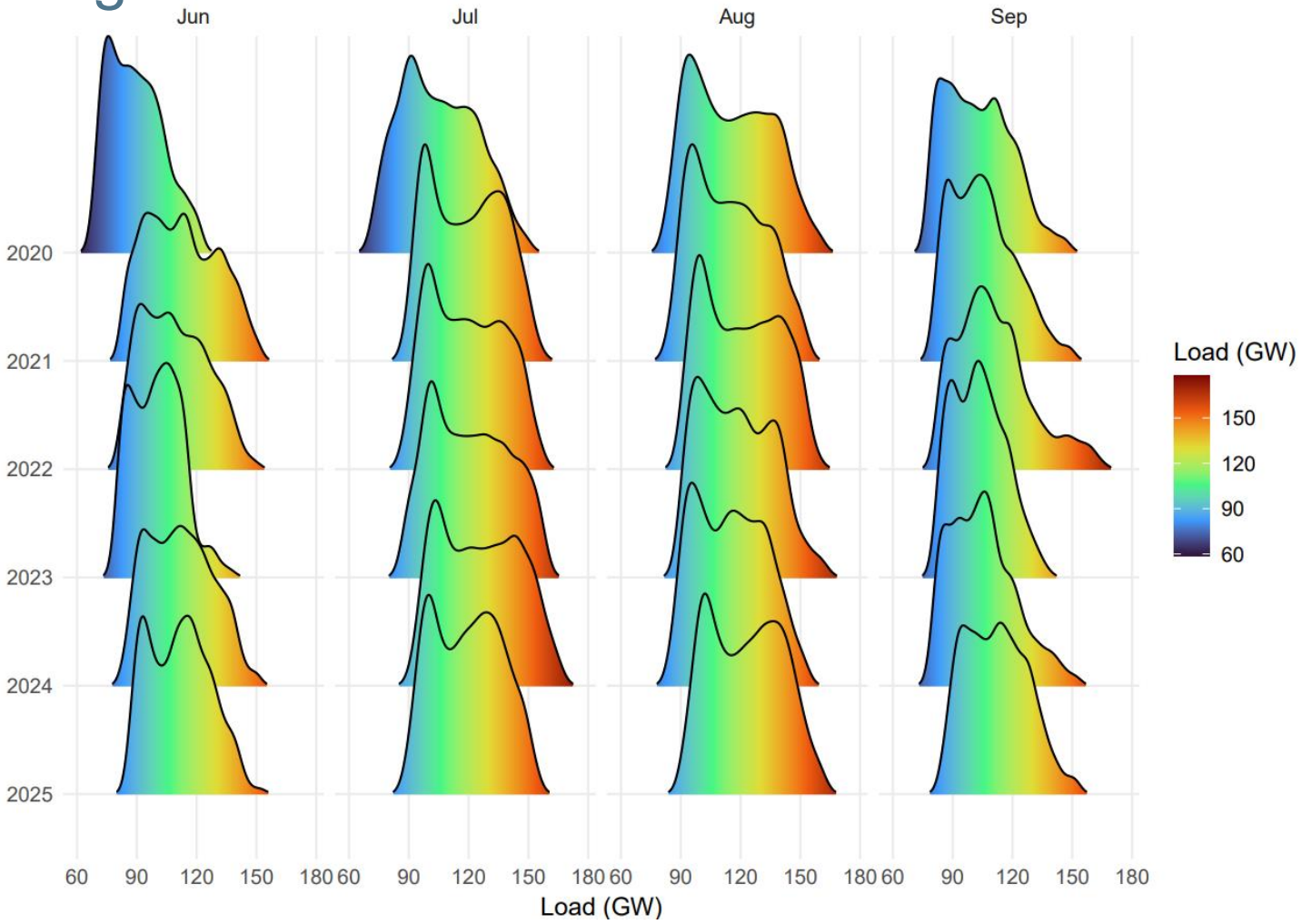
The assistance energy transfer program continues to be a well used tool by WEIM entities. During summer, up to 10 different areas opted in to the program. The associated cost for use of transfers under test failure conditions was low, with a max daily cost under $60,000

CAISO's loads during summer were moderate, reaching a peak of 44,434 on August 21



For reference, the CAISO's area record peak was about 52 GW on September 7, 2022

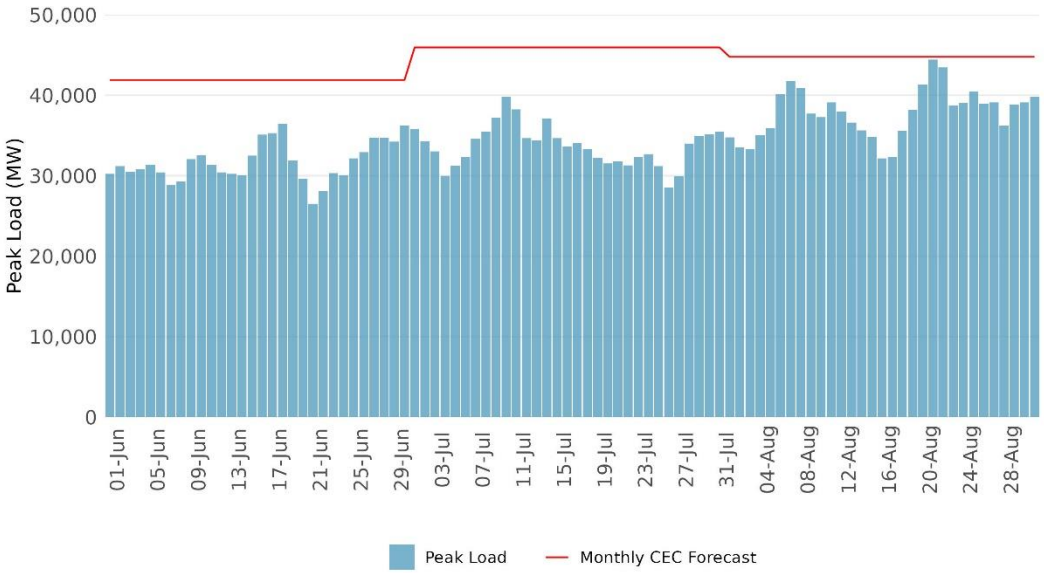
The Western Interconnection demand peaked at 163,553 MW on August 21



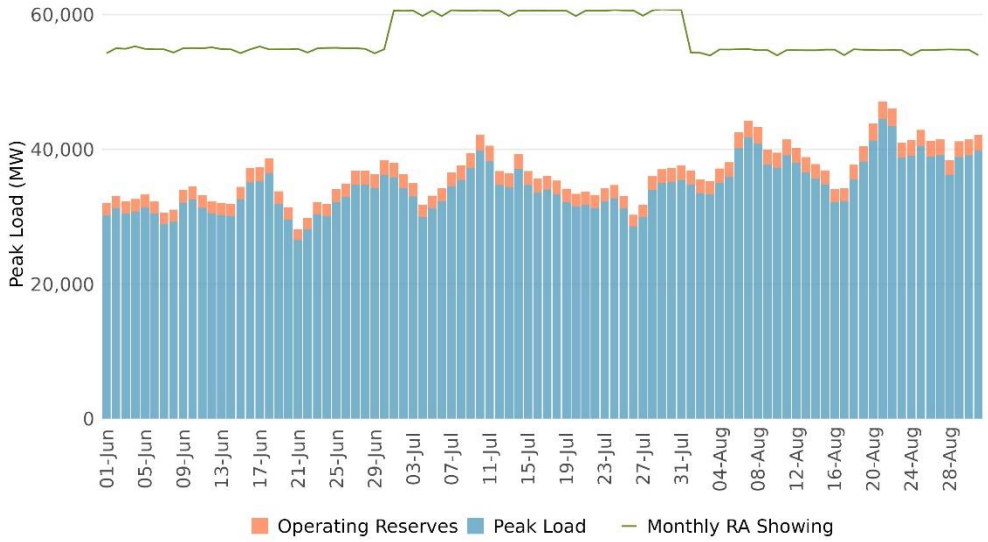
This peak was fairly lower than record peak of 167,988 MW in July 2024

CAISO's loads in summer were relatively moderate and below the CEC forecasts

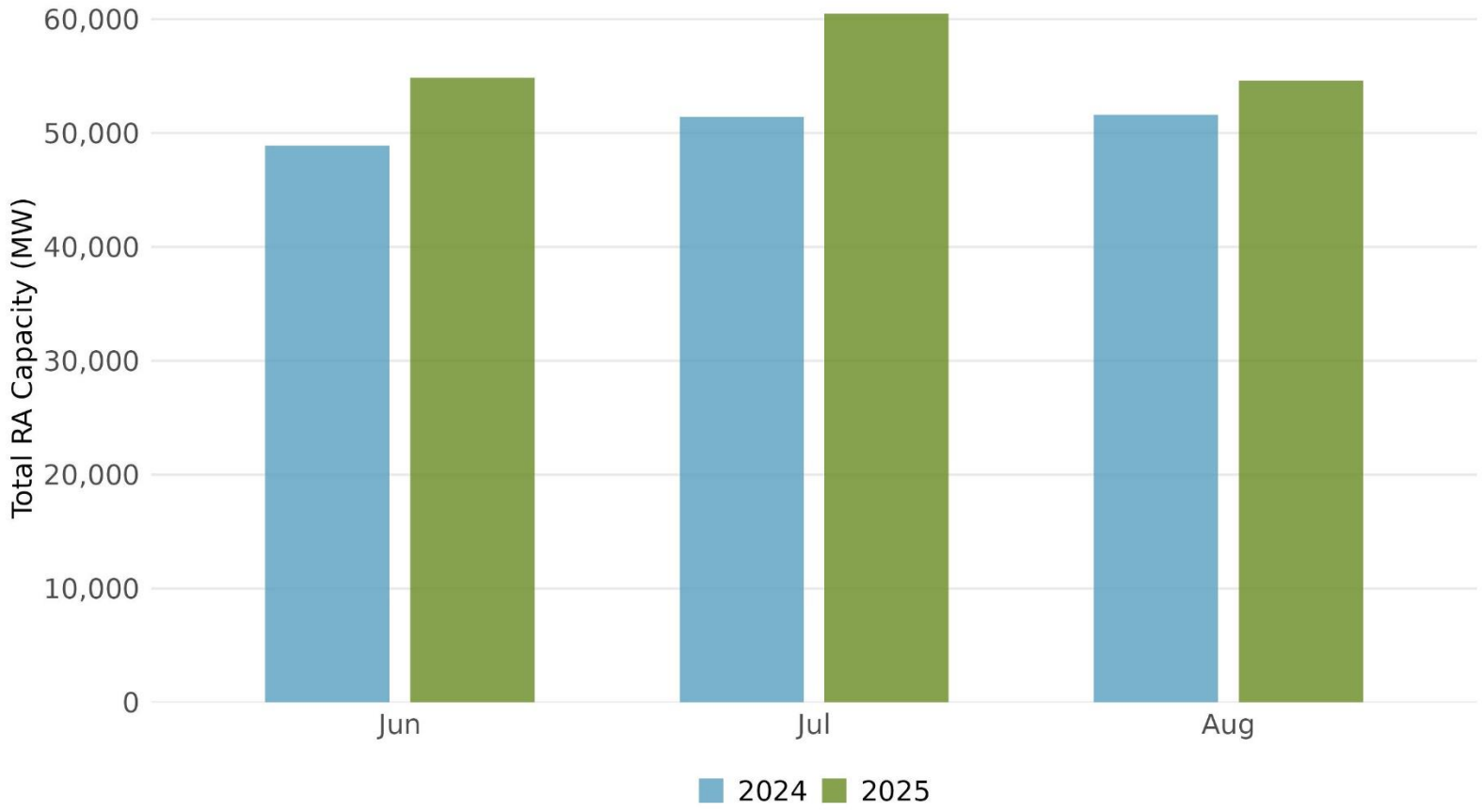
The CAISO's load peak happened on August 21st, at 44,434 MW, below the CEC forecast of 44,779 MW



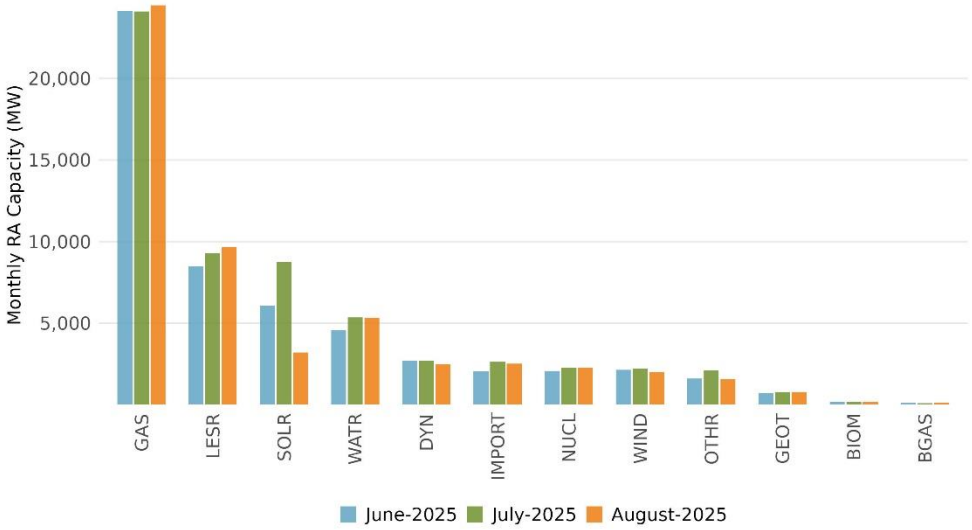
The monthly RA showings were largely sufficient to cover CAISO's load plus operating reserves.



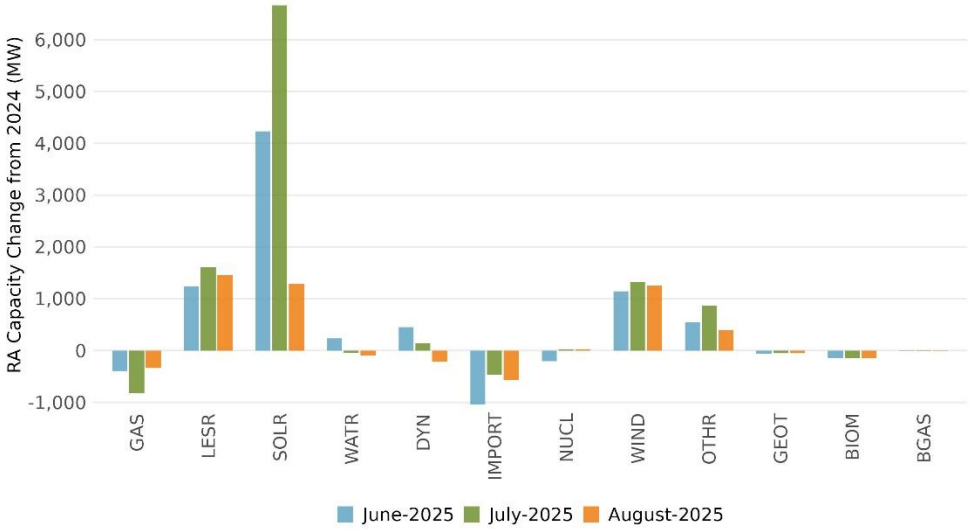
The monthly RA showing for Summer 2025 was higher than Summer 2024



The technology mix supporting the monthly RA showings for Summer 2025 was similar to Summer 2024

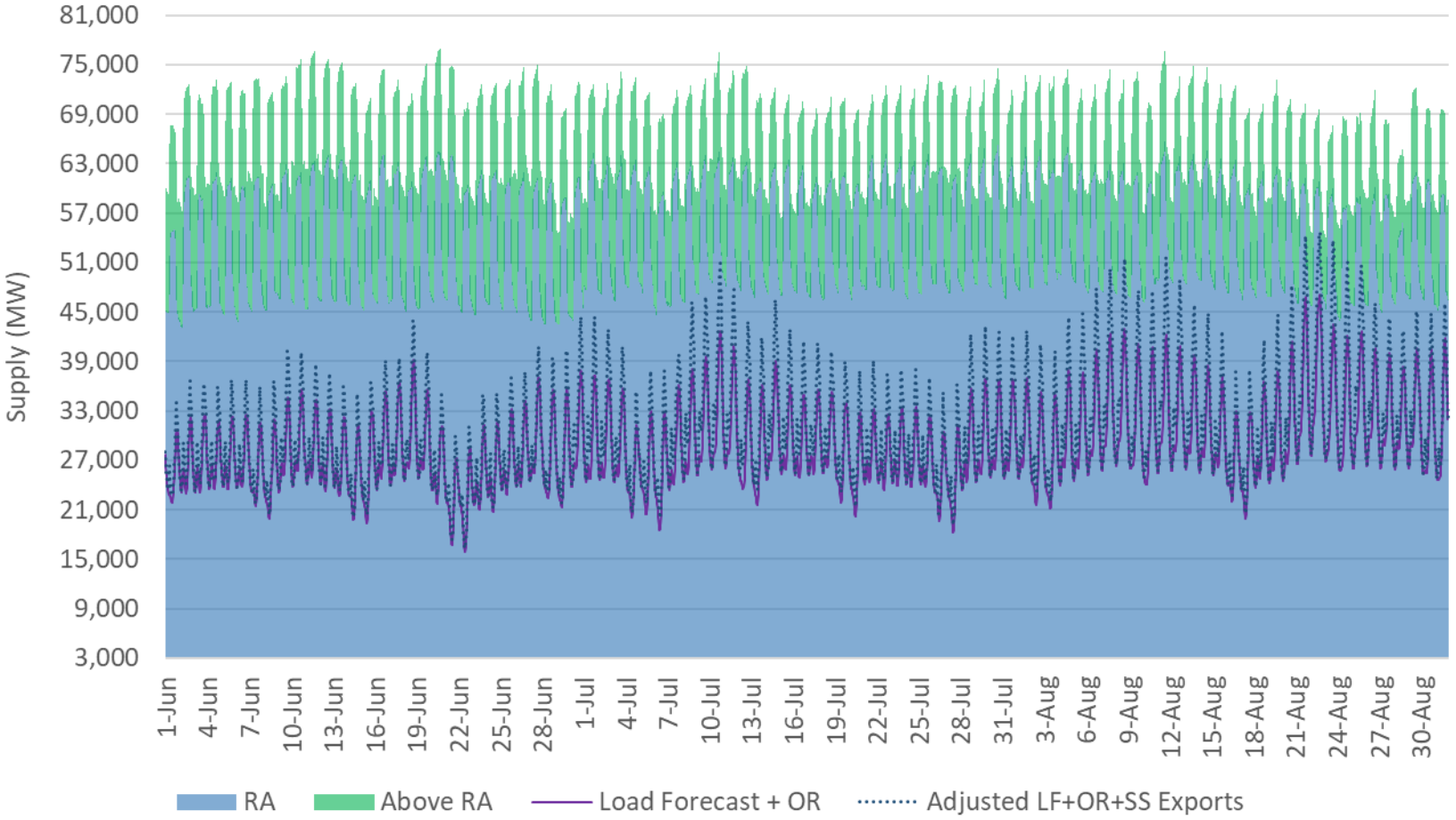


Compared to 2024, solar, storage, and wind resources provided more RA capacity while gas and imports provided less

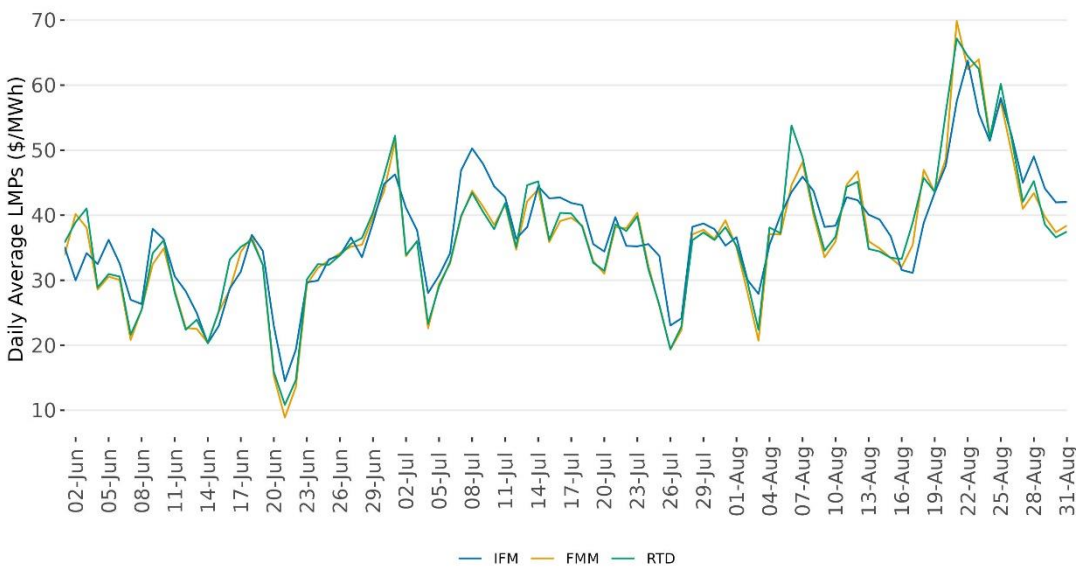


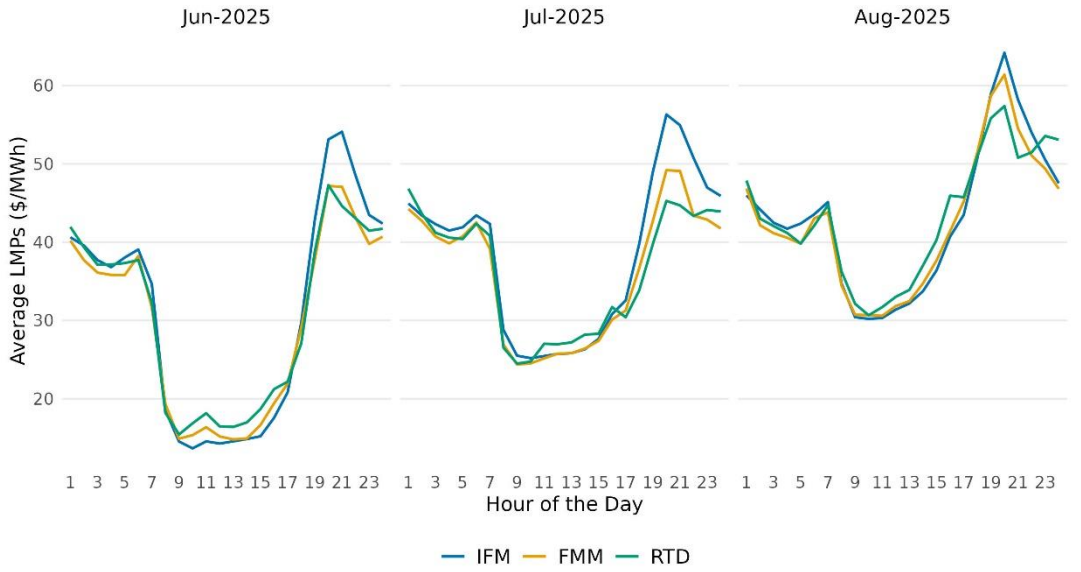
California ISO

RA capacity was sufficient throughout the summer to meet load needs

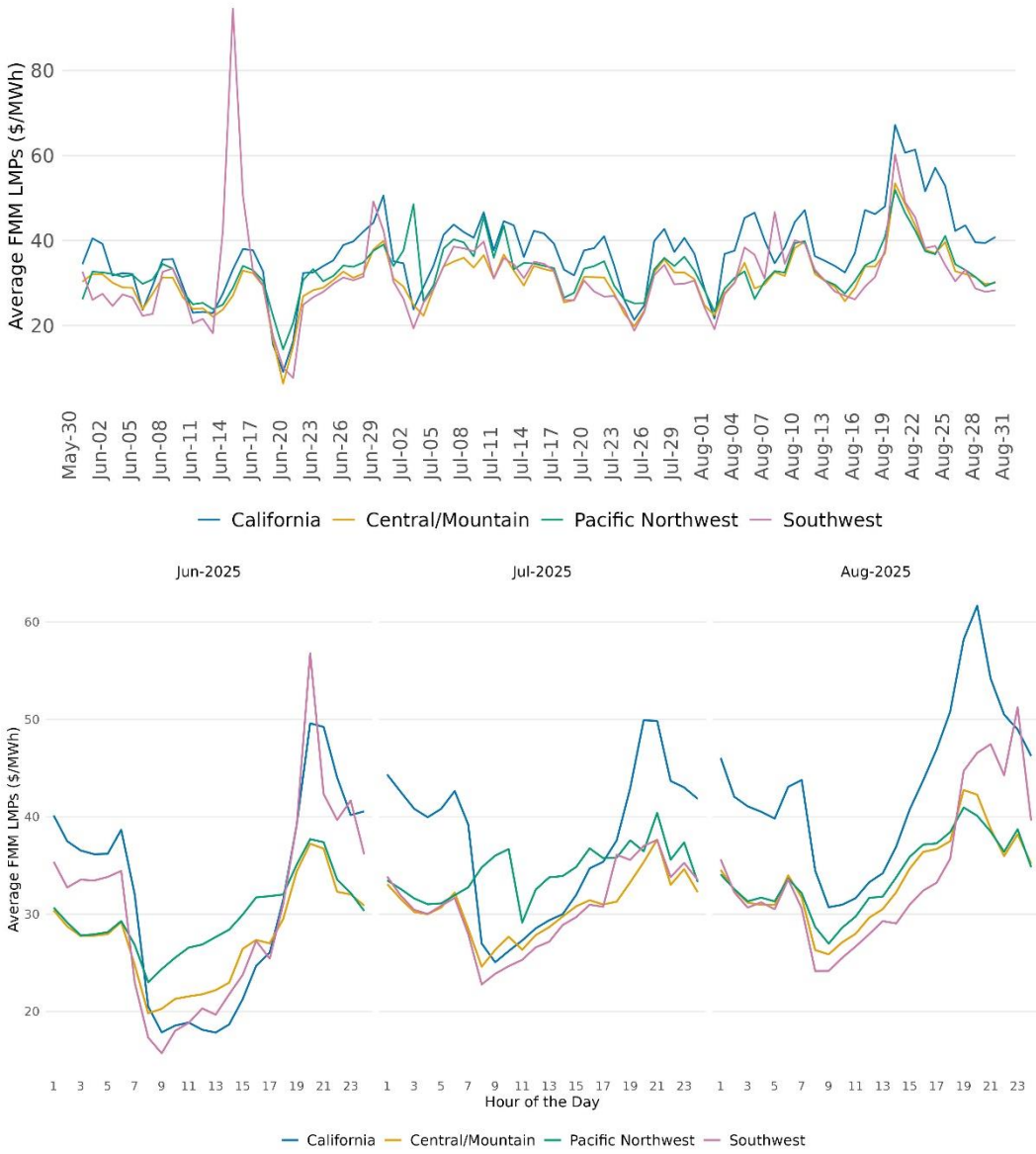


This summer, CAISO's prices peaked in August, mainly during the days of highest loads

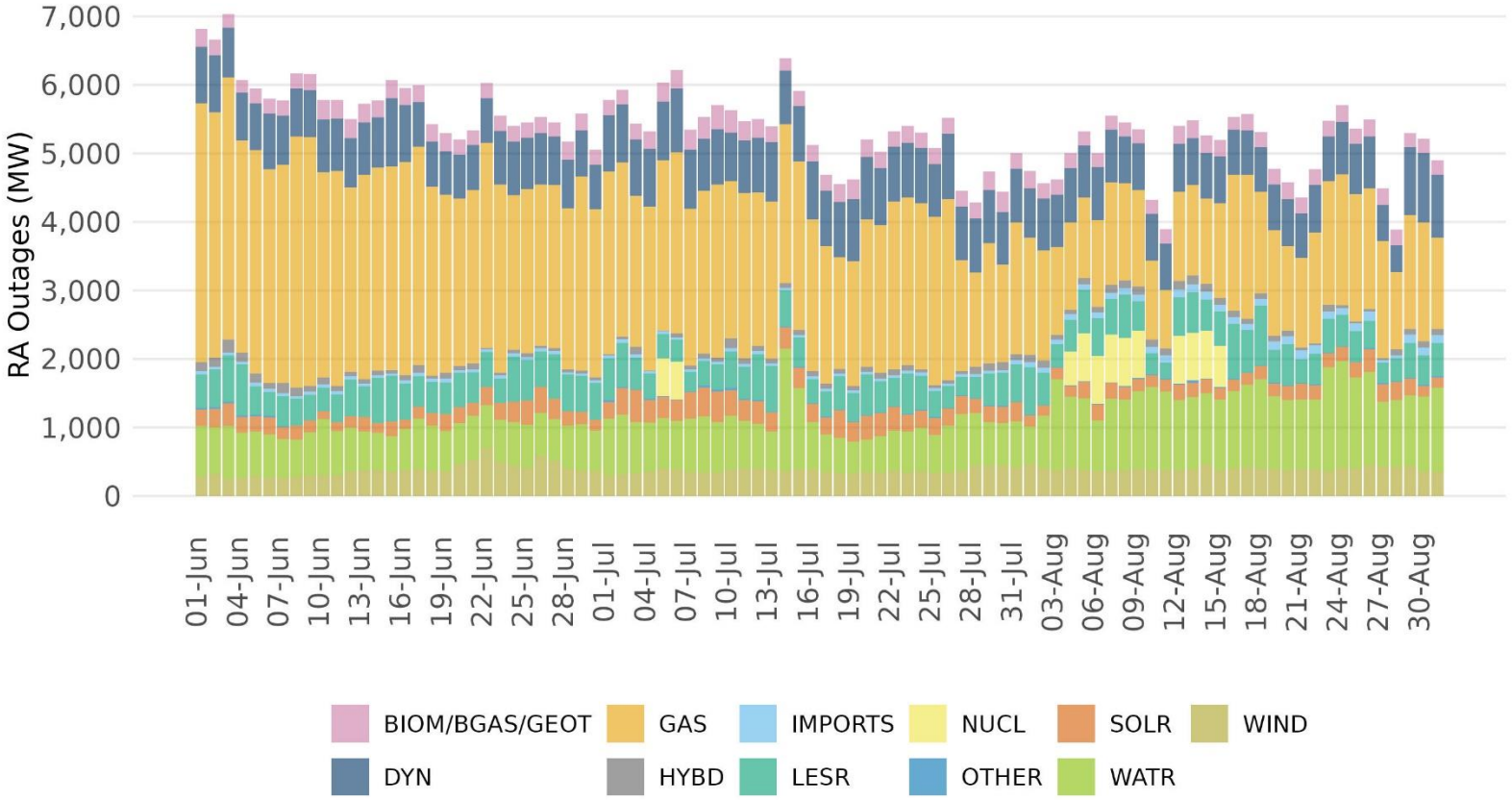




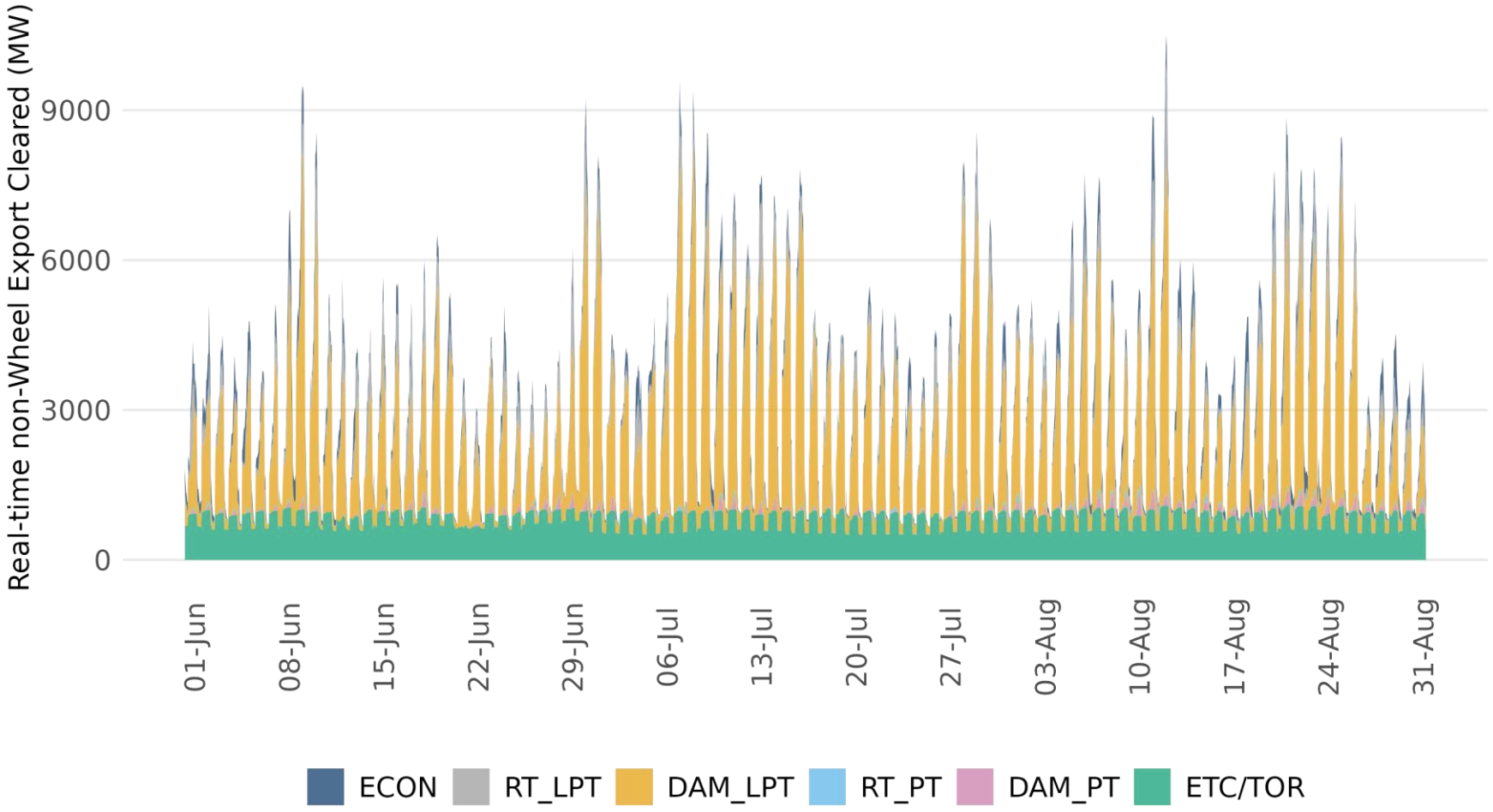
Prices in the imbalance market exhibit similar trends, with maximum levels on August 21st, with the exception of a spike for Southwest on June 16th.



Average daily resource-adequacy capacity on outage was within typical ranges, at about 5,400 MW

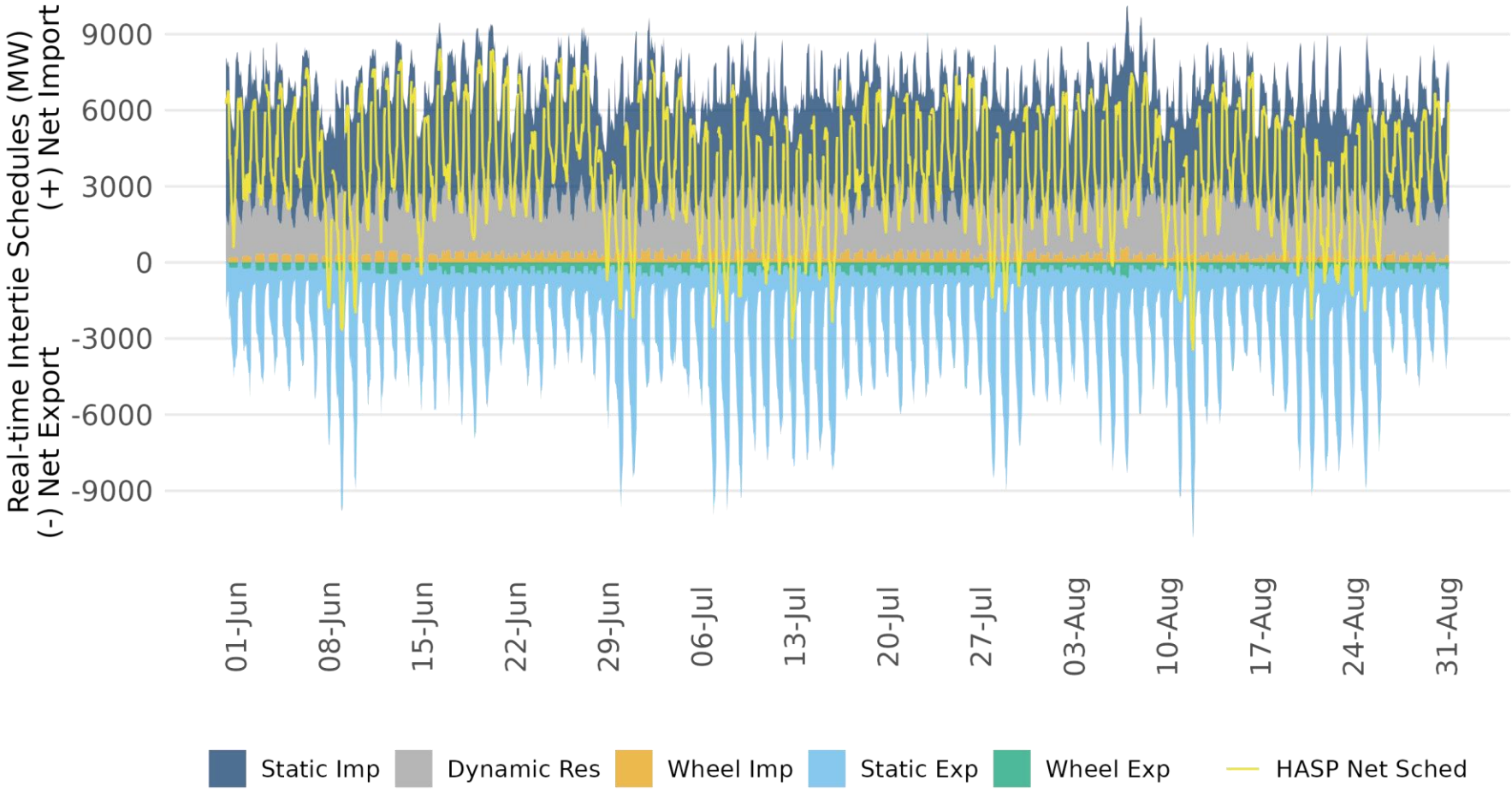


High volume of exports observed in July and August



Most exports were self-schedule bids in the day-ahead market

The market cleared large volumes of CAISO exports this summer, resulting in several days with a net export position

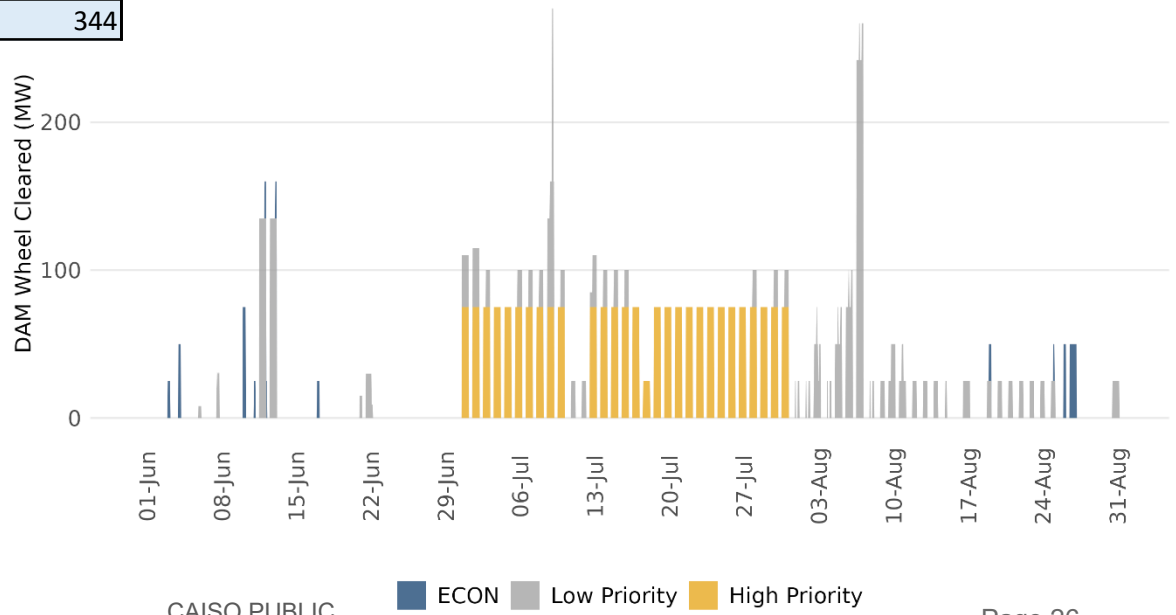


Up to 344 MW of high priority wheel-through transactions were registered for use in summer months

Month	Source	Sink	Total
Jun-25	NOB	MEAD230	250
Total			250
Jul-25	MALIN500	MEAD230	50
	MEAD2MSCHD	SYLMAR	40
	NOB	MEAD230	250
Total			340
Aug-25	MALIN500	MEAD230	50
	MEAD2MSCHD	SYLMAR	40
	NOB	MEAD230	229
	PVWEST	MIR2	25
Total			344

There were also modest level of low-priority wheel-through transactions participating in the CAISO market

No wheel-through transactions were reduced this summer

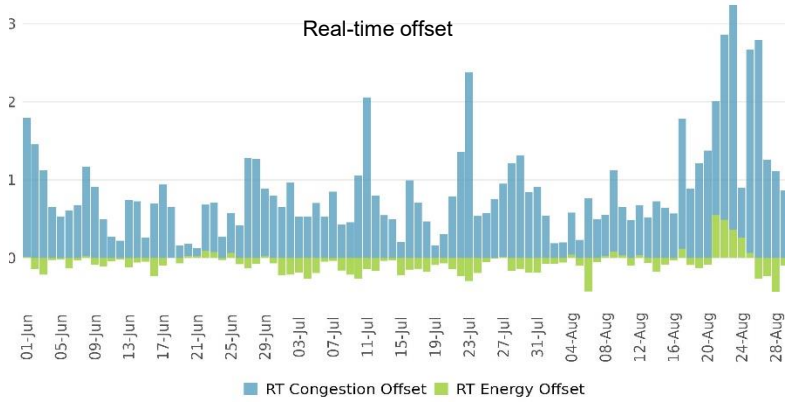


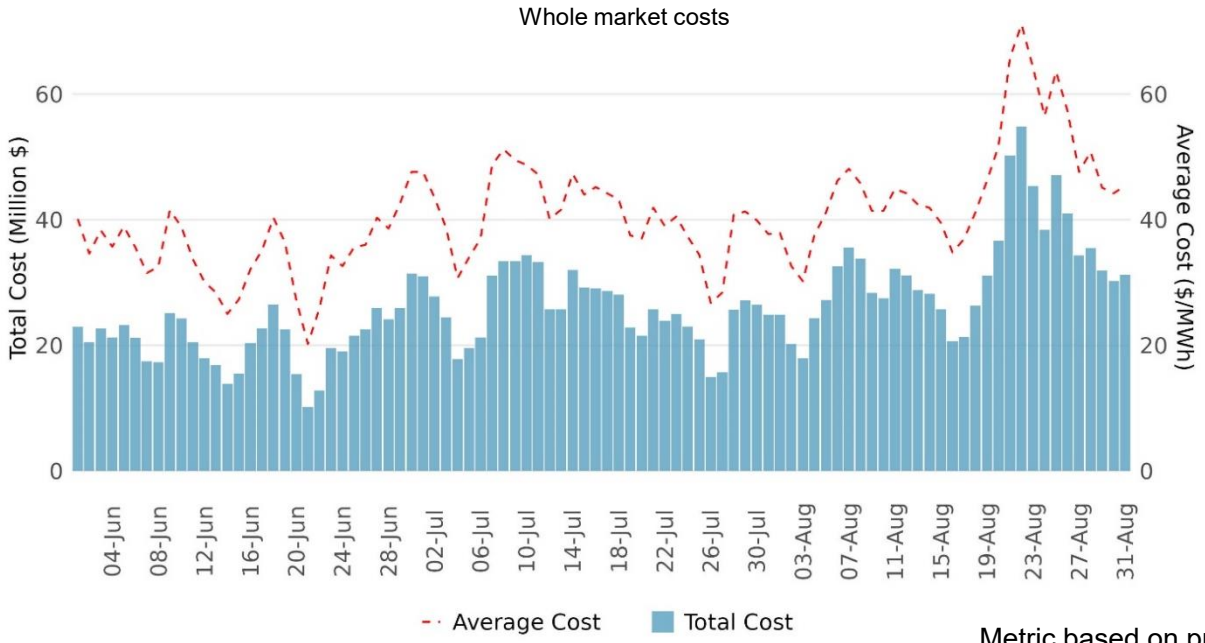
The residual unit commitment process reduced low priority exports by up to 739 MW only in a few days in August when CAISO area experienced higher loads

Date	HASP Export Reductions (Max)*	RUC Export Reductions (Max)*
10-Jun-2025	3	
30-Jun-2025	2	
1-Jul-2025	84	
9-Jul-2025	0.43	
11-Jul-2025	38	
12-Jul-2025	5	
14-Jul-2025	52	
15-Jul-2025	44	
25-Jul-2025	9.77	
26-Jul-2025	10	
27-Jul-2025	10	
29-Jul-2025	18	
6-Aug-2025	57	
11-Aug-2025		0.01
21-Aug-2025		311.62
22-Aug-2025		210.80
24-Aug-2025		739.19

** This only includes self schedules*

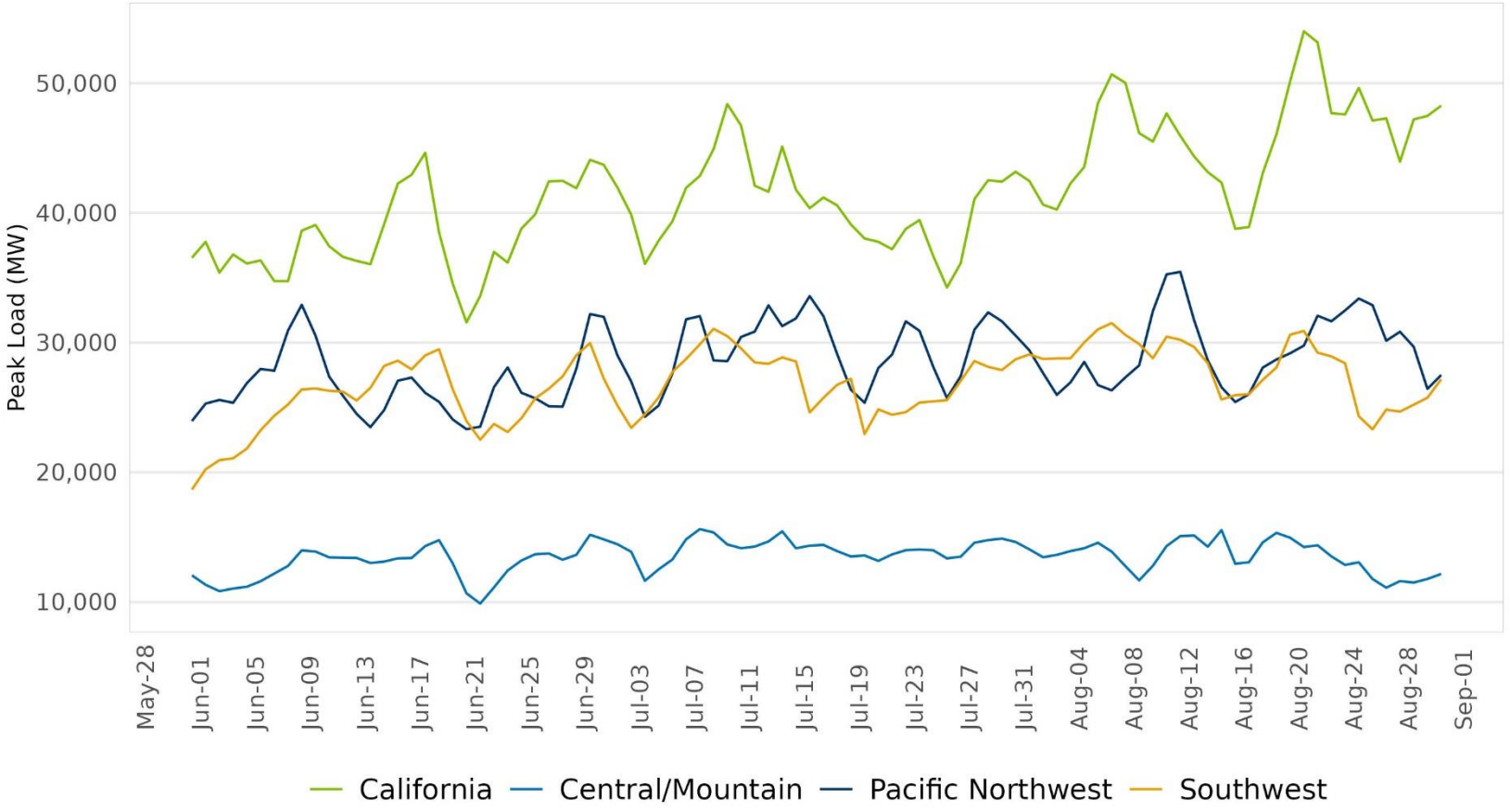
Average CAISO wholesale cost in July was about $26 million/day, peaking at $54 million/day on August 22



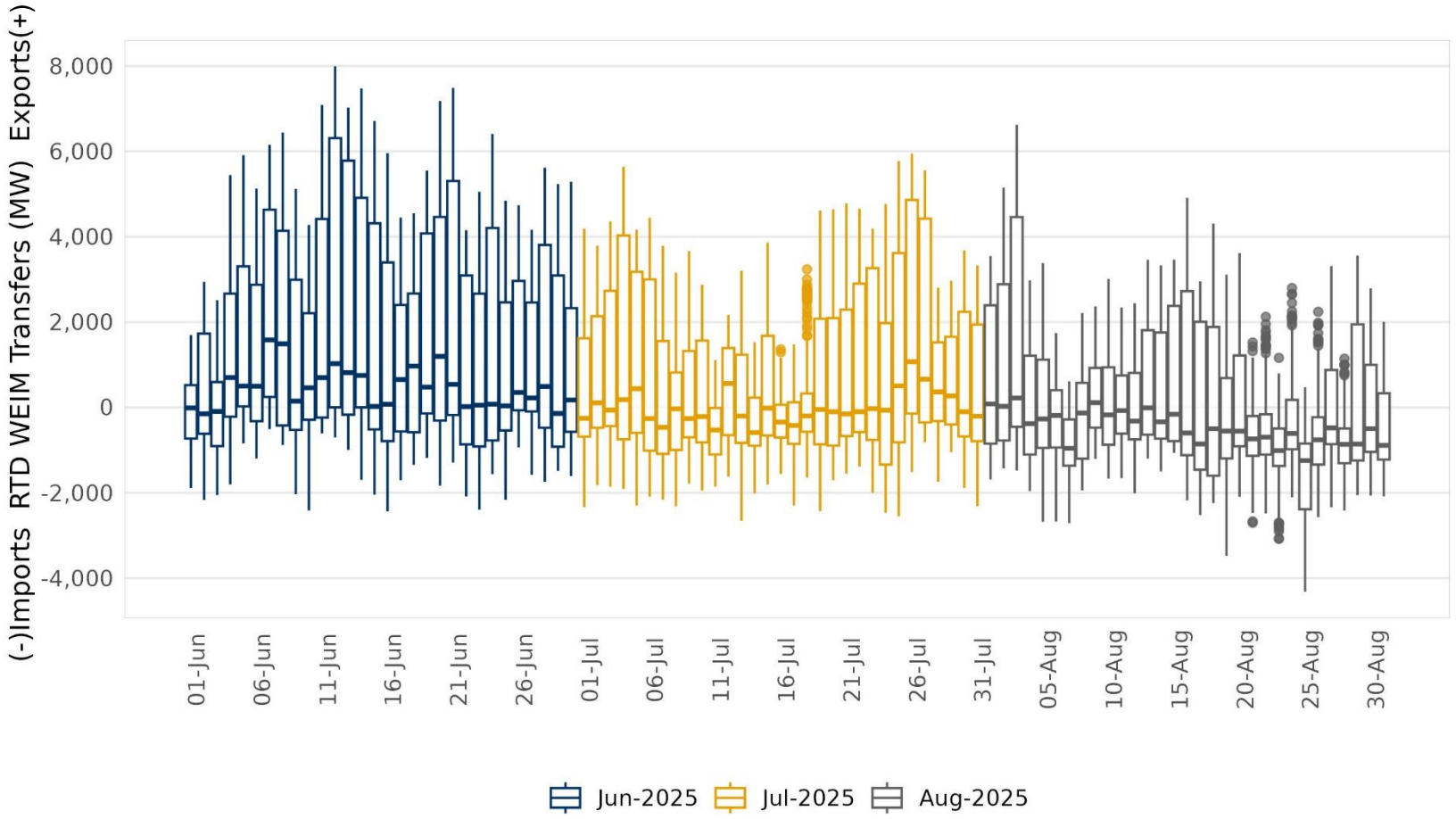


Metric based on preliminary settlements data and subject to updates

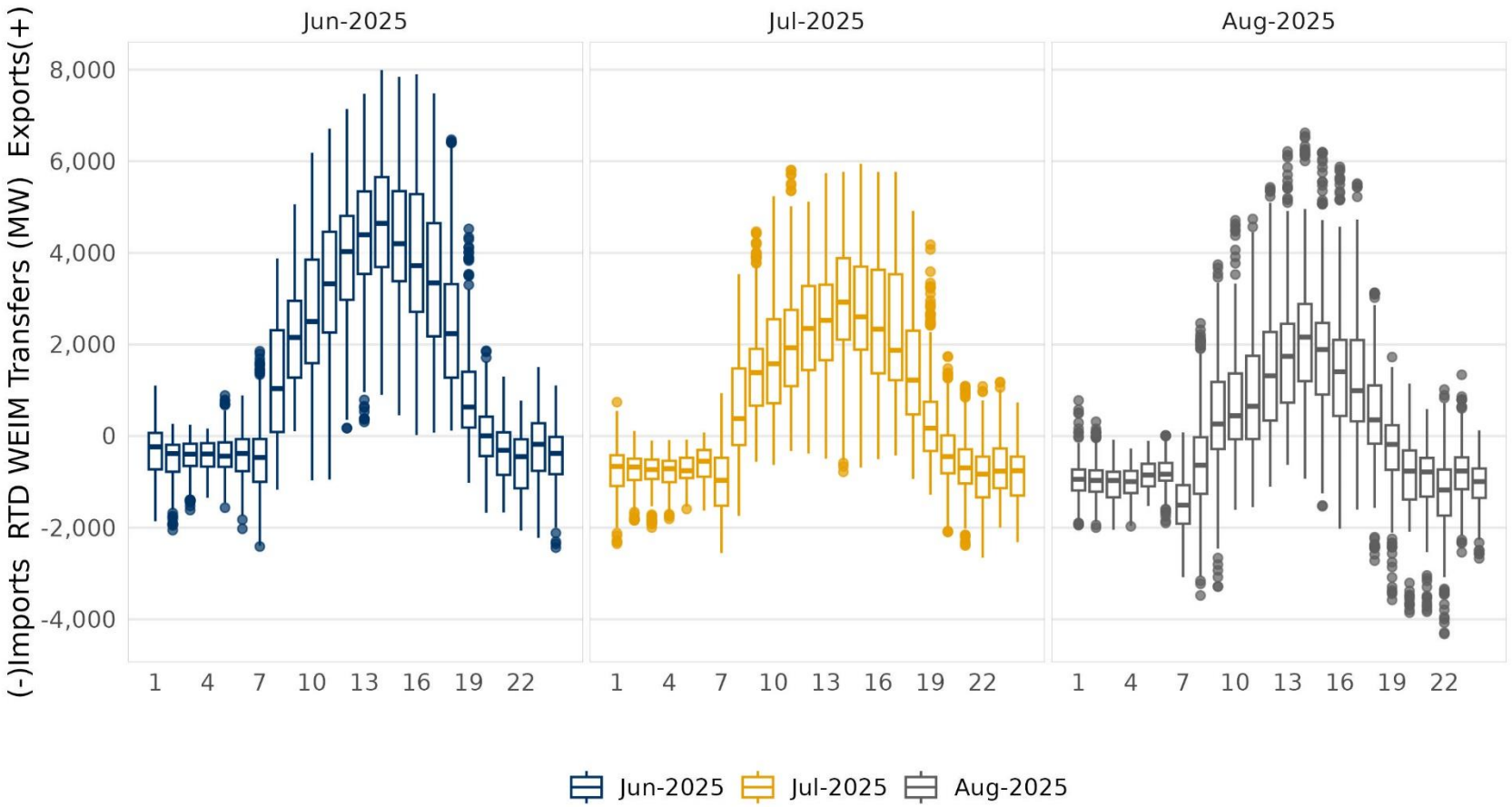
WEIM load peaked on August 21 at 128, 916 MW



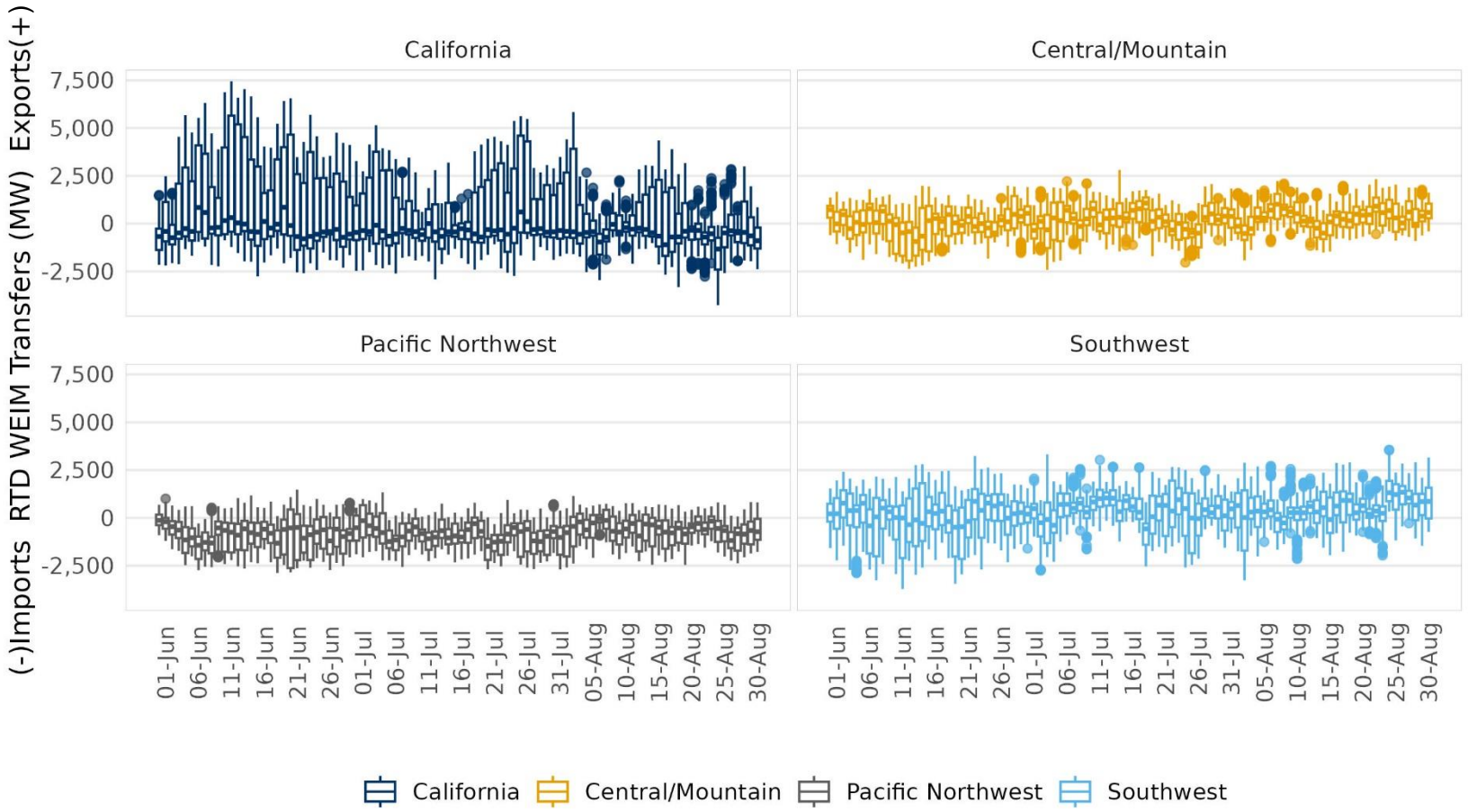
WEIM transfers for CAISO in the five-minute market were mostly net exports, except in August where average transfers shifted towards net imports



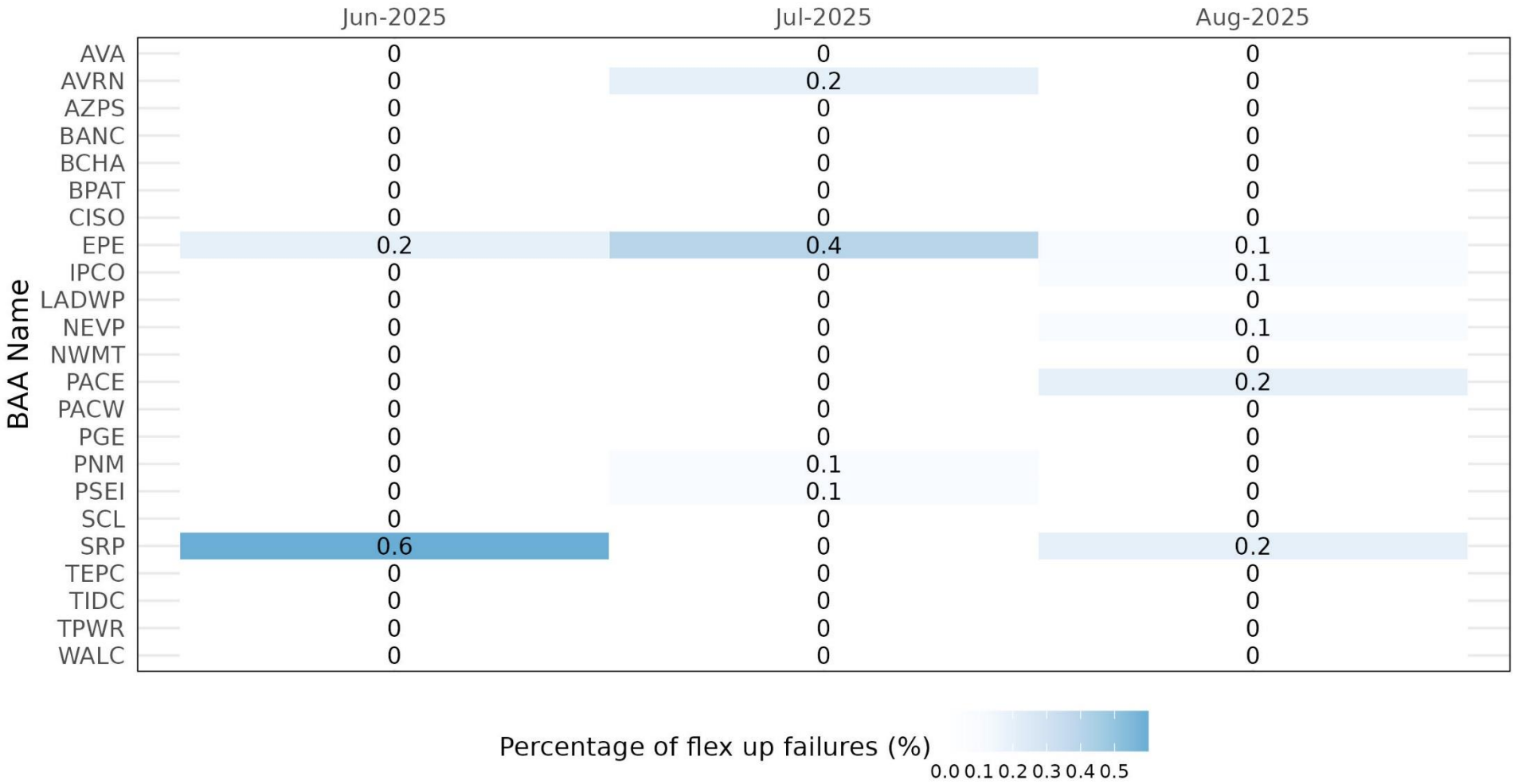
WEIM transfers for CAISO followed typical daily profile; net exports during midday were highest in June, net imports during evening ramp were highest in August



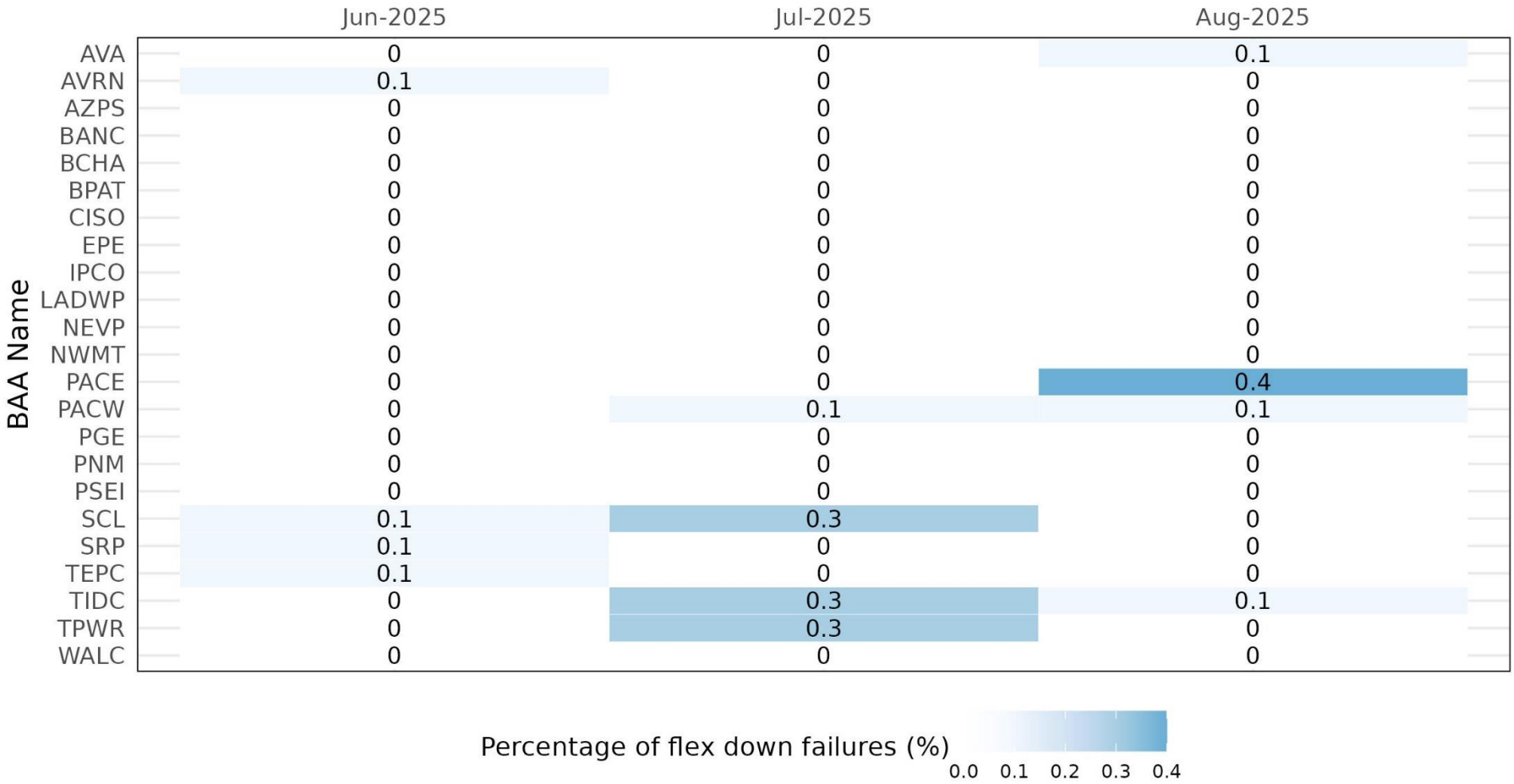
WEIM transfers for California were net exports, but net exports decreased from June to August



Flexible ramp up test failures were low from June to August, peaking at 0.6%

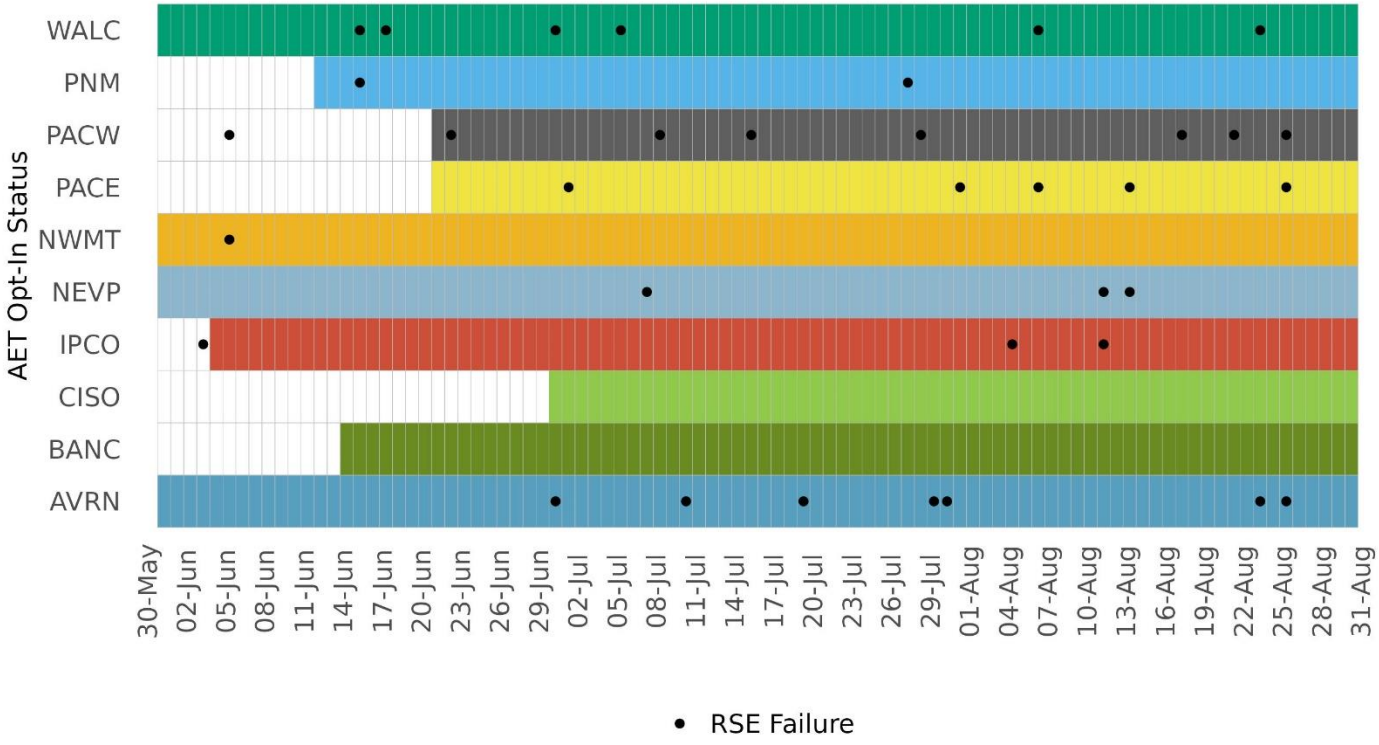


Flexible ramp down test failures were low from June to August, peaking at 0.4%



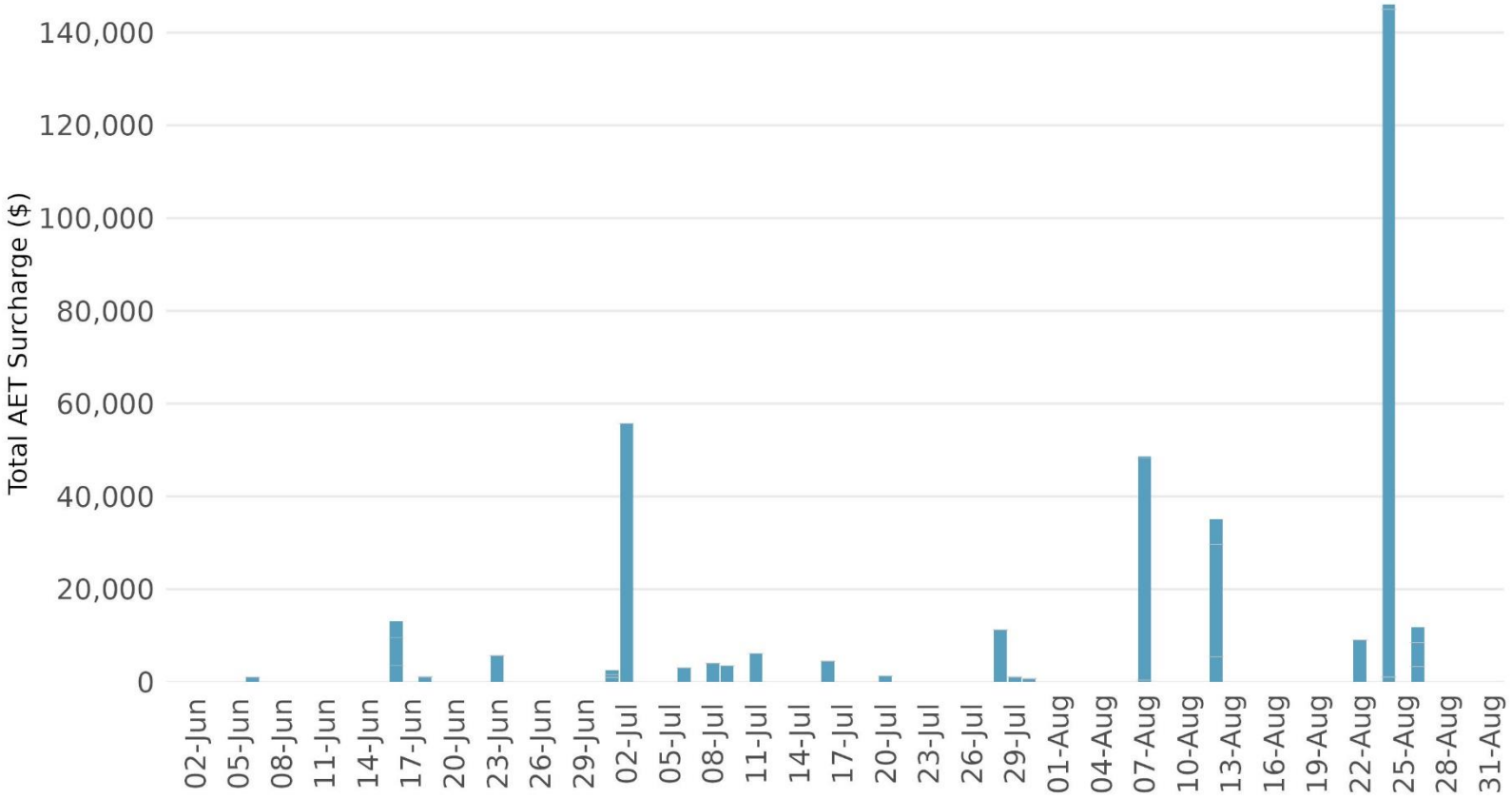
The WEIM facilitated balancing area access to assistance energy transfers, providing operational benefits

- 10 WEIM balancing areas opted in to the assistance energy transfer (AET) program in summer
- This program allows areas to receive energy transfers when they do not meet resource sufficiency requirements



Total AET surcharges across all WEIM BAAs were highest in August, driven by a large surcharge on August 24

- The total AET surcharges across all BAAs from June to August were approximately: $21,000 in June; $94,000 in July; $251,000 in August



Storage enhancement and FRP performance

Market Performance and Advanced Analytics

Storage Enhancements and FRP Performance

Action taken: On June 3, 2025, CAISO implemented an enhancement to the real-time market state of charge constraint to account for the impact of flexible ramping product (FRP) up awards for batteries

Impact: The share of FRP up awards from batteries remained stable after the launch, with a modest shift in FRP up awards in the morning and evening peaks. Moderate summer conditions did not create tight supply conditions to exhibit the benefits of this change

Next Steps: CAISO will continue to monitor enhancement performance during morning peaks in winter conditions. CAISO is assessing a few instances of negative FRU prices

FRU in SOC modeling enhancement was activated on June 3rd, 2025

- FRU term was added to the SOC^{AT} equations in the real-time market to account for the impact of upward FRP awards on the battery state of charge (SOC) (Market Operations PRR #1627)

$$SOC_{i,t} = SOC_{i,t-1} - (EN_{i,t}^{(+)} + \eta EN_{i,t}^{(-)}) \frac{\Delta T}{T_{60}}$$

$$\underline{SOC_{i,t}} \leq SOC_{i,t} \leq \overline{SOC_{i,t}}$$

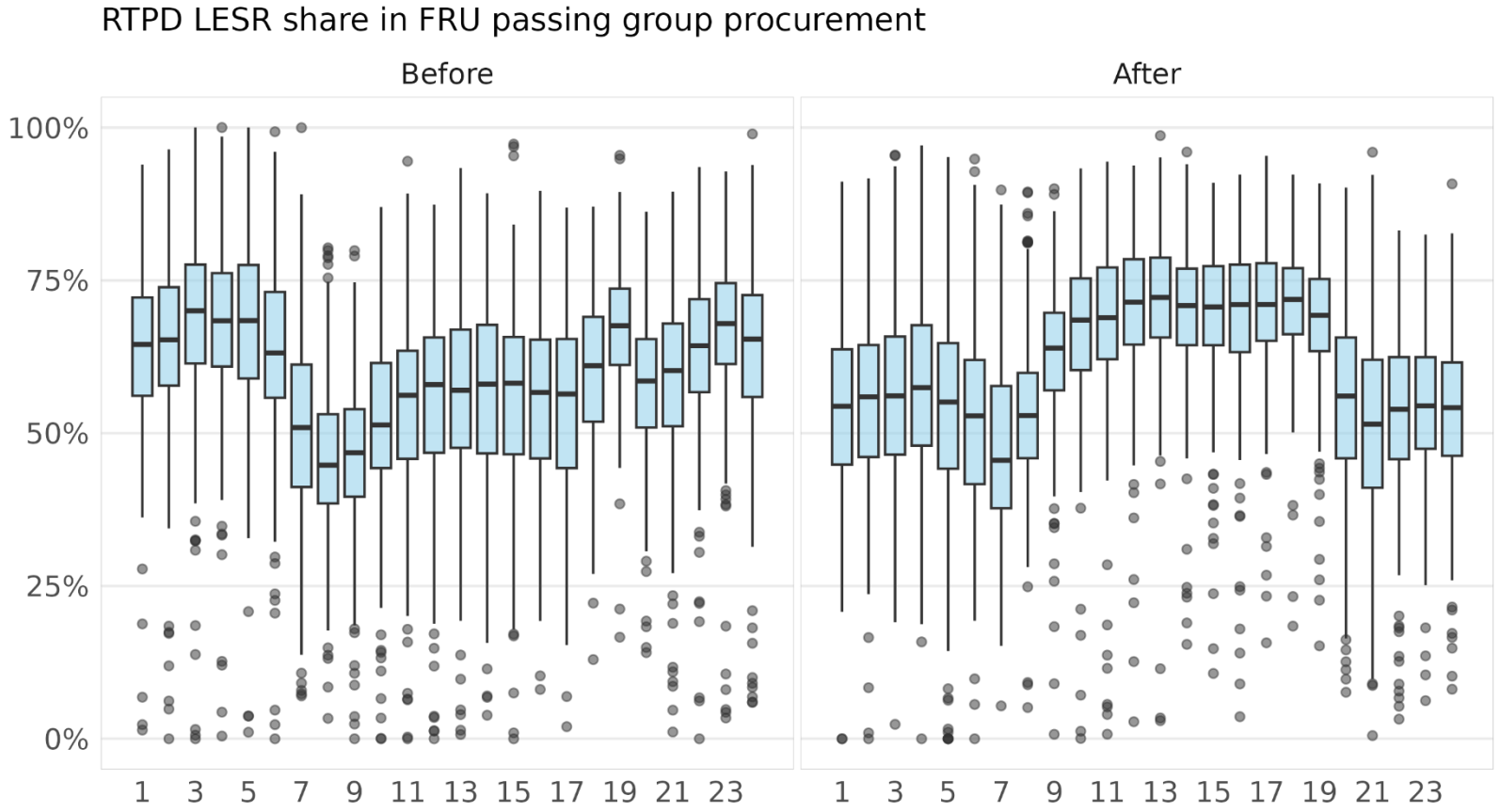
(SOC: SOC with energy impact only)

$$SOC_{i,t}^{AT} = SOC_{i,t-1}^{AT} - (FRU_{i,t} + EN_{i,t}^{(+)} + \eta EN_{i,t}^{(-)} + ATRU_t RU_{i,t} - ATRD_t \eta_i RD_{i,t}) \frac{\Delta T}{T_{60}}$$

$$\underline{SOC_{i,t}} \leq SOC_{i,t}^{AT} \leq \overline{SOC_{i,t}}$$

(SOC^{AT} : SOC with attenuation factors)

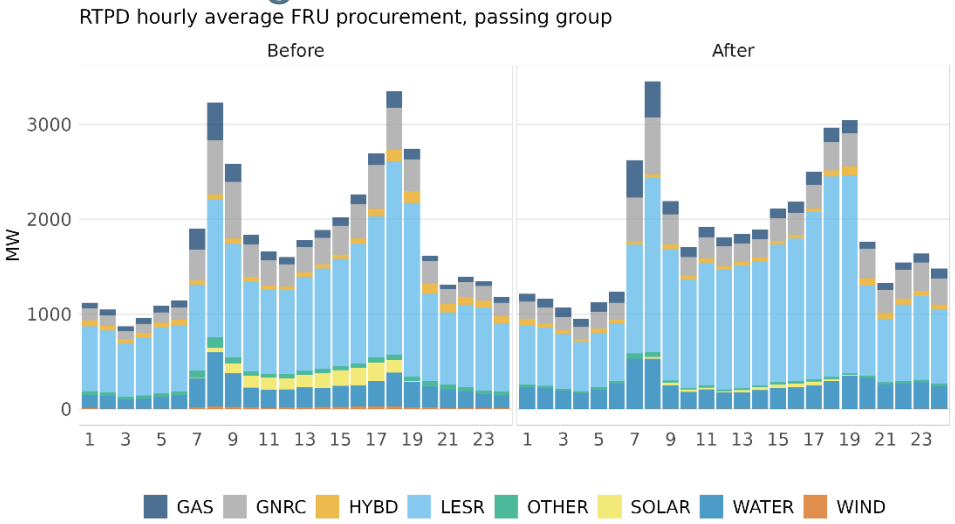
Hourly distributions of LESR share in FRU procurement show lower share in early hours and late hours of the day. Higher share observed in the midday hours.

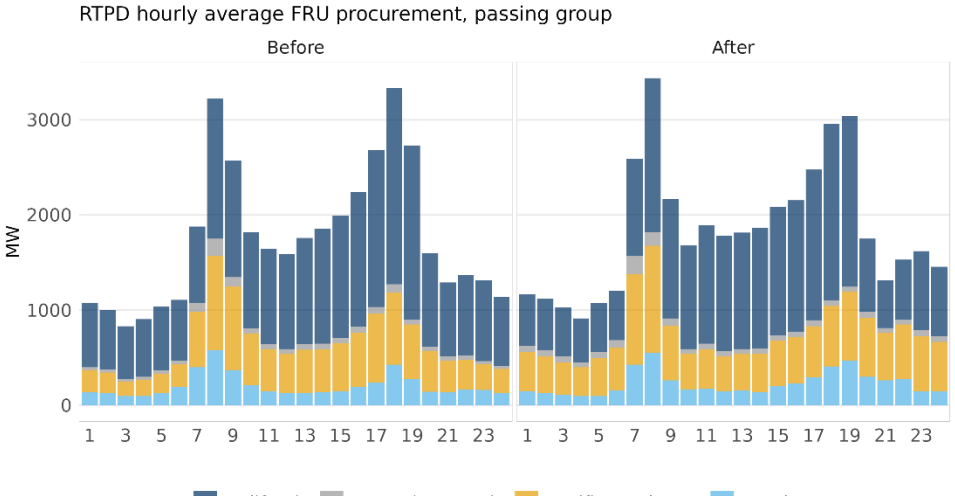


From hourly averages, in early hours and late hours of the day, slight reduction in FRU procurement was observed in LESR share in resource breakdown, and CAISO share in region breakdown.

- On average, the slightly smaller FRU volume from LESR in early hours and late hours of the day was mainly picked up by GNRC and WATER.

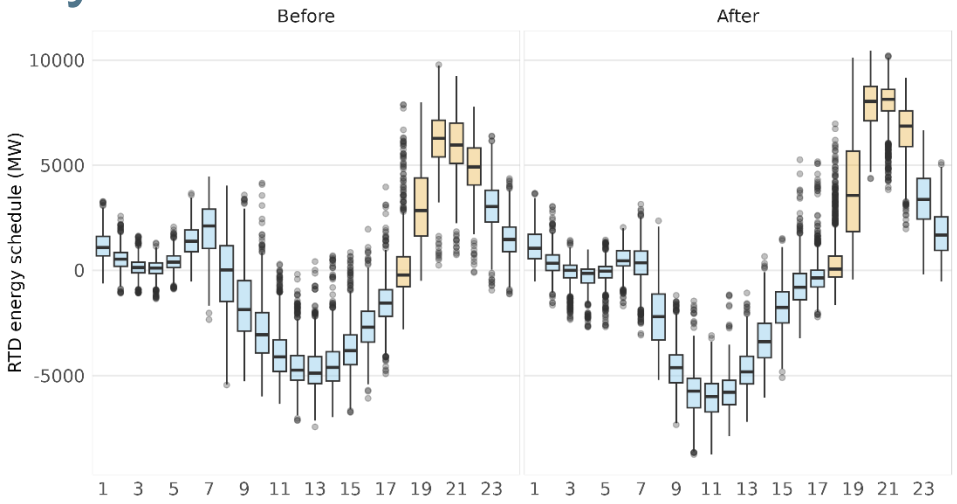
- California region showed slight reduction in early morning and late hours of the day, mainly picked by Pacific Northwest and Southwest regions



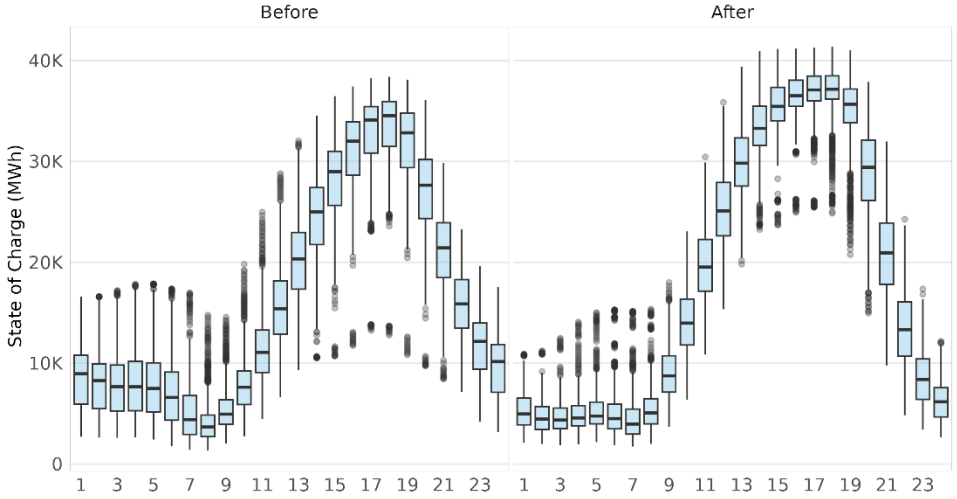


CAISO real-time energy schedule and total state of charge trends remain steady.

- Energy schedule trends show slightly higher discharging schedules in the afternoon peak hours



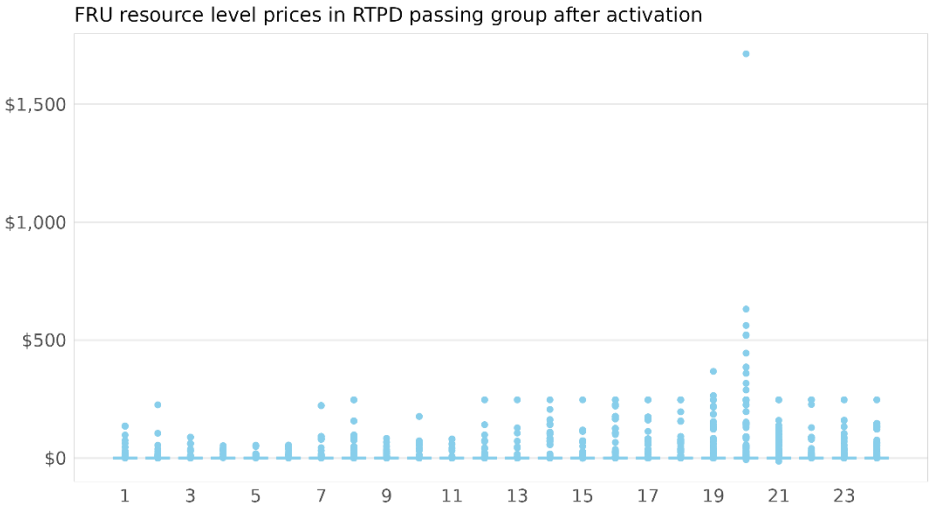
- Total state of charge continued to peak around hour ending 18

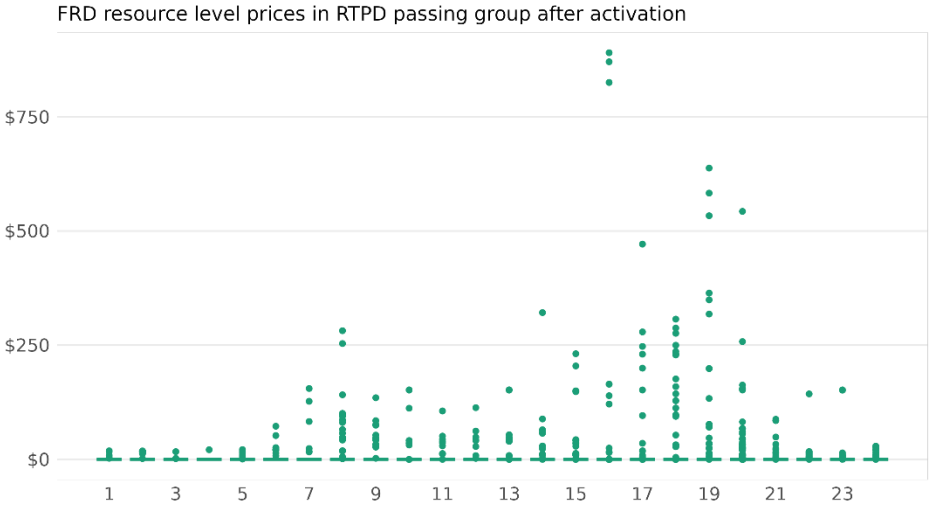


Resource level FRU & FRD prices showed zero values up to 75 percent of the time.

- Resource level FRU prices remain minimal.
  - Seven negative FRU price cases were observed after activation. Resolutions under discussion.

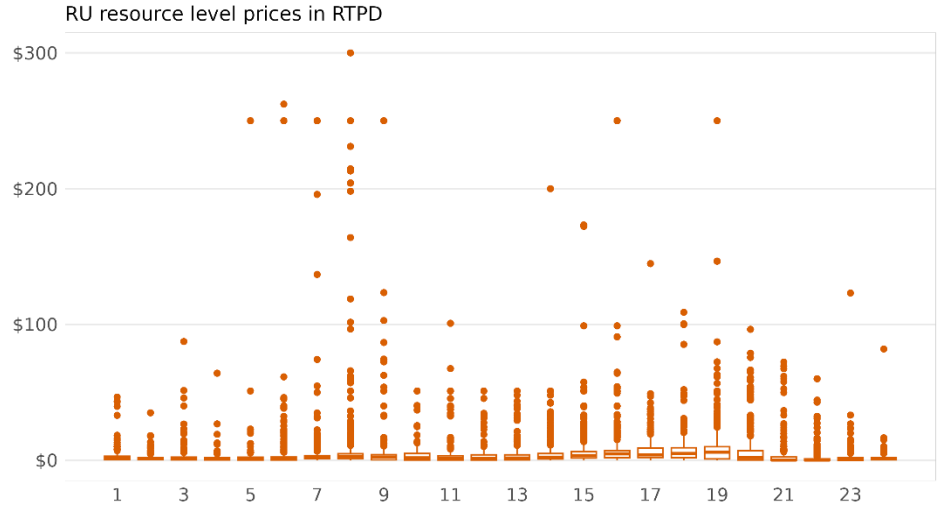
- Resource level FRD prices remain non-negative



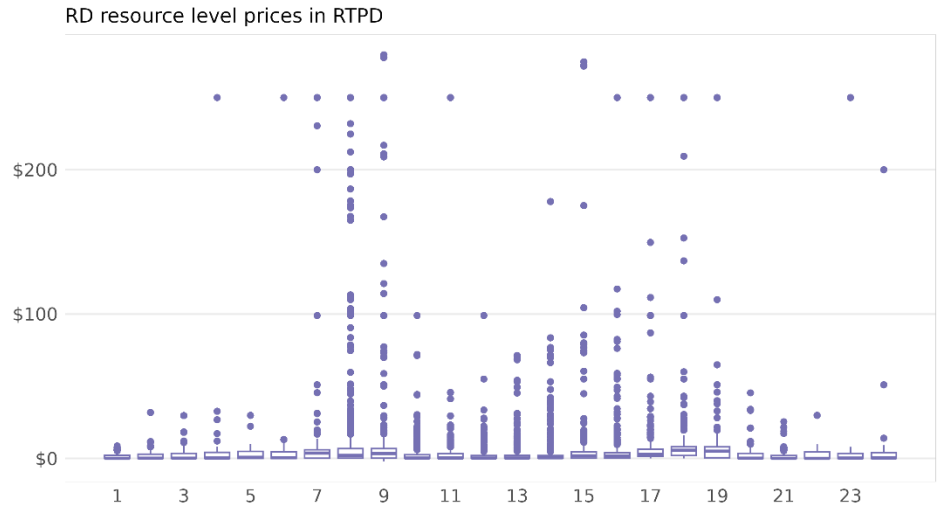


Resource-level regulation up and down prices remained non-negative and within typical ranges.

- Resource level regulation up prices remained non-negative and within typical ranges.



- Resource level regulation down prices remained non-negative and within typical ranges.
  - 7/6/2025 HE 9 interval 1, Rd price -$2.08 in one of the CAISO subregions due to manual procedure error. Impacted resource prices were corrected.



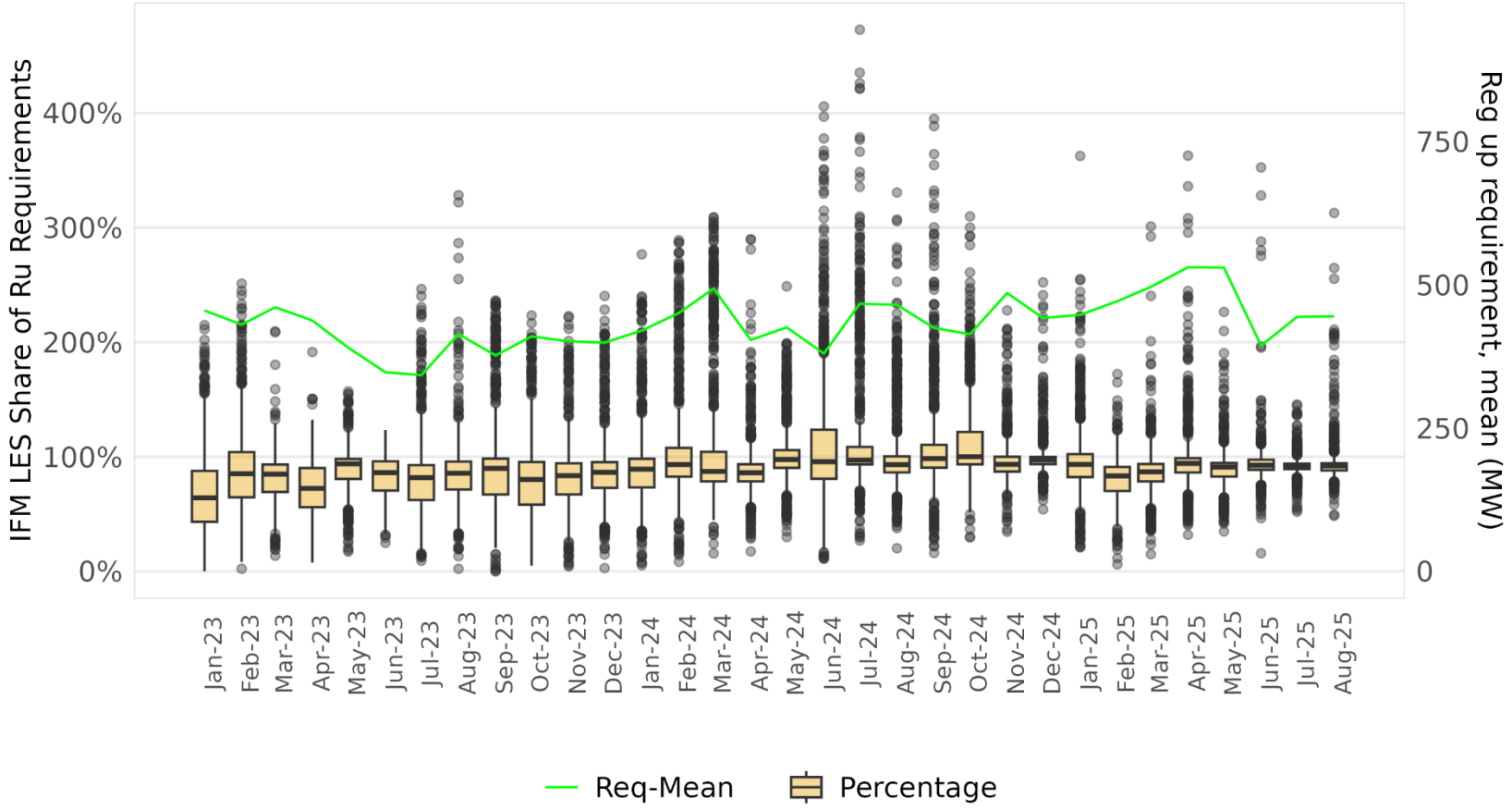
Example: negative FRU price

Interval	Ru	Rd	En	En_price	FRU	FRU_price	SOC_EN	SOC_AT
HR1:30	66	99	0	32.1	0	0	449.1	460.3
:45	66	99	-33	22.9	4.6	0	456.2	477.6
HR2:00	66	35.8	-73.1	15.9	17.5	-13.4	472.2	491.8
:15	66	35.8	-46.9	15.9	19.2	-13.4	482.4	500
:30	66	35.8	0	30.6	10.98	0	482.4	500
:45	66	35.8	0	30.8	10.98	0	482.4	500

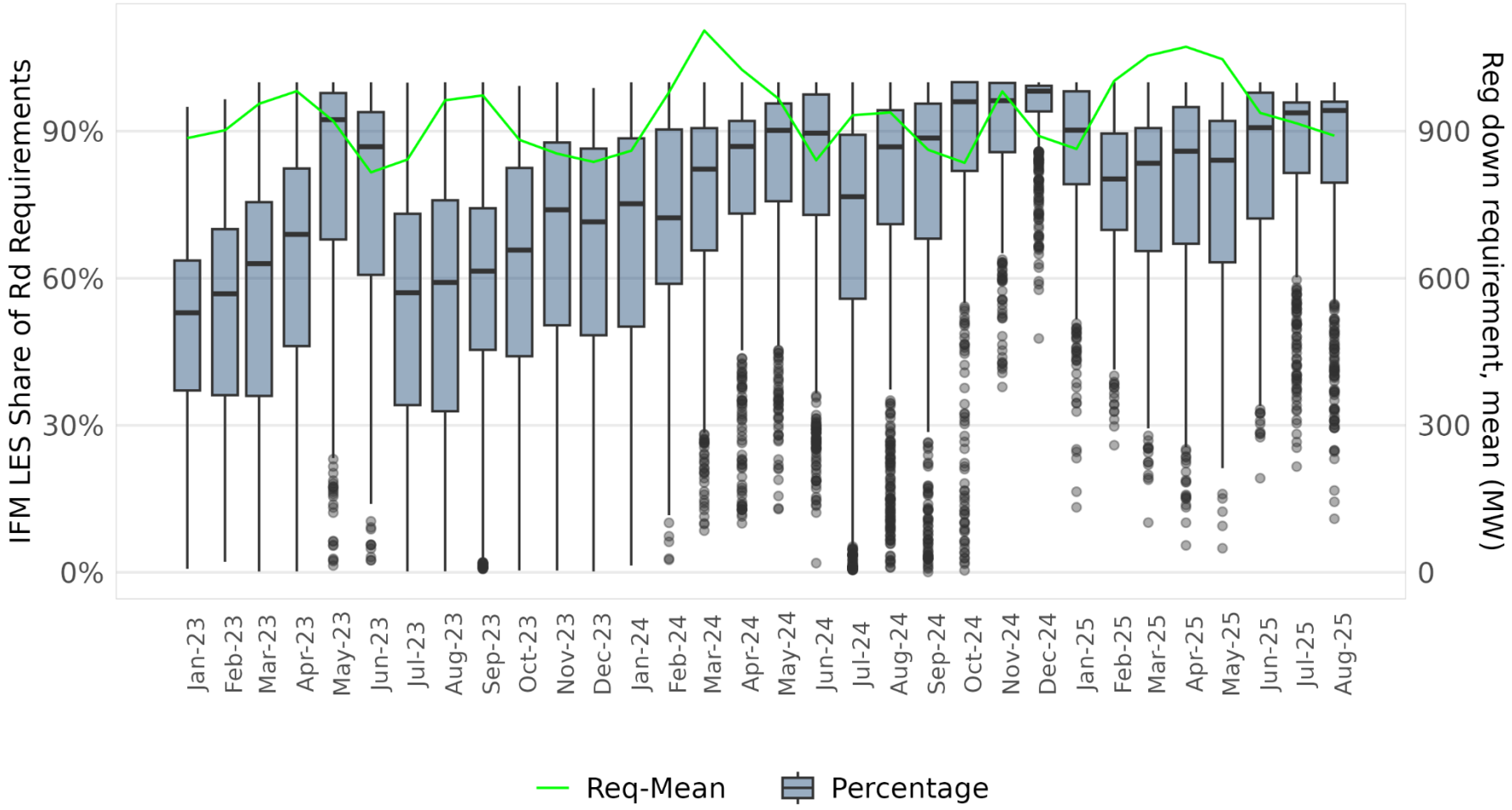
- Resource charging coefficient: 0.87
- Resource bid: $27.58 to charge

- FRU price = (15.9474-27.58)/0.87 = -$13.3708
  (Energy opportunity cost)

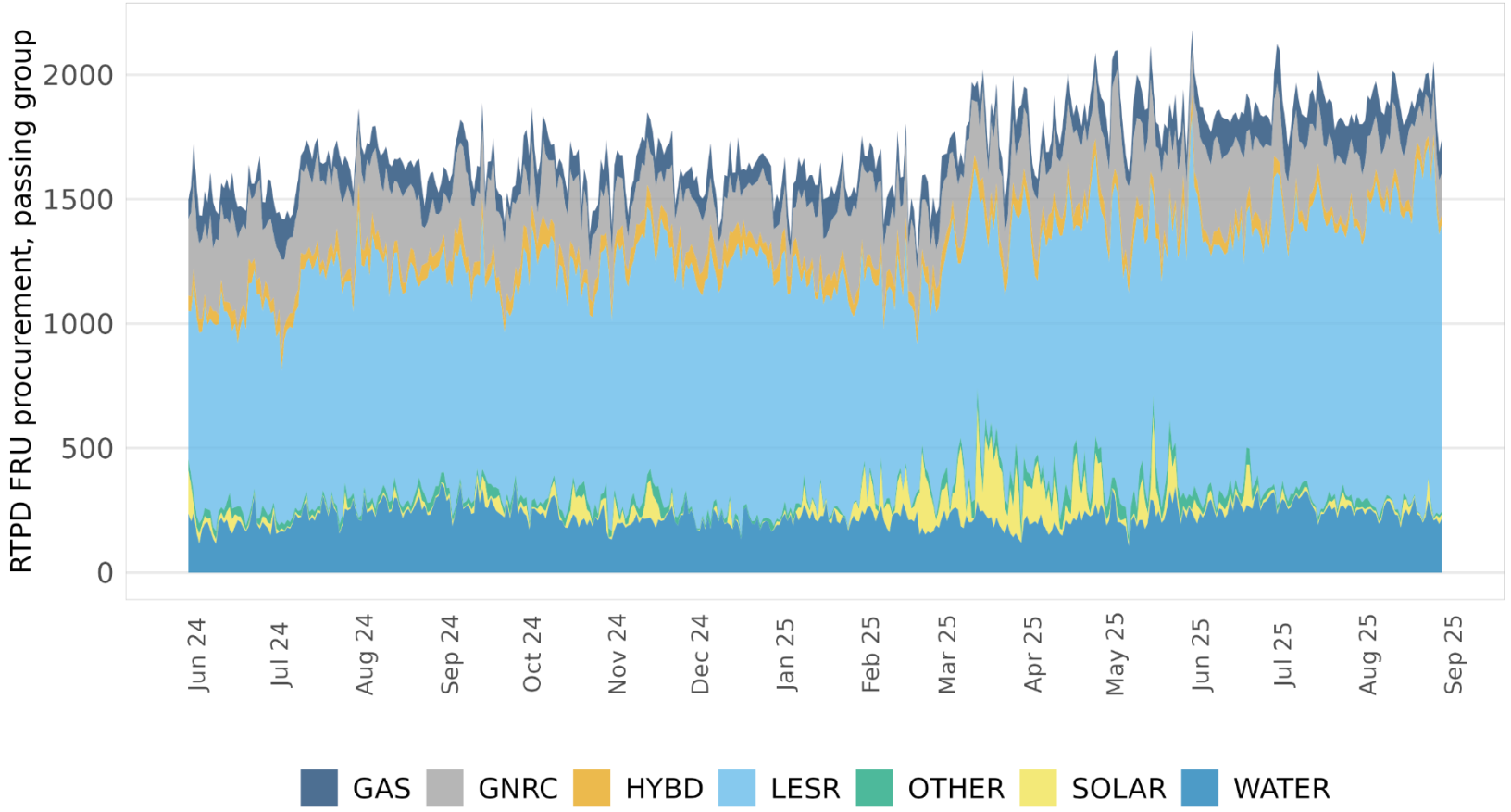
The market for upward regulation market continue to be saturated by storage resources procuring over 100 percent of the requirements



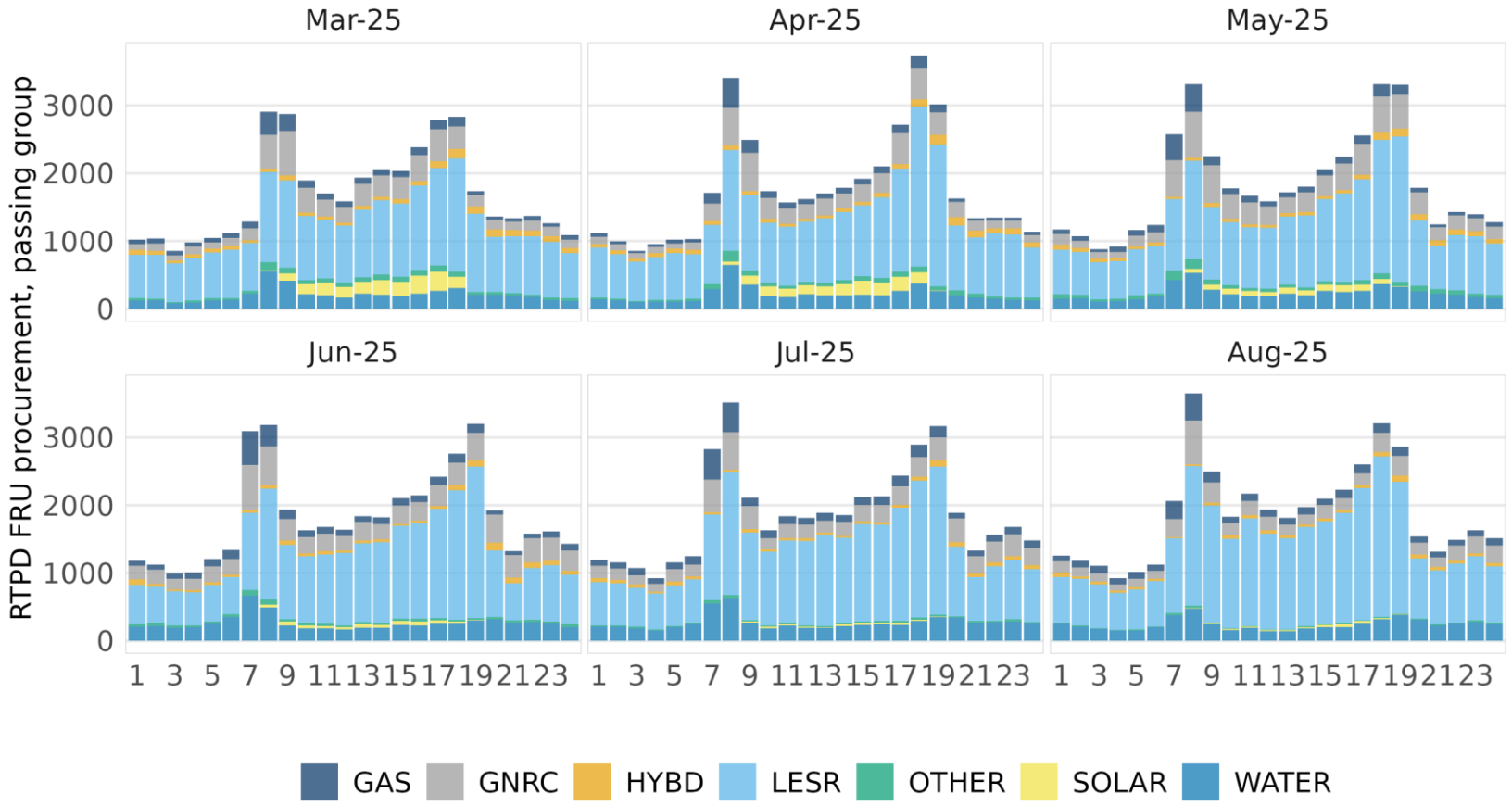
Procurement of regulation down continue to be dominated by storage resources



Upward FRP procurement is supported by various types of technologies with the main share coming from storage resources



Storage resources tend to support upward FRP procurement throughout the day



Enhancement to mitigate for market disruptions

Market Performance and Advanced Analytics

Enhancement to mitigate for market disruptions

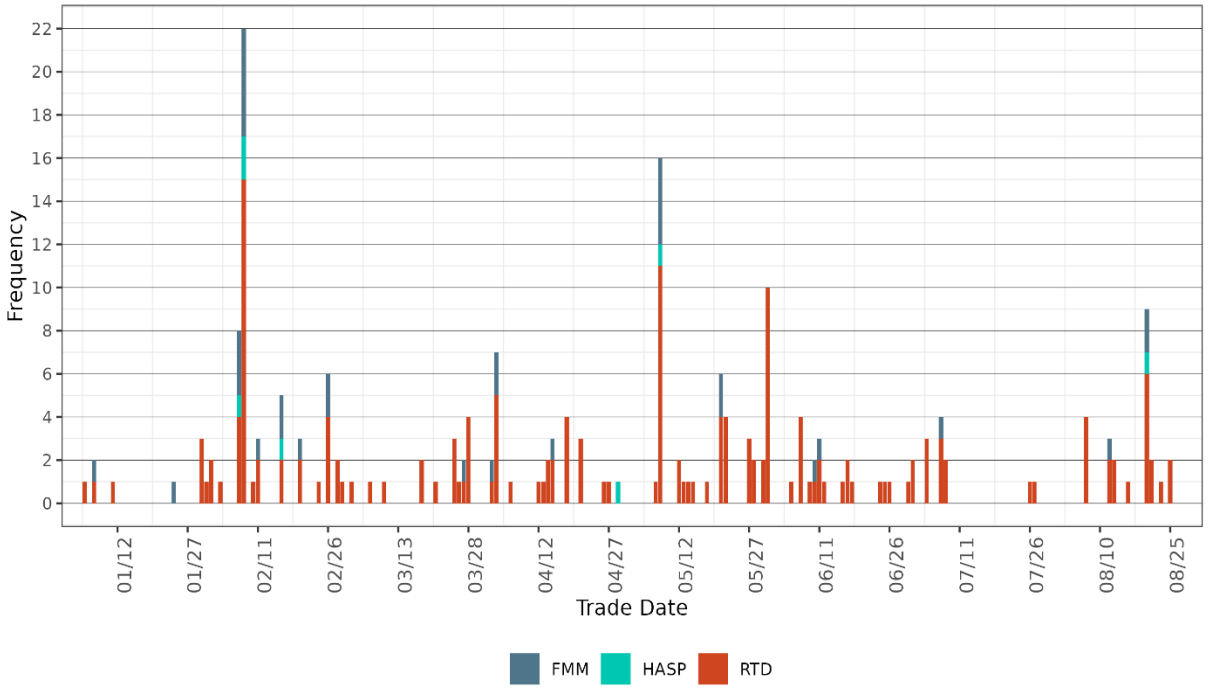
Action taken: CAISO is exploring the development of a market enhancement to mitigate for market disruptions observed in real-time market

Impact: Reduce market disruptions in real-time and the companion manual actions taken in real time

Next Steps: CAISO will proceed to implement enhancements and will communicate and document its implementation through a Business Practice Manual change

CAISO's Market Disruptions -Background

- Under certain complex scenarios in RTD/RTPD or STUC, there may be constraints that are not feasible to manage, resulting in a market infeasibility/failure known as a *market disruption*
- A market infeasibility/failure means there is no market solution; this is known also as a *market disruption*



CAISO's market disruptions -Current practice

- A market disruption impacts all resources in the system, even if the infeasible constraint is related to a single resource

- One tool available to address market disruptions is to make the resource creating the infeasibility non-participating in the market
  - Effectively, the resource is not longer dispatched through the market
  - CAISO notifies the scheduling coordinator of the action taken
  - The resource does not receive a schedule or award
  - The resource is settled based on its actual production point
  - CAISO generally reports in the performance reports the instances of market disruptions

The software enhancement will eliminate the practice of excluding the resource from participating in the market

- As part of the market clearing process, the CAISO is assessing a software enhancement to identify infeasible constraints and the magnitude of the infeasibility
- The market can then find a solution by clearing schedules and awards for all resources by relaxing it by the amount of infeasibility
- The resource with the infeasible constraint will also get an optimal dispatch
- Although infrequent and potentially minor, there may be instances where the resource with relaxed constraint cannot meet dispatch
- CAISO has revised its original proposal presented in Q2 MPPF to address this condition in the RTD market

Proposed enhancement for the 5-minute RTD market

- Use the software enhancement logic to address infeasible constraints at the resource level to prevent a market disruption

- Replace the resulting market dispatch with the previous dispatch for the resource with infeasibility

- This approach is supported by existing tariff provisions. Tariff sections 7.7.6 and 7.7.7. Section 7.7.9 (e) states:

  "In circumstances that are not described in subsections (a) through (d) of this section or if the market results are for any reason unavailable, the CAISO shall use market results, as applicable, from the most recent preceding applicable interval that produced acceptable market results."

Revised Enhancement – 15-minute market (FMM)

FMM presents a series of challenges including MSG commitments, transitions and incremental AS procurements.

- Use of last dispatch (schedule) may not be ideal for all for different scenarios
- An advisory solution may be a superior solution but may require additional logic to be developed
- This effort may be re-evaluated after the benefits of the RTD and STUC solutions are assessed

Proposed Enhancement for short-term unit commitment (STUC) market

- Leverage the software enhancement to identify infeasible constraints at the resource level to prevent a market disruption
- Implement “As-Is” -- allowing STUC to complete and dispatch including a dispatch for the resource with relaxed constraint to have an optimal schedule.
- STUC does not produce binding dispatches; STUC produces commitments that are re-evaluated subsequently in FMM

Load Conformance

Market Performance and Advanced Analytics

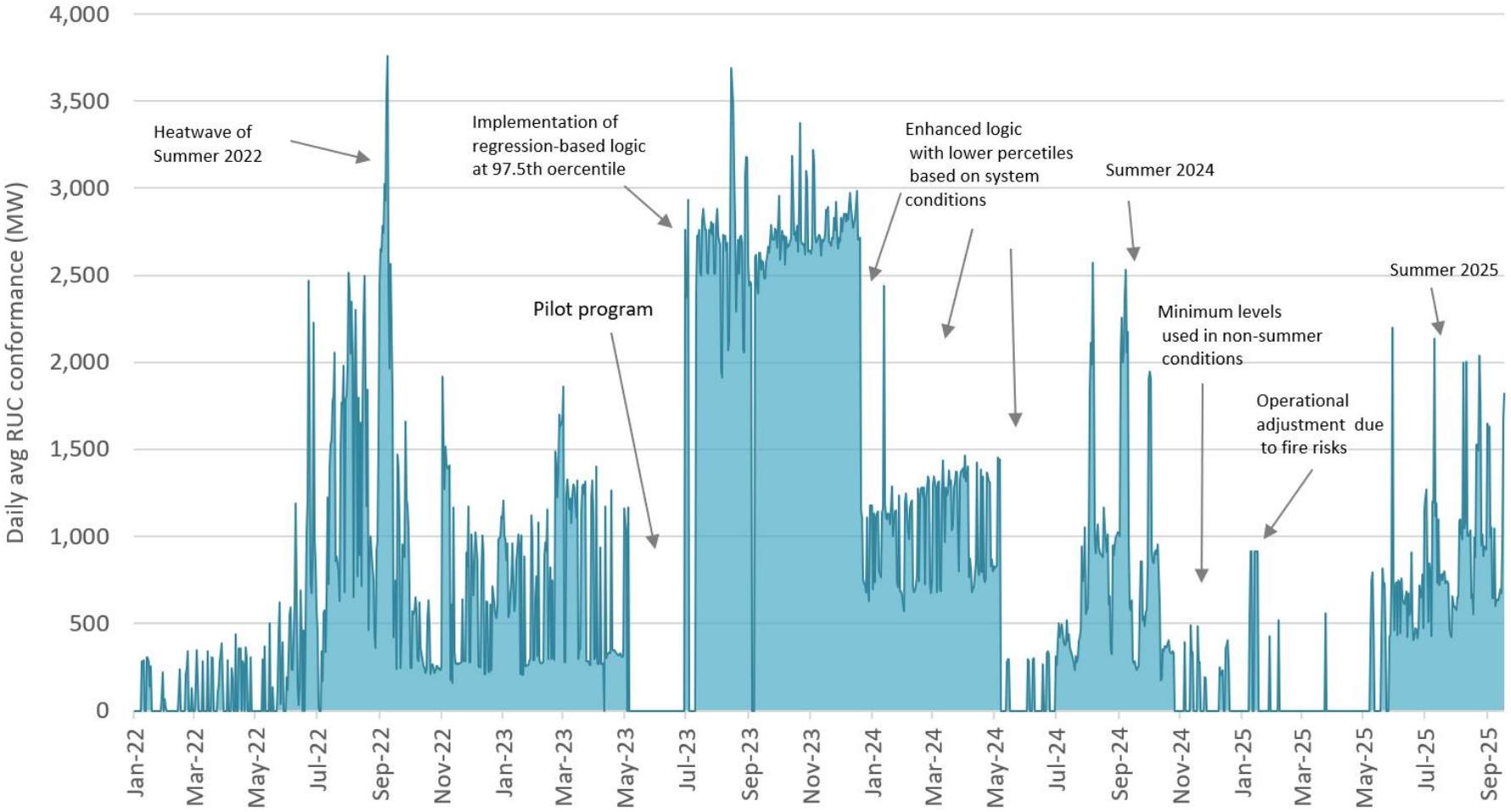
Load Conformance

Action taken: CAISO has implemented a series of improvements to processes and market logic that may impact the extent of use for load conformance

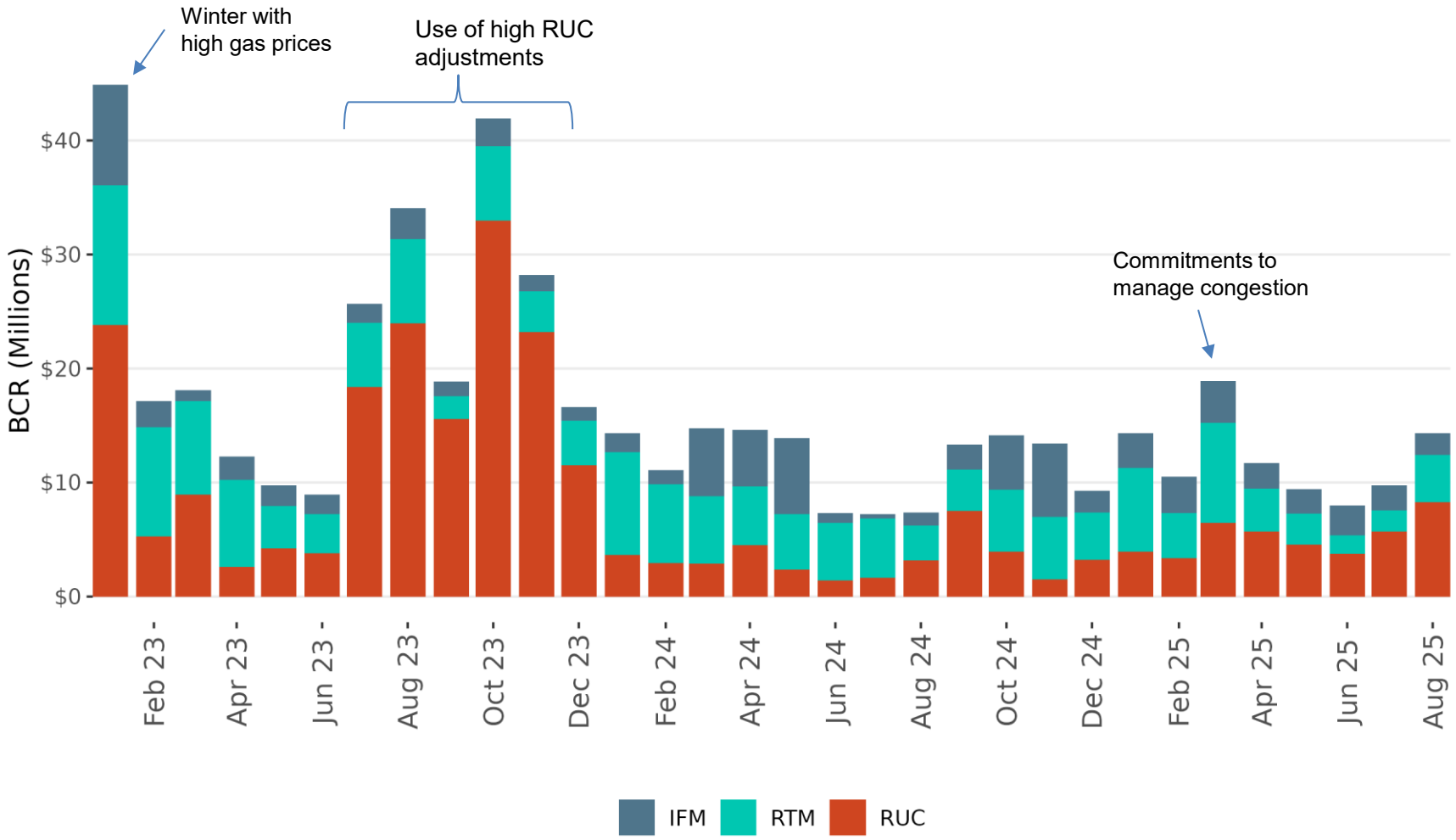
Impact: Over time, there has been a controlled reduction of RUC adjustments in the day ahead market and more moderate use of load conformance in the hour-ahead market

Next Steps: CAISO continues to assess use of load conformance across markets and to target market improvements. Implementation of DAME will have a direct impact on use of RUC adjustments

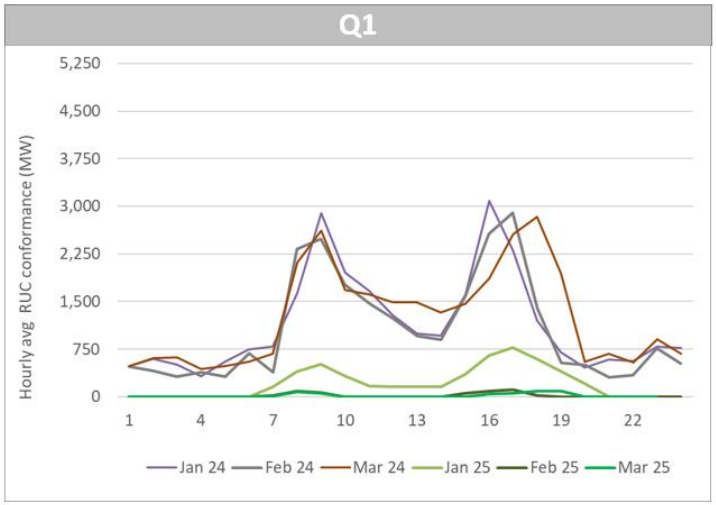
After minimum adjustments in winter and spring months, there were moderate RUC adjustments during summer conditions

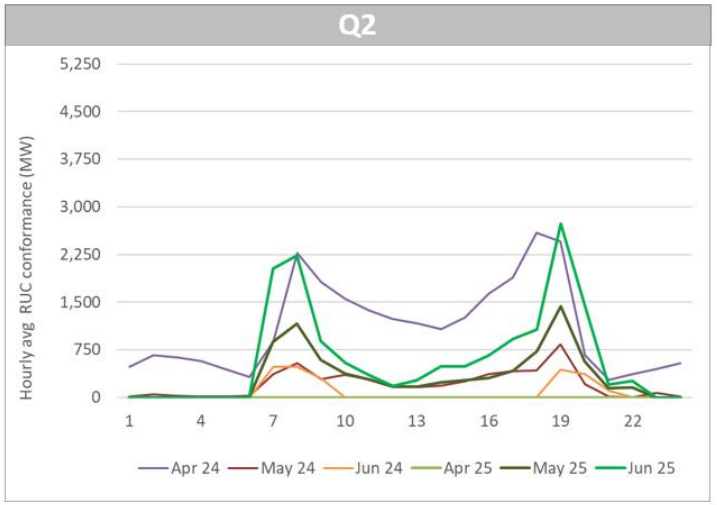


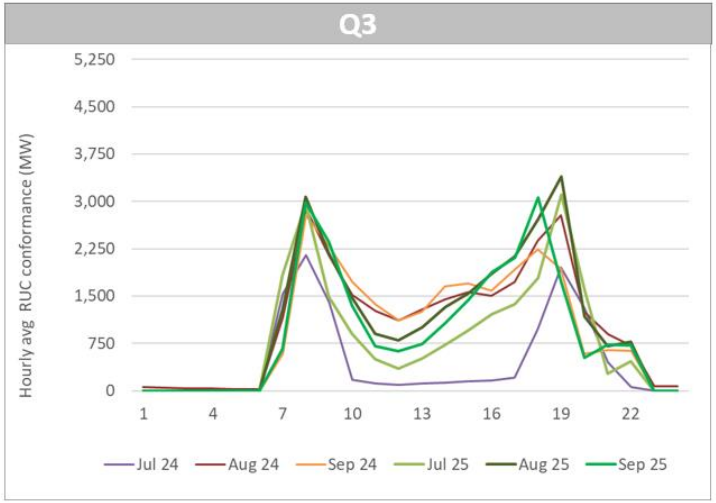
High bid cost recovery in RUC subsided since the enhancement to the requirement estimates in December 2023

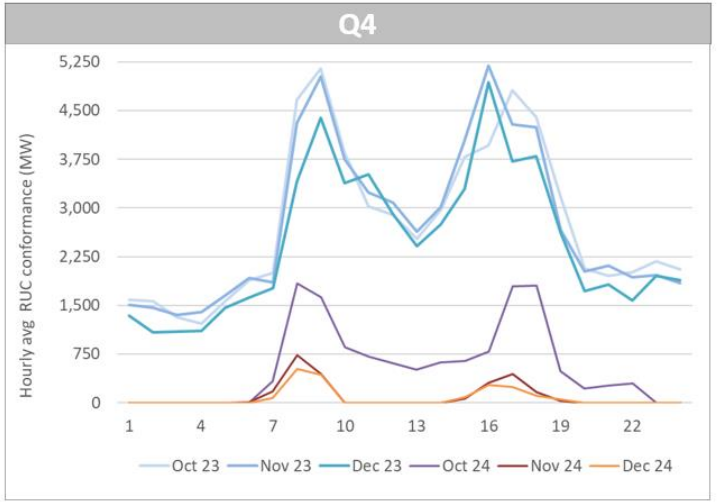


The hourly profile of RUC adjustments during summer reached the highest during evening peak hours

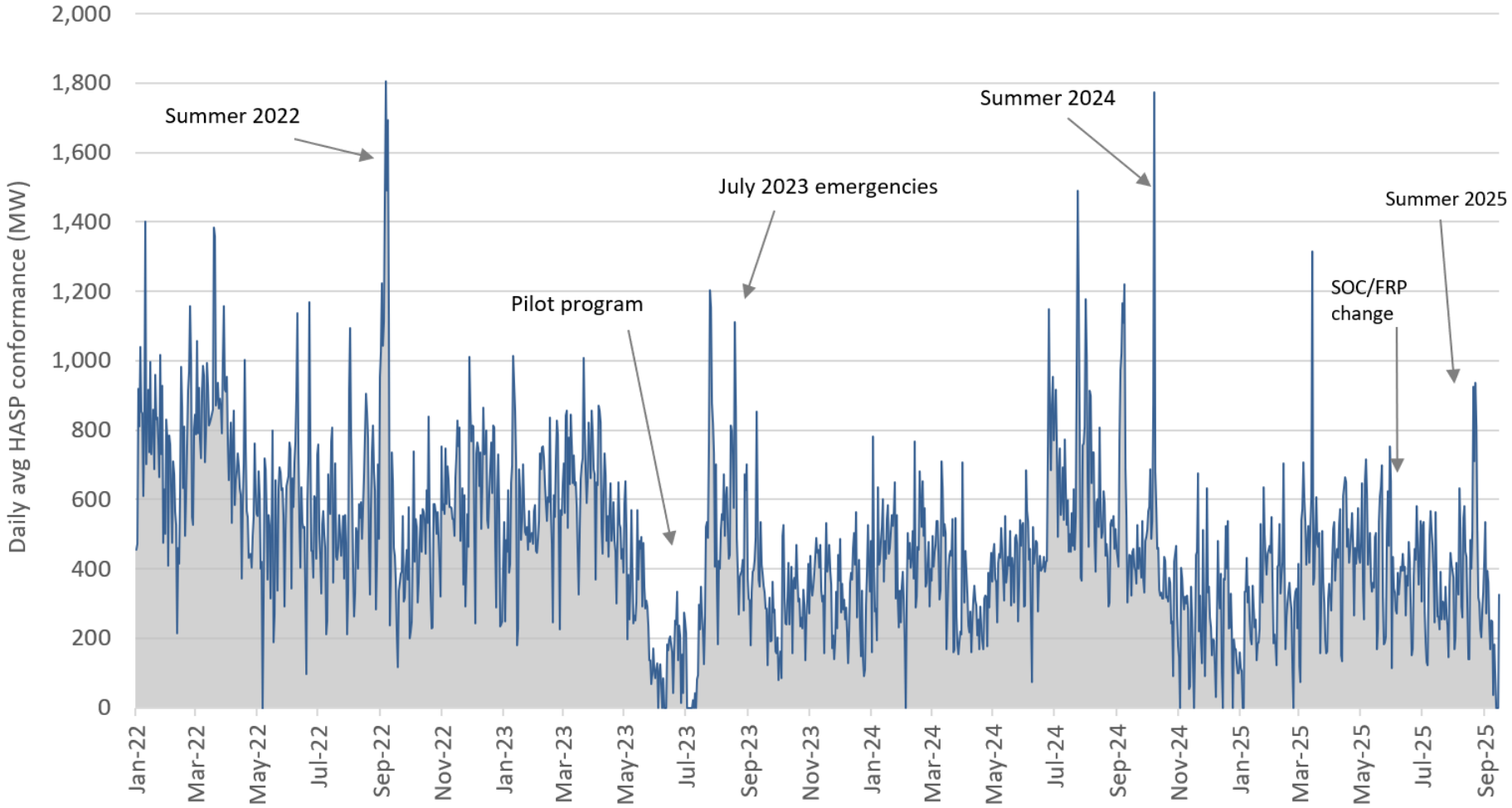








Use of load conformance in HASP was moderate in summer 2025, relative to summer 2024 and 2023



Gas and Power index prices, and market costs

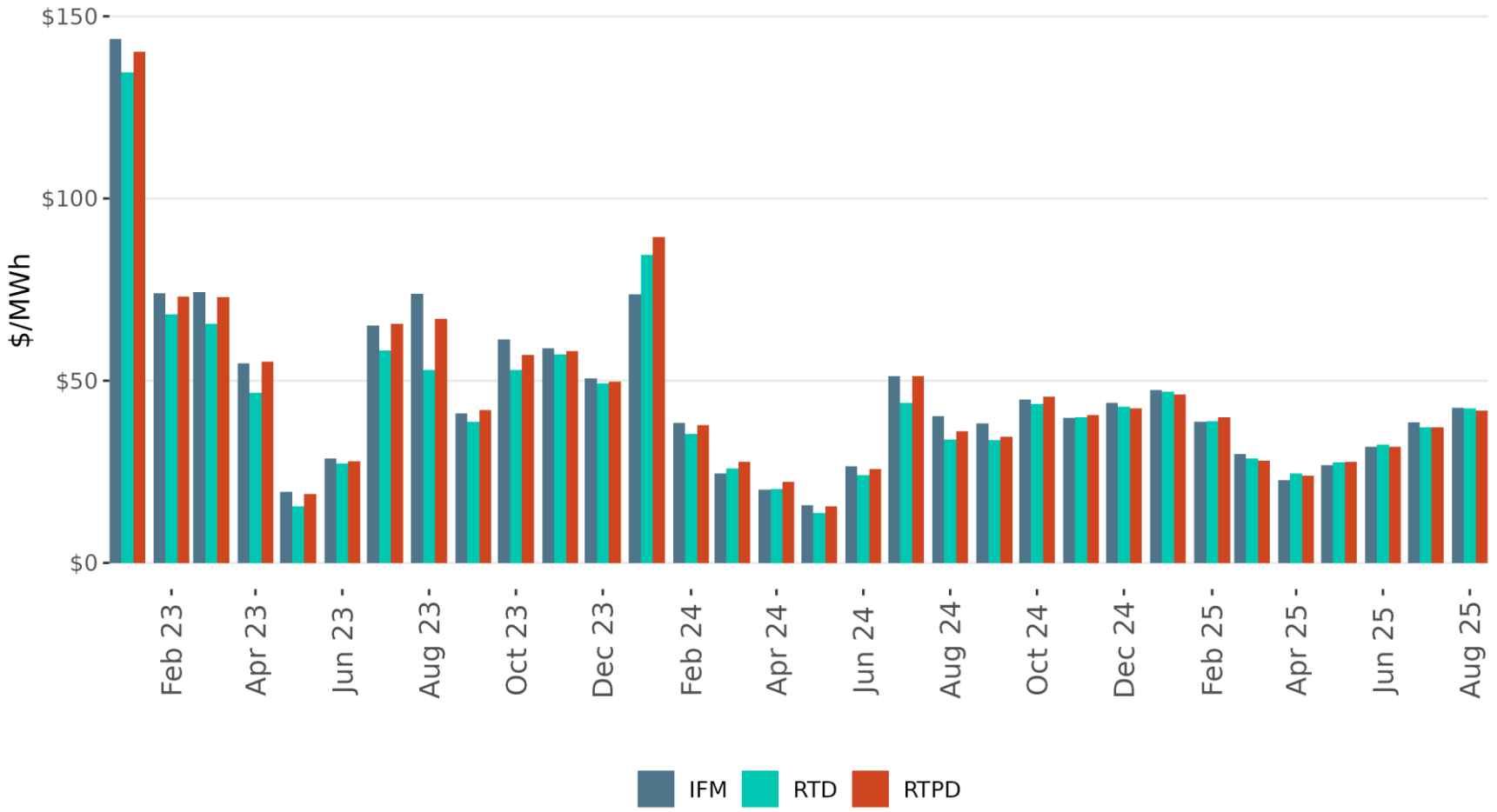
Market Performance and Advanced Analytics

Gas and Power index prices, and market costs

Summary: Due to a calm summer and limited gas price volatility, prices in the CAISO BAA and WEIM were stable throughout the summer months. As a results, total wholesale electricity costs are on track to be in the lower range in the last several years

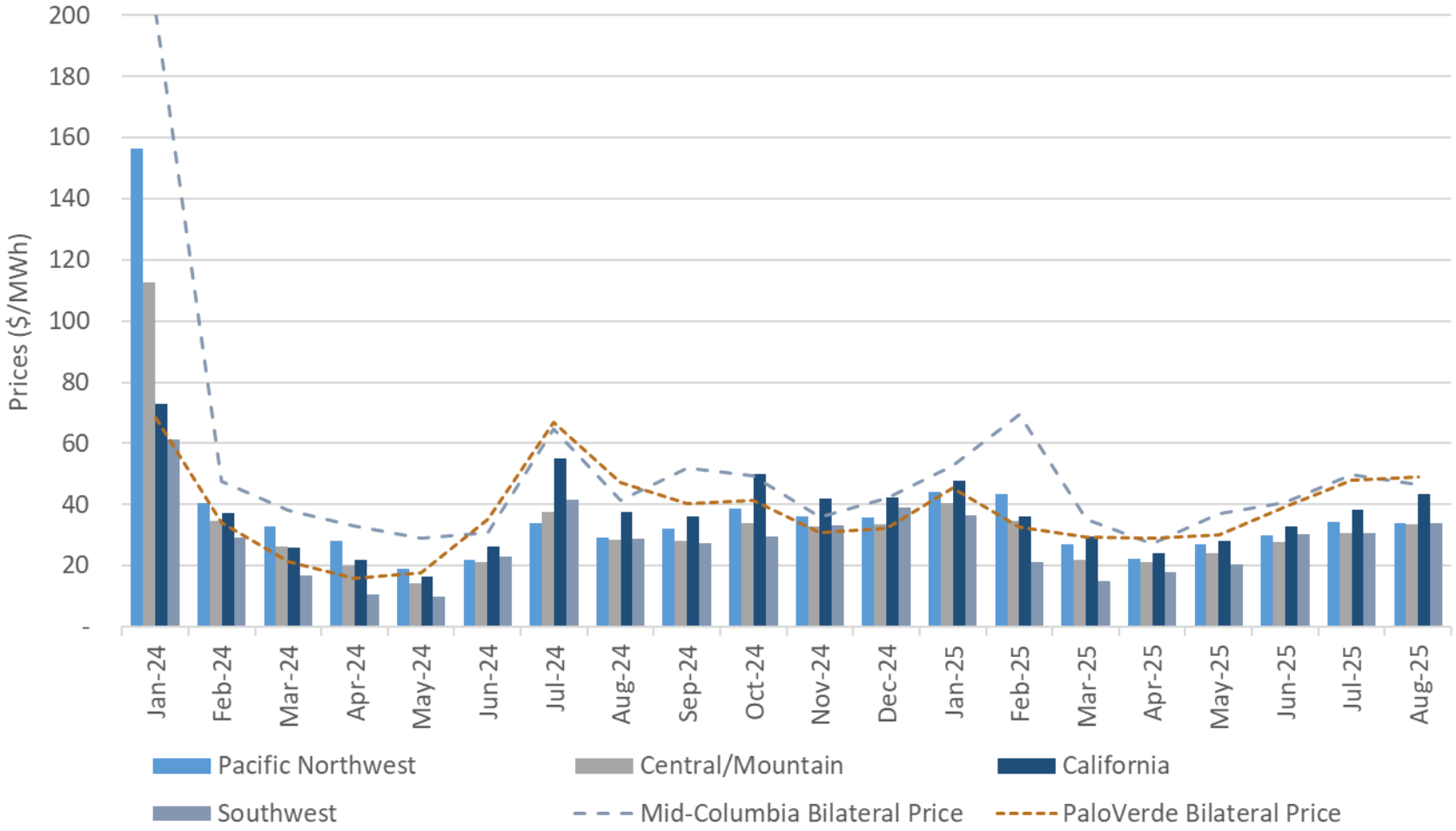
Next Steps: ISO staff continuously monitor Western bilateral markets and forward prices and provide updates on their impact to CAISO markets to stakeholders

Prices remain stable as system conditions progress towards Fall

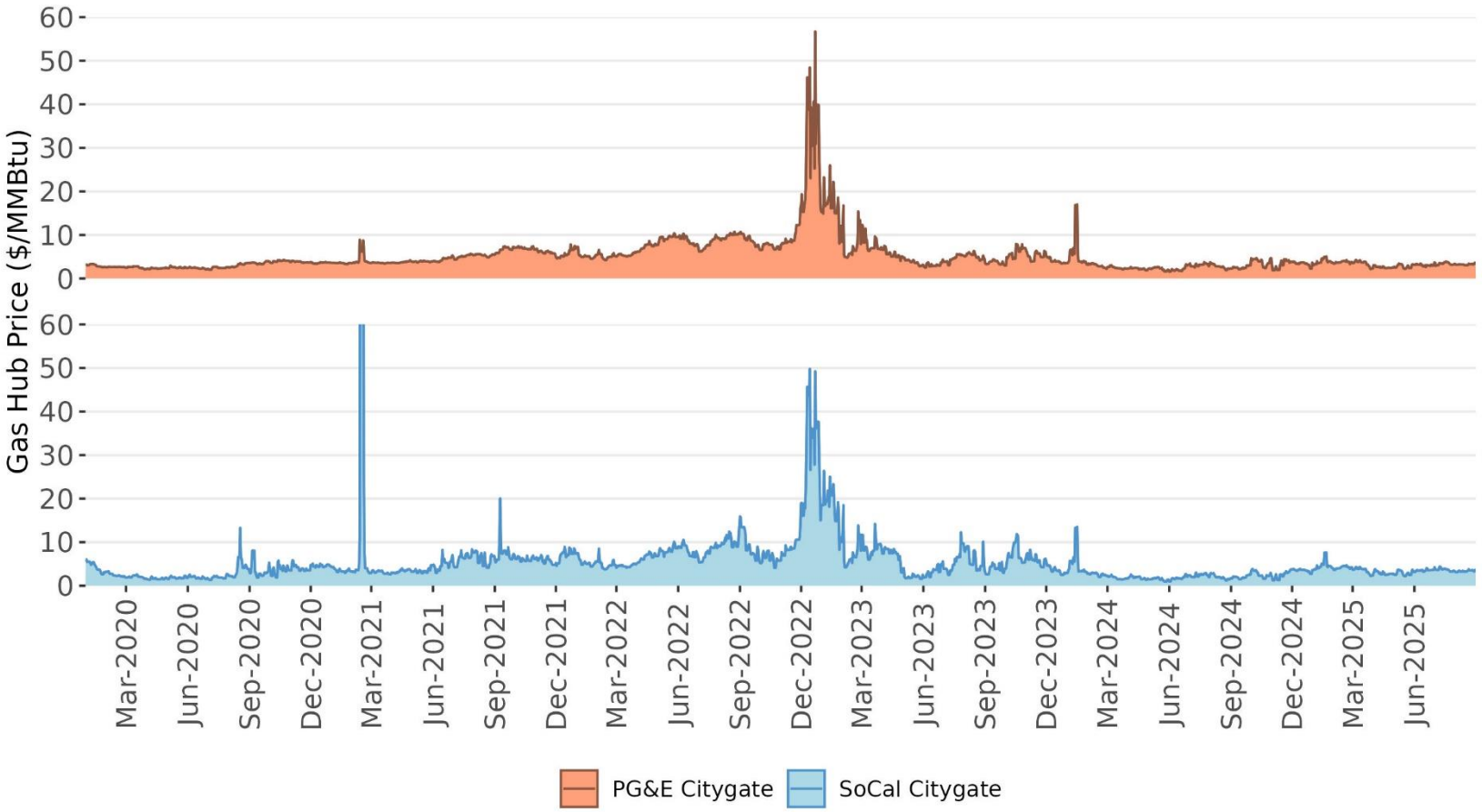


Note: Metric Based on System Marginal Energy Component (SMEC)

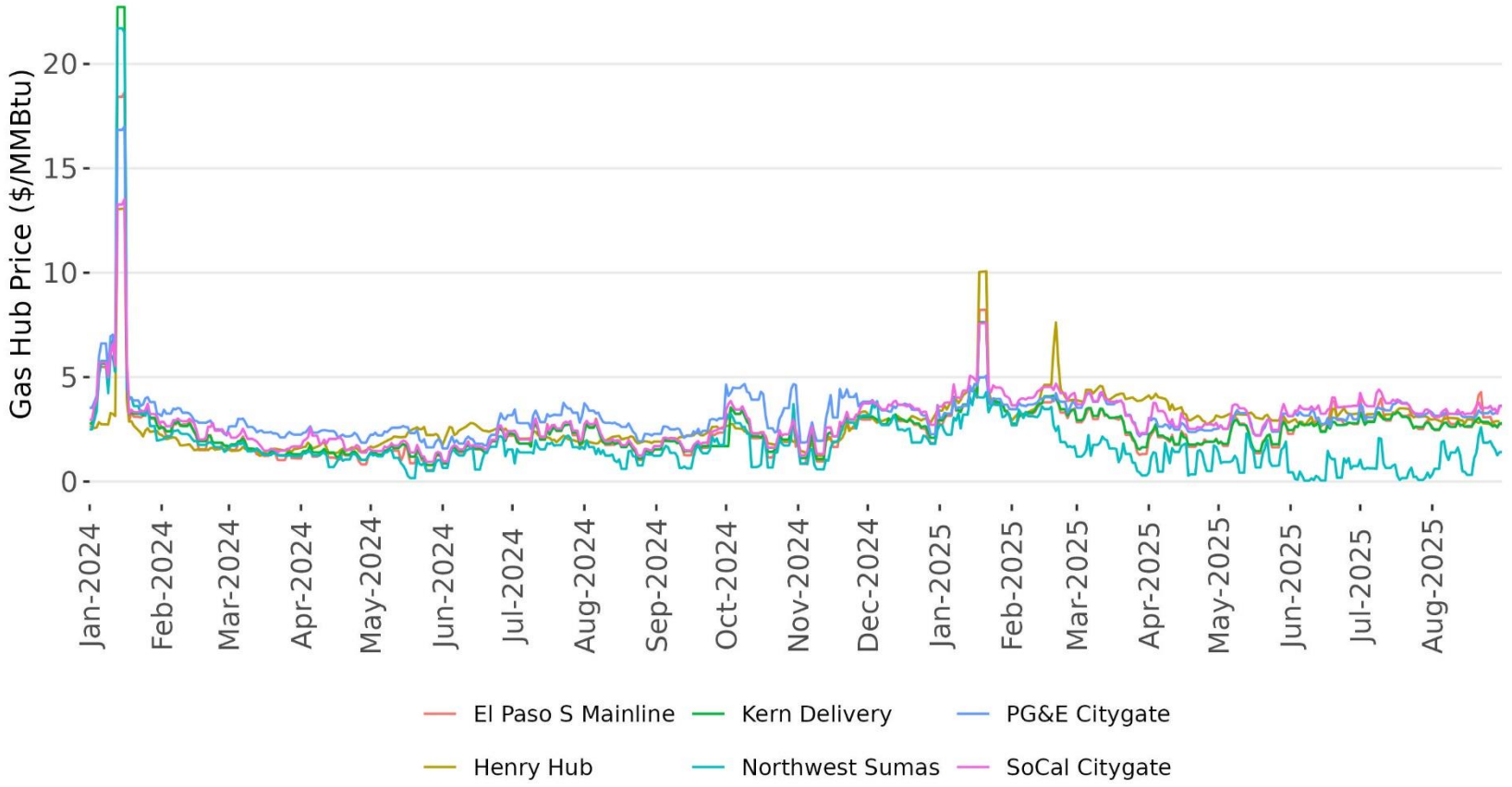
Real-time prices in the western energy imbalance market remain stable through Summer



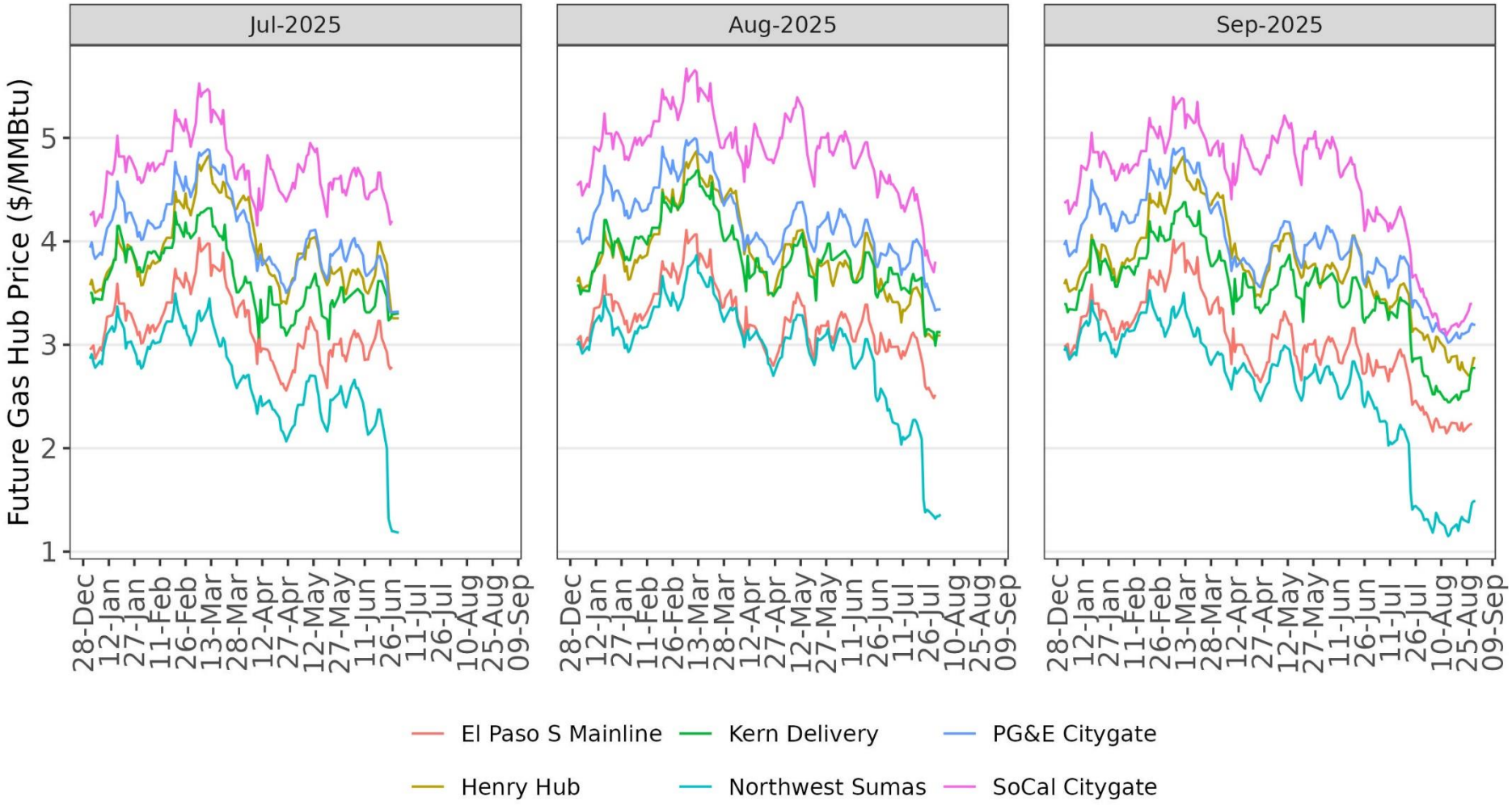
California next-day gas prices has seen slightly higher levels from June to August 2025 compared to 2024



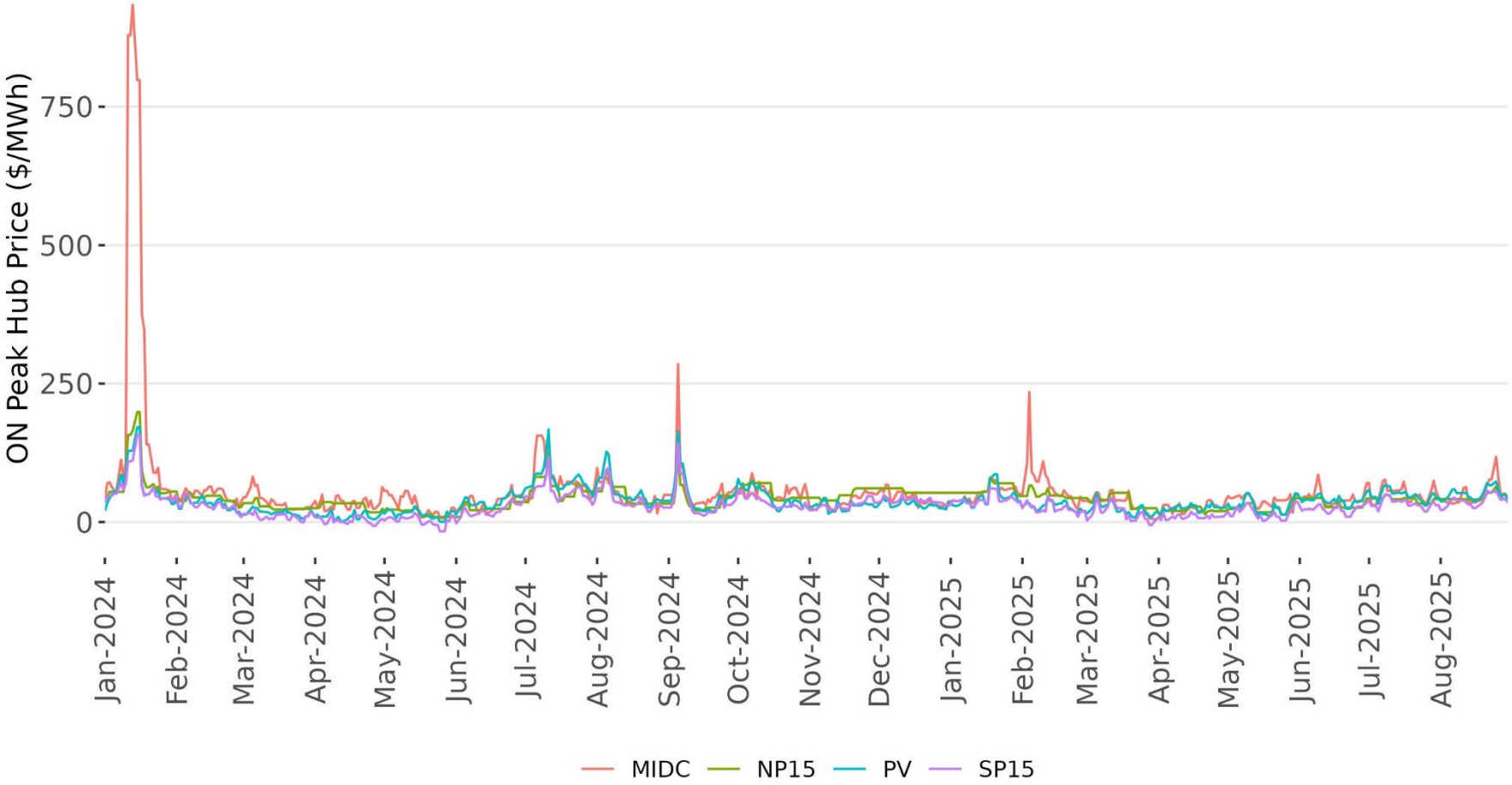
Western next-day gas prices for major hubs closely followed each other from June to August 2025, except for NW Sumas



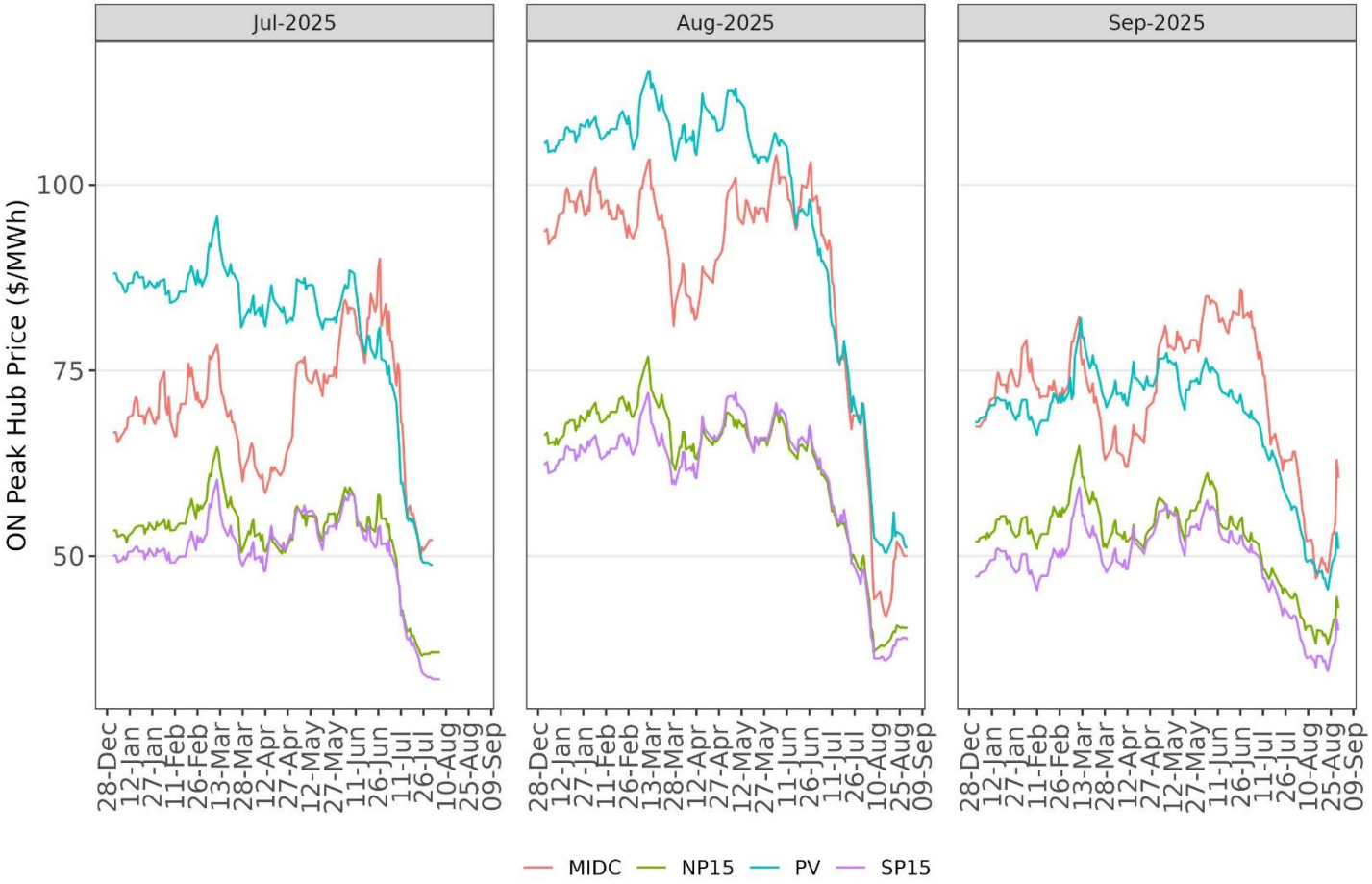
Future gas prices for June to August 2025 have declined since late February 2025



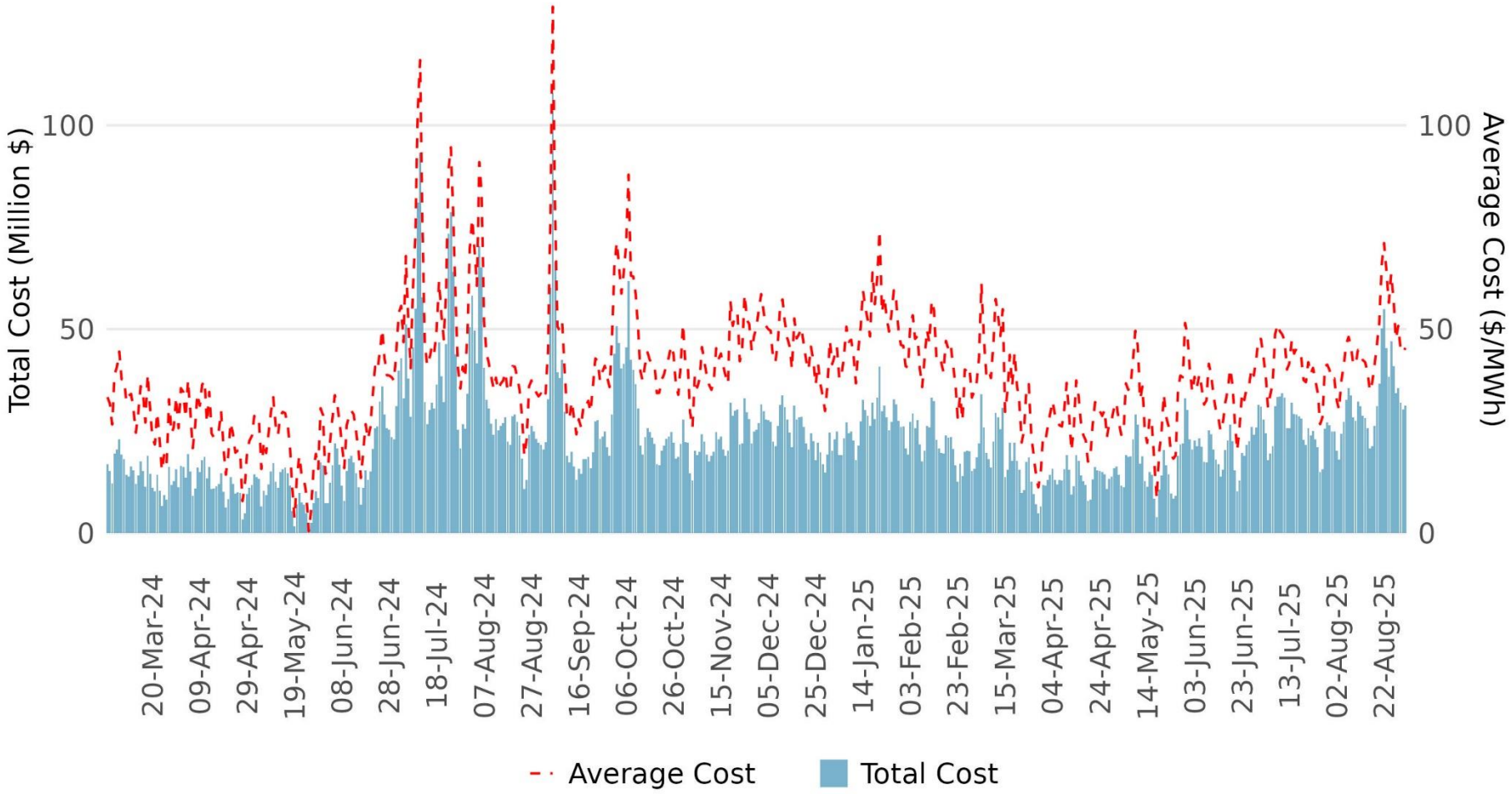
Next-day on-peak bilateral power prices remained below $118/MWh for June to August



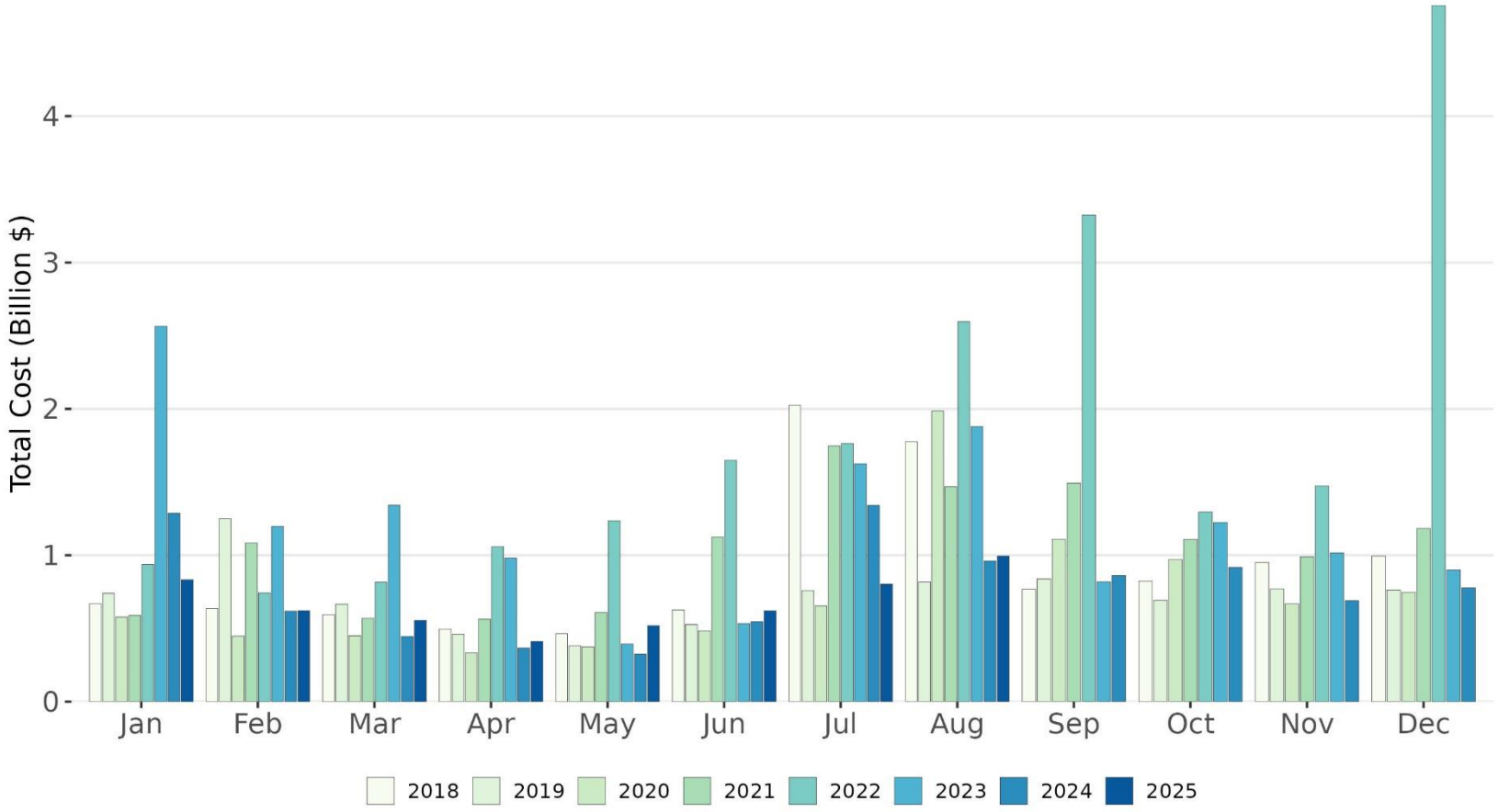
Future on-peak power prices for delivery in July and August showed price separation between Mid Columbia and Palo Verde; prices converged and dropped since July



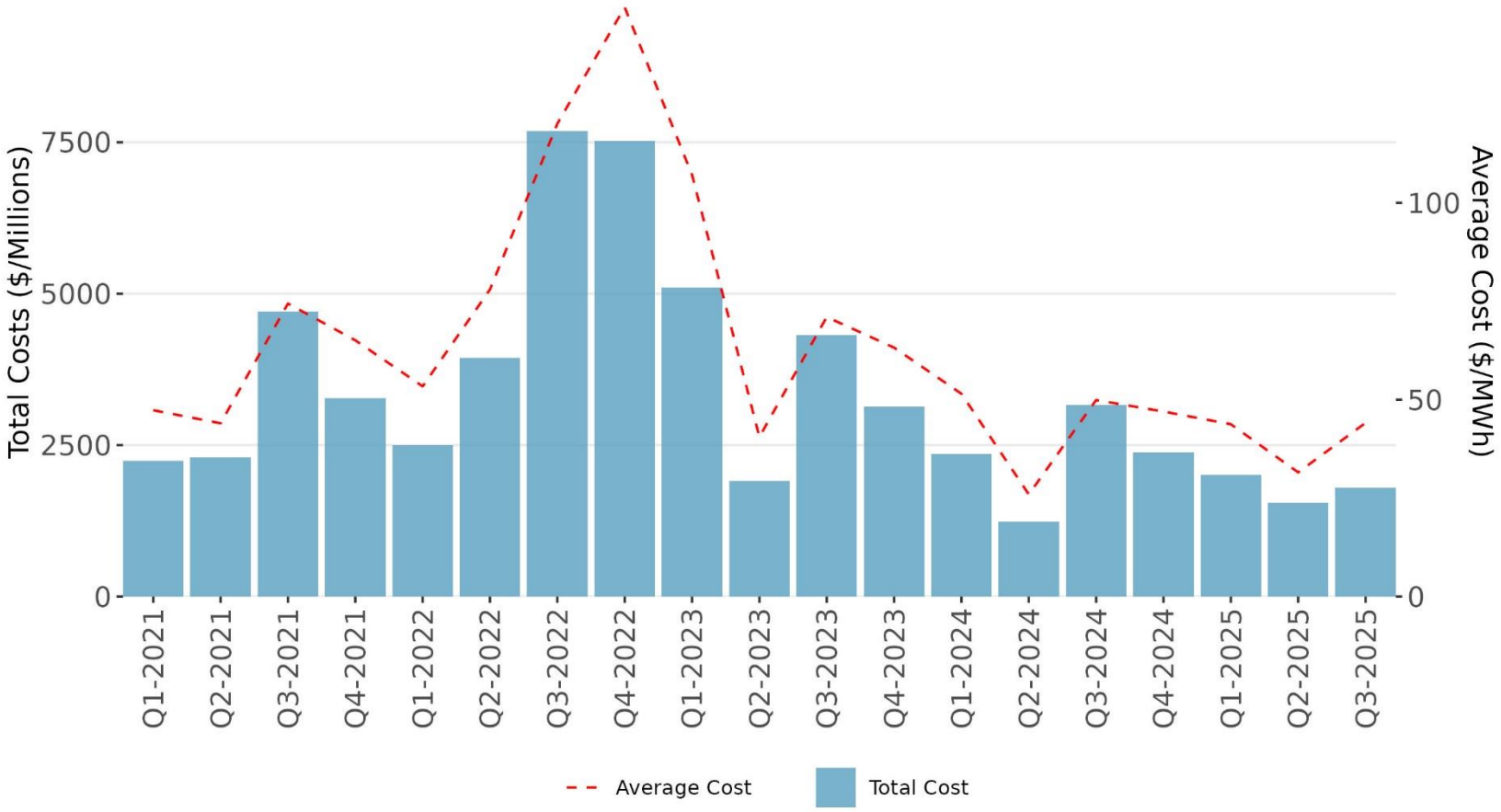
Daily market costs reached the highest level in 2025 on January 21



Monthly totals for June and August 2025 were higher than previous year, but was lower for July



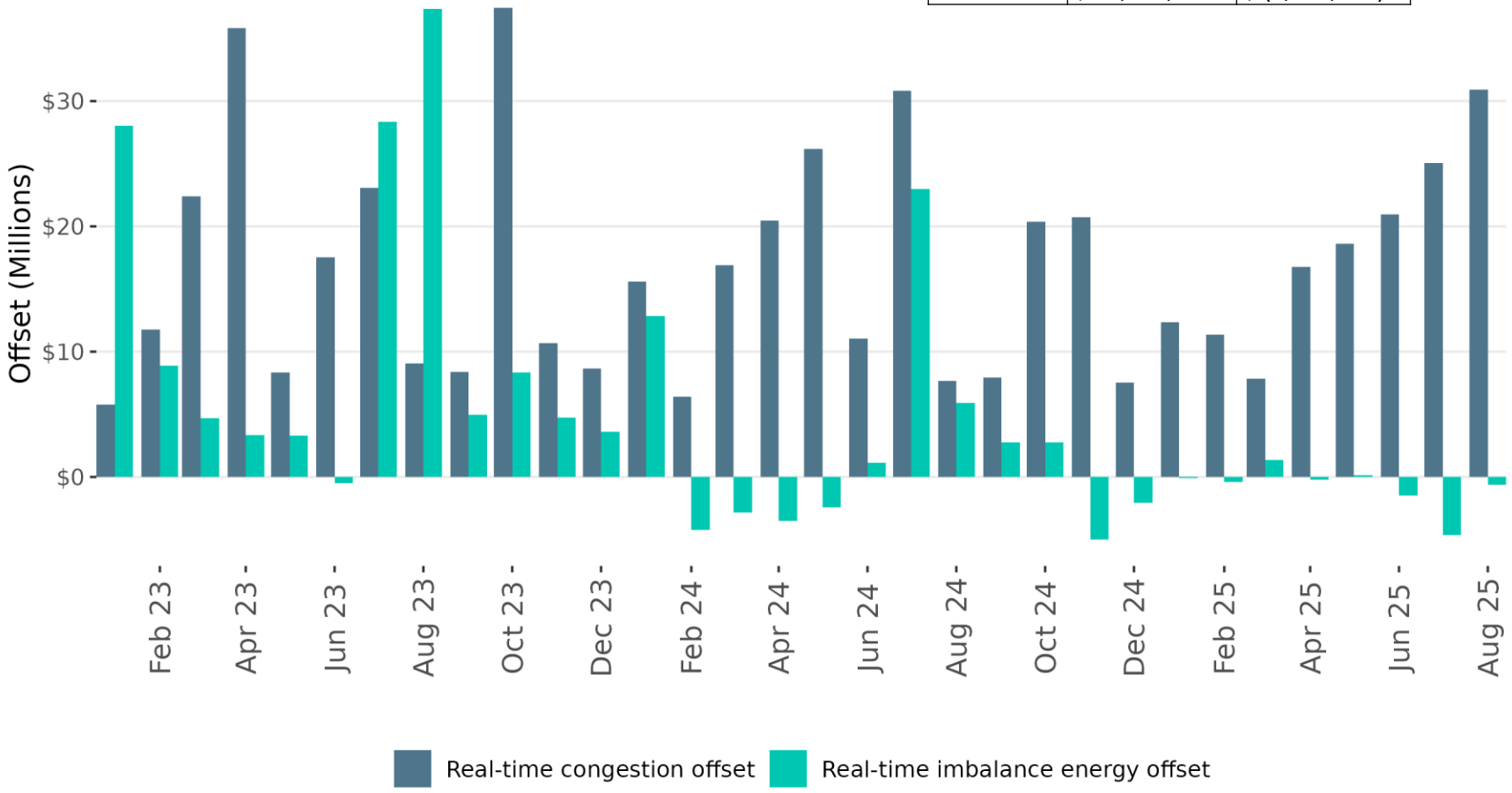
Q2 2025 total costs are slightly higher than Q2 2024 total costs



Note: Q3 2025 includes data for July, and August

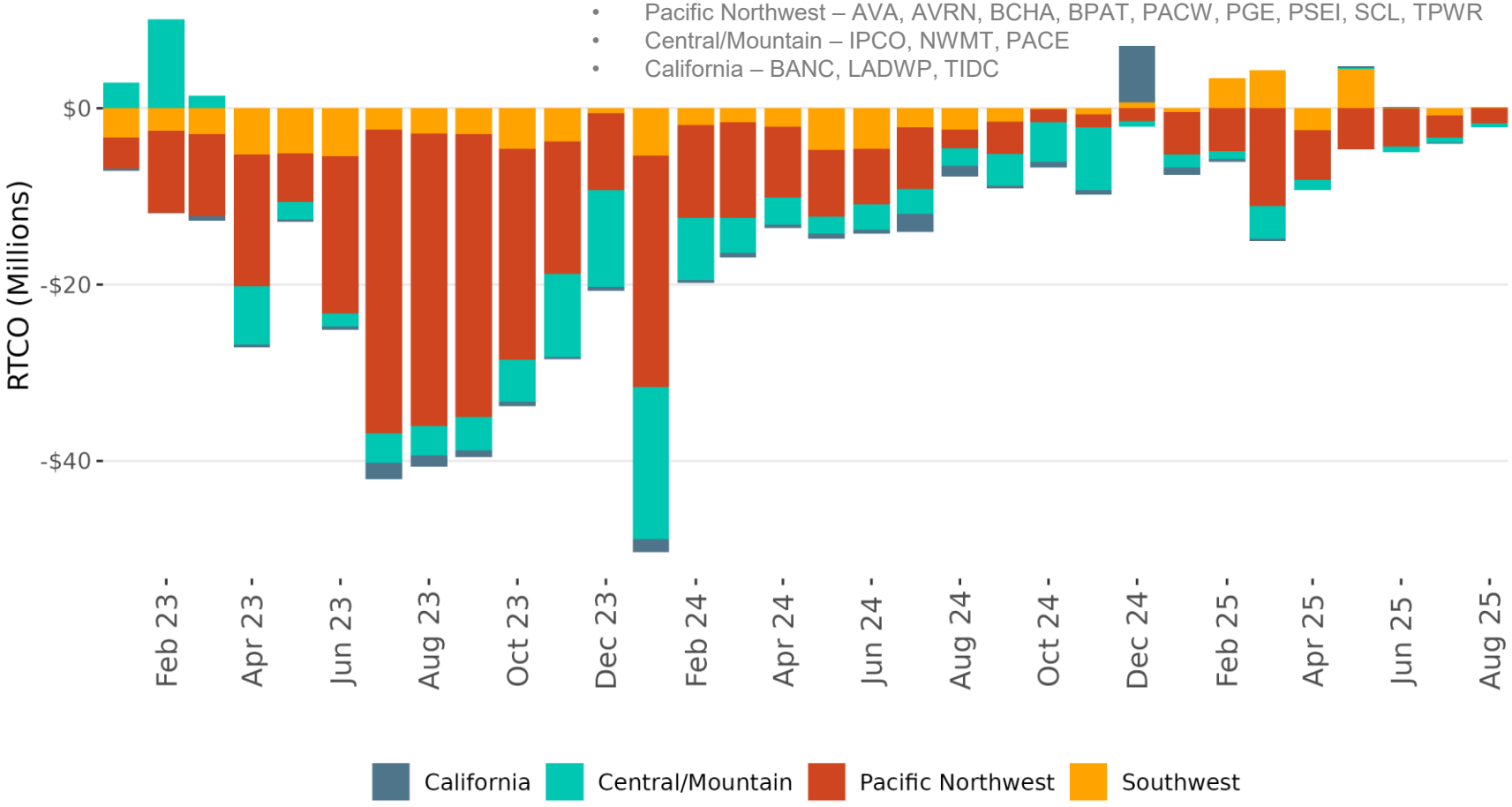
ISO area real-time congestion offset cost has risen since Spring, peaking in August

Costs	2024	2025 (YTD)
RTCO	$ 191,658,516	$ 143,885,612
RTIEO	$ 28,348,073	$ (5,935,178)

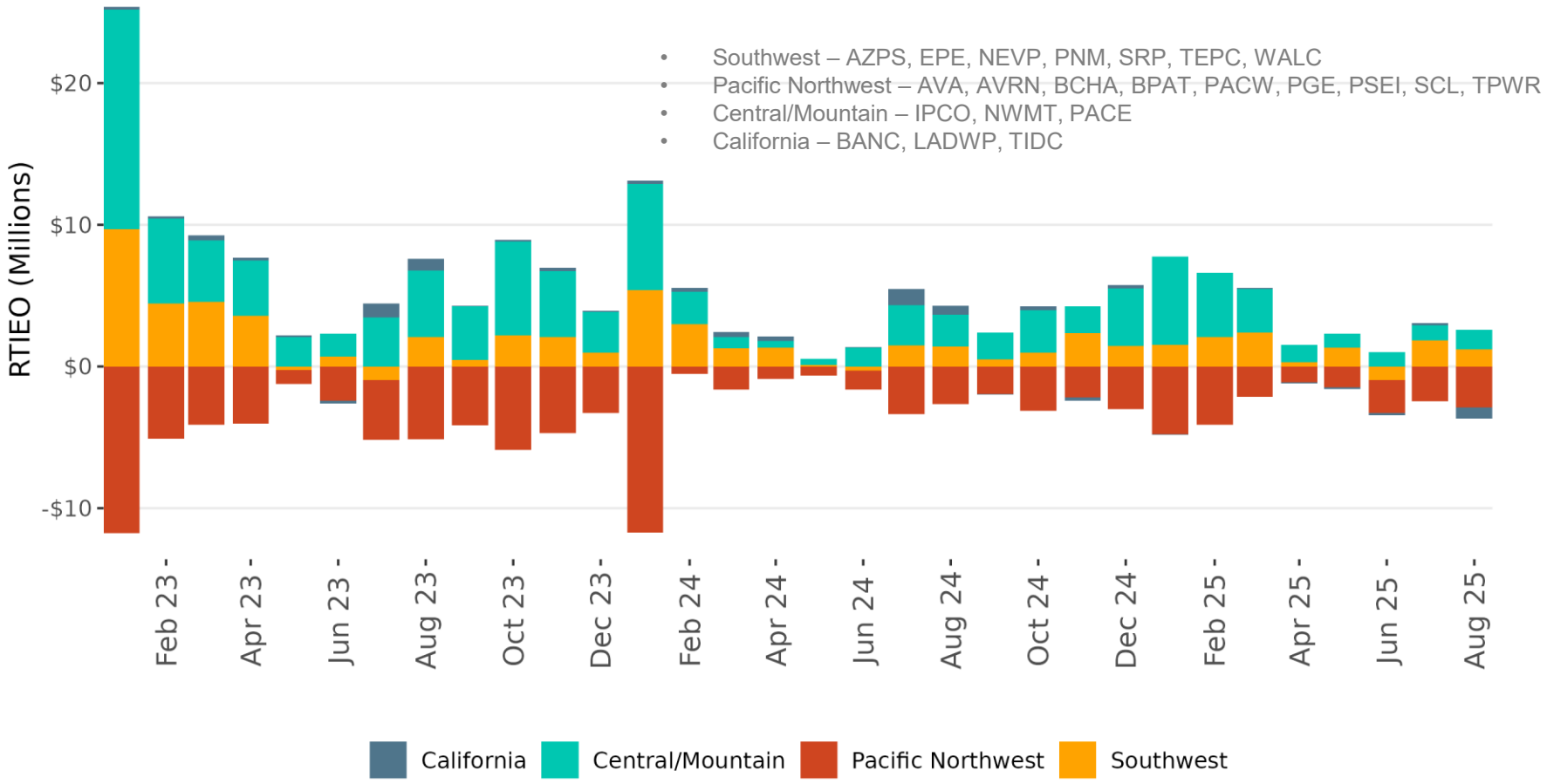


Pacific Northwest is allocated approximately 66 percent of total net Real time congestion offset for all WEIM entities

- Southwest – AZPS, EPE, NEVP, PNM, SRP, TEPC, WALC
- Pacific Northwest – AVA, AVRN, BCHA, BPAT, PACW, PGE, PSEI, SCL, TPWR
- Central/Mountain – IPCO, NWMT, PACE
- California – BANC, LADWP, TIDC



Real time imbalance energy offset has been low since January 2024



* Does not include CAISO

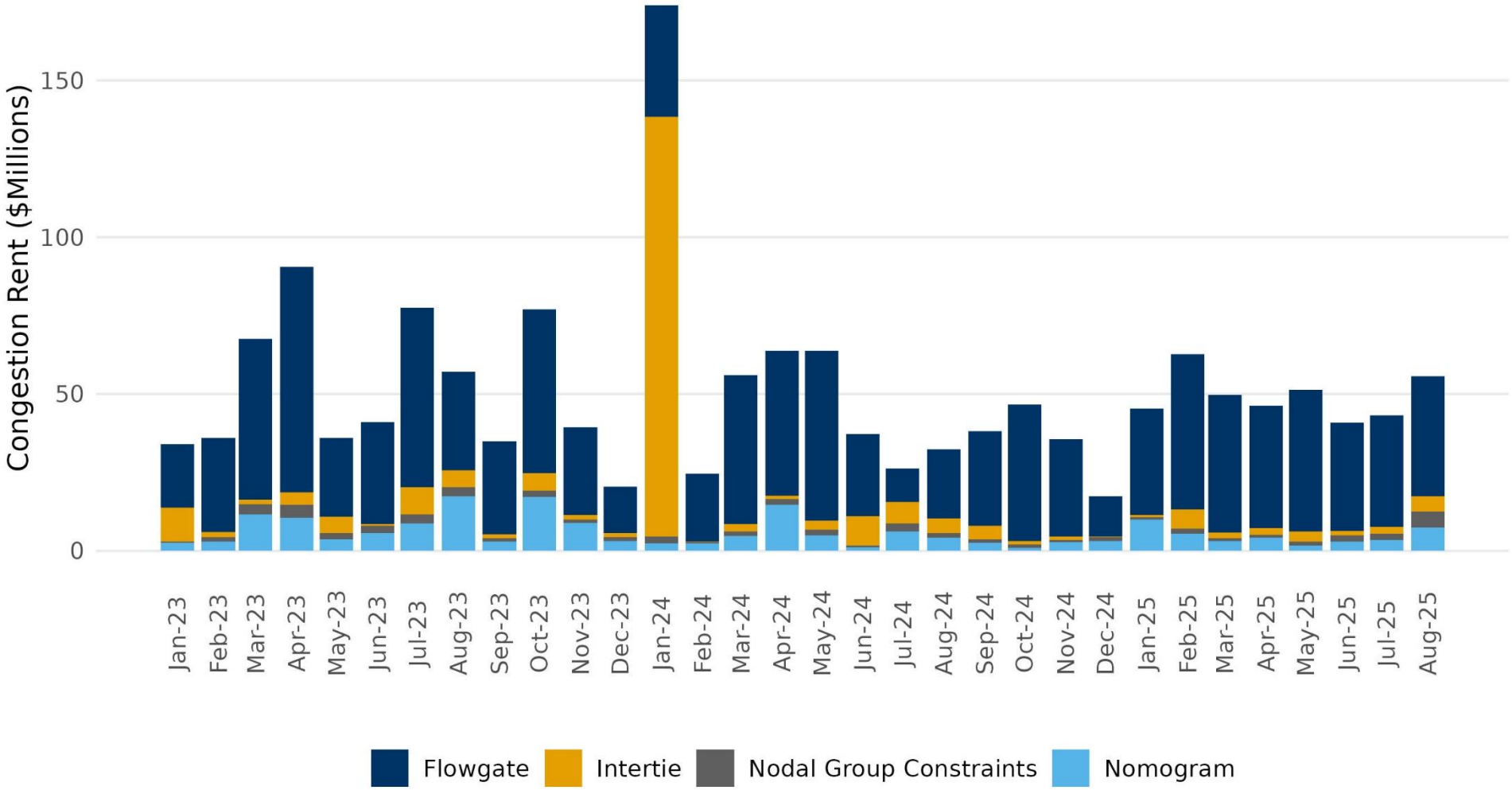
Congestion and Congestion revenue rights

Market Performance and Advanced Analytics

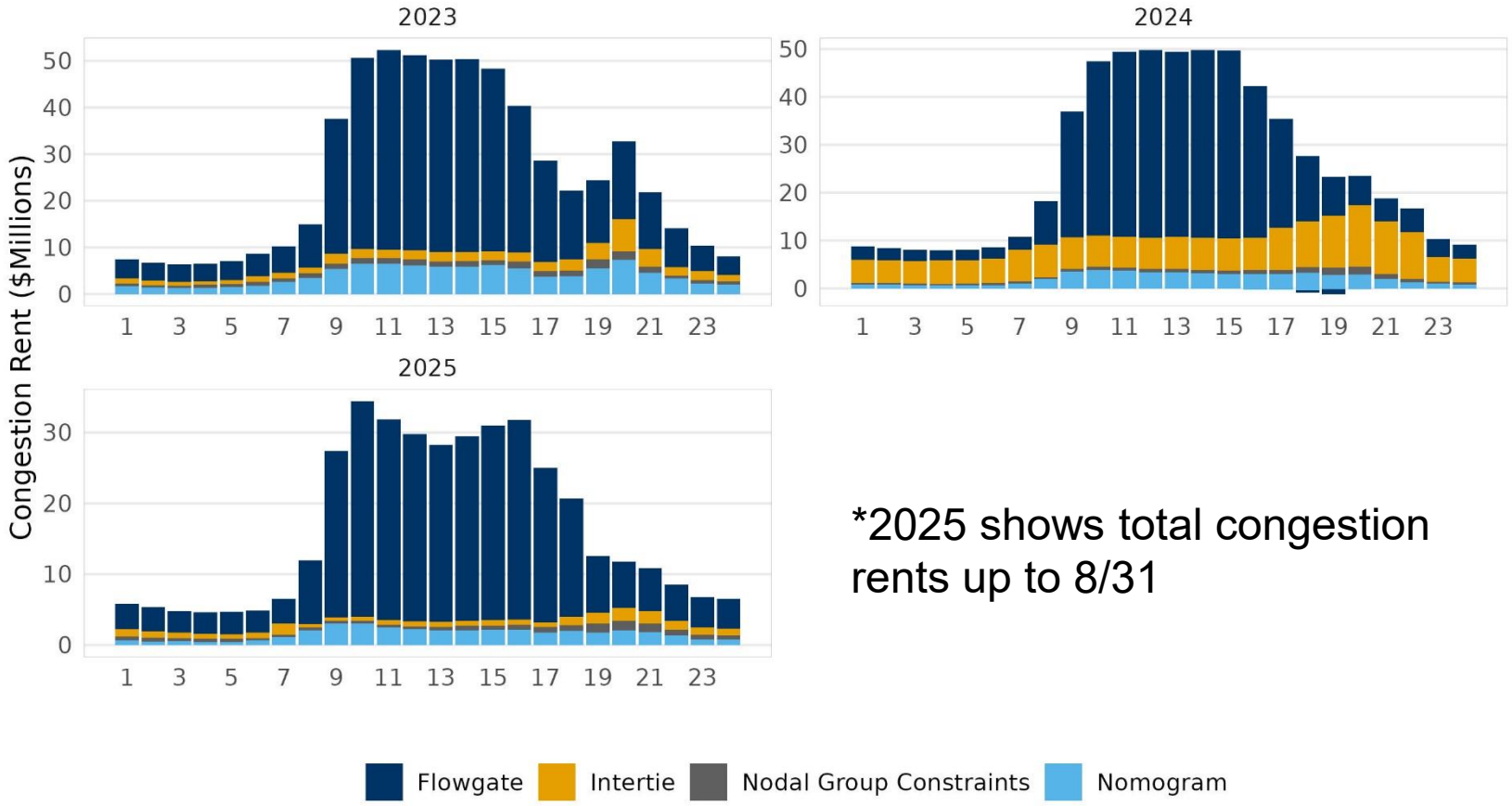
Congestion and CRRs

Summary: Congestion in 2025 has been within typical ranges observed in previous years. Most of the congestion has accrued during peak solar hours. CRR revenue inadequacy has been lower than in summer 2025.

Congestion rents remain stable through Summer 2025

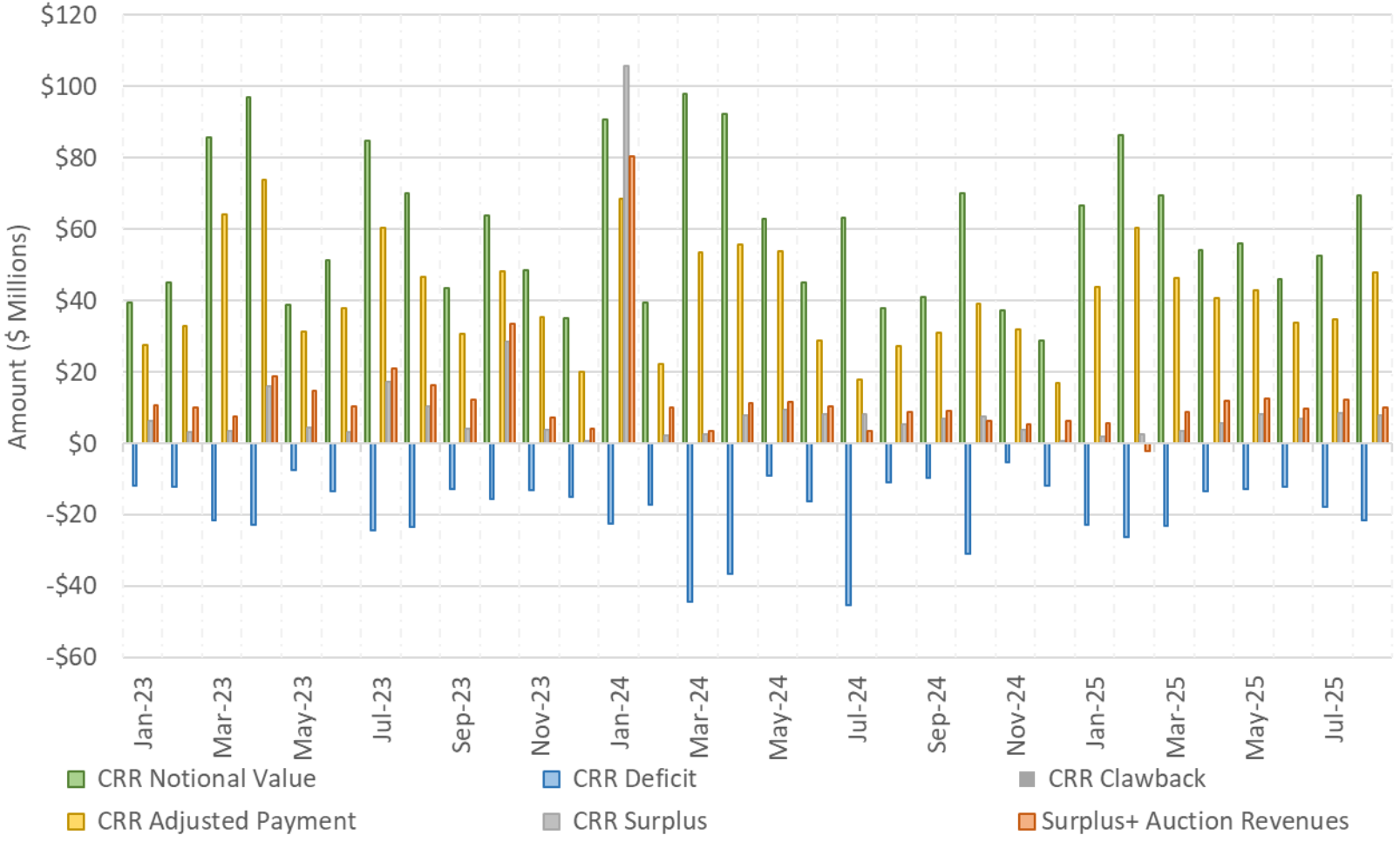


Hourly profile of congestion rents remains consistent into 2025

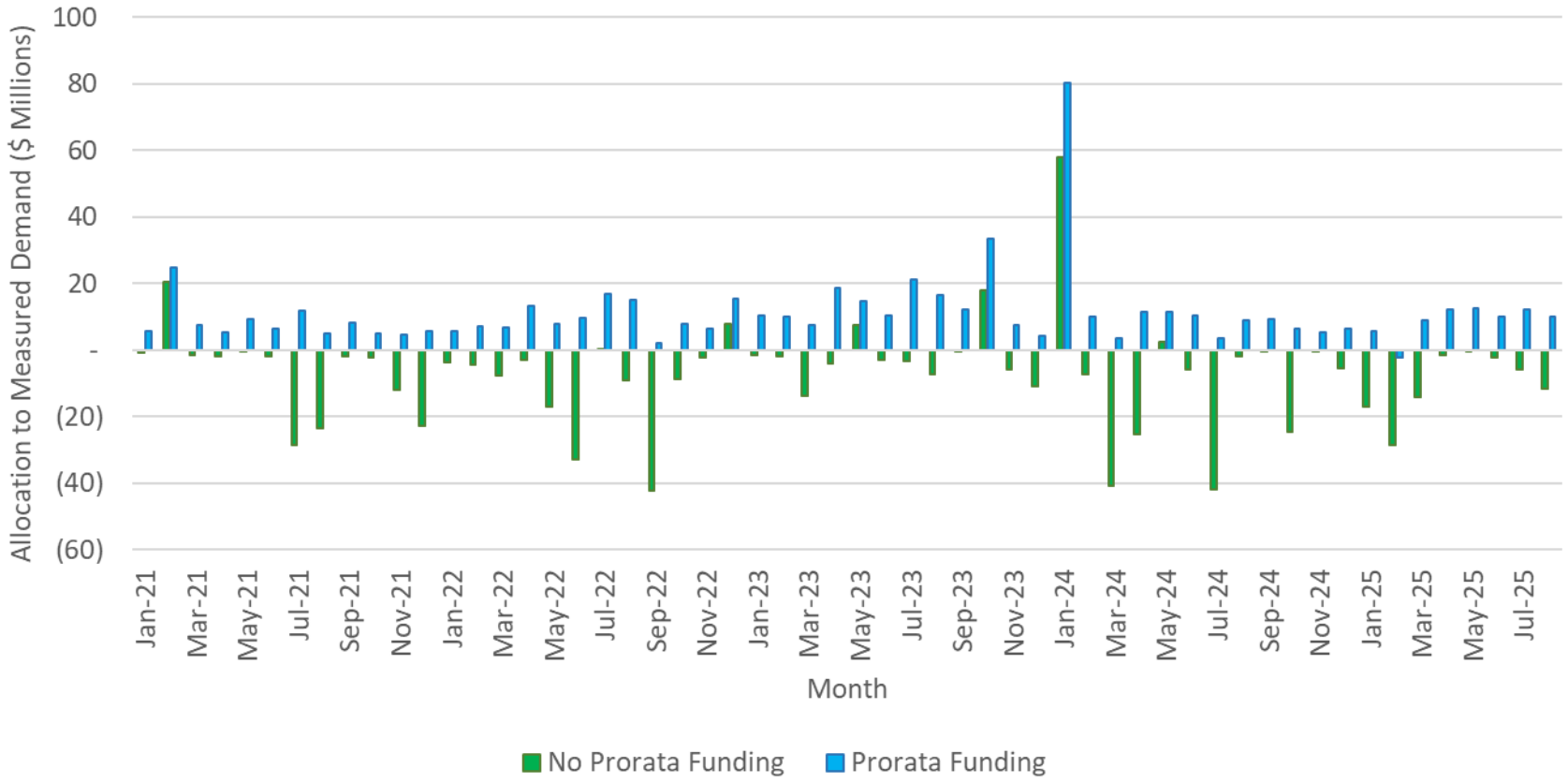


*2025 shows total congestion rents up to 8/31

CRR performance over the Summer months remains in line with previous Summer periods



The level of revenue adequacy in summer 2025 has been lower than that of 2025. This has resulted in a consistent surplus to measured demand



Public reports on market performance

Market Performance and Advanced Analytics

CAISO post a series of reports to ensure timely and transparent communication on market performance

Title	Overview	Publications Available
Monthly Market Performance Report	Provides a monthly summary of day-ahead and real-time market performance. Exceptional Dispatch information is included in the Market Manual Adjustment section. Market Disruption metric is included in the report Library | Monthly market performance reports | California ISO	Jan 2017 – Present
Market Performance and Planning Forum	Quarterly forum for stakeholders to review market performance. It includes Exceptional Dispatch, and analysis on the gas burn constraint if enabled Library | Market performance and planning forum | California ISO	Apr 2018 – Present
Exceptional Dispatch (OASIS Tool)	Generates reports by date, instruction type, and TAC area. Data retention has been up to the past 39 months. OASIS.caiso.com > Energy > System > Exceptional Dispatch OASIS.caiso.com > Energy > System > Operator-Initiated Commitment OASIS.caiso.com > Energy > Uplift > Resource-Specific Uplift OASIS - PRODUCTION - PUBLIC - fpapjbos4391 - 0	Rolling 39 months*
Daily Energy Storage Report	Provides the daily performance of energy storage resources. Library | Daily energy storage reports | California ISO	Aug 2022 - present
Daily Renewable Report	Provides the daily performance and curtailment of renewable resources Library | Daily renewable reports | California ISO	June 2025 - present
Monthly renewable performance report	Provides renewable performance that includes net load metrics, negative prices, reliability metrics (CPS1) Library | Monthly renewables performance report | California ISO	Nov 2017 - present
Daily DA summer report	Provides the Day-Ahead System summary that includes DA forecast, net load forecast, RUC adjustment (if any) and RUC shortfalls (if any) Library | Day-ahead daily market watch and summer reports | California ISO	Summer only (June – September) 2021 - present
Daily Day – Ahead Market Watch	Provides the daily Day-ahead market performance from prices, congestion and CRR results Library | Day-ahead daily market watch and summer reports | California ISO	January 2017 - present
Daily Real Time Market Watch	Provides the daily Real Time market performance from prices, congestion, EIM and AS. Library | Real-time daily market watch reports | California ISO	January 2017 - present
Bi-weekly market performance reports	Provides market performance that includes energy and AS prices, and congestion rents every two weeks Library | Weekly market performance reports | California ISO	January 2017 - present
Greenhouse gas emission tracking report	Monthly report to provide GHG emissions for ISO dispatched resources – Library | Greenhouse gas emissions tracking reports | California ISO	Nov 2016 - present
Average Emission Report	Provides the hourly data for system level MWh and emissions for WEIM. Library | Average emissions rate reports | California ISO	Jan 2022 - present

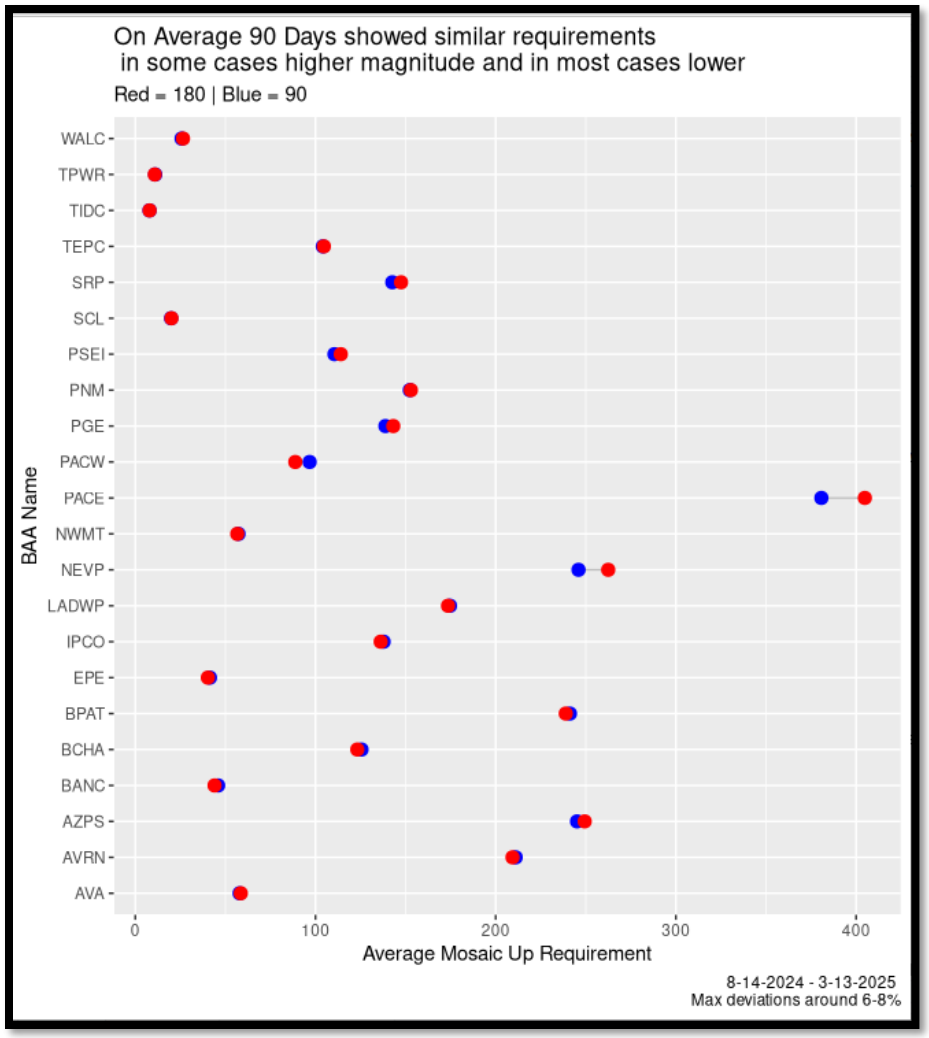
Market Issues

Market Performance and Advanced Analytics

Short Term Forecasting

Issue: FRP requirements were calculated using an erroneous sampling period

- **FRP requirement** was calculated with **90 rolling days** in the sample, instead of **180 days (forward and backward)** from **8/14/2024** to **3/12/2025**.
  - The average mosaic up requirement by BAA showed little deviation, at most **+/- 6-8%** in either direction when averaged over all hours.
  - EIM Area Overall coverage decreased to about **91.5%** vs. **93%** the year prior.

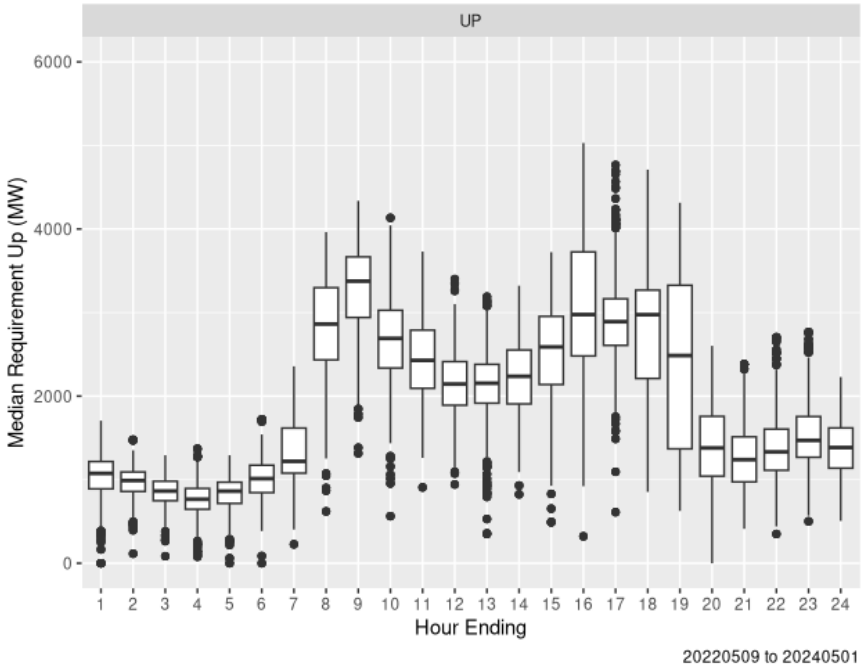


CAISO BAA simulated IR requirements

Short Term Forecasting

CAISO BAA simulated IR requirements

UP



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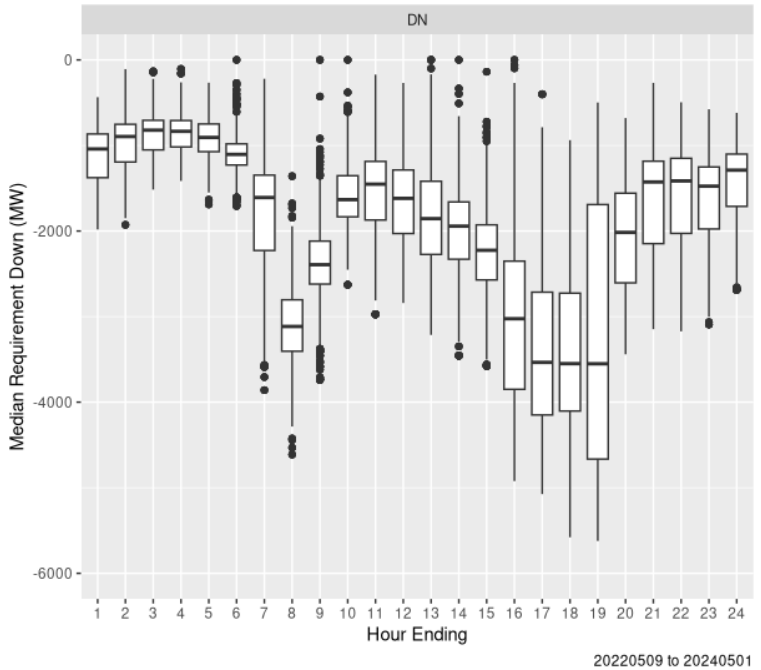


Two years of simulated data of the unadjusted IR requirement

Unadjusted = no diversity benefit

More detail on CAISO BAA simulated IR requirements to be posted soon on the Imbalance Reserves Mosaic Parameter Requirement Stakeholder page

STF Revised Metrics

Short Term Forecasting

STF Revised Metrics

Action taken: Short Term Forecasting (STF) has added additional metrics for enhanced tracking and to provide added context around forecast performance over time.

Impact: Stakeholders can refer to MPPF appendices for quick snapshots of forecast performance.

Next Steps: STF continues to develop tools for monitoring and analysis. Comments or questions on trends or specific examples can be submitted to STF through CIDI.

New suite of metrics for Short Term Forecasting

	Summary of forecasting metrics in MPPF
Load	- Top 10 days MAPE (*Q3 and Q4 only) - CAISO DA load (1) MAPE w/ minimum load and (2) MAE w/ maximum load - CAISO DA peak forecast MAPE - EIM T60 forecast MAPE w/ minimum load - EIM T60 forecast MAE w/ maximum load
Renewable	- Solar/wind capacity growth by resource type - DA/RT CAISO solar MAPE - DA/RT CAISO wind MAPE - RT CAISO solar hybrid MAPE
Uncertainty	- Quarterly coverage (EIM_AREA/EIM and overall/FRU/FRD) - Quarterly requirement (EIM_AREA/EIM and FRU/FRD) - Quarterly exceedance (EIM_AREA/EIM and FRU/FRD)

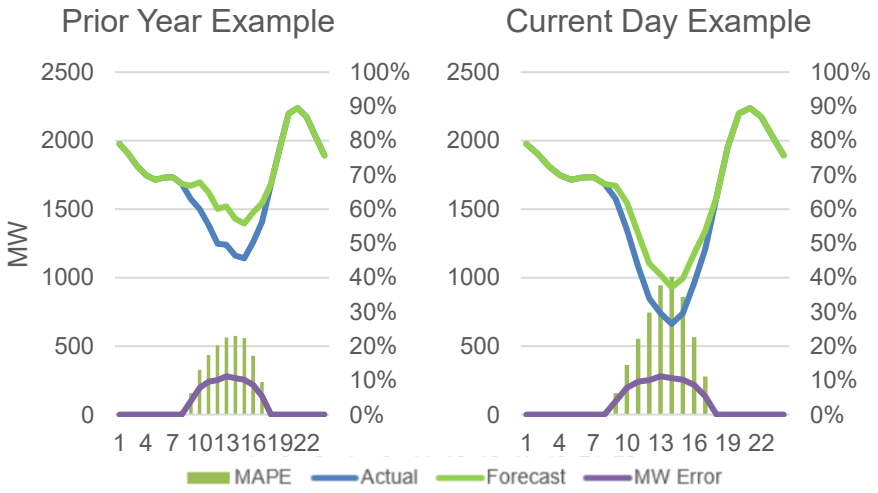
Changes in red

- Starting in this Q3 2025 MPPF presentation, metrics for load, renewable, and uncertainty forecasting are expanded for improved tracking.
- STF metrics suite will be included in MPPF appendices. Specific visuals or trends will be presented in MPPF as needed.
- Demand and Uncertainty (FRP) metrics sections in the appendix contain supporting slides to aid interpretation for this MPPF Q3 introduction.

Motivation for changes

Load

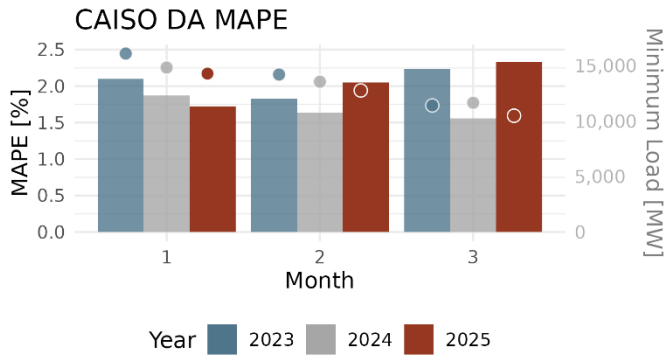
- Load patterns (e.g. DER growth) impact error metrics. Context on load gives context to error metrics.
  - Low midday loads will tend to increase mean average percent error (MAPE).
  - Higher loads will tend to increase mean average error (MAE).



Uncertainty

- Uncertainty trends vary by BAA and may be sensitive to large uncertainty observations over shorter timeframes.
  - BAAs can review their individual FRP metric trends.
  - Larger samples give better average picture of trends.
- Broadly the aim is to minimize requirements and exceedance without compromising coverage. And in general, requirements and exceedance will increase in MW value as load and renewable uncertainty grows.

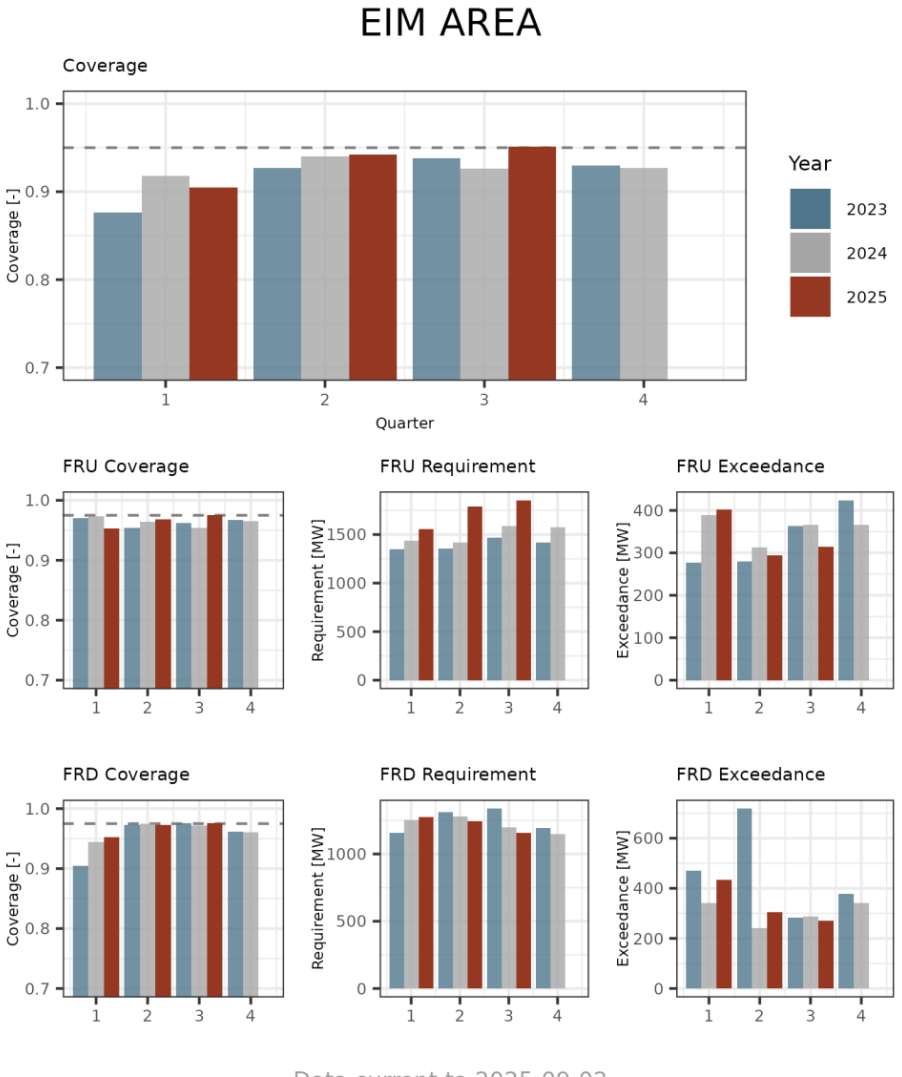
Highlights on changes to STF metrics



Above: Additional load information in MAPE and MAE plots

Right: Overview of quarterly trends for each BAA

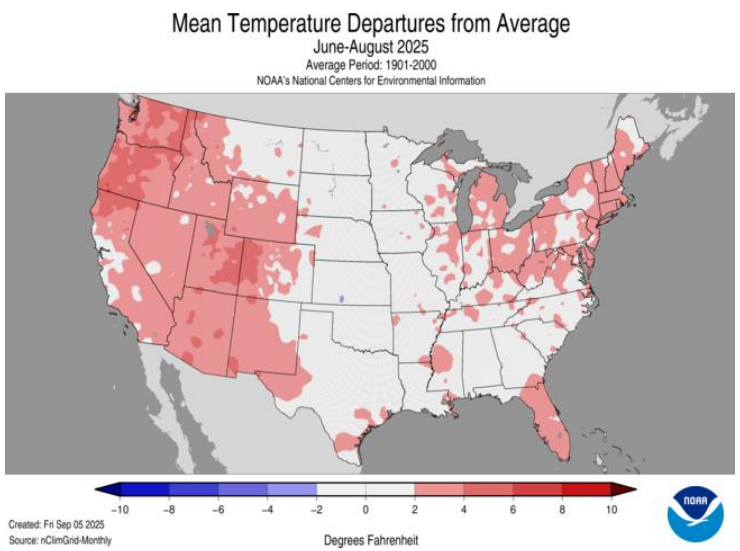
More detail in the supplementary slides included in the appendix.

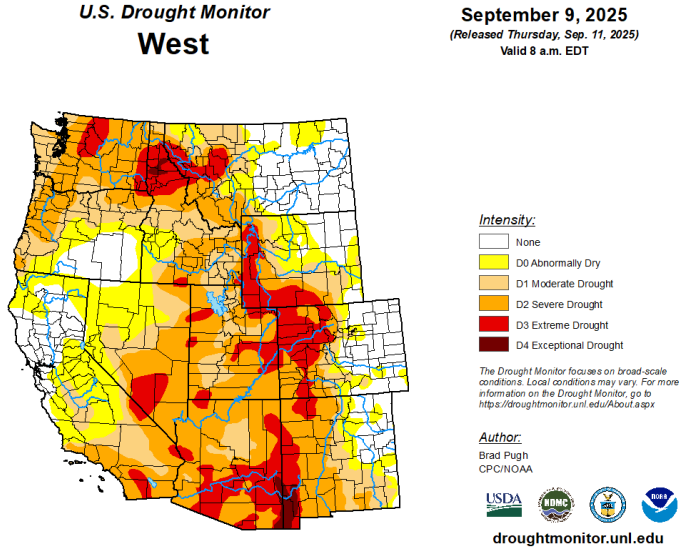


Data current to 2025-09-02

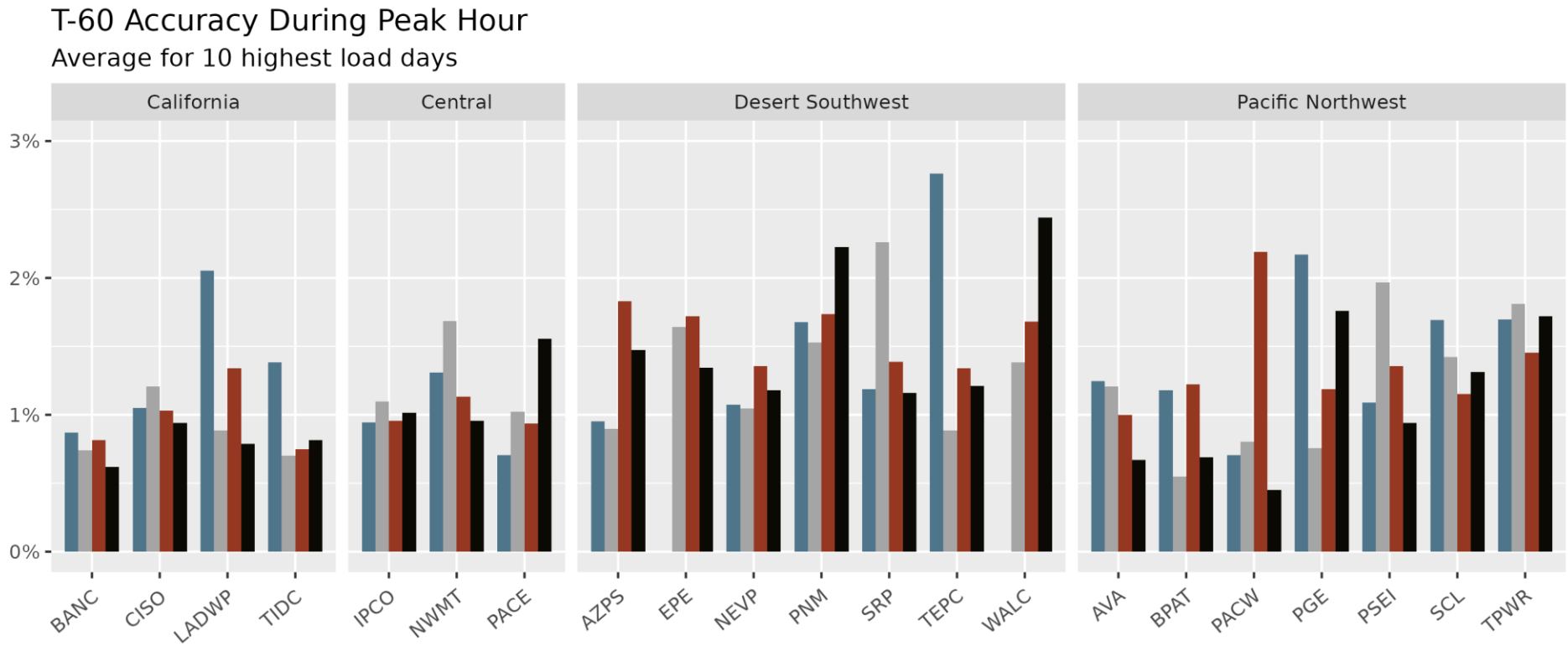
June - August 2025 was below normal for CAISO BAA on average

- CAISO
  - Highs 1.5°F **below** normal; lows 1°F **above** normal
- WEIM
  - Pac NW entities had most extreme and widespread departures above normal
  - Desert SW entities had below normal June, July, above normal August





2025 accuracy on high load days so far



Most regions are trending well for 2025. PACE, PNM, and WALC 2025 error driven by a subset of high load days.

- PACE 6/30
- PNM 8/4, 8/5, 8/11
- WALC 6/19, 8/6, 8/7, 8/11

PNM and WALC have generally had higher MAPE than previous years. We are continuing to work with these entities on data integrity for forecasting.

Sample current through 2025-09-02

Takeaways from STF metrics

Highlights:

- CAISO DA forecast error in summer 2025 has been low, partially driven by relatively cool temperatures and low loads.
- FRP coverage is near target.

Areas for additional monitoring:

- PNM forecast accuracy in spring/summer 2025 has generally been higher than previous years.
- FRP requirement growth in a handful of regions (APS, CAISO, EPE, IPCO).

Policy Update

Market Strategy and Governance

Market Policy Development

Gas Resource Management

- Draft final proposal (published September 17) identifies enhancements in three areas:
  - Changes to the multi-day ahead advisory market runs to improve fuel procurement forecasts available during gas nomination timelines
  - Additional options for cost inputs, fuel cost adjustments, and recovery
  - Considerations for managing a resource's gas system limitations

- On September 19th, the Market Surveillance Committee held a public discussion to discuss gas burn forecasting and commitment cost mitigation.

- Decisional classification: Primary authority of WEM Governing Body

Greenhouse Gas Coordination

- The Accounting and Reporting Approach final proposal to be published in early October
  - Out-of-market approach that facilitates accounting for state/corporate policies without a price on carbon emissions
  - Produces data that will allow entities to see and understand the emissions intensity of their portfolio
  - A sub-group and the working group have developed the report format
- Non-decisional item: ISO staff providing informational briefing at the October Joint ISO Board of Governors and WEM Governing Body General Session meeting

Background: Track 1 CAISO default Qualifying Capacity (QC) methodology & Planning Reserve Margin (PRM)

CAISO has **default** QC methodologies (RA counting rules) and PRM in Section 40 of the tariff as a "fallback" when LRAs have ***not*** specified their own resource counting methods or PRMs

- Default rules *inform* LRA resource adequacy programs
- CAISO has not updated counting rules and PRM in 20 years
- Need timely and actionable information on a portfolio that would meet reliability needs

RA Track 1 Proposal: CAISO default Qualifying Capacity (QC) methodology & Planning Reserve Margin (PRM)

Track 1
Draft Final Proposal

- Default **QC methodologies**
  - Average ELCC for wind, solar, storage, and hydro, with resource-specific adjustment factors
  - UCAP for thermal, nuclear and pumped storage hydro
  - Performance-based counting for DR
- Monthly default **PRMs** to achieve a 0.1 Loss Of Load Expectation (LOLE)
- **Annual process** to review counting methodologies and publish default QC values and PRM

Resource Adequacy Track 3A Decision: Resource Visibility

- New reporting requirements for scheduling coordinators of RA-eligible capacity that is not shown as RA:
  - On the same year-ahead and month-ahead timeline as the supply plans
  - Applies only to resources appearing on the ISO's Net Qualifying Capacity list
  - Does not impose any new availability requirements on the capacity being reported
  - Will help the ISO more efficiently conduct its backstop procurement processes
- Retirement of the monthly Non-RA Capacity Report
- Precursor to the structural review of backstop processes the ISO will undertake in RAMPD Track 3B, which will begin the stakeholder process by the end of 2025

Congestion Revenue Rights Enhancements

- ISO held an EDAM implementation workshop on August 21st that discussed an EDAM Day 1 implementation plan for CRR modeling and settlement
- Although CRRs are currently only for the CAISO Balancing Area (BA), as we implement EDAM, day-ahead market modeling changes will flow through into the CRR market model in the CRR annual and monthly processes
- The congestion revenue rights enhancements initiative is a venue for discussing policy evolution for how the CRR process suballocates congestion revenue allocated to the CAISO balancing area.
  - Final Working Group Meeting on Sept. 8 to finalize goals, principles and problem statements in September 2025.
  - Congestion Revenue Allocation should inform any future evolution of ISO CRR policy

Resource Adequacy Track 2: Outage and Substitution Background

- Reform to the ISO's outage and substitution processes was unanimously supported during the working group phase

- Stakeholders recommended developing and outage and substitution pool

- The purposes of the pool are to:

  1. Remove friction for SCs with today's substitute capacity procurement process
  2. Overcome challenges with some SCs holding back RA capacity for outage substitution for a partial-month outage which results in:
     - Artificial tightness in the RA bilateral market
     - Potential maintenance delays
     - Higher forced outage rates

Track 2: Outage and Substitution Straw Proposal Overview

- **Multiple Options to create a more efficient procurement process for outage and substitution:**
  - Recommended Option: Participant Matching - functionality for SCs to buy and sell substitute capacity with increased visibility
  - Alternative Options: Optimization Optimized (price or MW) approach whereby the ISO would procure on behalf of SCs and allocate the costs of substitution

Demand and Distributed Energy Market Integration

- Working group has explored development or enhancement of participation models and market rules associated with demand response and distributed energy resource participation

- Stakeholder problem statement development topics (Completed)
  - Problem statements finalized:
    - Performance Evaluation Methodology enhancements
    - Enhancing demand flexibility market options
    - Reliability based demand response
    - Economic demand response
    - Distributed energy resource participation

- Final scoping meeting in October
  - ISO staff to present initial assessment of problem statements
  - Transition from scoping phase to policy development – issue paper to follow

- Proposed decisional classification: TBD

EDAM Congestion Revenue Allocation

- ISO Board of Governors and WEM Governing Body approved the proposed transitional design at the joint meeting session on June 19th
  - Proposal allocates parallel flow congestion revenues associated with the exercise of eligible transmission rights to the EDAM balancing area where these revenues accrued
- On August 29th, tariff revisions supporting the proposal were approved, along with PacifiCorp's and Portland General Electric's tariff revisions to implement EDAM
- Three phase detailed analysis plan: looking at WEIM data to-date, market simulation results later this year, and EDAM data after go-live
- Start stakeholder workshops on design evolution in Q4 and share initial analysis then

Price Formation Enhancements Initiative

- BAA-Level MPM and Scarcity Pricing Straw Proposal published on August 22. Stakeholder comments submitted September 19.
- Proposal reduces unnecessary market power mitigation and expands scarcity pricing during grid emergencies to strengthen reliability signals.
- Re-engages stakeholders on these important topics; ISO had paused stakeholder meetings to accommodate work on congestion revenue allocation.
- Proposed decisional classification: primary authority of WEM Governing Body.

Storage Design & Modeling Initiative

- Scope of the initiative has been organized into four topic groups:
  - Outage Management, Uplift & Default Energy Bids, State-of-Charge Management, and Mixed-Fuel & Distribution-Level Resources

- The September 29 stakeholder meeting discussed:
  - Eliminating day-ahead bid cost recovery for storage
  - Stakeholder-requested analysis on multi-interval optimization
  - Outage reporting for distribution-level charging constraints
  - Improving mixed-fuel solar capability data
  - Two stakeholder presentations

- Ongoing monitoring reveals storage bid cost recovery remains stable despite battery fleet growth

- Proposed decisional classification: TBD (by topic group)

Policy initiatives catalog & roadmap

- Revised 2025 Policy Roadmap published June 2025
  - Recalibrated policy initiative prioritization and scheduling to accommodate EDAM Congestion Revenue Allocation initiative
- 2025 Catalog published July 2025
- 2026-2028 draft Policy Roadmap published mid-October
  - Stakeholder meeting (early Nov)
  - Comments accepted
- 2026-2028 final Policy Roadmap published December
  - Includes disposition of each catalog item

2025 Policy Calendar

2025					
		Q1	Q2	Q3	Q4
Congestion Revenue Rights		Scoping working groups		Policy development	
Demand and Distributed Energy Market Integration		Scoping working groups			Policy Development
EDAM Congestion Revenue Allocation			Policy Development & Decision	Implementation	
					Working groups
Gas Resource Management		Proposal working groups	Straw proposal	Policy development	Decision
Greenhouse Gas Coordination					
	Topic 1: WEIM/EDAM GHG design	Scoping working groups		Postponed	
	Topic 2: Non-priced approaches for GHG reduction	Policy development	Straw proposal	Policy development	Decision
	Topic 3: Additional GHG-related metrics	Addressed & closed out			

2025 Policy Calendar (cont.)

2025					
		Q1	Q2	Q3	Q4
Price Formation Enhancements					
	Scarcity pricing & market power mitigation	**Proposal working groups**	**Straw proposal**	**Policy development**	
	Fast start pricing	**Postponed**			
Resource Adequacy Modeling and Program Design					
	Track 1: Modeling, Defaults, and Accreditation	**Policy development**			**Decision (Default Counting Rules/PRM)**
	Track 2: Outage & substitution and availability and incentive mechanisms	**Policy development**			
	Track 3a: RA status visibility	**Policy development**			
	Track 3b: Backstop reform and long-term EDAM RSE solutions		**Postponed**		**Policy development**
Storage Design and Modeling		**Scoping working groups Issue papers & straw proposals**		**Policy development**	
WEIM Resource Sufficiency Evaluation Enhancements		**Postponed**			
WEIM Assistance Energy Transfer			**Policy development**	**Decision**	

Policy initiative process

Stakeholder meetings, working groups and workshops may occur throughout the process

This represents the typical process, and often stages run in parallel.

**Discussion papers and working groups will be incorporated into the process as needed.*

BPM change management: Definitions and Acronyms BPM Declassified as BPM

- The California ISO announces the declassification of the Definitions and Acronyms Business Practice Manual (BPM) with updated link on how to find ISO definitions and acronyms.

  The Definitions and Acronyms BPM previously served as a consolidated reference for all definitions and acronyms in the ISO Tariff and other BPMs.

  A link to the ISO glossary is now available in the BPM Library, where you can find the most current definitions and acronyms formerly included in the Definitions and Acronyms BPM. Definitions and acronyms will also remain accessible within the individual BPMs.

  For more information about the BPM Change Management process, please visit the BPM webpage on the ISO website.
- Glossary | California ISO

Next Forum

Upcoming MPPF meeting

The next MPPF is tentatively scheduled for Dec. 11, 2025. https://www.caiso.com/meetings-events/topics/market-performance-and-planning-forum

California ISO

2025

Market Performance and Planning Meetings

Note: dates subject to change; for the latest information please visit the Calendar on www.caiso.com

January

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

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March

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30	31					

April

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27	28	29	30			

May

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25	26	27	28	29	30	31

June

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29	30					

July

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August

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September

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October

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November

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30						

December

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	1	2	3	4	5	6
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Meeting

Follow us on Twitter @California_ISO for our latest updates

WEIM Modeling and Resource Registration Forum on 10/7/25 and CAISO New Resource Implementation Forum 10/8/25

- If you plan to attend in person, please register by end of day Sept. 30, 2025
- In-Person Registration:https://caiso.regfox.com/weim-forum (10/7)
- In-Person Registration:https://caiso.regfox.com/new-resource-implementation-fair (10/8)
- The final agenda and a presentation will be available prior to the meeting on the **public forums webpage**.

Energy Matters blog provides timely insights into ISO grid and market operations as well as other industry-related news.

https://www.caiso.com/about/news/energy-matters-blog

Story | Operations

Control center modernization is enhancing reliability

By John Phipps

09/10/2025

Story | Inside the California ISO

Market simulation for EDAM – a milestone on the way to next spring's launch

By Dr. Khaled Abdul-Rahman

09/05/2025

Story | Inside the California ISO

New EDAM training sessions will provide valuable insights for market participants

By ISO Staff

08/13/2025

Subscribe to Energy Matters blog monthly summary

For reference

Visit user group webpage for more information: https://www.caiso.com/meetings-events/topics/market-performance-and-planning-forum

If you have any questions, please contact Brenda Marquez at bmarquez@caiso.com or isostakeholderaffairs@caiso.com

Appendix
General Metrics

Energy Storage Performance

Energy storage enhancements Track 2 was activated on November 1, 2023

- The original state of charge equation

$$SOC_{i,t} = SOC_{i,t-1} - \left(EN_{i,t}^{(+)} + \eta_i \, EN_{i,t}^{(-)}\right) \frac{\Delta T}{T_{60}}$$

$$\underline{SOC}_{i,t} \leq SOC_{i,t} \leq \overline{SOC}_{i,t}$$

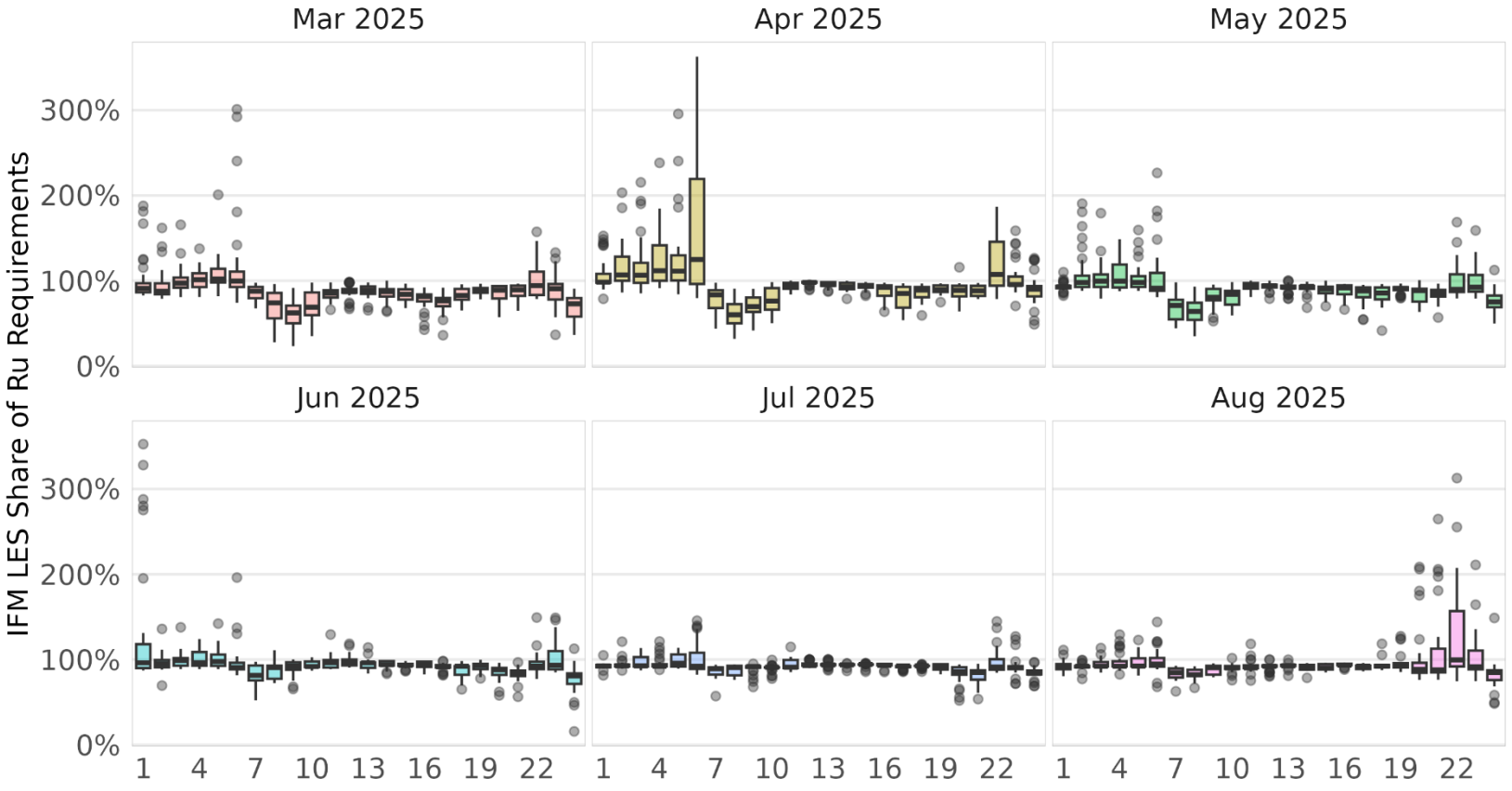
(SOC: original SOC with energy impact only)

- A new set of constraints is introduced

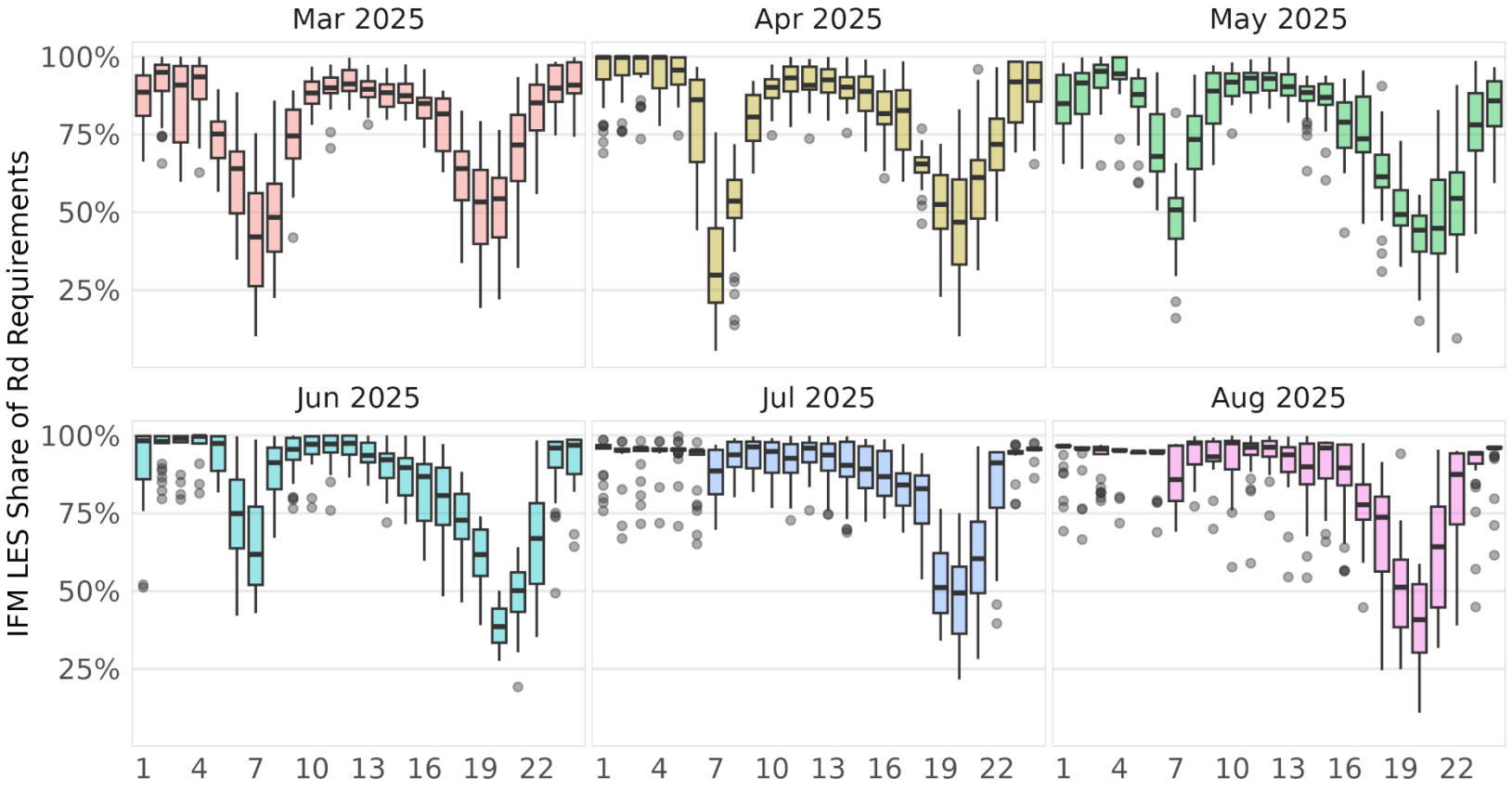
$$SOC_{i,t}^{AT} = SOC_{i,t-1}^{AT} - \left(EN_{i,t}^{(+)} + \eta_i \, EN_{i,t}^{(-)} + \boldsymbol{ATRU_t} \, RU_{i,t} - \boldsymbol{ATRD_t} \eta_i RD_{i,t}\right) \frac{\Delta T}{T_{60}}$$

(SOC^{AT} : SOC with attenuation factors)

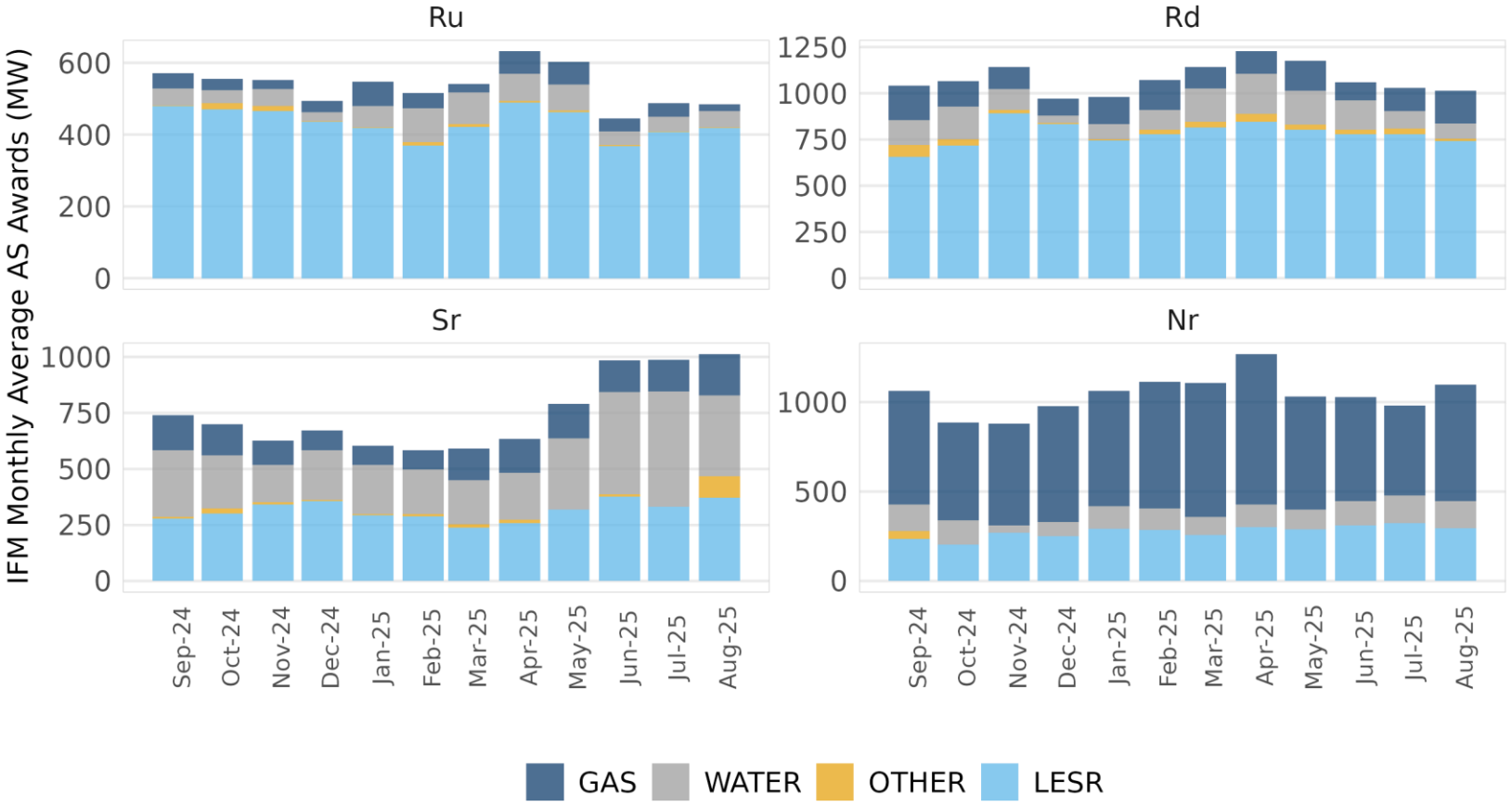
No material change in the hourly profile of the LESR percentage share of the Ru requirement after implementation of enhancements



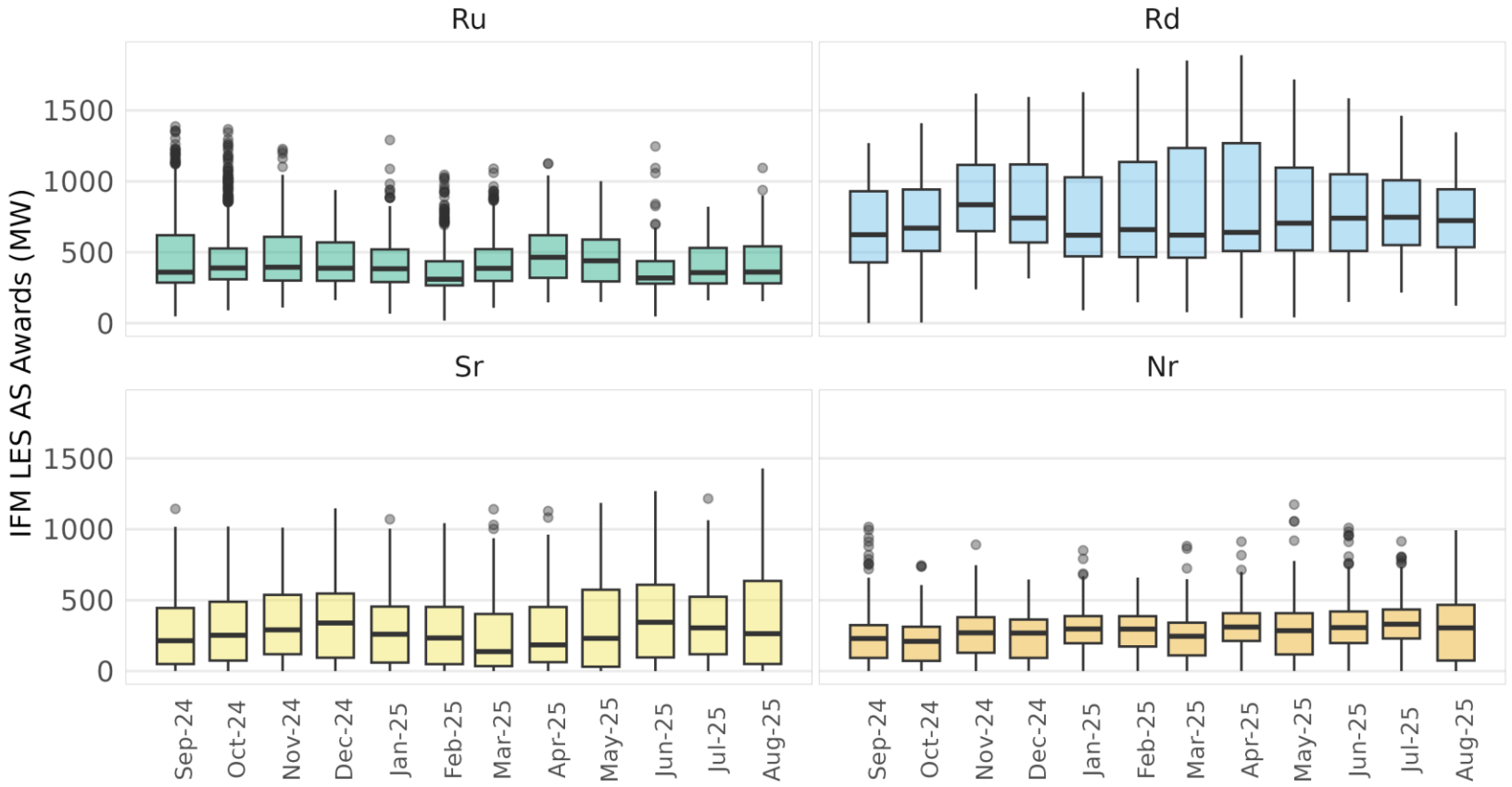
No material change in the hourly profile of the LESR percentage share of the Rd requirement



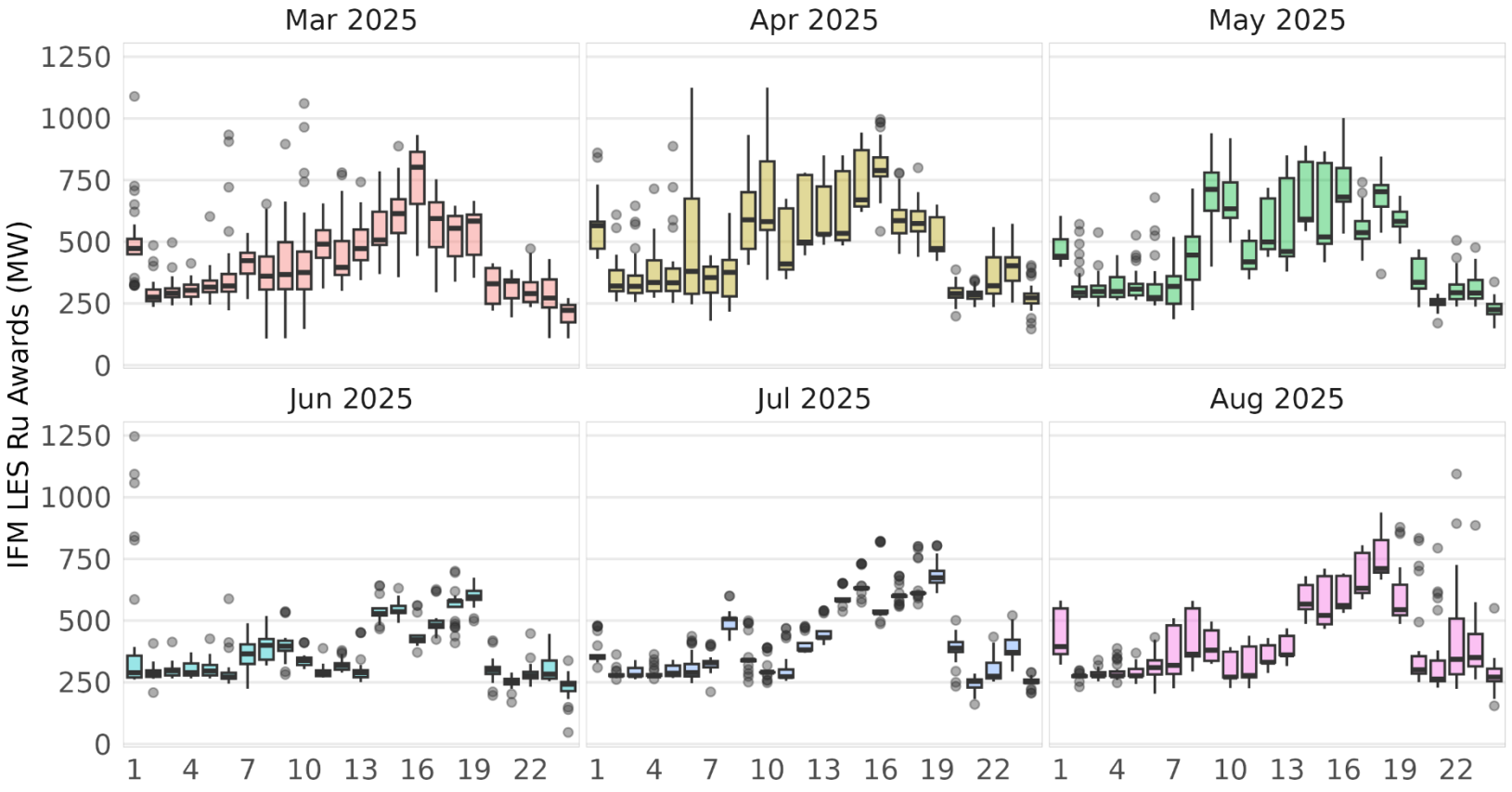
Monthly average IFM AS awards for storage shows no significant change in Rd and Nr, but reduction in Ru and increase in Sr are observed.



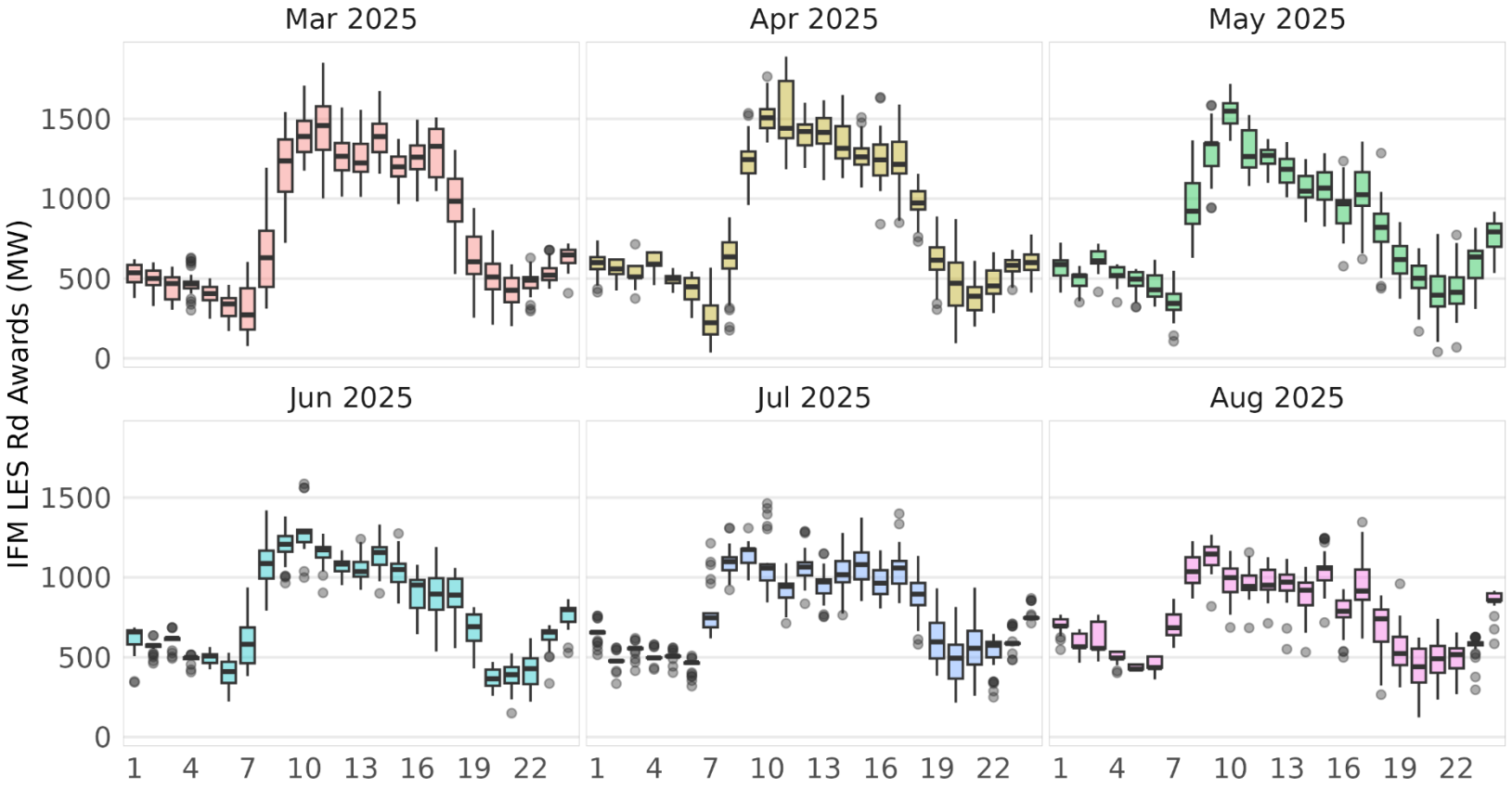
Monthly IFM AS market awards show no significant change in pattern



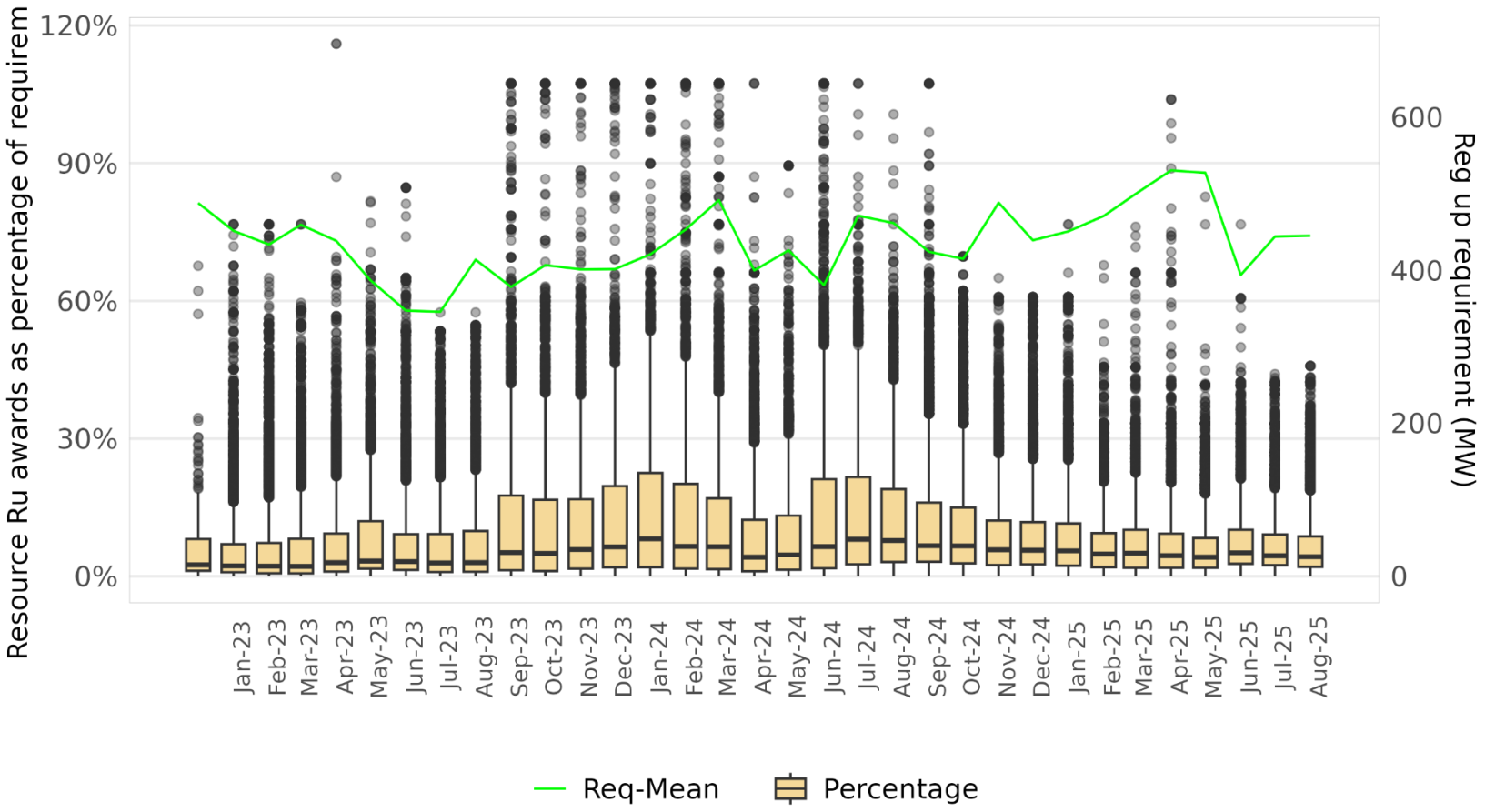
Regulation up awards in the day-ahead market have not seen a material change in trend



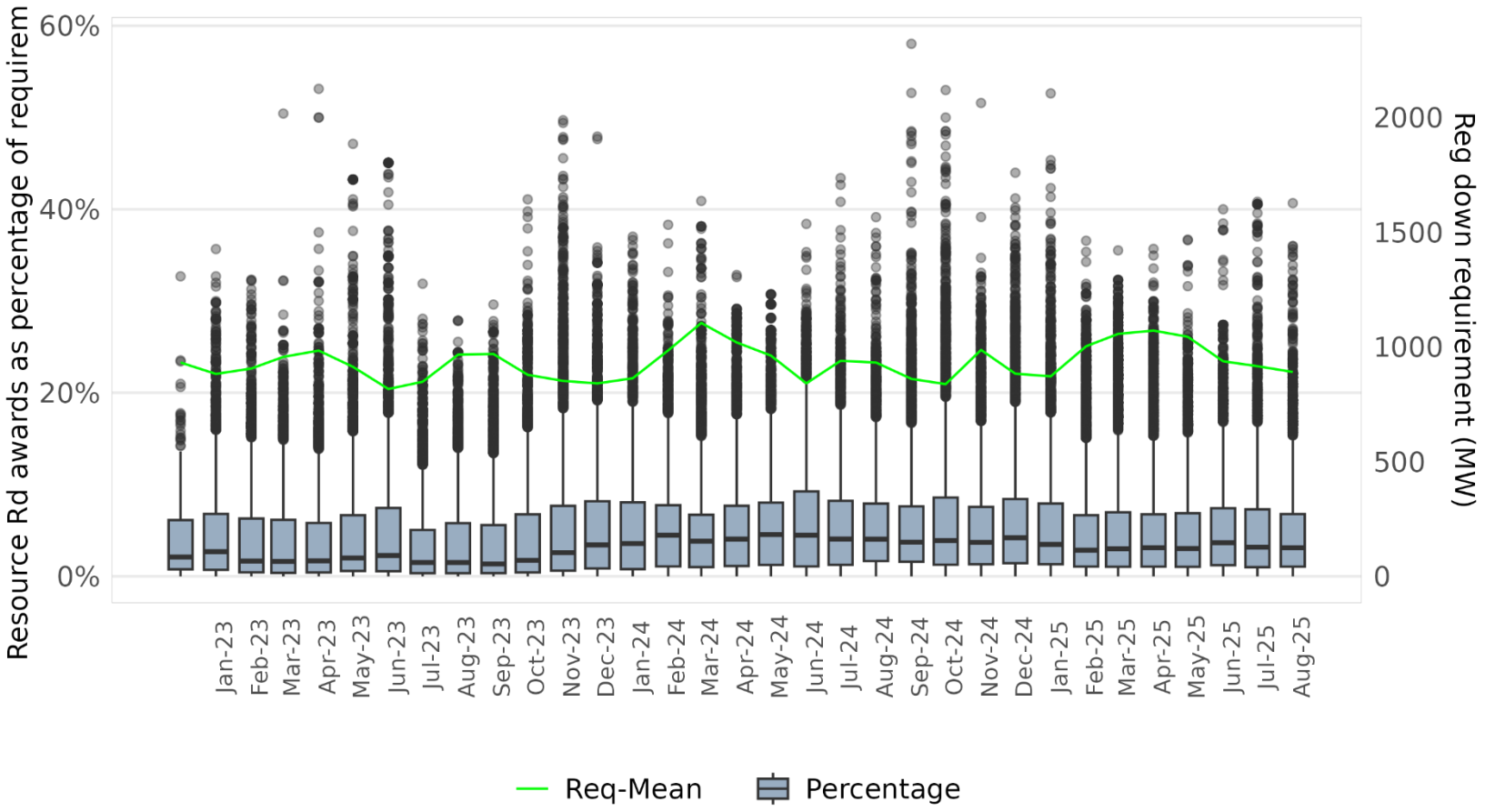
Regulation down awards in the day-ahead market have not seen a material change in trend



The relative size of Regulation award on individual resources tends to be within typical ranges



Resource Rd awards as percentage of Rd requirement sees not notable change in pattern with enhancements

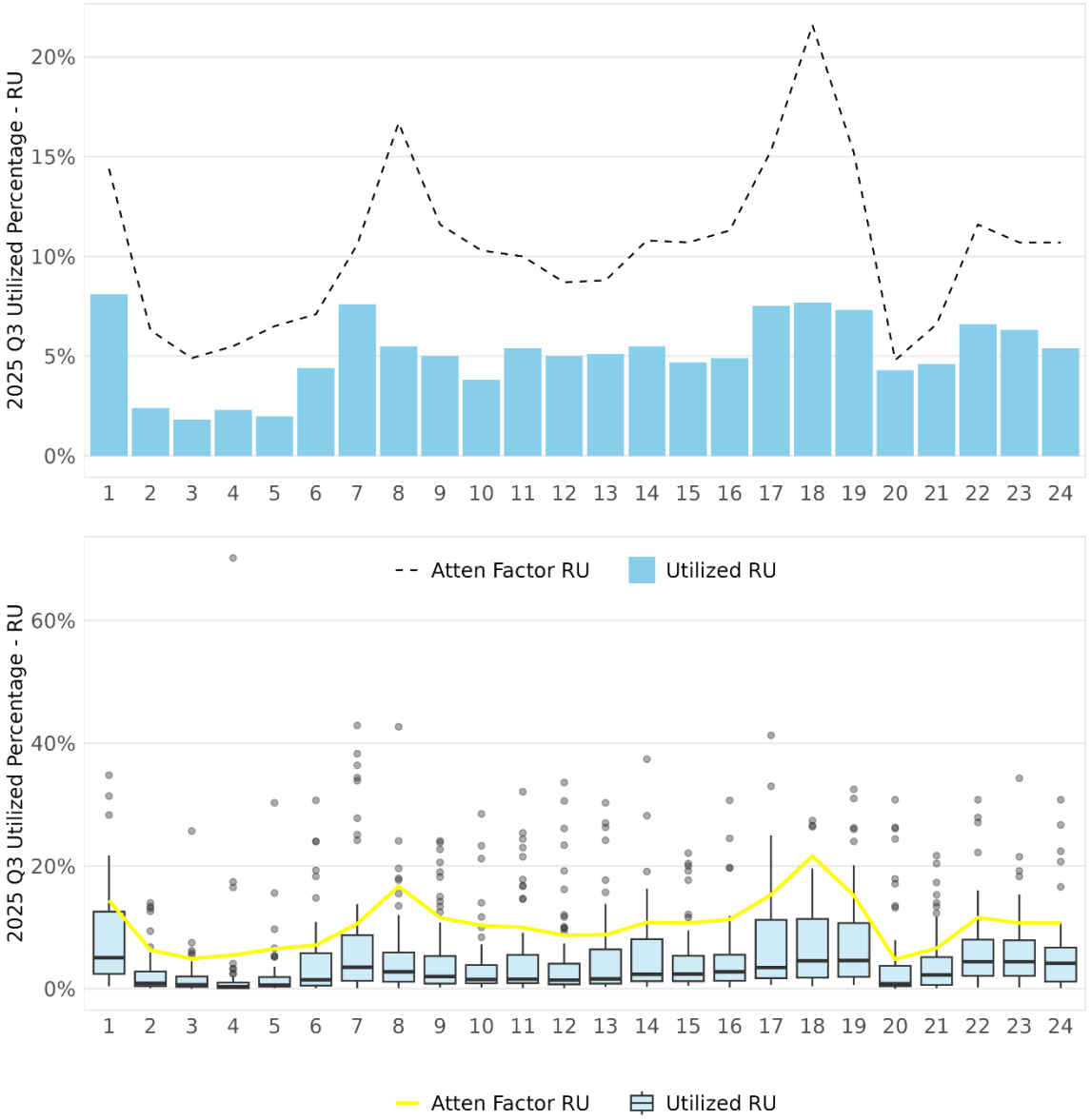


As part of the storage enhancements, the ISO estimates attenuation factors for each calendar season

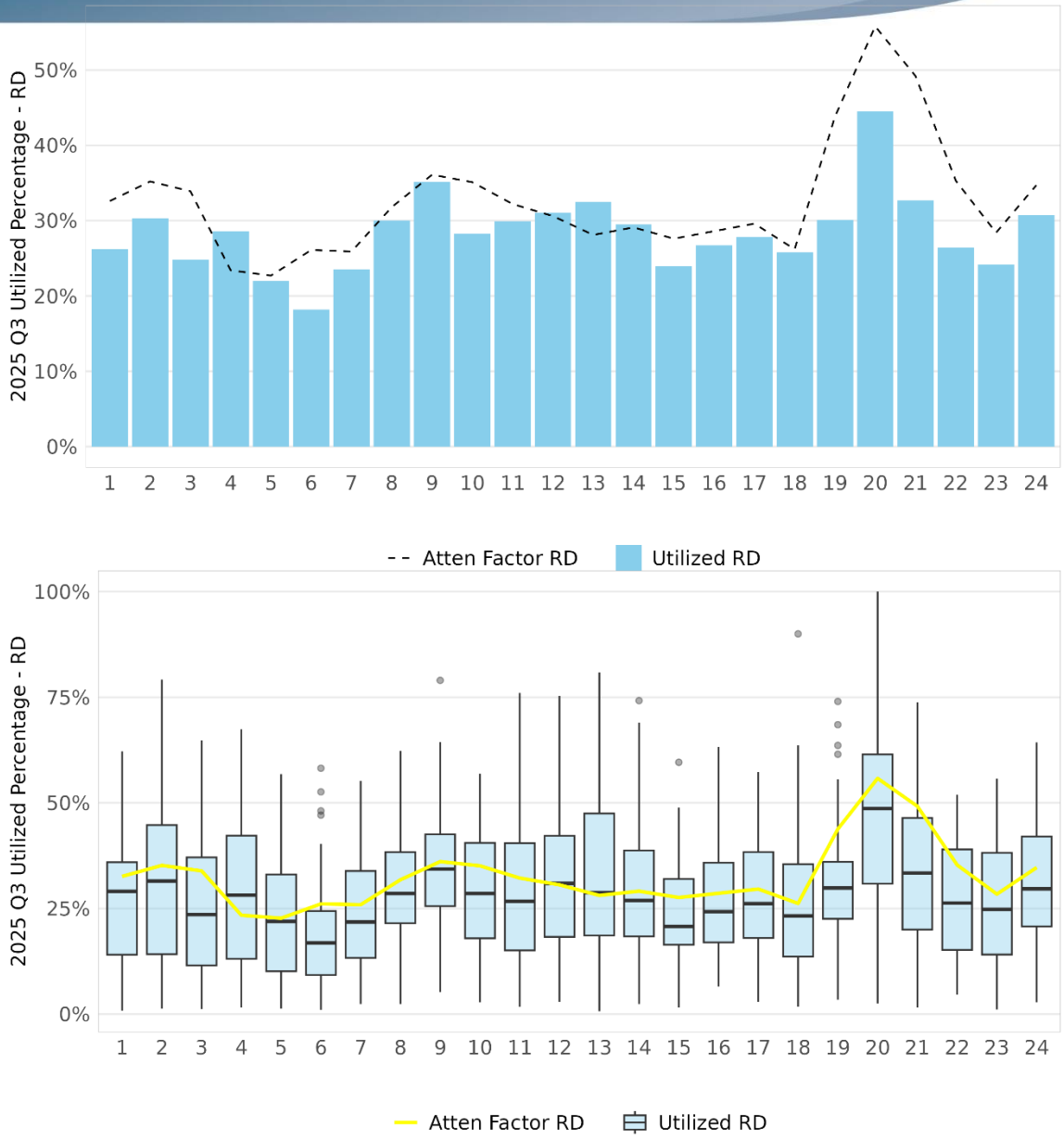
- Estimating the actual utilization of regulation
- Data: the corresponding quarter from the prior year
- Metric:
  a) Data source: resource level AGC setpoint vs. DOP
  b) Reference: RTPD regulation awards
  c) System aggregated percentages

$$Percentage\ utilization\ Ru(Rd) = \frac{Total\ utilized\ Ru(Rd)}{Total\ Ru(Rd) awards}$$

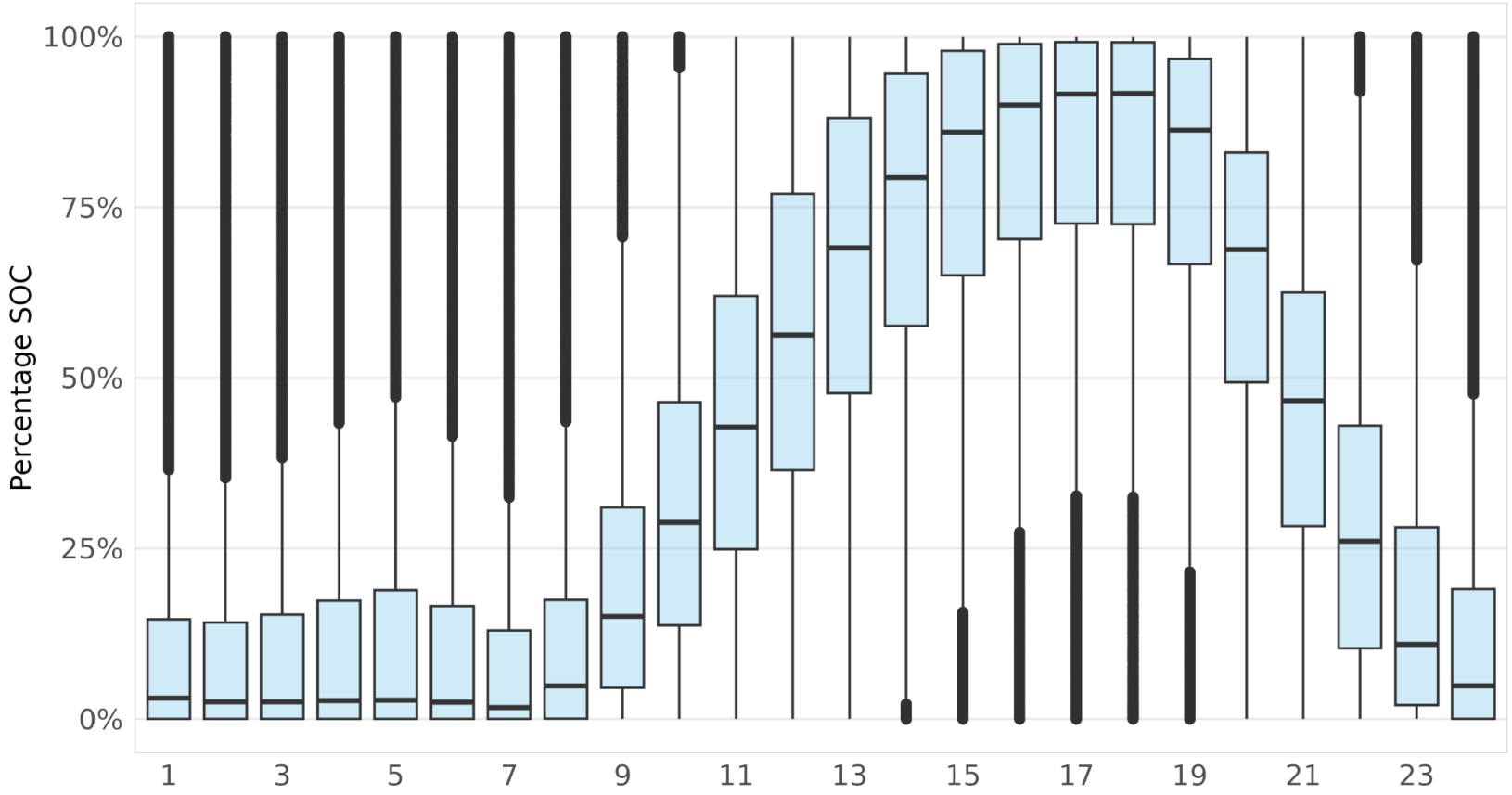
2025 Q3 (Jul.-Aug.) Actual utilization of regulation up remains relatively low



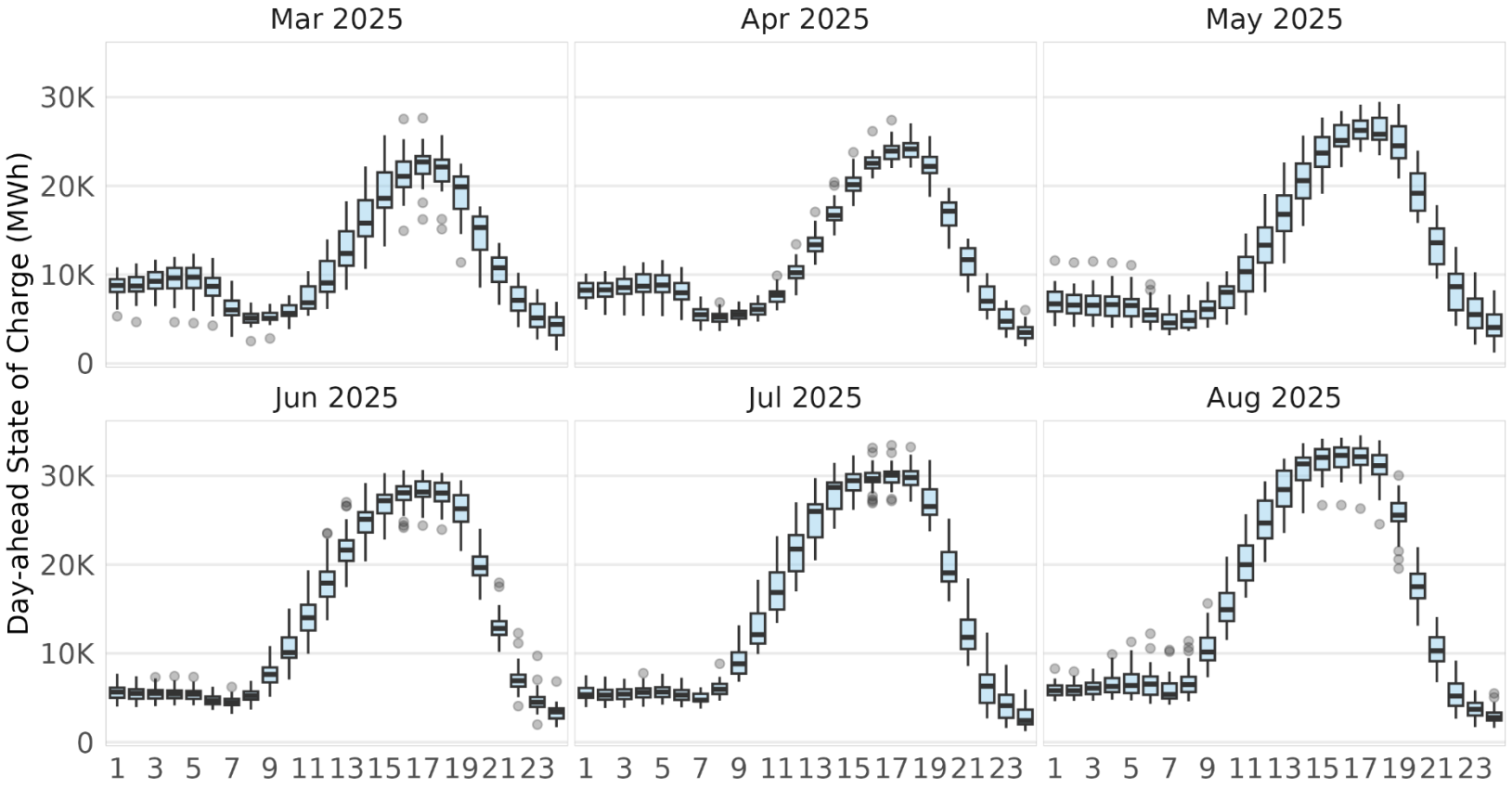
2025 Q3 (Jul.-Aug.) Actual utilization for regulation down continues to be high



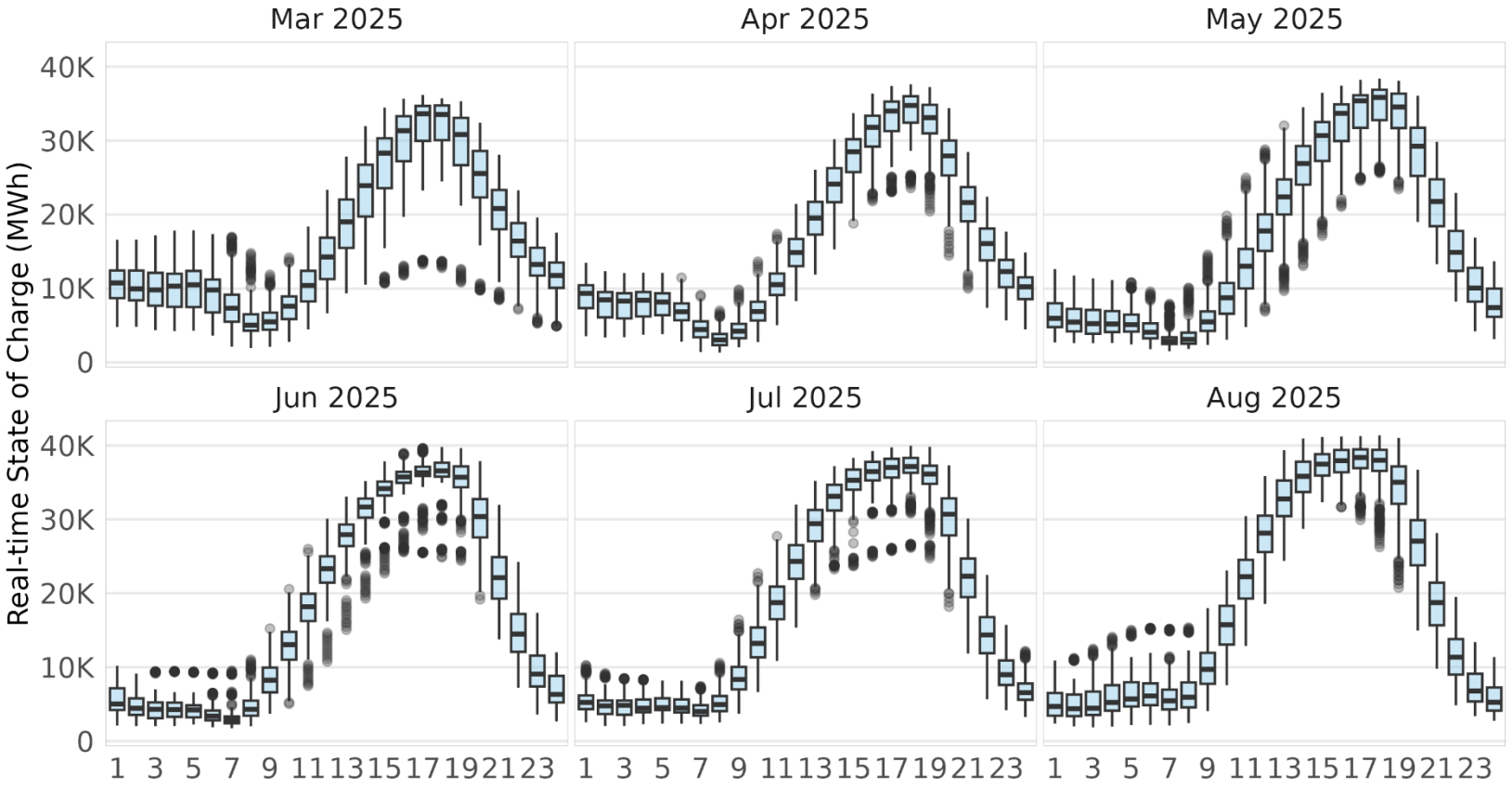
Most of the time storage resources have SOC below full capacity for months from Jun 2025 to Aug 2025



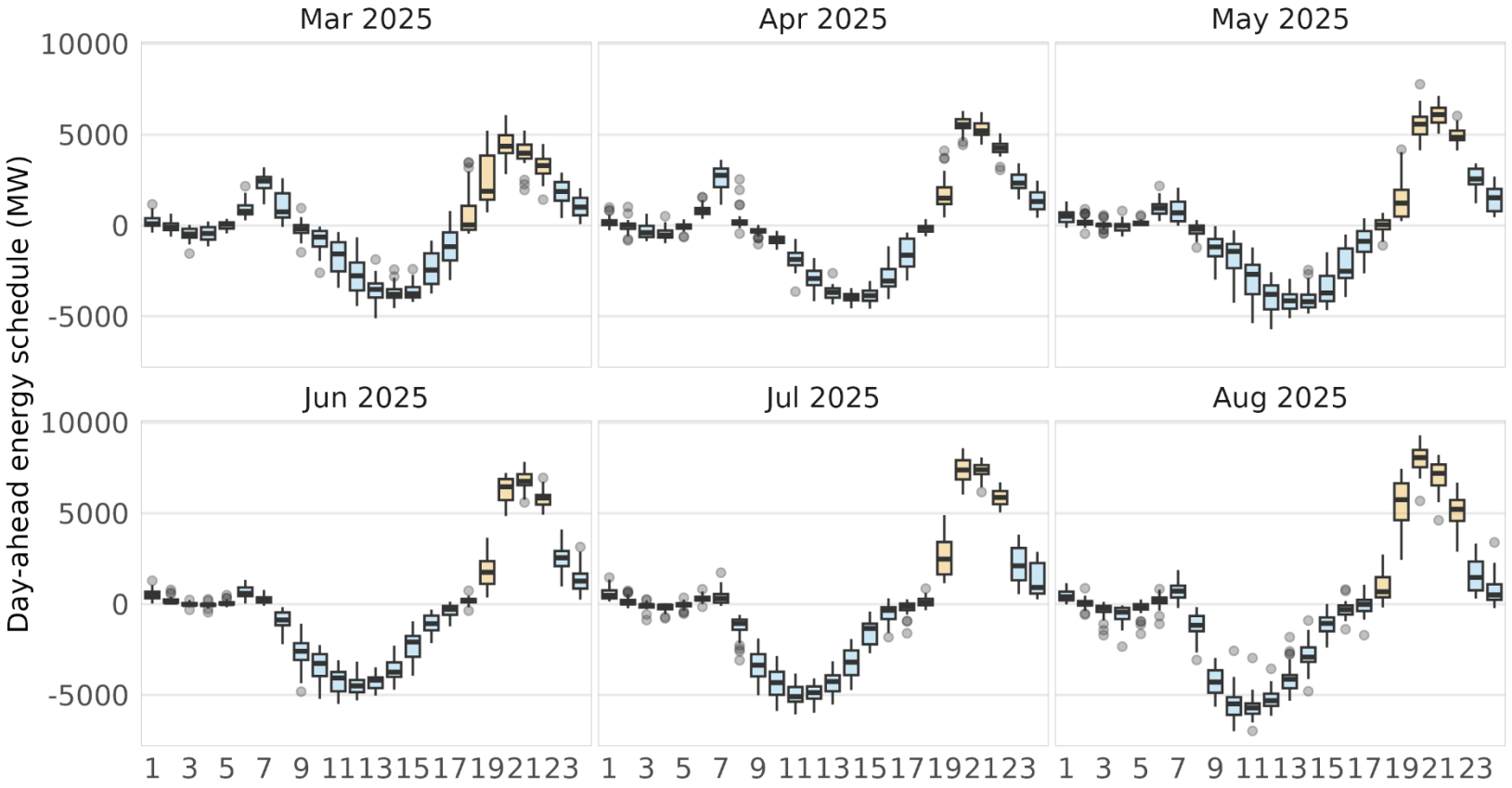
Day-Ahead state of charge for storage resources is typically achieved between hour ending 16 and 17



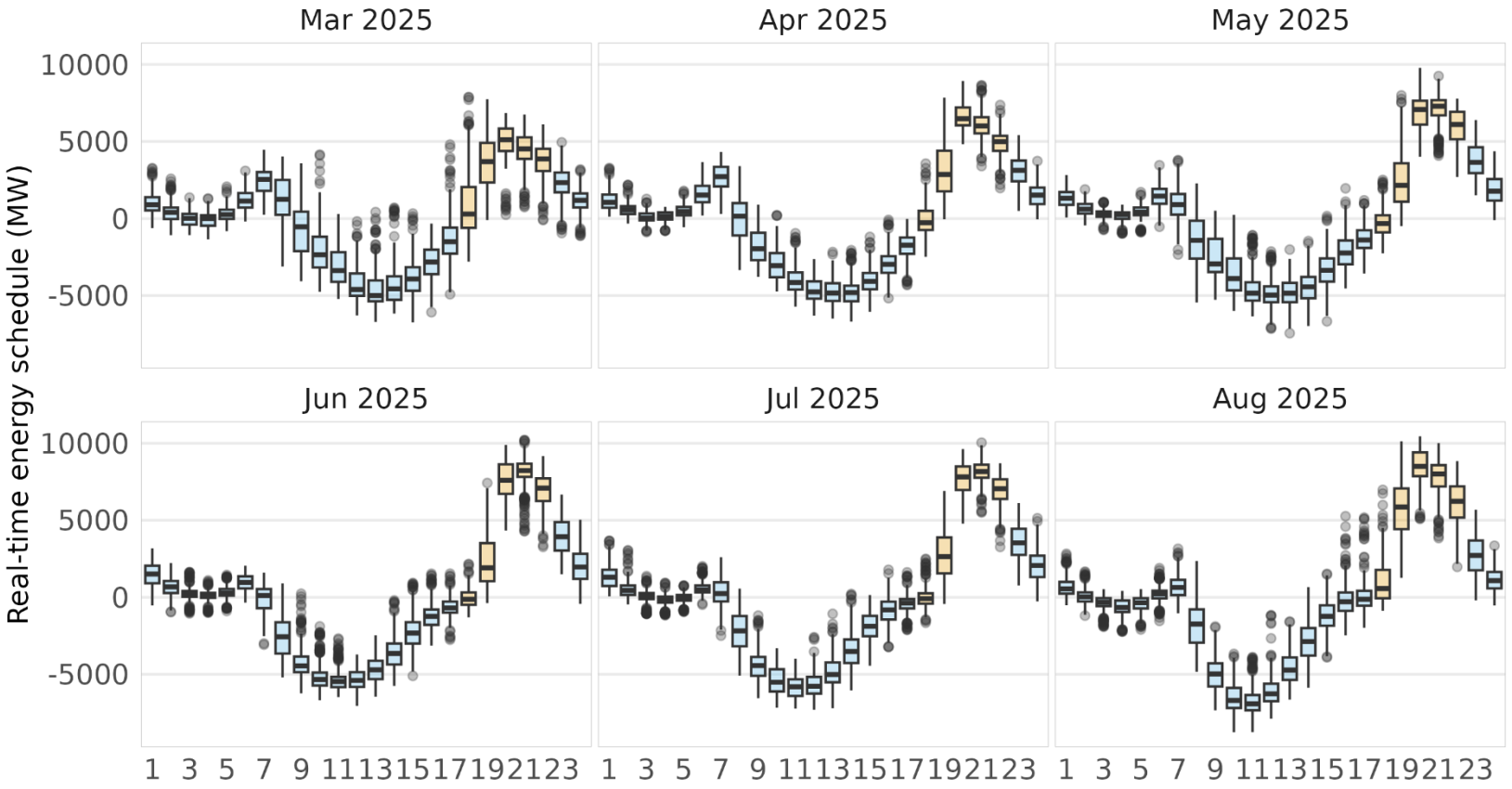
Real-Time State of charge for storage resources was in line with the day-ahead state of charge



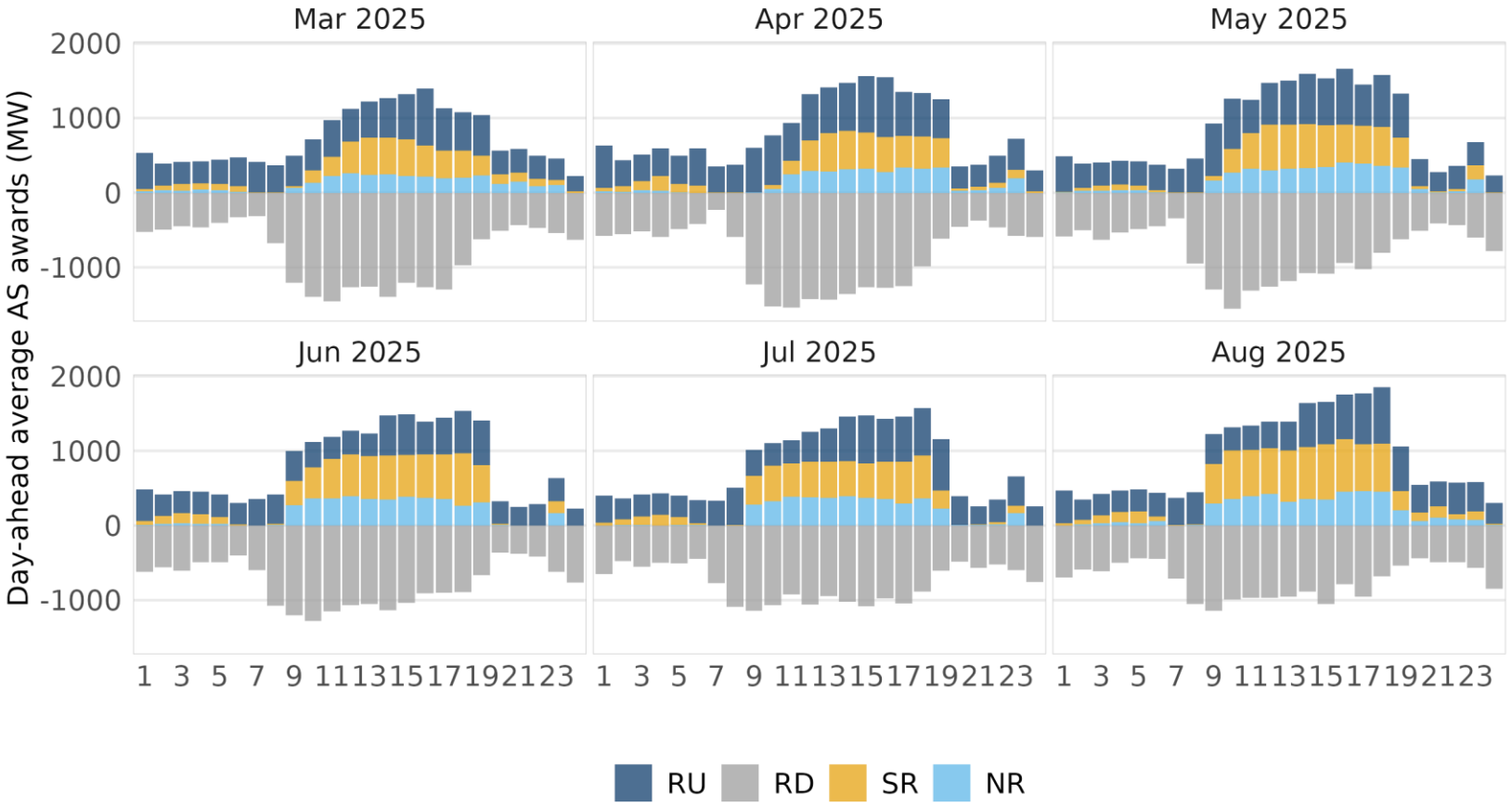
Storage resources were consistently charging during solar hours and discharging during net load peaks. Day-ahead



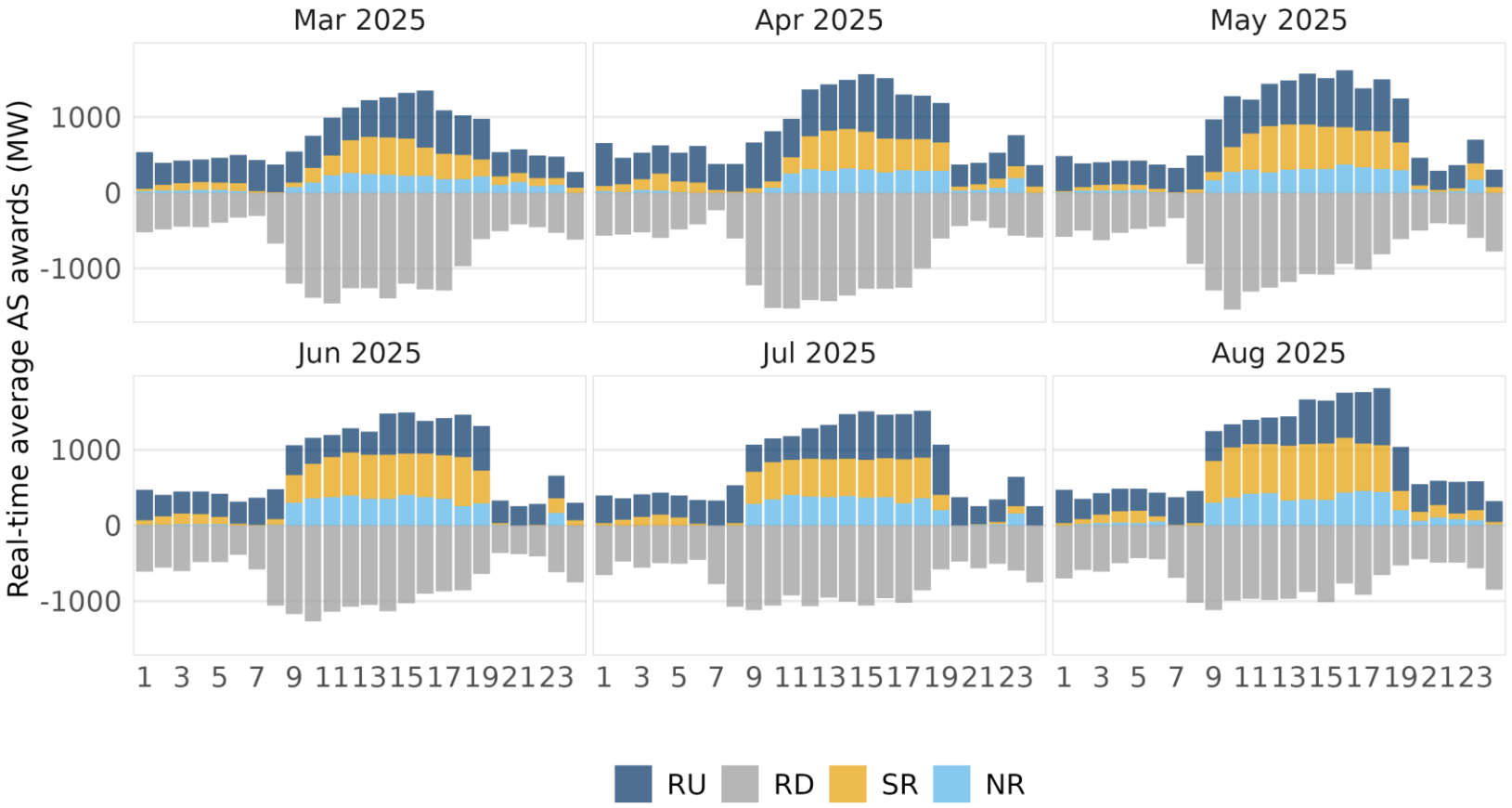
Storage resources were consistently charging during solar hours and discharging during net load peaks. Real-time



Storage resources procure mostly regulation while in recent months they have also increased the provision of Spinning reserves. Day-ahead

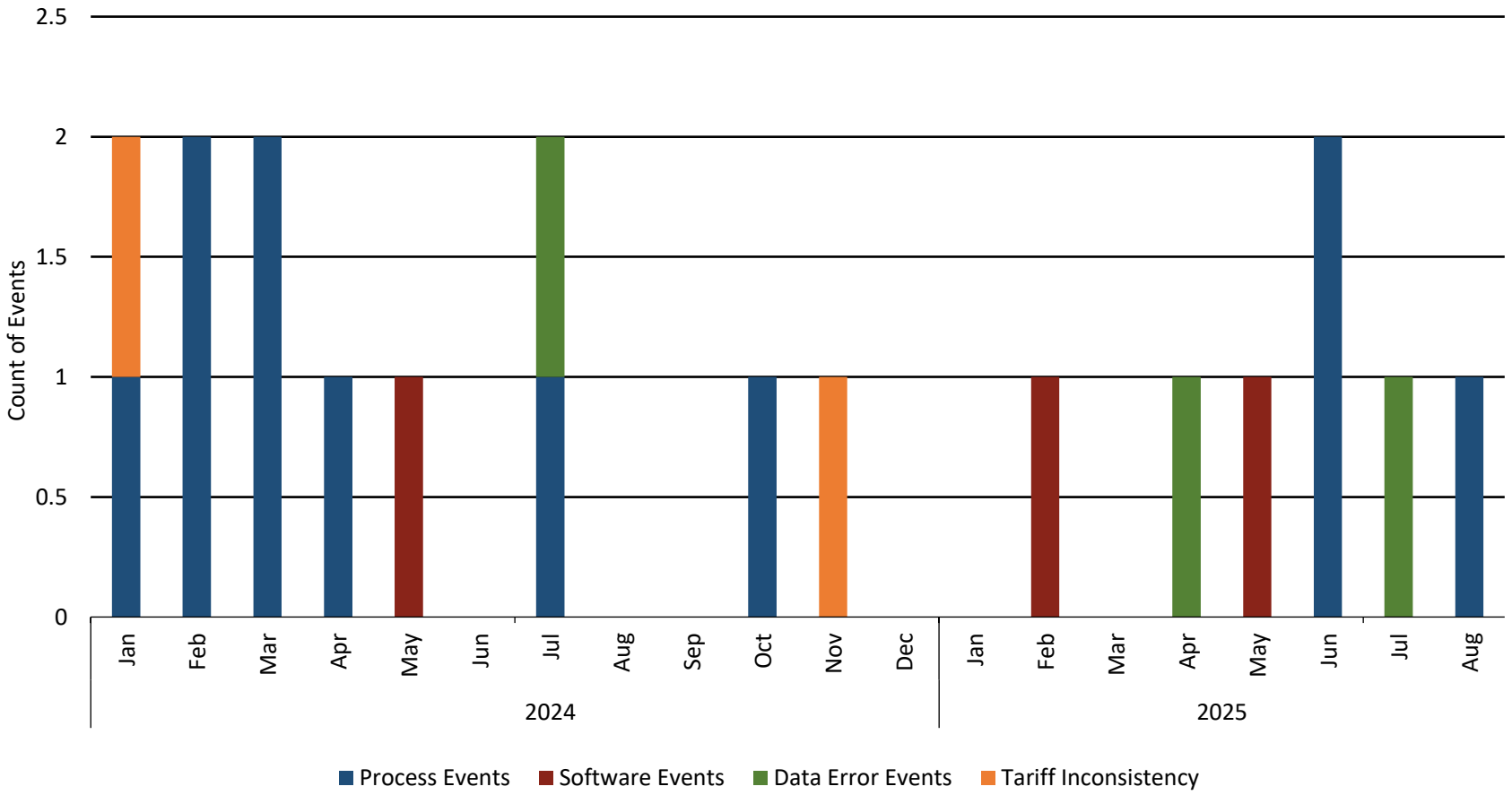


Storage resources procure mostly regulation while in recent months they have also increased the provision of Spinning reserves. Real-time

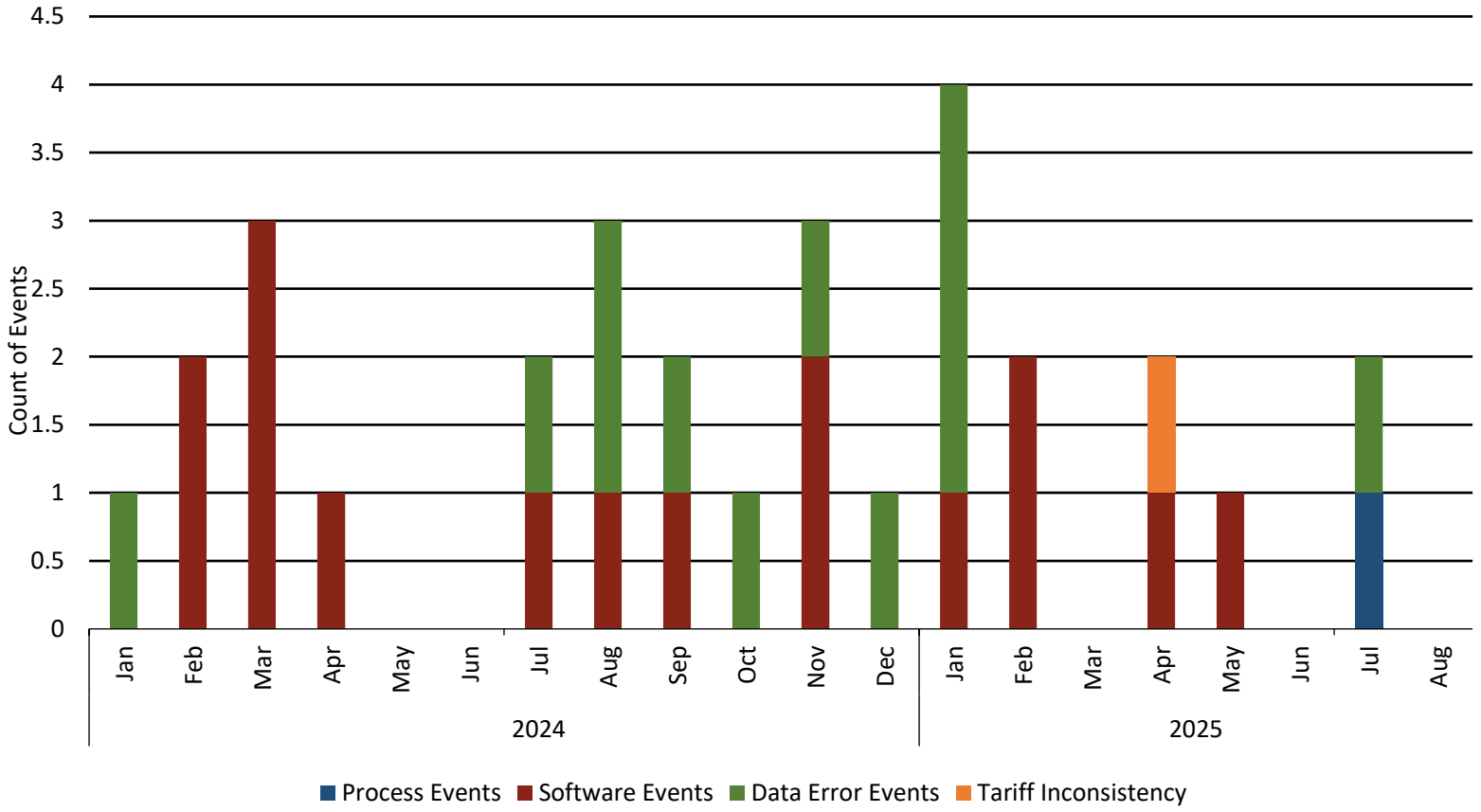


Price Corrections

CAISO price correction events remain low

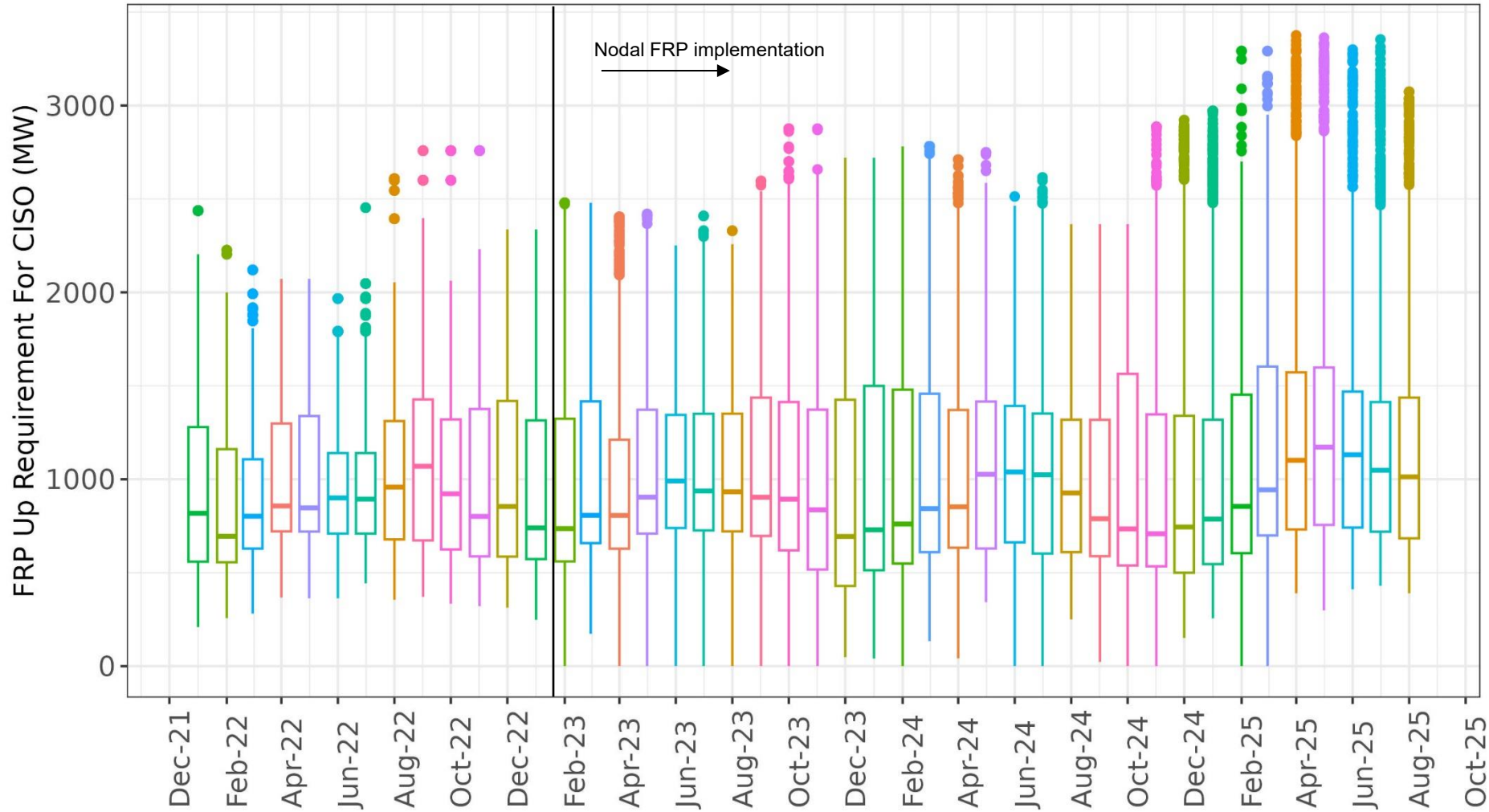


WEIM-related price correction events remain low

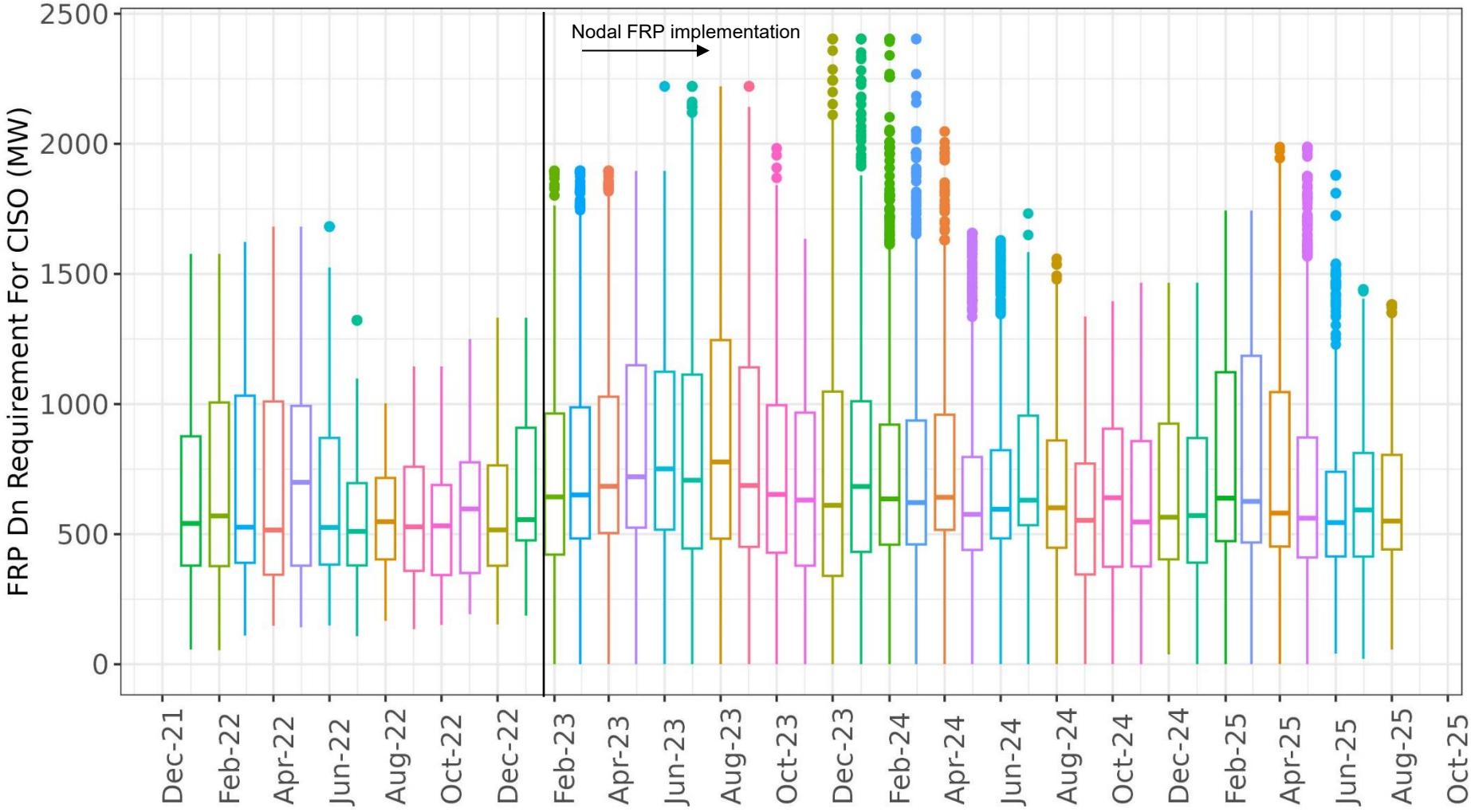


Flexible Ramping Product

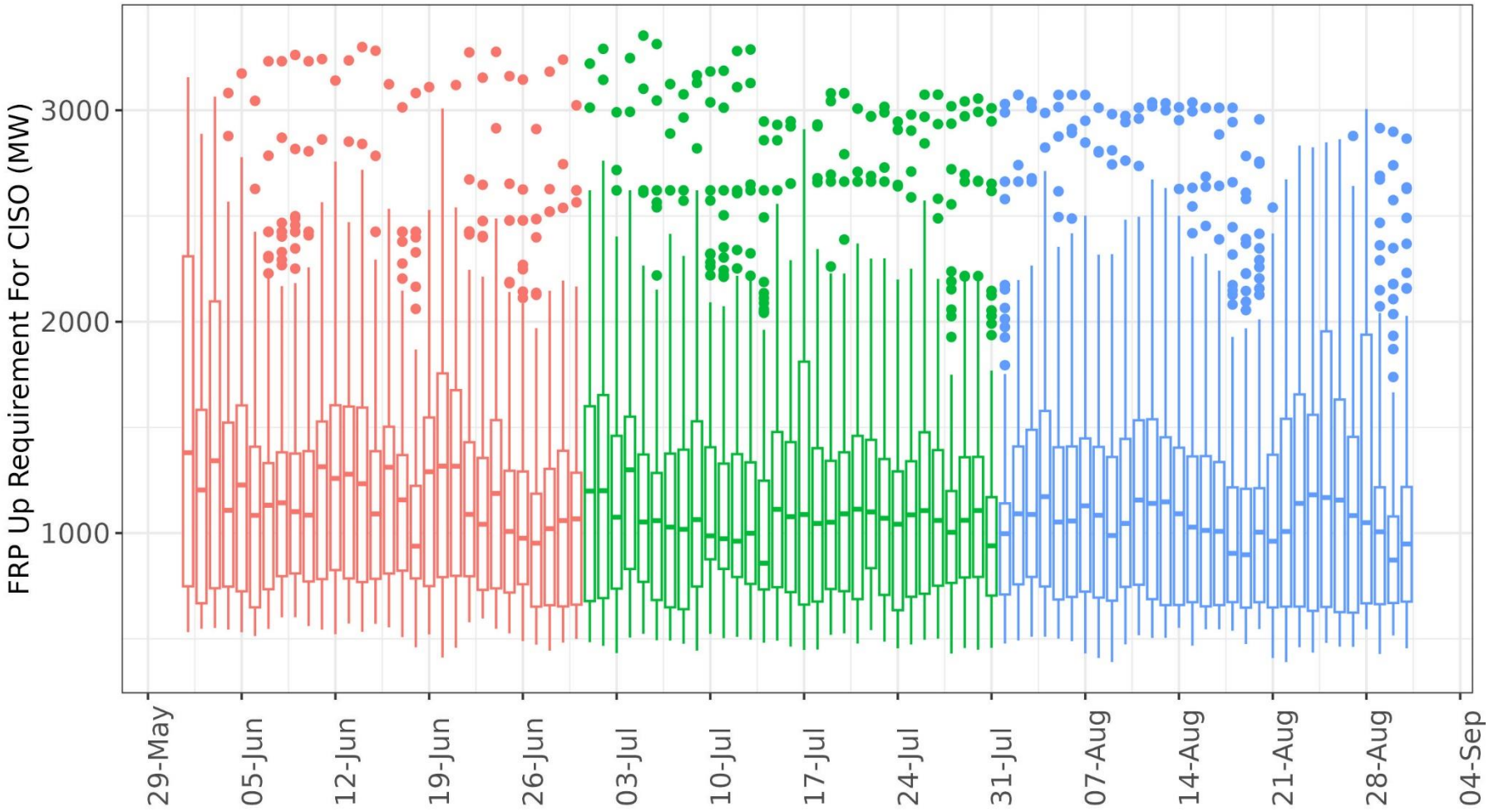
FRP Up Requirement for CAISO area remain within typical ranges but the number of outliers is increasing



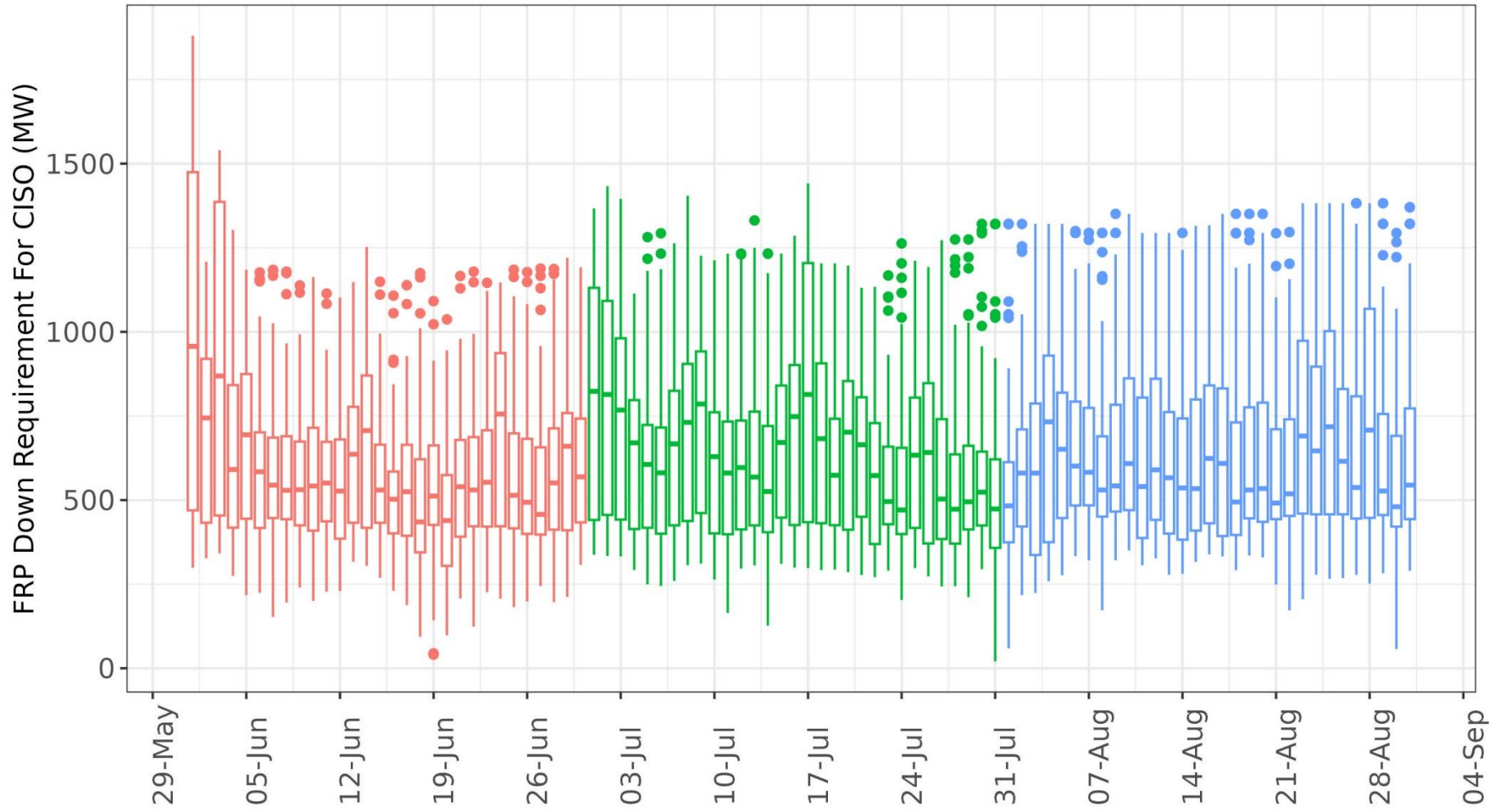
FRP Down Requirement for CAISO area remain within typical ranges



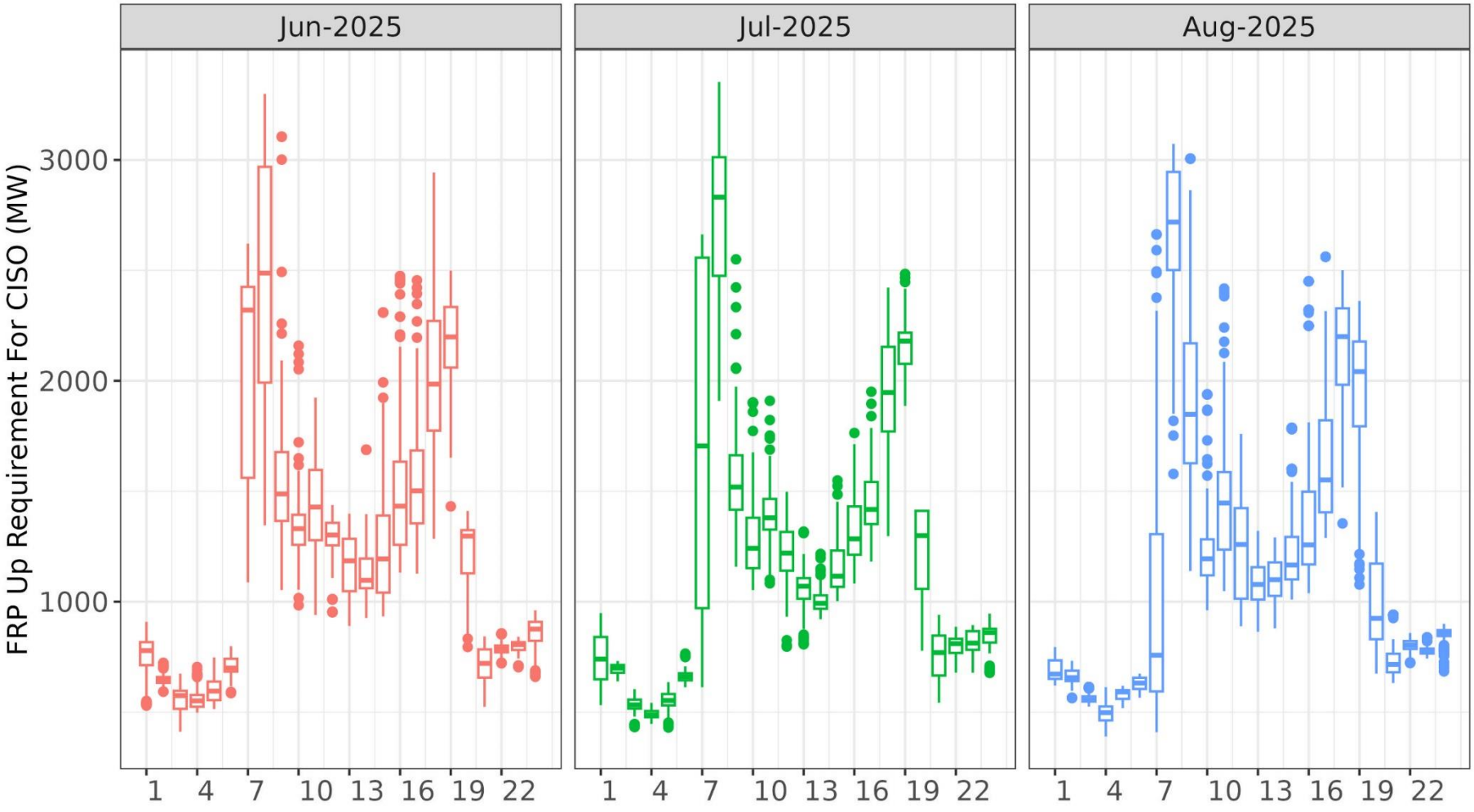
The daily distribution of FRP Up requirement in the last 3 months for CAISO area exhibits a steady trend



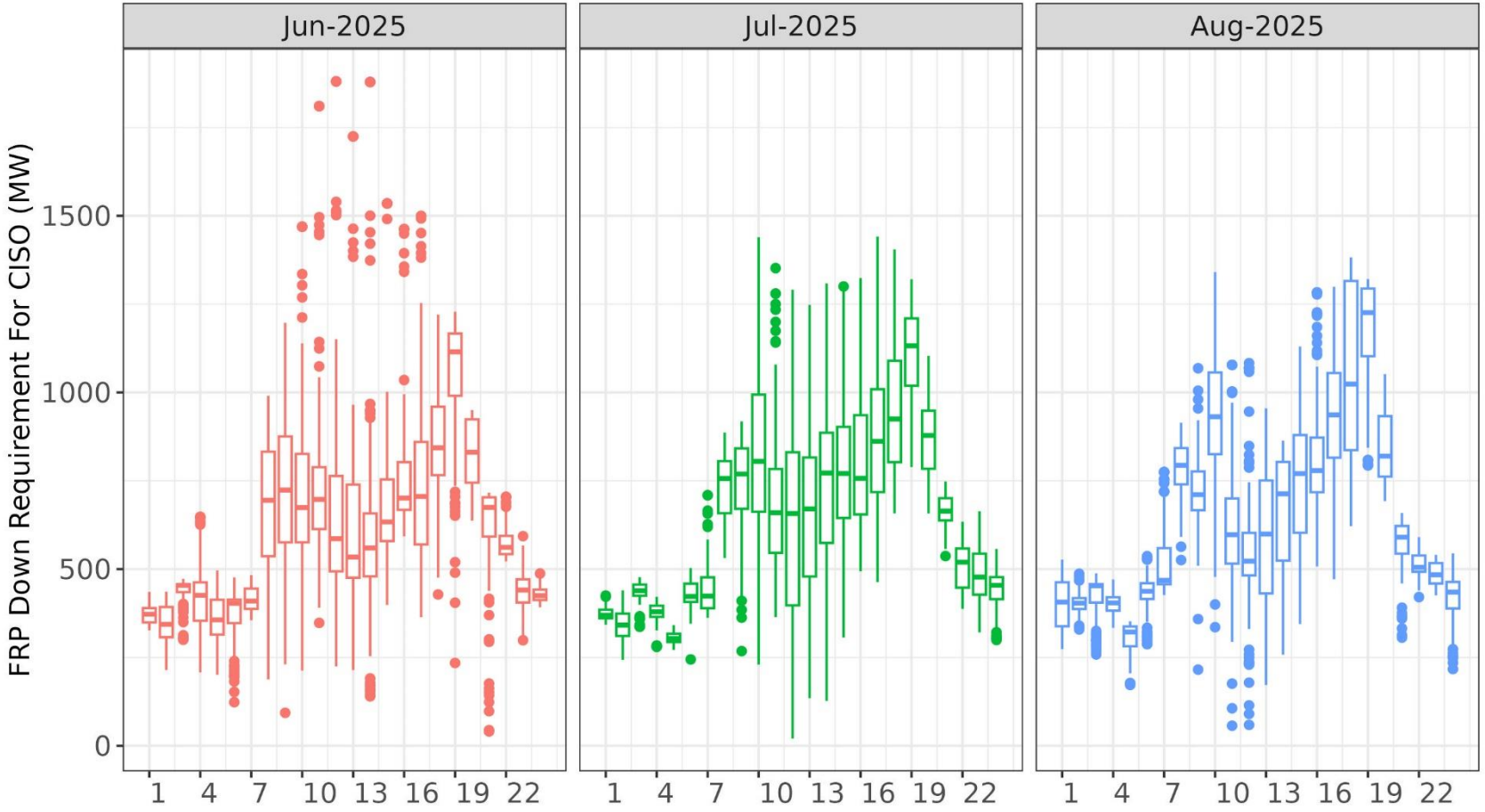
The daily distribution of FRP Down requirement in the last 3 months for CAISO area exhibits a steady trend



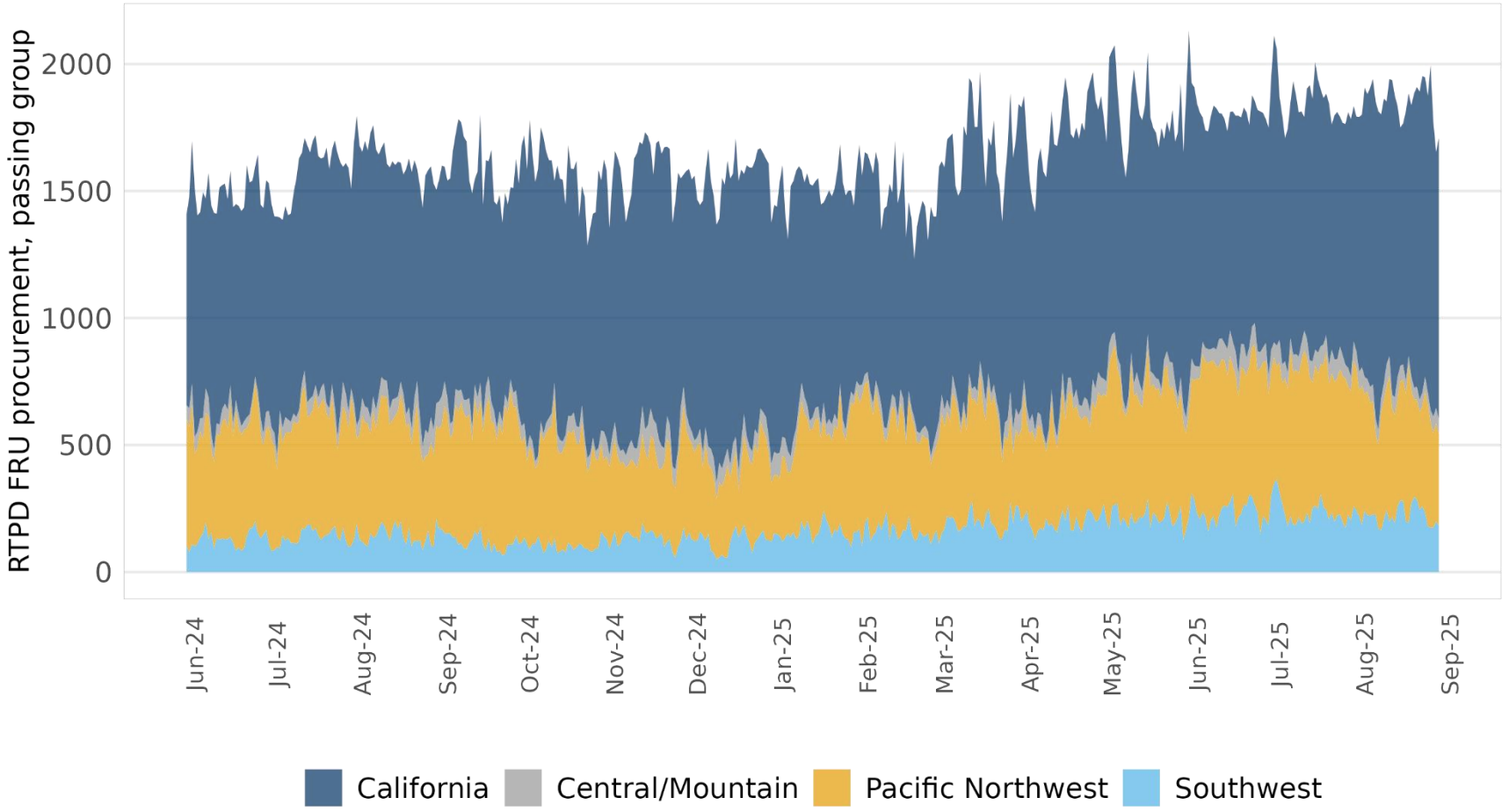
The hourly profile of upward FRP tends to follow a pattern of morning and evening peaks



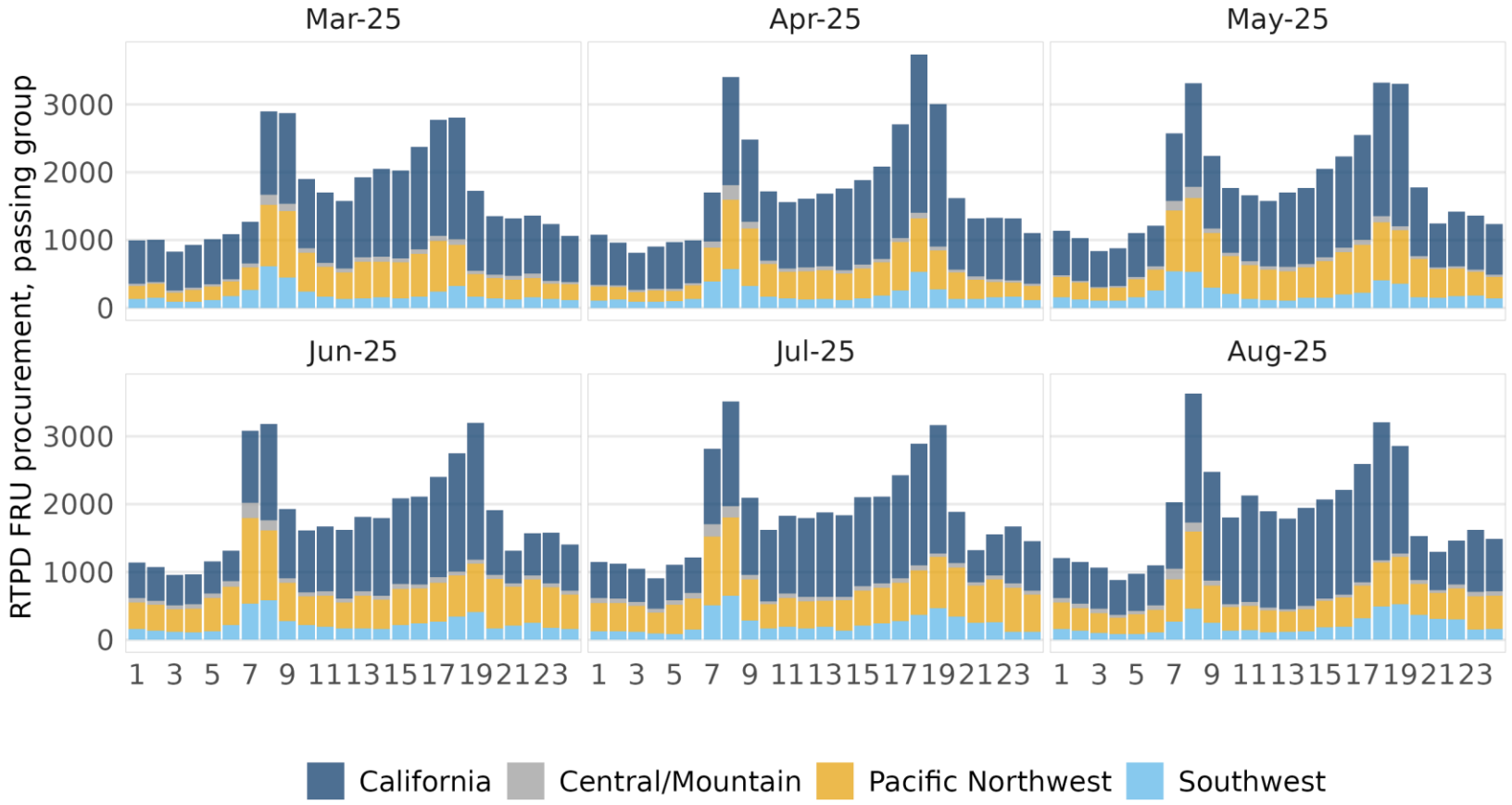
The hourly profile of downward FRP tends to follow a complementary pattern to the upward FRP, with higher values in midday hours



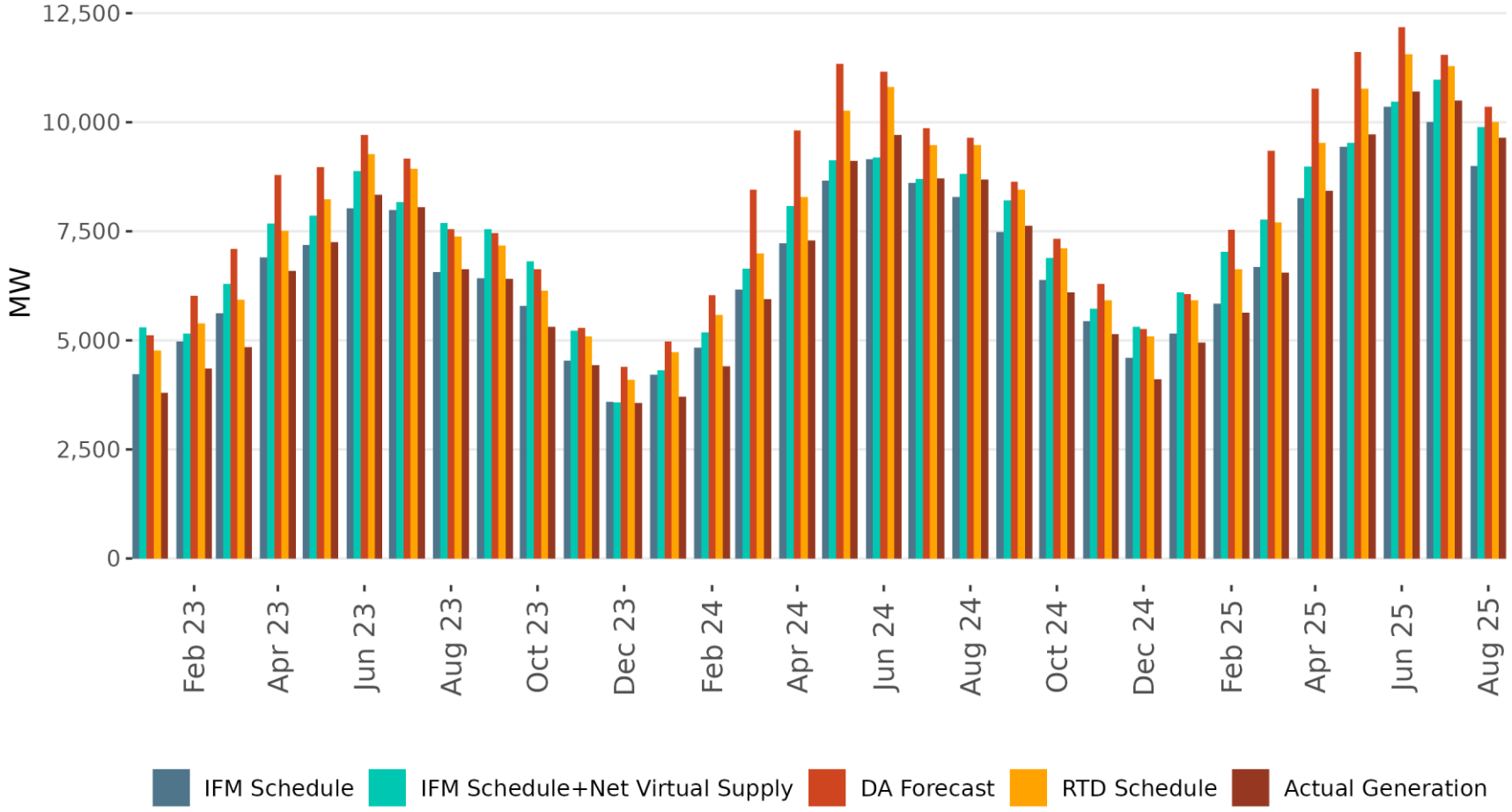
Upward FRP is largely procured from areas in the Pacific Northwest and California



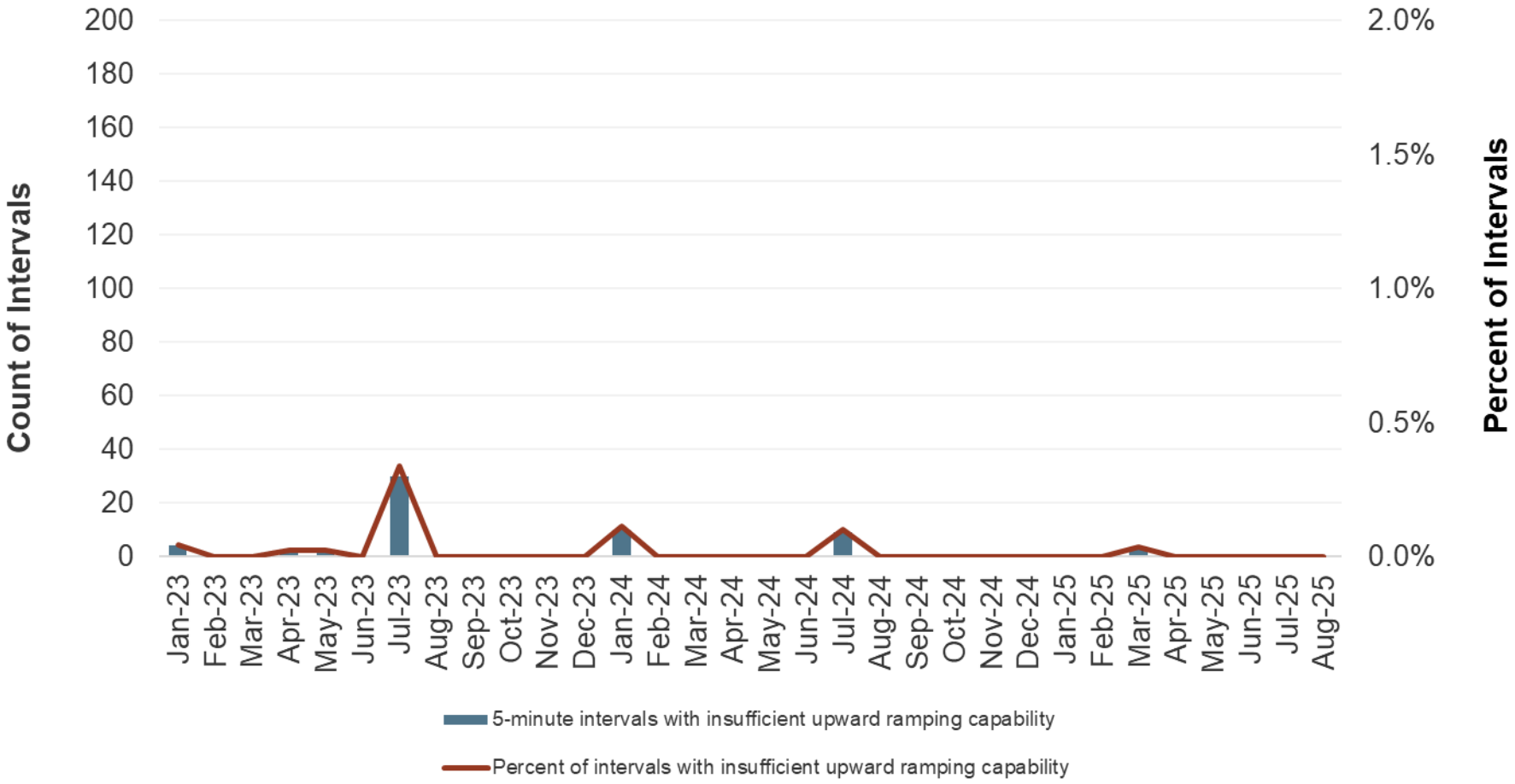
Upward FRP procurement from CAISO area is largely occurring in the peak hours



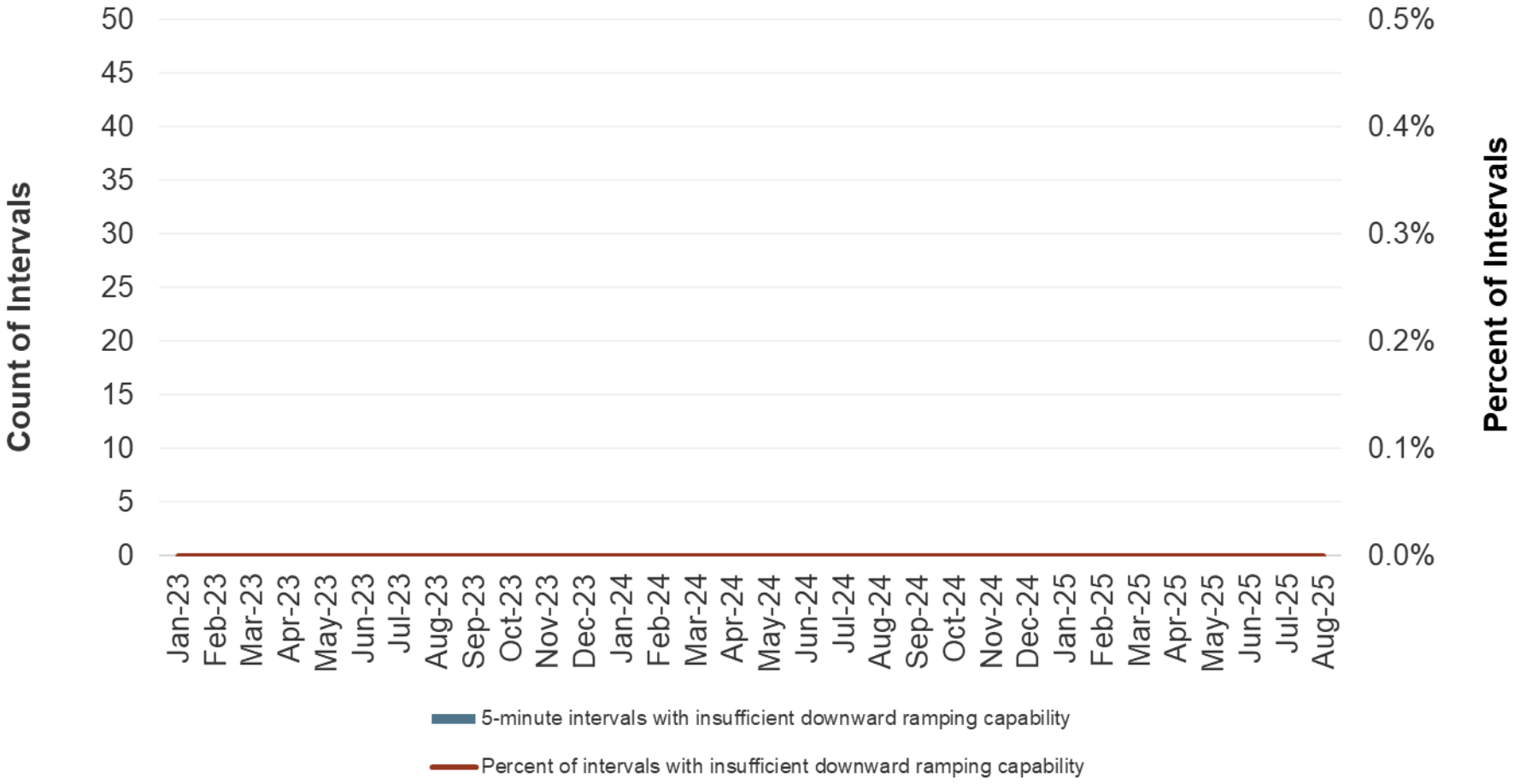
ISO total monthly VERS schedules and forecasts compared to actuals



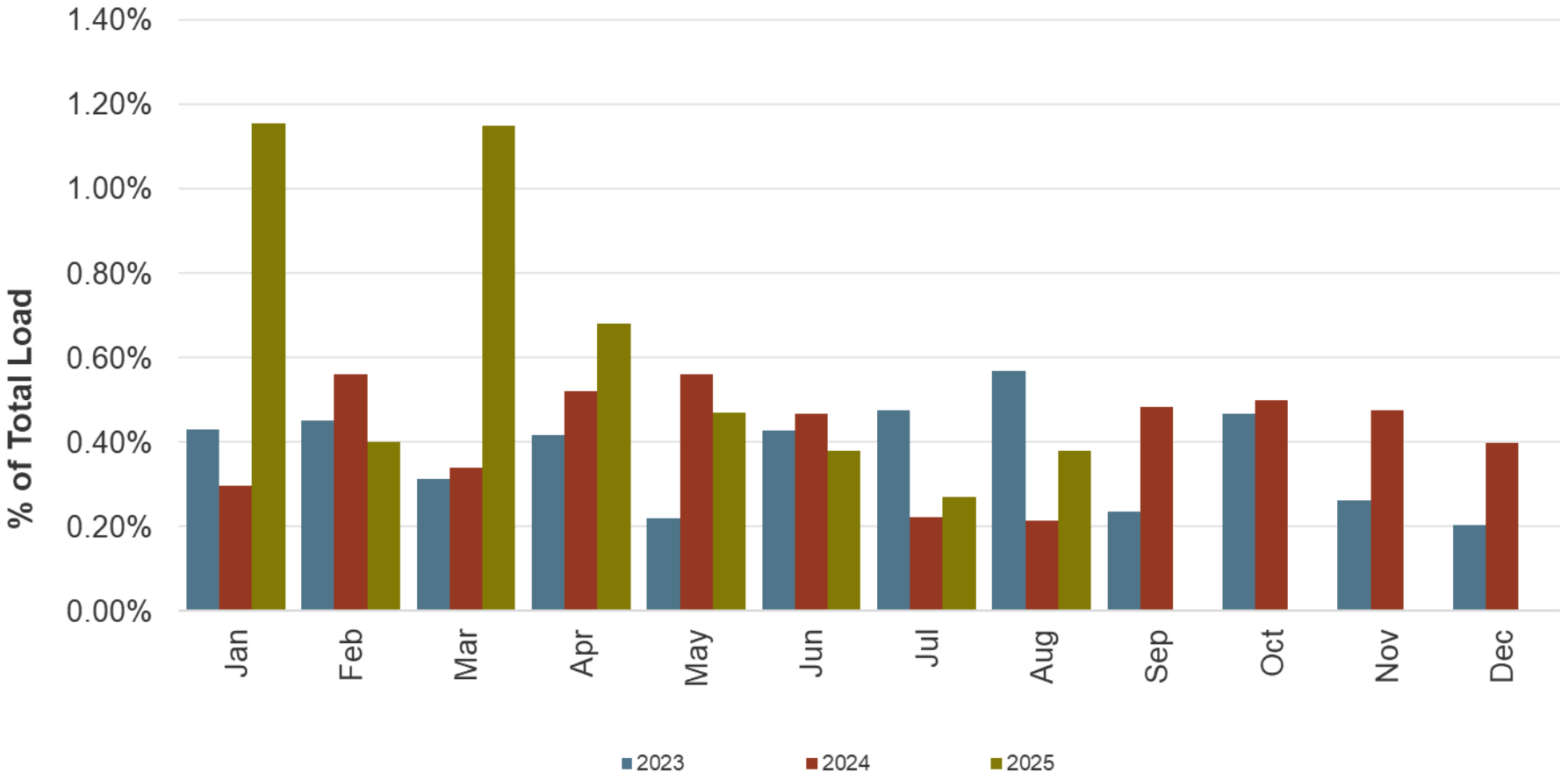
Insufficient upward ramping capacity in ISO real-time stayed at low levels



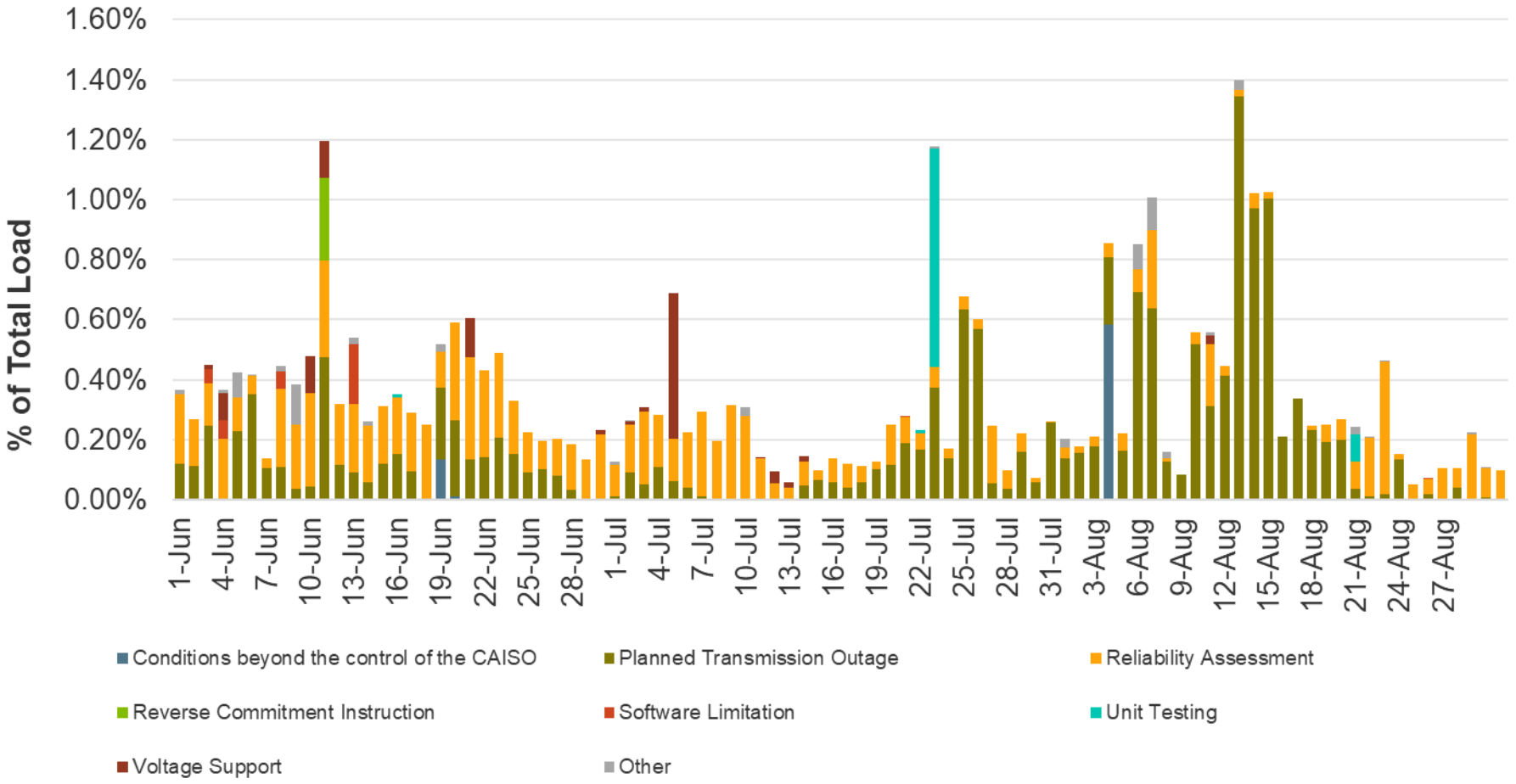
Insufficient downward ramping capacity in real-time remained low



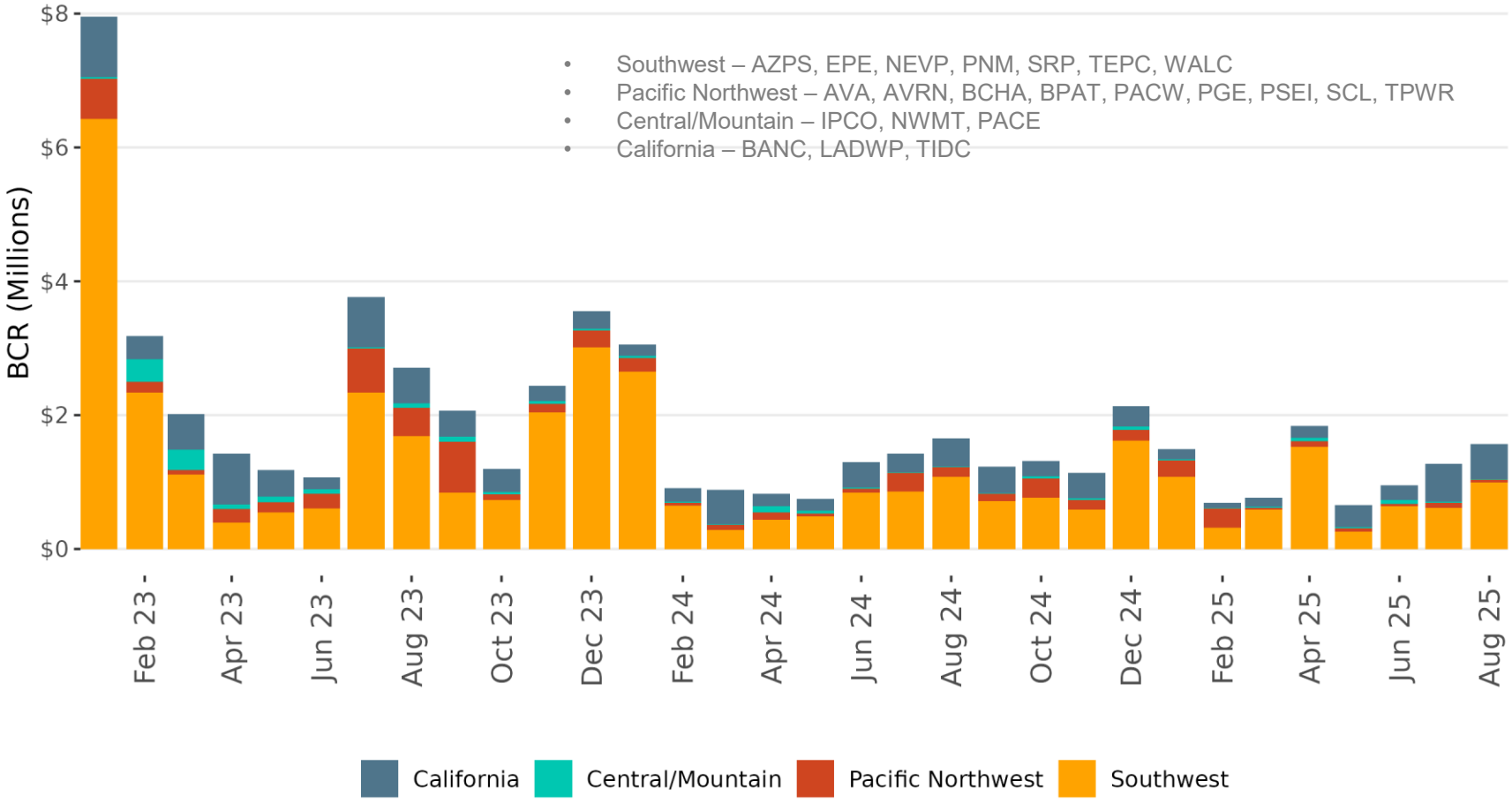
Exceptional dispatch volume in the ISO area this Summer was in line with recent years



Exceptional dispatches volume is driven by a variety of reasons



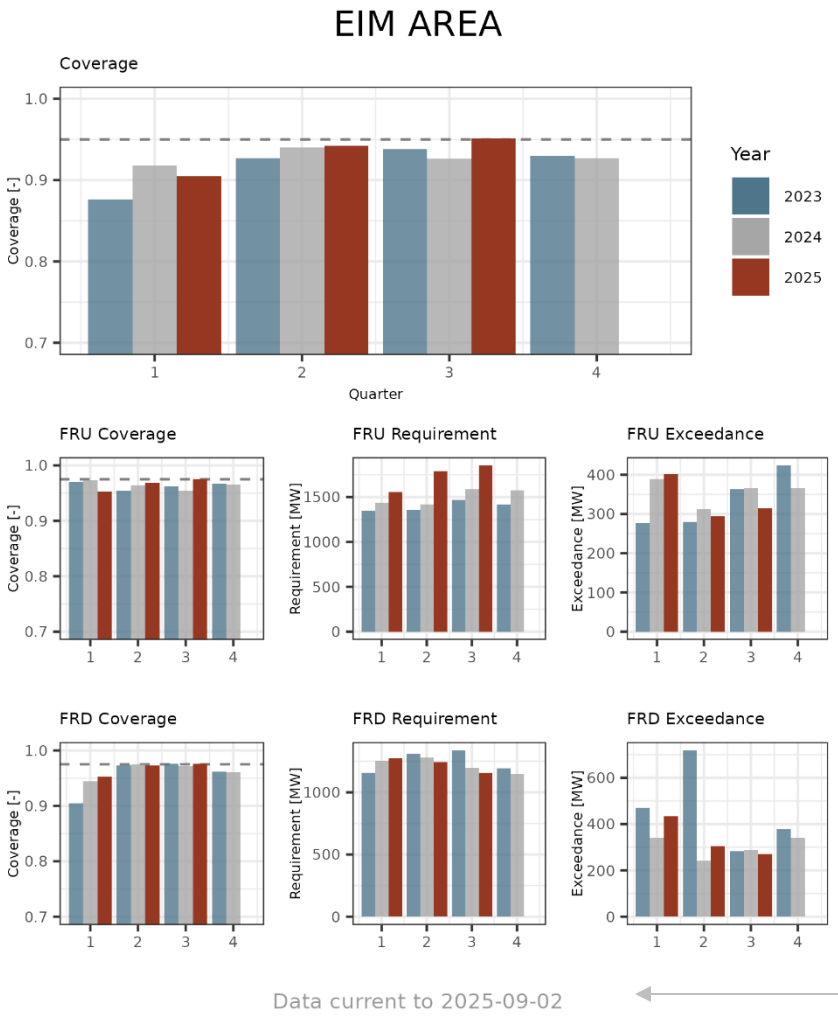
Southwest WEIM entities has accrued about 67 percent of total Bid Cost Recovery to all WEIM entities



* Does not include CAISO

FRP Requirements

Supporting slide for interpreting uncertainty plots



An overview of coverage, requirement, and exceedance are reported per BAA.

Overall coverage evaluates the percentage of intervals where net demand uncertainty fell between FRU and FRD.

Statistics for RTPD FRP are reported. Target lines for coverage are added.

Goal:

- Obtain coverage near target
- Keep requirement magnitudes comparable to observed net demand uncertainty
- Decrease average exceedance

FRP quarters are defined by calendar month. Quarter 1 is Jan – Mar, Quarter 2 is Apr – Jun, etc.

Caption notes the latest trade date included in the current quarter evaluation as MPPF slides are prepared prior to the end of the quarter.

Uncertainty metric definitions

x_i is observed uncertainty for interval i

Observed uncertainty is the net demand forecast to forecast difference.

Coverage captures the percentage of time when uncertainty falls within the requirement range.

$$\text{coverage} = \frac{1}{N}\sum_{i=1}^{N}(\text{FRD} \le x \le \text{FRU})_i$$

$$\text{FRU coverage} = \frac{1}{N}\sum_{i=1}^{N}(x \le \text{FRU})_i$$

$$\text{FRD coverage} = \frac{1}{N}\sum_{i=1}^{N}(x \ge \text{FRD})_i$$

$$\text{FRU requirement} = \frac{1}{N}\sum_{i=1}^{N}(\text{FRU})_i$$

$$\text{FRD requirement} = \frac{1}{N}\sum_{i=1}^{N}(\text{FRD})_i$$

Requirement captures average directional requirement MW value.

Exceedance captures average MW value that observed uncertainty exceeds the directional requirement.

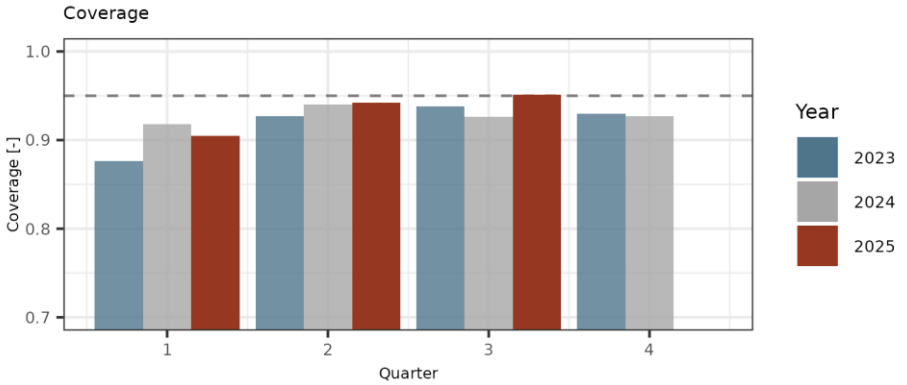
$$\text{FRU exceedance} = \frac{1}{M}\sum_{j=1}^{M}(x - \text{FRU})_j,$$

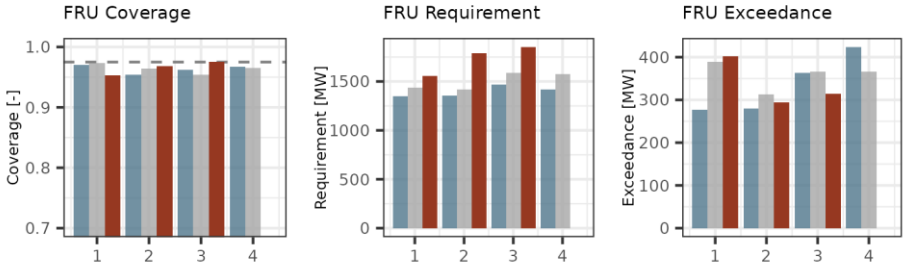
for interval j where $x_j > \text{FRU}$

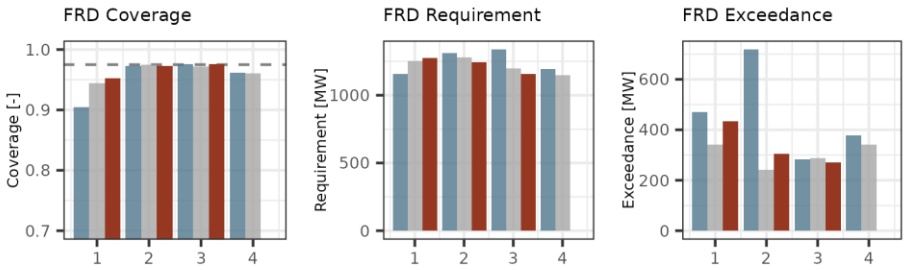
$$\text{FRD exceedance} = \frac{1}{M}\sum_{j=1}^{M}(x - \text{FRD})_j,$$

for interval j where $x_j < \text{FRD}$

EIM AREA







Data current to 2025-09-02

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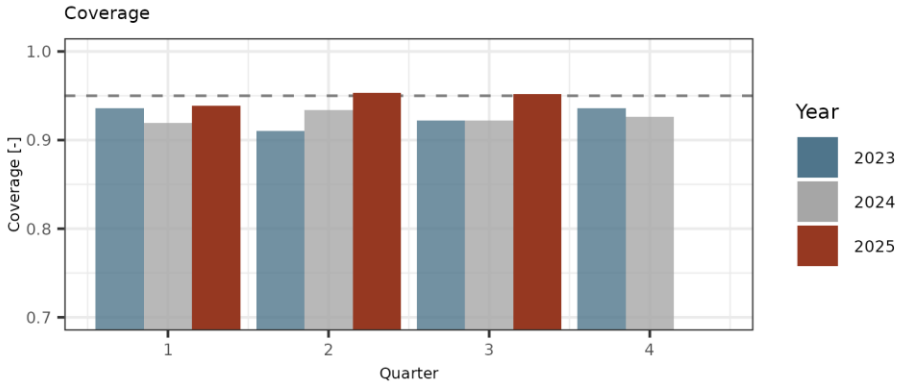

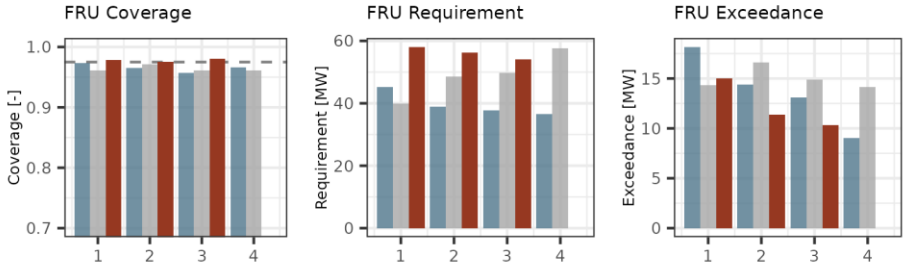

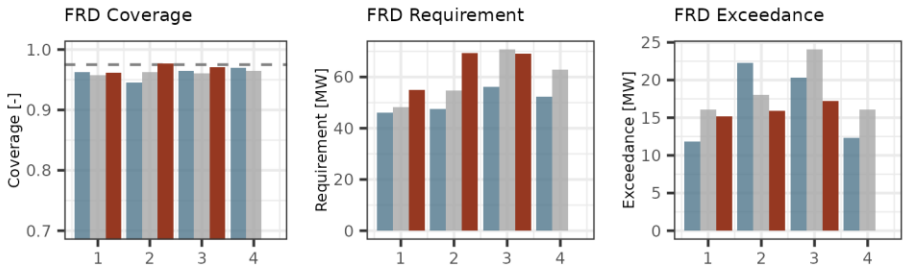

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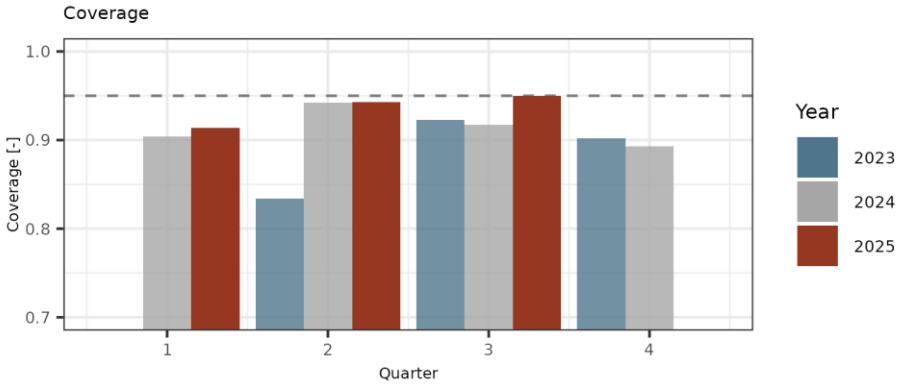

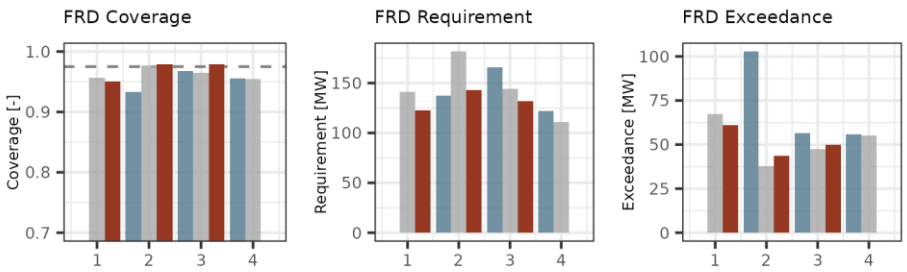

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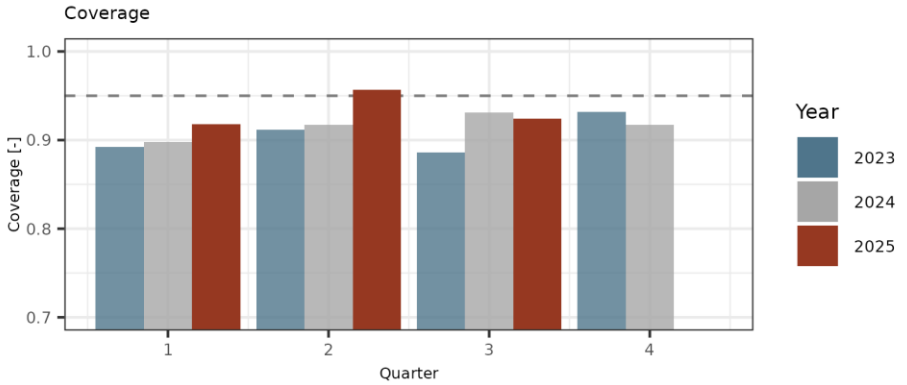

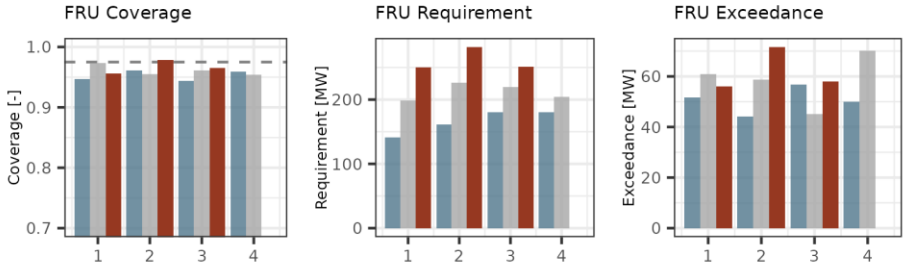

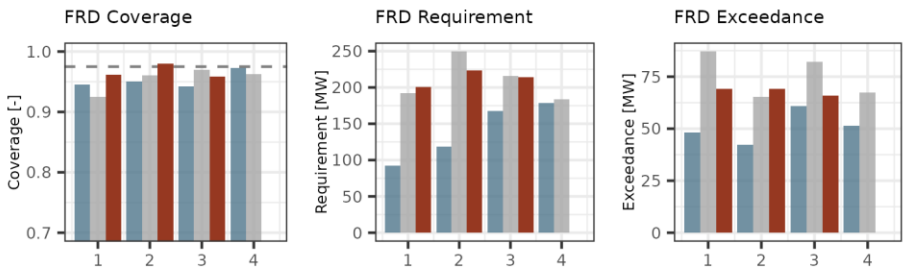

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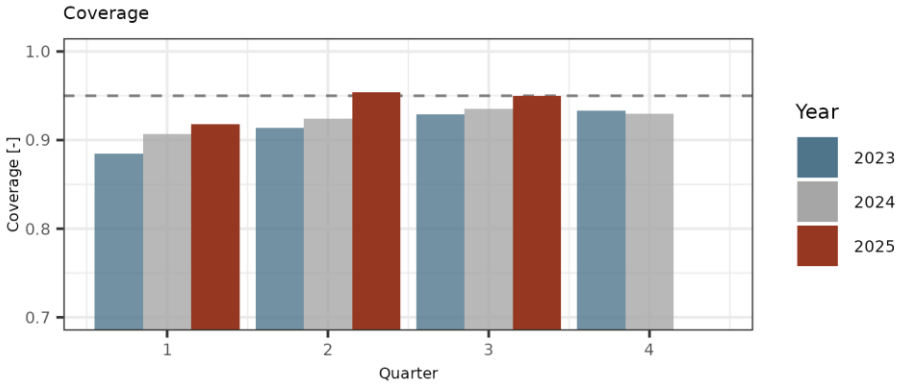

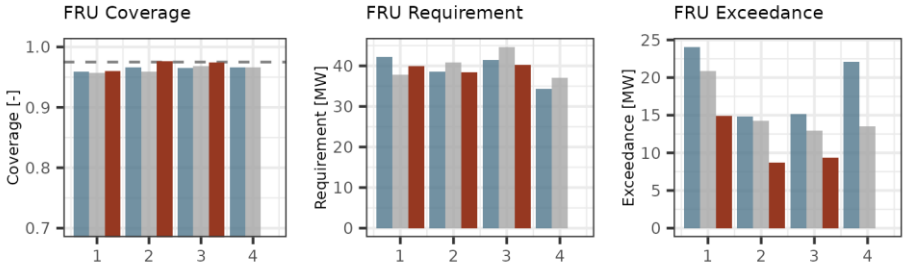

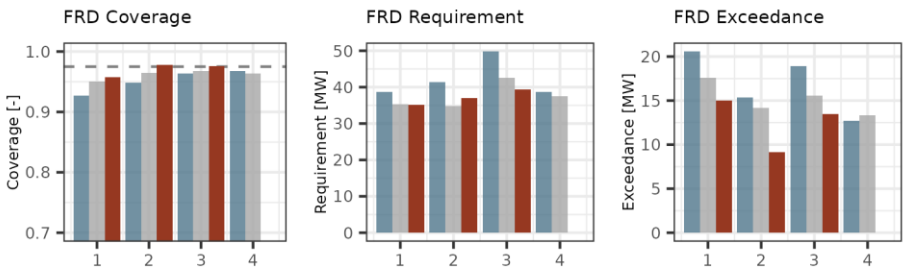

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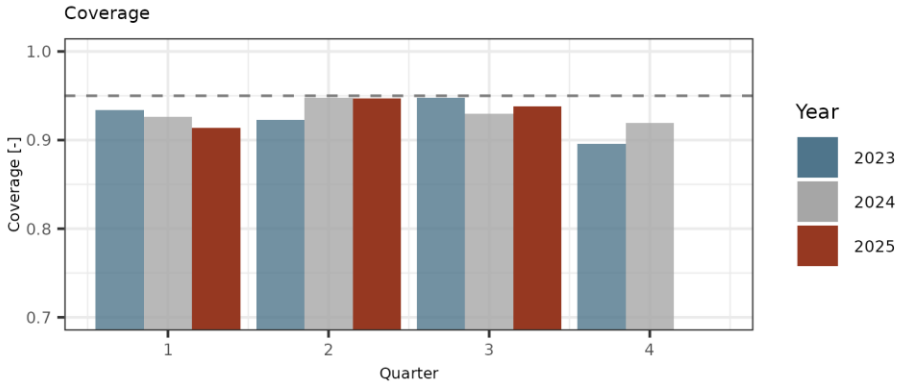

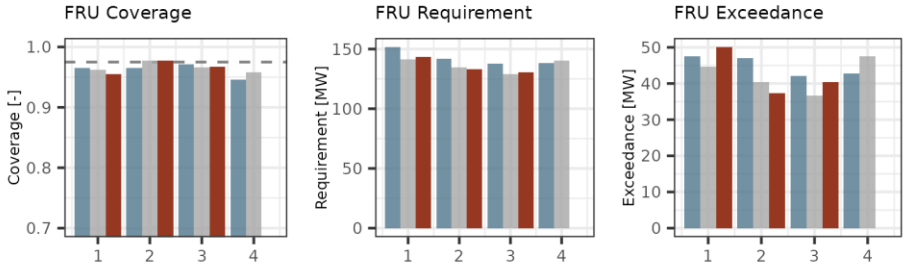

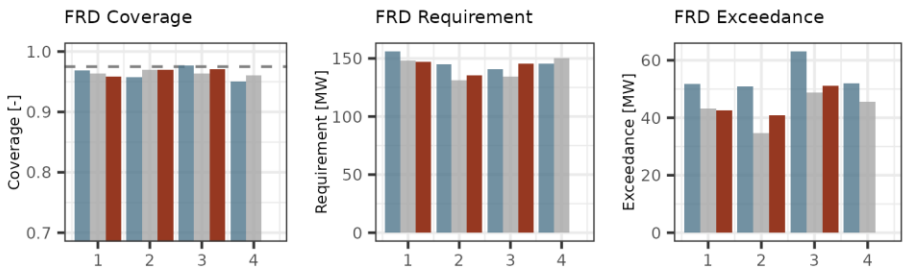

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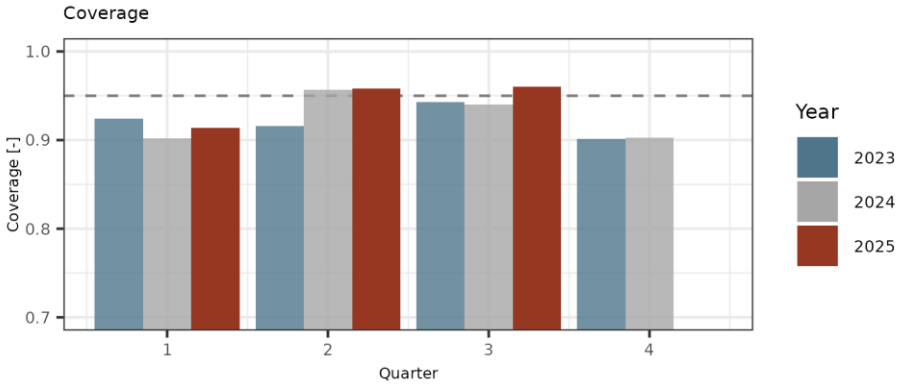

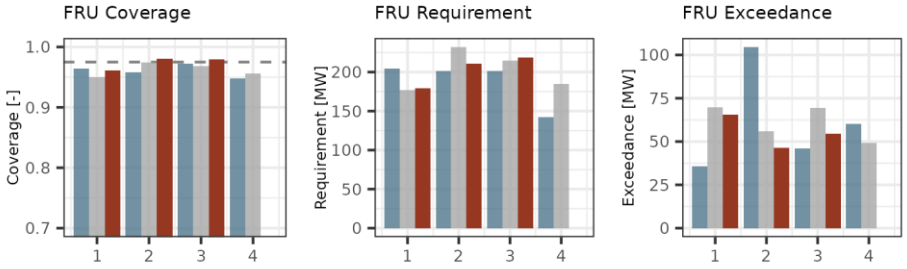

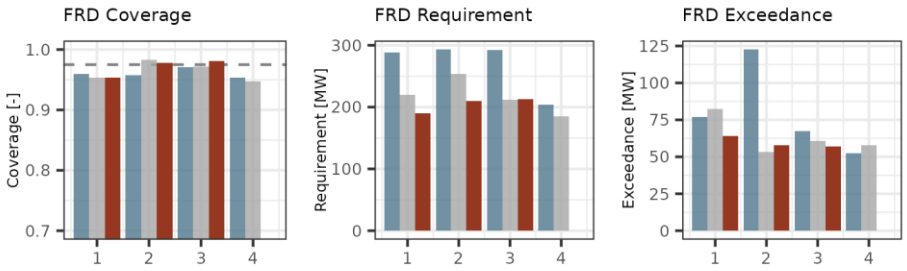

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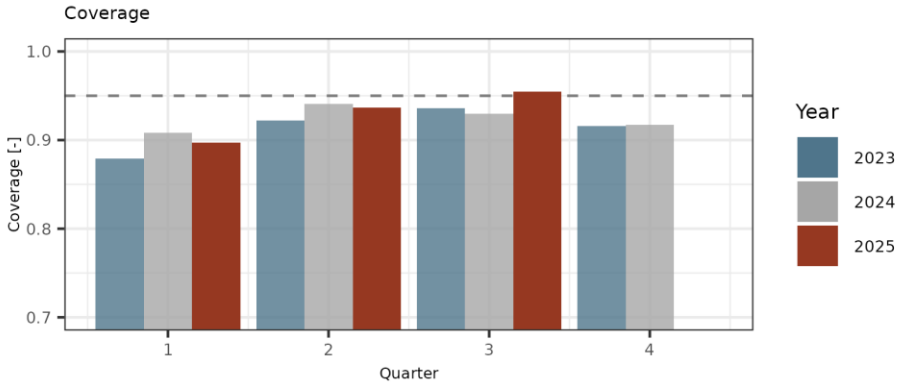

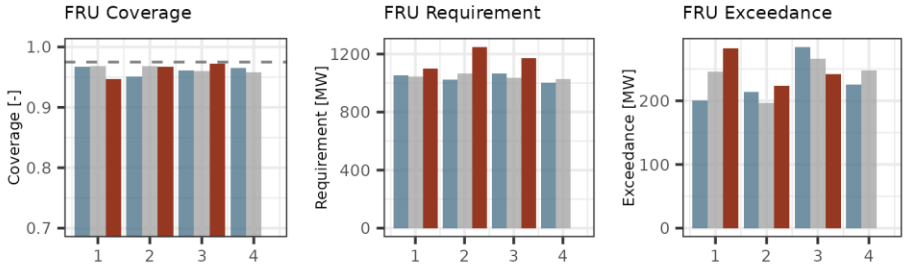

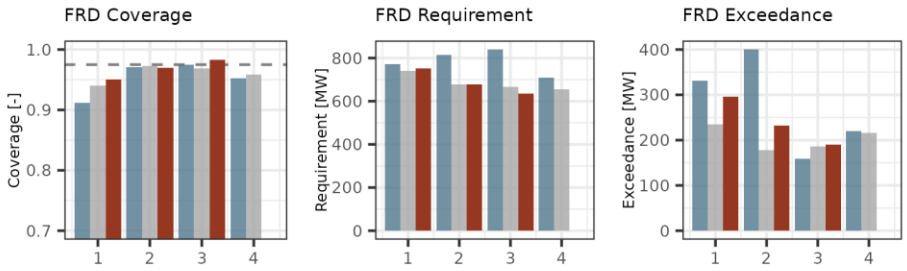

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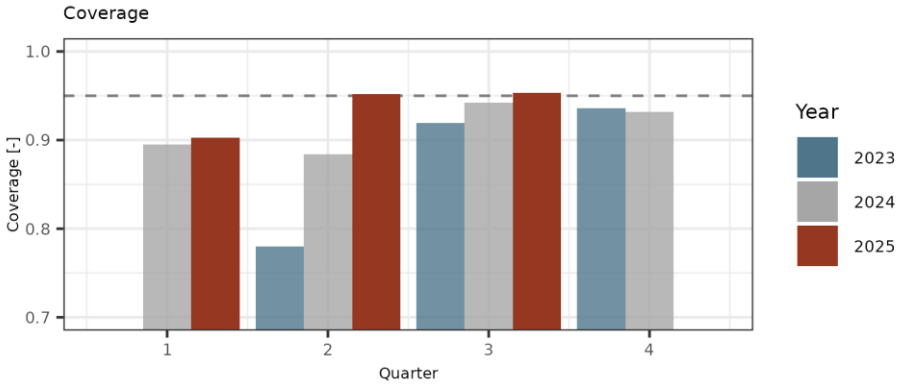

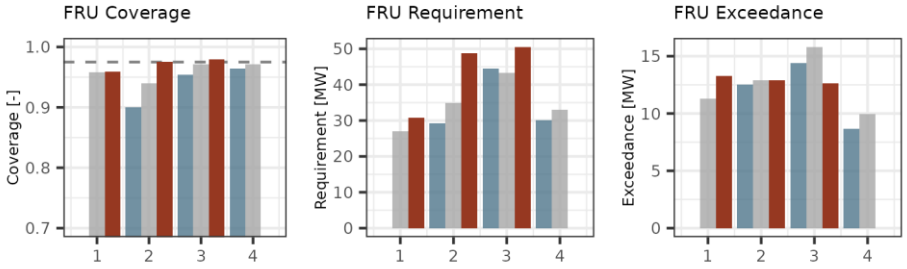

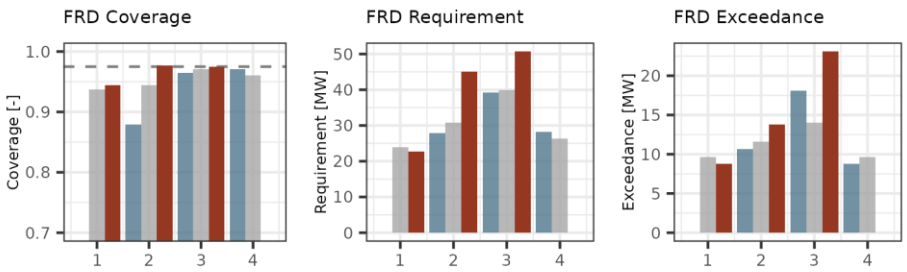

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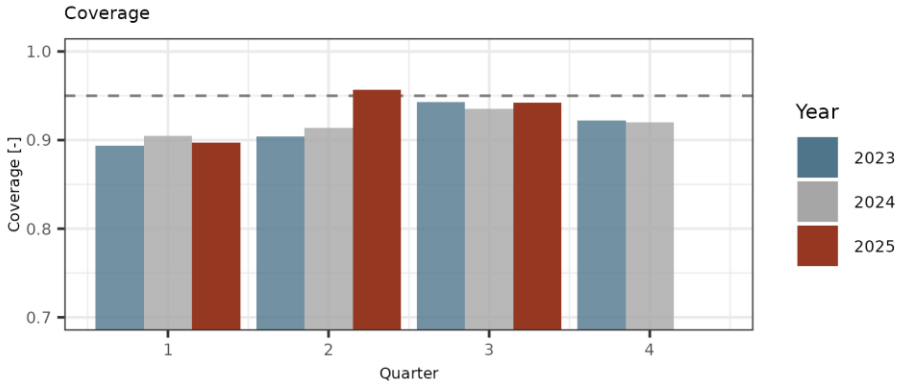

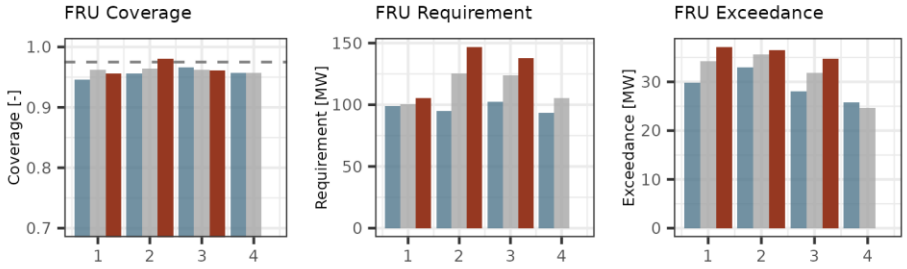

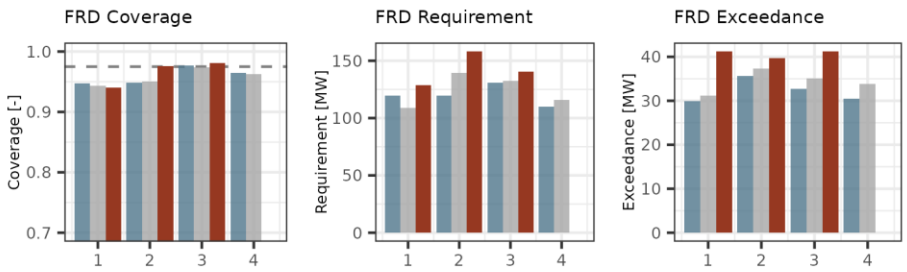

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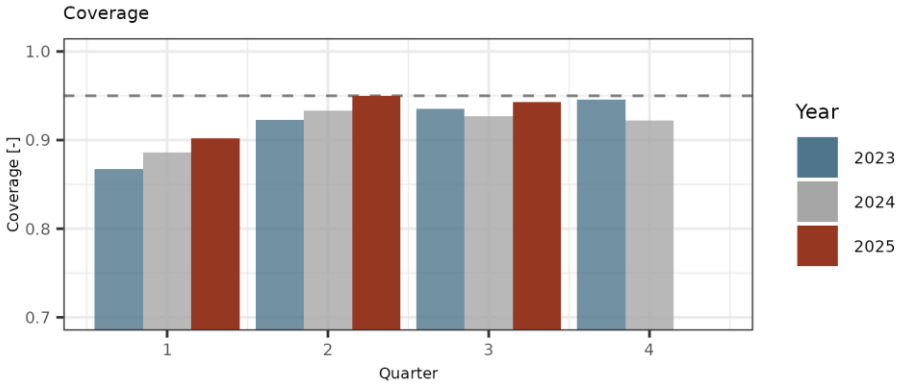
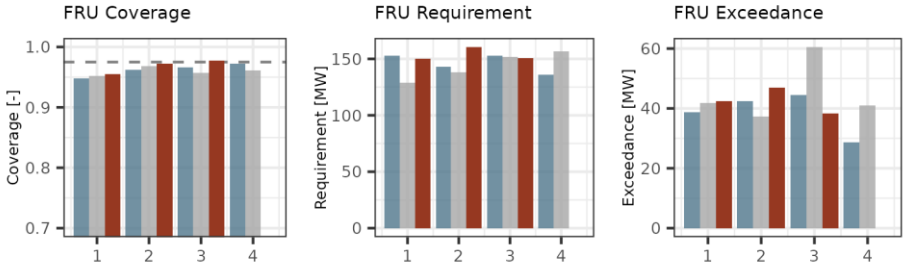
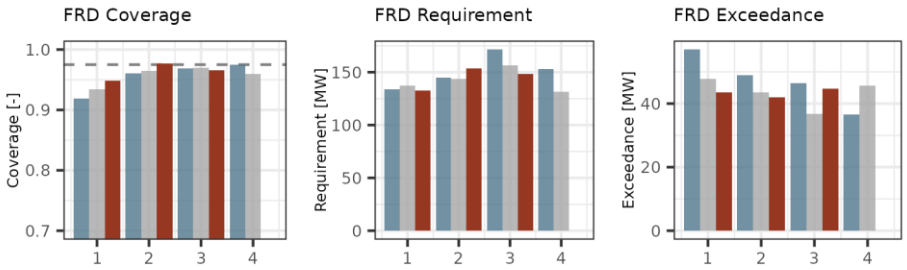
LADWP







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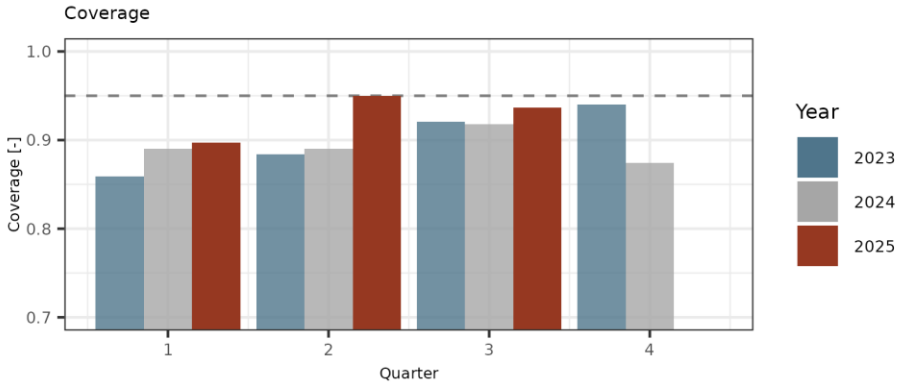

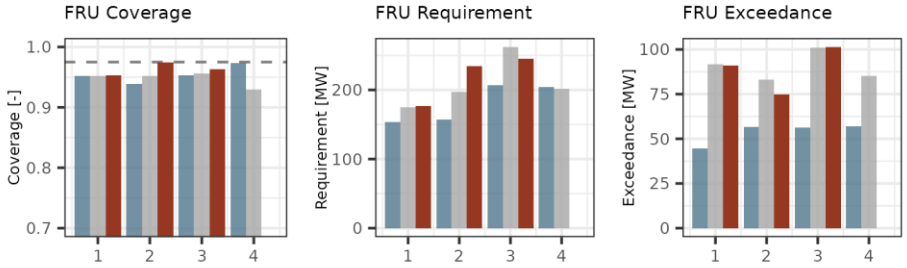

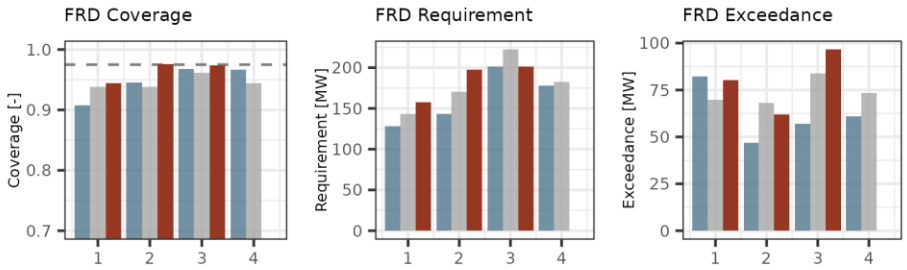

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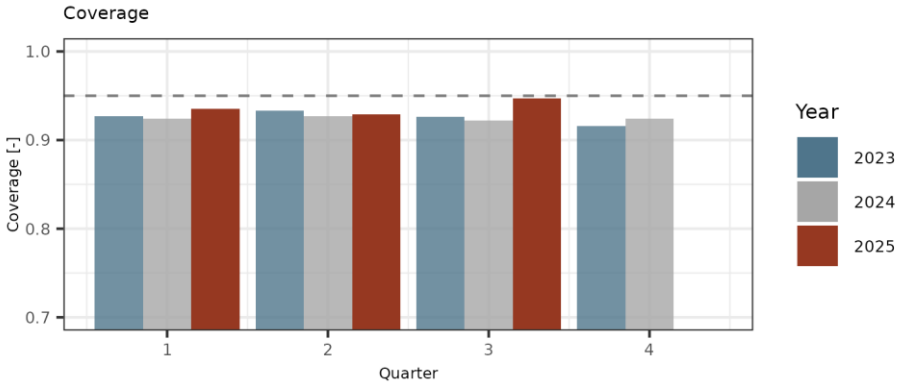

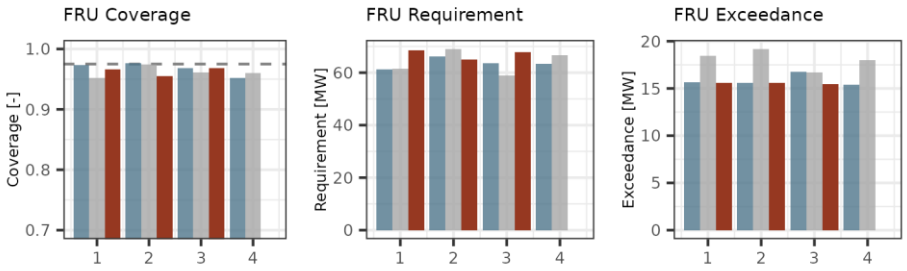

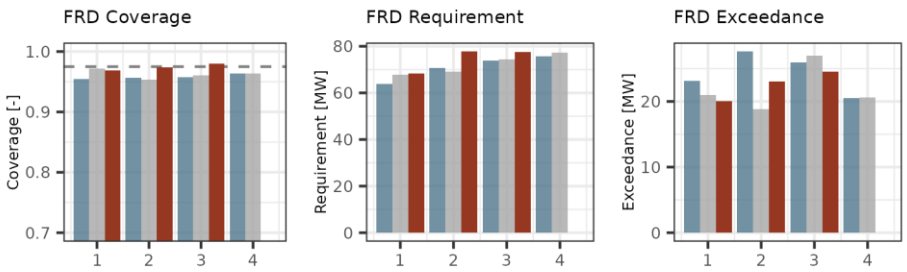

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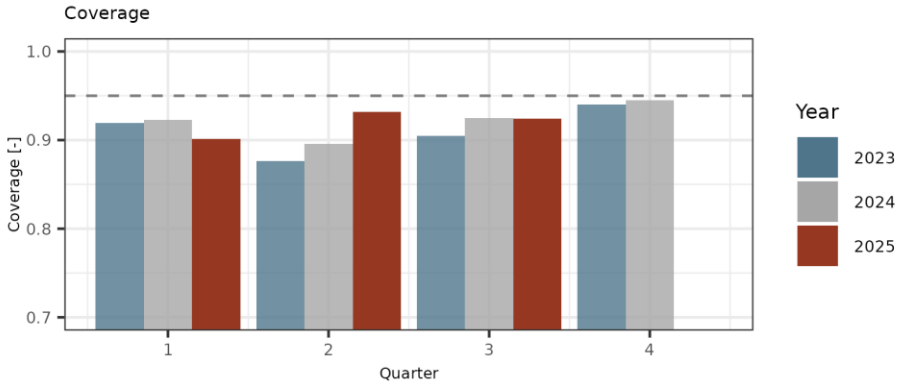

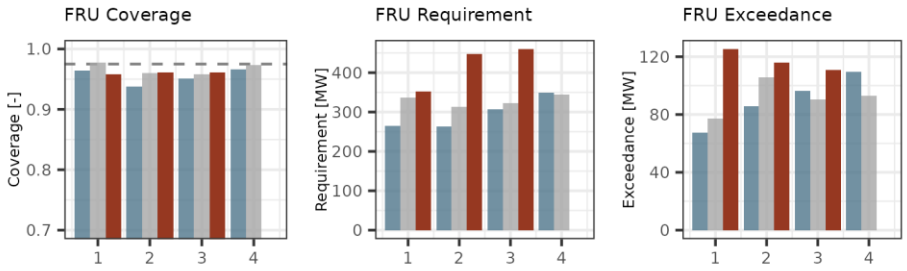

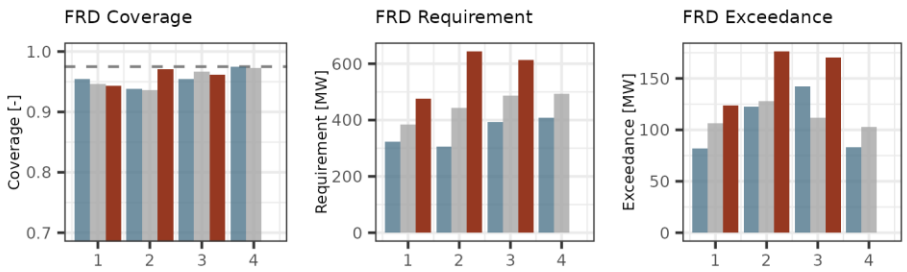

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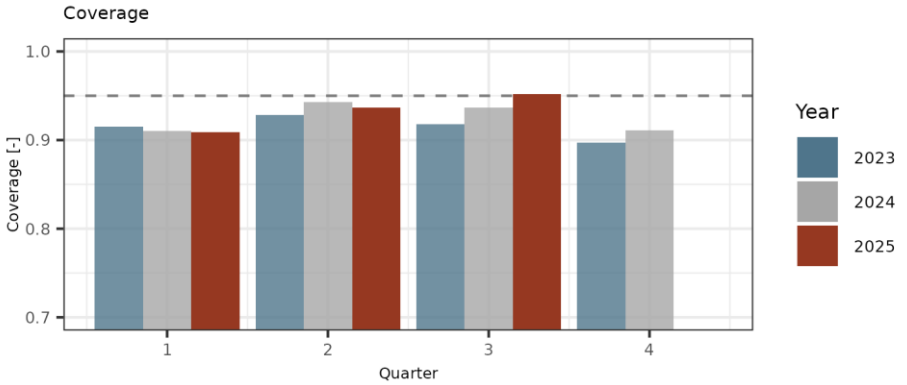

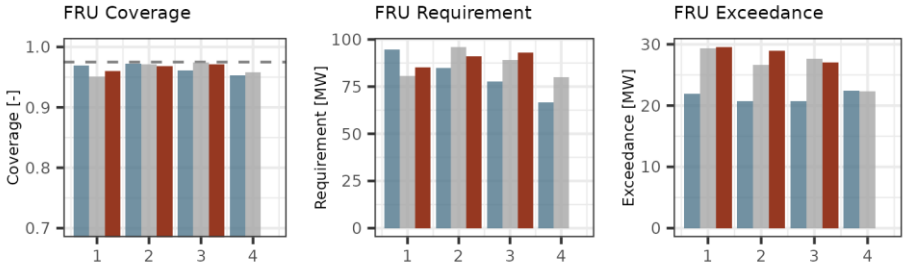

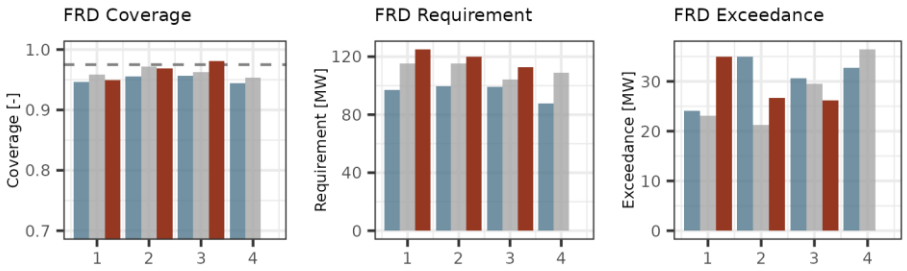

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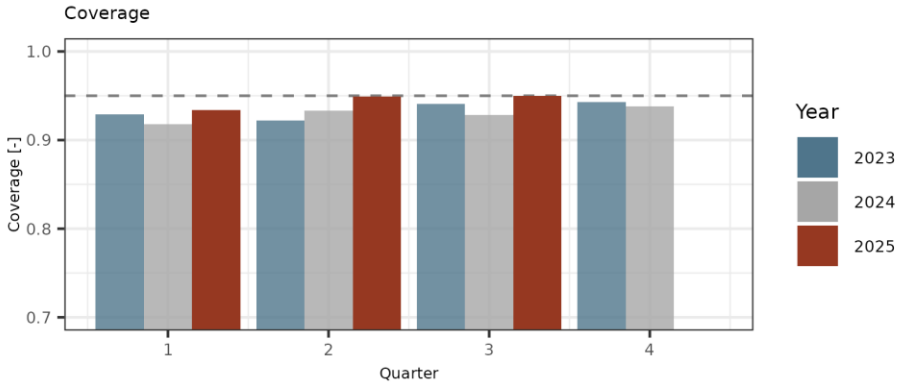

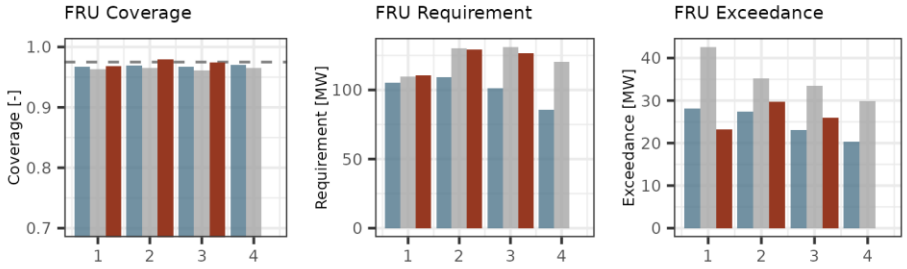

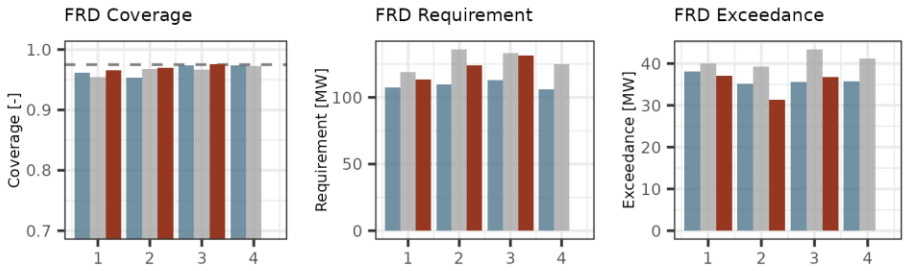

Data current to 2025-09-02

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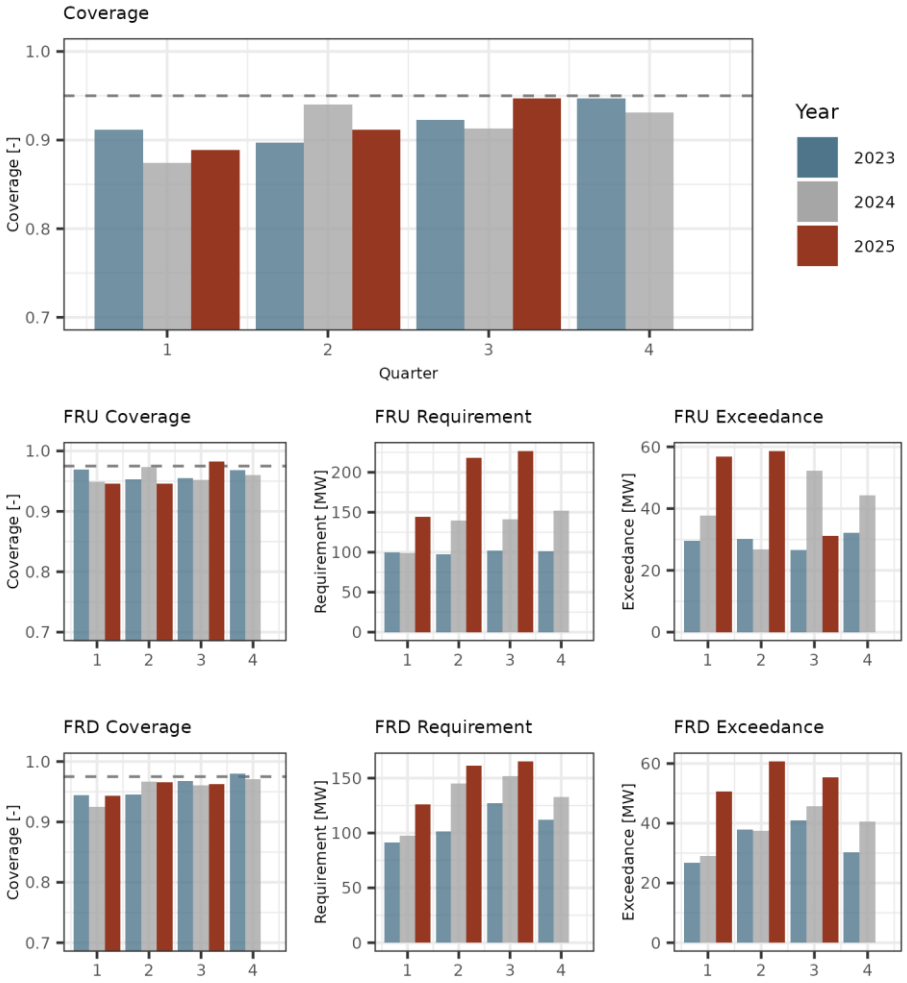
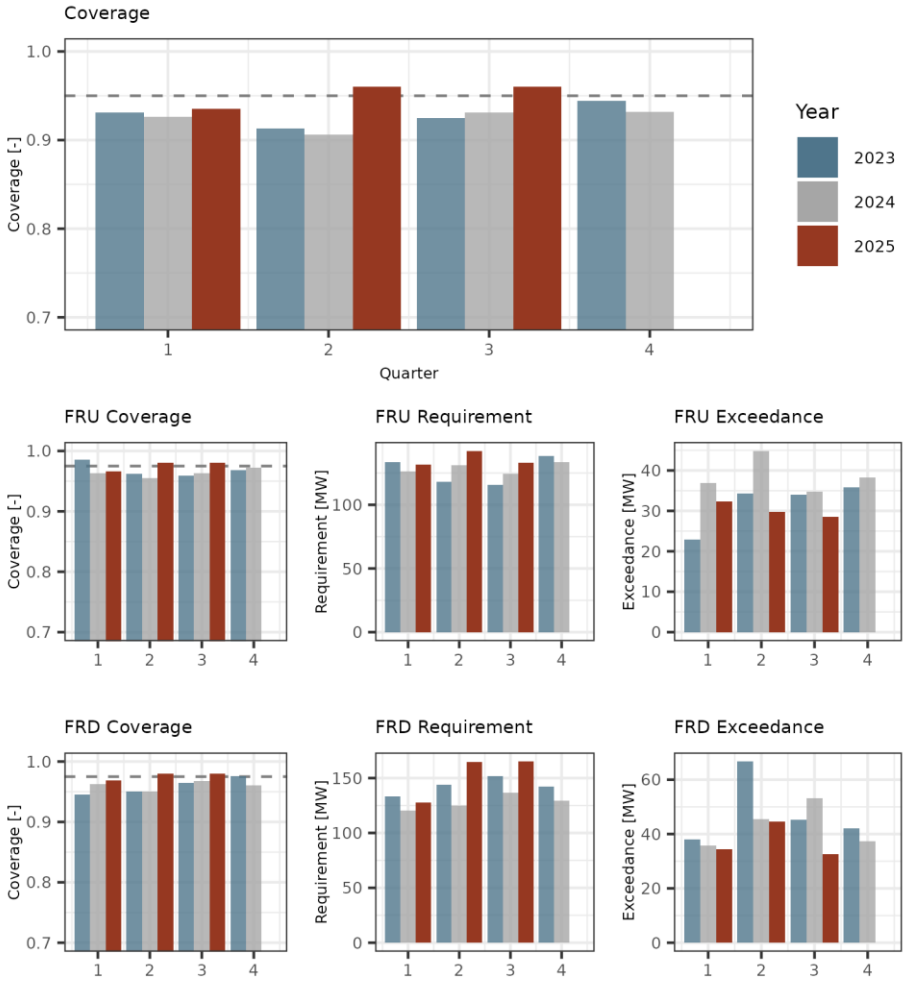


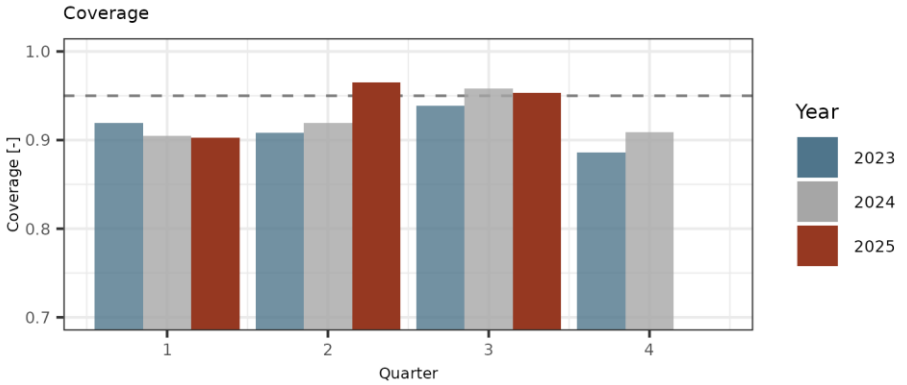
Data current to 2025-09-02

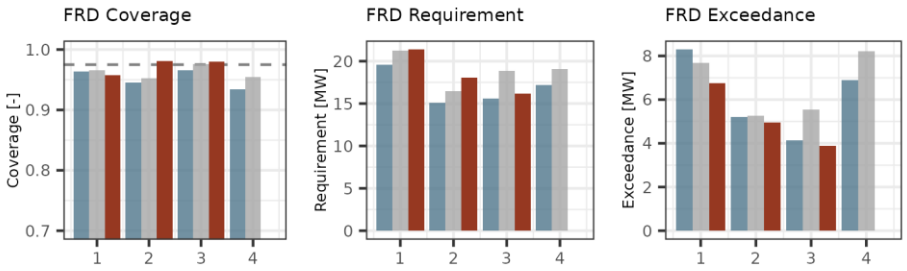
PSE



Data current to 2025-09-02

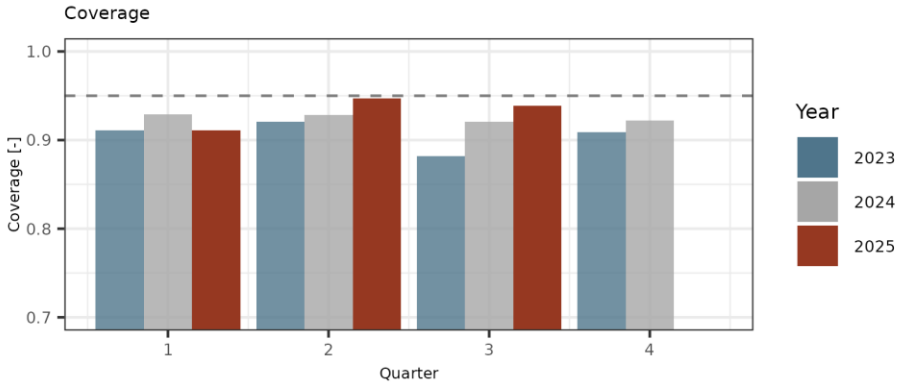
SCL

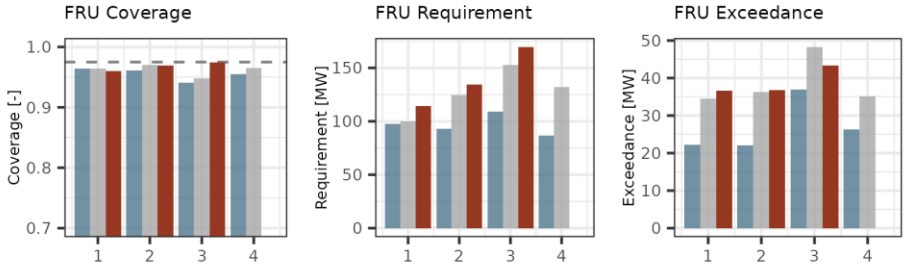


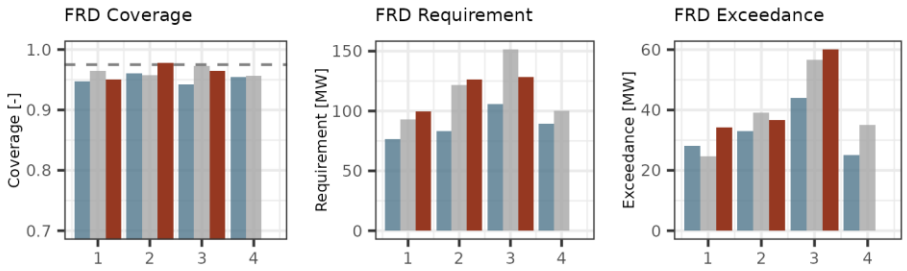


Data current to 2025-09-02

SRP

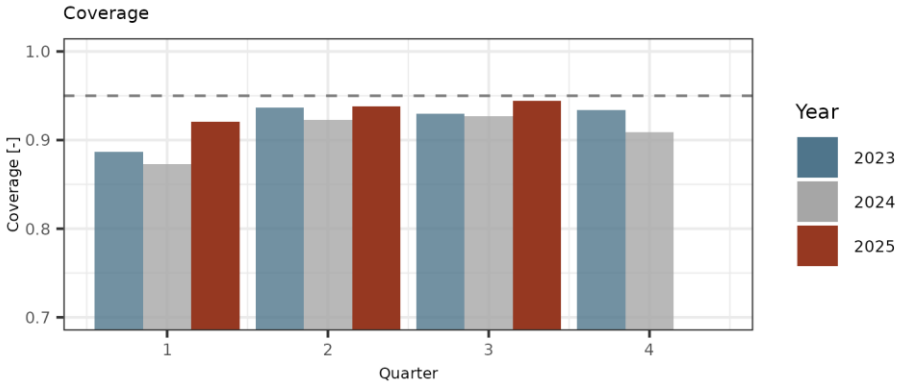


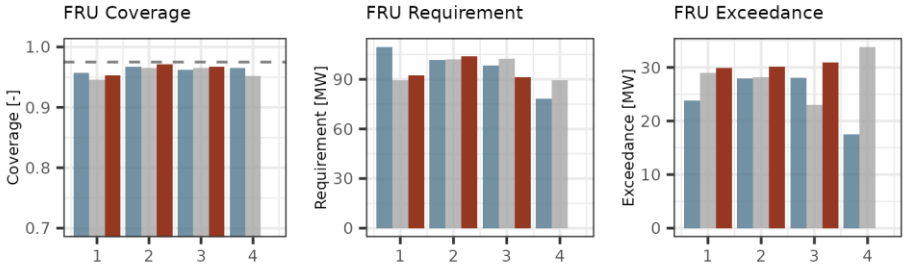


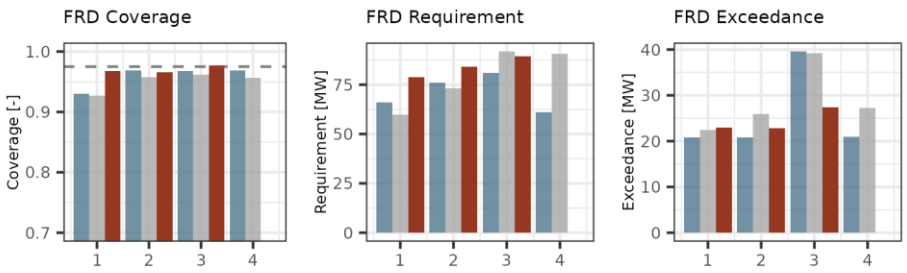


Data current to 2025-09-02

TEP

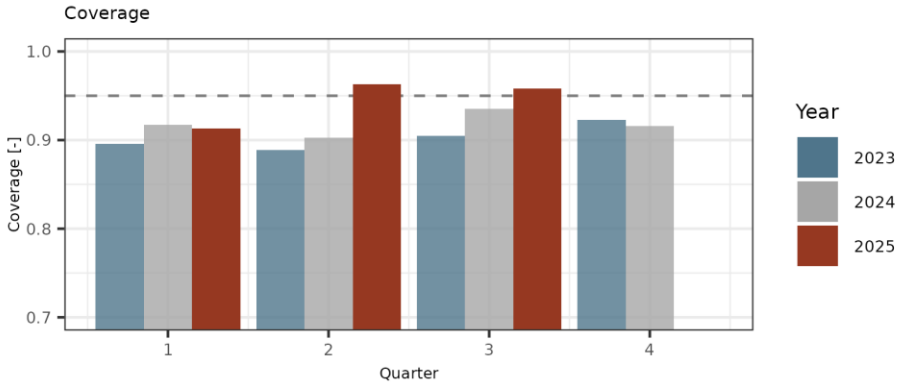


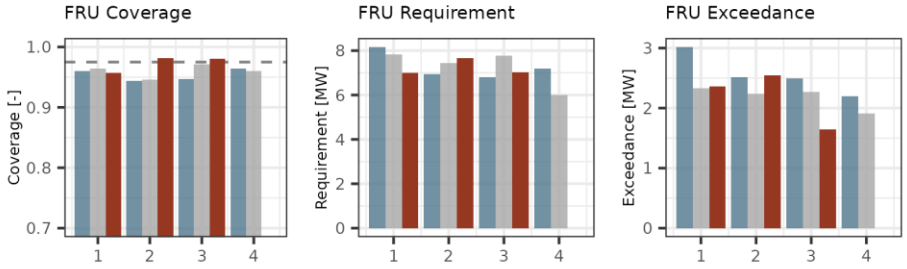


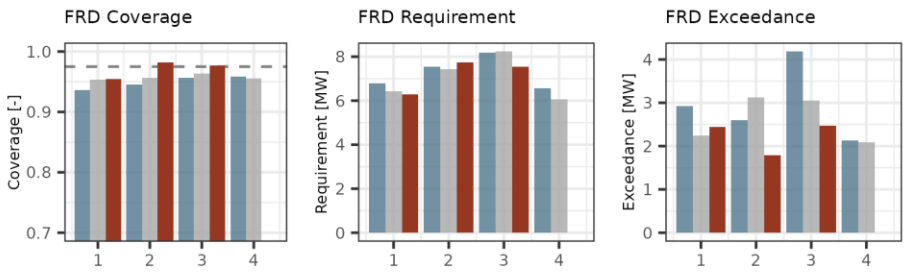


Data current to 2025-09-02

TID

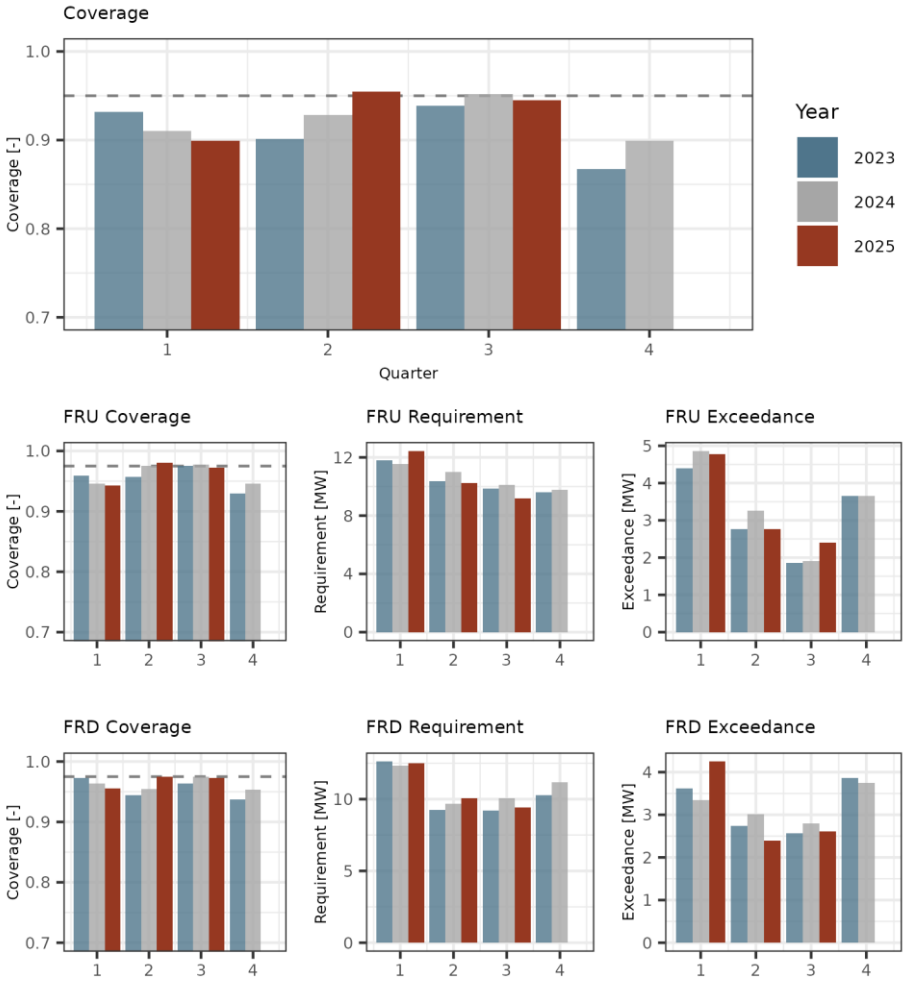






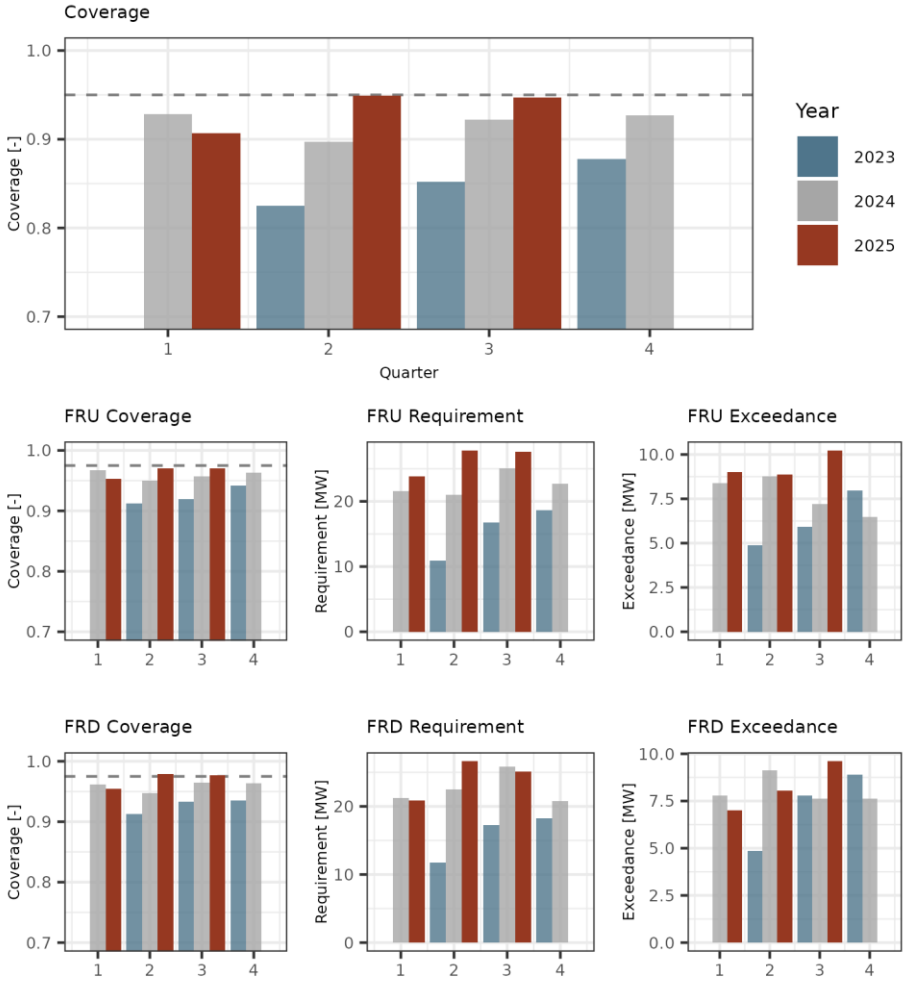
Data current to 2025-09-02

TPWR



Data current to 2025-09-02

WALC



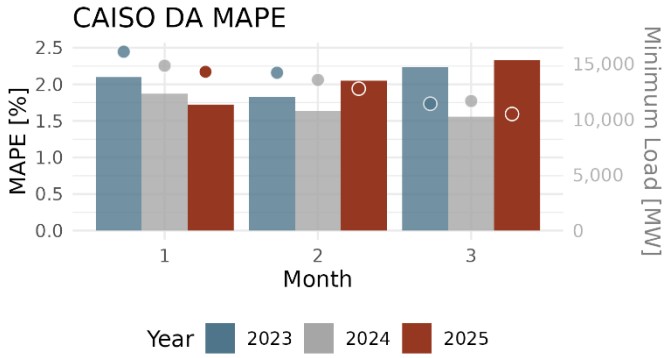
Data current to 2025-09-02

Demand Forecasting

Supporting slide for interpreting load forecast accuracy plots

Mean absolute percent error (MAPE)

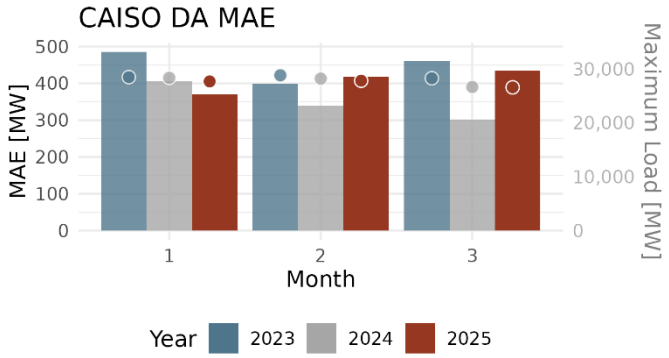
$$\text{MAPE} = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{|\text{Forecast} - \text{Actual}|}{\text{Actual}}\right)_i$$



- MAPE is shown with *minimum* load per month on a secondary y-axis.
- **Expected:** Low midday loads will lead to higher MAPE. More BTM solar and DERs will decrease midday load.
- **Desired:** MAPE decreases over time.

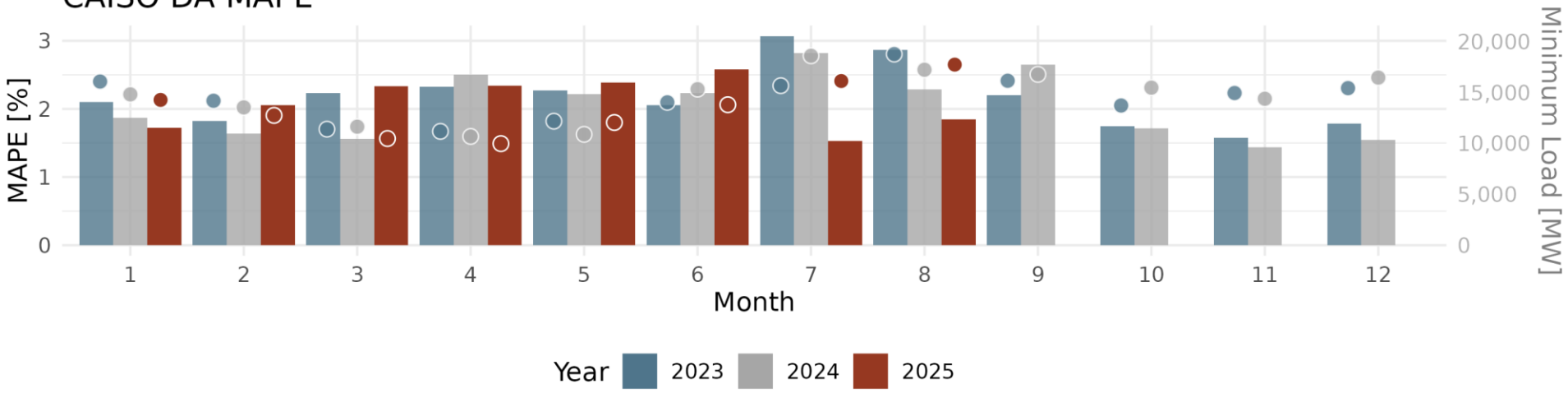
Mean absolute error (MAE)

$$\text{MAE} = \frac{1}{N}\sum_{i=1}^{N}(|\text{Forecast} - \text{Actual}|)_i$$

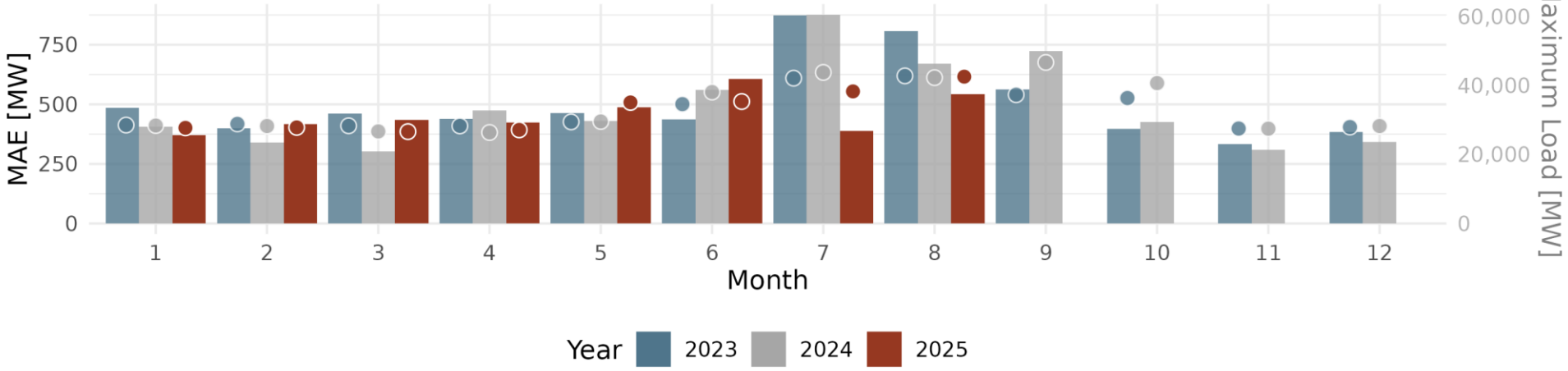


- MAE is shown with *maximum* load per month on a secondary y-axis.
- **Expected:** Higher loads will lead to higher MAE. Peak loads may grow over time.
- **Desired:** MAE decreases over time.

CAISO DA MAPE

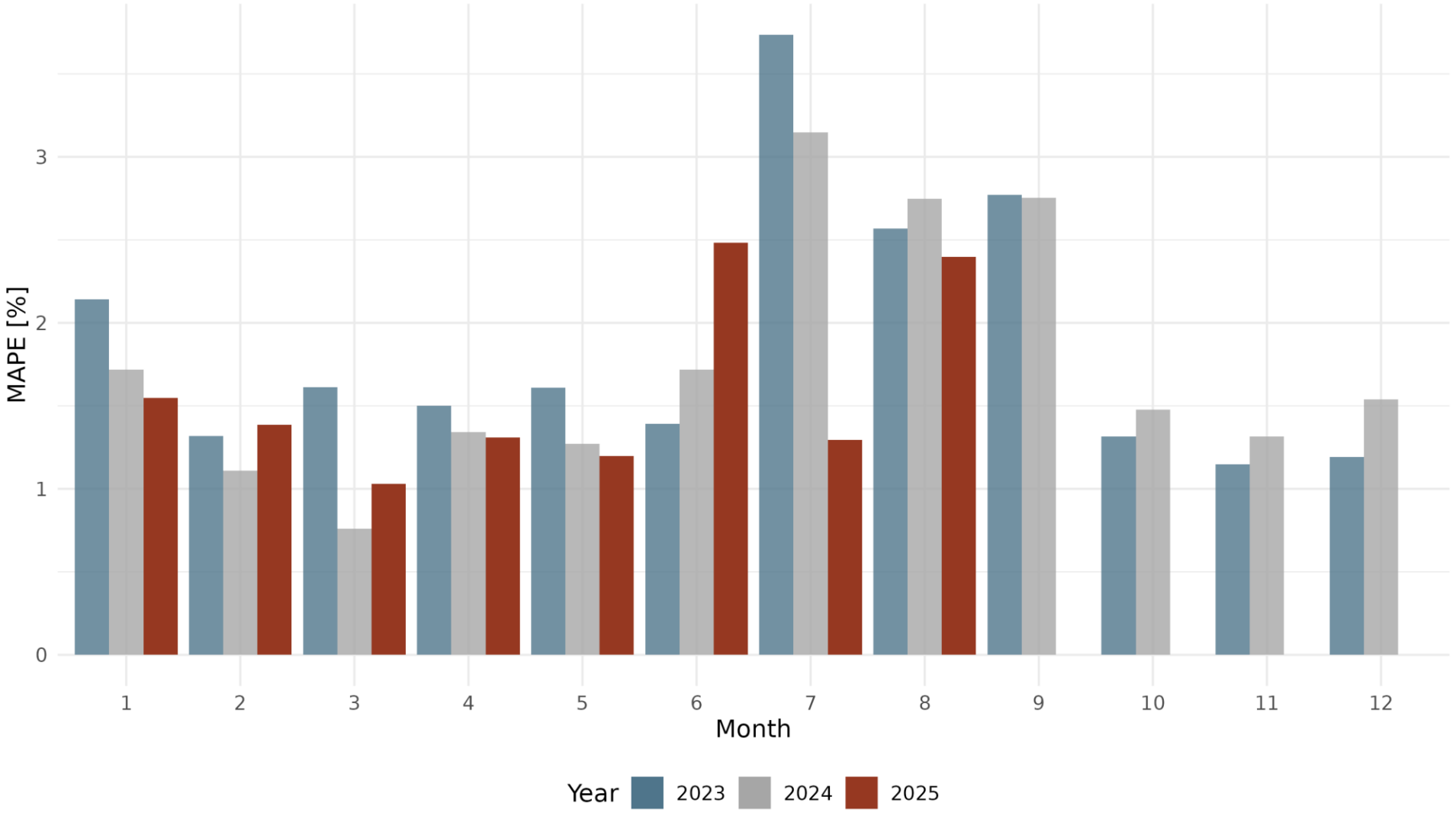


CAISO DA MAE

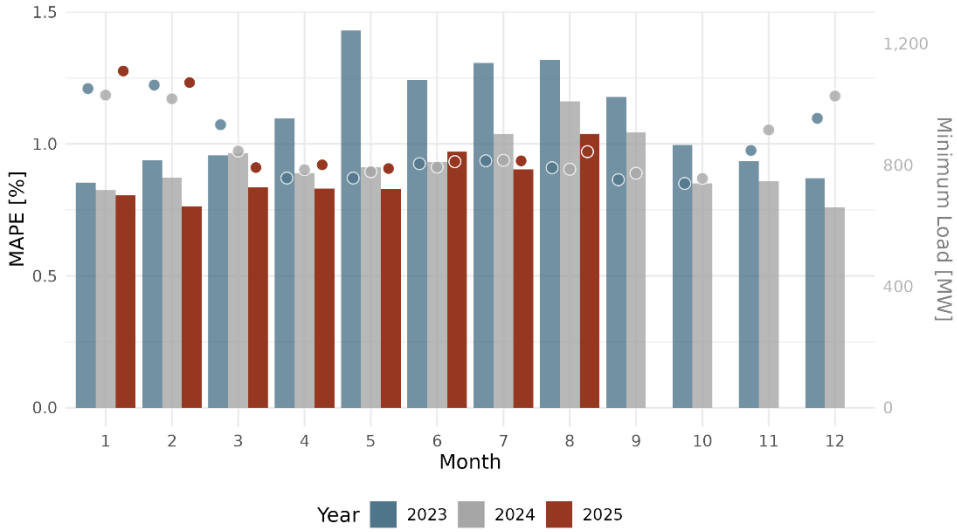


MAPE = abs(Forecast – Actual)/Actual
MAE = abs(Forecast – Actual)

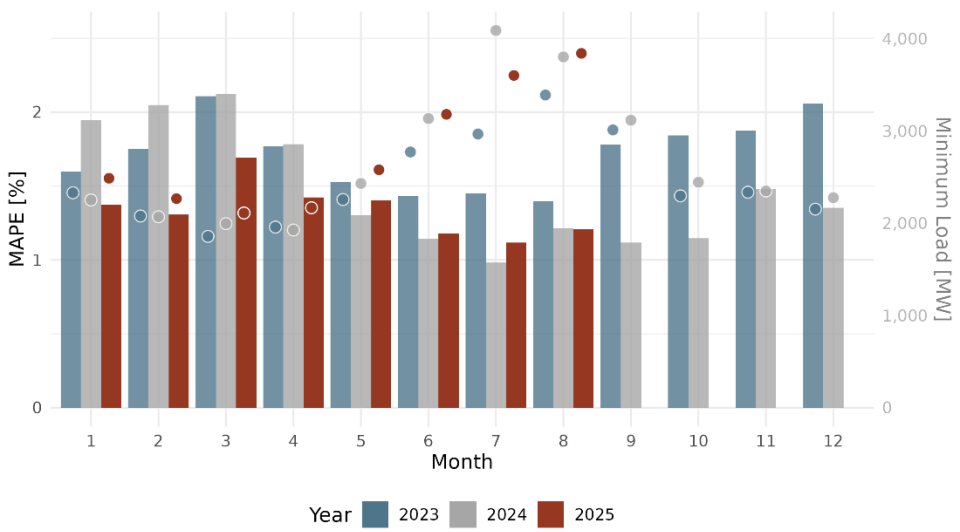
Bars use primary y-axis. Points use secondary y-axis.


CAISO DA Peak Forecast
MAPE [%]
0
1
2
3
1
2
3
4
5
6
7
8
9
10
11
12
Month
Year
2023
2024
2025

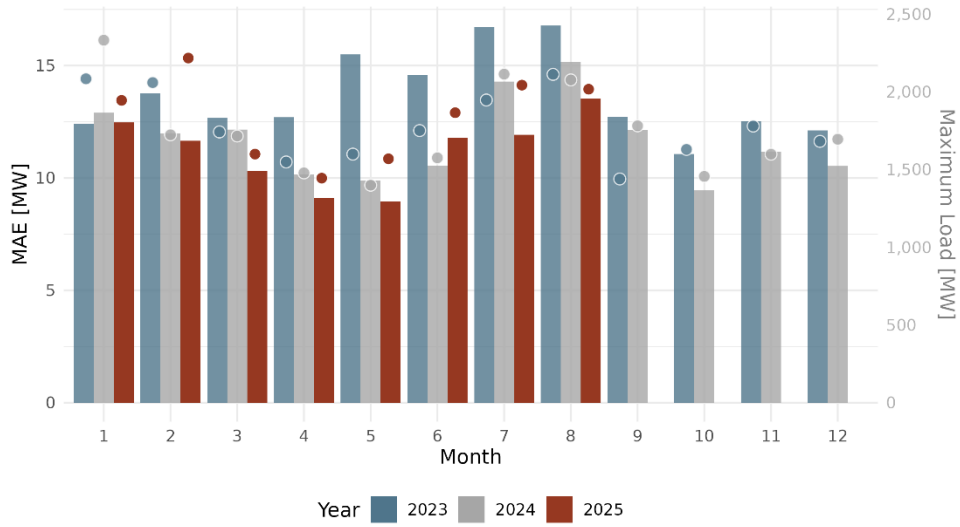
AVA T-60 MAPE



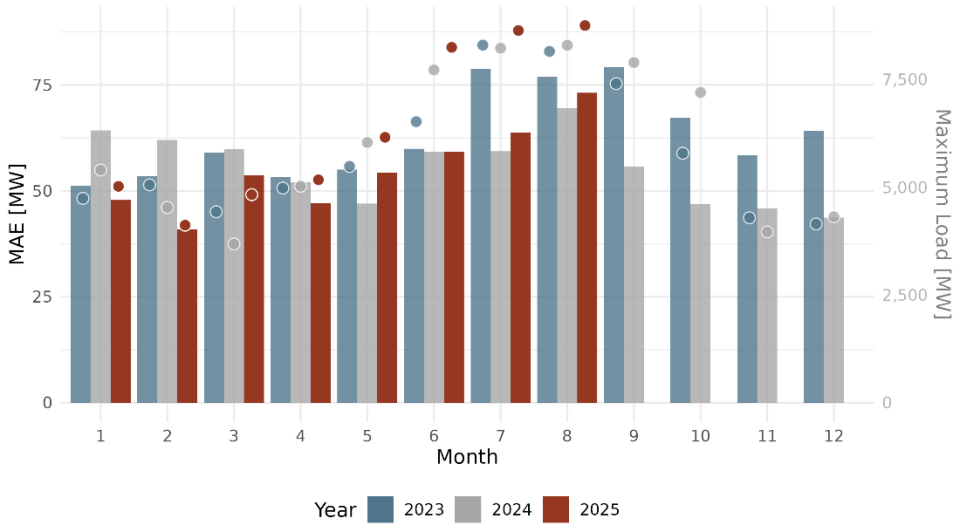
APS T-60 MAPE



AVA T-60 MAE



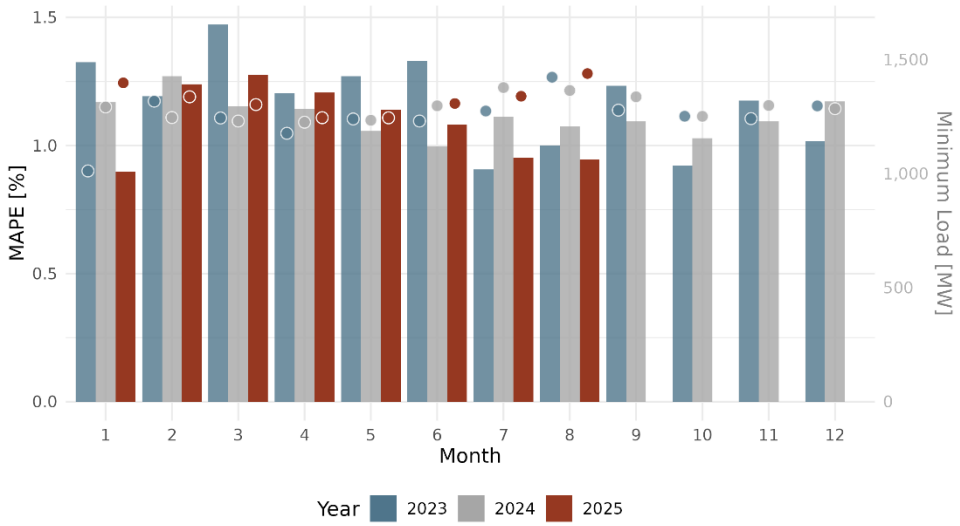
APS T-60 MAE



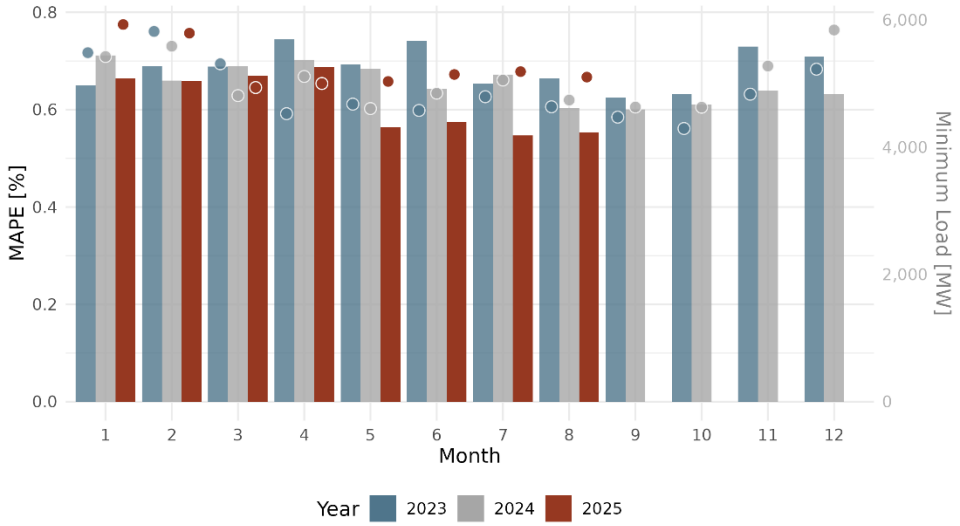
Bars use primary y-axis at left. Points use secondary y-axis at right.

Bars use primary y-axis at left. Points use secondary y-axis at right.

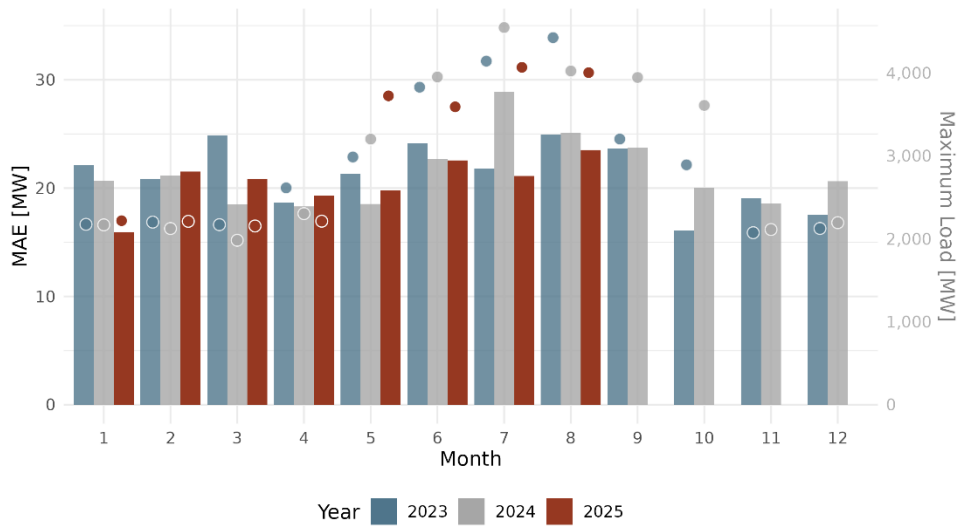
BANC T-60 MAPE



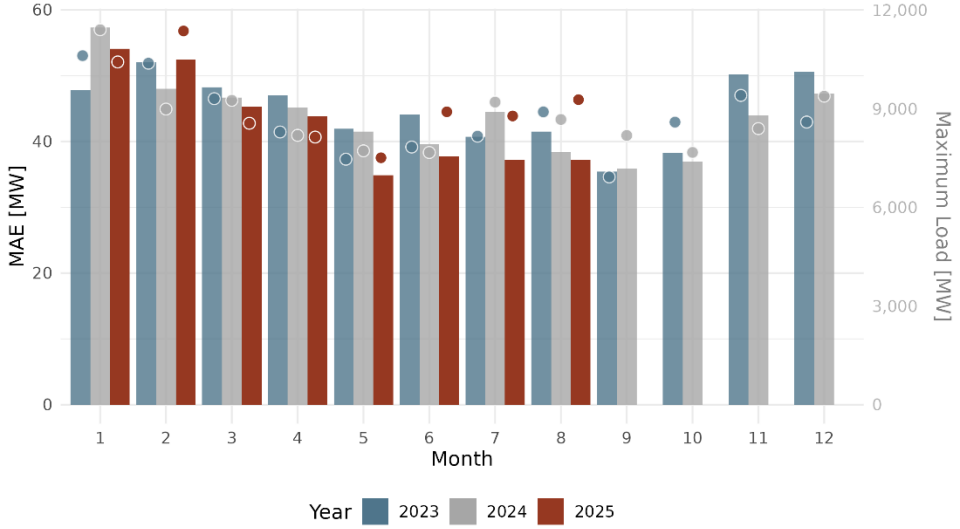
BPA T-60 MAPE



BANC T-60 MAE



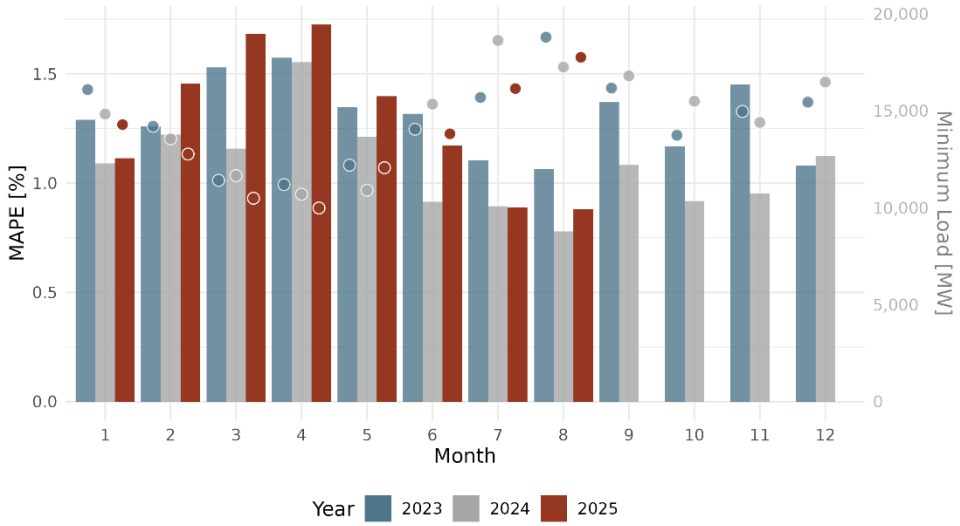
BPA T-60 MAE



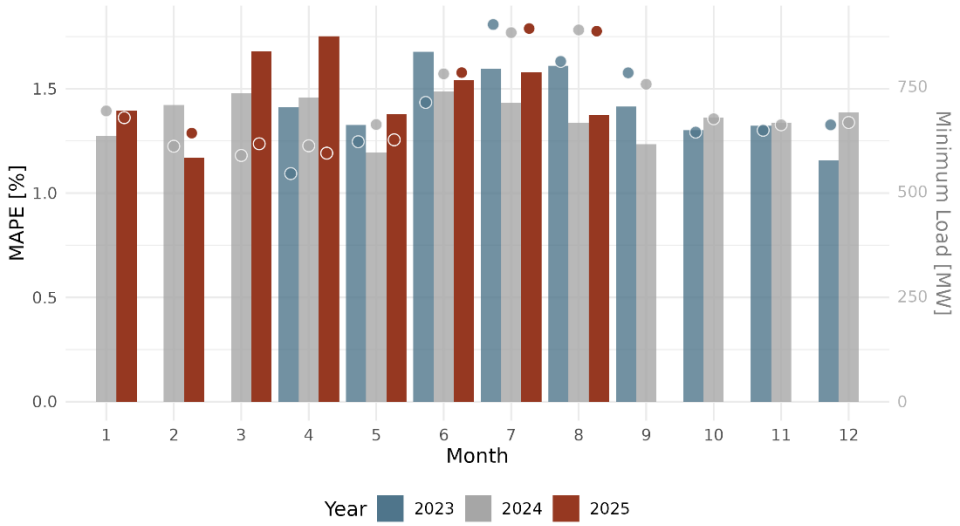
Bars use primary y-axis at left. Points use secondary y-axis at right.

Bars use primary y-axis at left. Points use secondary y-axis at right.

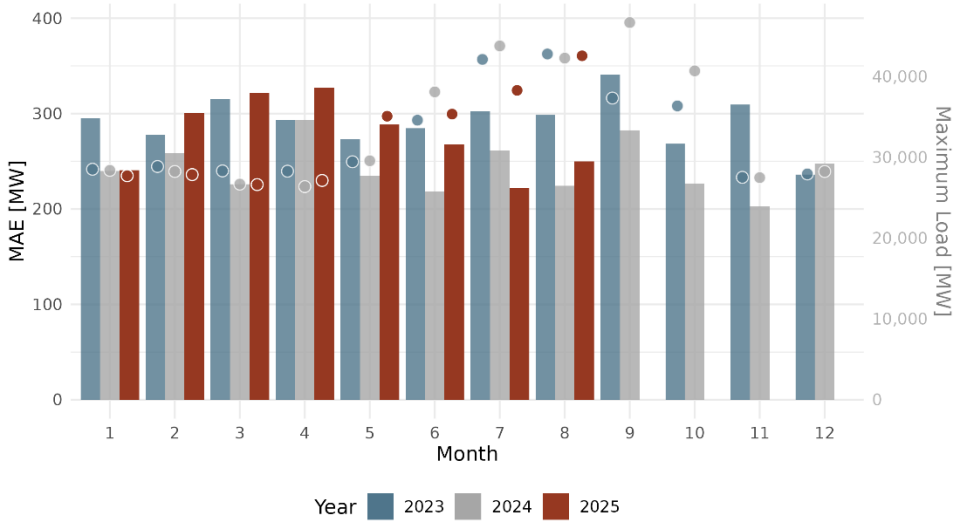
CAISO HASP MAPE



EPE T-60 MAPE

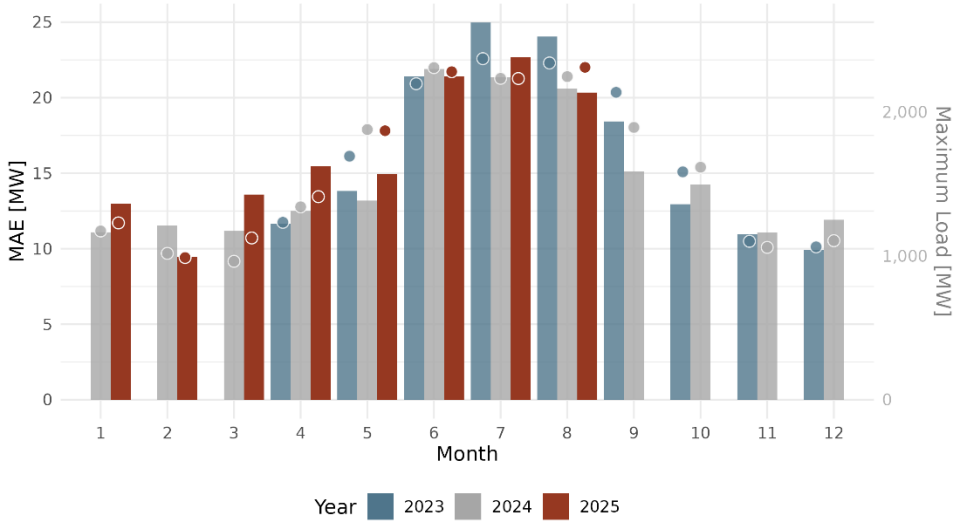


CAISO HASP MAE



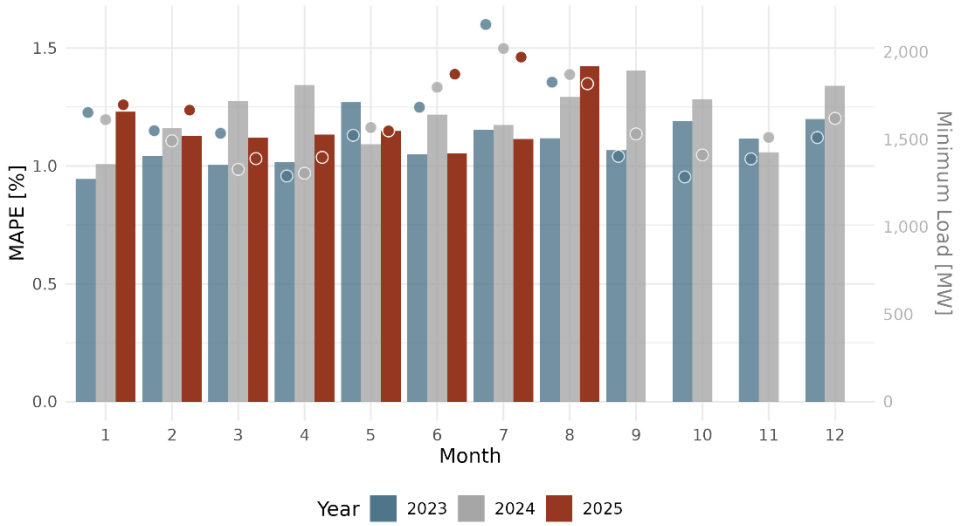
Bars use primary y-axis at left. Points use secondary y-axis at right.

EPE T-60 MAE

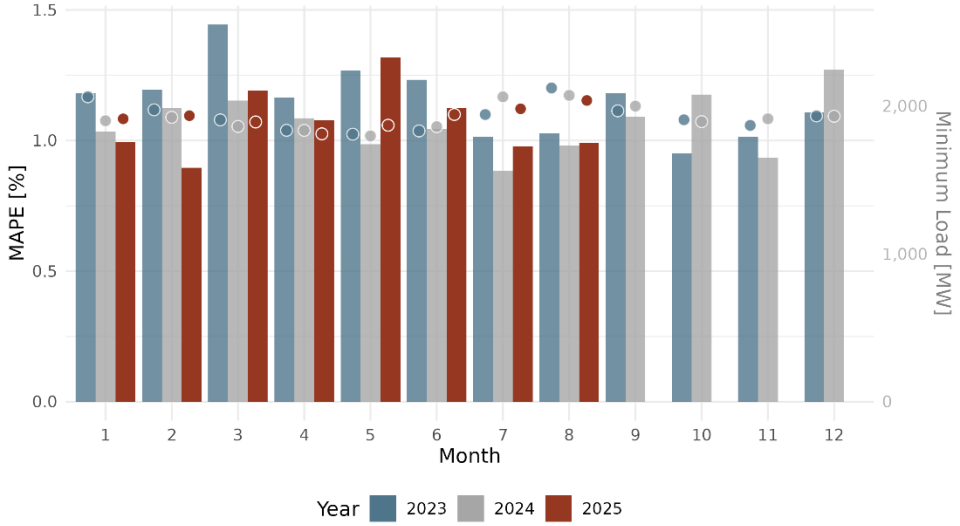


Bars use primary y-axis at left. Points use secondary y-axis at right.

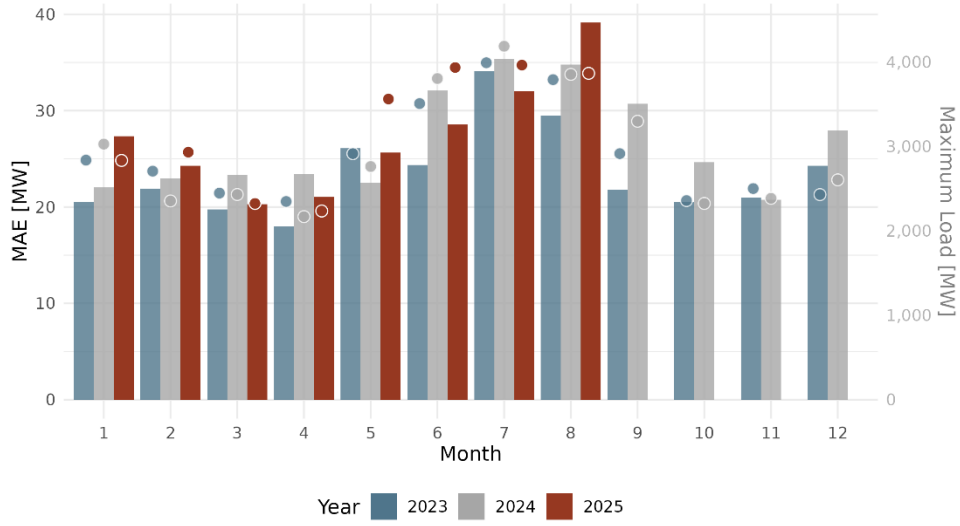
IPCO T-60 MAPE



LADWP T-60 MAPE

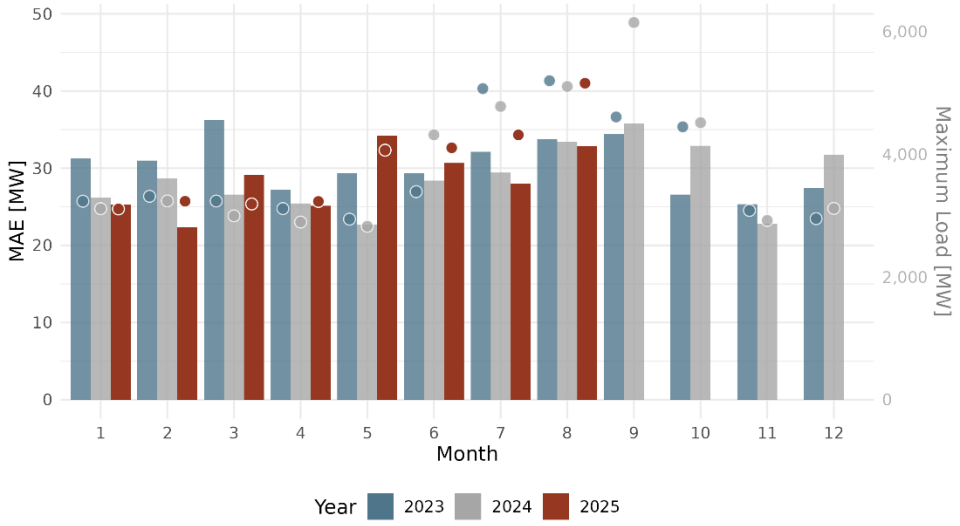


IPCO T-60 MAE



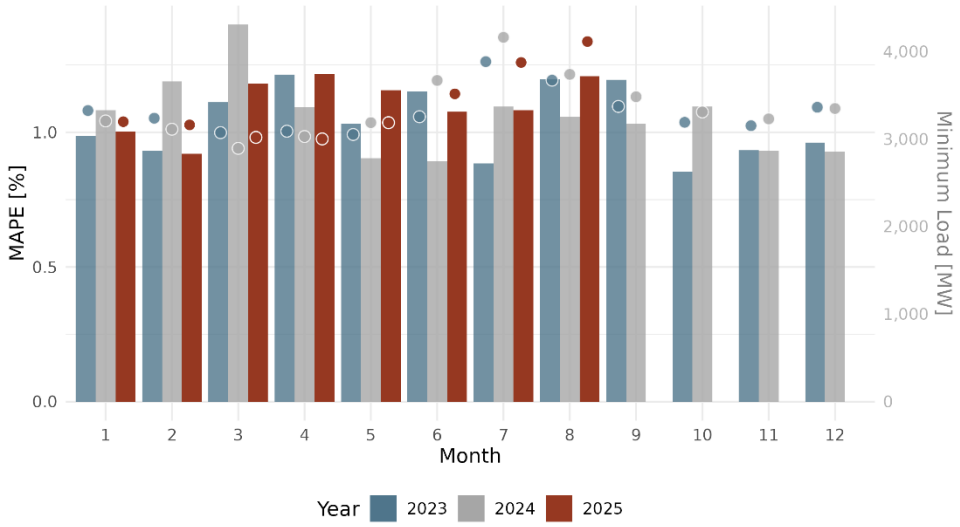
Bars use primary y-axis at left. Points use secondary y-axis at right.

LADWP T-60 MAE

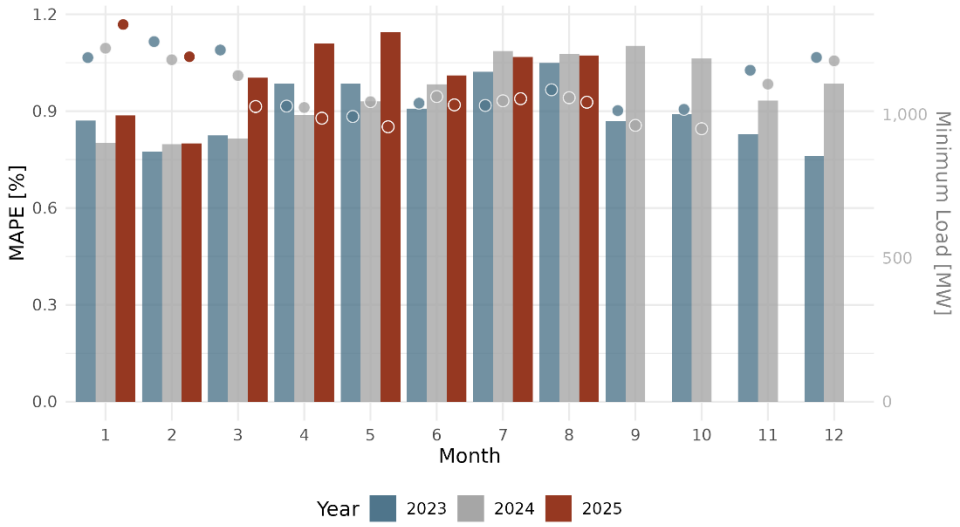


Bars use primary y-axis at left. Points use secondary y-axis at right.

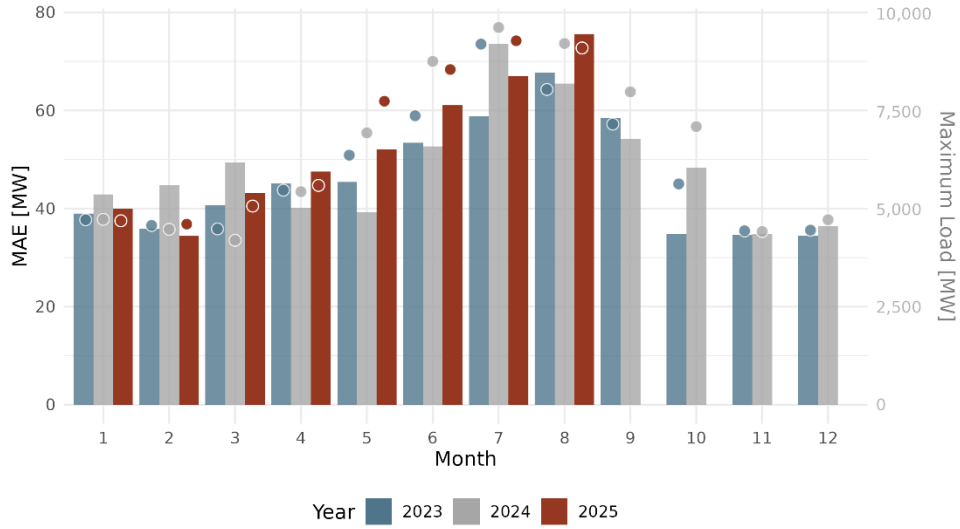
NVE T-60 MAPE



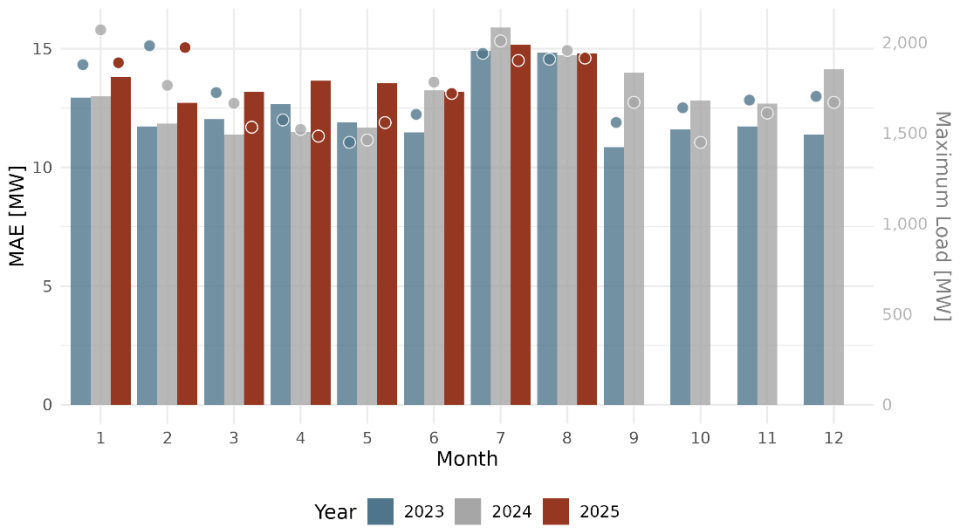
NWMT T-60 MAPE



NVE T-60 MAE



NWMT T-60 MAE



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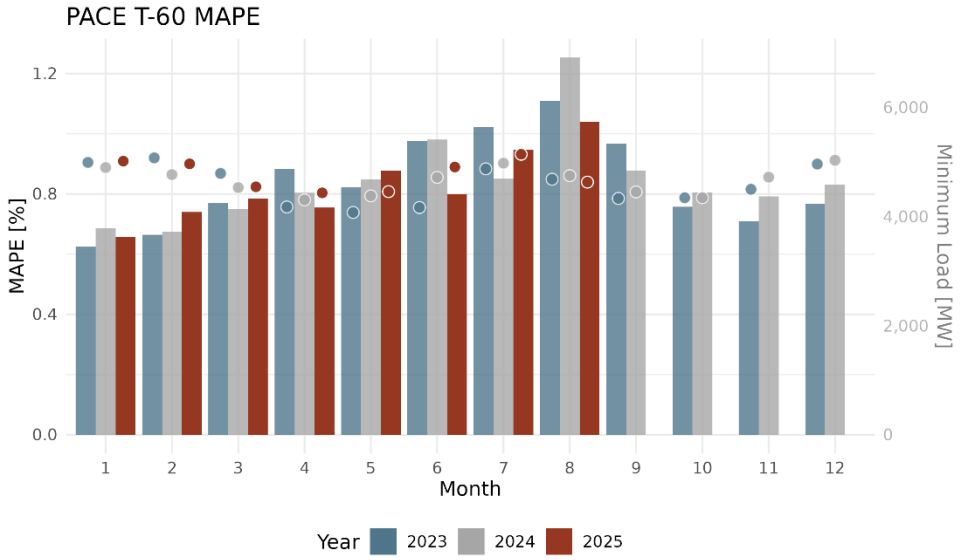
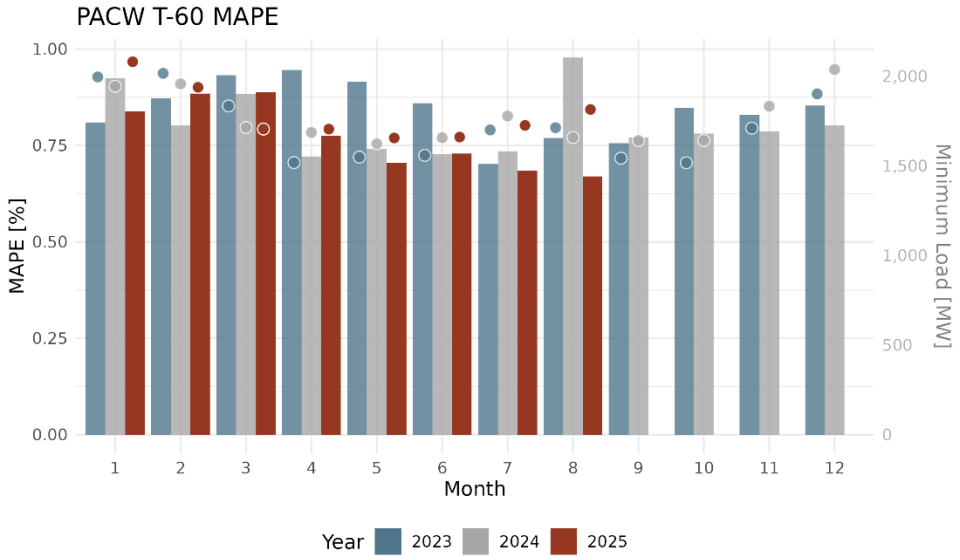
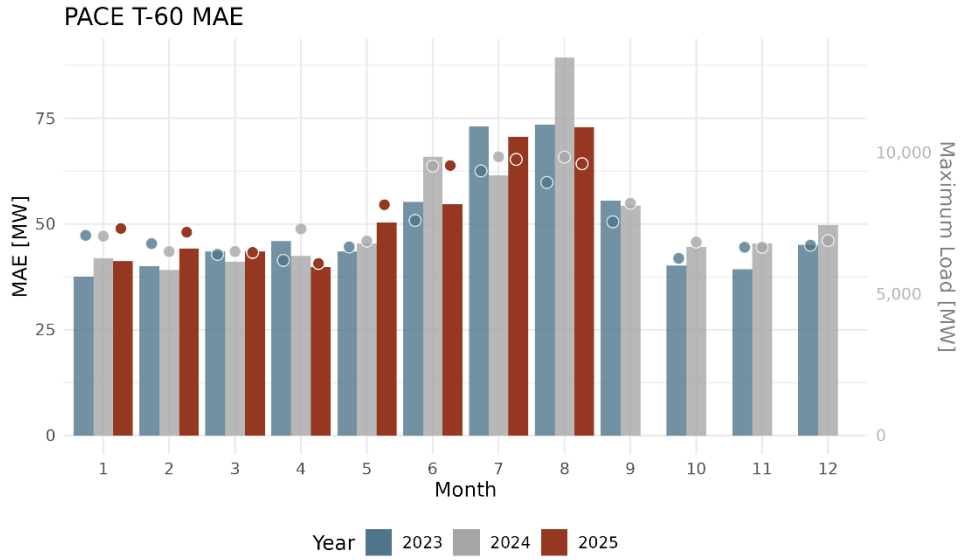
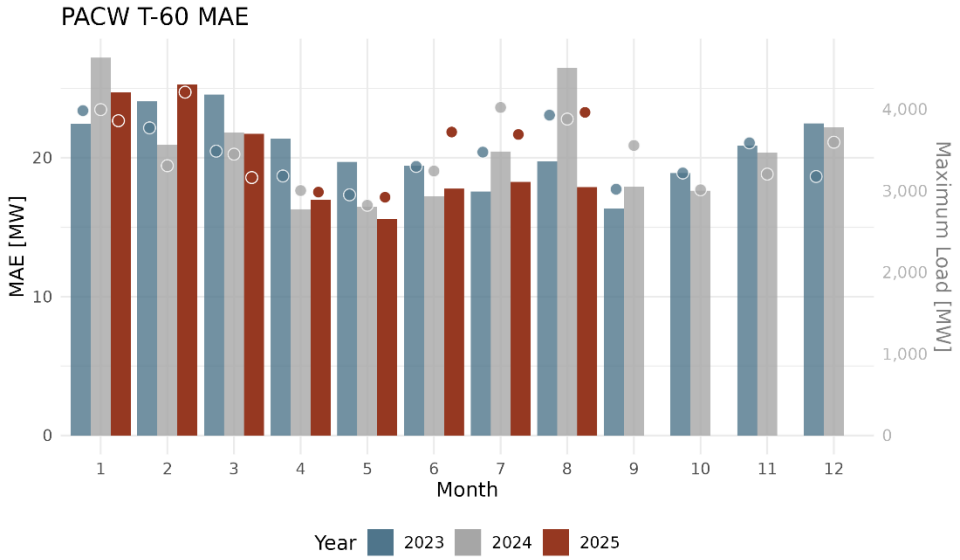
Bars use primary y-axis at left. Points use secondary y-axis at right.





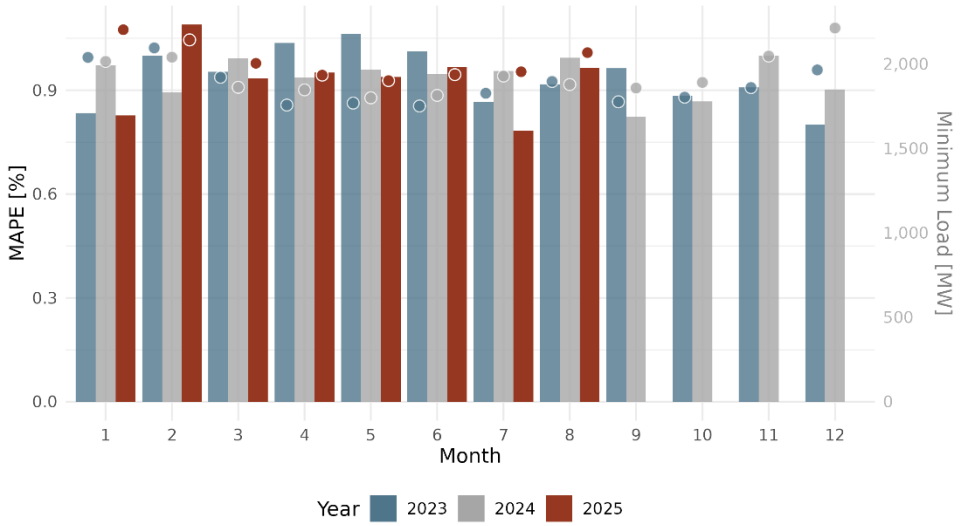


Bars use primary y-axis at left. Points use secondary y-axis at right.

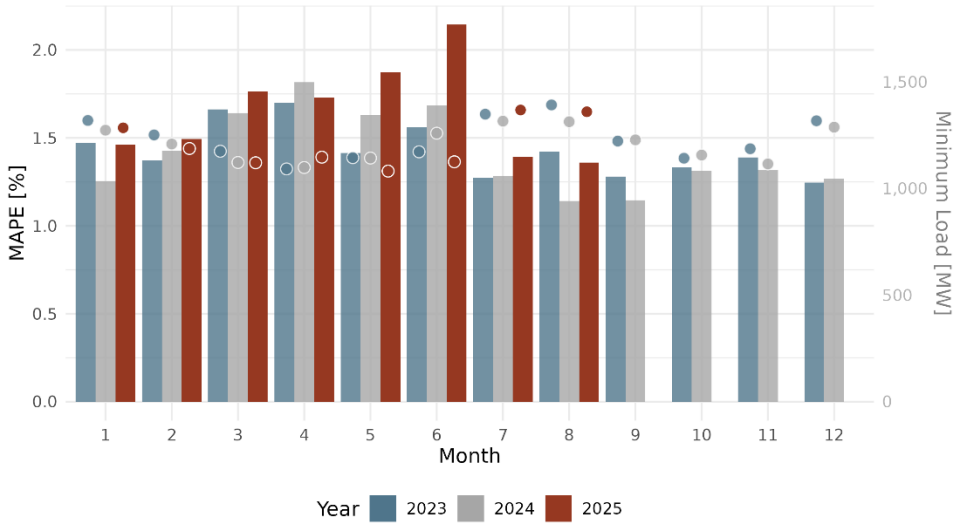


Bars use primary y-axis at left. Points use secondary y-axis at right.

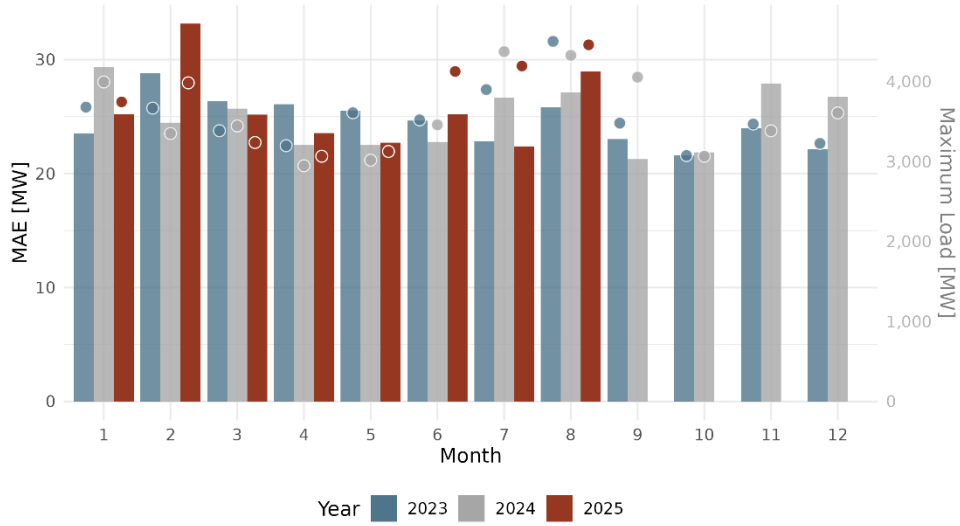
PGE T-60 MAPE



PNM T-60 MAPE

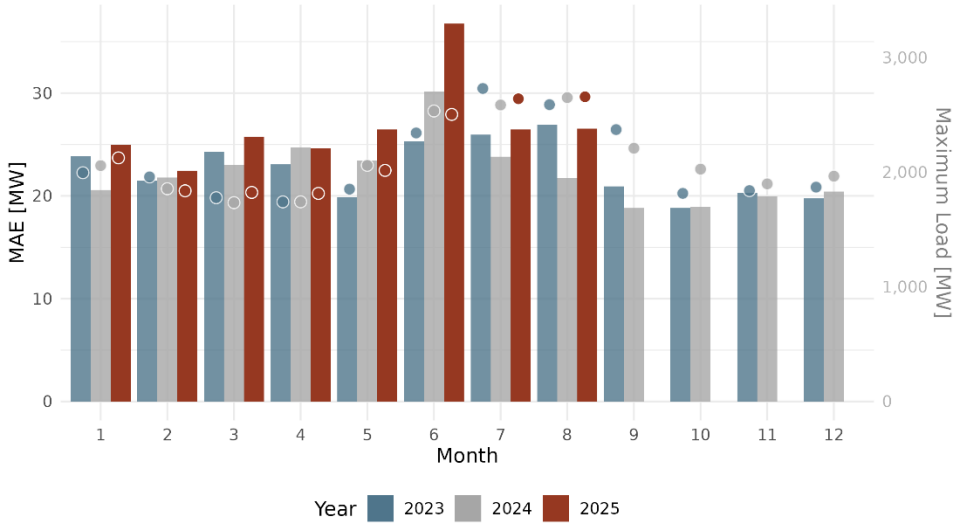


PGE T-60 MAE



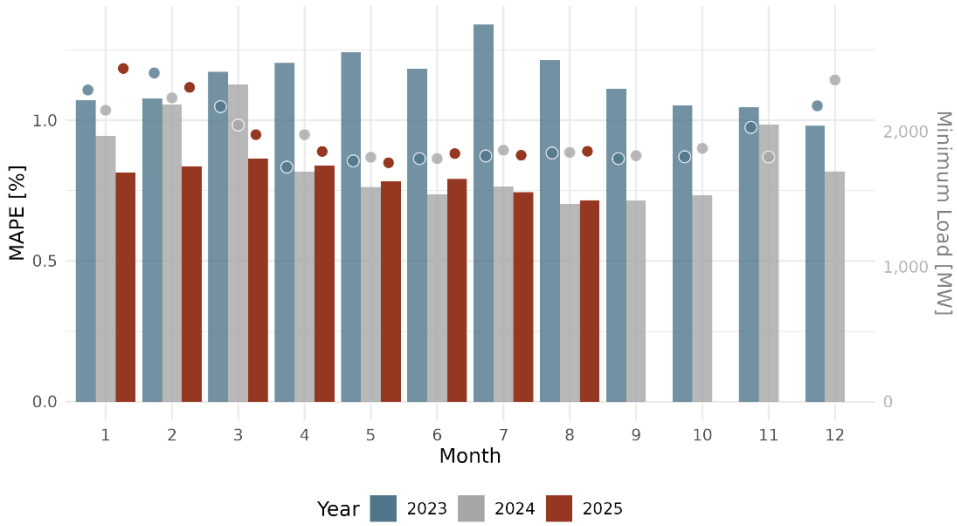
Bars use primary y-axis at left. Points use secondary y-axis at right.

PNM T-60 MAE

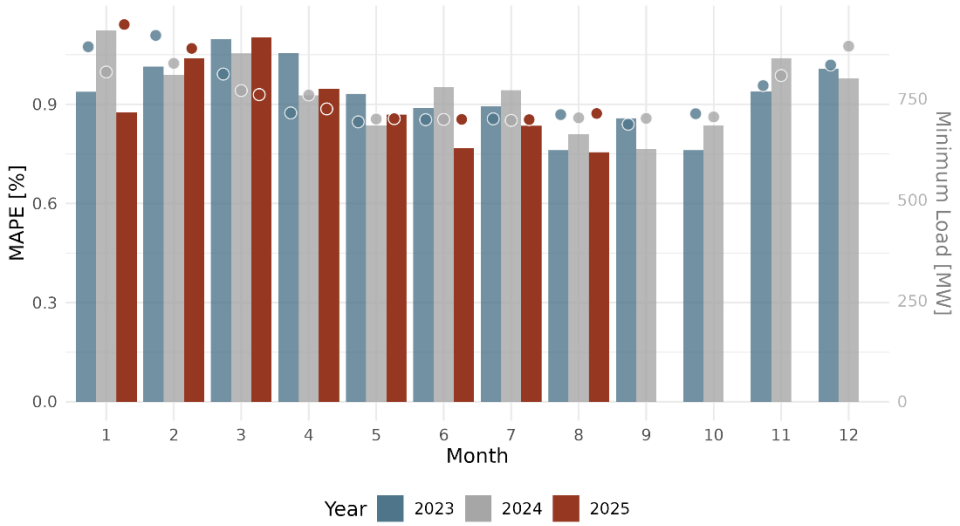


Bars use primary y-axis at left. Points use secondary y-axis at right.

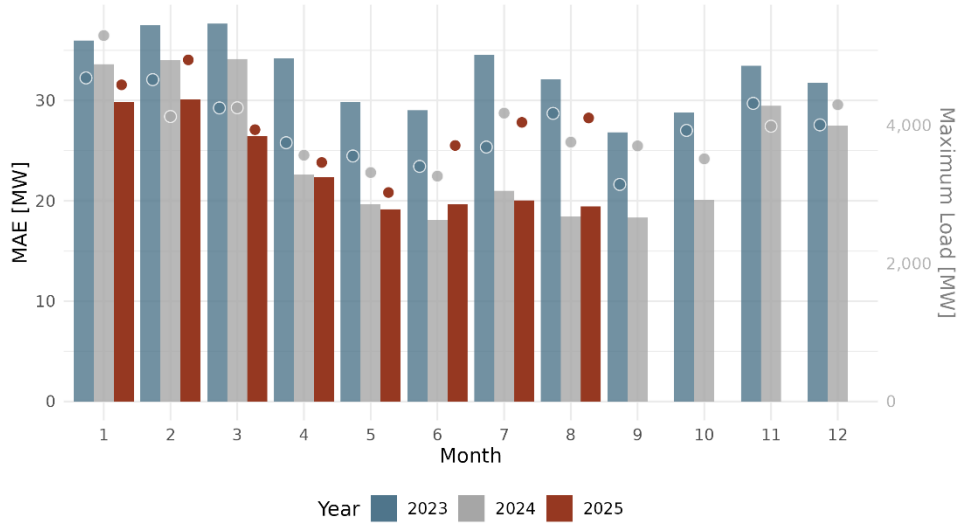
PSE T-60 MAPE



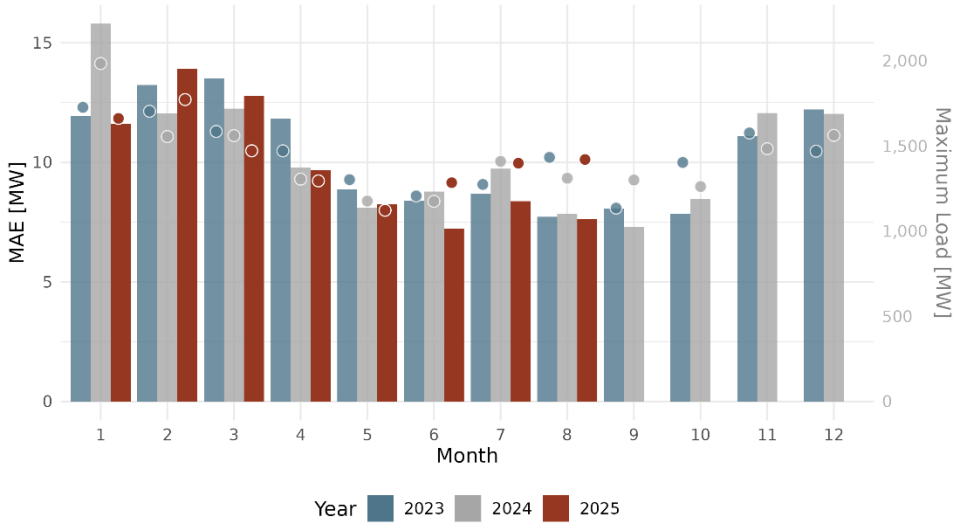
SCL T-60 MAPE



PSE T-60 MAE



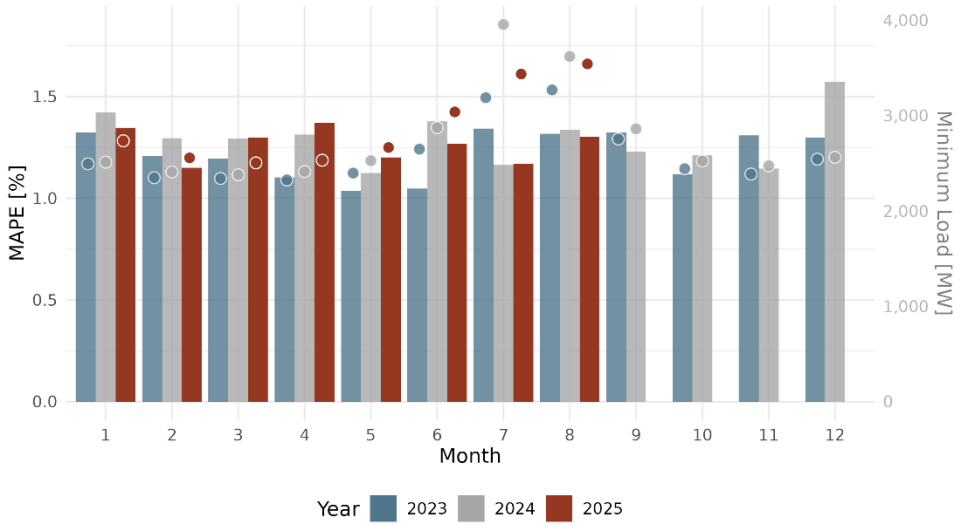
SCL T-60 MAE



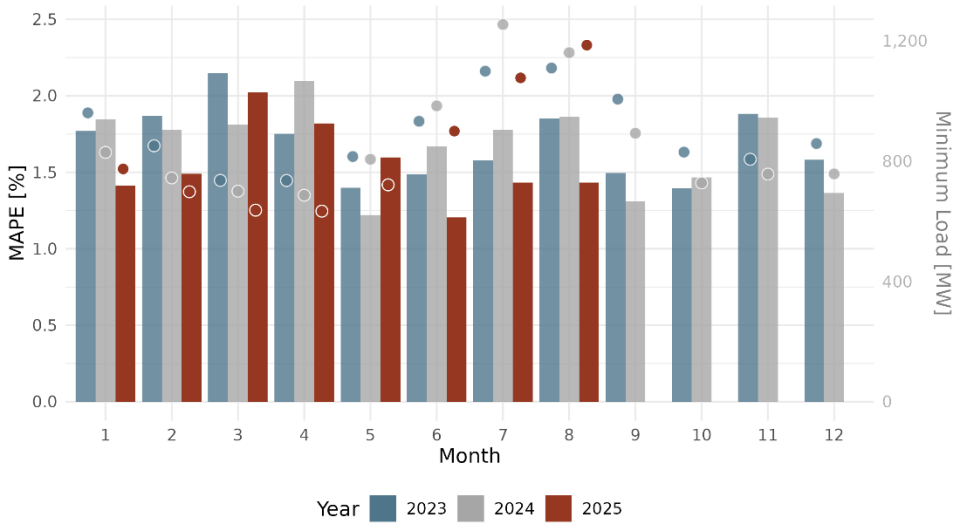
Bars use primary y-axis at left. Points use secondary y-axis at right.

Bars use primary y-axis at left. Points use secondary y-axis at right.

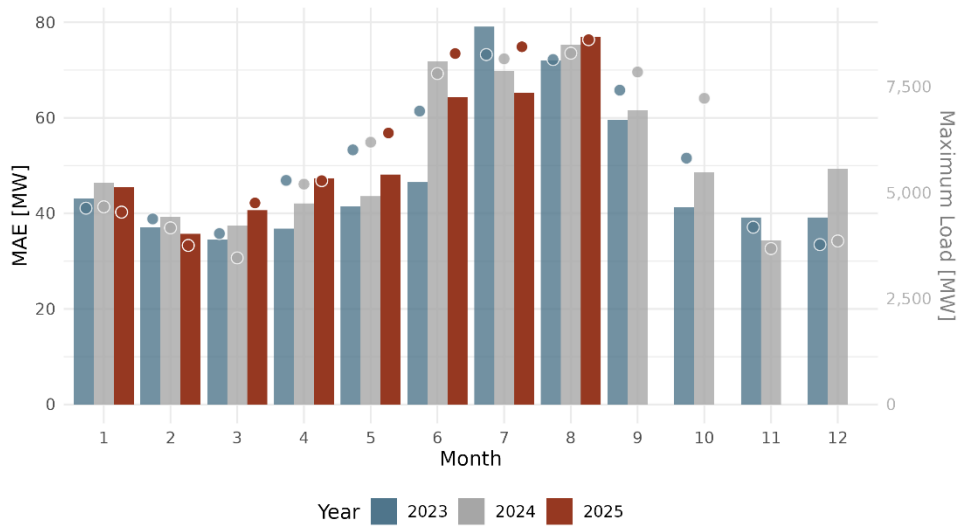
SRP T-60 MAPE



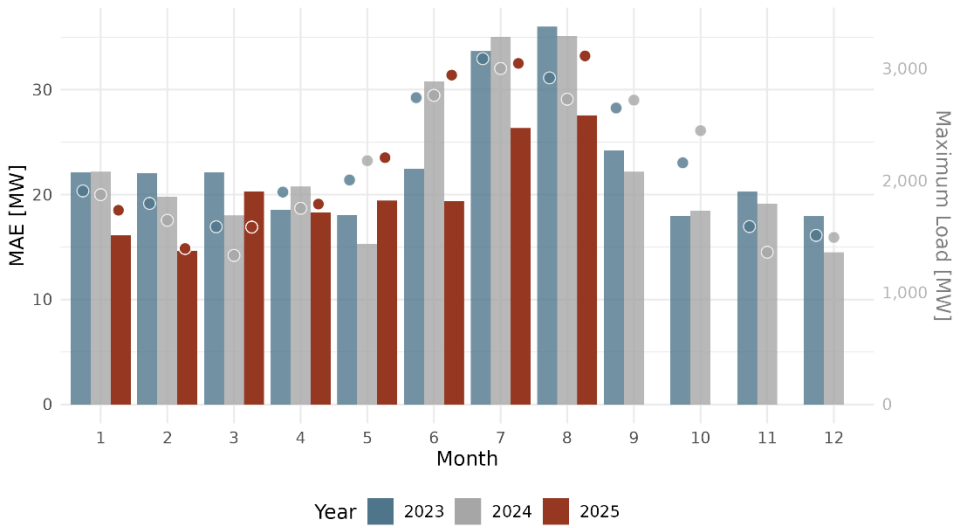
TEP T-60 MAPE



SRP T-60 MAE



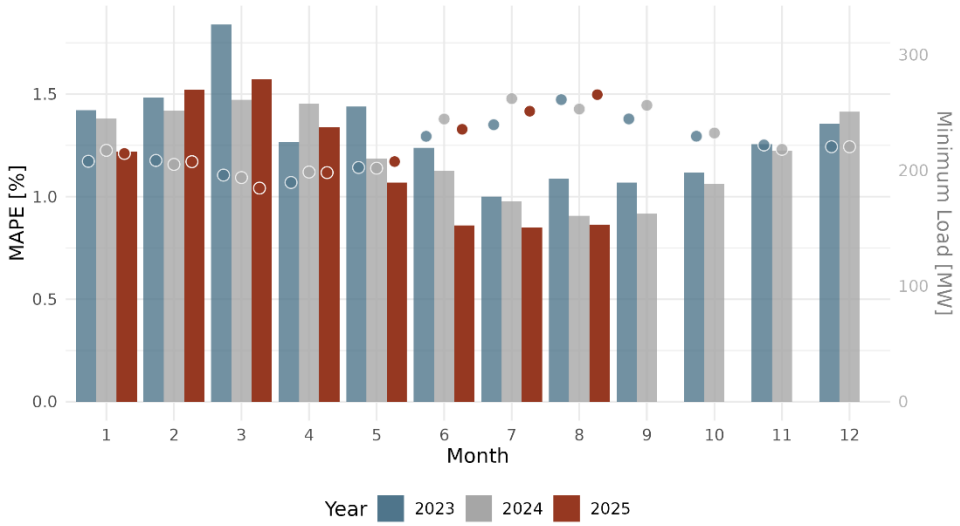
TEP T-60 MAE



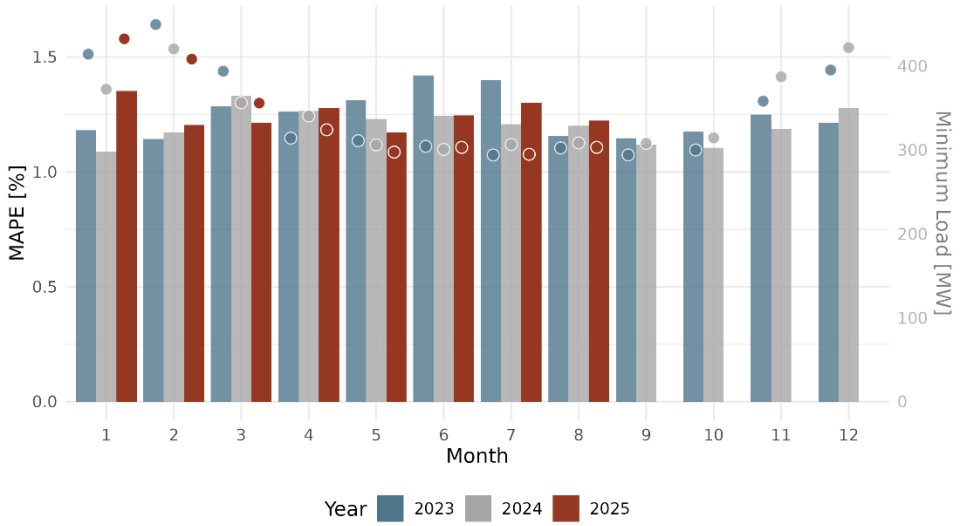
Bars use primary y-axis at left. Points use secondary y-axis at right.

Bars use primary y-axis at left. Points use secondary y-axis at right.

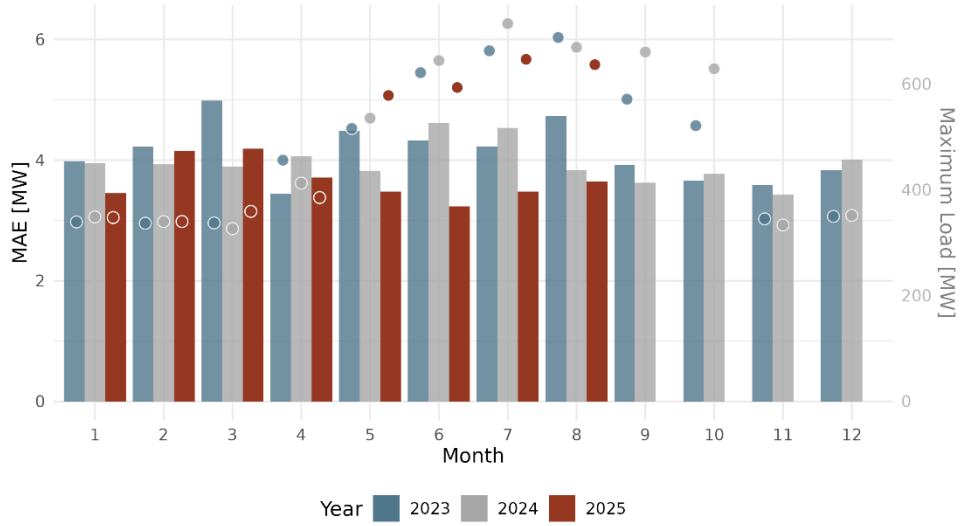
TID T-60 MAPE



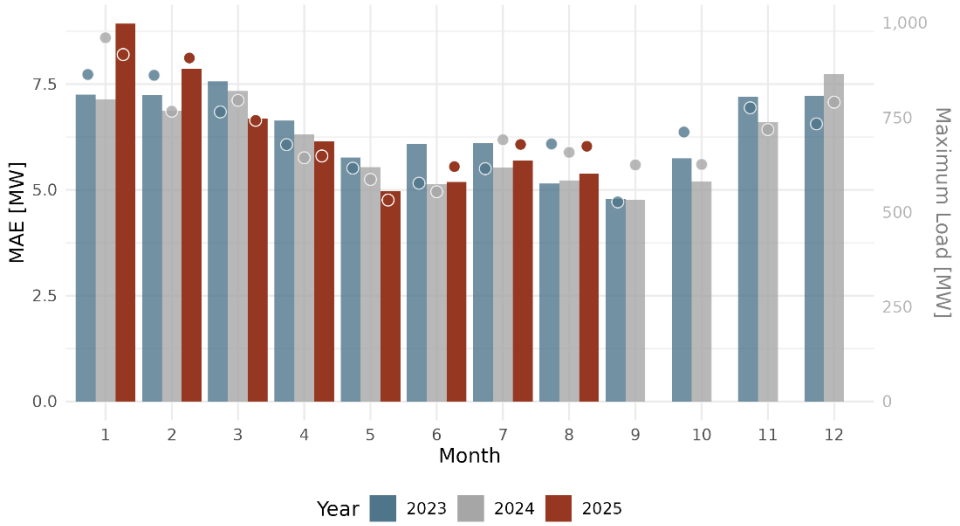
TPWR T-60 MAPE



TID T-60 MAE



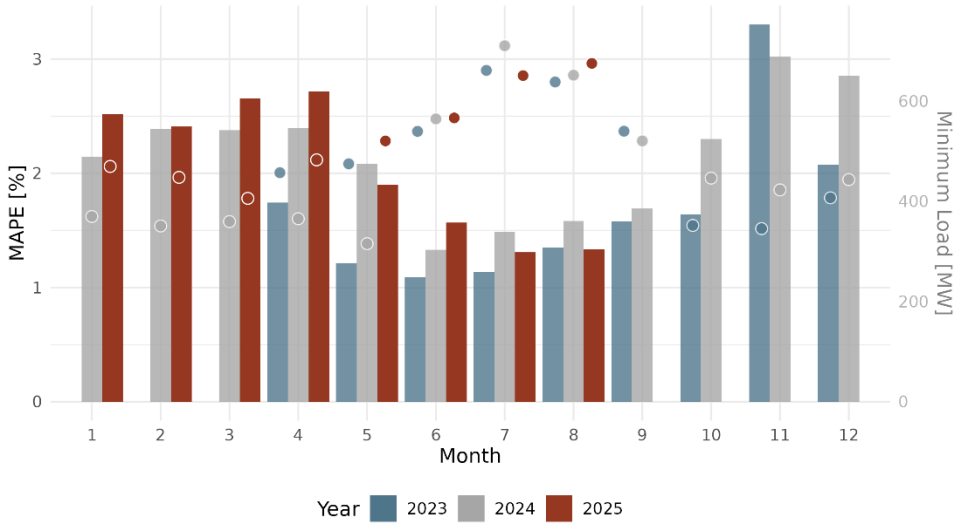
TPWR T-60 MAE



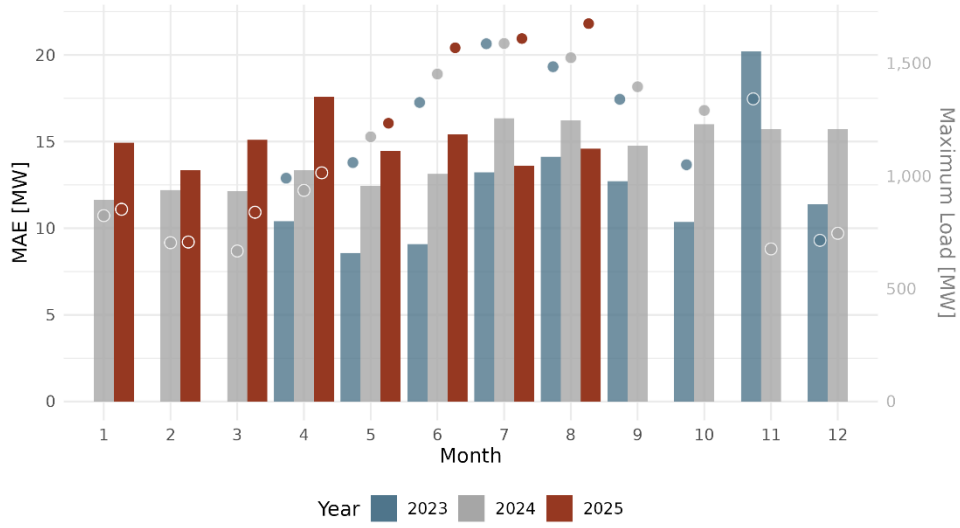
Bars use primary y-axis at left. Points use secondary y-axis at right.

Bars use primary y-axis at left. Points use secondary y-axis at right.

WALC T-60 MAPE



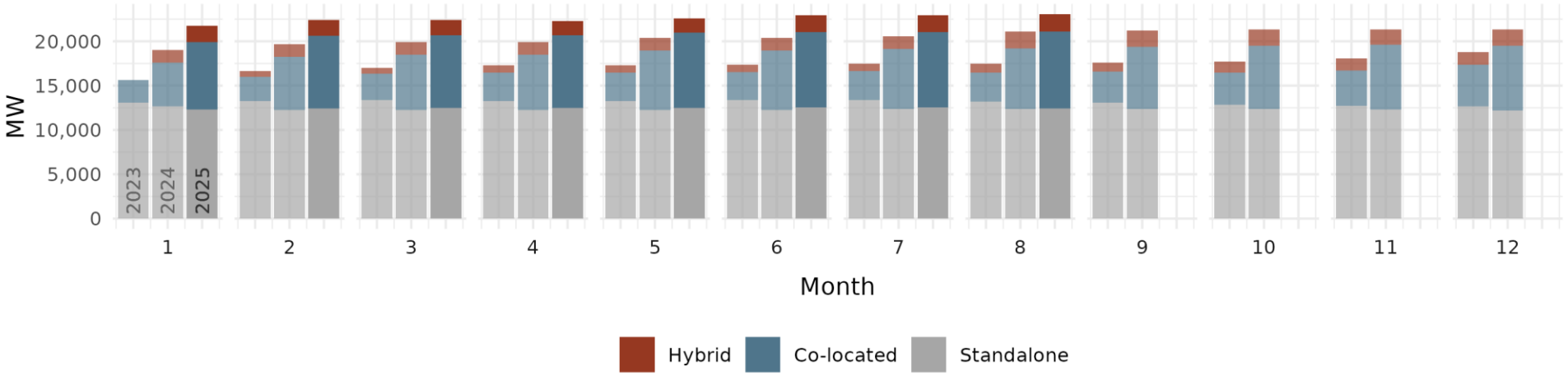
WALC T-60 MAE



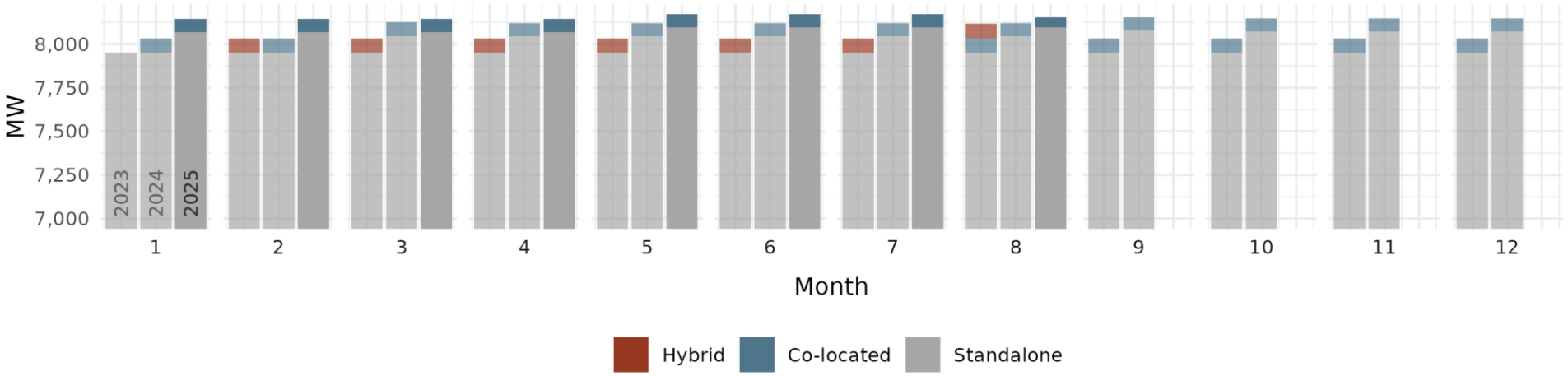
Bars use primary y-axis at left. Points use secondary y-axis at right.

Renewable Forecasting

CAISO solar capacity

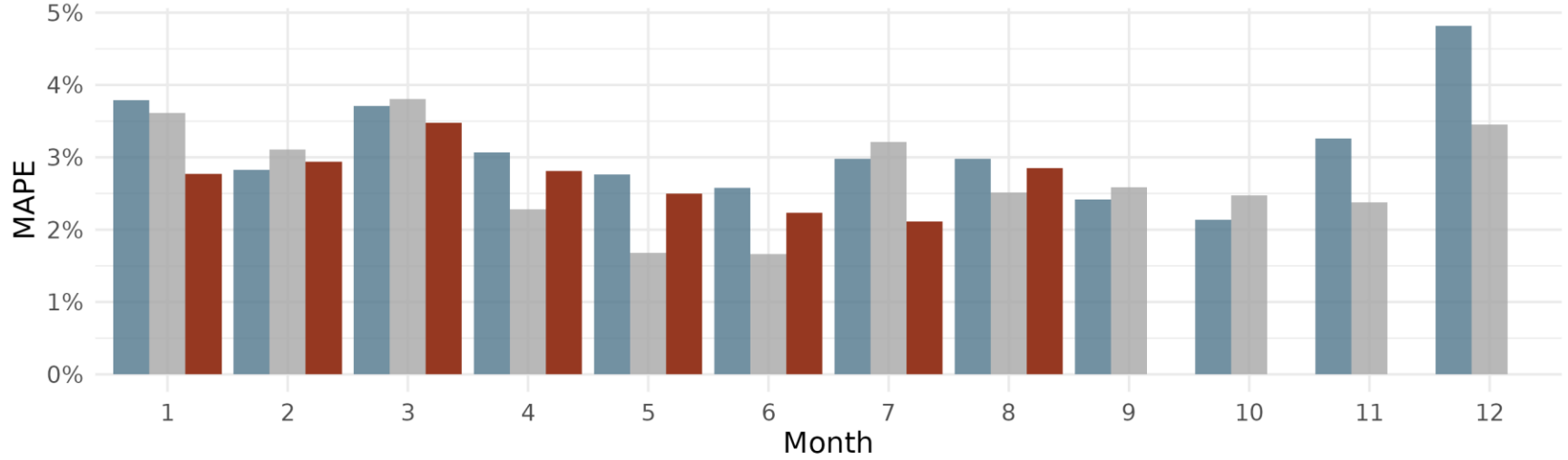


CAISO wind capacity

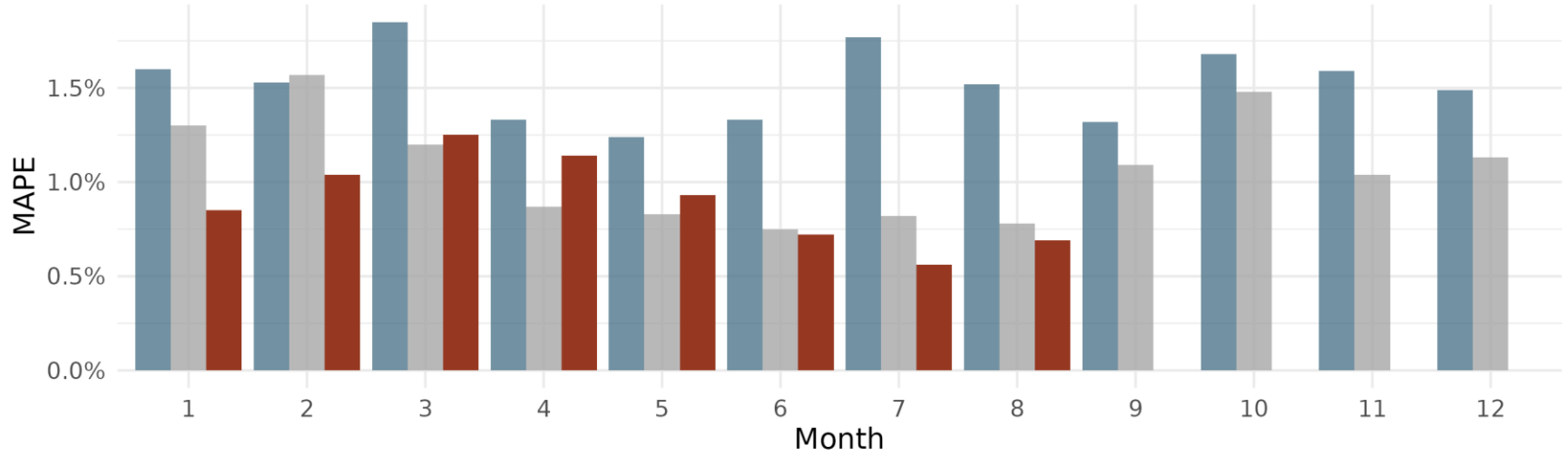


Note, the y-axis uses a non-zero baseline.

DA solar forecast

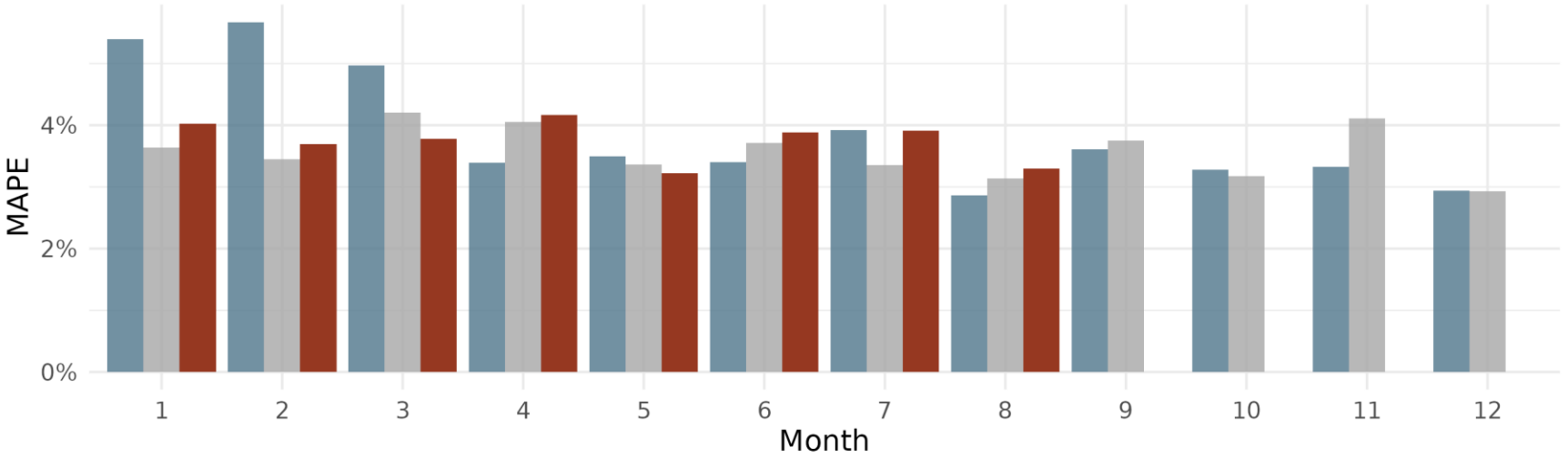


RTD solar forecast

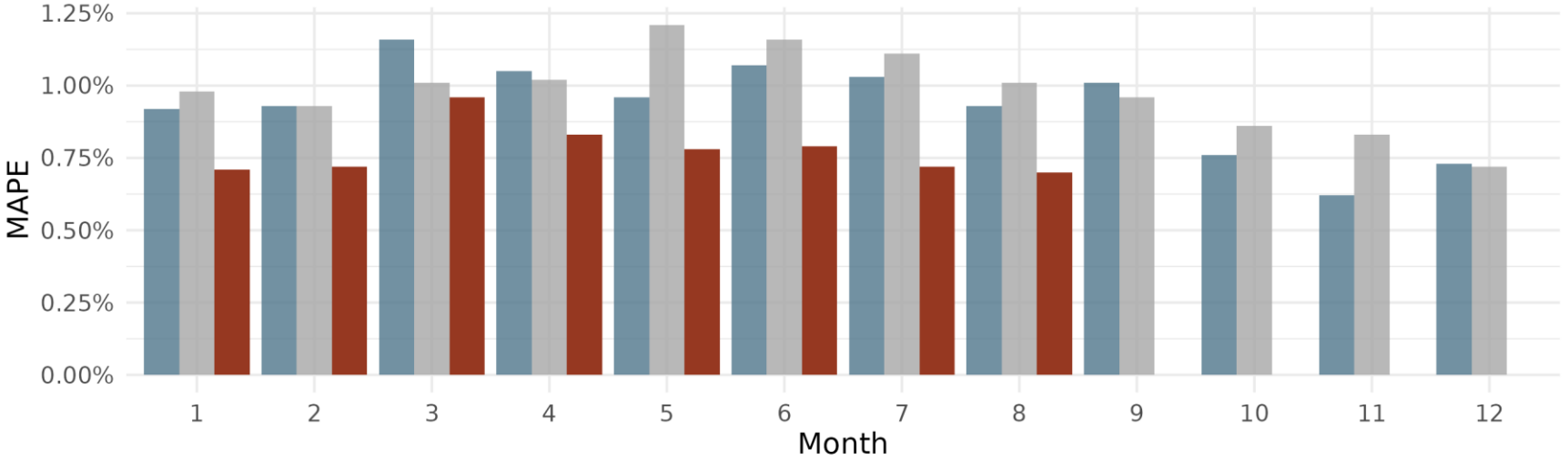


*MAPE = abs(Forecast – Actual)/Actual
**MAPE only calculated for intervals where Forecast > 0

DA wind forecast



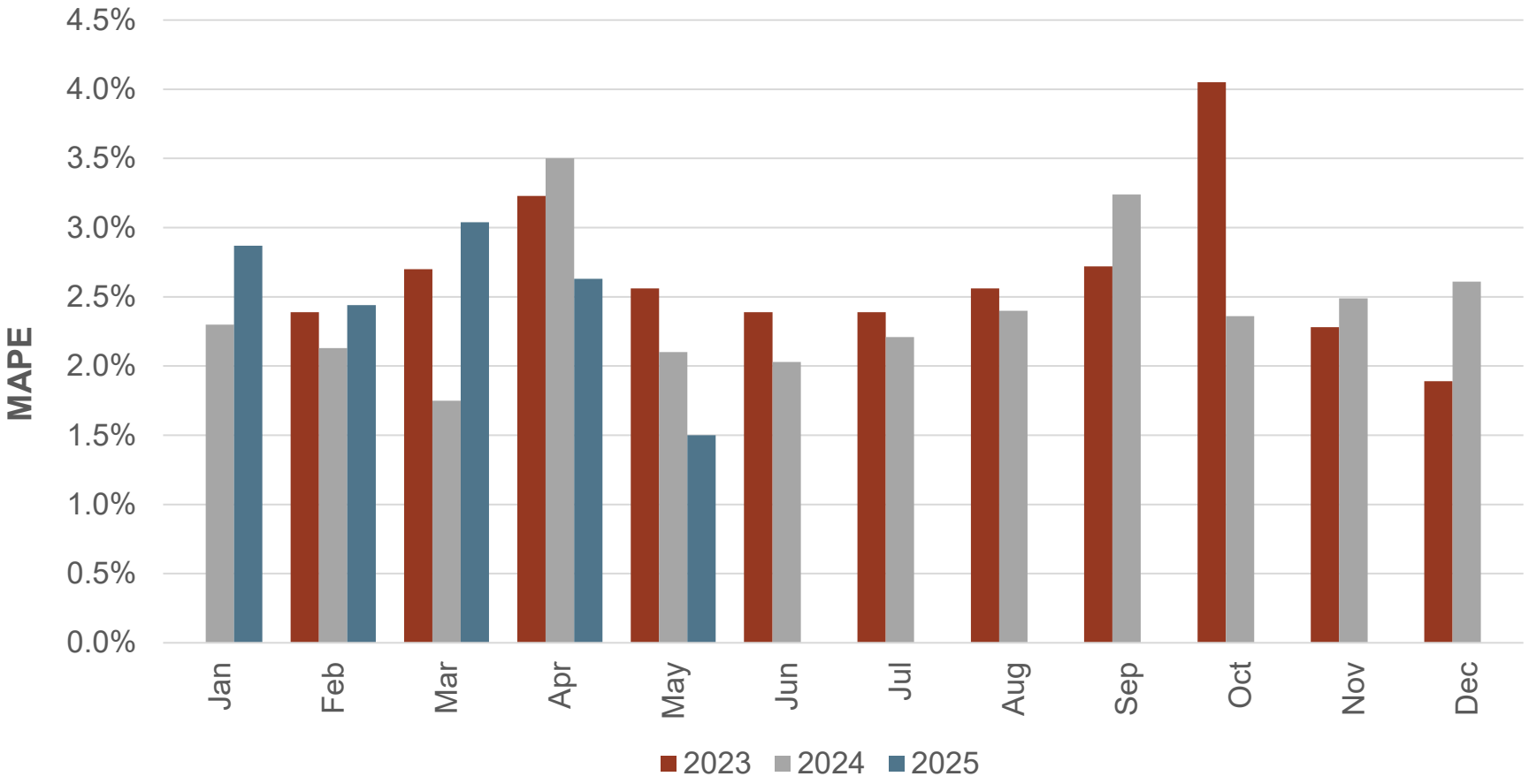
RTD wind forecast



*MAPE = abs(Forecast – Actual)/Actual

Real Time Solar Hybrid Performance

*Comparison of DOT to MW Production



*MAPE = abs(DOT – Actual)/Capacity