



2019 Q2 Report on Market Issues and Performance

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Department of Market Monitoring, California ISO

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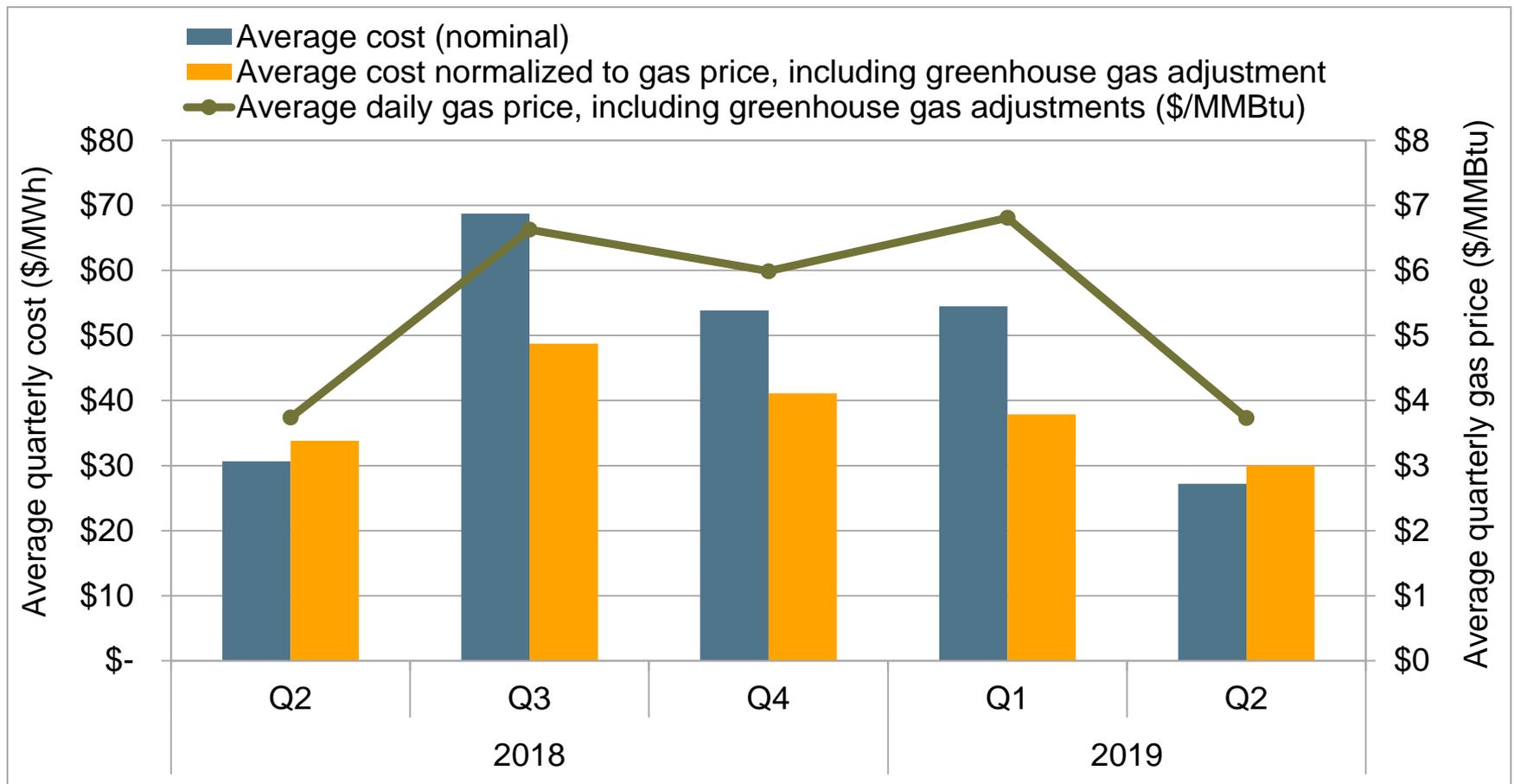
<http://www.caiso.com/Documents/2019SecondQuarterReportonMarketIssuesandPerformance.pdf>

<http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyIssuesPerformanceReports/Default.aspx>

Highlights of Q2 market performance

- Wholesale energy costs stable, somewhat lower due to higher hydro.
- Real-time prices continue to be lower than day-ahead most intervals
 - Average real-time prices driven above average day-ahead by real-time price spikes on a few days
 - Increase in exceptional dispatches and upward load adjustments contribute to lower real-time prices.
- Congestion revenue rights losses to ratepayers fall due to recent changes and lower congestion.
- CCE3 opportunity costs added to commitment cost bid caps -- but initial impact low.

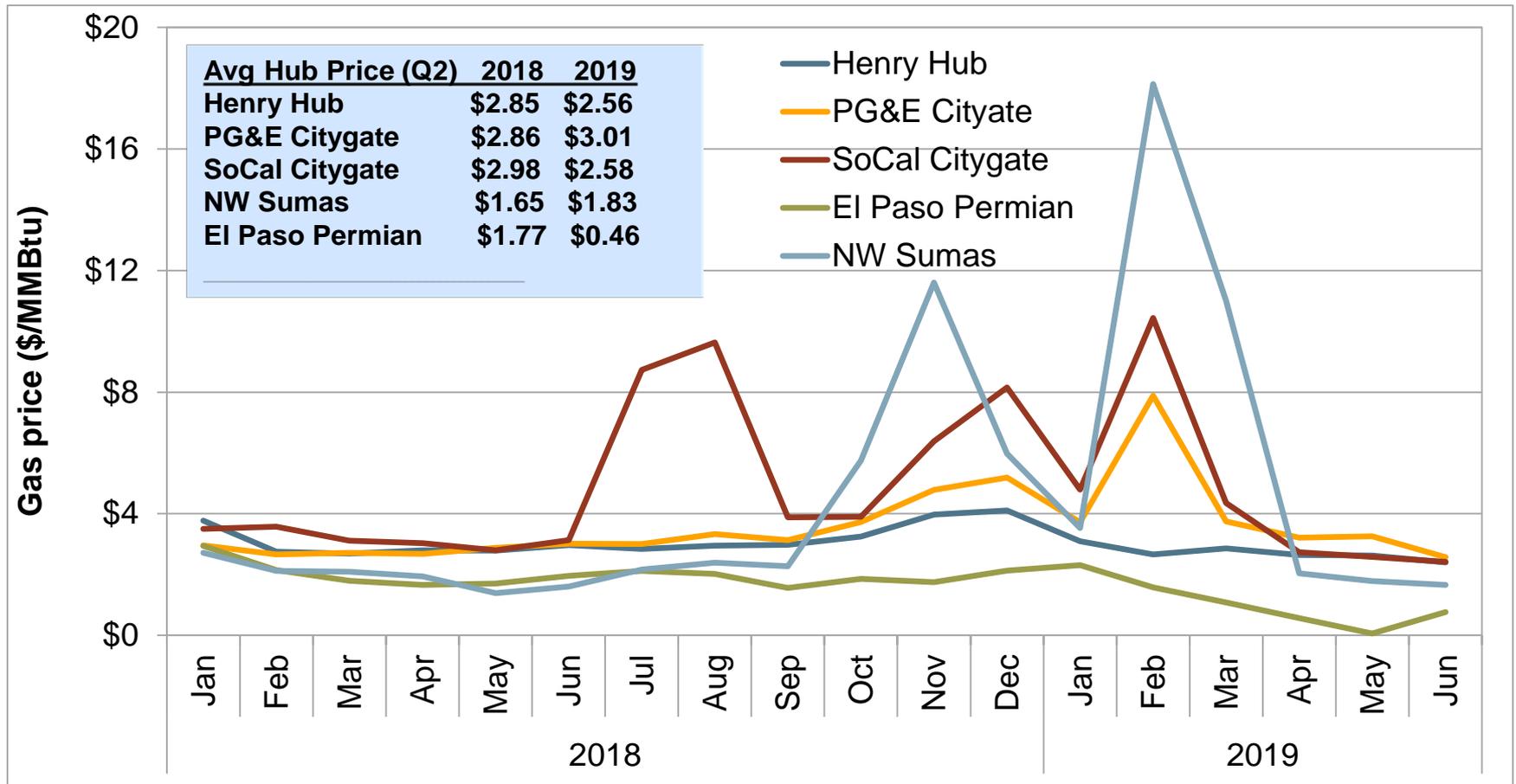
Total CAISO Q2 wholesale costs decreased 11% compared to Q2 2018, driven by increased availability of renewables



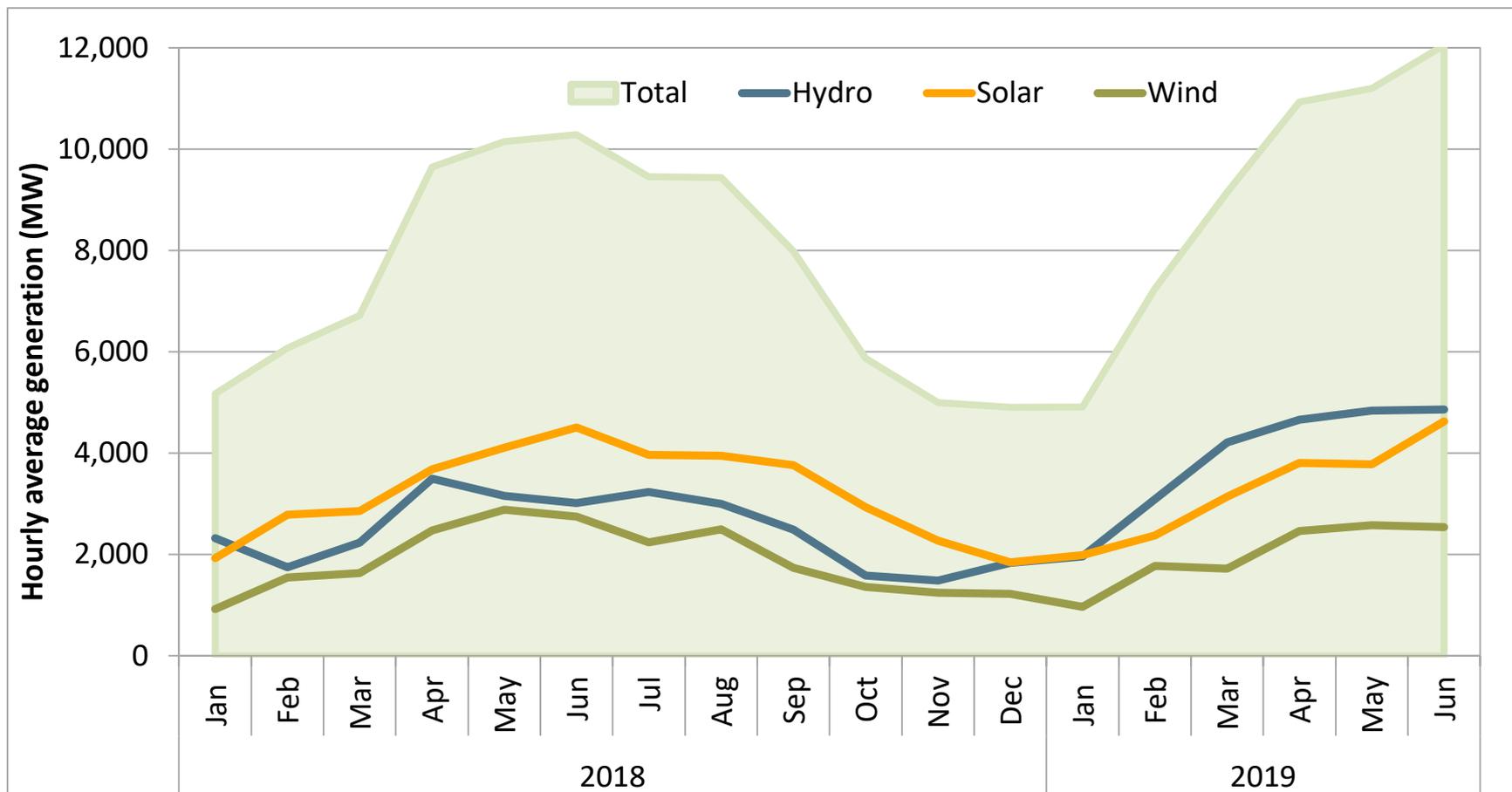
Q2 CAISO wholesale costs totaled \$1.4 billion or about \$27/MWh

	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Change Q2 2018- Q2 2019
Day-ahead energy costs	\$ 27.66	\$ 64.52	\$ 51.44	\$ 52.24	\$ 23.89	\$ (3.77)
Real-time energy costs (incl. flex ramp)	\$ 0.60	\$ 0.69	\$ 0.00	\$ 0.25	\$ 1.20	\$ 0.60
Grid management charge	\$ 0.43	\$ 0.43	\$ 0.43	\$ 0.42	\$ 0.42	\$ (0.01)
Bid cost recovery costs	\$ 0.34	\$ 1.27	\$ 0.54	\$ 0.56	\$ 0.48	\$ 0.14
Reliability costs (RMR and CPM)	\$ 0.68	\$ 0.63	\$ 0.90	\$ 0.06	\$ 0.05	\$ (0.63)
Average total energy costs	\$ 29.71	\$ 67.54	\$ 53.32	\$ 53.53	\$ 26.04	\$ (3.67)
Reserve costs (AS and RUC)	\$ 0.95	\$ 1.19	\$ 0.53	\$ 0.94	\$ 1.14	\$ 0.19
Average total costs of energy and reserve	\$ 30.66	\$ 68.73	\$ 53.85	\$ 54.47	\$ 27.19	\$ (3.47)

Average CAISO gas prices 0.3 % less than Q2 2018

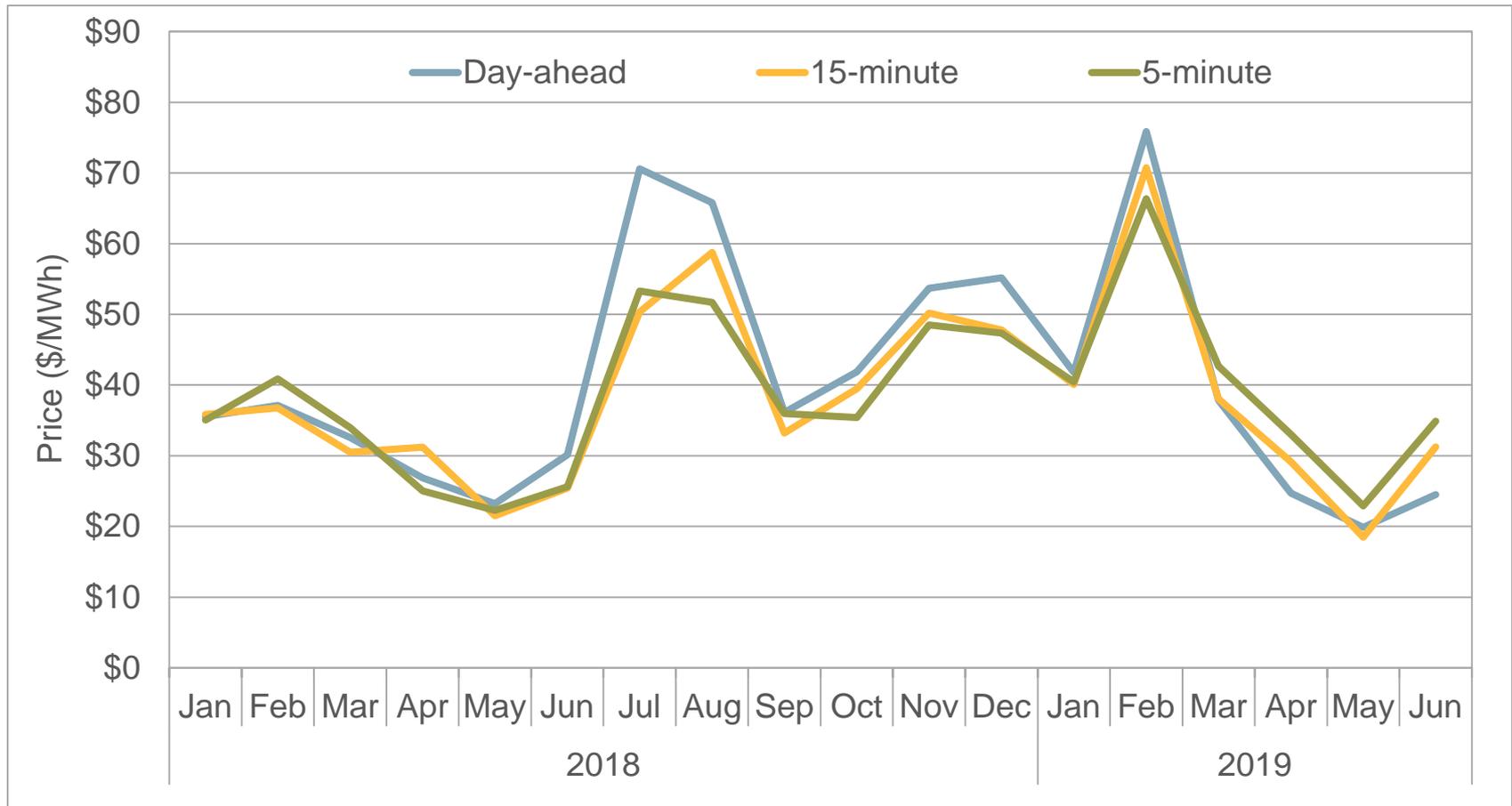


Renewable generation increases over Q2 2018 due to higher hydro



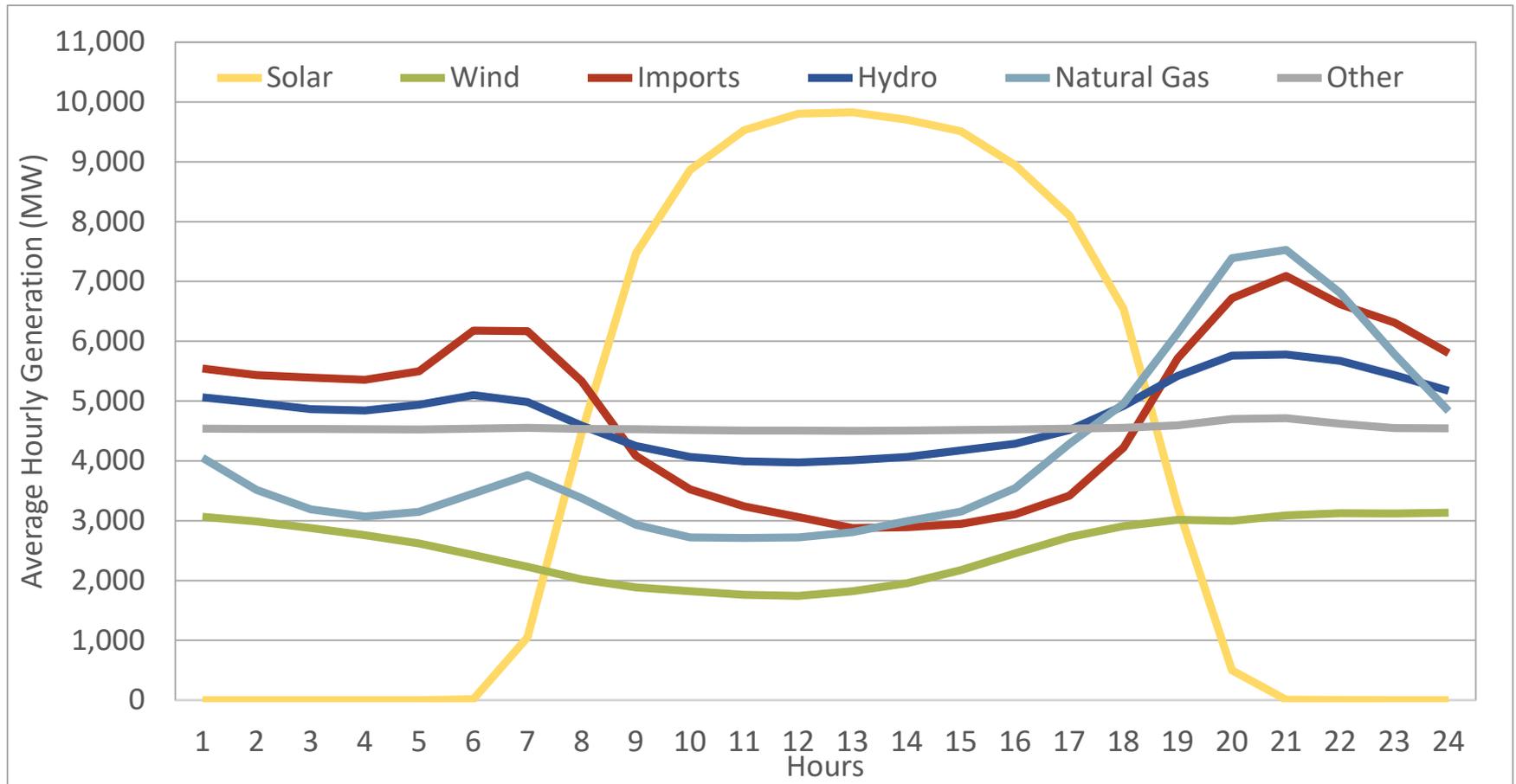
Energy prices decreased compared to the same quarter in 2018

Real-time price spikes drove average real-time prices higher than average day-ahead prices

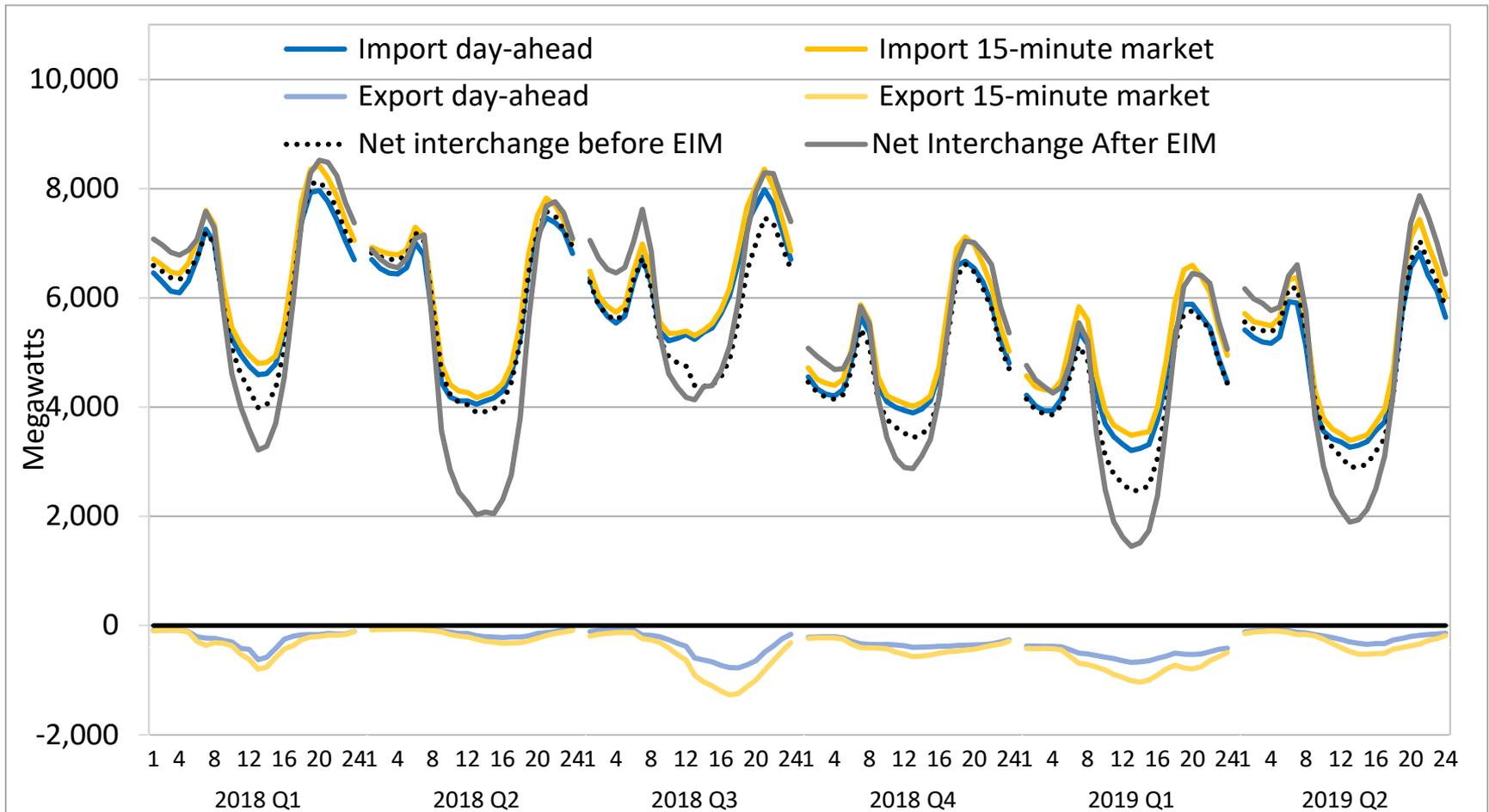


Variation in generation by fuel type, Q2 2019

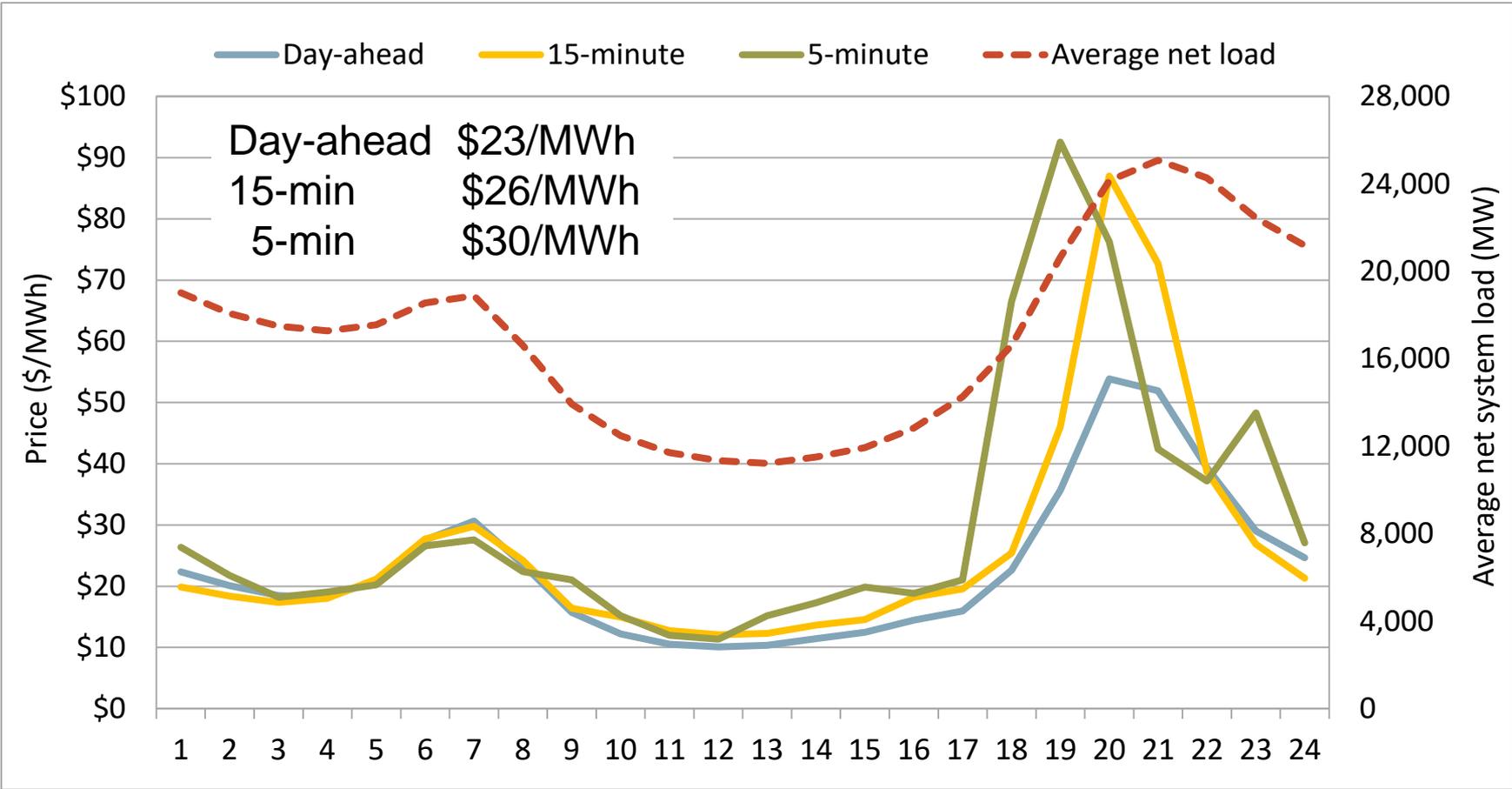
Hourly variation driven by solar



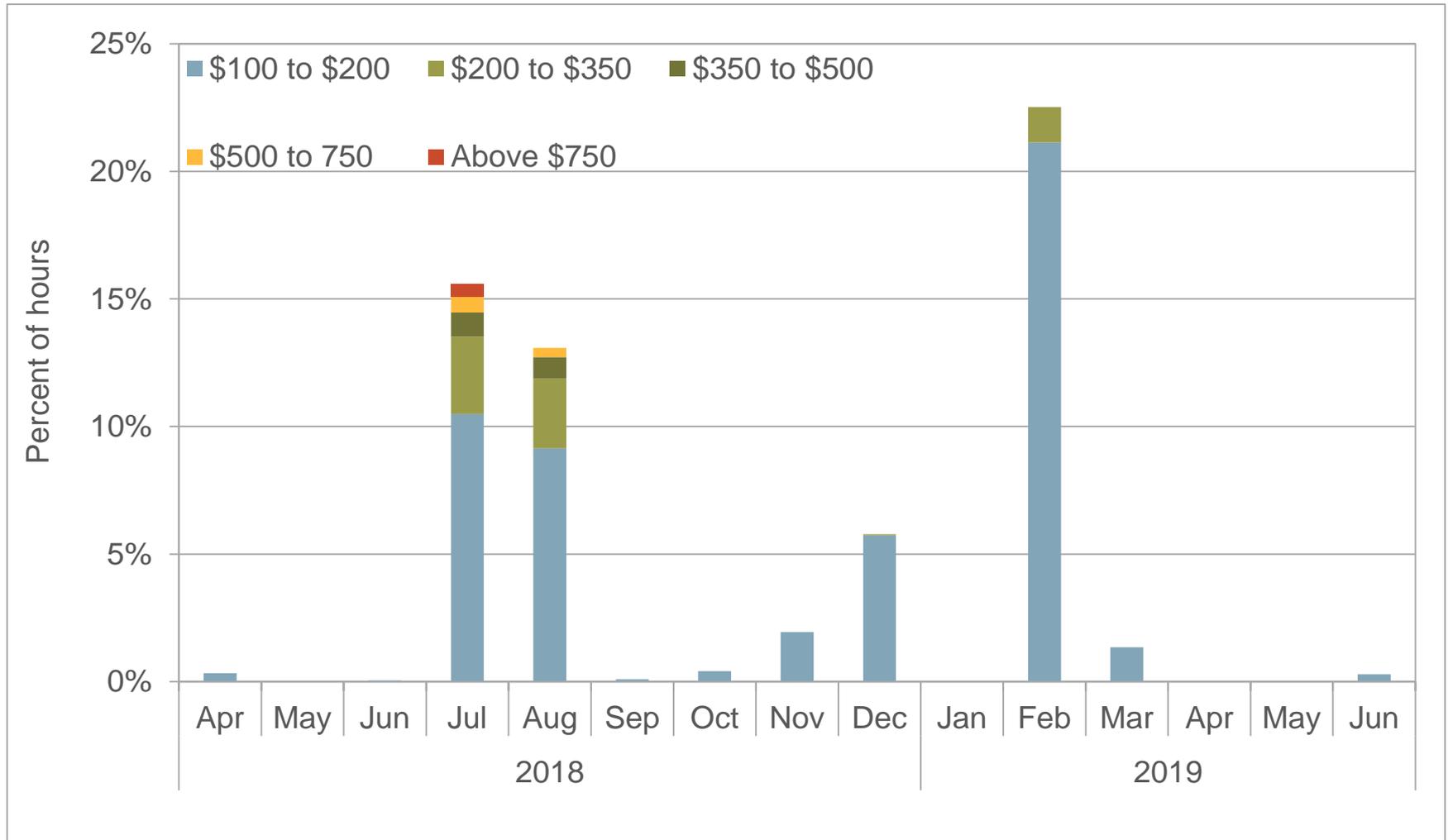
ISO continues to rely on imports to meet peak net load in ramping hours



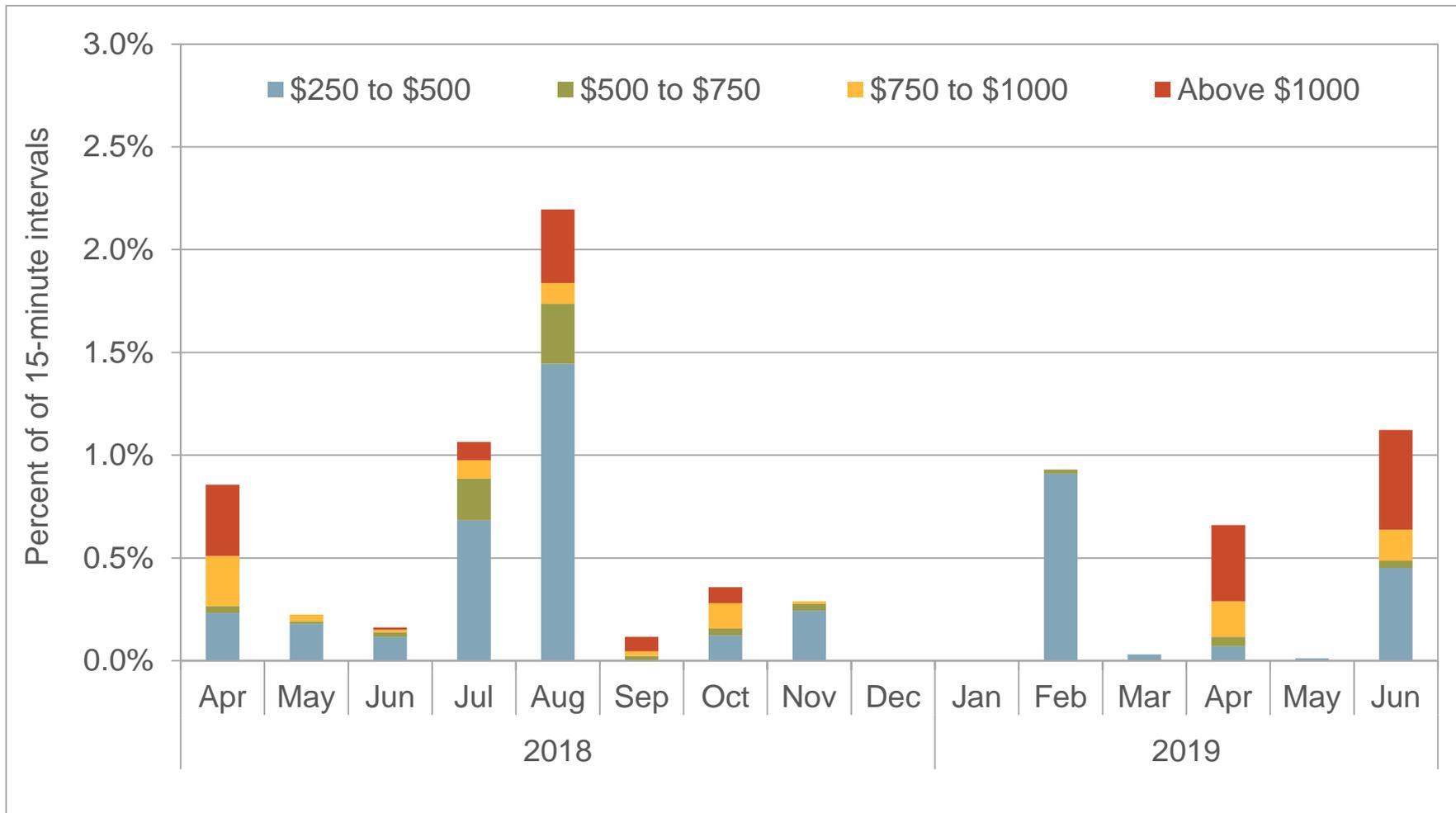
Average day-ahead prices down in Q2 2019 over Q2 2018



Frequency of high day-ahead prices (MWh) by month

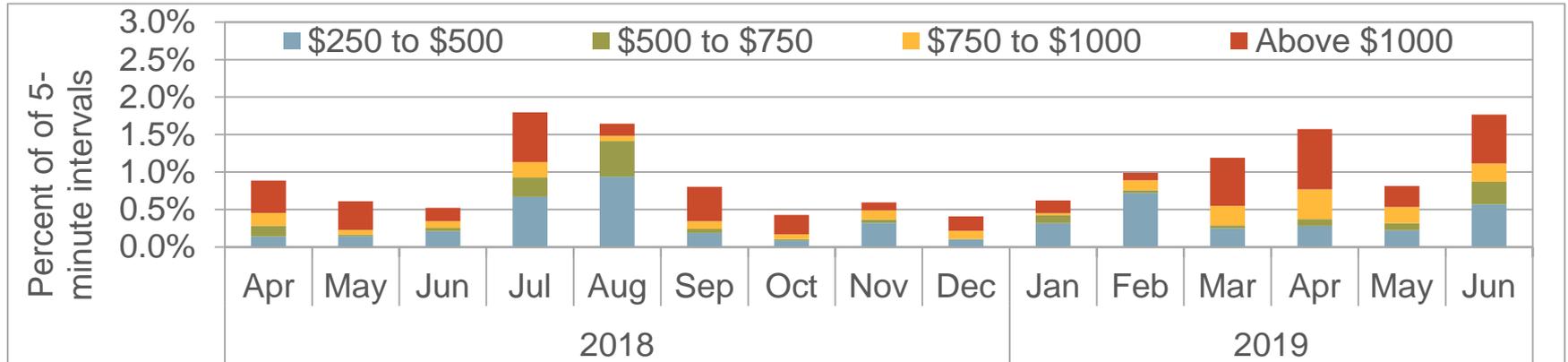


Frequency of high 15-minute prices by month (ISO LAP areas)

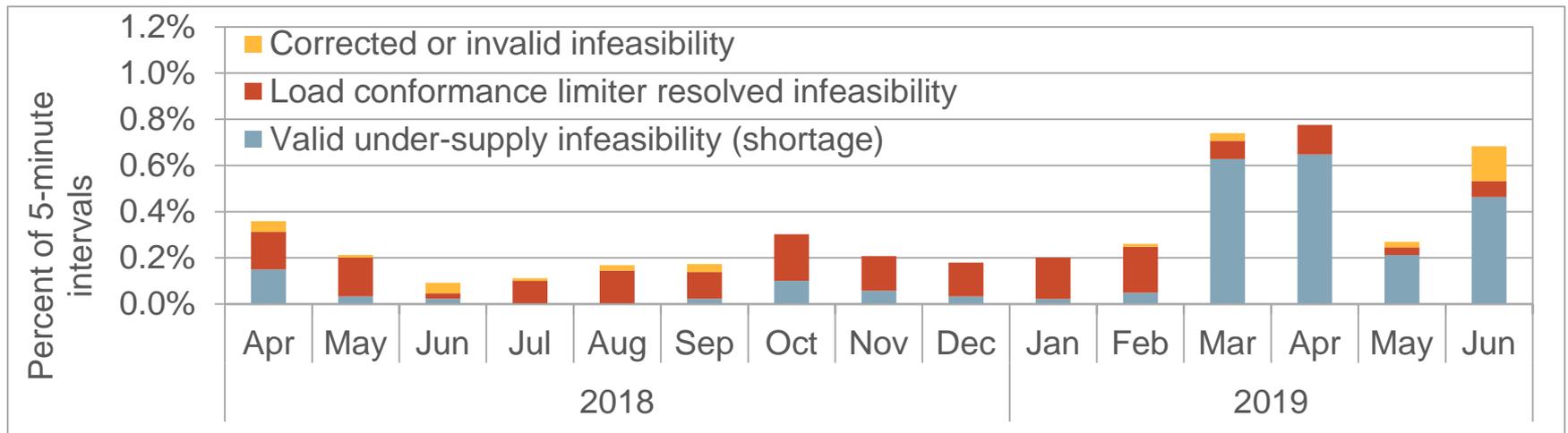


The ISO implemented changes to the load conformance limiter on February 27 which reduce impact of limiter

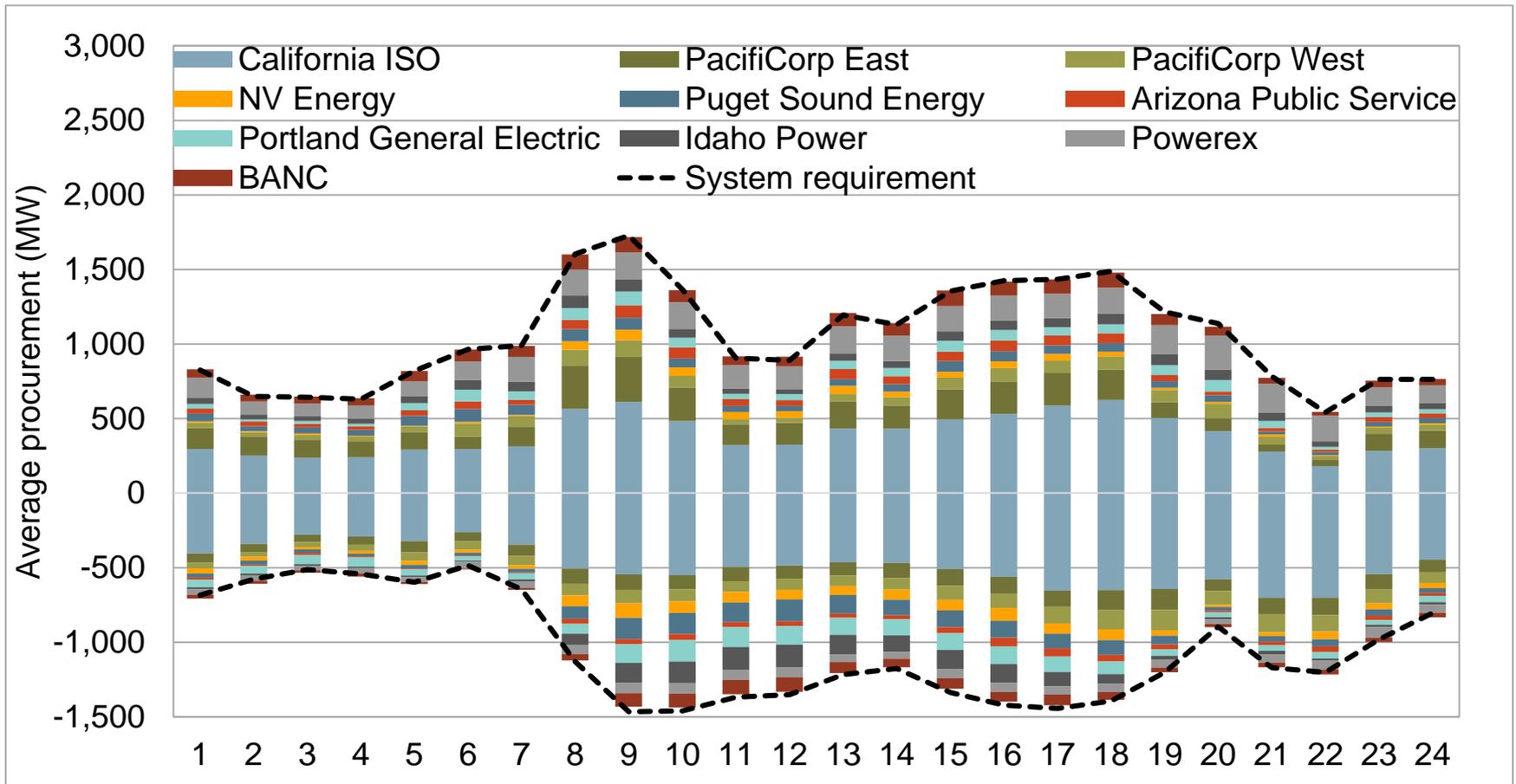
Frequency of high 5-minute prices by month (ISO LAP areas)



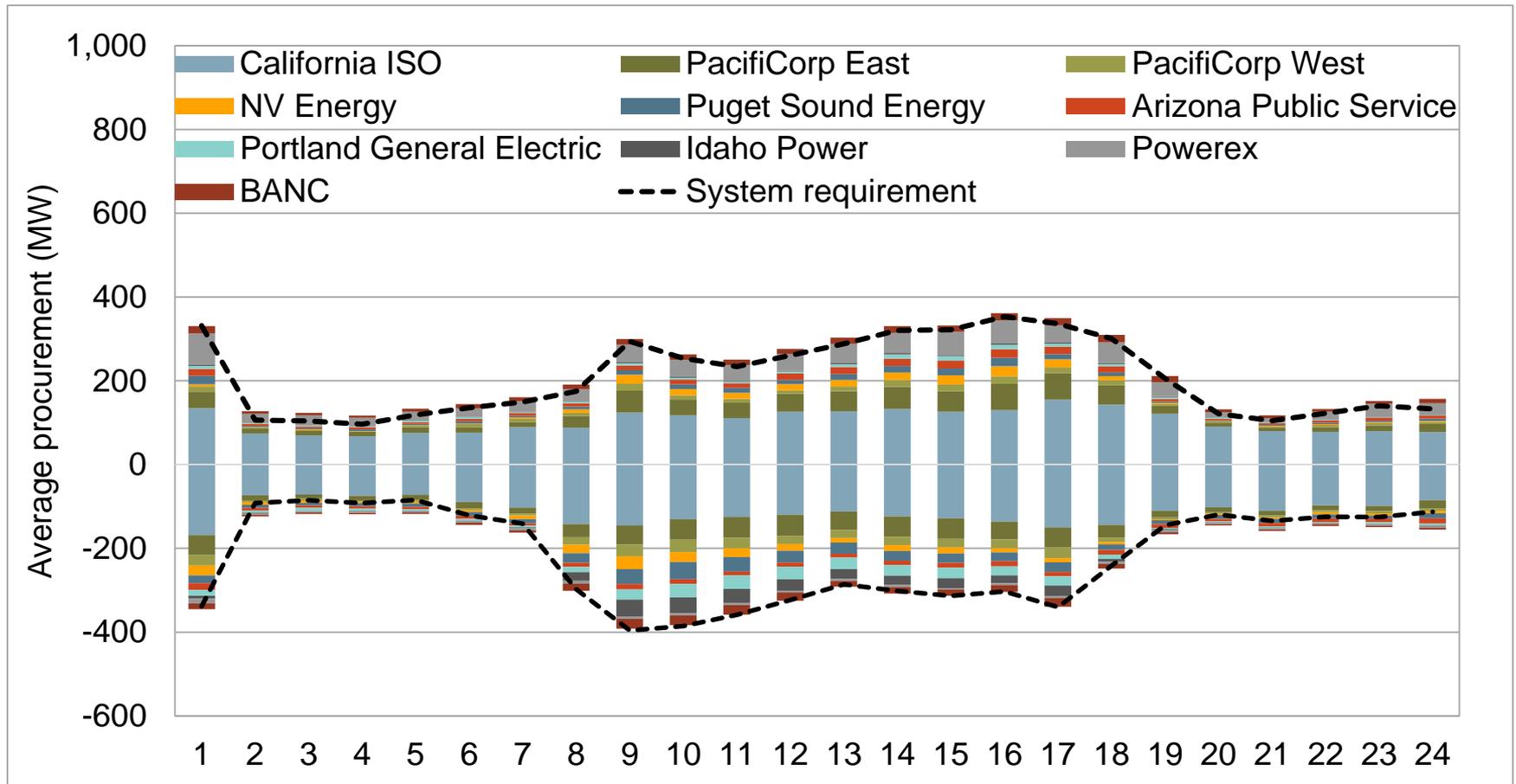
Frequency of under-supply power balance constraint infeasibilities (5-minute market)



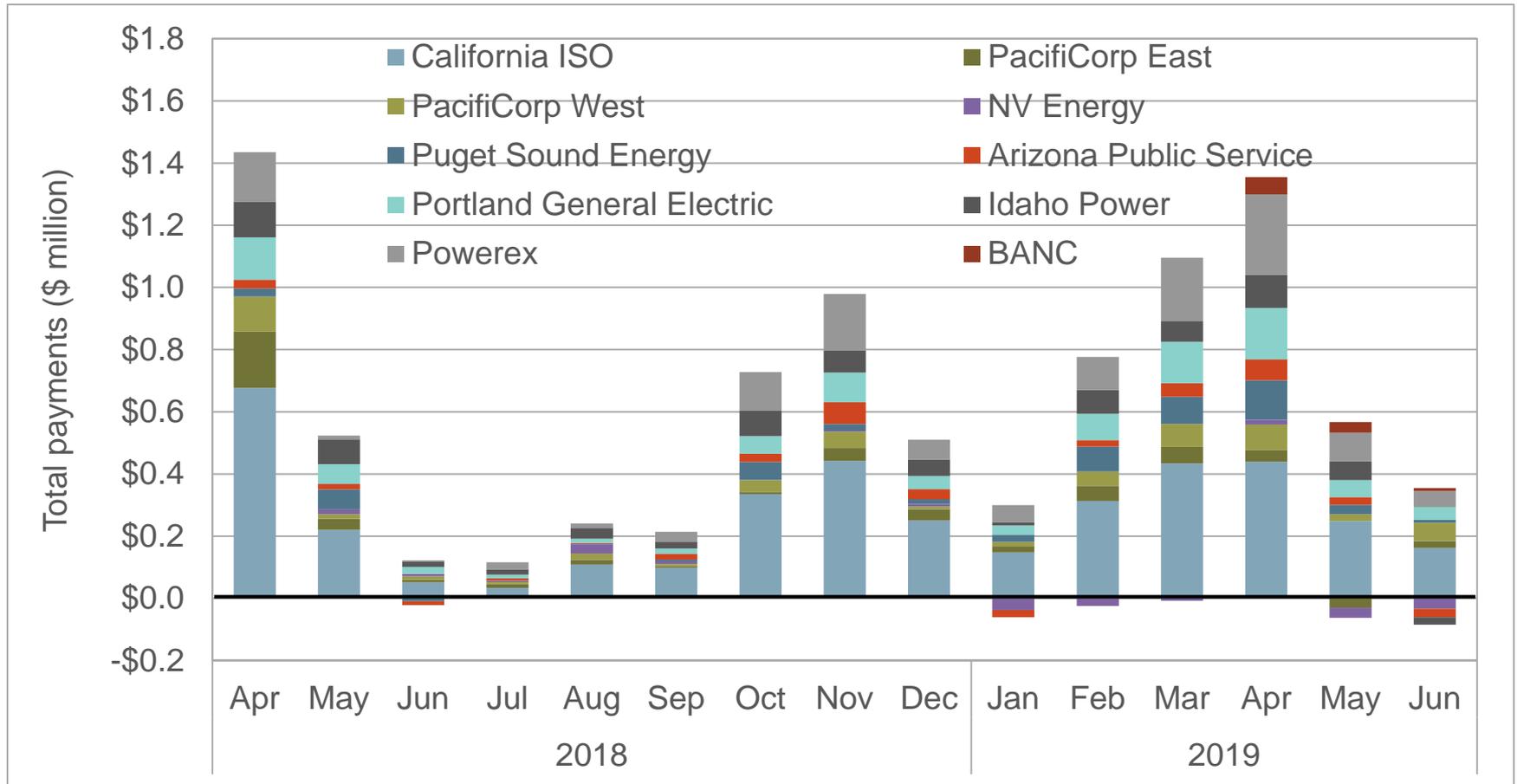
Hourly average flexible ramping capacity procurement in 15-minute market (April – June 2019)



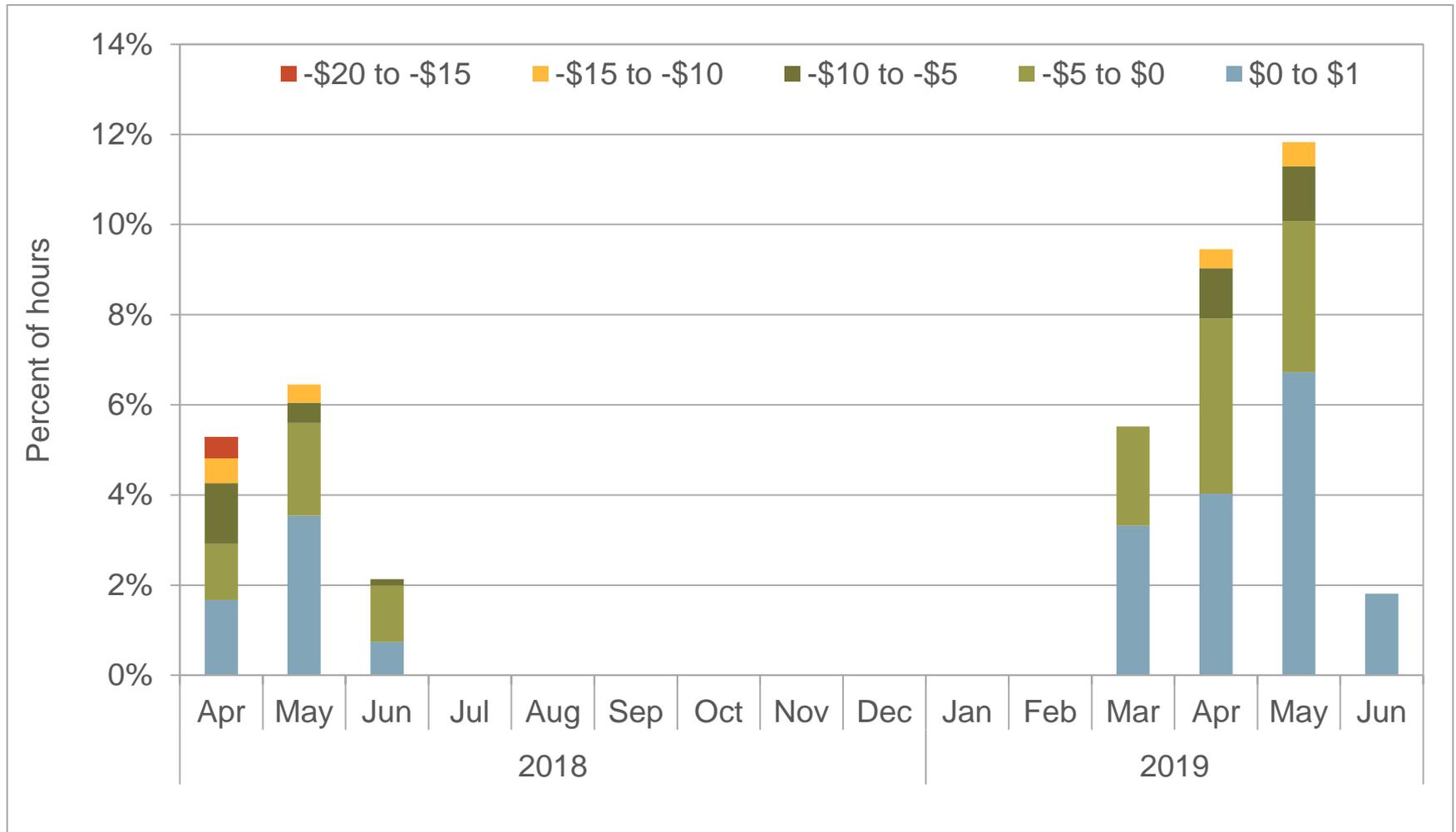
Hourly average flexible ramping capacity procurement in 5-minute market (April – June 2019)



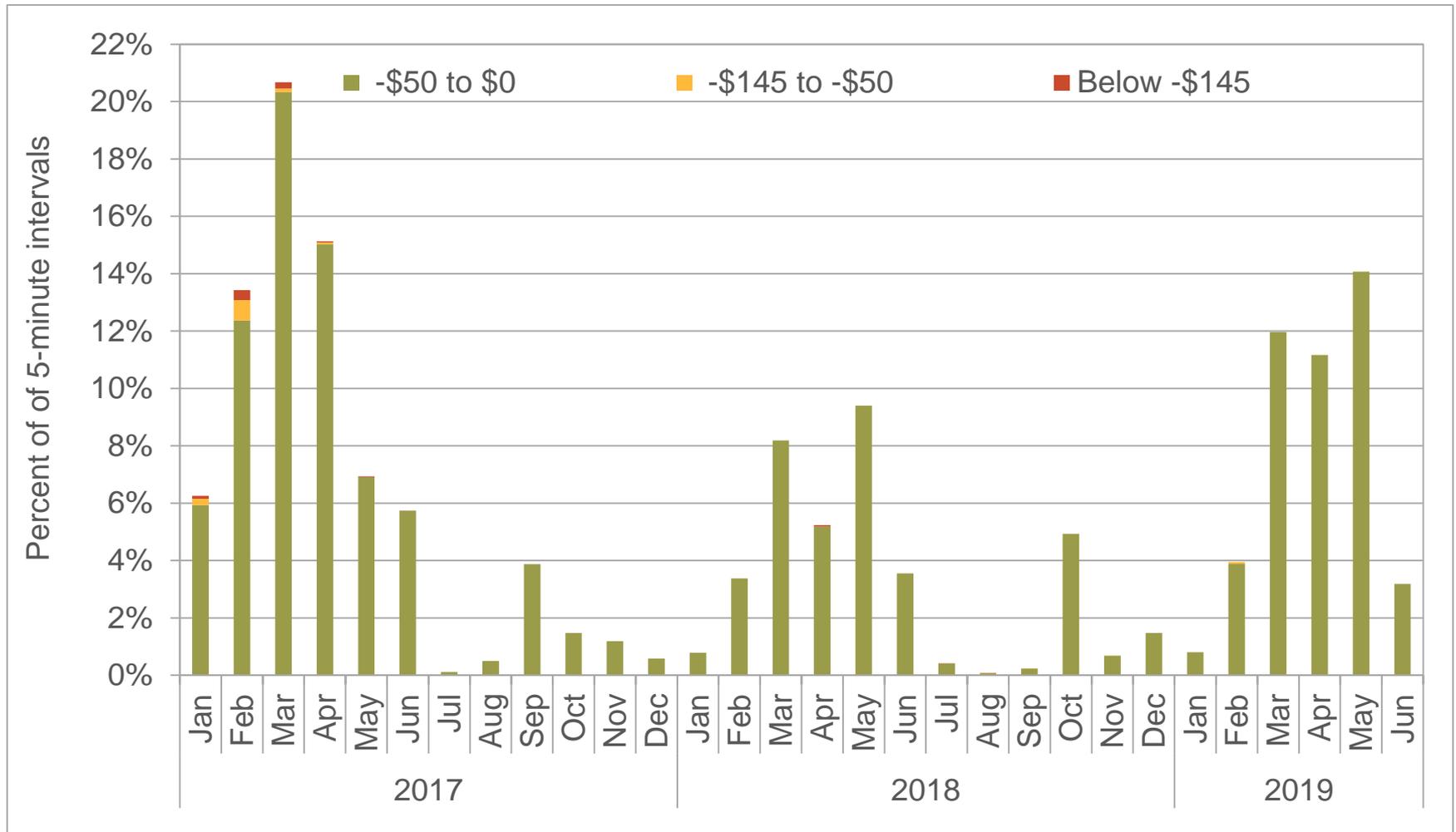
Monthly flexible ramping payments to all balancing areas totaled \$2.1 million



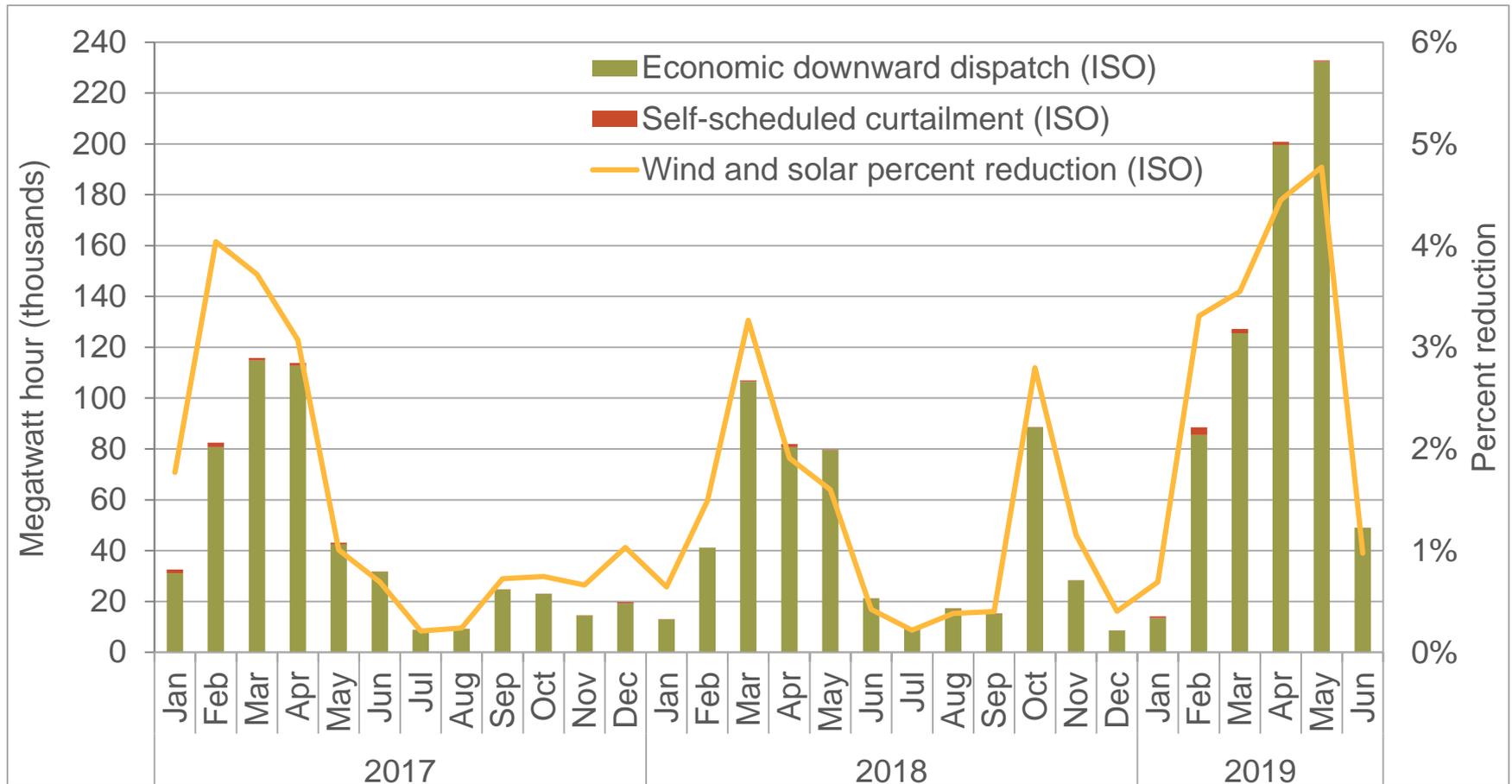
Frequency of negative day-ahead prices (MWh) by month



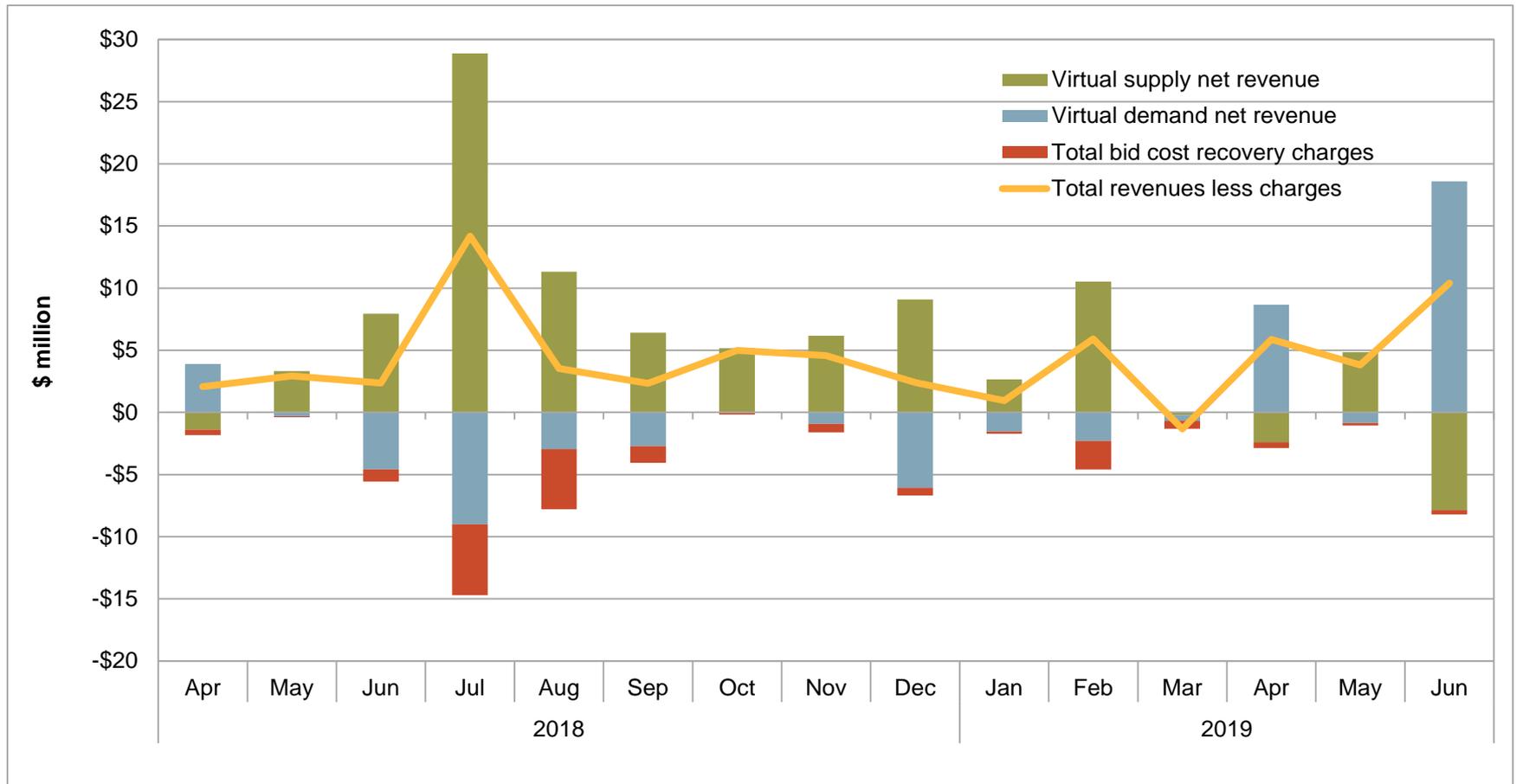
Frequency of negative 5-minute prices (MWh) by month



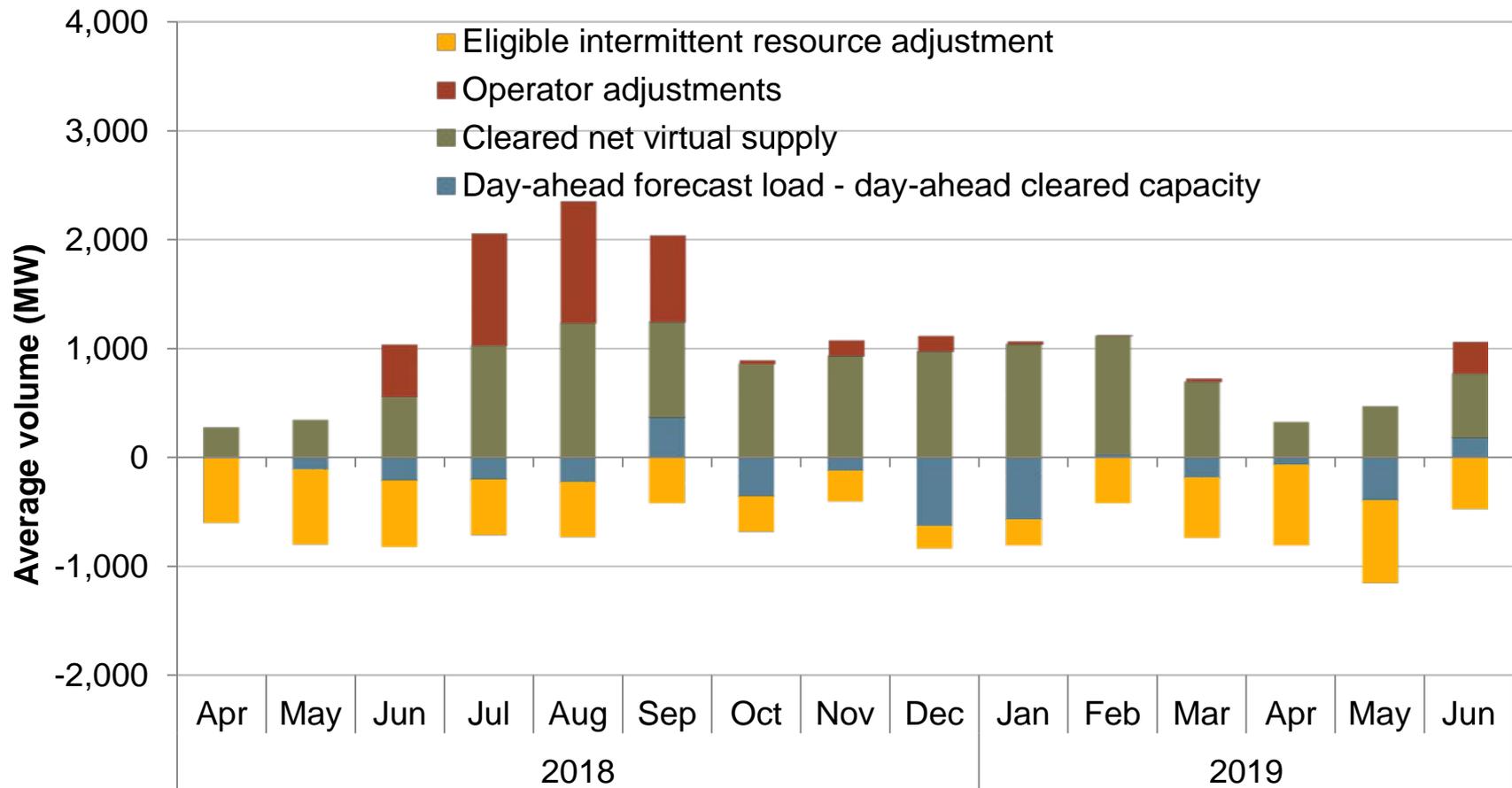
Economic downward dispatch and self schedule curtailment of wind and solar generation by month



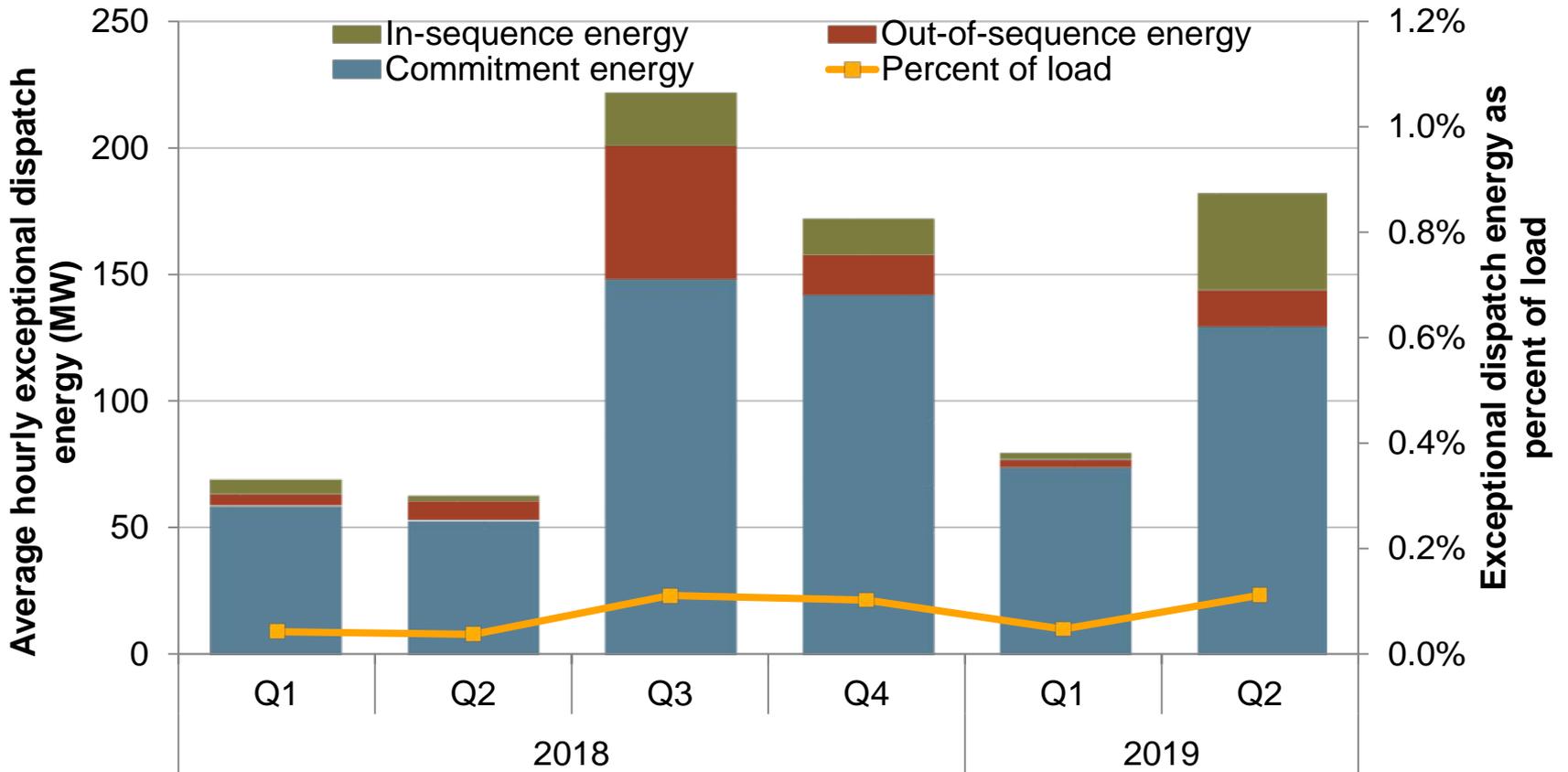
Convergence bidding revenue totaled \$20 million in Q2 Virtual demand profitable for the first time since 2017



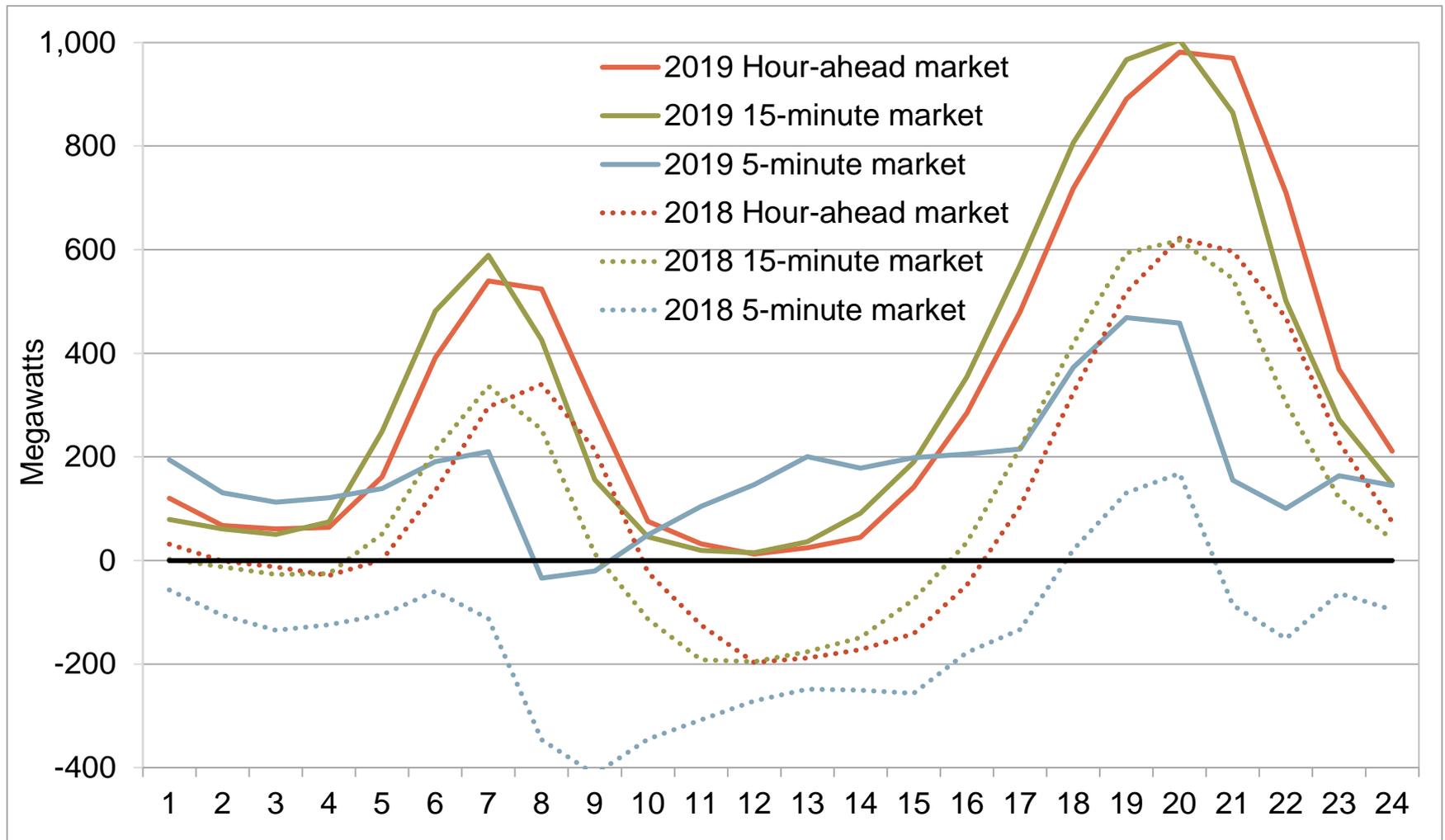
Determinants of residual unit commitment procurement



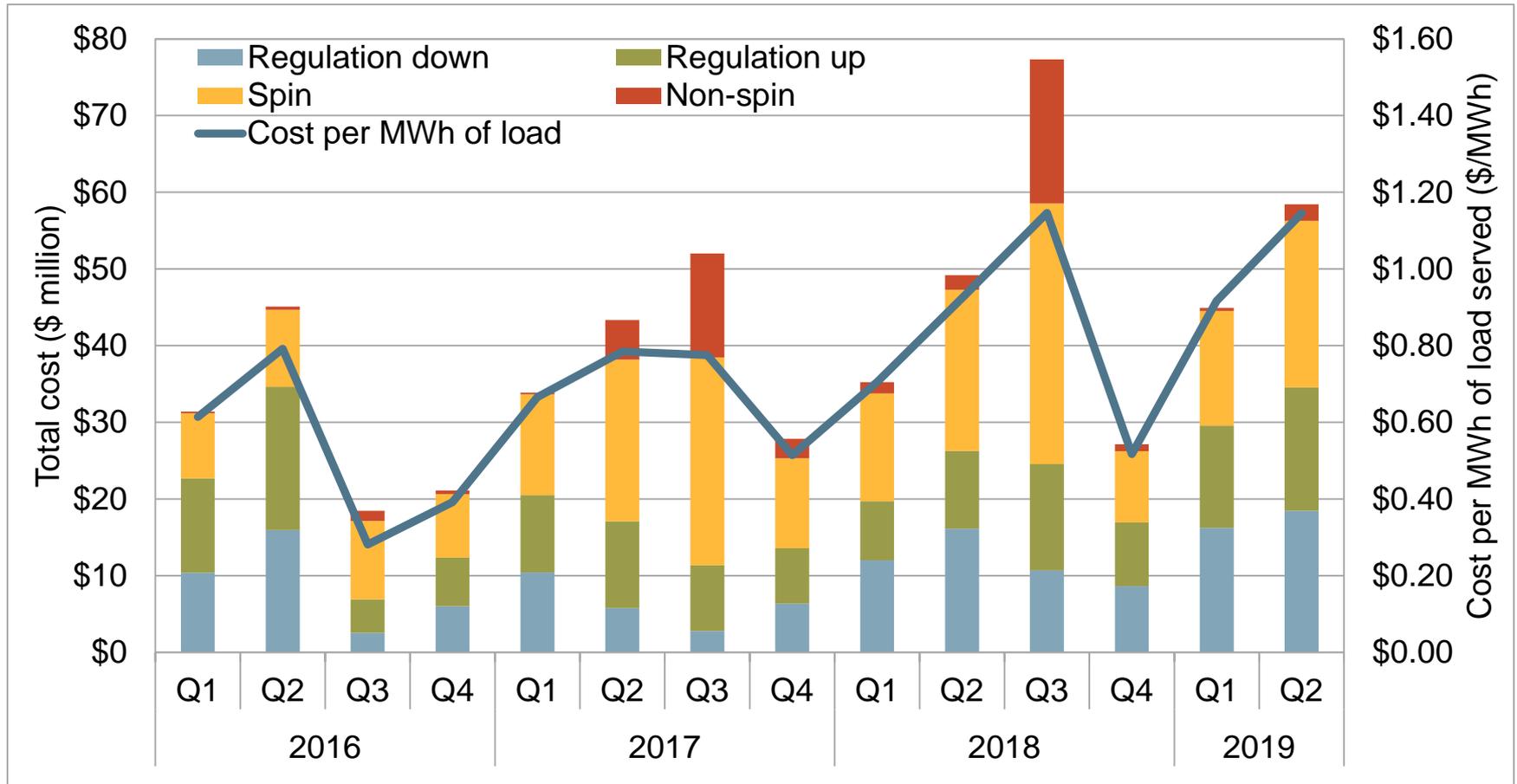
Average hourly energy from exceptional dispatch nearly tripled compared to Q2 2018 totaling 0.11% system load



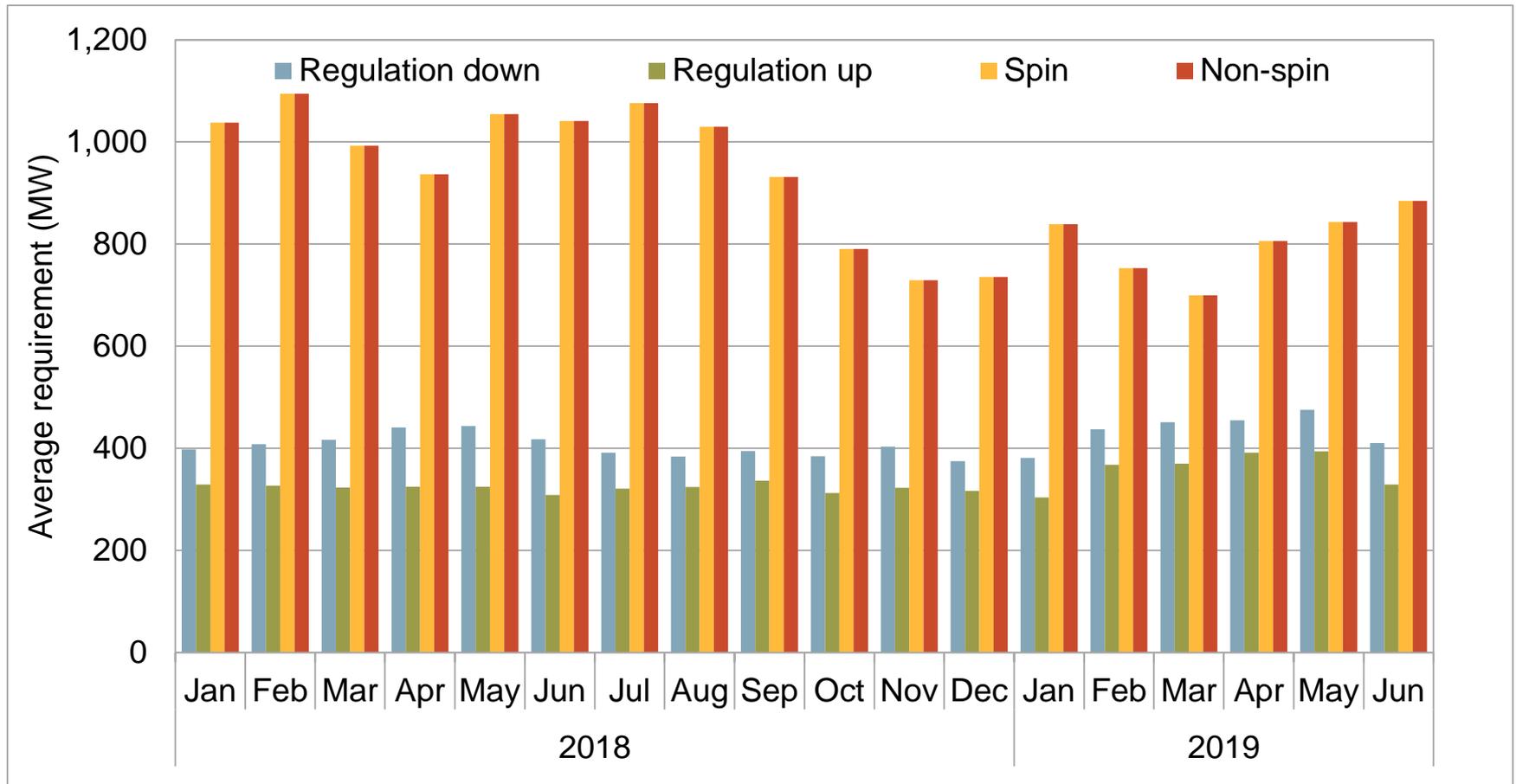
Average hourly load adjustment (Q2 2019, Q2 2018)



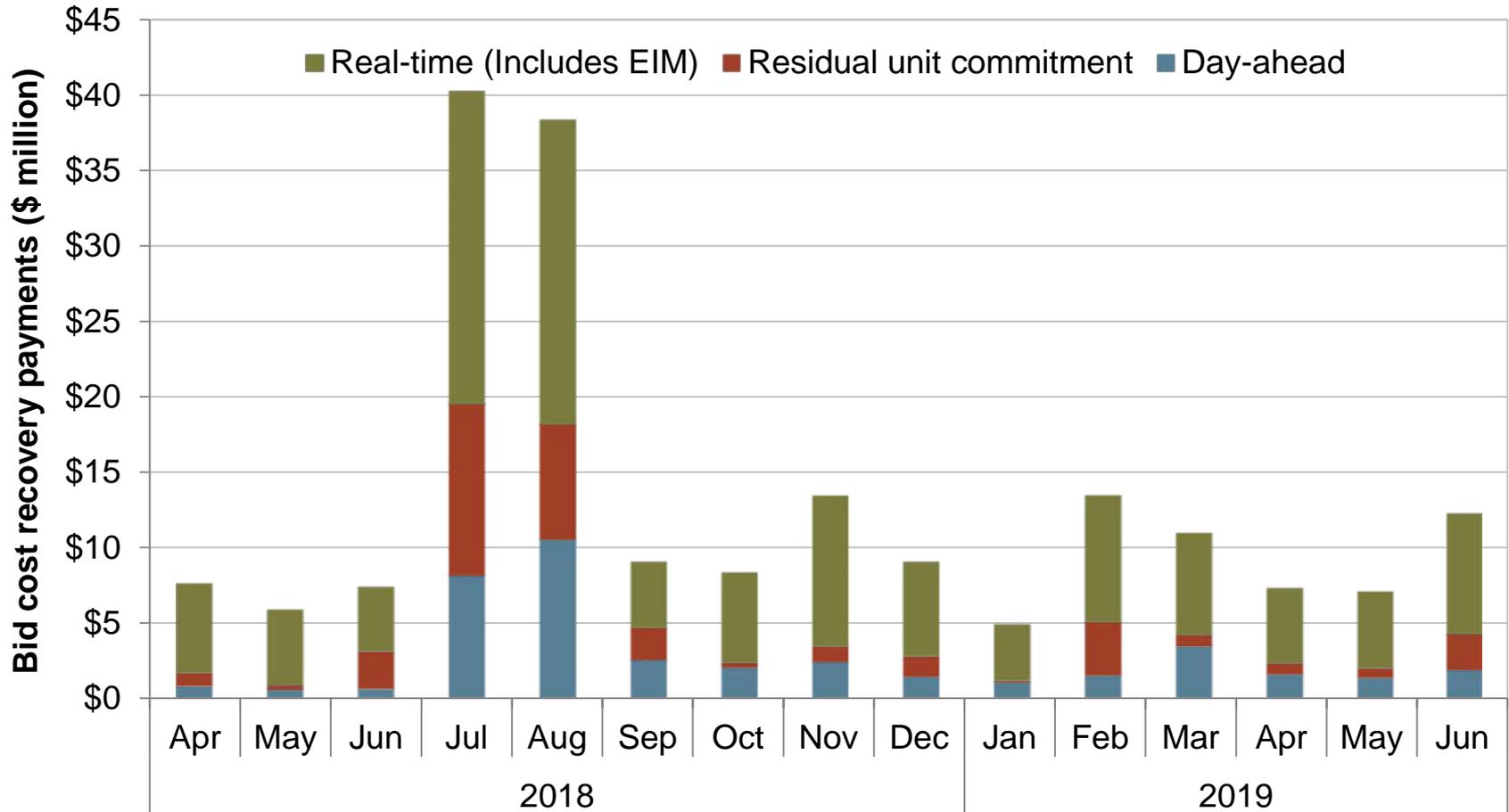
Ancillary service cost by product



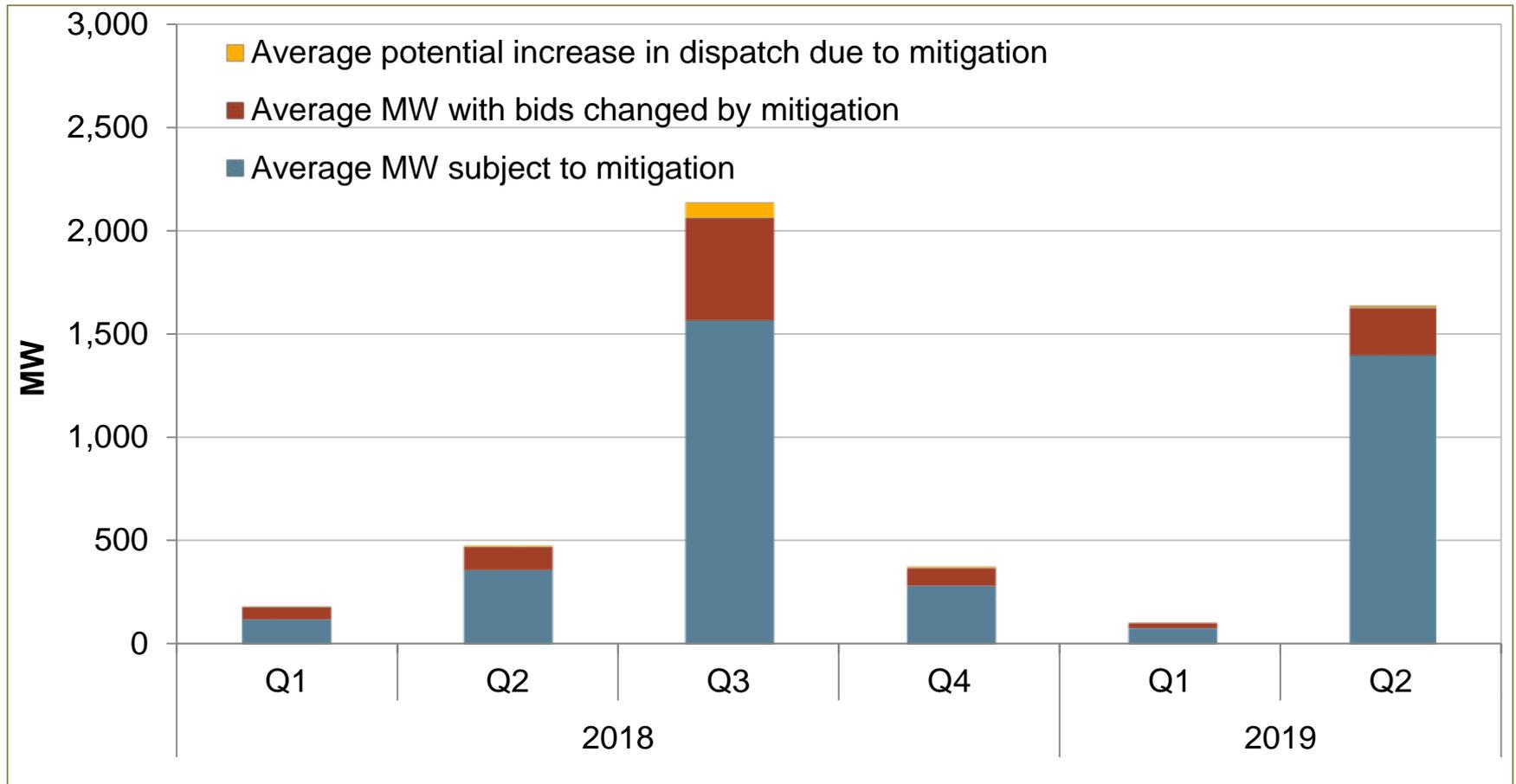
Average monthly day-ahead ancillary service requirements



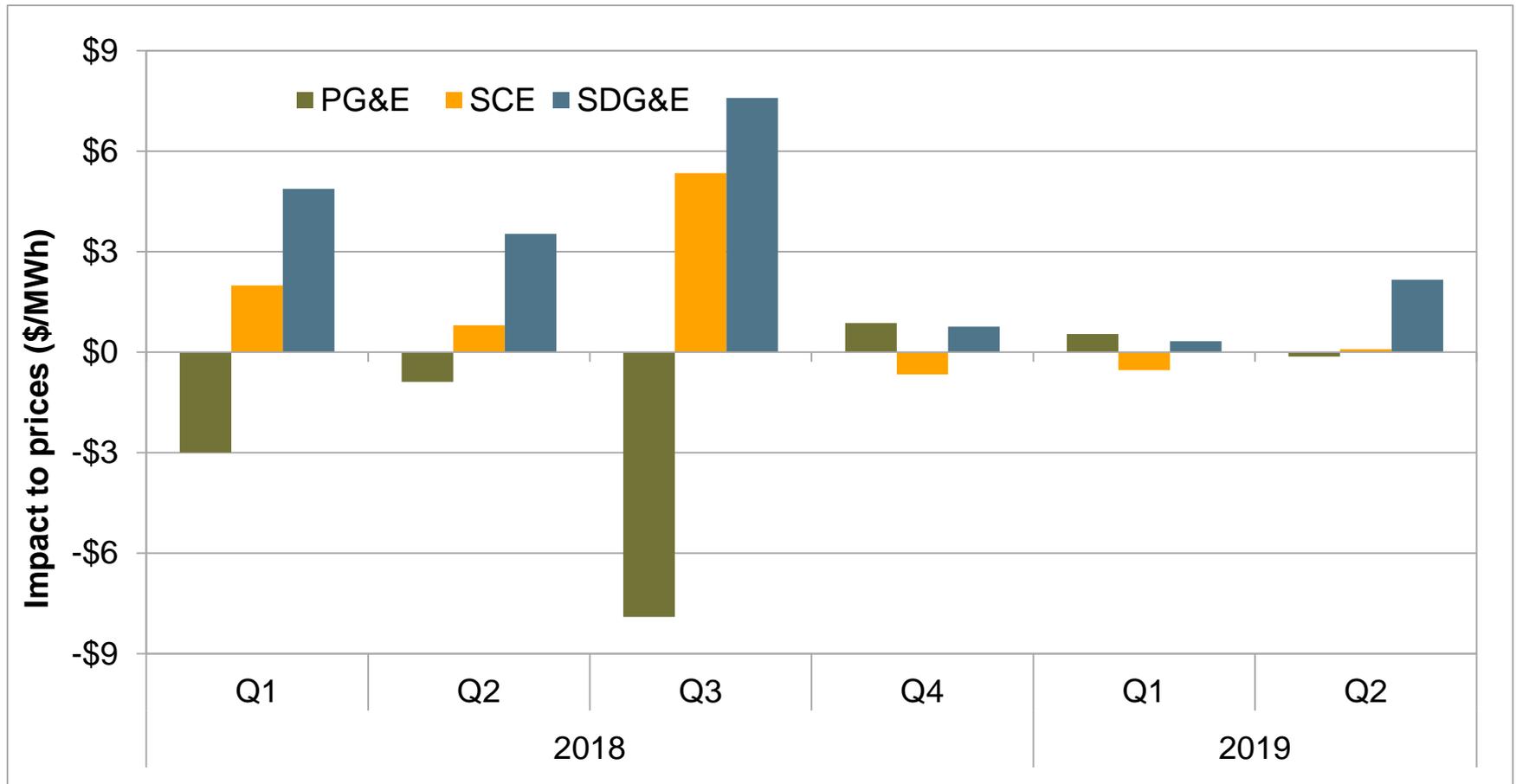
Q2 bid cost recovery \$27 million, \$6 million above Q2 2018



Energy bid mitigation had very minor overall impact on day-ahead energy dispatches



Overall impact of congestion on prices in the day-ahead market continues to be lower in 2019

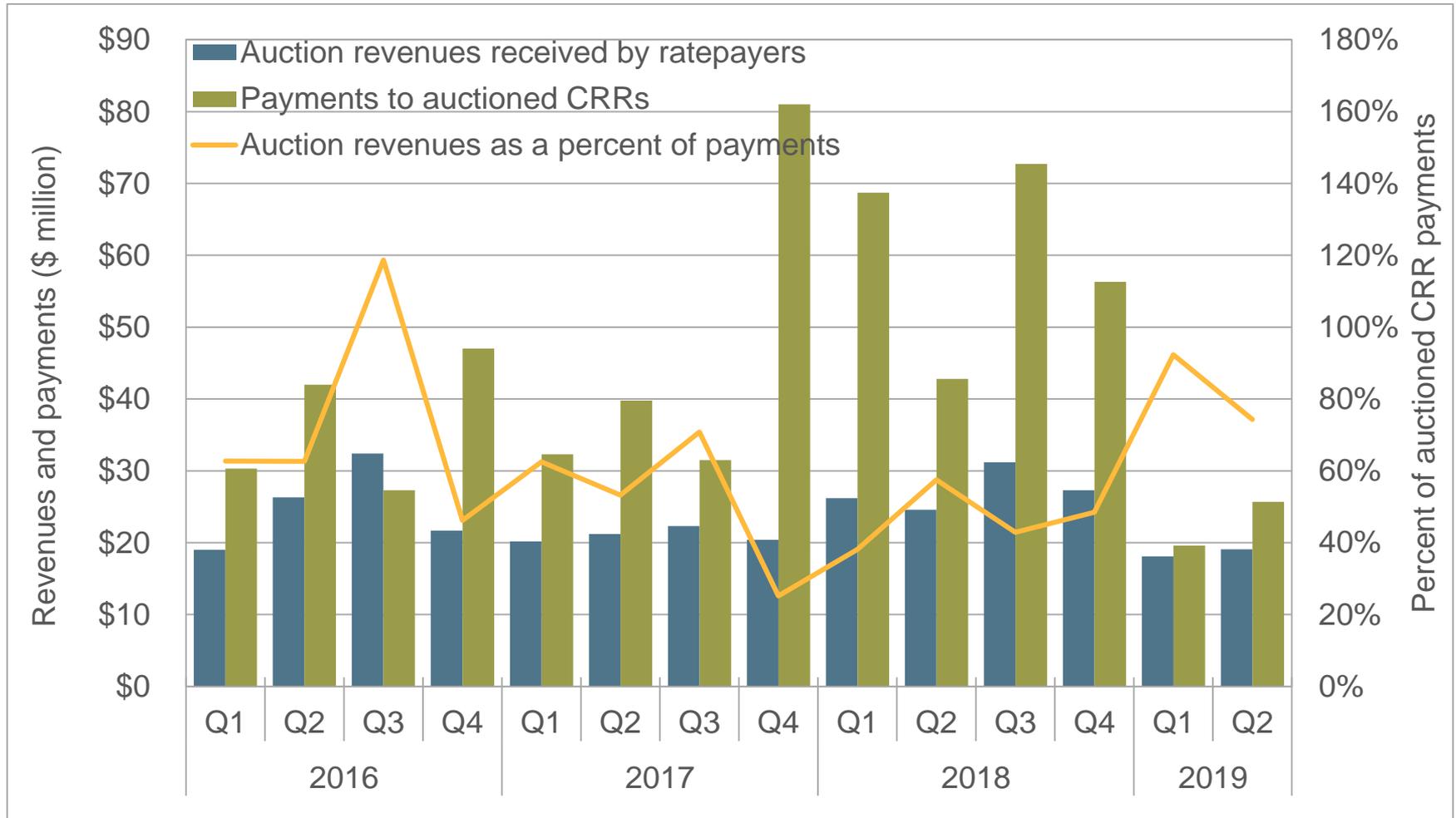


Congestion revenue right auction changes implemented January 2019

- **Track 1A:**
 - Significantly reduces the number and pairs of nodes at which congestion revenue rights can be purchased in the auction.
 - Designed to limit auction sales to pairs of nodes with physical generation / load due to potential use as hedges for actual sales and trading of energy.
- **Track 1B.**
 - Limits the net payments to CRR holders if payments exceed congestion charges collected in the day-ahead market on a targeted constraint-by-constraint basis.

Auction revenues and payments to non-load-serving entities

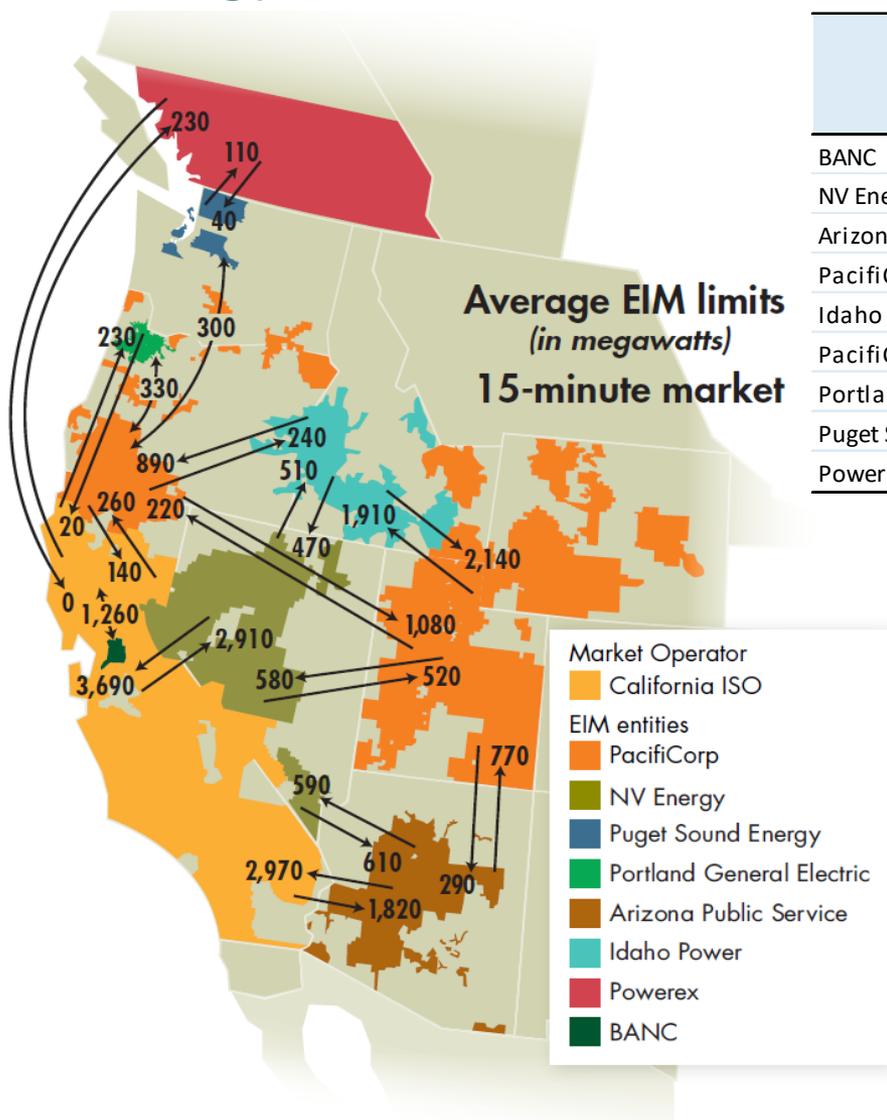
Q2 payments \$6.6 million more than auction revenues



Track 1B changes ensure CRRs paid no more than congestion rent

- Total CRR payments, netted by scheduling coordinator from each constraint, are calculated over the month.
- Total congestion rent is calculated by constraint.
- If all SC CRR payments on constraint > congestion rent:
 - Offset = CRR payment – congestion rent
 - Charged to SCs with net positive flows on constraint
- DMM estimates track 1B reduced losses by ~\$5.5 million

Energy imbalance market transfer limits

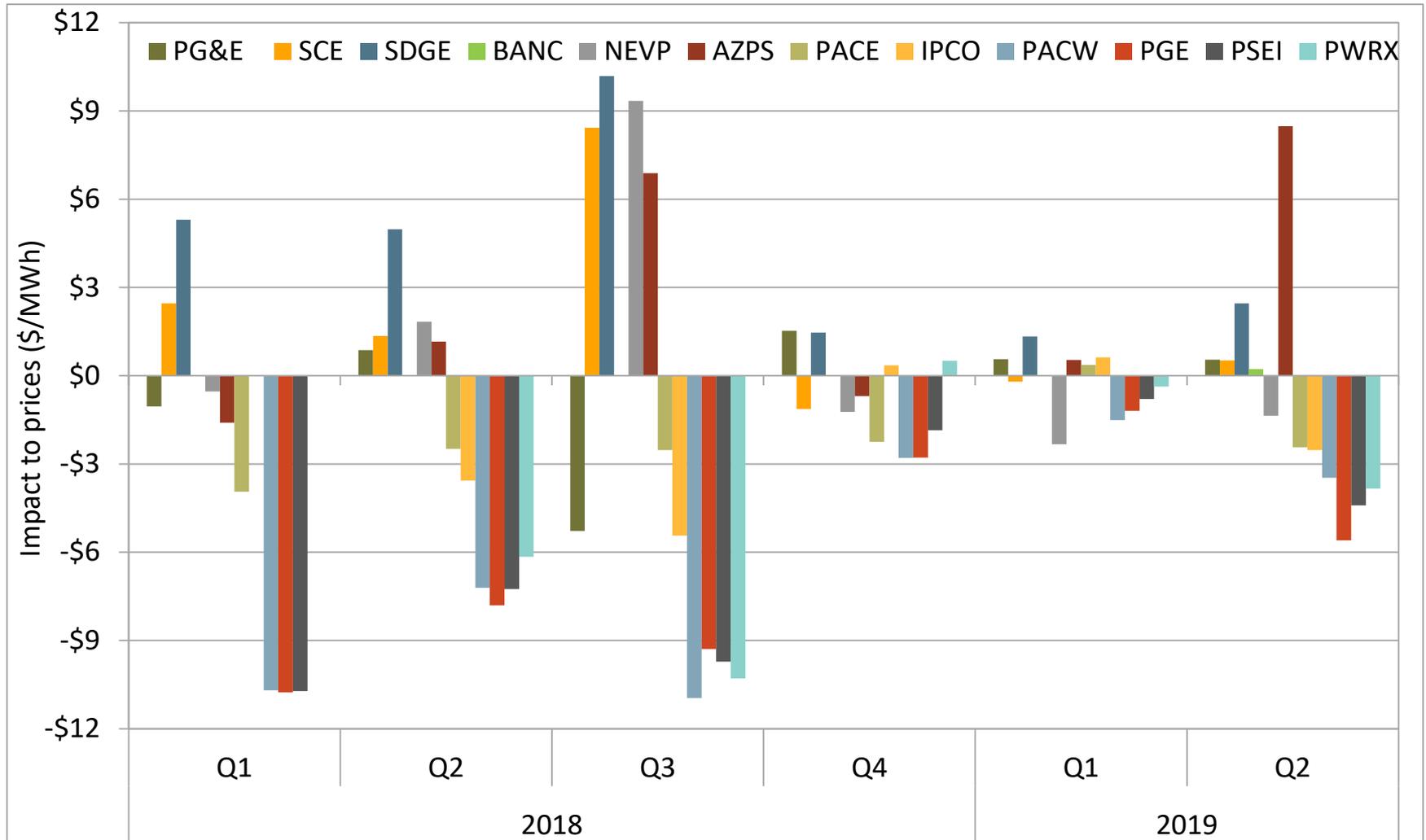


	15-minute market		5-minute market	
	Congested toward ISO	Congested from ISO	Congested toward ISO	Congested from ISO
BANC	2%	2%	2%	2%
NV Energy	3%	1%	3%	1%
Arizona Public Service	3%	4%	2%	2%
PacifiCorp East	4%	7%	2%	5%
Idaho Power	4%	7%	2%	5%
PacifiCorp West	17%	11%	14%	8%
Portland General Electric	23%	10%	20%	6%
Puget Sound Energy	19%	12%	16%	9%
Powerex	21%	32%	34%	42%

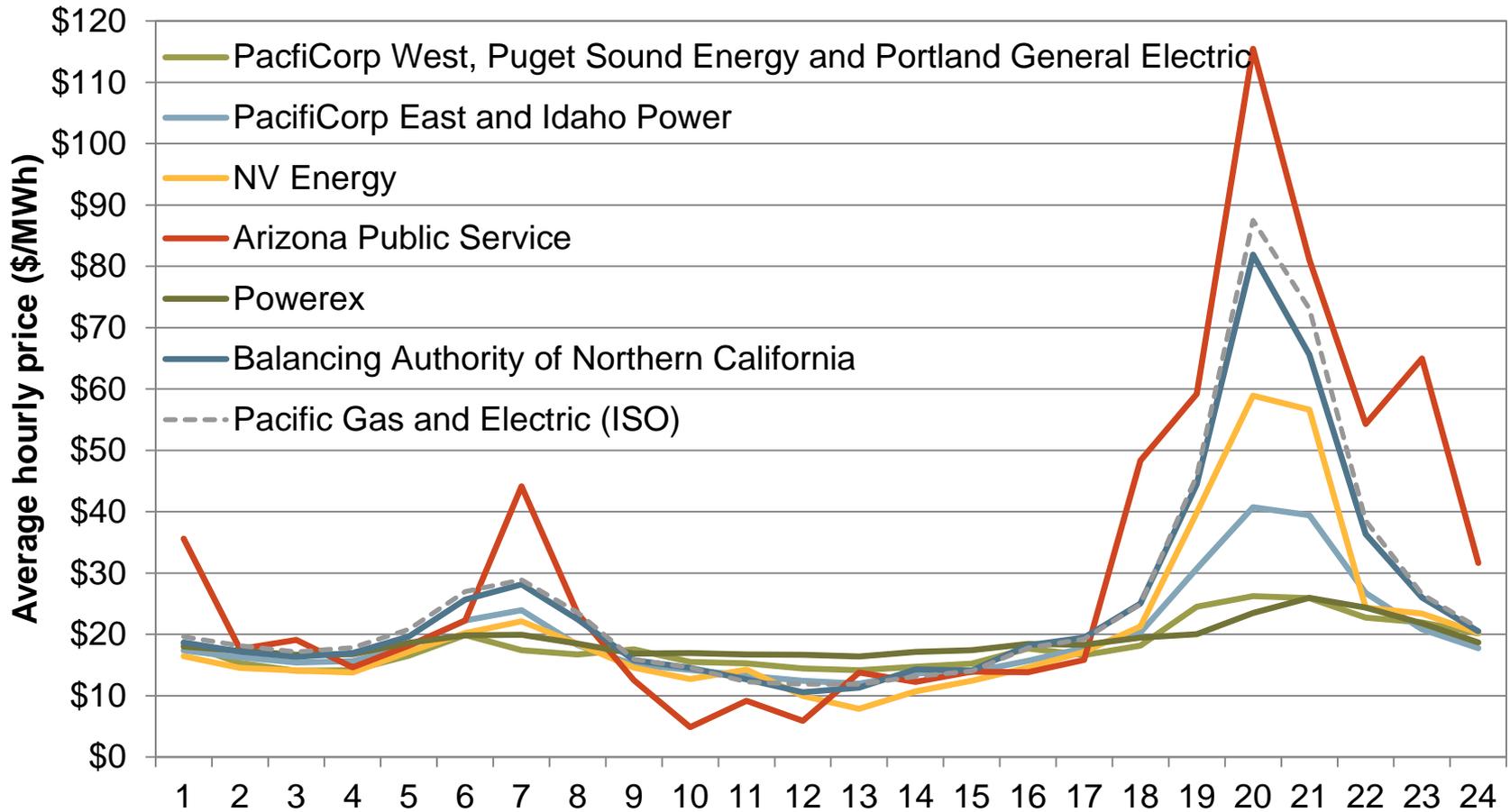
Energy imbalance market changes:

- BANC – SMUD added April 3
- Flexible ramping sufficiency test changes

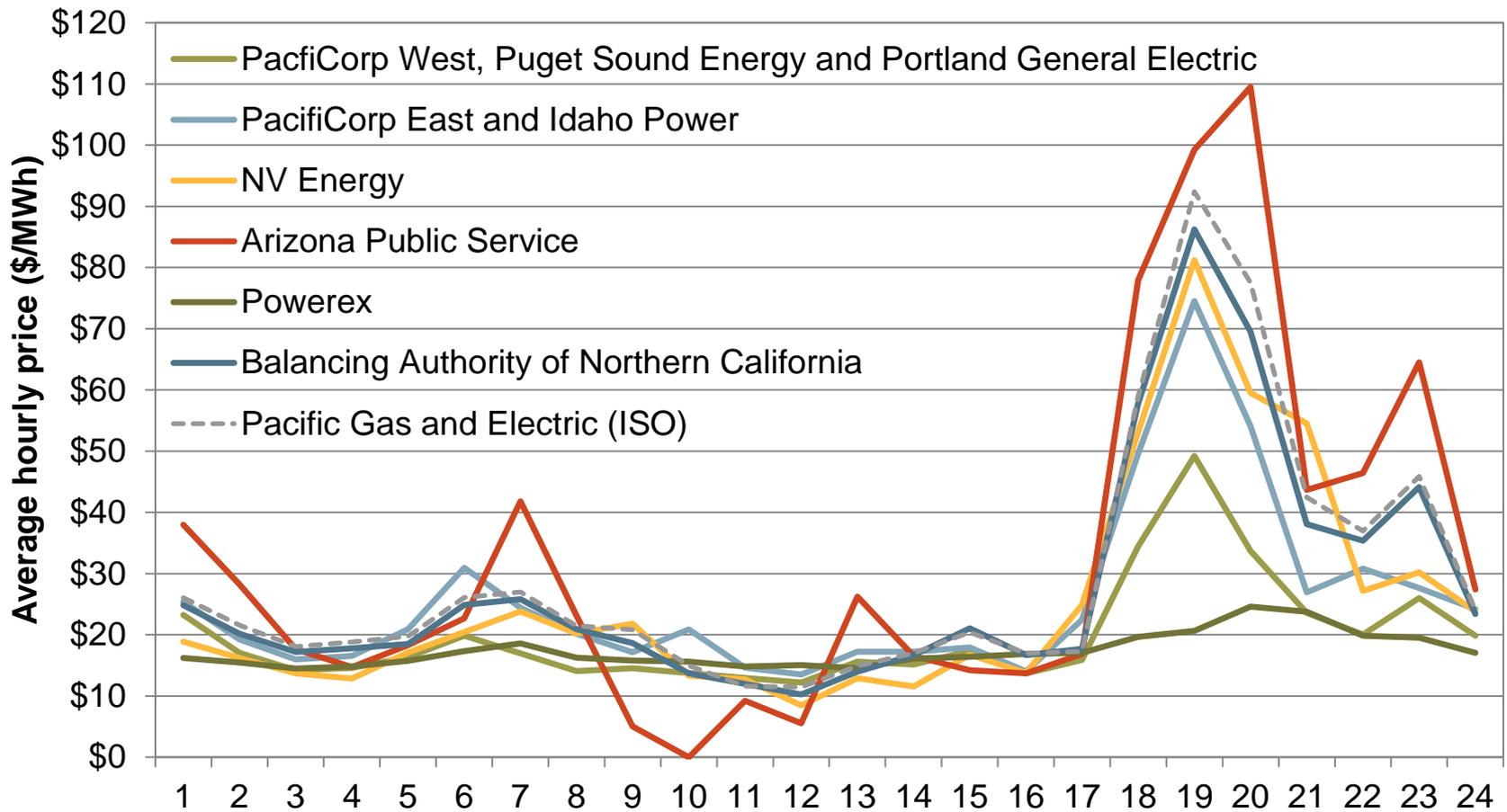
Impact of congestion on 15-minute prices



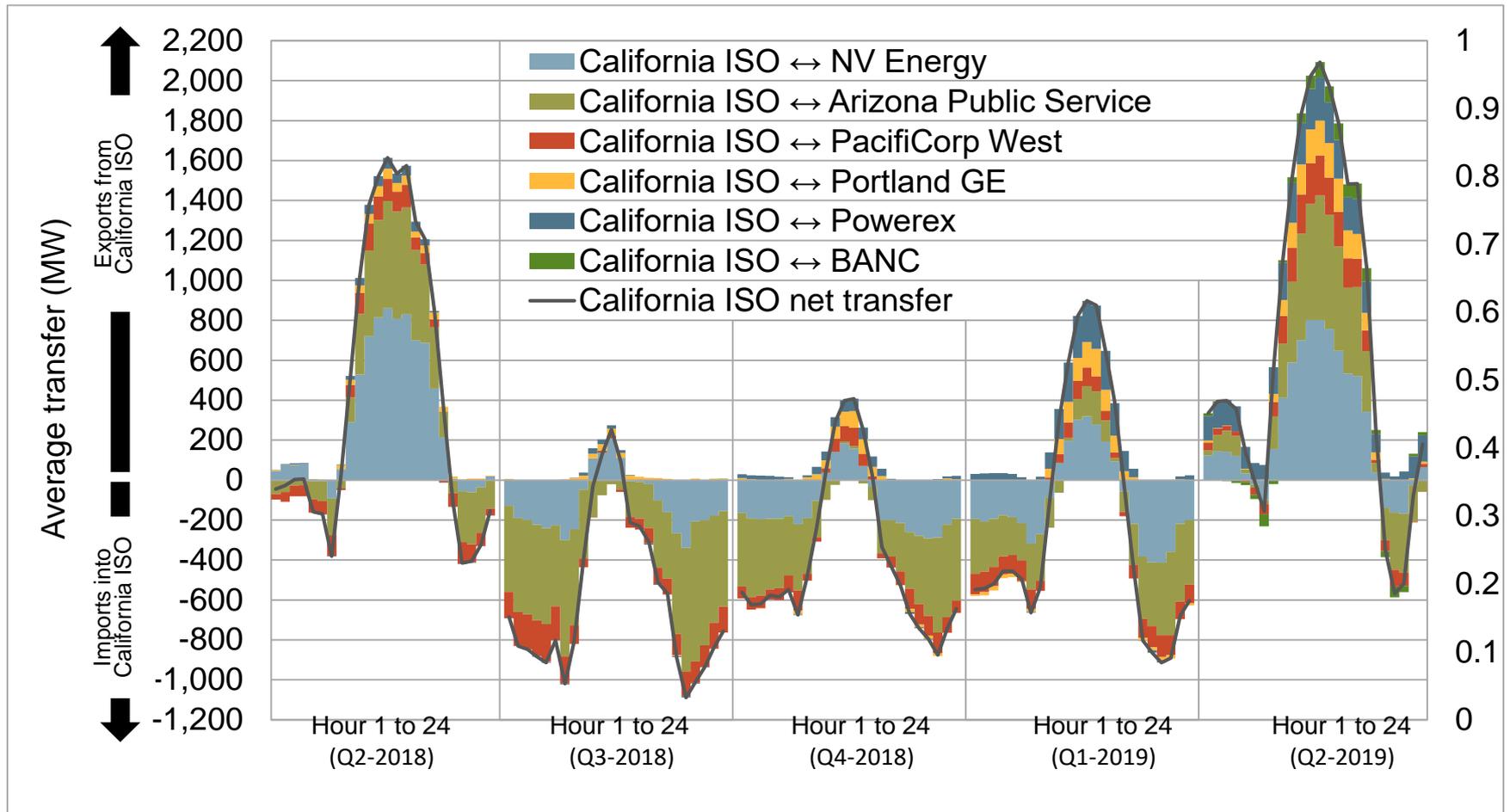
Hourly 15-minute market prices Q2 2019



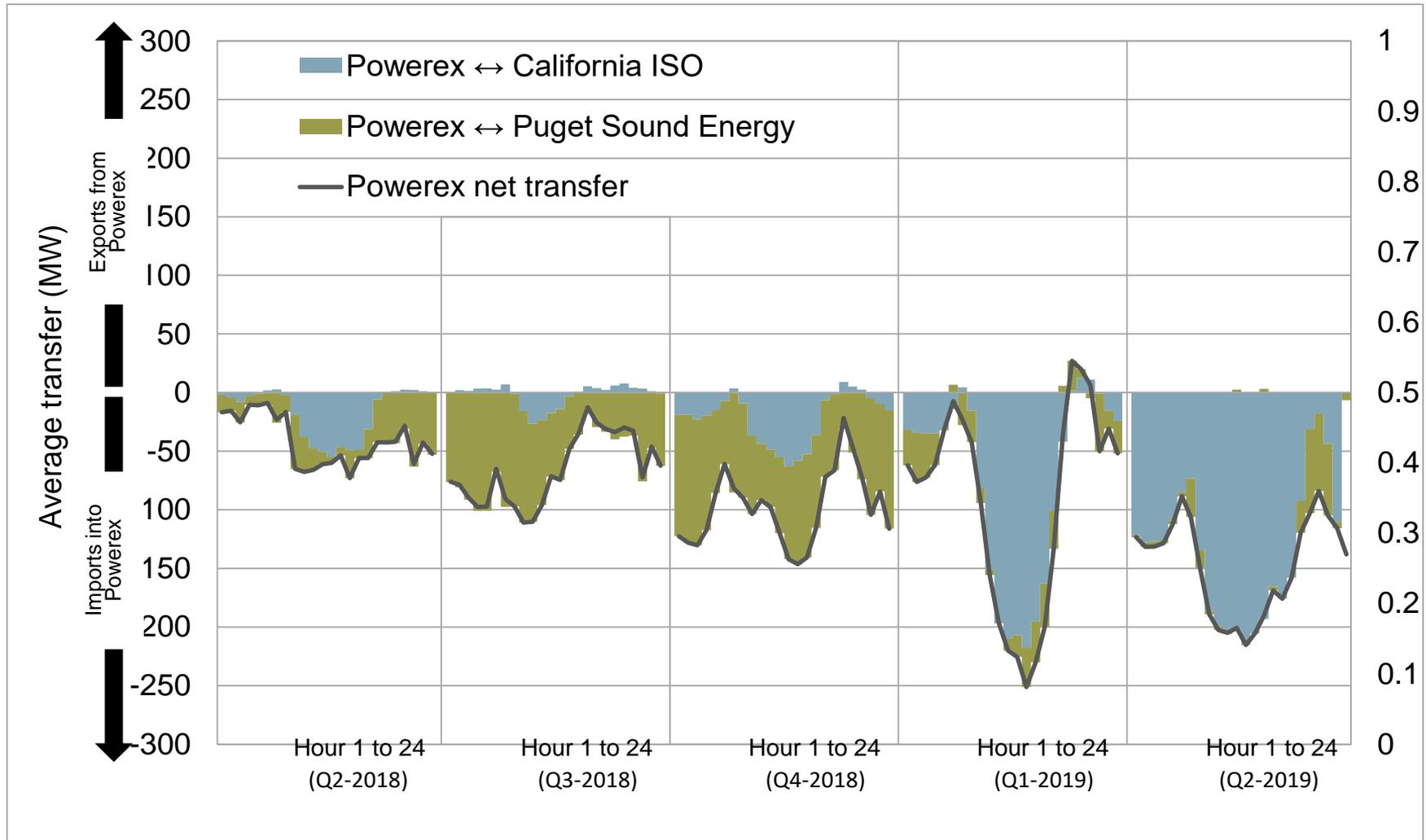
Hourly 5-minute market prices Q2 2019



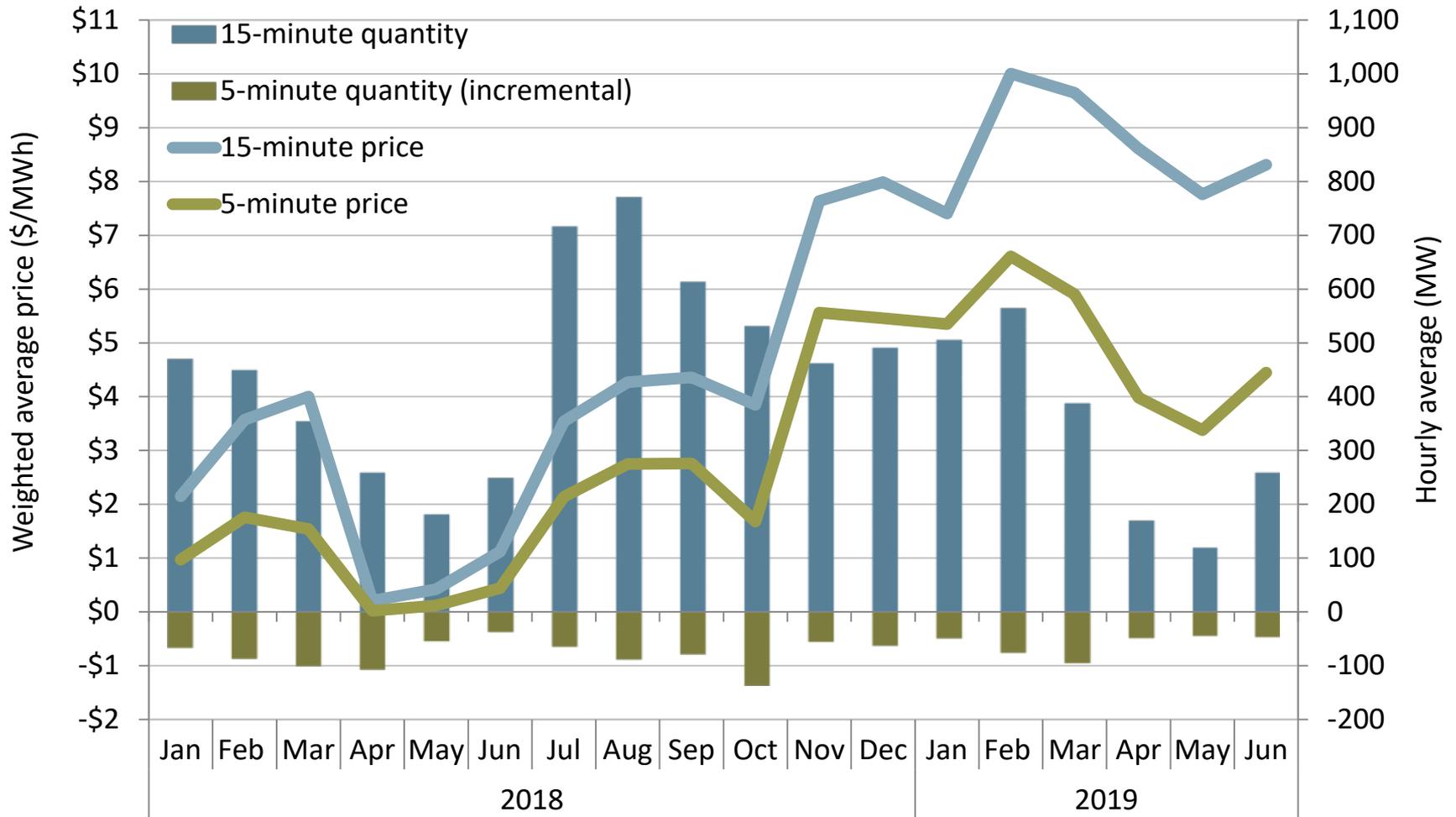
California ISO - average hourly 15-minute market transfer



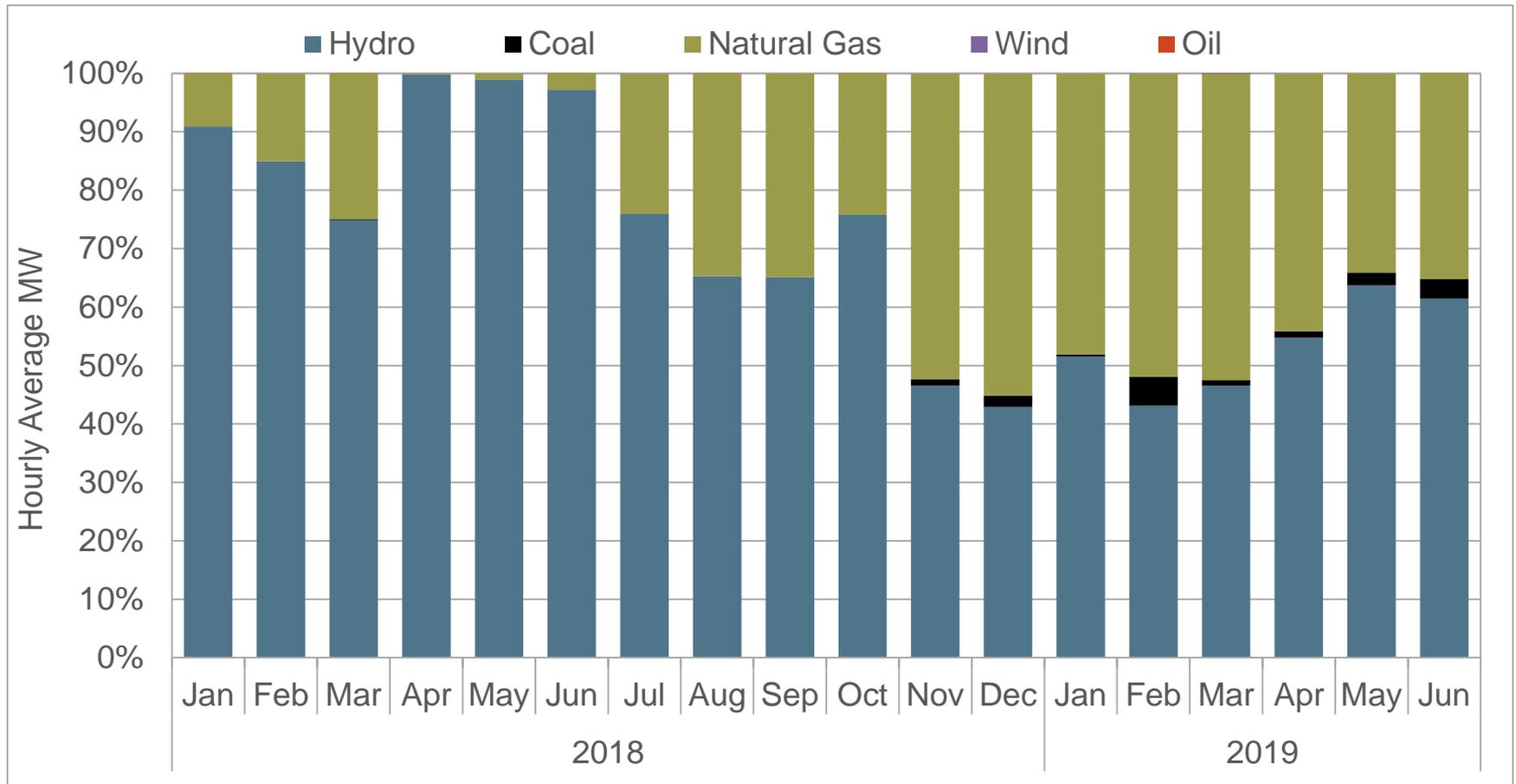
Powerex – average hourly 15-minute market transfer



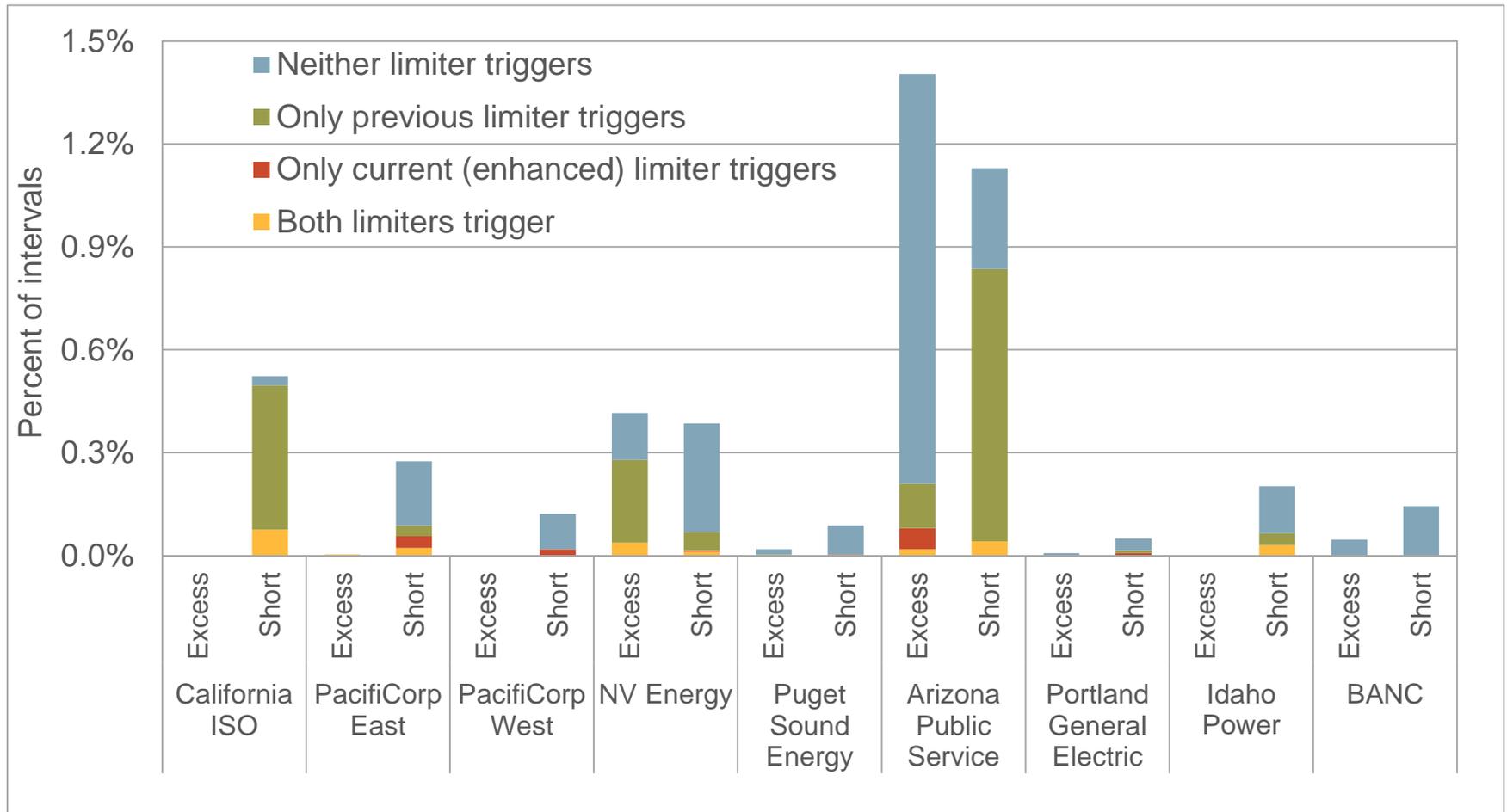
Energy imbalance market greenhouse gas price and cleared quantity



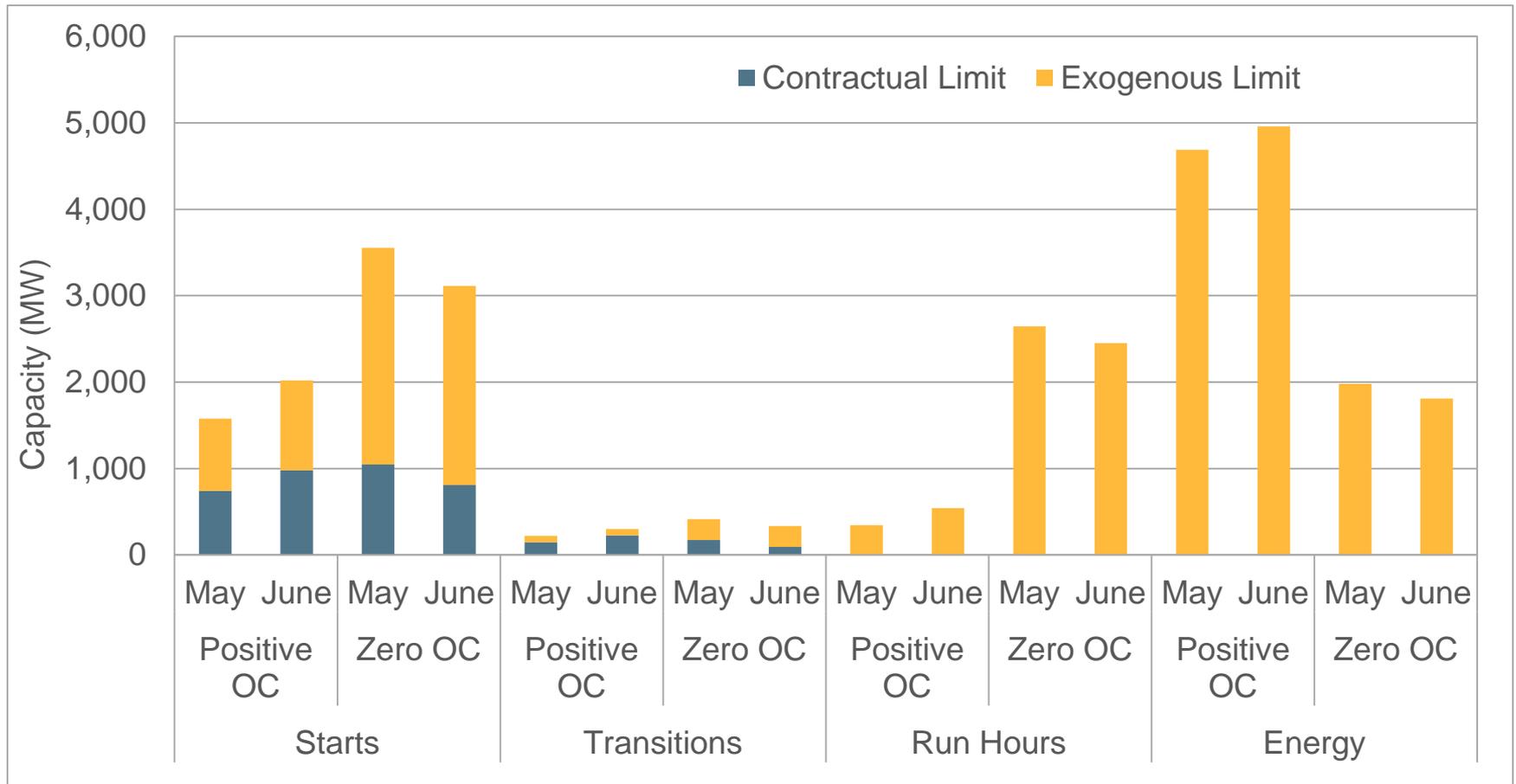
Hourly average EIM greenhouse gas megawatts by fuel type



Frequency of load conformance limiter in the 5-minute market (April - June)



Beginning in May, commitment cost bid caps have included opportunity costs adders for use-limited resources



Average of maximum daily generation outages by type - peak hours

