

WESTERN ENERGY MARKETS

2024 Annual Report on Market Issues and Performance

Ryan Kurlinski

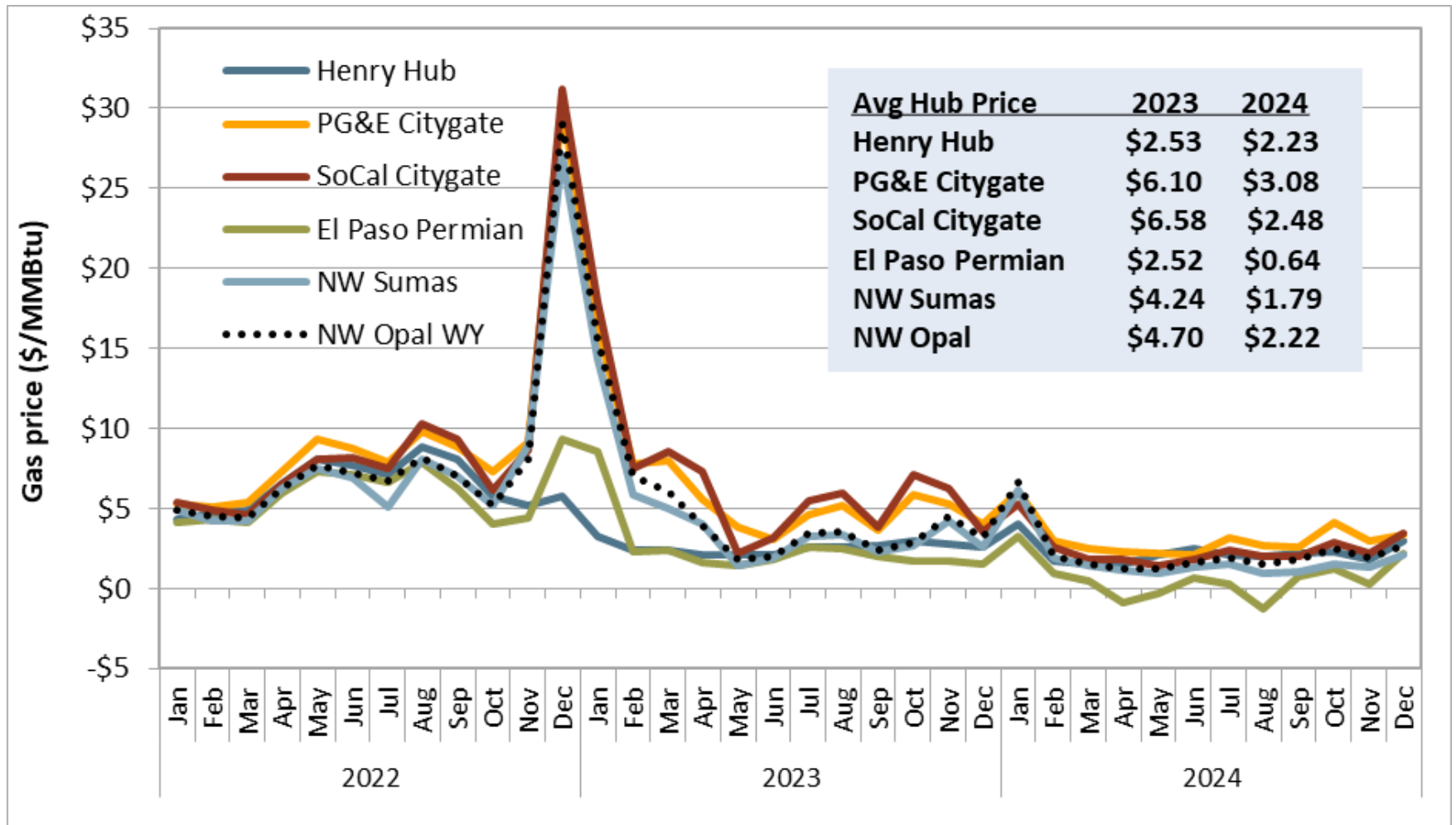
Senior Manager, Monitoring and Reporting
Department of Market Monitoring

August 12, 2025



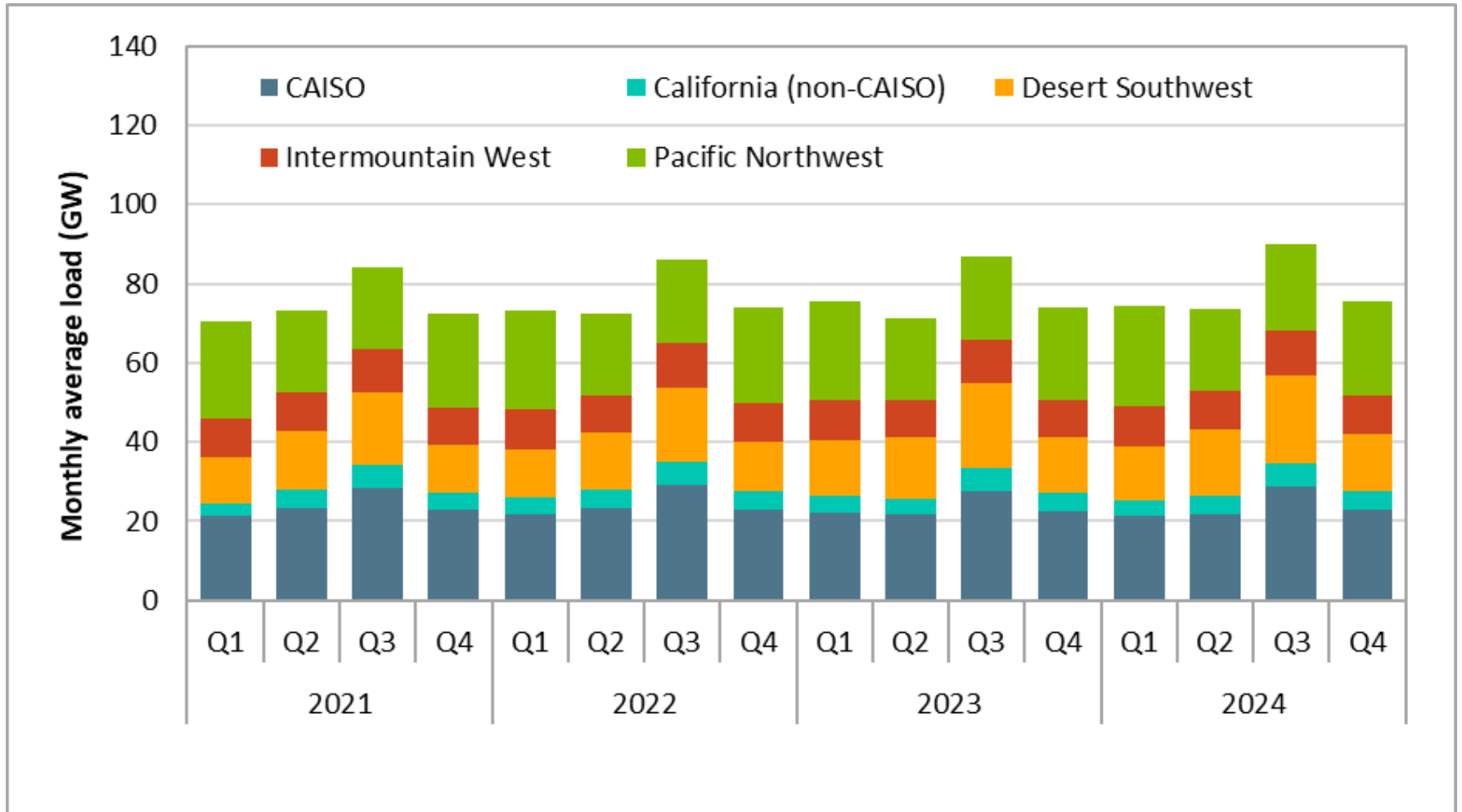
Natural gas prices at major Western hubs down over 50%

Monthly average natural gas prices (2022–2024)



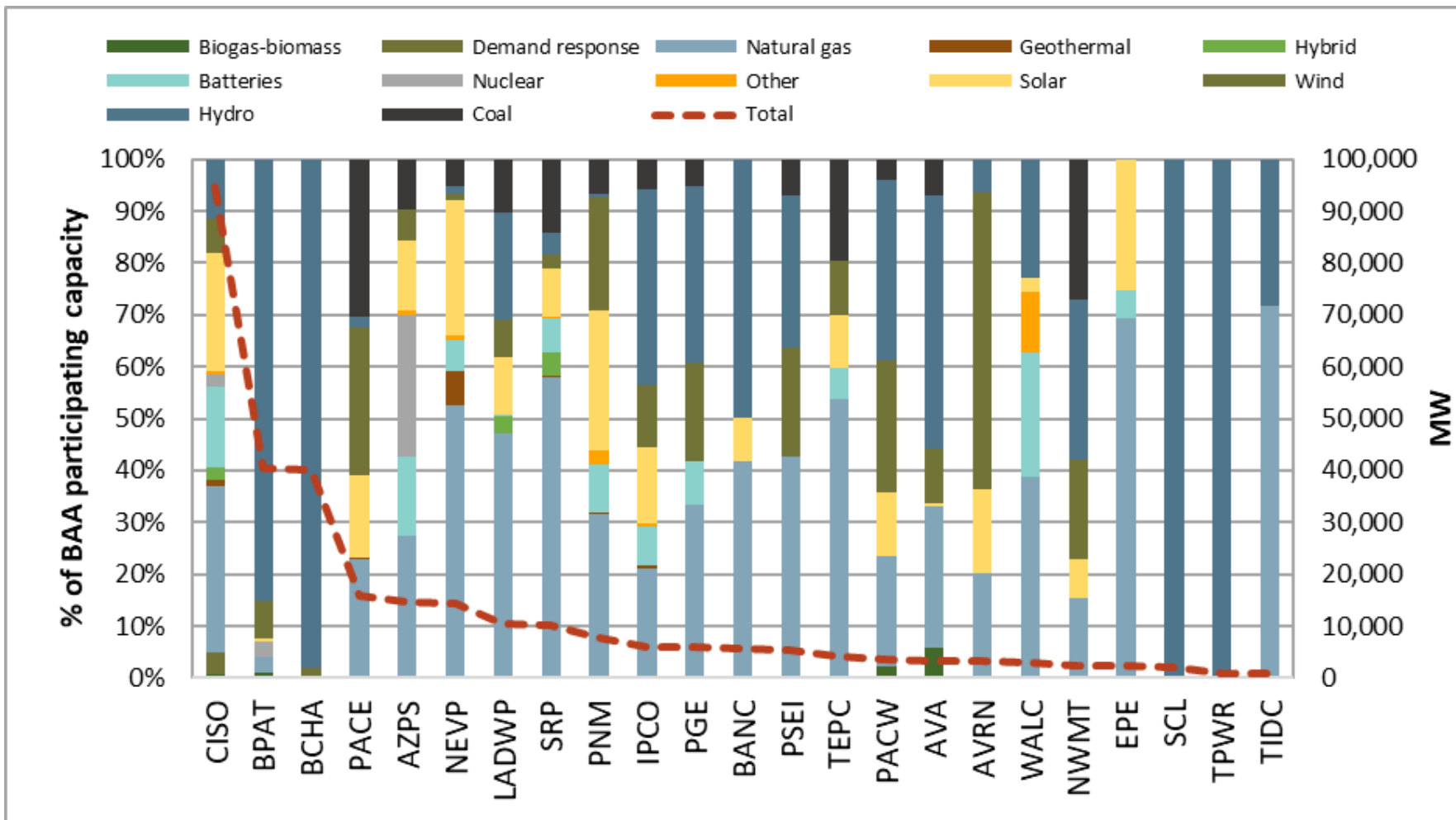
Load increased in every region, up 2% overall

Quarterly average 5-minute market load by region (GW)



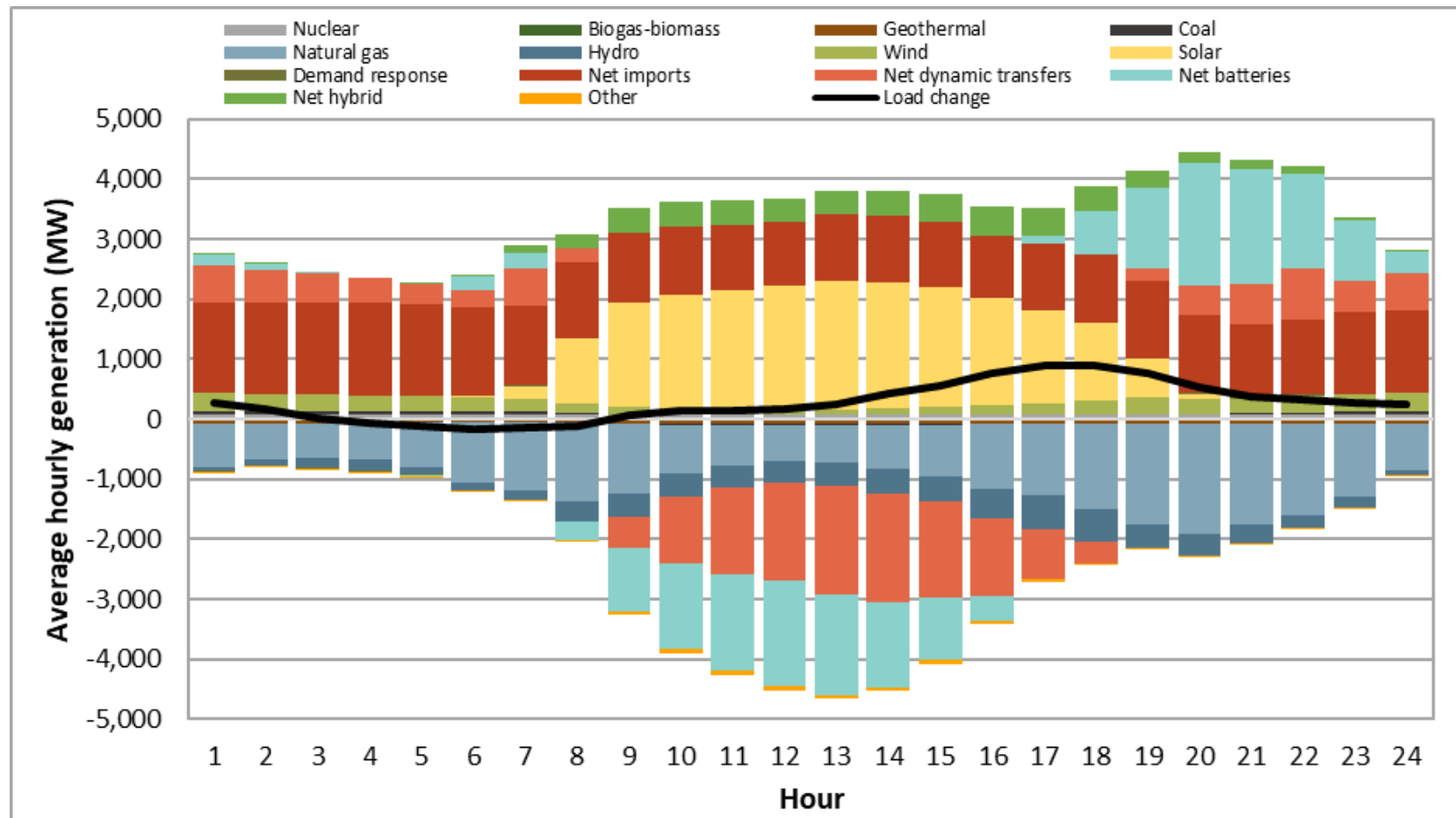
Diverse fuel mix across WEIM BAs

Fuel mix of WEIM nameplate capacity by BAA (as of June 1, 2025)



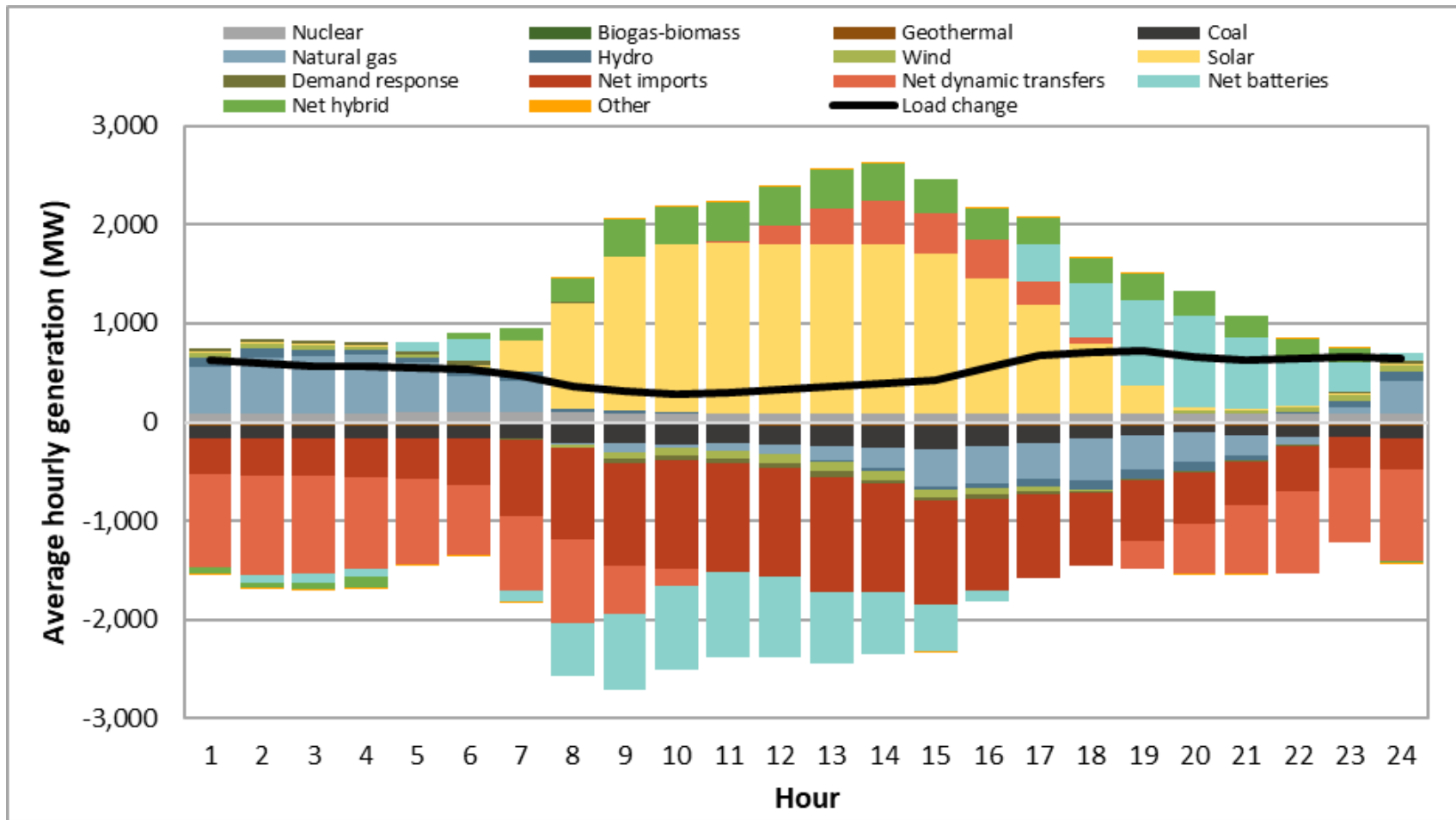
Solar, imports, and battery charge and discharge increased in California; natural gas generation down

Change in average hourly generation by fuel type in the California region (2024 compared to 2023)



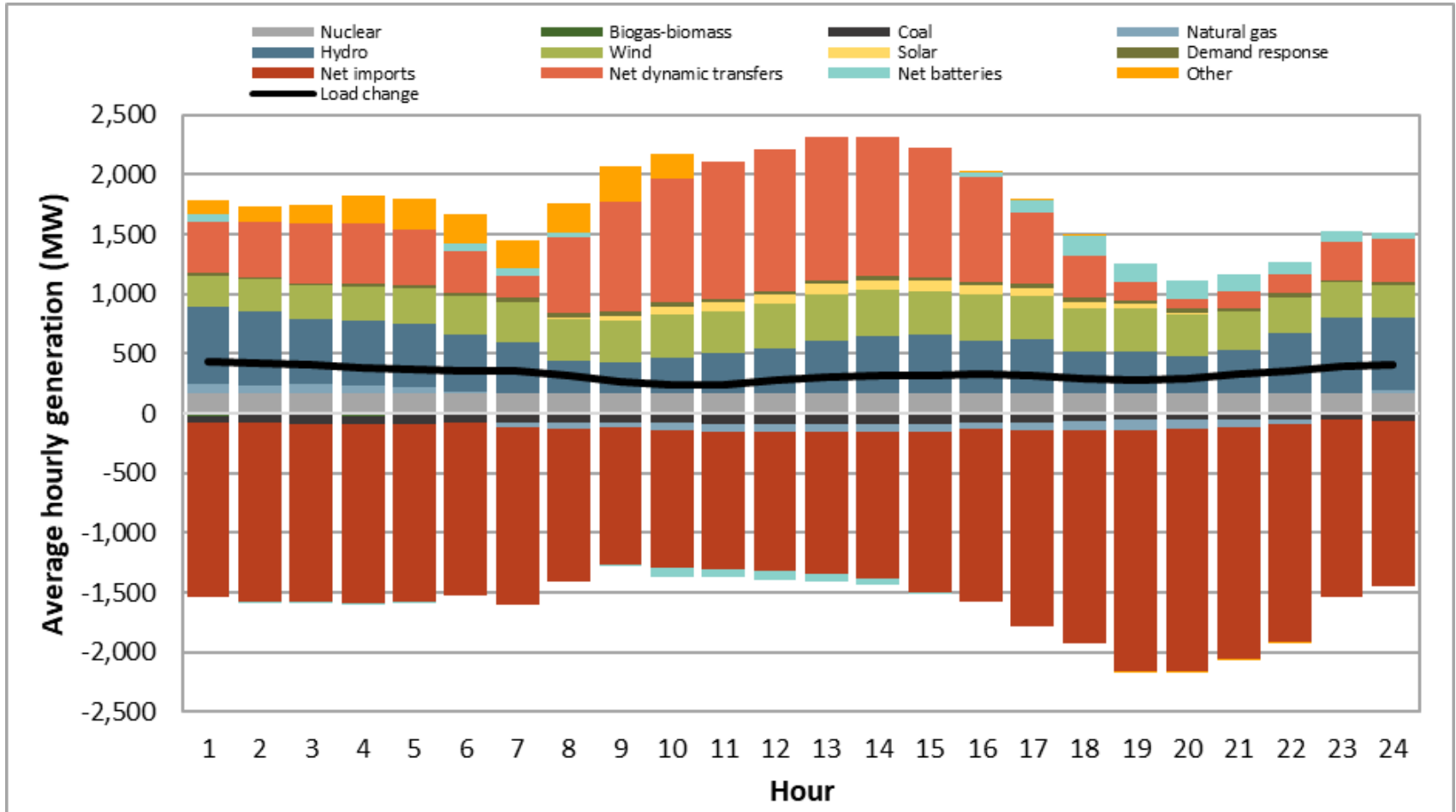
Desert Southwest: Solar and batteries up; imports and WEIM transfers in down

Change in average hourly generation by fuel type in the Desert Southwest region (2024 compared to 2023)



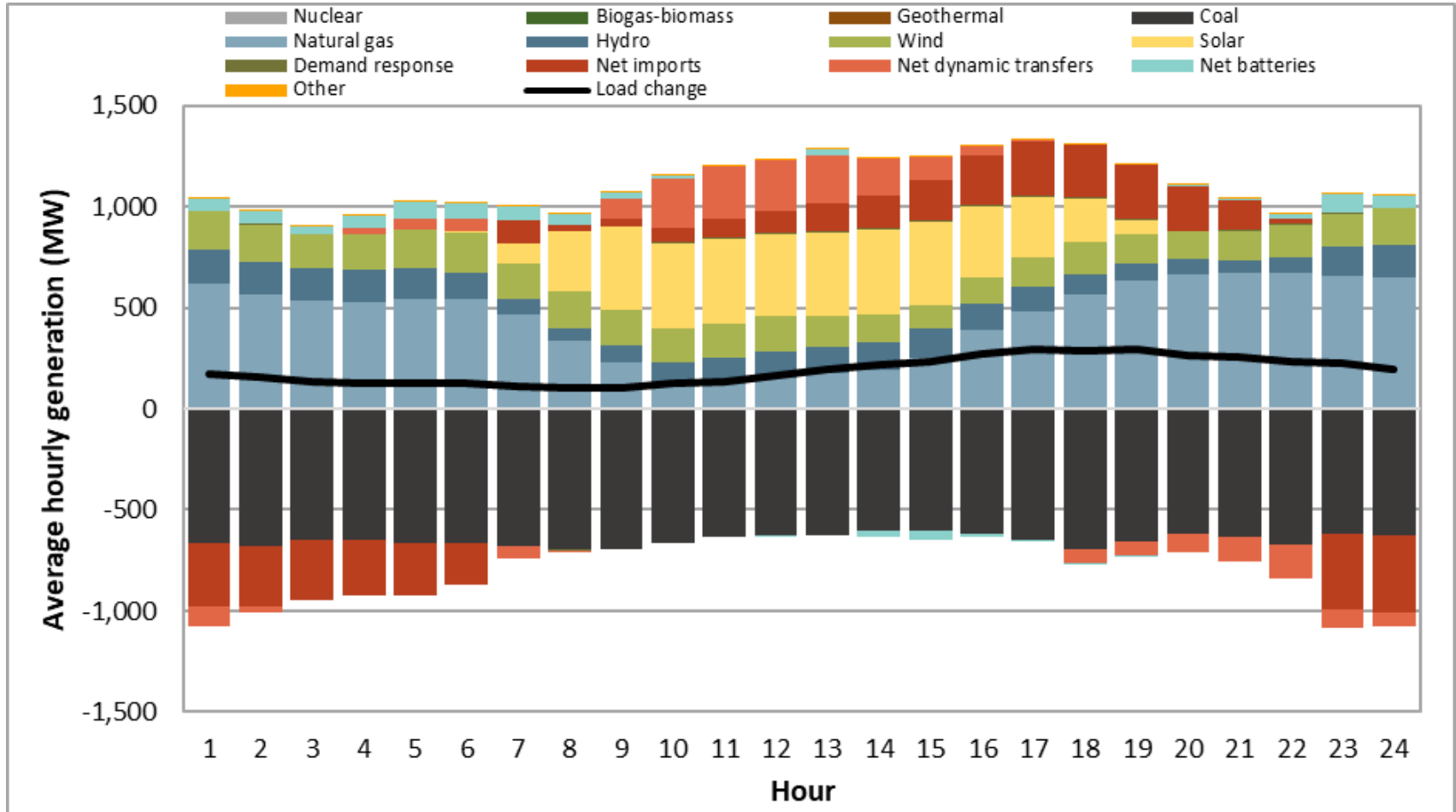
Pacific Northwest: hydro, wind, and WEIM transfers in increased; net imports decreased

Change in average hourly generation by fuel type in the Pacific Northwest region (2024 compared to 2023)



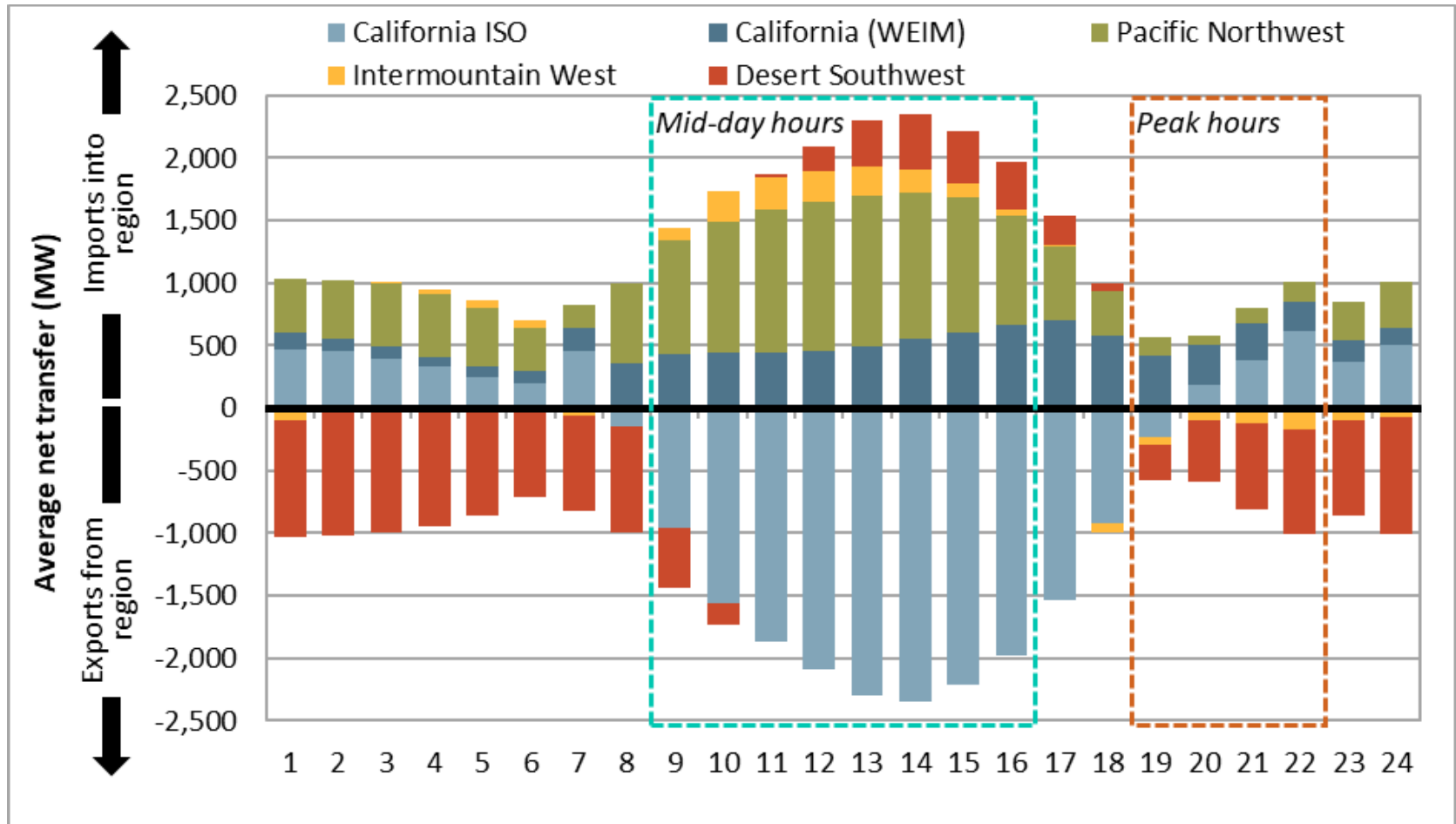
Intermountain West: Coal down; natural gas, solar and wind up

Change in average hourly generation by fuel type in the Intermountain West region (2024 compared to 2023)



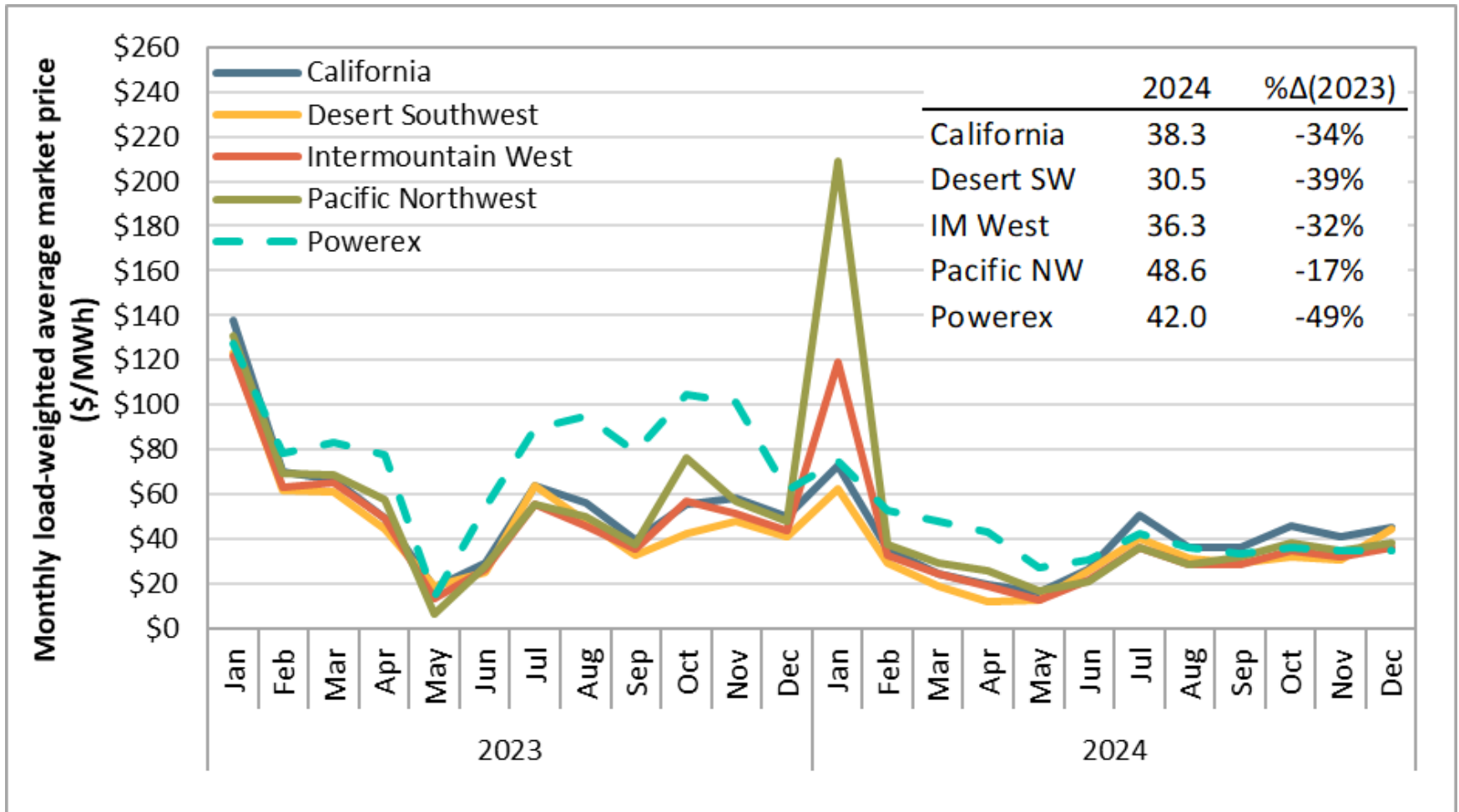
Main exporters of WEIM transfers: CAISO in solar hours; Desert Southwest in other hours

Average dynamic inter-regional WEIM transfers by hour
(5-minute market, 2024)



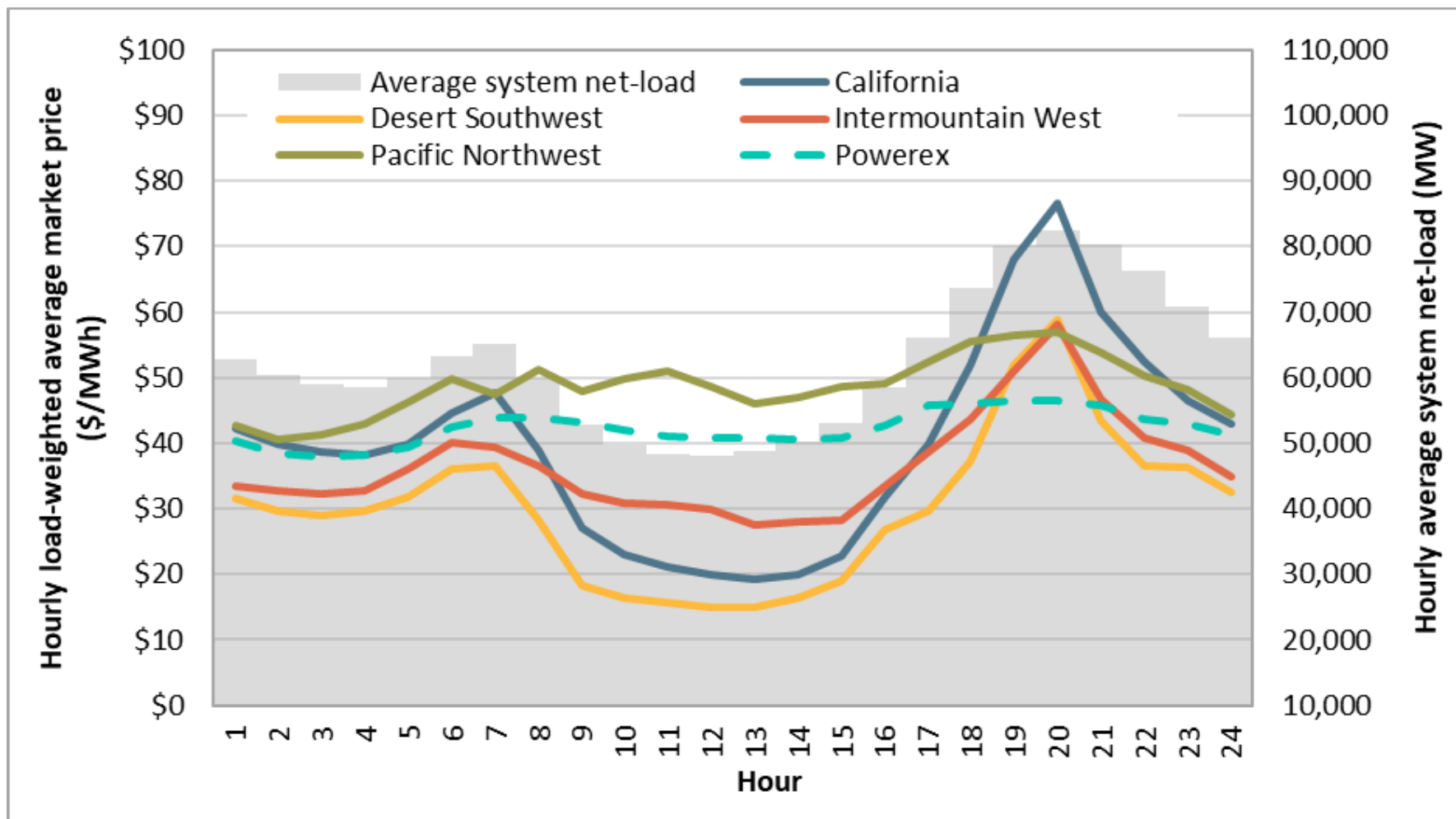
Across WEIM, 15-minute prices averaged \$40/MWh, down 35% due to lower natural gas prices

Weighted average monthly 15-minute market prices by region



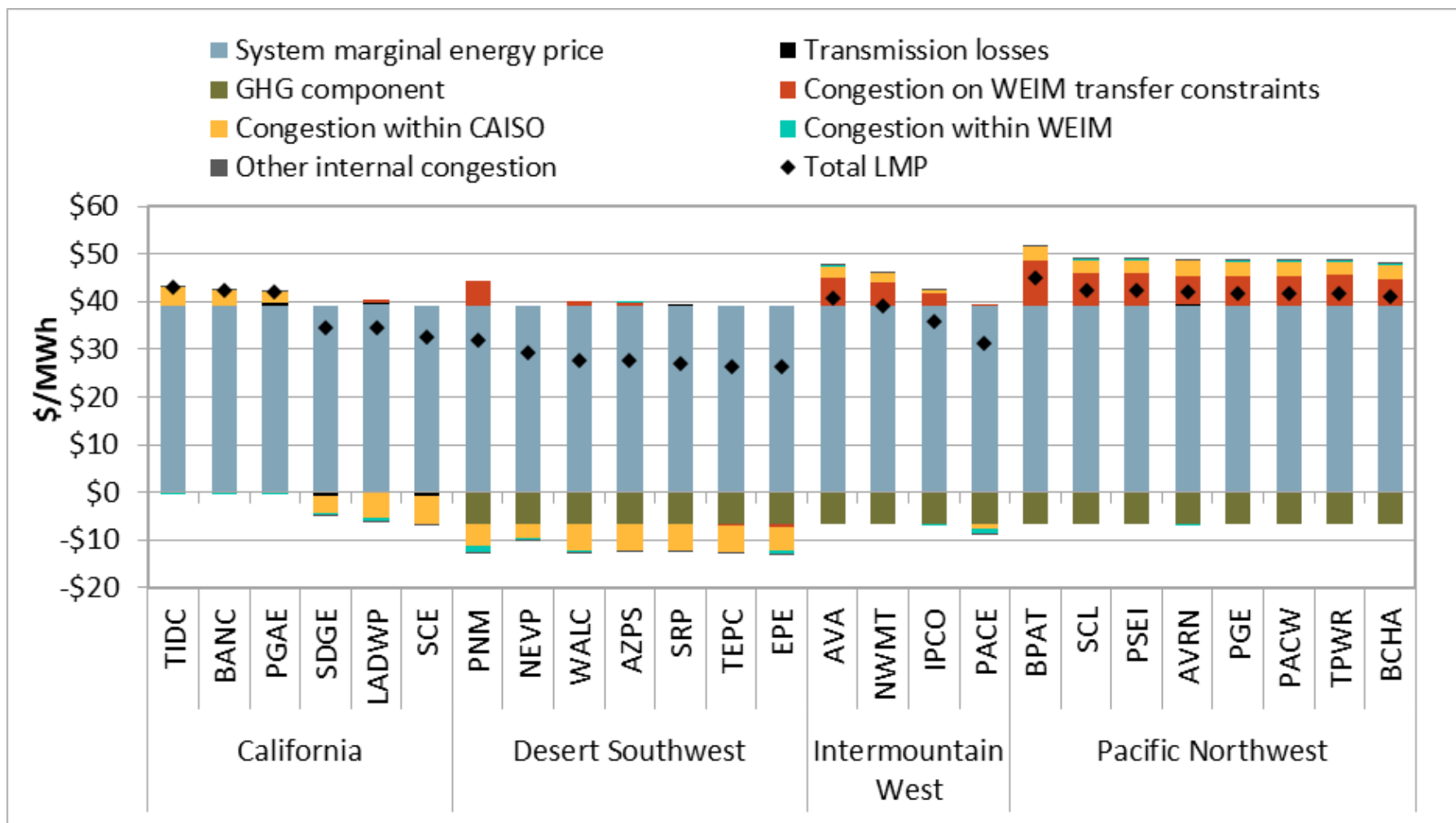
Pacific NW prices higher during mid-day solar hours; Other regions' prices follow net load pattern

Weighted average hourly 15-minute market prices by region (2024)



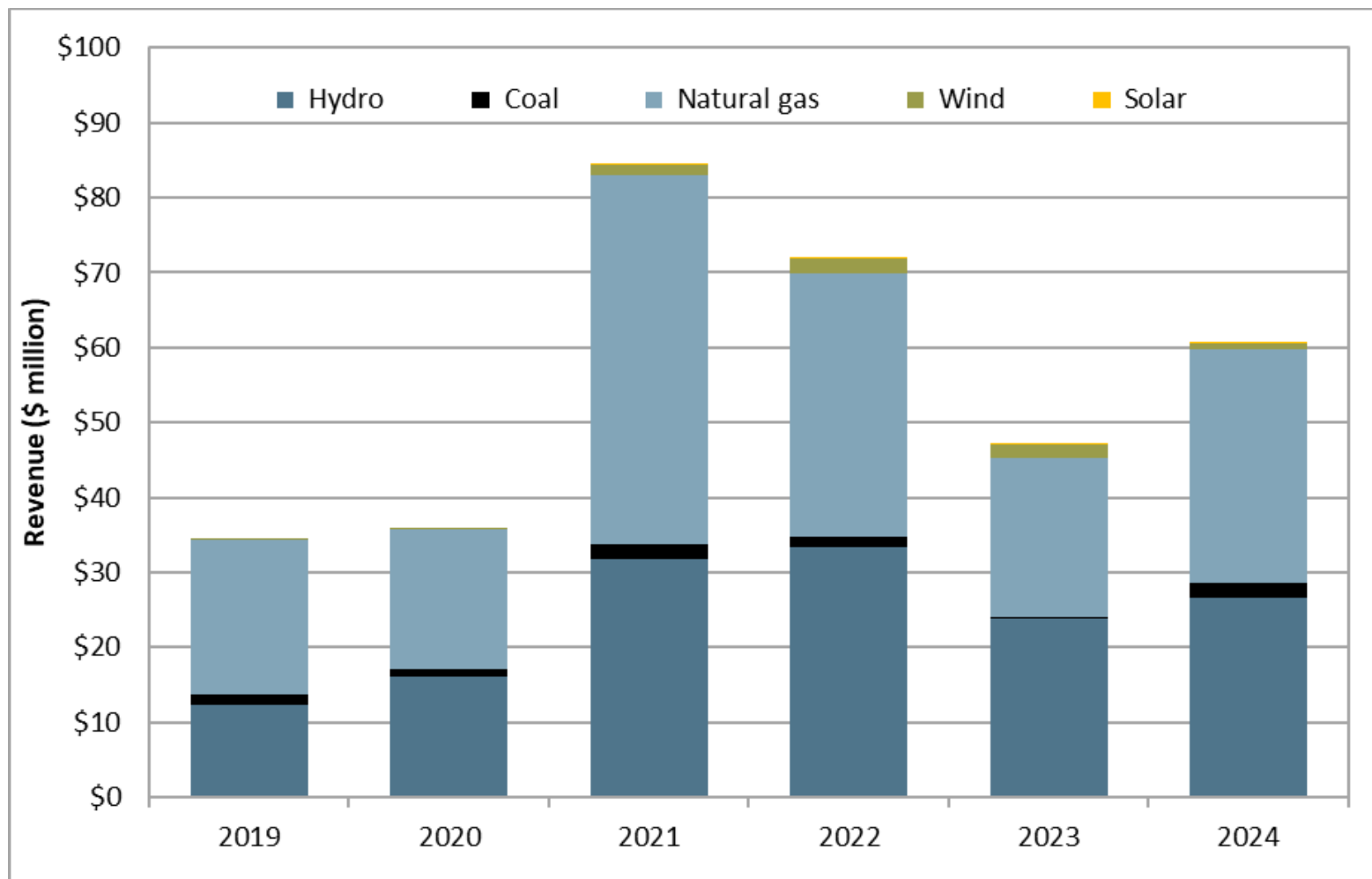
GHG costs increase prices in California; transfer congestion elevates prices in Northwest

Average 15-minute market prices by balancing area (2024)



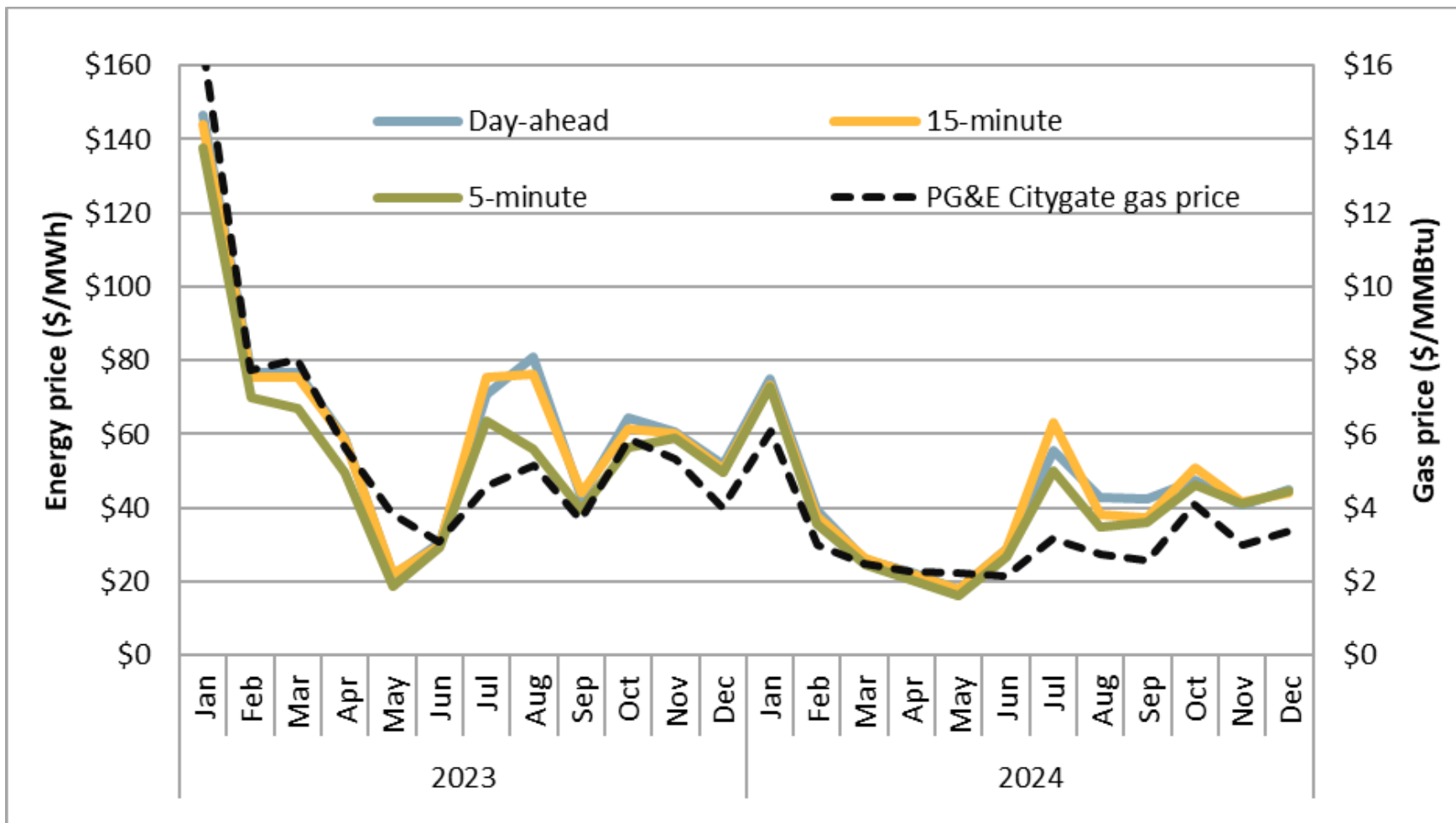
GHG revenues from transfers to California almost \$61 million

Annual greenhouse gas revenues from WEIM transfers to California



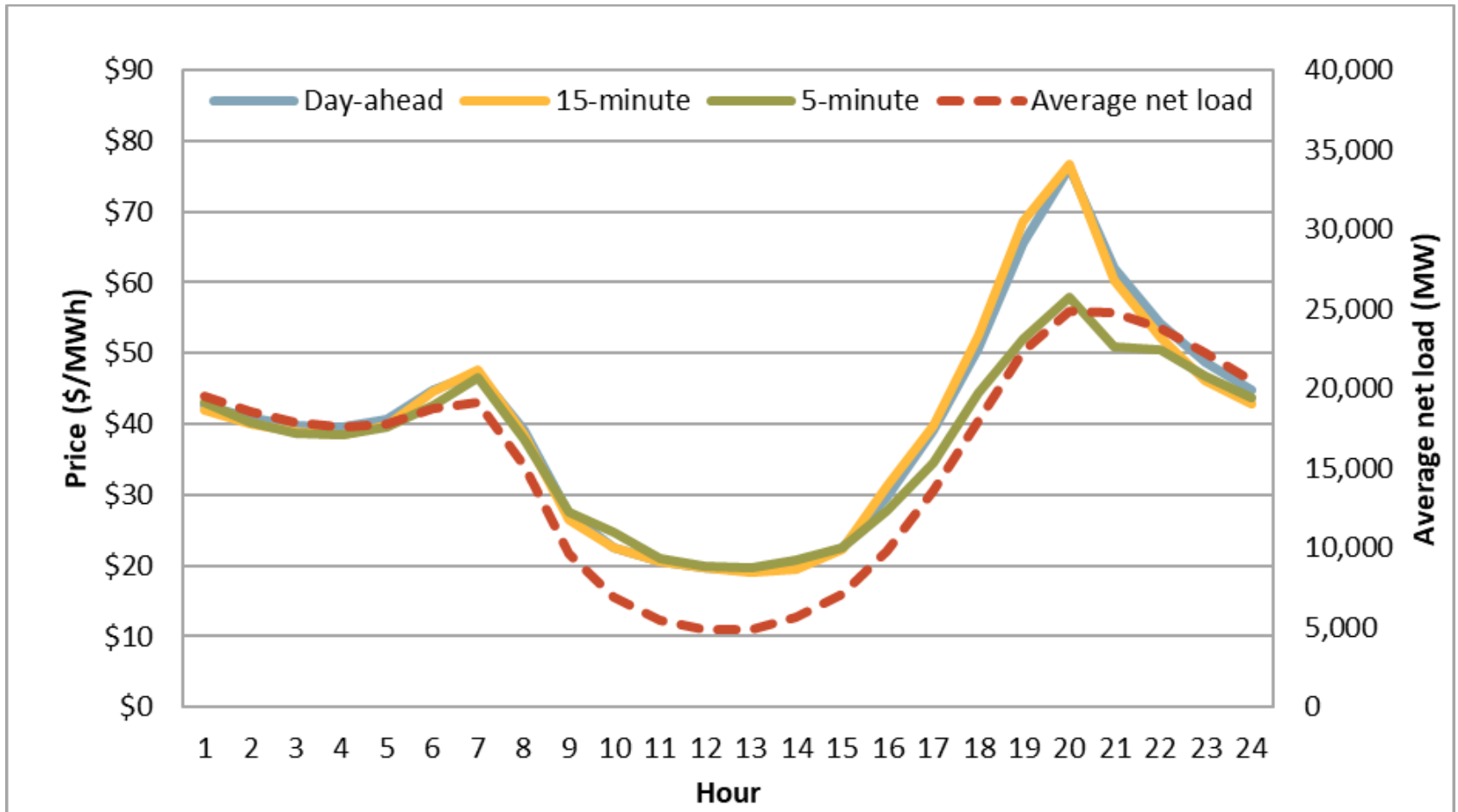
Electricity prices continue to follow natural gas prices

Monthly average PG&E Citygate gas price and load-weighted average electricity prices for balancing areas in day-ahead market (CAISO)



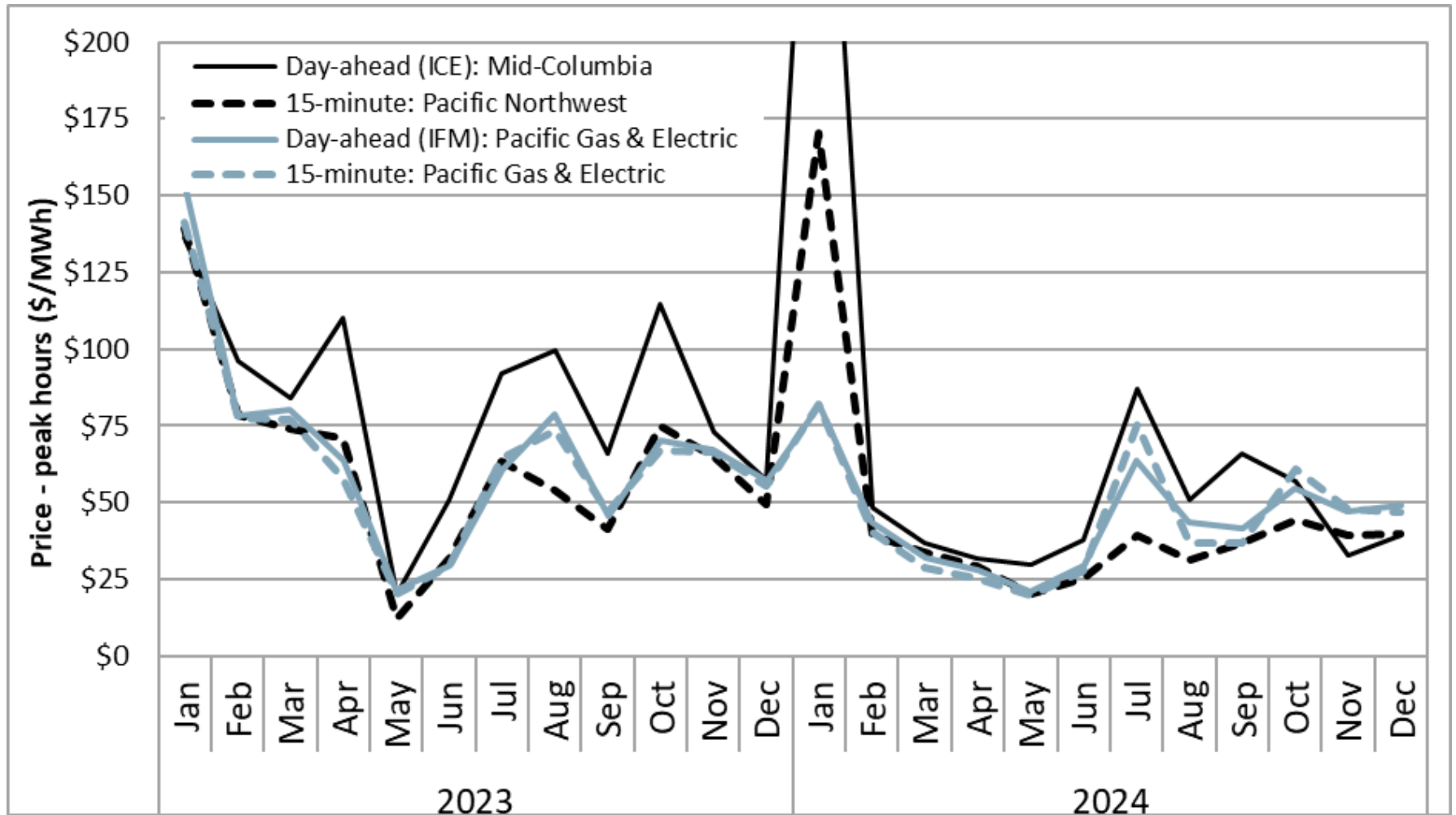
CAISO 15-minute > 5-minute prices over peak net load hours due to load adjustments

Hourly load-weighted average energy prices for balancing areas in day-ahead market (CAISO 2024)



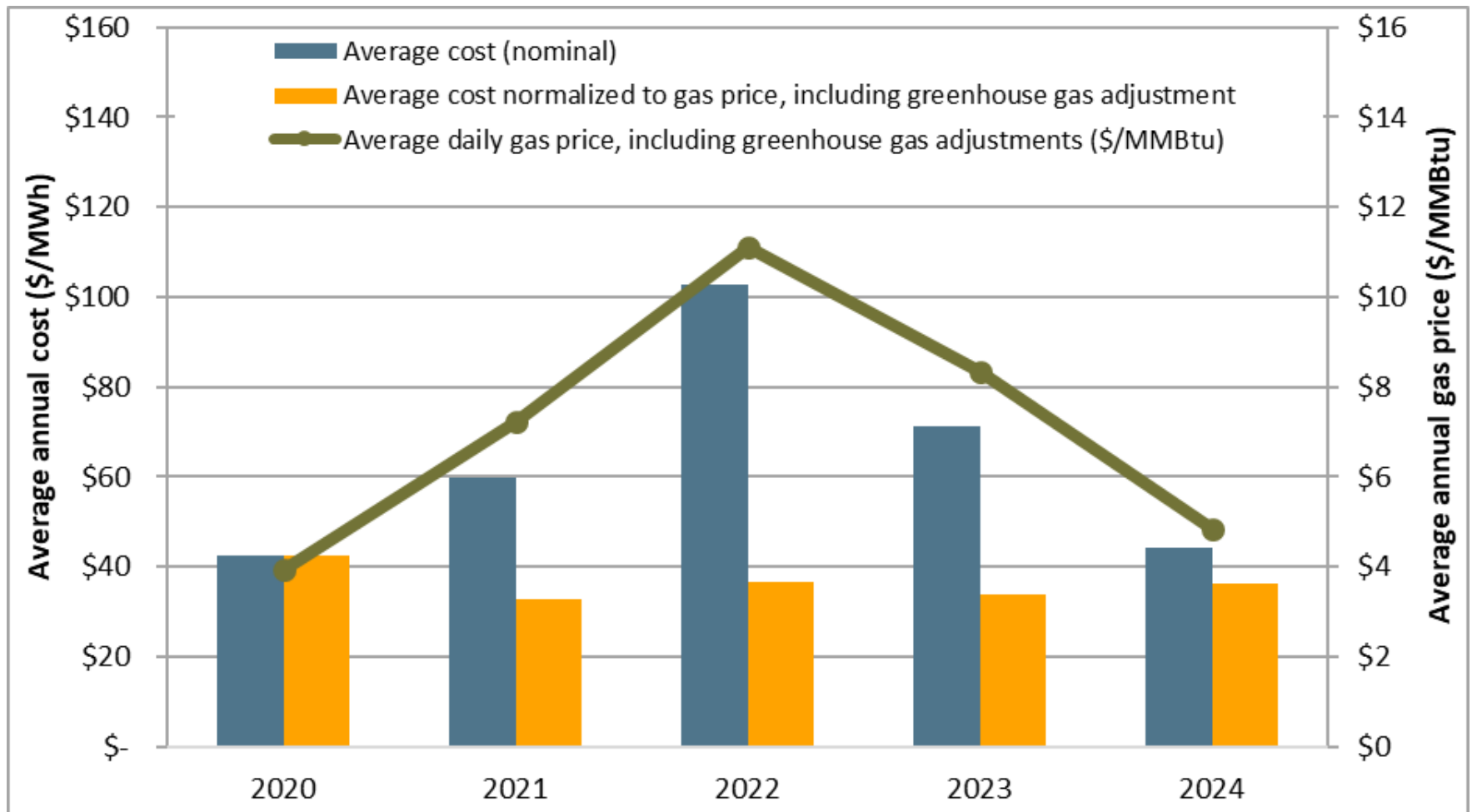
Mid-C bilateral day-ahead prices > comparable ISO market prices through the 3rd quarter

Mid-C bilateral ICE vs. Pacific Northwest 15-minute market prices (peak hours)



Total CAISO wholesale costs down 38%, but up 7% after accounting for lower gas costs

Total annual wholesale costs per MWh of load (2020–2024)



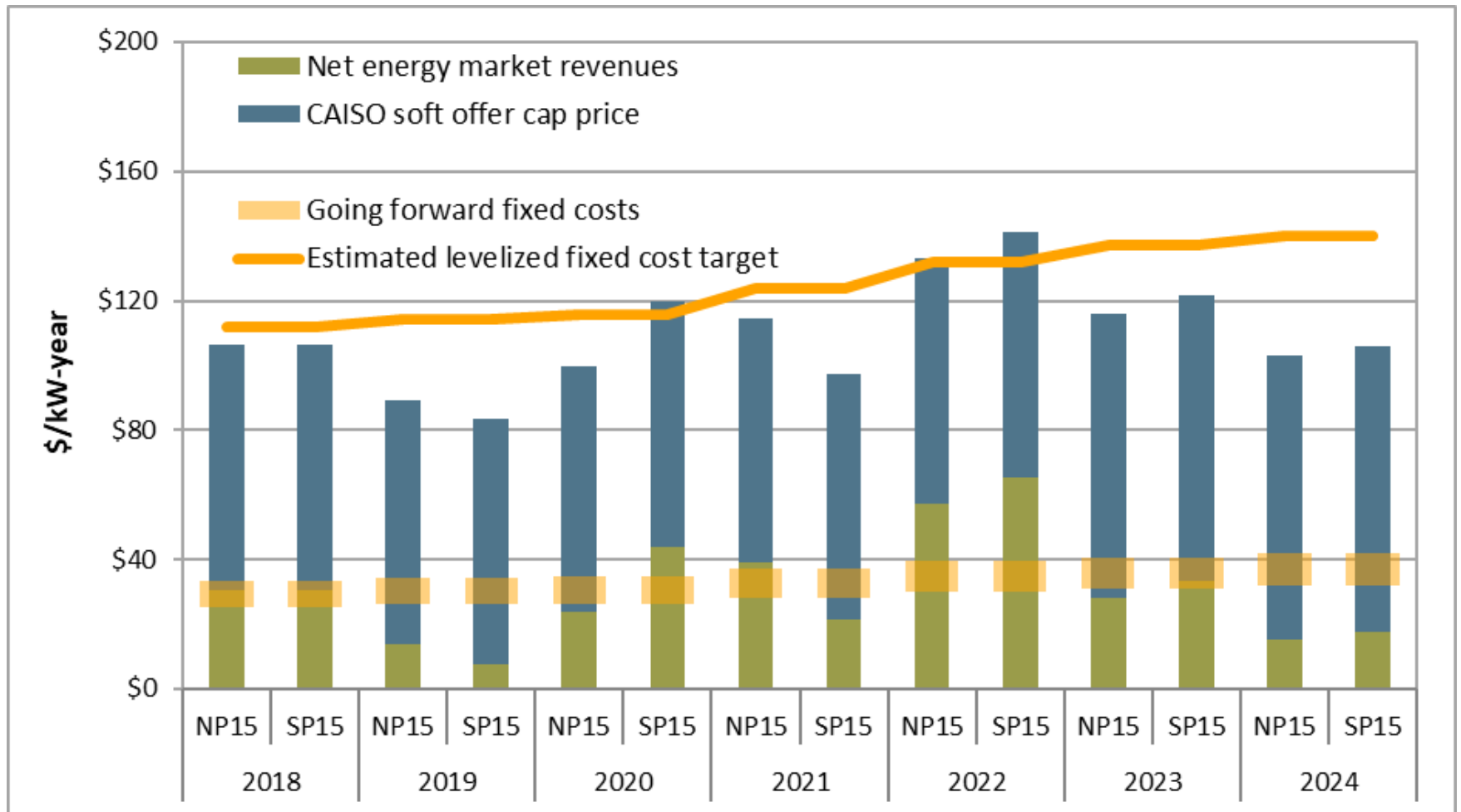
Most significant components of wholesale costs decreased around 30% - 40%

Estimated average wholesale energy costs per MWh (2020–2024)

	2020	2021	2022	2023	2024	Change '23-'24
Day-ahead energy costs	\$ 38.61	\$ 56.37	\$ 96.06	\$ 65.92	\$ 40.94	\$ (24.97)
Real-time energy costs (incl. flex ramp)	\$ 1.65	\$ 1.28	\$ 3.51	\$ 2.42	\$ 1.52	\$ (.90)
Grid management charge	\$.46	\$.45	\$.45	\$.50	\$.51	\$.01
Bid cost recovery costs	\$.59	\$.74	\$ 1.18	\$ 1.36	\$.68	\$ (.67)
Reliability costs (RMR and CPM)	\$.07	\$.19	\$.23	\$.07	\$ 0.00	\$ (.07)
Average total energy costs	\$ 41.39	\$ 59.03	\$ 101.43	\$ 70.26	\$ 43.66	\$ (26.60)
Reserve costs (AS and RUC)	\$ 1.02	\$.84	\$ 1.20	\$.81	\$.56	\$ (.25)
Average total costs of energy and reserve	\$ 42.41	\$ 59.87	\$ 102.63	\$ 71.08	\$ 44.22	\$ (26.86)

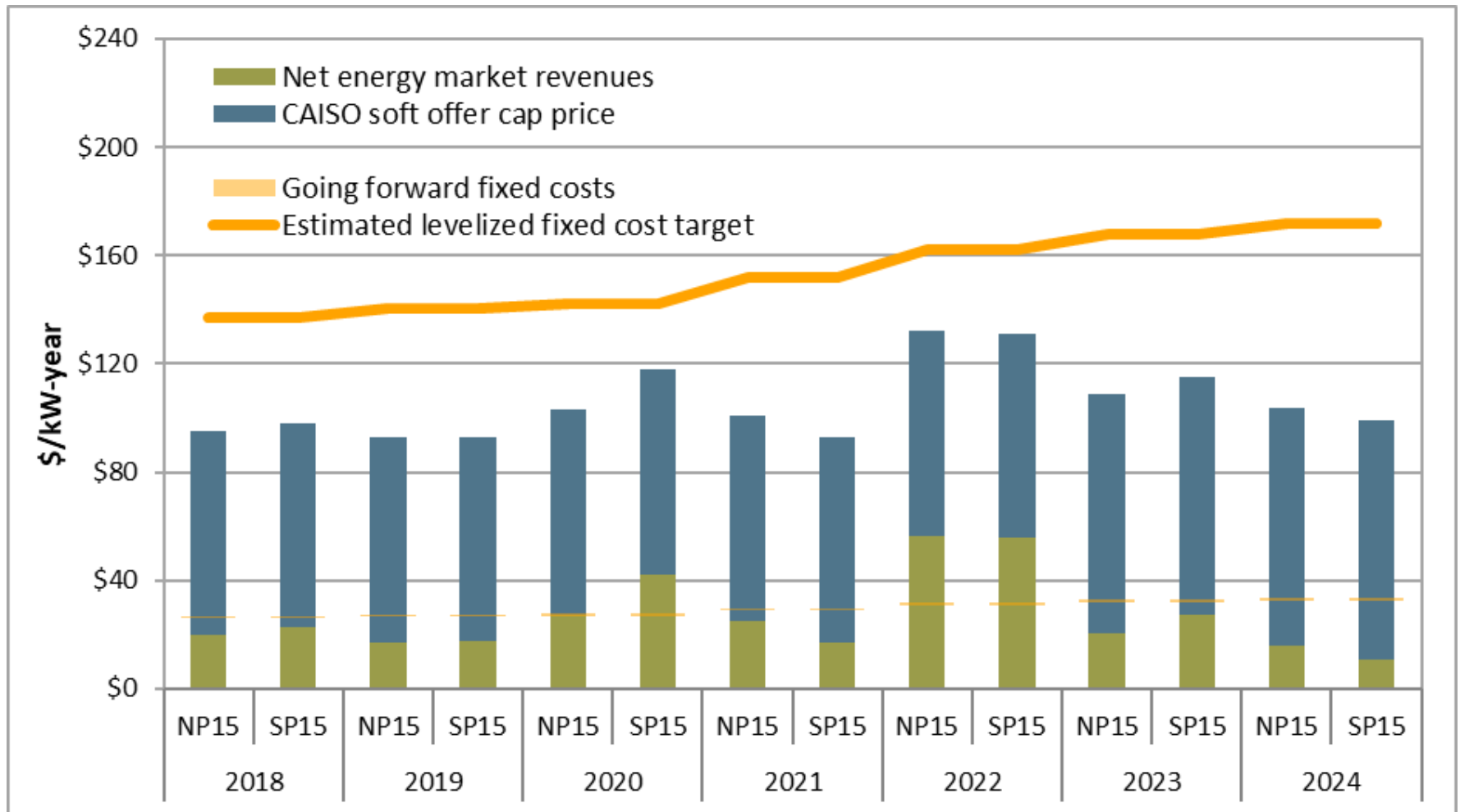
Estimated net energy market revenues for new combined cycle below levelized and going forward fixed costs

Estimated net revenue of hypothetical combined cycle unit



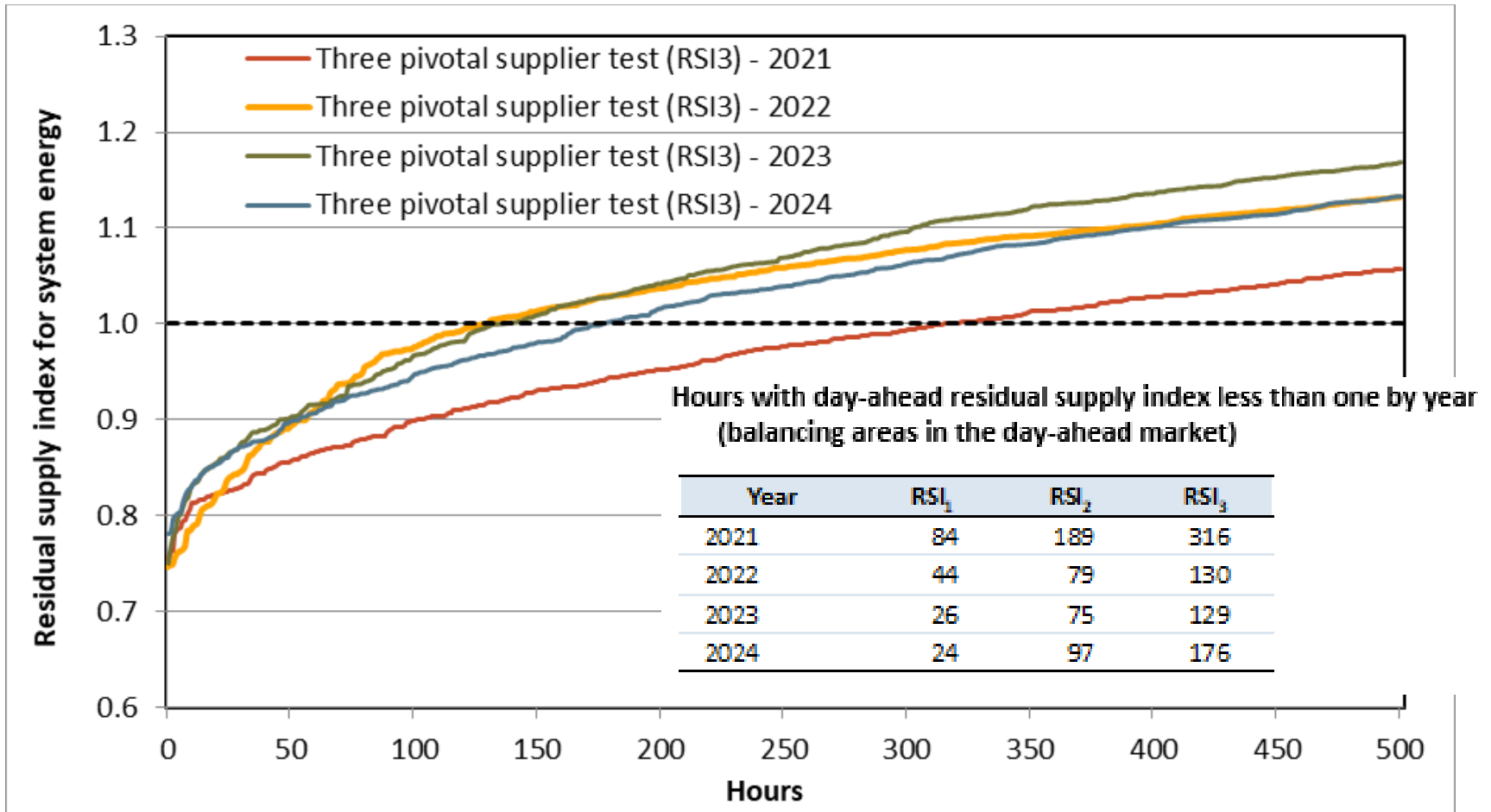
Estimated net energy market revenues for new combustion turbine below levelized and going forward fixed costs

Estimated net revenue of hypothetical combustion turbine unit



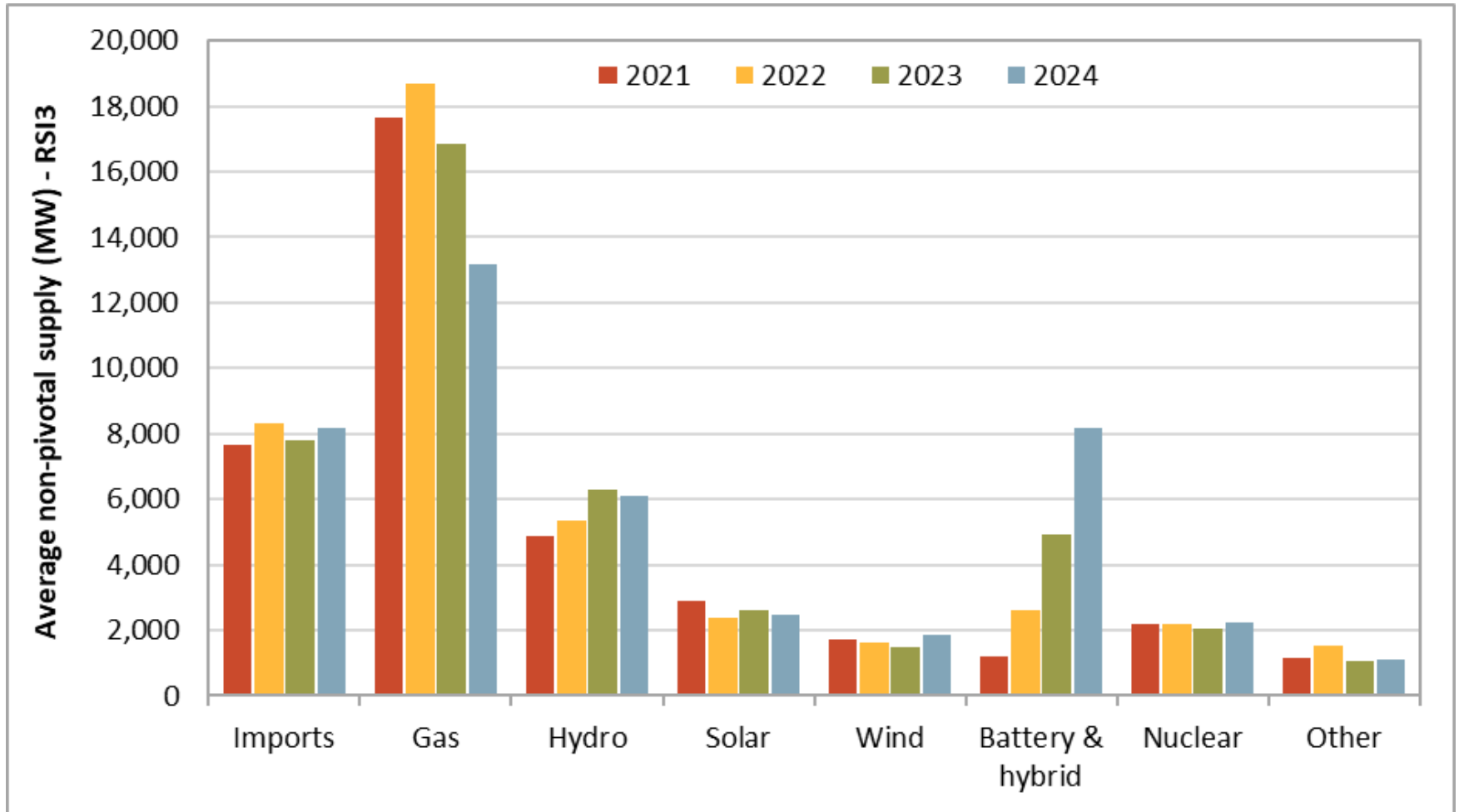
Structural competitiveness of day-ahead market similar to 2022 and 2023

Day-ahead residual supply index with largest three suppliers excluded (balancing areas in the day-ahead market, lowest 500 hours)



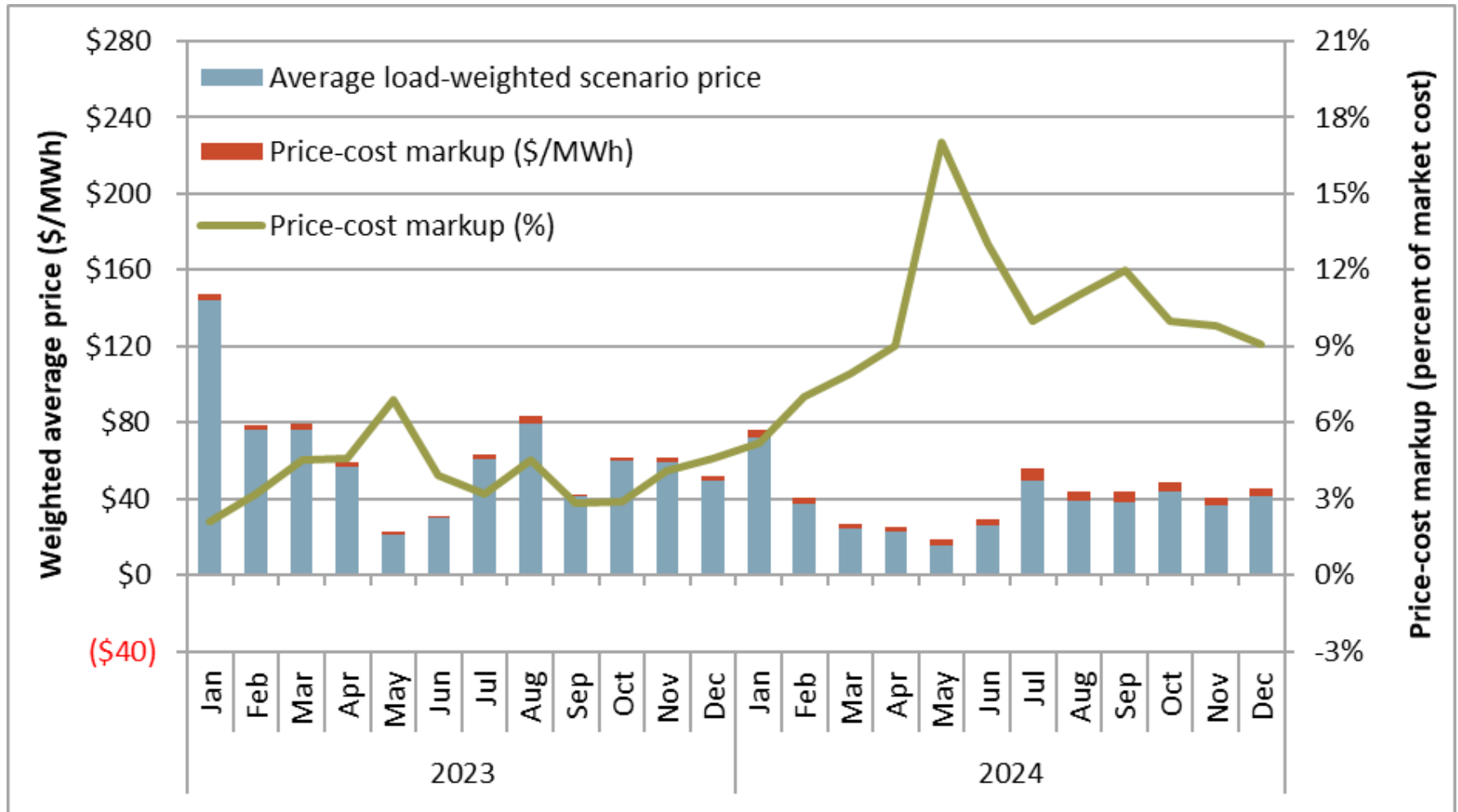
Growing battery capacity contributing to market competitiveness

Non-pivotal supply with the largest three suppliers excluded
(balancing areas in the day-ahead market, lowest 500 hours)



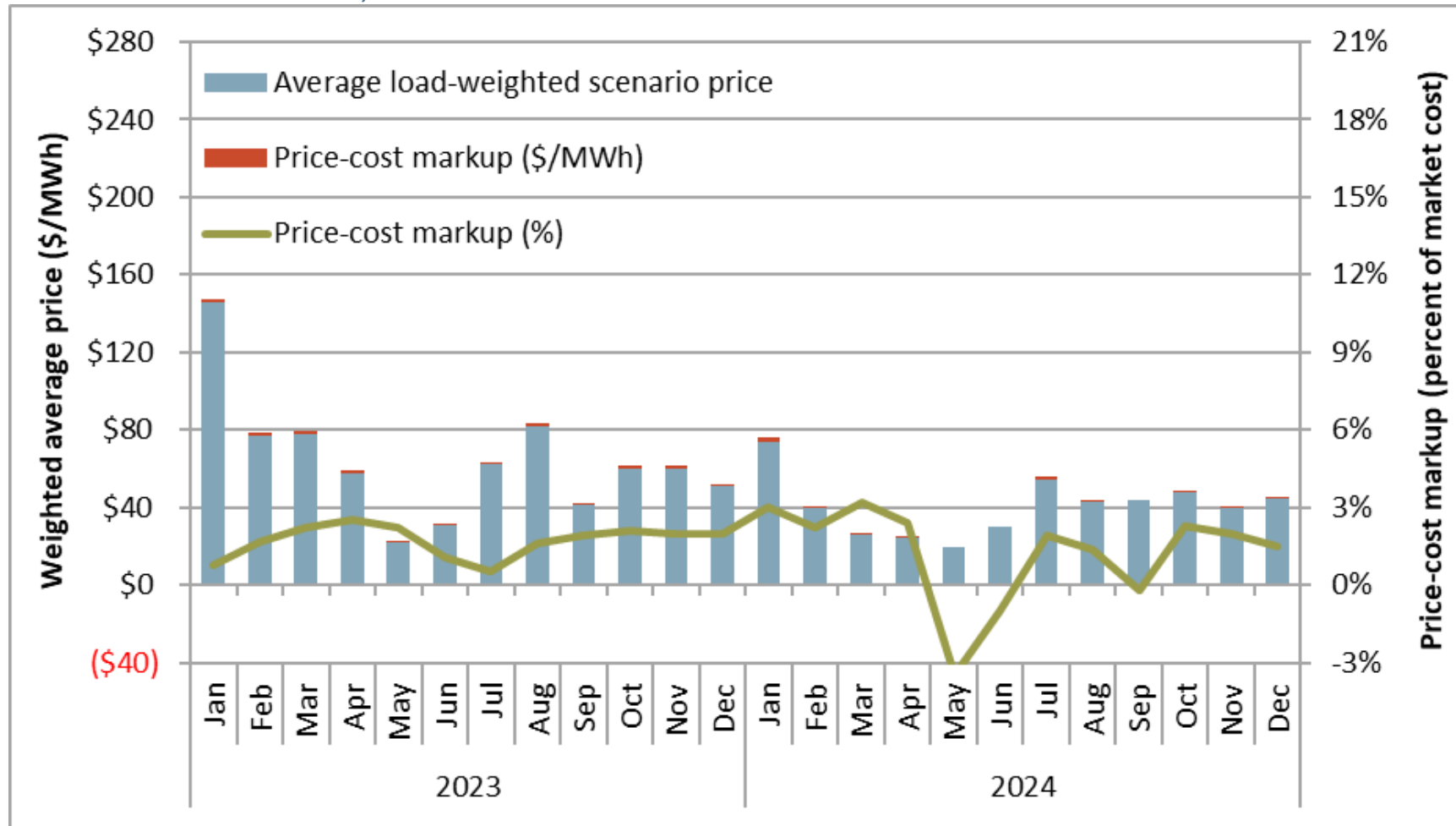
Price-cost markup increases to \$4.08/MWh

Day-ahead market price-cost markup (comprehensive scenario)



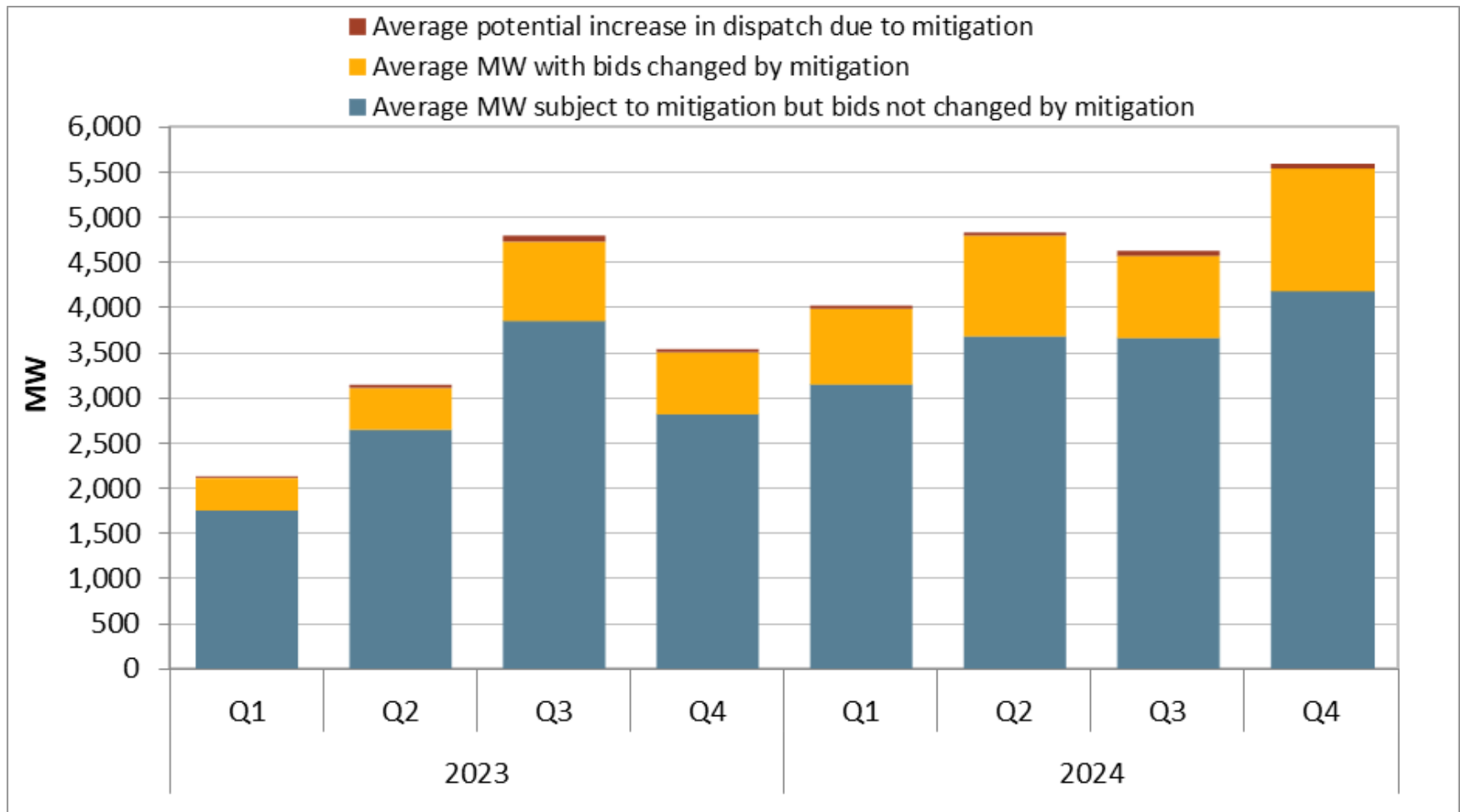
Increased price-cost markup due to less commitment of gas resources

Day-ahead market price-cost markup (gas cost-based scenario – no substitution of commitment cost bids)



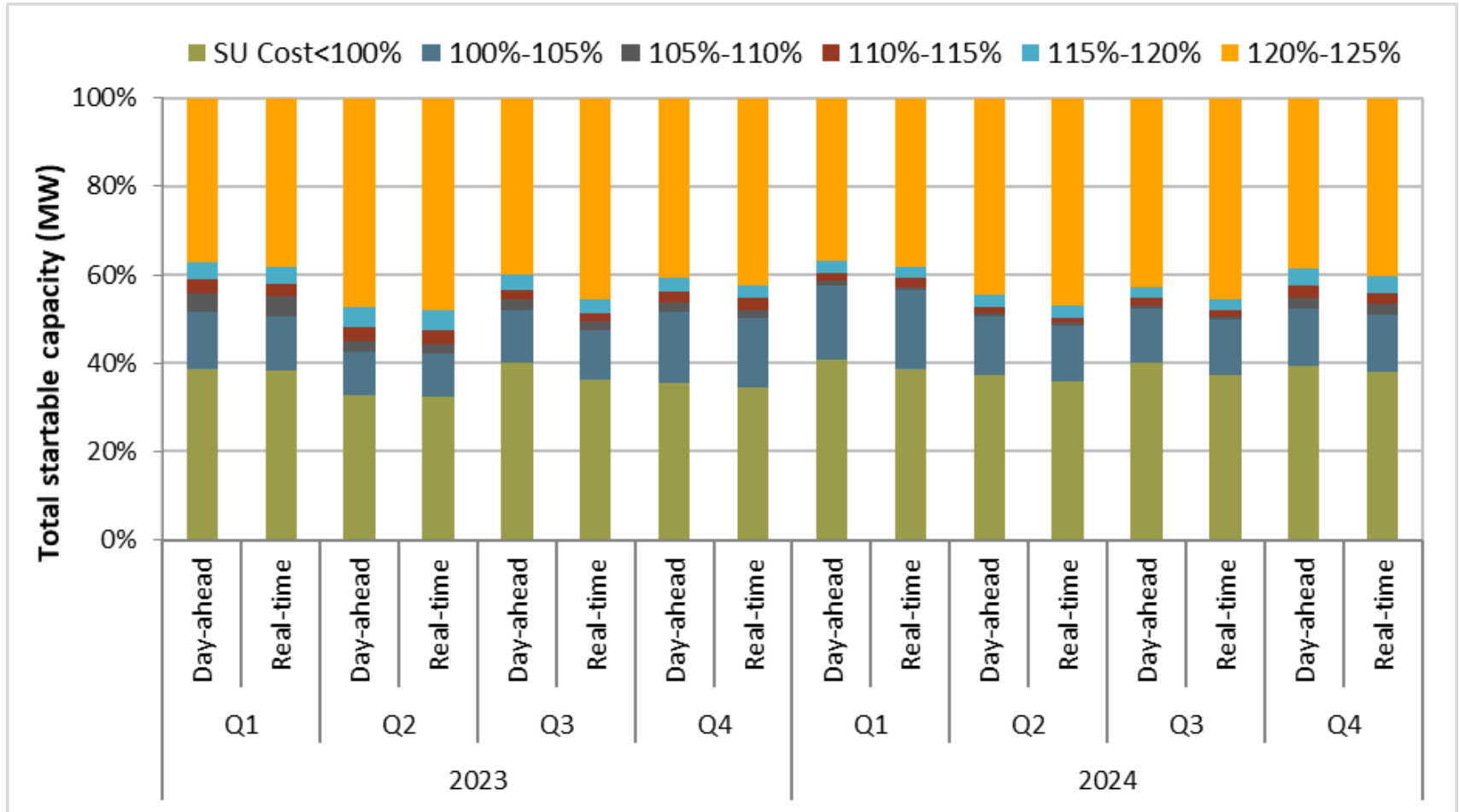
Bids considered for mitigation up in 2024, but bids changed by mitigation and increase in dispatch remained very low

Average incremental energy considered for mitigation in day-ahead market



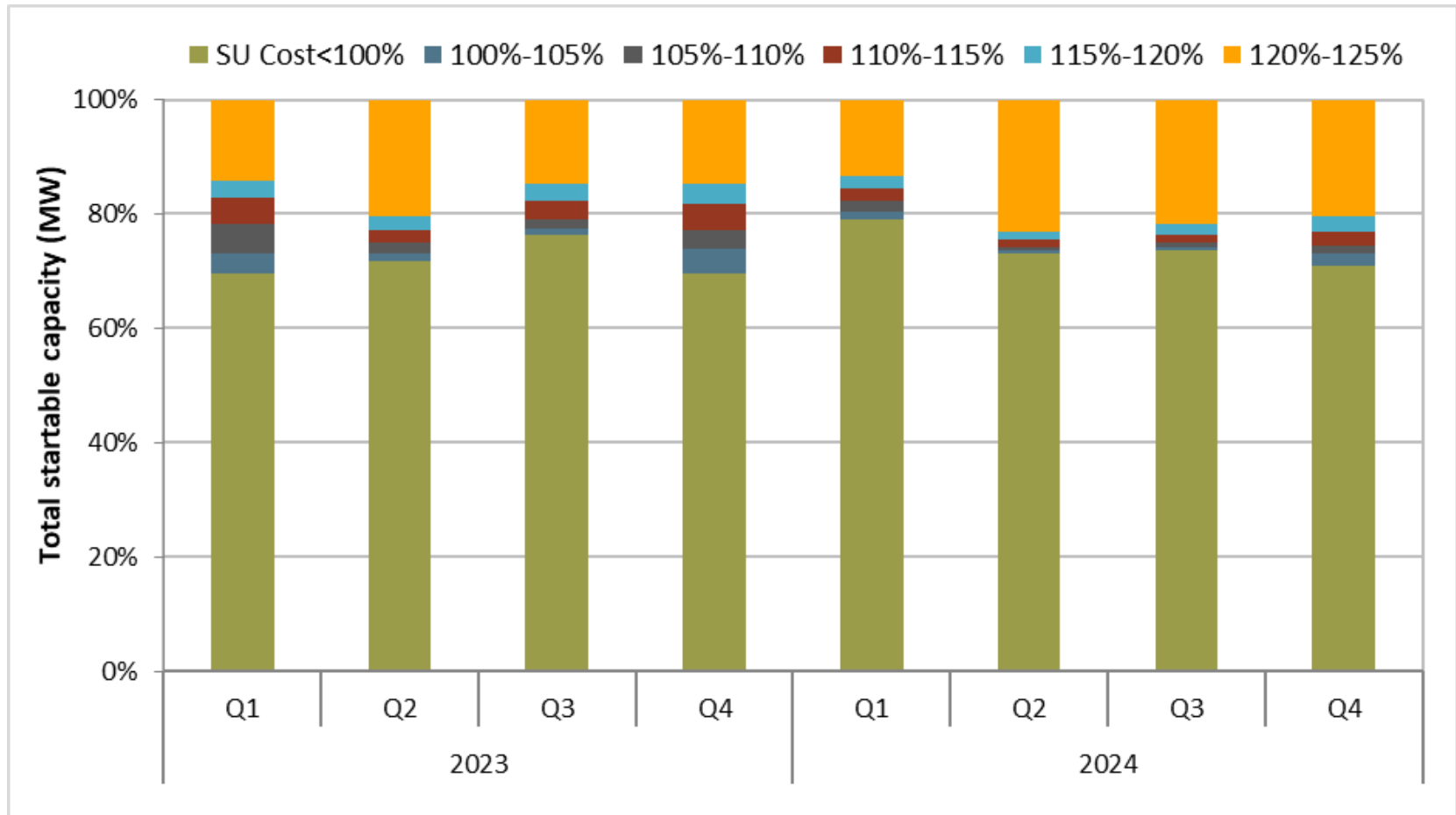
41% of CAISO gas capacity bidding start-up costs near cap, similar to 2023

Day-ahead and real-time gas-fired CAISO BA capacity under the proxy cost option for start-up cost bids (percentage)



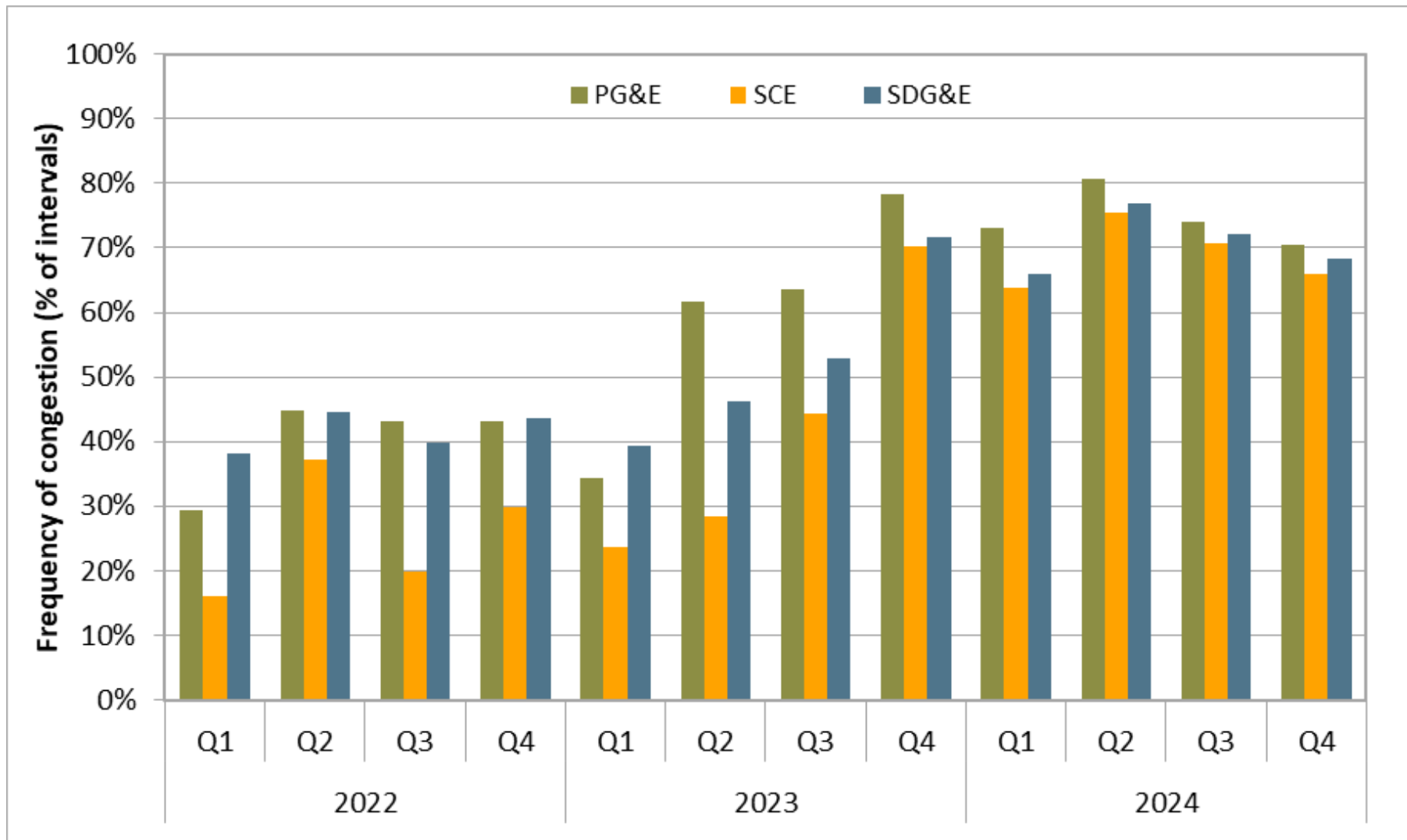
20% of gas capacity in non-CAISO WEIM BAs bid start-up costs near bid cap

Real-time gas-fired WEIM capacity under the proxy cost option for start-up cost bids (percentage)



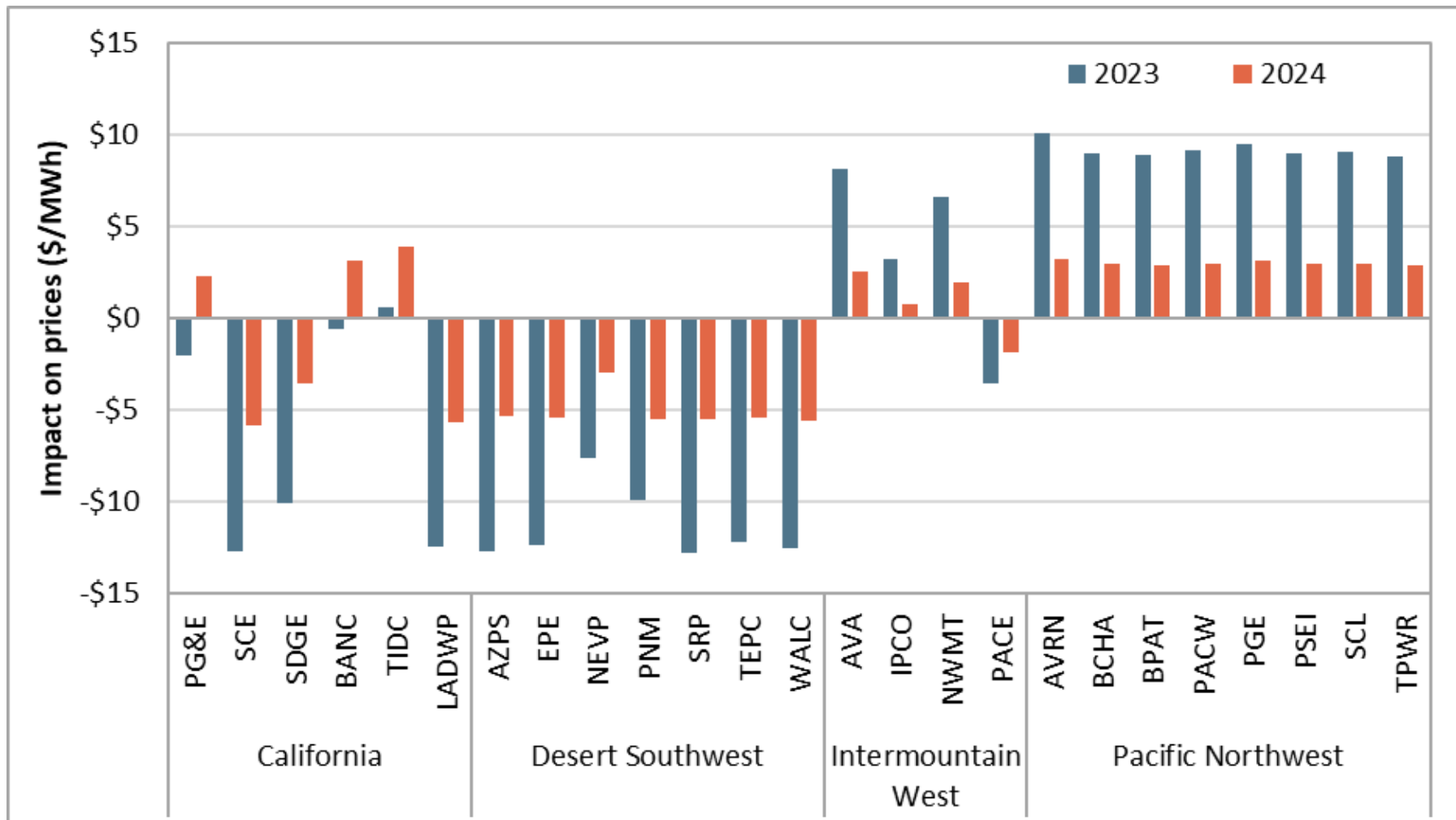
Frequency of day-ahead congestion up significantly

Hours with congestion impacting day-ahead prices by load area (>\$0.05/MWh)



Impact of internal congestion on RT price separation down in 2024

Average impact of internal congestion on real-time market price (2023-2024)



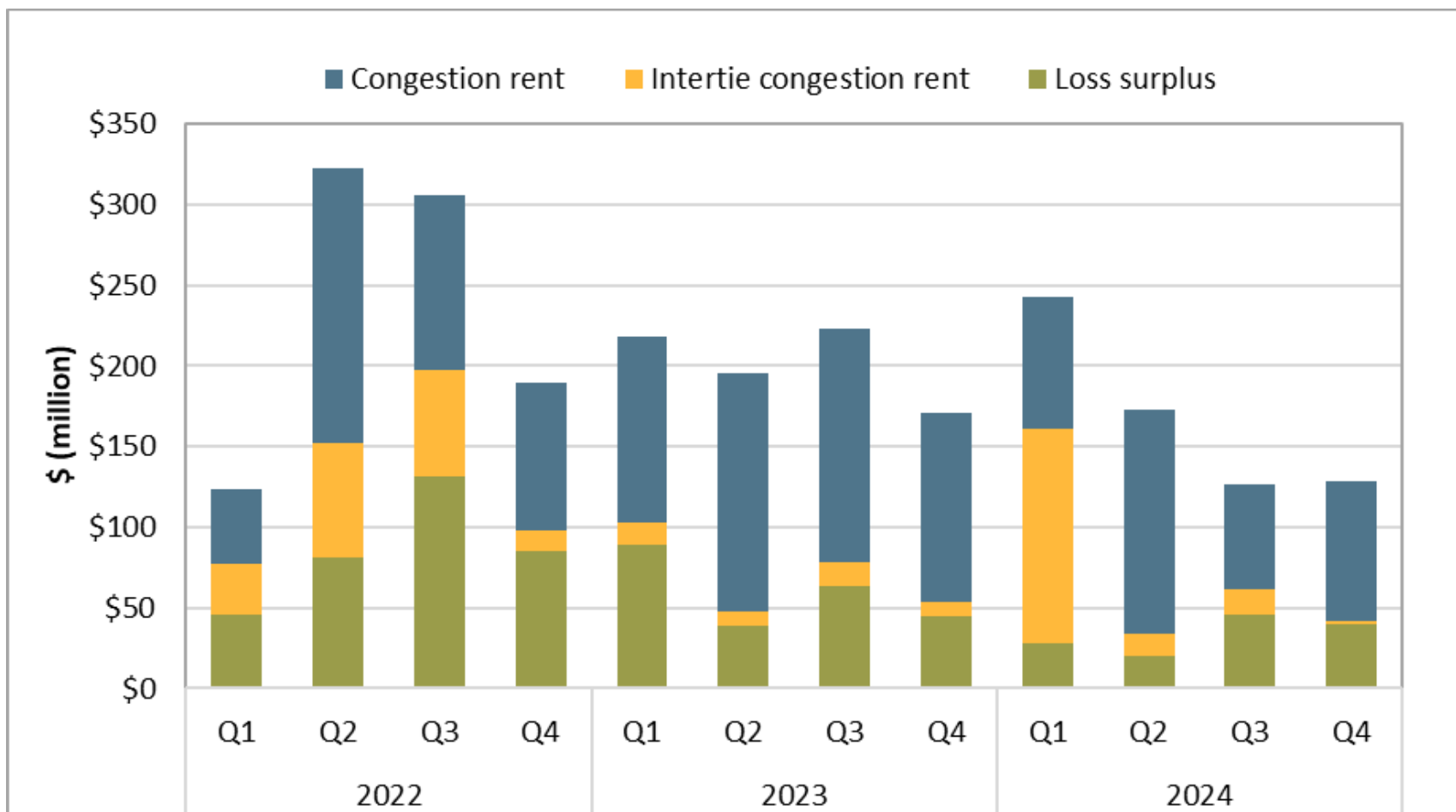
Congestion from south-to-north during mid-day solar hours; into California during evening and morning

Overall impact of internal congestion on price separation in the 15-minute market by hour (2024)

PG&E	.3	-.2	.3	.7	.6	.6	.8	3.5	5.1	5.6	3.1	2.5	2.6	2.9	3.7	3	2.8	4.9	5.4	3.4	2.3	.4	.9	0
BANC	.1	-.1	.3	.7	.6	.6	.7	3.2	6.2	7.8	6.8	6.1	5.8	6.5	8	6.5	3.7	2.3	1.9	2.4	1.5	.1	.8	-.1
Turlock ID	.1	-.3	.1	.5	.4	.5	.6	3.6	8.1	10.8	10.3	9.5	9.4	10.4	11.7	9.5	5	1.7	.2	-.1	-.2	-.7	.3	-.4
SCE	0	-.4	-.1	.2	.2	.3	.2	-3.4	-10.9	-13.9	-15.7	-16	-15.3	-15.8	-15.4	-13.2	-10.8	-7.2	-3.8	-2.1	-1.7	-1	.3	-.2
SDG&E	1.4	.7	.6	.9	1	.9	.9	-1.2	-6.8	-10.1	-12.4	-13.4	-13.2	-13.7	-12.5	-10.2	-7.7	-3.2	-.4	.5	1.5	2.4	2	.8
LADWP	-.1	-.8	-.4	-.1	-.4	-.7	-1.3	-4.9	-9.8	-12.5	-14.9	-14.9	-14.4	-14	-13.3	-11	-10.3	-7	-3.5	-2.2	-2	-1.3	-.9	-.5
NV Energy	-.2	-.4	-.2	0	-.1	-.1	-.3	-2.3	-5.4	-6.3	-7.9	-7.8	-7.3	-6.9	-6.3	-5.7	-5.3	-3.9	-1.9	-1.6	-1.7	-1.1	-.2	-.3
Arizona PS	-.6	-.9	-.5	-.2	-.3	-.2	-.2	-4.4	-10.3	-12.3	-14.3	-14.1	-13.5	-12.7	-11.7	-9.9	-8.2	-5.8	-3.6	-2.5	-2.4	-1.8	-.5	-.6
Tucson Electric	-.6	-.9	-.5	-.3	-.4	-.3	-.6	-4.2	-9.9	-11.9	-13.8	-13.7	-13.2	-13.2	-12.9	-11.1	-8.7	-6.1	-3.5	-2.5	-2.3	-1.8	-.5	-.6
Salt River Project	-.6	-.9	-.5	-.2	-.3	-.3	-.5	-4.4	-10.4	-12.4	-14.3	-14.2	-13.6	-13	-12.2	-10.6	-8.7	-6.2	-3.6	-2.6	-2.4	-1.8	-.6	-.6
PSC New Mexico	-.2	-.6	-.5	-.2	0	.3	-.3	-4.8	-10.6	-13.1	-14.1	-14.5	-14.8	-14.5	-13.3	-11.3	-8	-5.8	-3.4	-2.4	-2.3	-1.7	-.2	-.3
WAPA - Desert SW	-.6	-.9	-.5	-.2	-.3	-.3	-.6	-4.3	-10.2	-12.2	-14.2	-14	-13.4	-13.6	-13.3	-11.4	-9	-6.3	-3.6	-3	-2.4	-1.8	-.6	-.6
El Paso Electric	-2.2	-2.3	-2.2	-2	-2.2	-2.2	-2.1	-4.9	-9.8	-11.7	-13.1	-13.1	-12.1	-11.8	-11.5	-8.4	-7	-4.4	-2.3	-1	-1.7	-1.8	-1.4	-1.8
PacifiCorp East	-1.2	-1.2	-1.1	-1.1	-1	-1.1	-1.2	-1.6	-2.1	-2.2	-2.4	-2.4	-2.4	-2.4	-2.3	-2.1	-1.9	-1.7	-2.2	-2.7	-2	-1.5	-1.2	-1.1
Idaho Power	0	.1	0	-.1	-.1	-.1	-.1	.4	1.4	1.9	2.3	2.3	2.1	2.2	2.3	2.2	2.2	1.5	-.4	-.8	-.2	0	-.1	.1
NorthWestern	0	.2	-.1	-.3	-.2	-.3	-.2	1.2	3.6	4.7	5.9	5.9	5.5	5.6	5.6	5.3	4.8	3	-.2	-1	-.5	-1	-.3	.1
Avista Utilities	-.1	.2	-.2	-.4	-.3	-.4	-.3	1.7	5	6.3	7.7	7.7	7.2	7.4	7.3	6.8	6.2	3.8	-.3	-1.2	-.6	-.2	-.5	.1
Avangrid	-.1	.3	-.2	-.5	-.4	-.4	-.2	2.3	6.5	8.1	9.5	9.2	8.2	9.2	9.3	8.4	7.6	4.9	0	-1	-.2	.1	-.5	.1
BPA	-.1	.3	-.2	-.5	-.4	-.4	-.3	1.9	5.7	7	8.7	8.7	8.2	8.4	8.2	7.7	6.9	4.2	-.2	-1.1	-.4	-1	-.5	.1
Tacoma Power	-.1	.3	-.2	-.5	-.3	-.4	-.3	1.9	5.6	6.9	8.8	8.6	8	8.3	8.2	7.6	7	4.2	-.2	-1.2	-.5	-.2	-.5	.1
PacifiCorp West	-.1	.3	-.2	-.5	-.3	-.4	-.2	2	5.7	7.3	8.7	8.6	8	8.3	8.3	7.6	6.9	4.4	-.2	-1.1	-.4	.2	-.5	.1
Portland GE	-.1	.3	-.2	-.5	-.3	-.4	-.3	2	5.9	7.2	9.4	9.6	9.2	9.4	9.2	8.8	7.5	4.5	-.2	-1.1	-.4	-1	-.5	.1
Puget Sound Energy	-.1	.3	-.2	-.5	-.3	-.4	-.3	1.9	5.8	7	8.9	8.9	8.5	8.7	8.4	7.9	7.1	4.3	-.2	-1.1	-.5	-.2	-.5	.1
Seattle City Light	-.1	.3	-.2	-.5	-.3	-.4	-.3	1.9	6.1	7	8.9	9.1	8.7	8.8	8.5	8	7.2	4.3	-.1	-1	-.5	-.2	-.5	.1
Powerex	-.1	.2	-.2	-.4	-.3	-.4	-.2	1.8	6.1	6.9	8.8	9.1	8.8	8.8	8.5	8	7.1	4.2	-.1	-1	-.5	-.2	-.5	.1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour																							

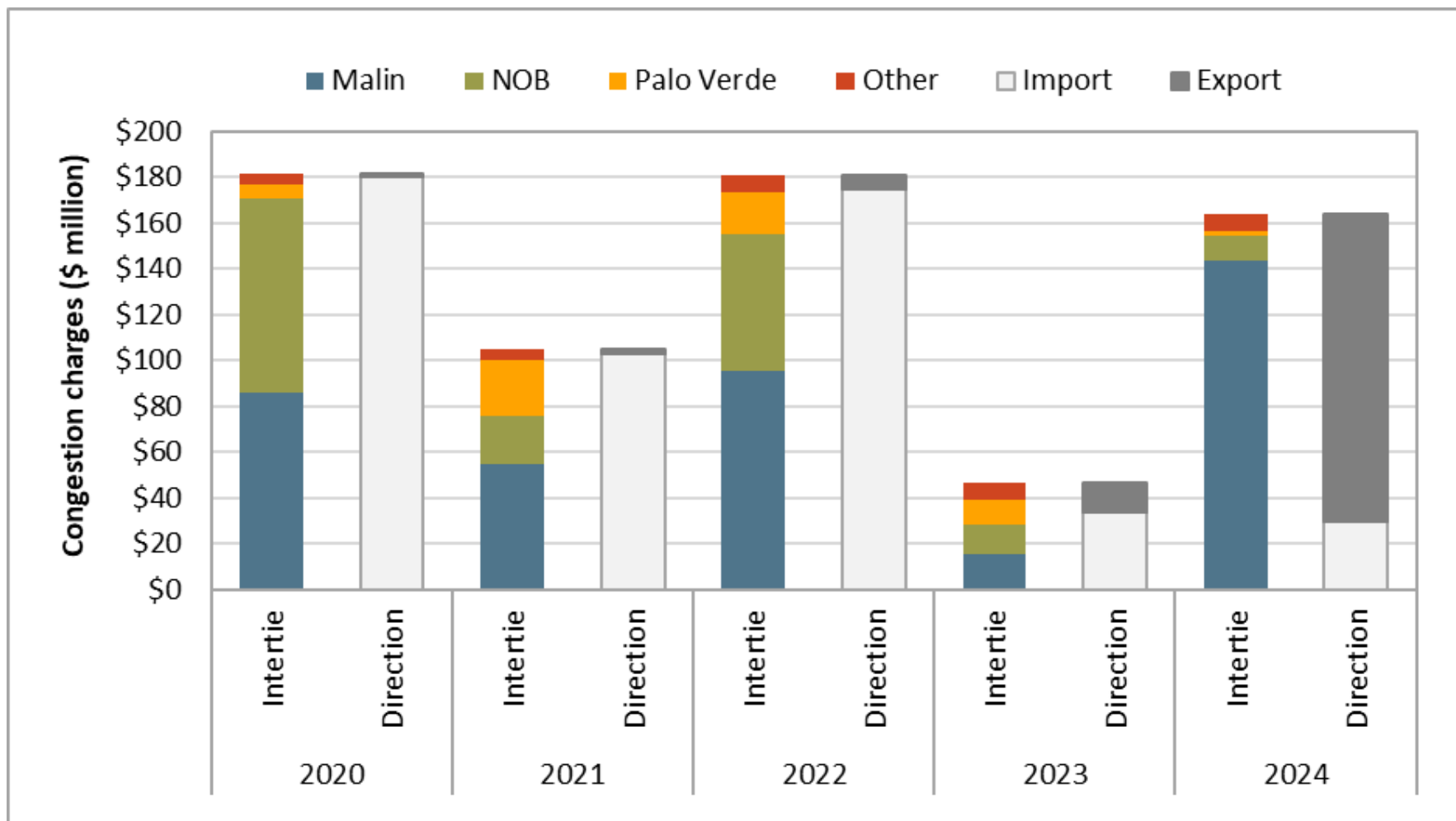
Day-ahead congestion rent down overall

Day-ahead congestion rent and loss surplus by quarter (2022-2024)



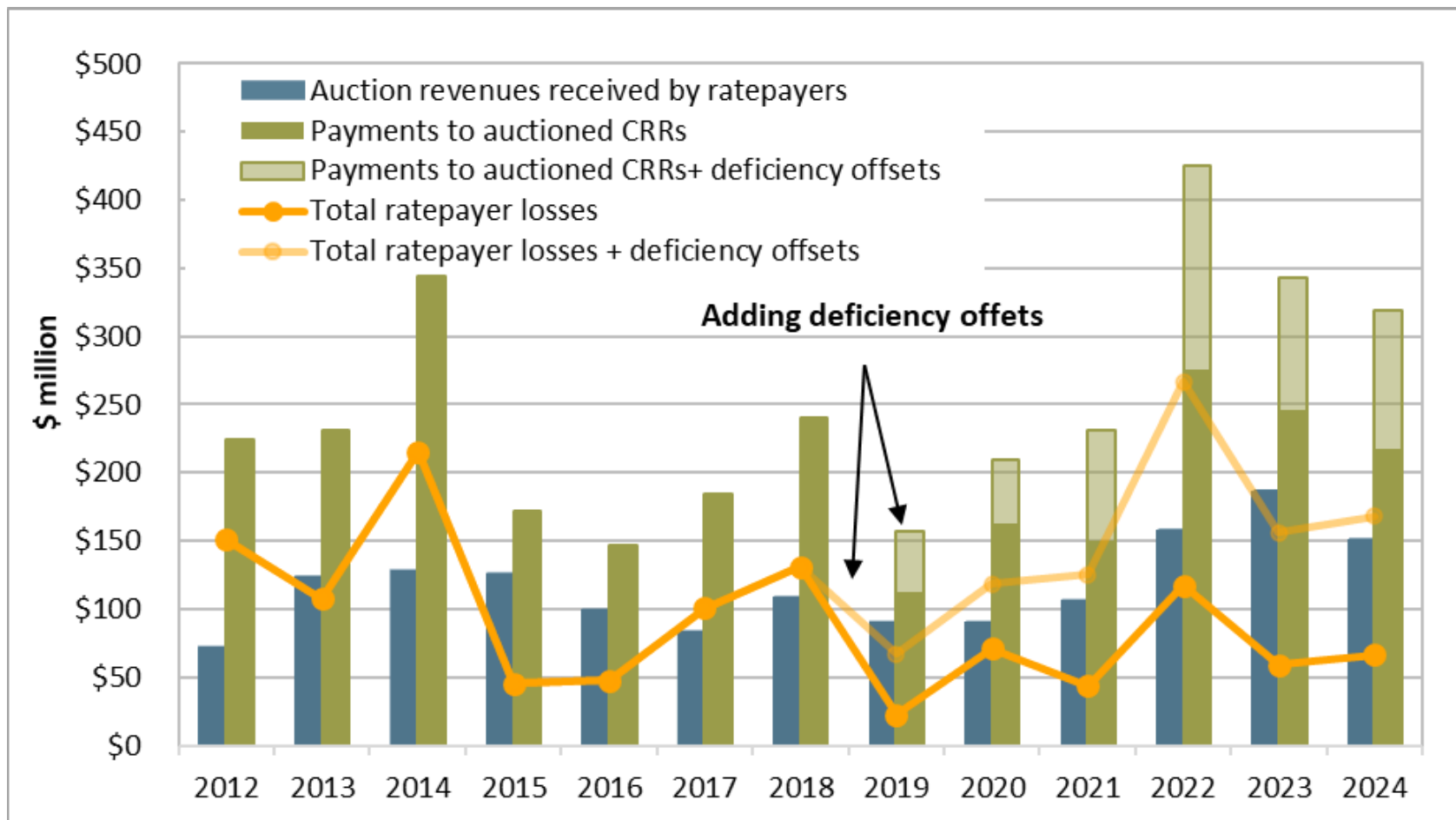
Day-ahead export congestion out of CAISO on Malin drives intertie congestion rent increase

Day-ahead congestion charges on major interties



Ratepayer losses from CRR auction increase to \$66 million

Auction revenues and payments to non-load serving entities



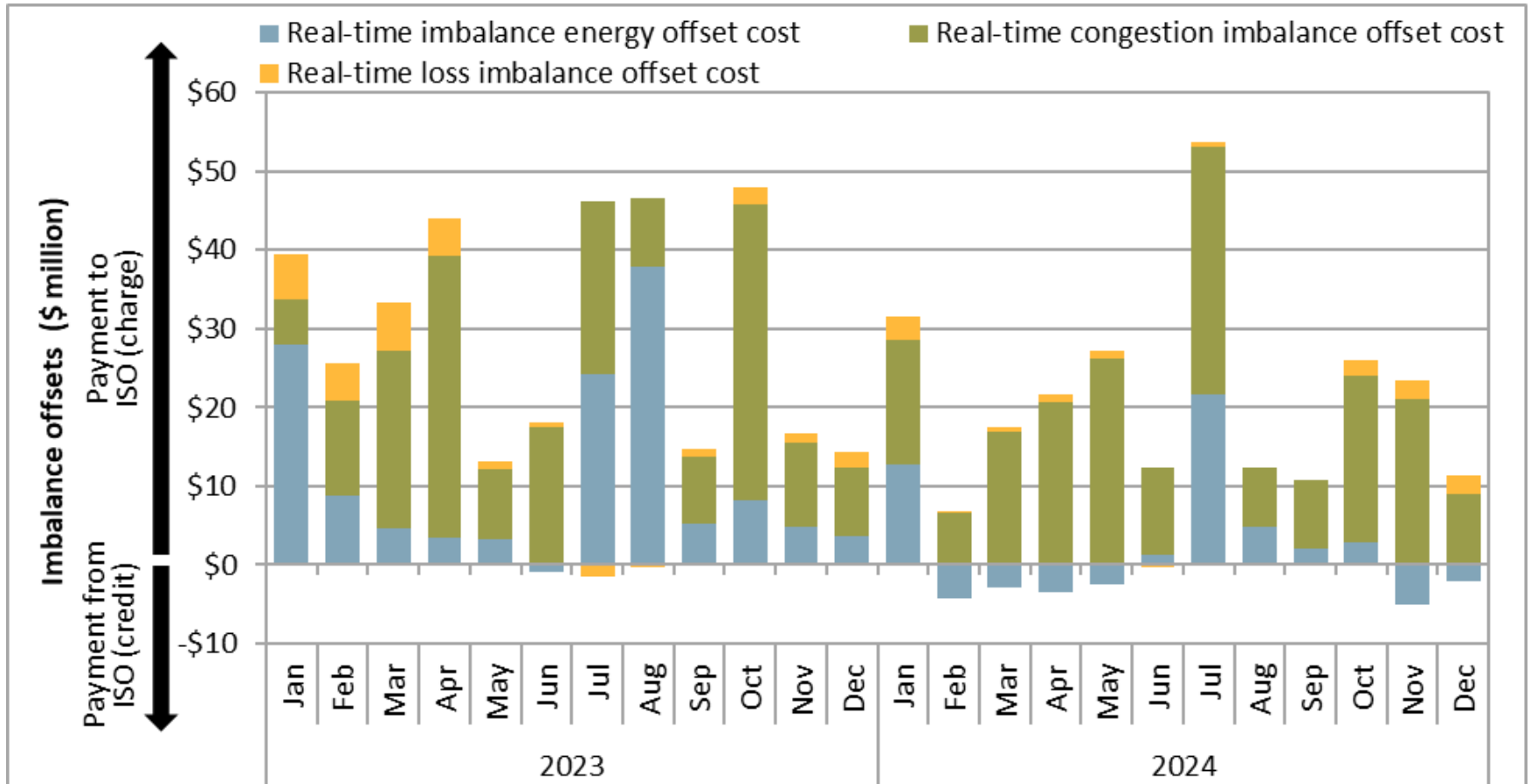
8 balancing areas received additional transfers during RSE failures due to assistance energy transfers

Resource sufficiency evaluation failures during assistance energy transfer opt-in (2024)

Balancing area	Days opted in to AET	RSE failures under AET (15-min. intervals)	Percent of failure intervals with additional WEIM imports due to AET	Average WEIM imports added (MW)	Max WEIM imports added (MW)	Total WEIM imports added (MWh)
Avangrid	366	72	26%	22	221	404
California ISO	32	1	0%	0	0	0
Idaho Power	214	32	38%	27	278	220
NorthWestern Energy	357	75	28%	13	158	247
NV Energy	366	13	56%	159	626	515
PacifiCorp East	194	4	25%	45	203	45
PacifiCorp West	194	23	41%	30	235	171
Portland General Electric	10	0	N/A	N/A	N/A	N/A
PSC of New Mexico	78	79	41%	49	434	973
WAPA Desert Southwest	100	9	56%	99	277	223

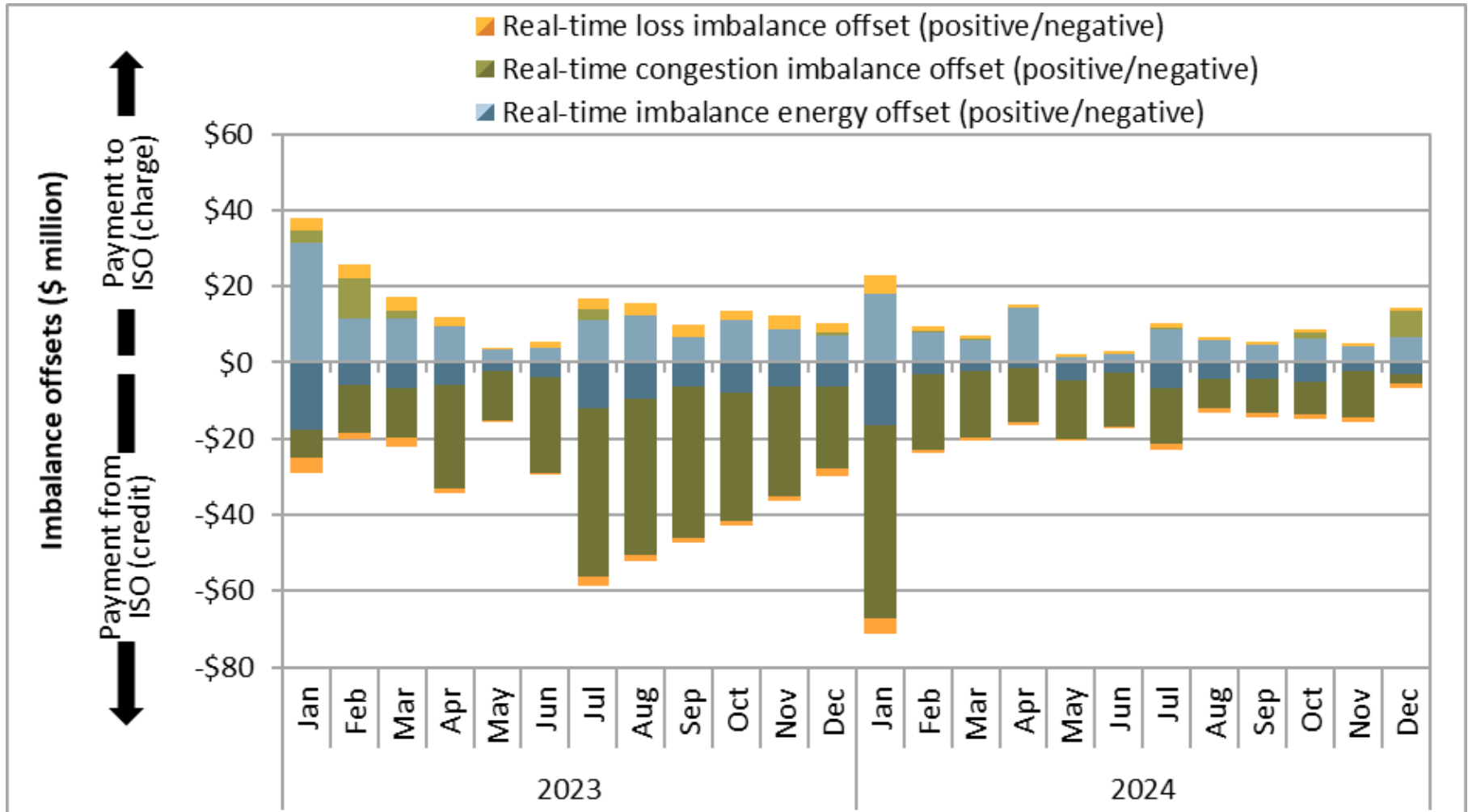
CAISO RTIO uplift costs were \$234 million

Monthly real-time imbalance offset costs (balancing areas in day-ahead market)



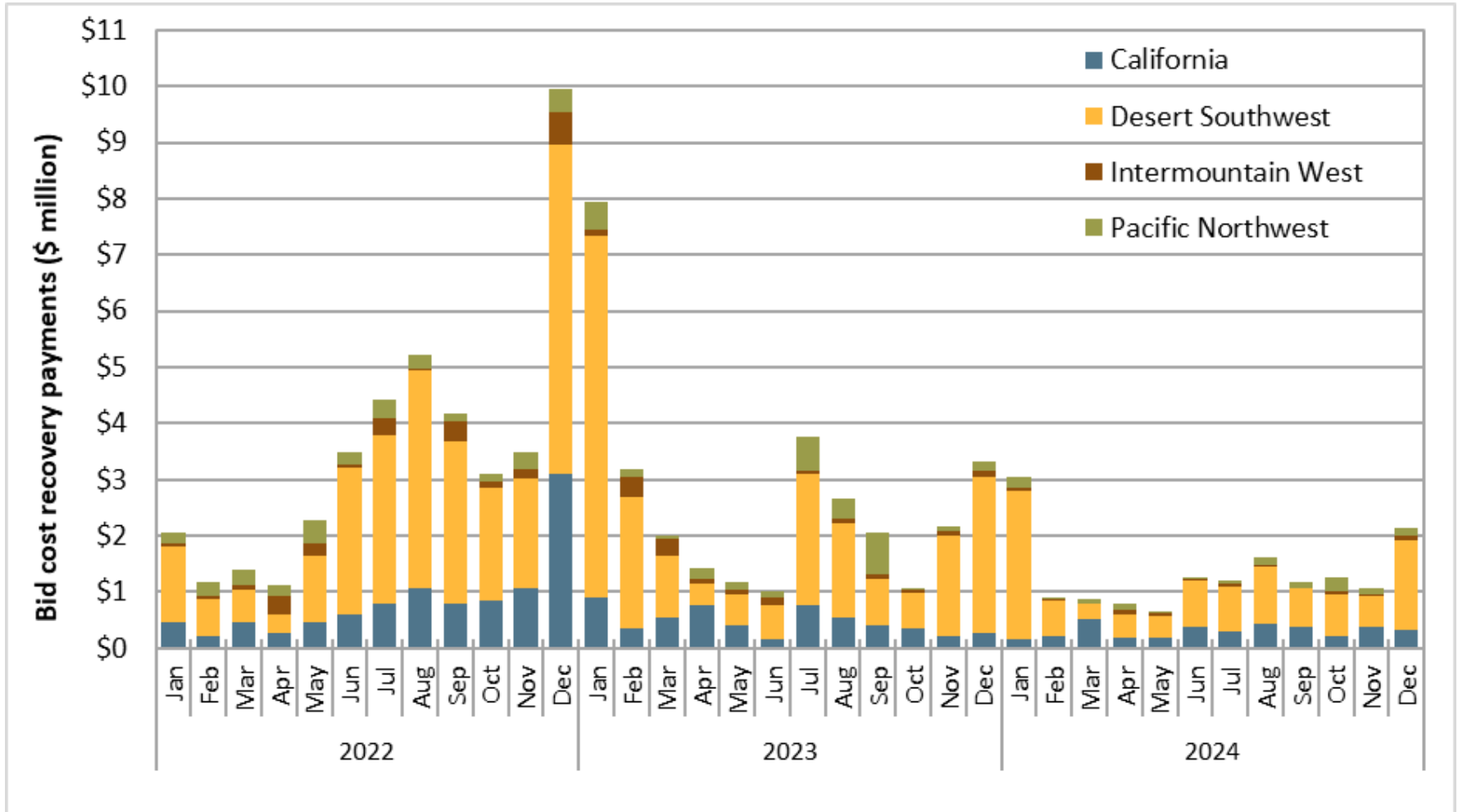
WEIM BAs' RTIO was credit of \$157 million

Monthly real-time imbalance offset costs (balancing areas participating only in WEIM)



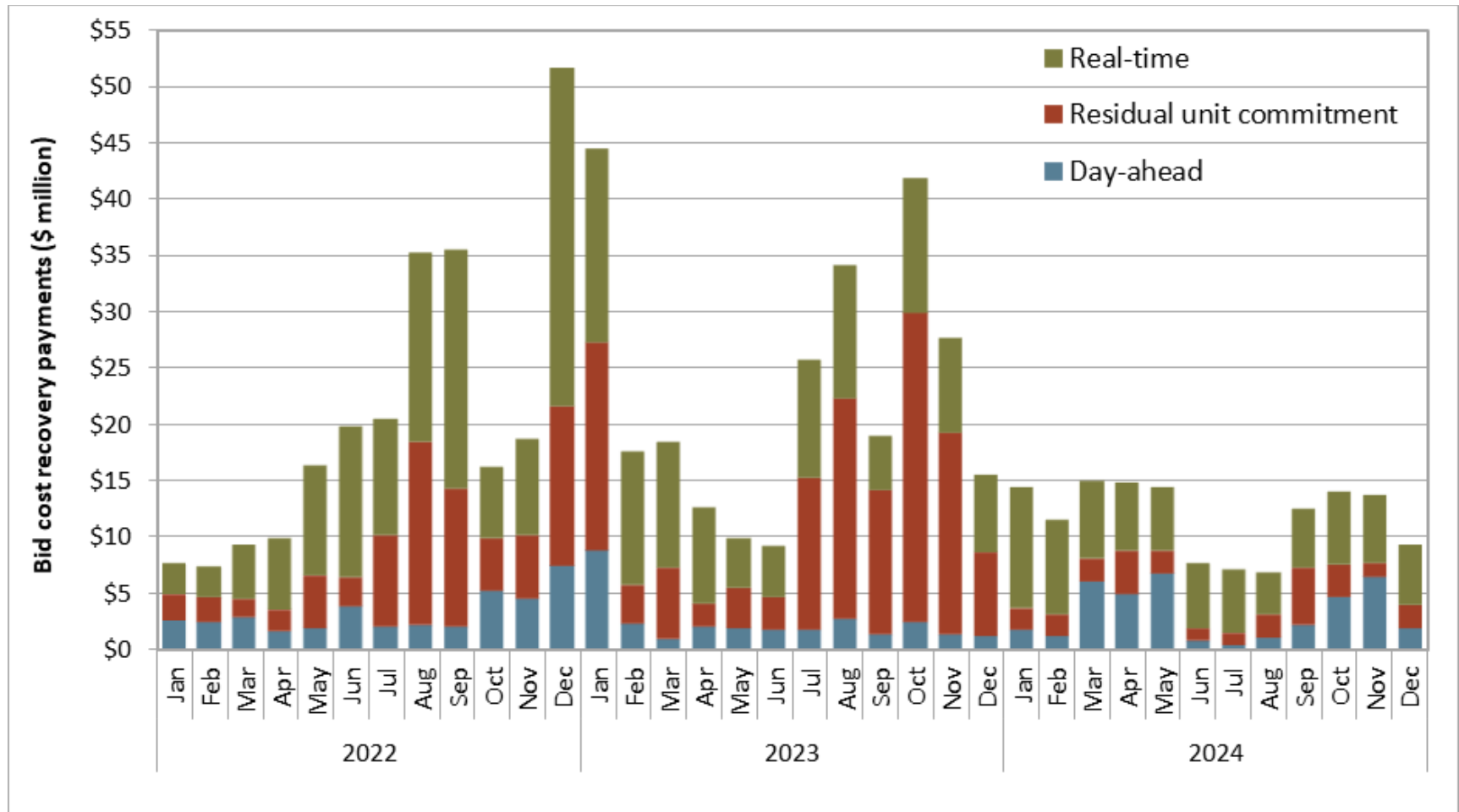
BCR for WEIM-only areas down 50% to \$16 million

Monthly bid cost recovery payments for the WEIM (non-CAISO)



BCR for CAISO down 48% to \$141 million due to large decrease in RUC BCR

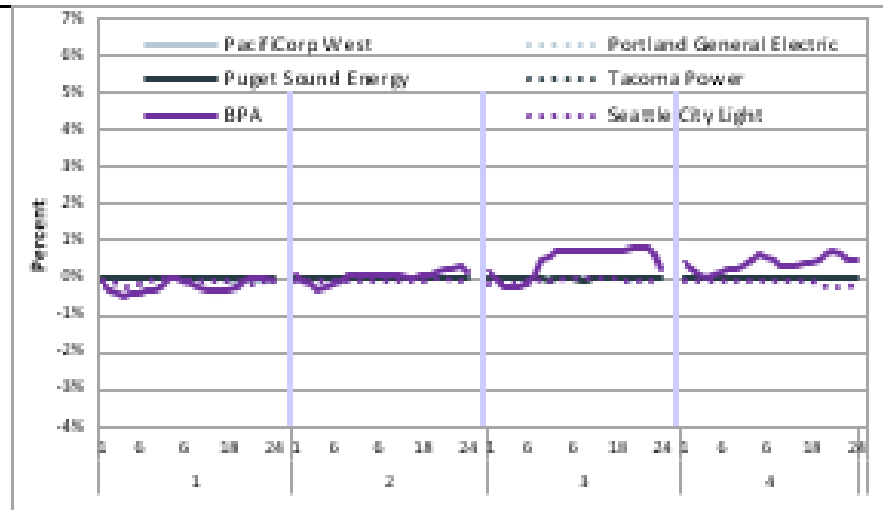
Monthly bid cost recovery payments for day-ahead market area (CAISO)



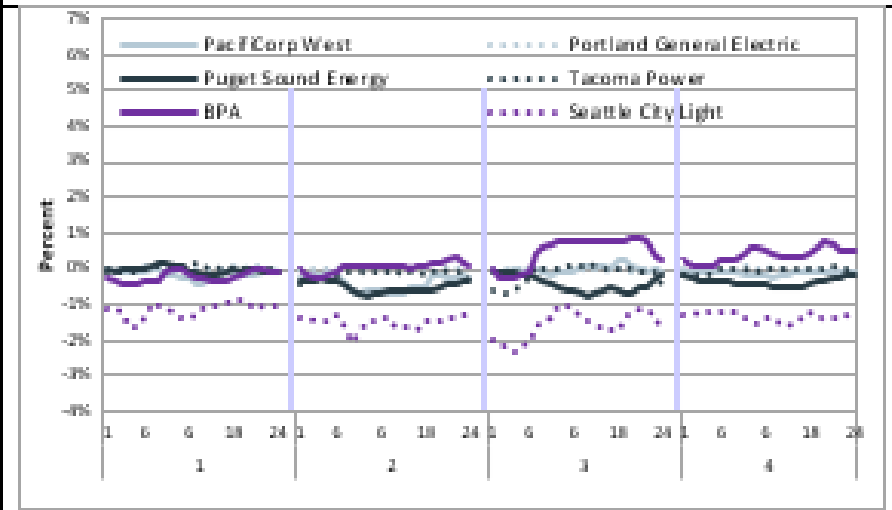
RTD load adjustments >> FMM in most BAs besides BPA and CAISO

Pacific Northwest: Average hourly imbalance conformance as a percent of average load in the 15-minute and 5-minute markets by balancing area (Q1-Q4 2024)

15-minute market

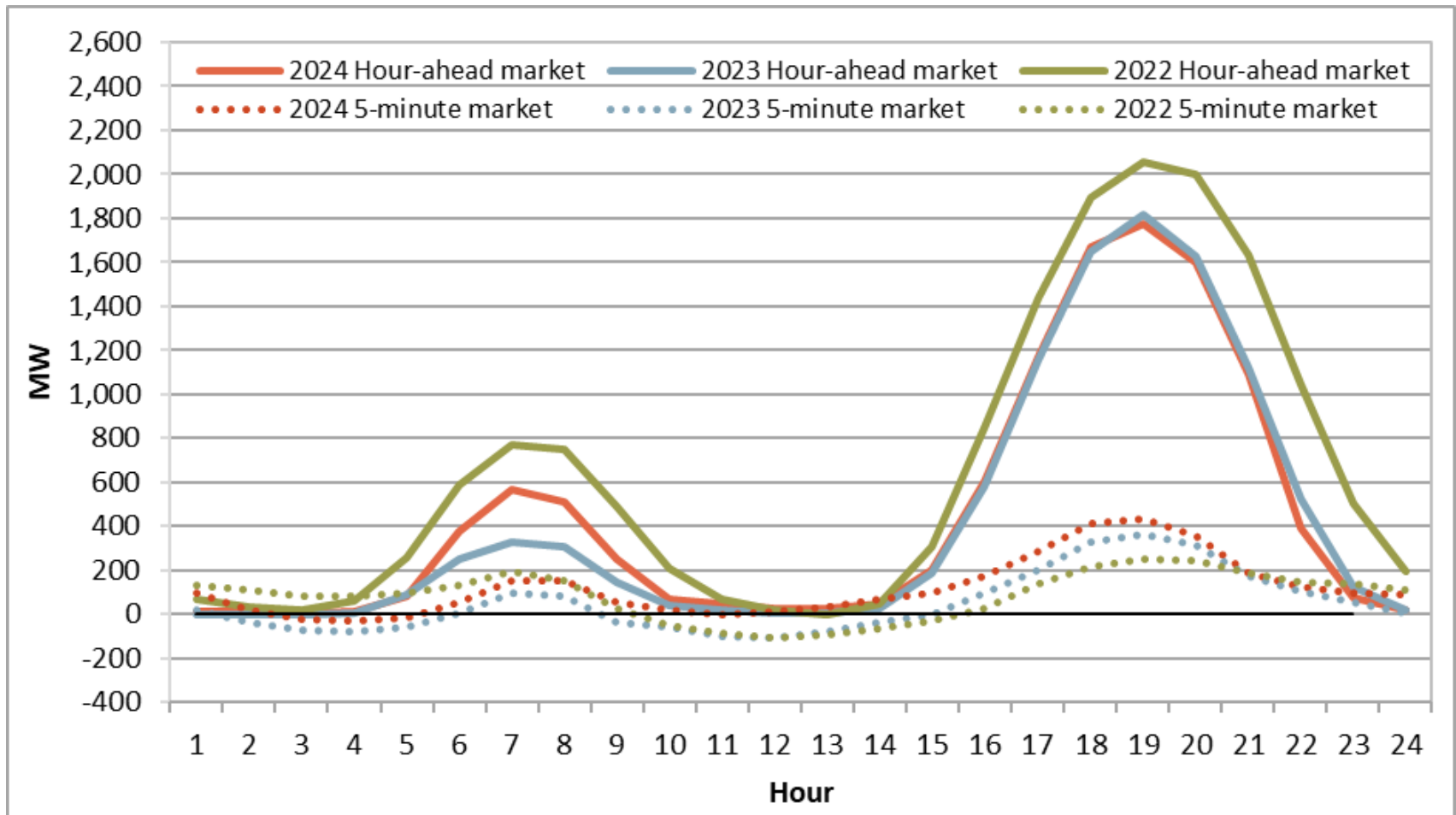


5-minute market



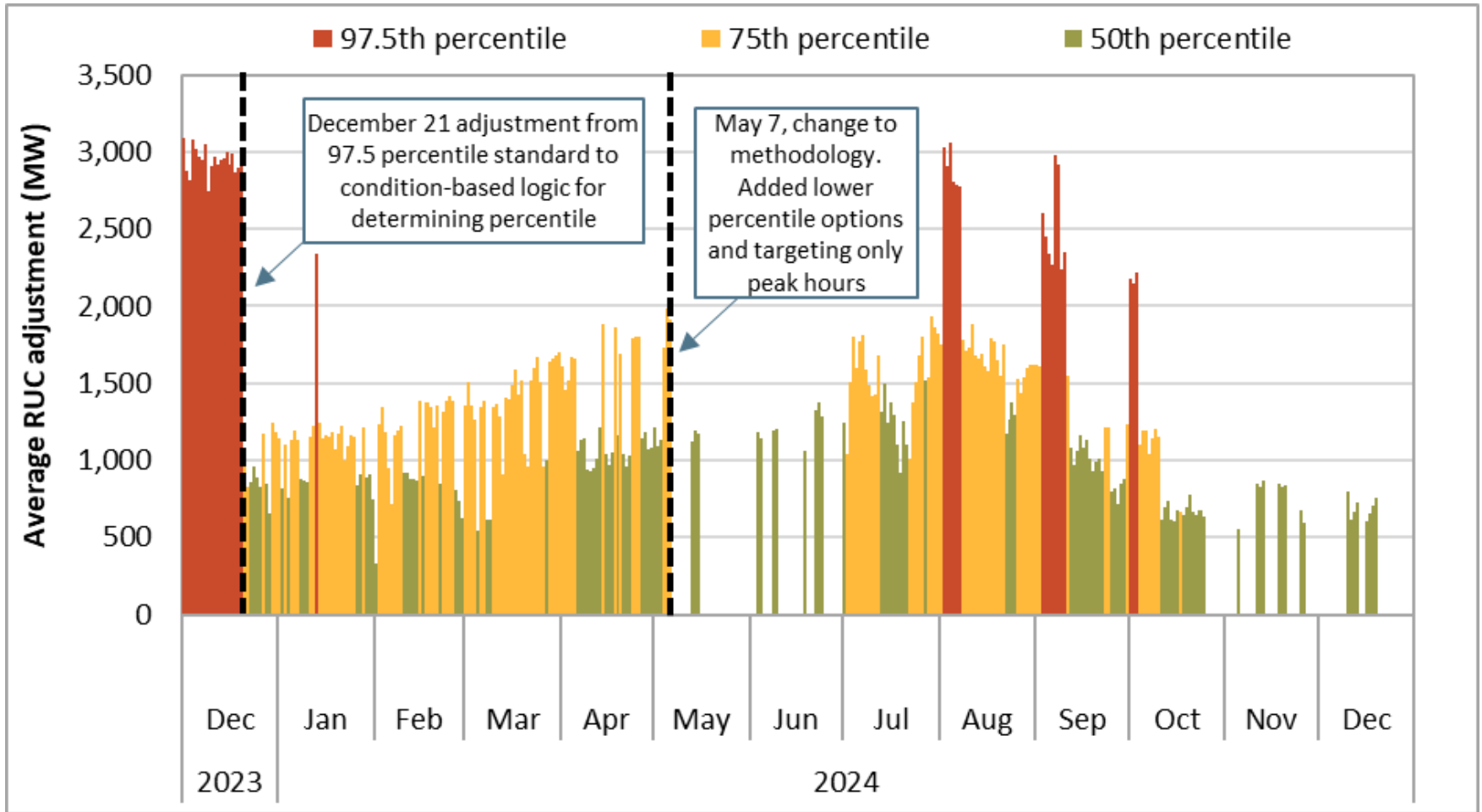
CAISO hour-ahead and 15-minute market load bias >> 5-minute market load bias over peak net load hours

Average CAISO balancing area hourly imbalance conformance adjustment
(2022—2024)



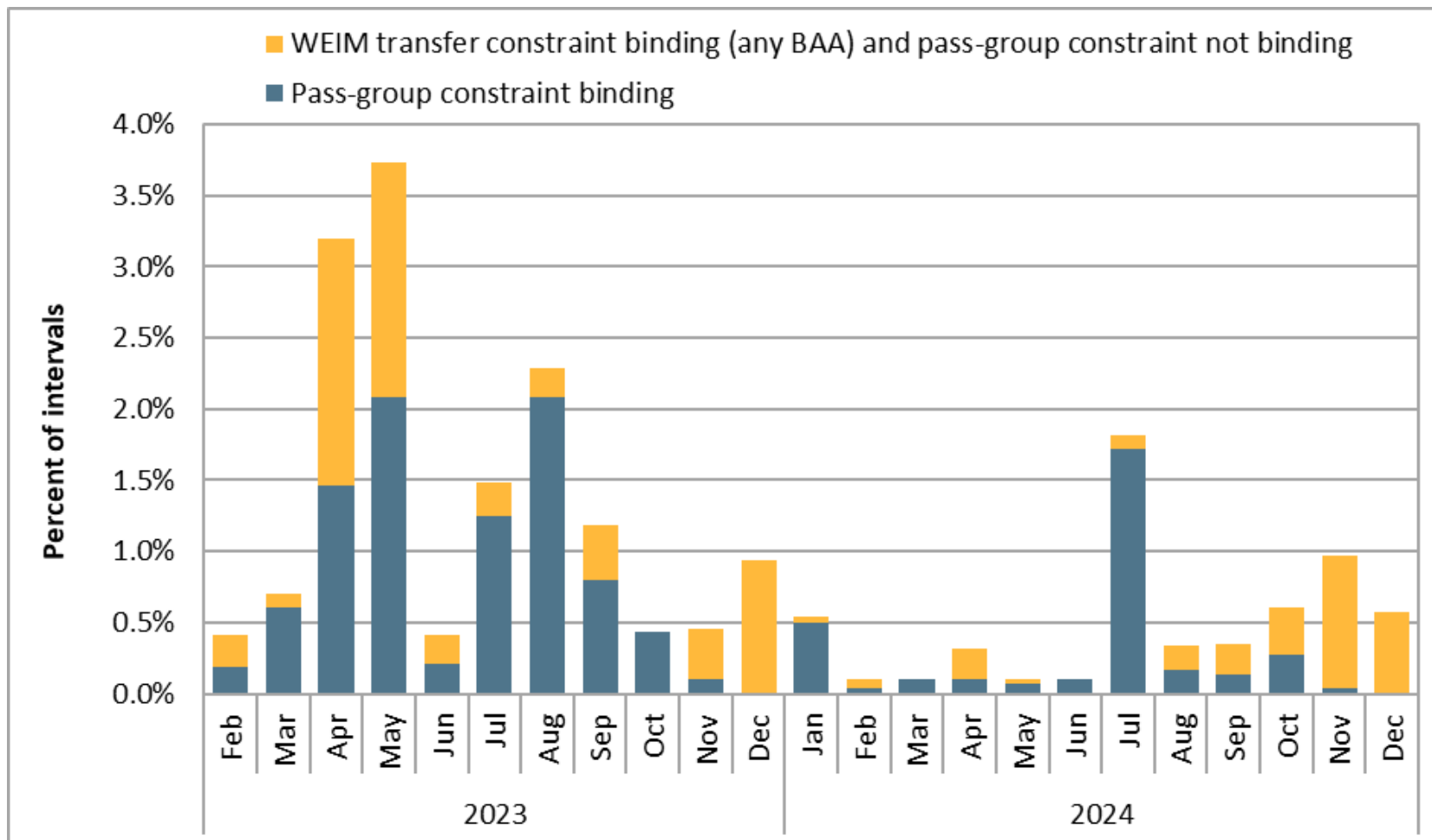
RUC adjustments targeted 97.5th percentile of net load uncertainty on only 5% of days

Average residual unit commitment adjustment by day
(peak morning and evening hours, 2024)



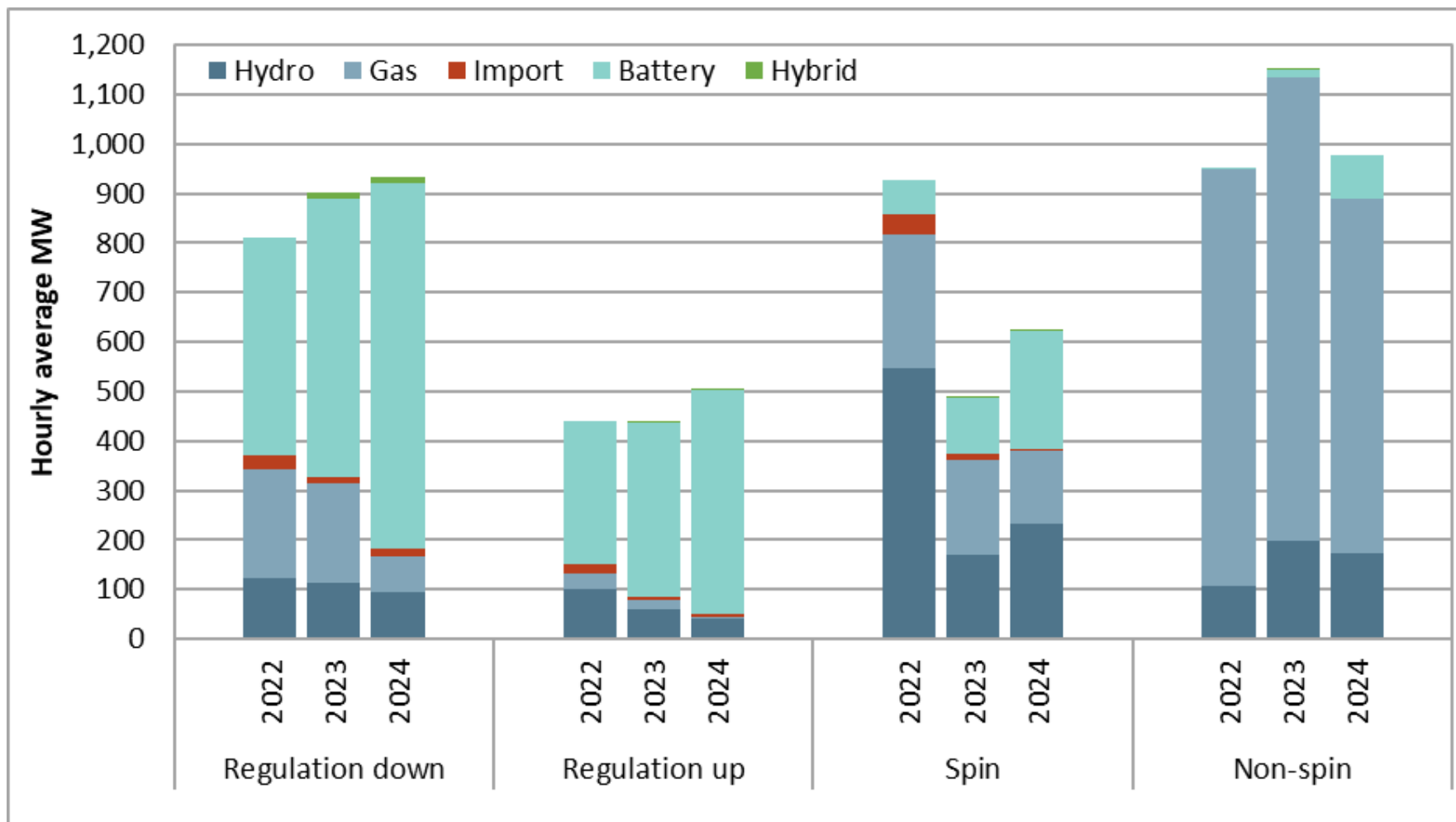
Infrequent flexible ramping product prices at system/BA level for BAs that pass RSE test

Frequency of upward flexible ramping product prices from pass-group or WEIM transfer constraints (15-minute market)



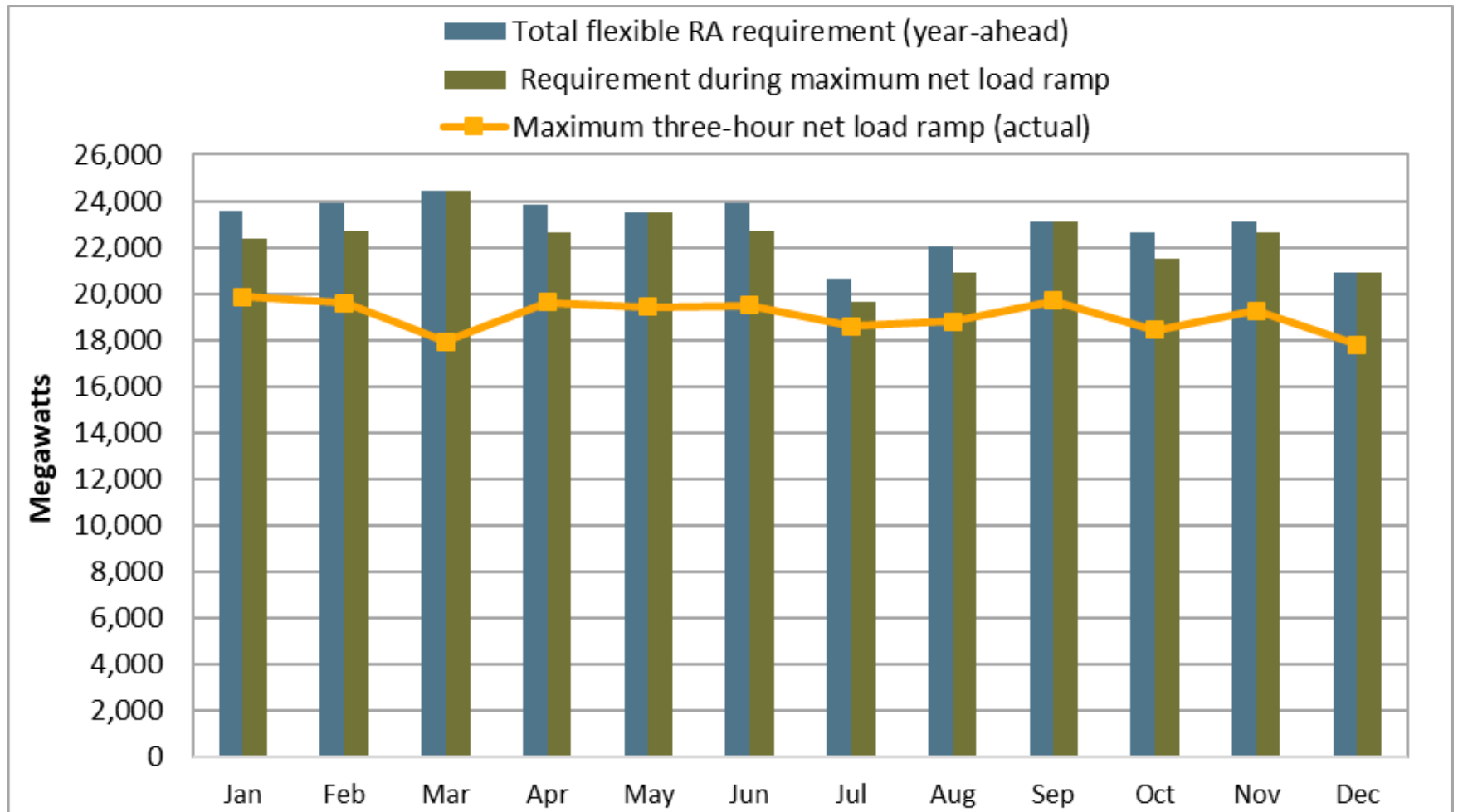
Batteries providing increasing share of ancillary services

Ancillary service procurement by internal resources and imports



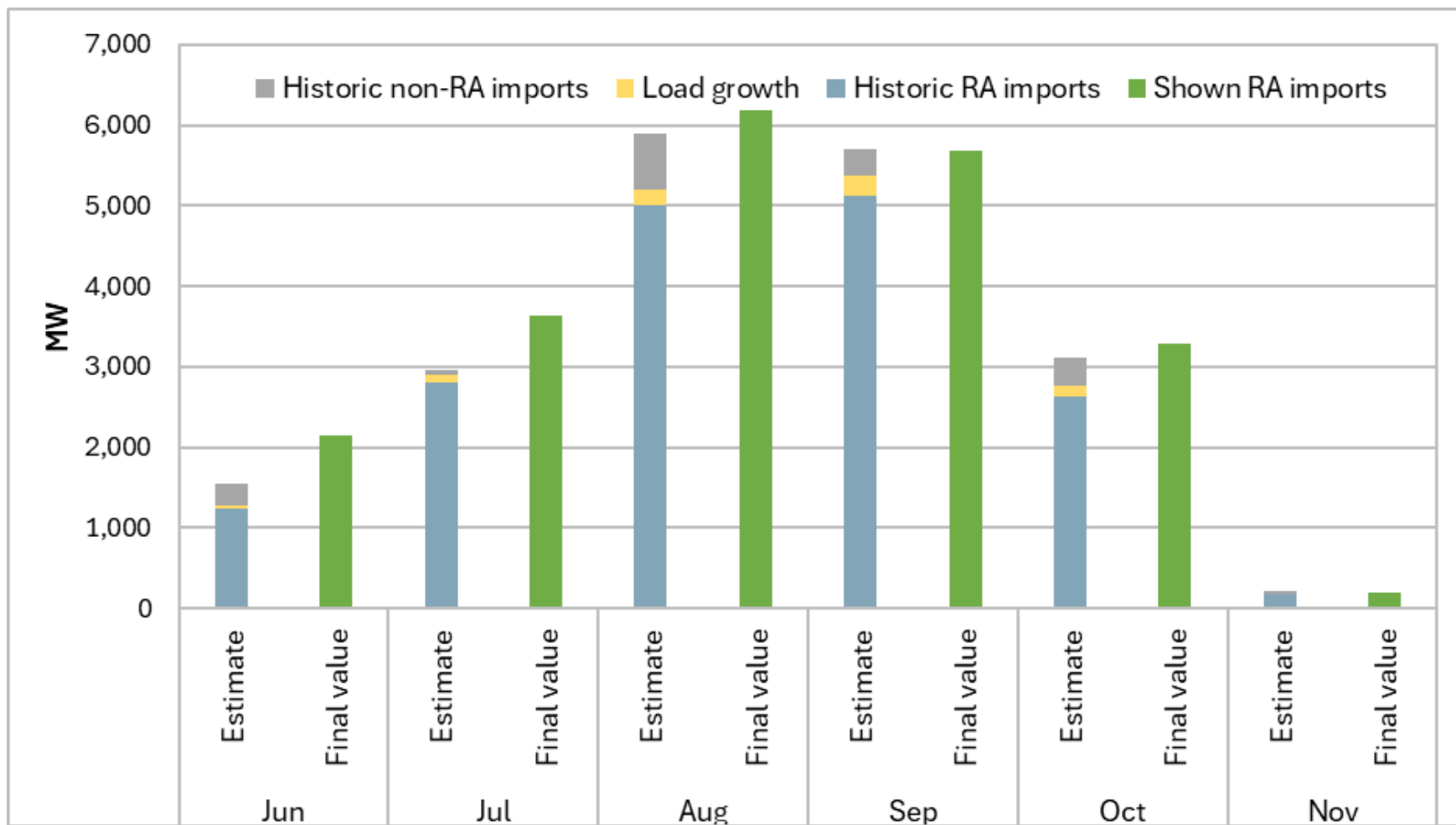
System RA meets instantaneous peak load; Flex RA requirements meet actual max 3-hour net load ramps

Flexible resource adequacy requirements during the actual maximum net load ramp



ISO underestimated native load needs on ties used for priority wheel-throughs

Native load need estimate vs. final import RA at all relevant market tie points



Recommendations

- Extended day-ahead market
 - congestion rent allocation
 - Decrease imbalance reserve product demand curve and consider procuring imbalance reserve only in residual unit commitment market
 - Develop real-time product covering uncertainty several hours out to retain imbalance reserves procured in EDAM
 - Address potential market power in resource sufficiency market created by requirement for firm transmission
 - Rules to help prevent supply in EDAM balancing area with EDAM energy or capacity award from subsequently supporting non-source specific import counted towards another balancing area's resource sufficiency requirement

Recommendations

- Congestion revenue rights
 - Eliminate auction based on transmission capacity that forces transmission ratepayers to offer to sell CRRs at a \$0 reservation price
 - Replace with auction in which every seller sets their reservation price
- Batteries
 - Further revise bid cost recovery rules
 - Eliminate BCR when batteries are constrained by operational parameters set by unit operators
 - Incentivize batteries to reflect real-time intraday opportunity costs in energy bids during the hours preceding the highest net load hours of the day.
 - Enhance default energy bids to allow variation throughout day based on current opportunity costs
 - Create standardized default energy bid for batteries in WEIM
 - Extend local market power mitigation to include hybrid resources

Recommendations

- Price formation enhancements
 - Extend flexible ramping product time horizon or develop simpler product to ensure ramping capacity to cover uncertainty several hours in future
 - Re-optimize ancillary services in real-time
- High priority wheeling rights
 - More thoroughly study internal constraint limitations in determination of transmission available for monthly high priority wheeling rights
- Resource adequacy
 - Redesign mechanism for incentivizing availability to evaluate performance and to have much larger financial penalties
 - Enhance outage reporting requirements so CAISO operators can decline discretionary maintenance outage requests made within the “forced outage” timeframe