



Q4 2018 Report on Market Issues and Performance

February 14, 2018

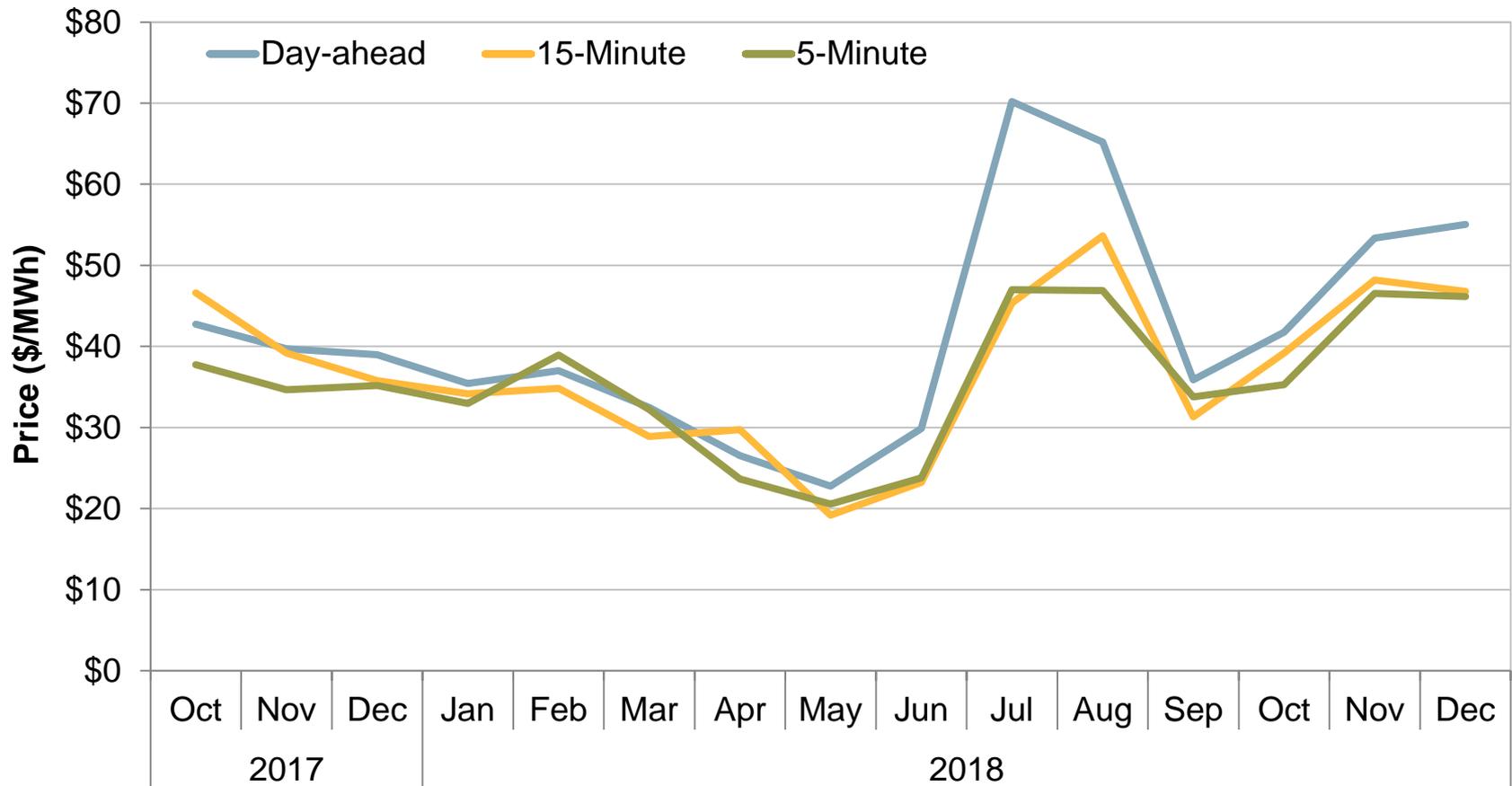
Amelia Blanke, Ph.D., Manager of Monitoring and Reporting
Department of Market Monitoring, California ISO

<http://www.caiso.com/Documents/2018FourthQuarterReportonMarketIssuesandPerformance.pdf>

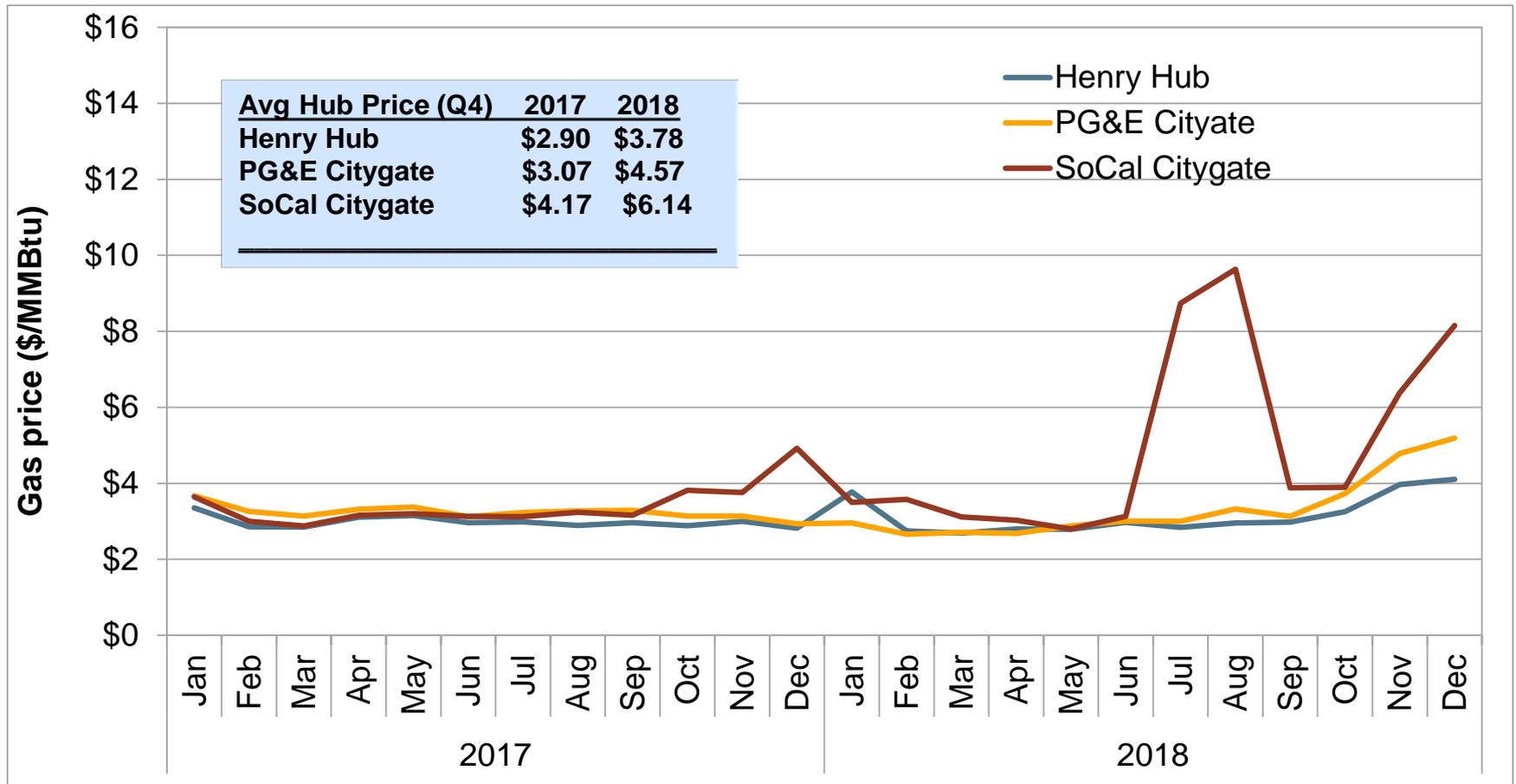
<http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyIssuesPerformanceReports/Default.aspx>

Energy prices increased compared to the same quarter in 2017, driven by higher gas prices.

Average monthly prices (all hours) – system marginal energy price

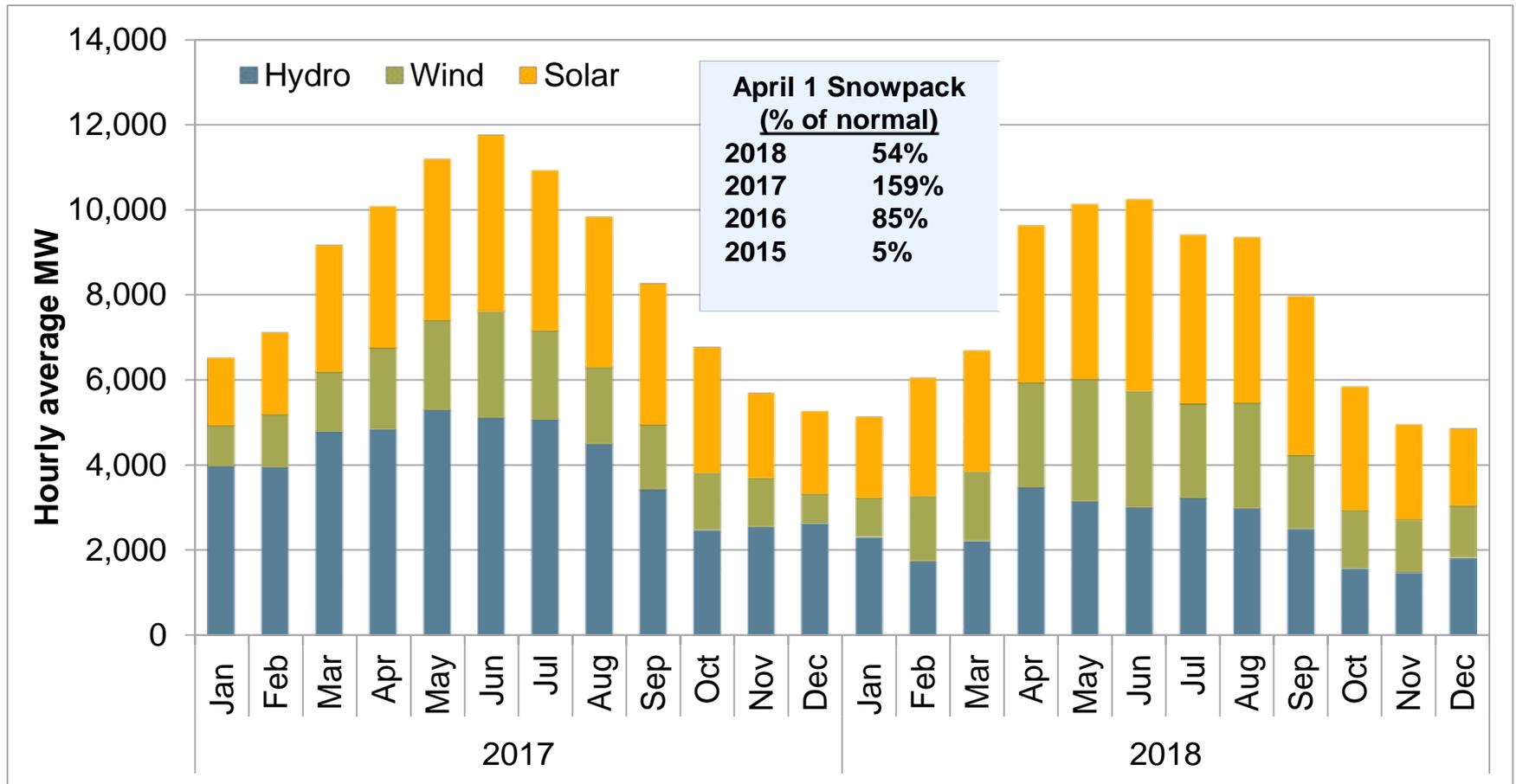


Gas prices up in Q4, particularly in the south, which is frequently the location of marginal resource.



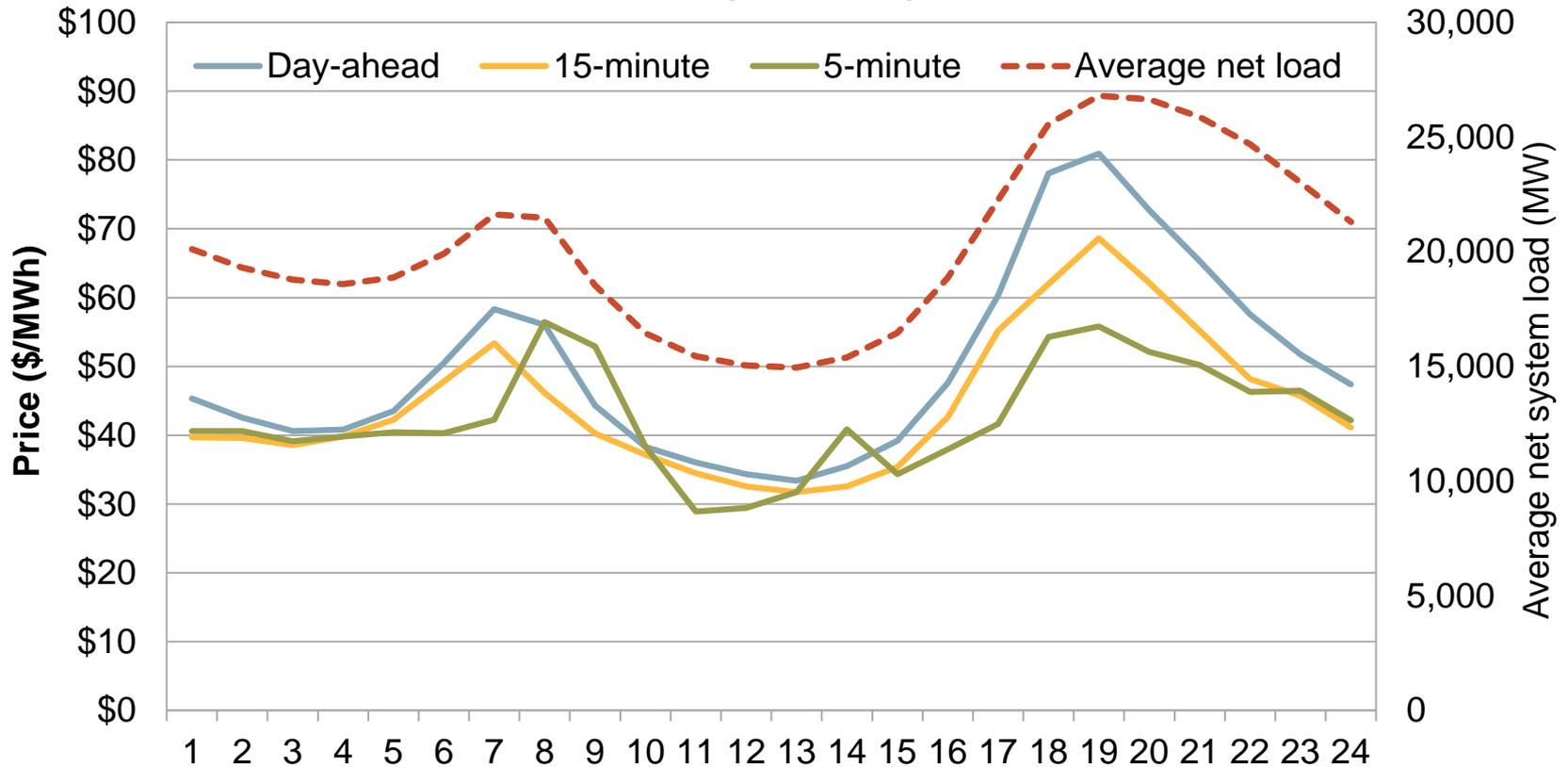
Total renewable production decreases in Q4, relative to Q4 2017, with hydro down 36%, solar up 20%, and wind unchanged.

Average hourly hydroelectric, wind, and solar generation by month

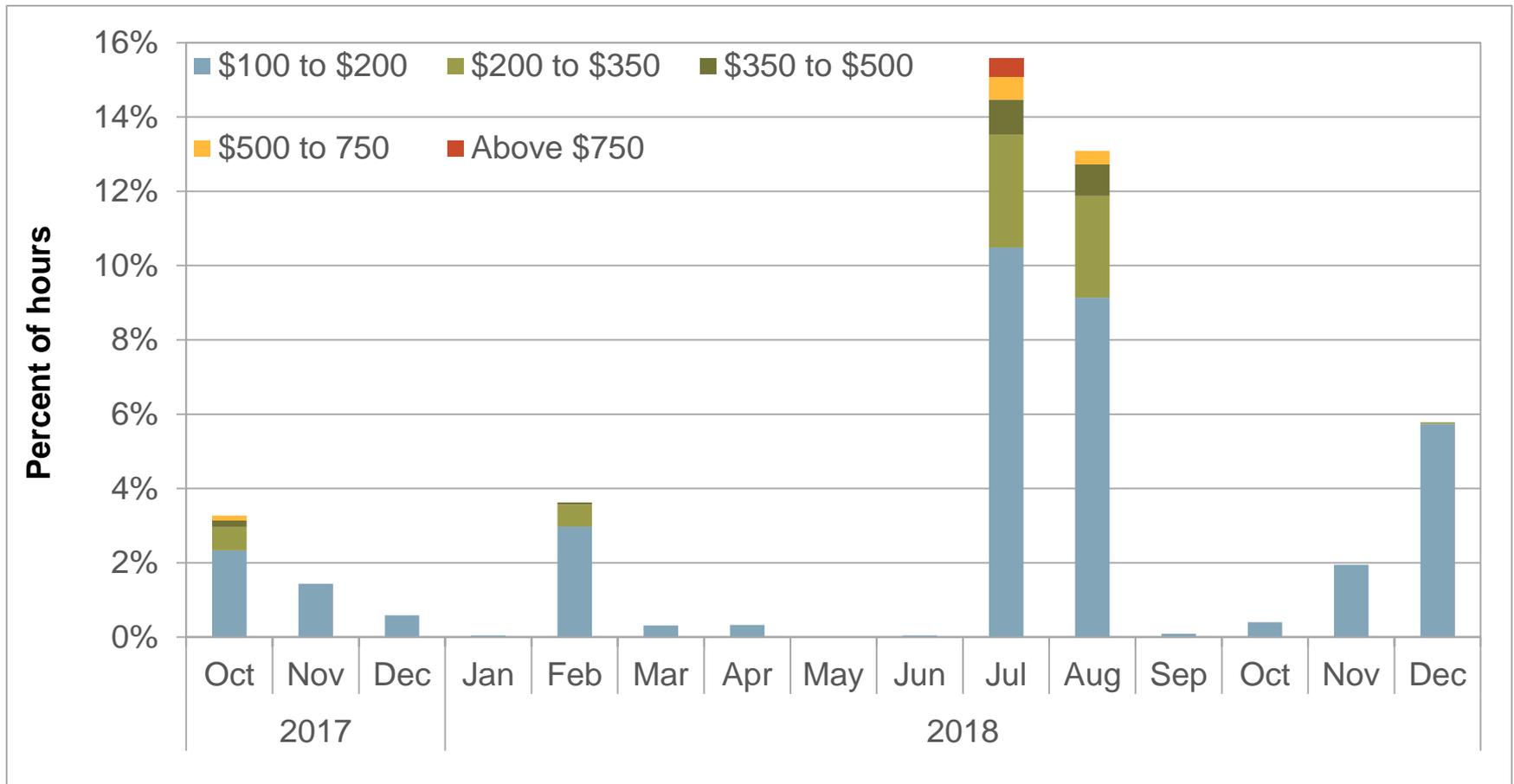


Average prices in Q4 up relative to Q4 2017, with day-ahead up \$10/MWh, 15-minute up \$4/MWh, and 5-minute up \$7/MWh.

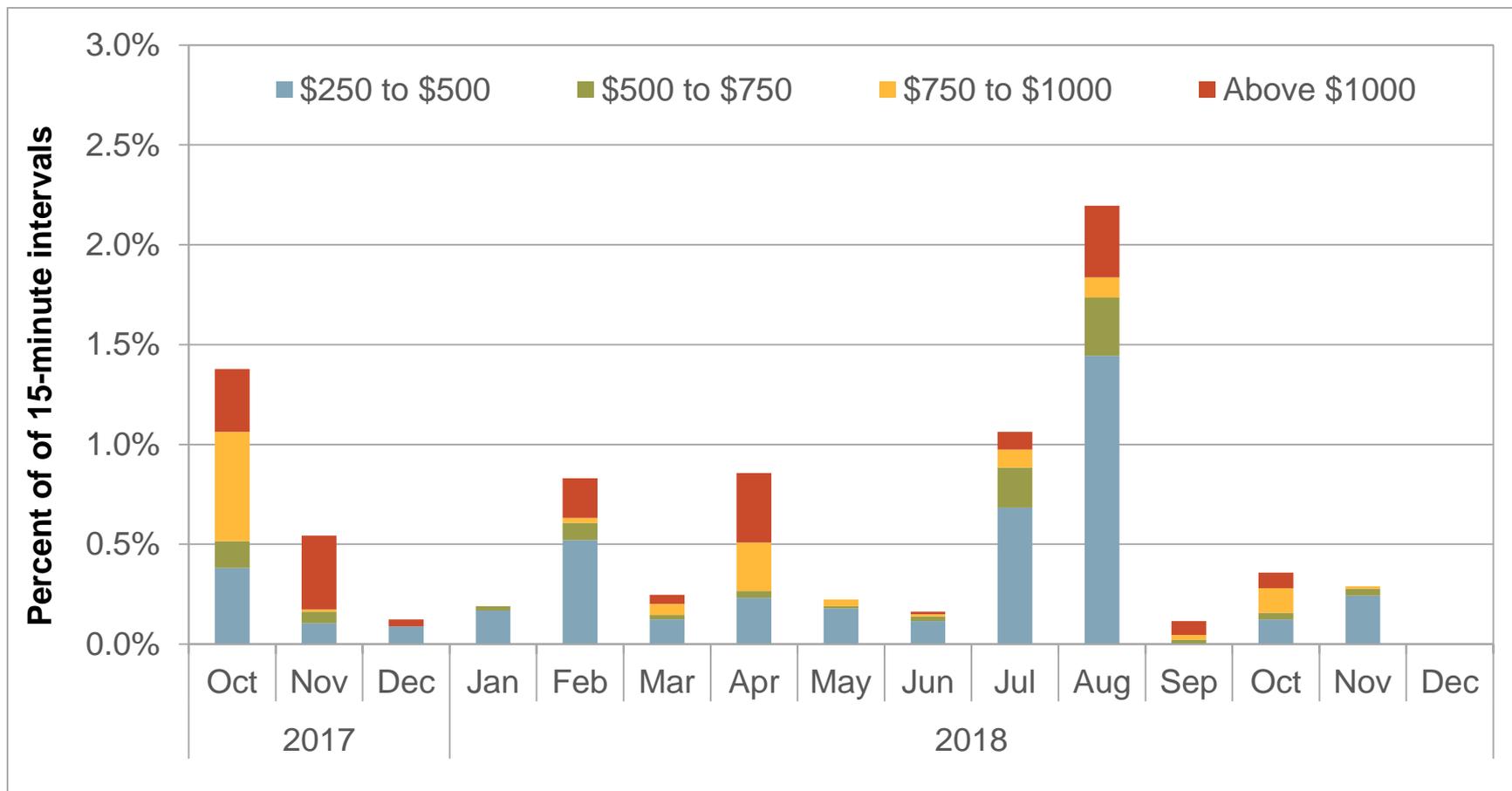
Hourly system marginal energy prices



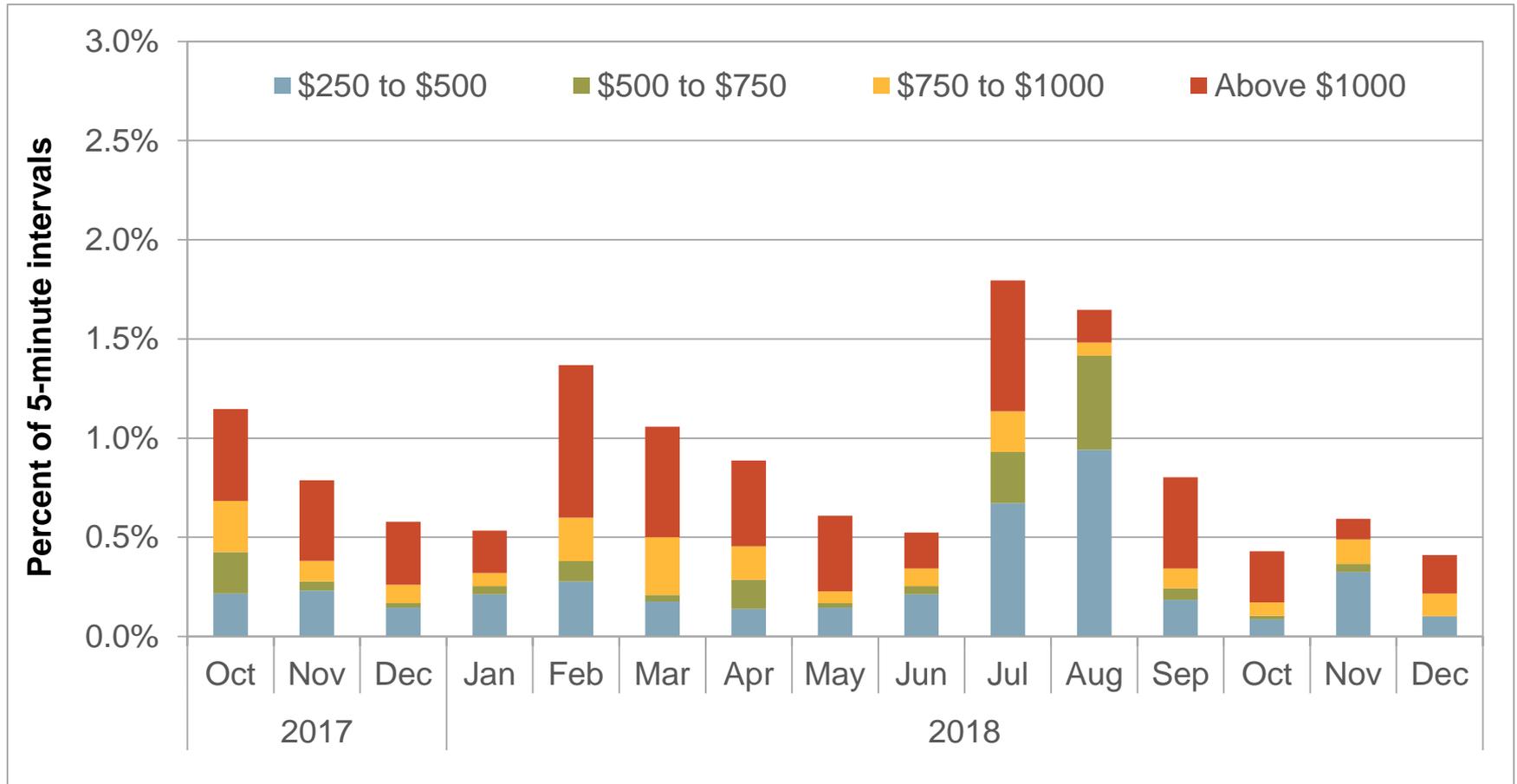
Frequency of high day-ahead prices by month: Most high prices set by unmitigated bids



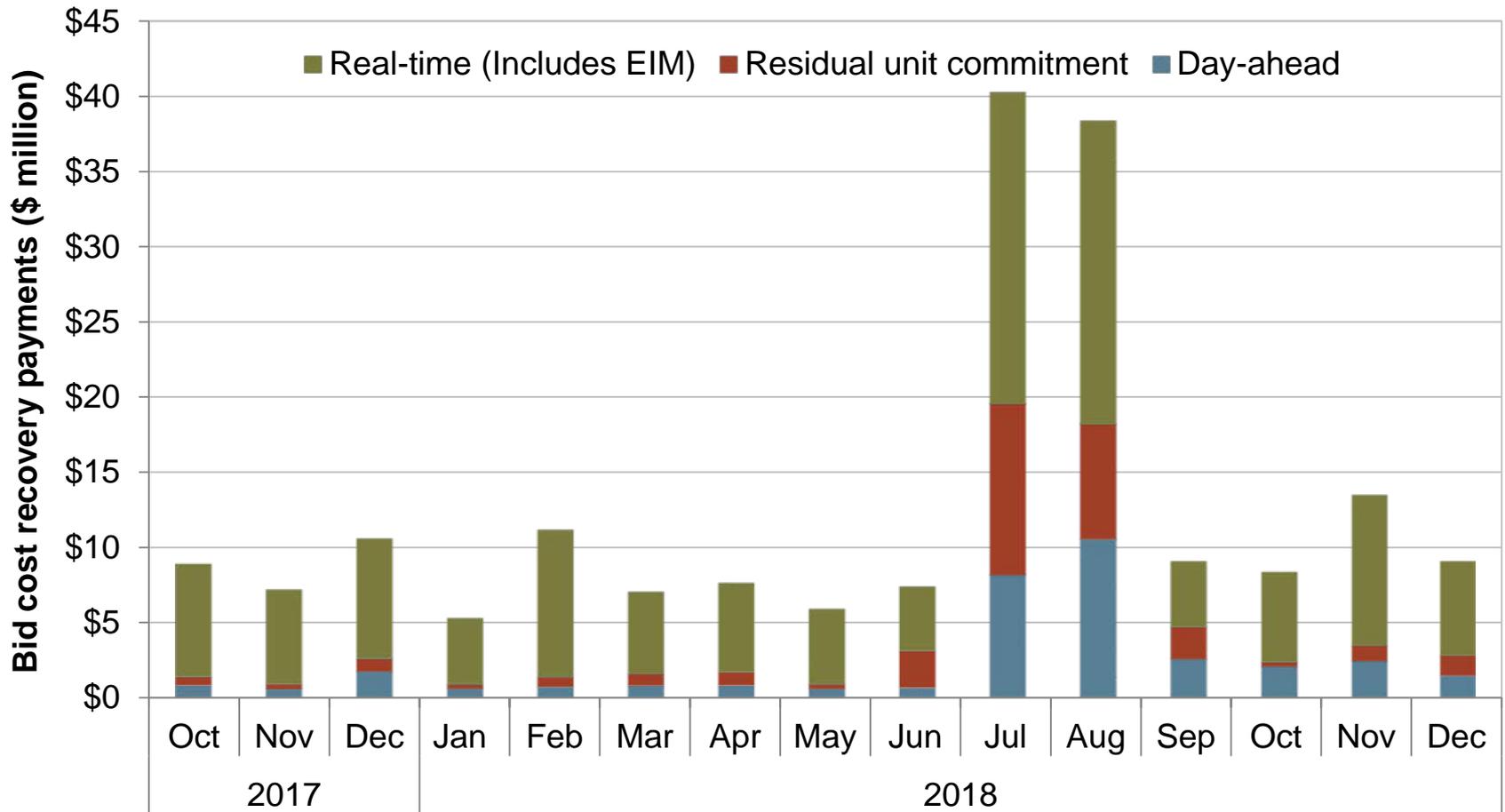
Frequency of high 15-minute prices by month



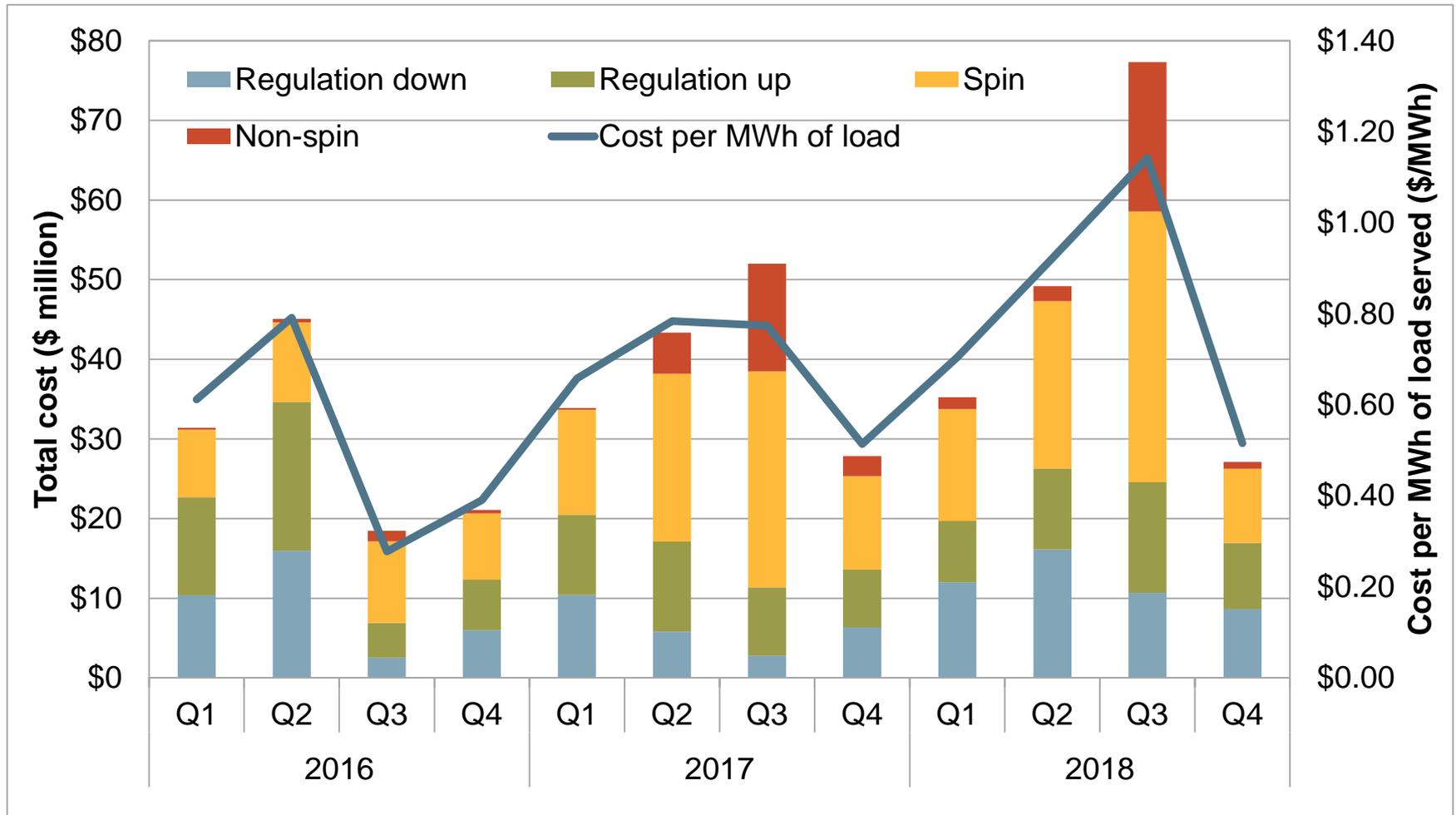
Frequency of high 5-minute prices by month



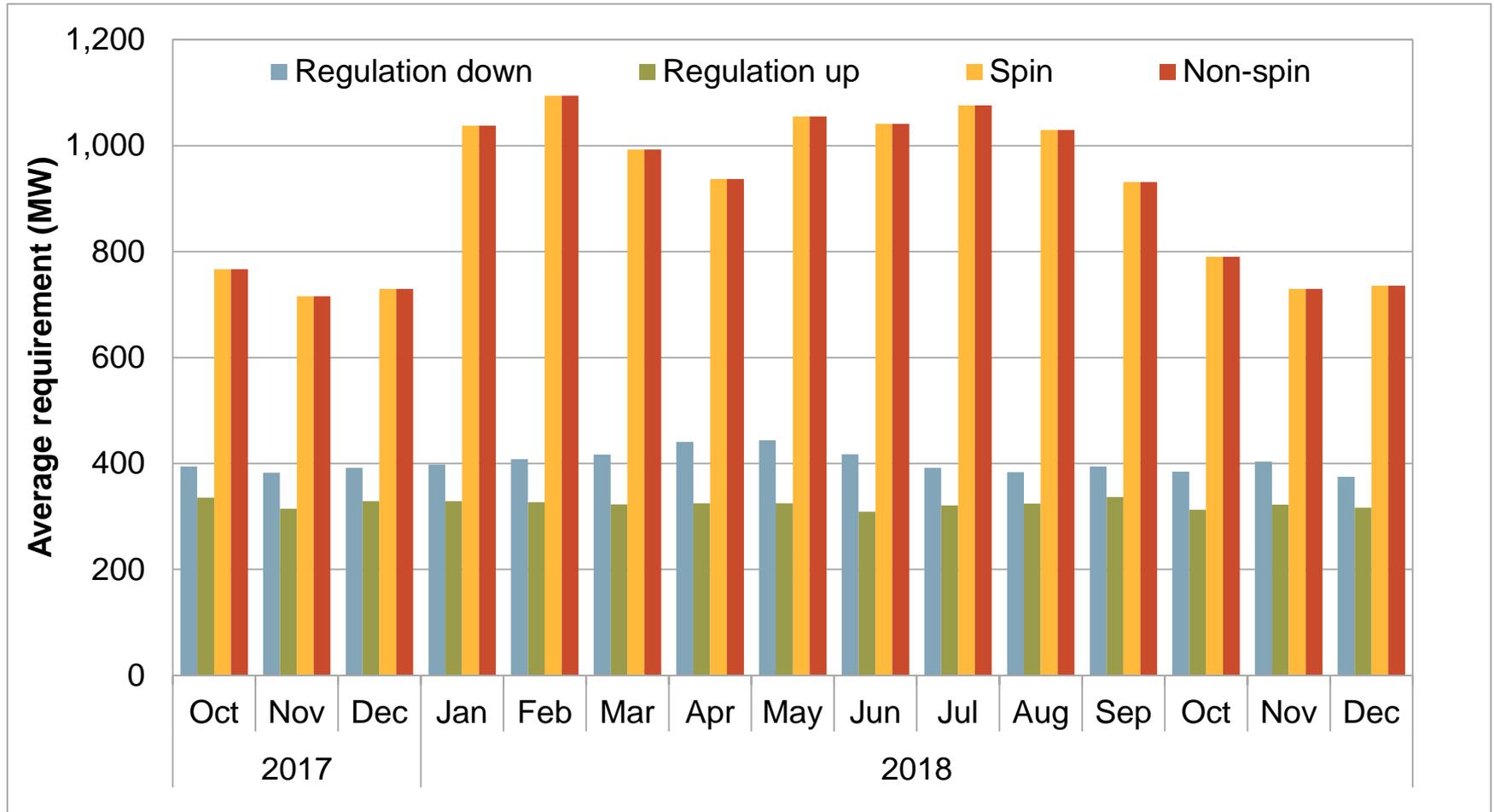
Bid cost recovery payments totaled \$31 million – compared to \$27 million in Q4 2017.



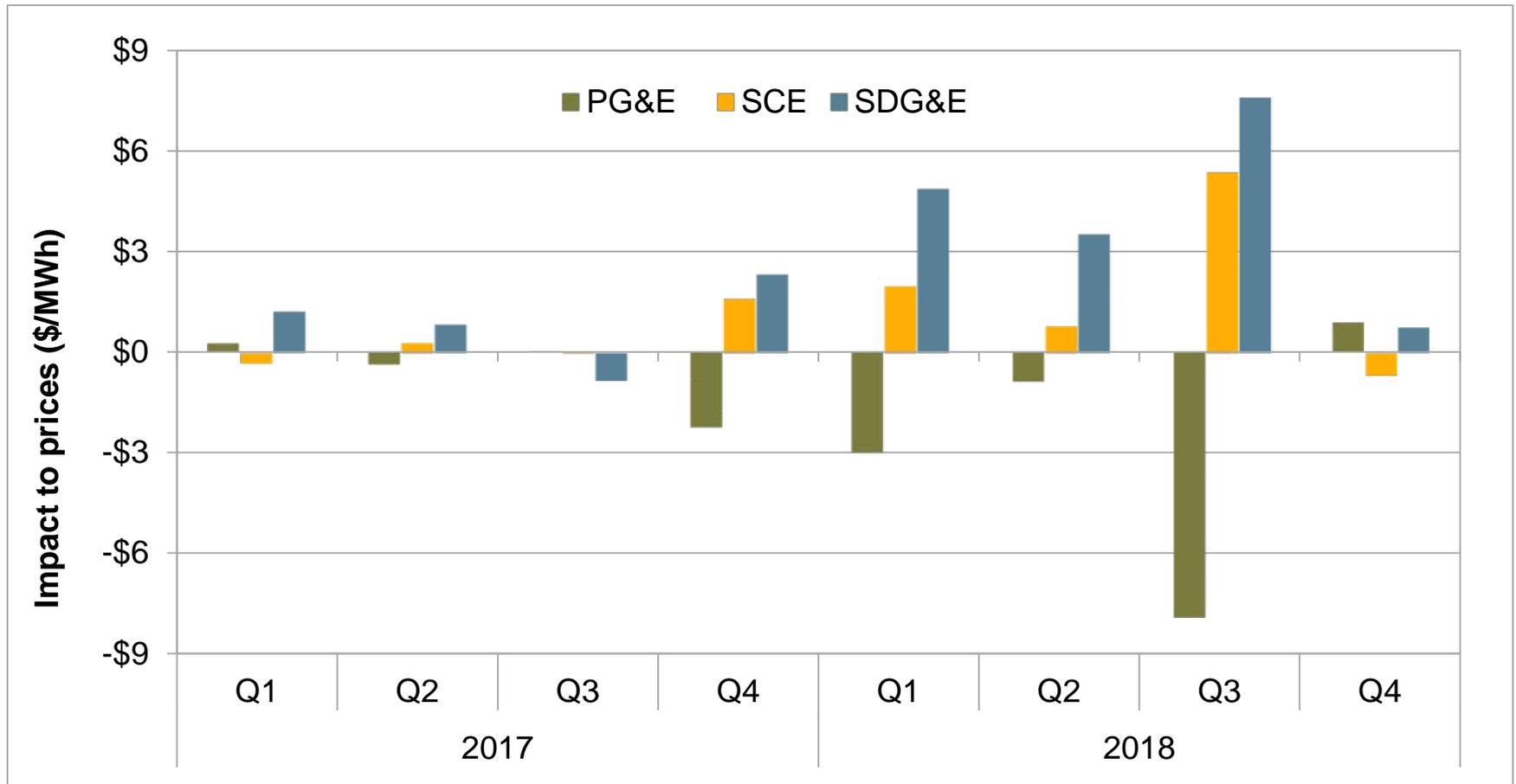
Ancillary service costs totaled \$27 million compared to \$28 million in Q4 2017



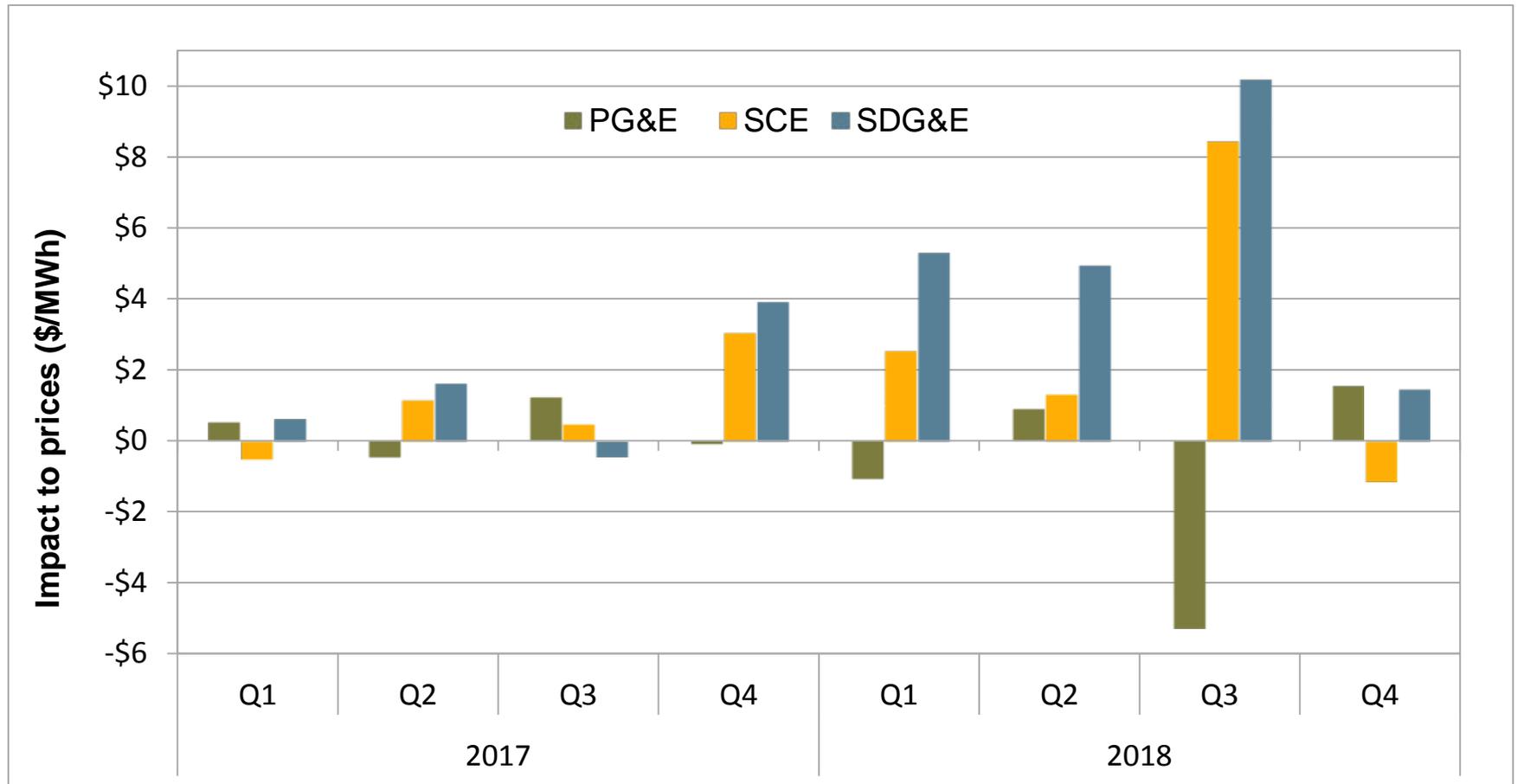
Average monthly day-ahead ancillary service requirements



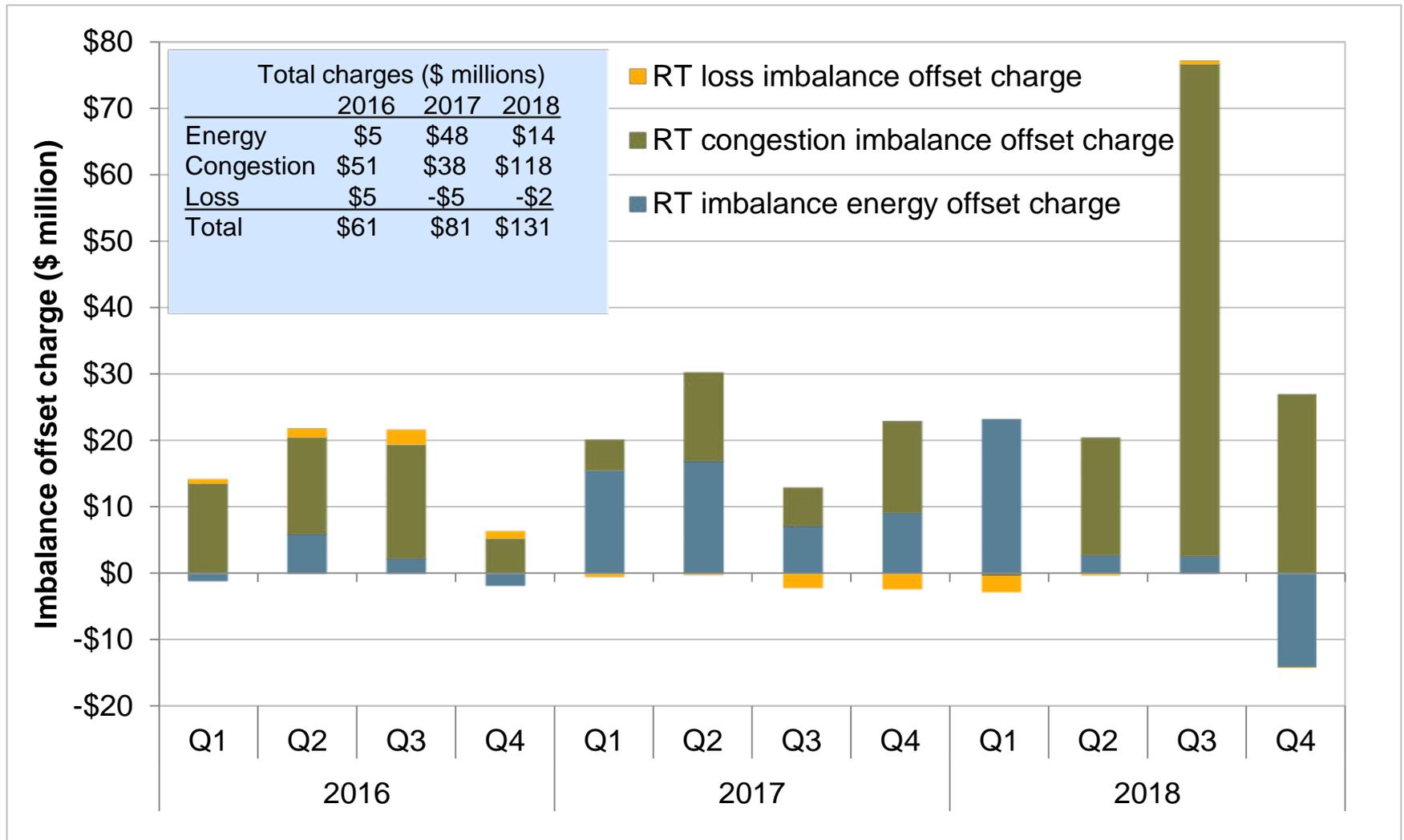
Impact of congestion on day-ahead prices down in Q4.



Impact of congestion on 15-minute prices



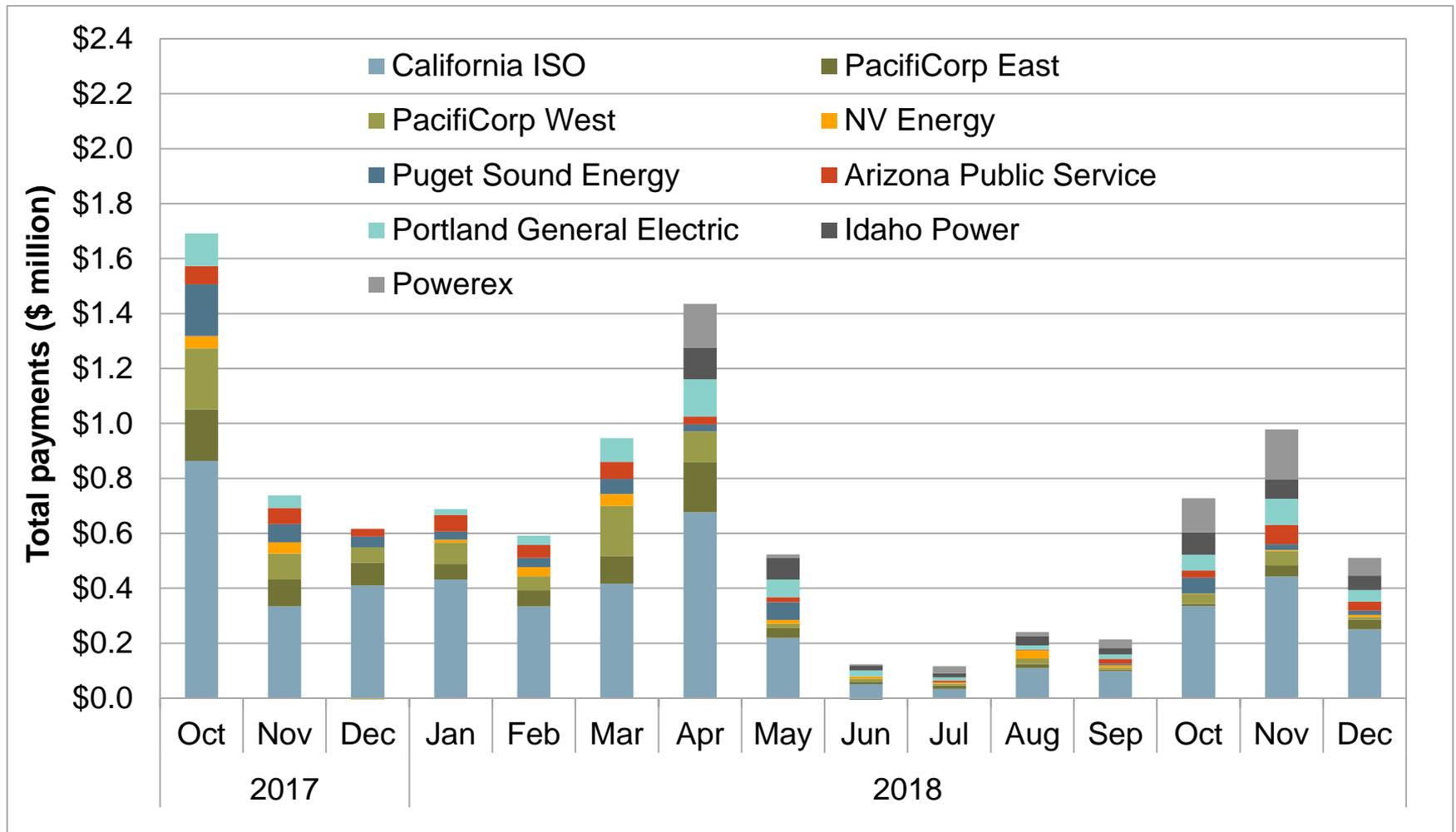
Real-time imbalance offset charges



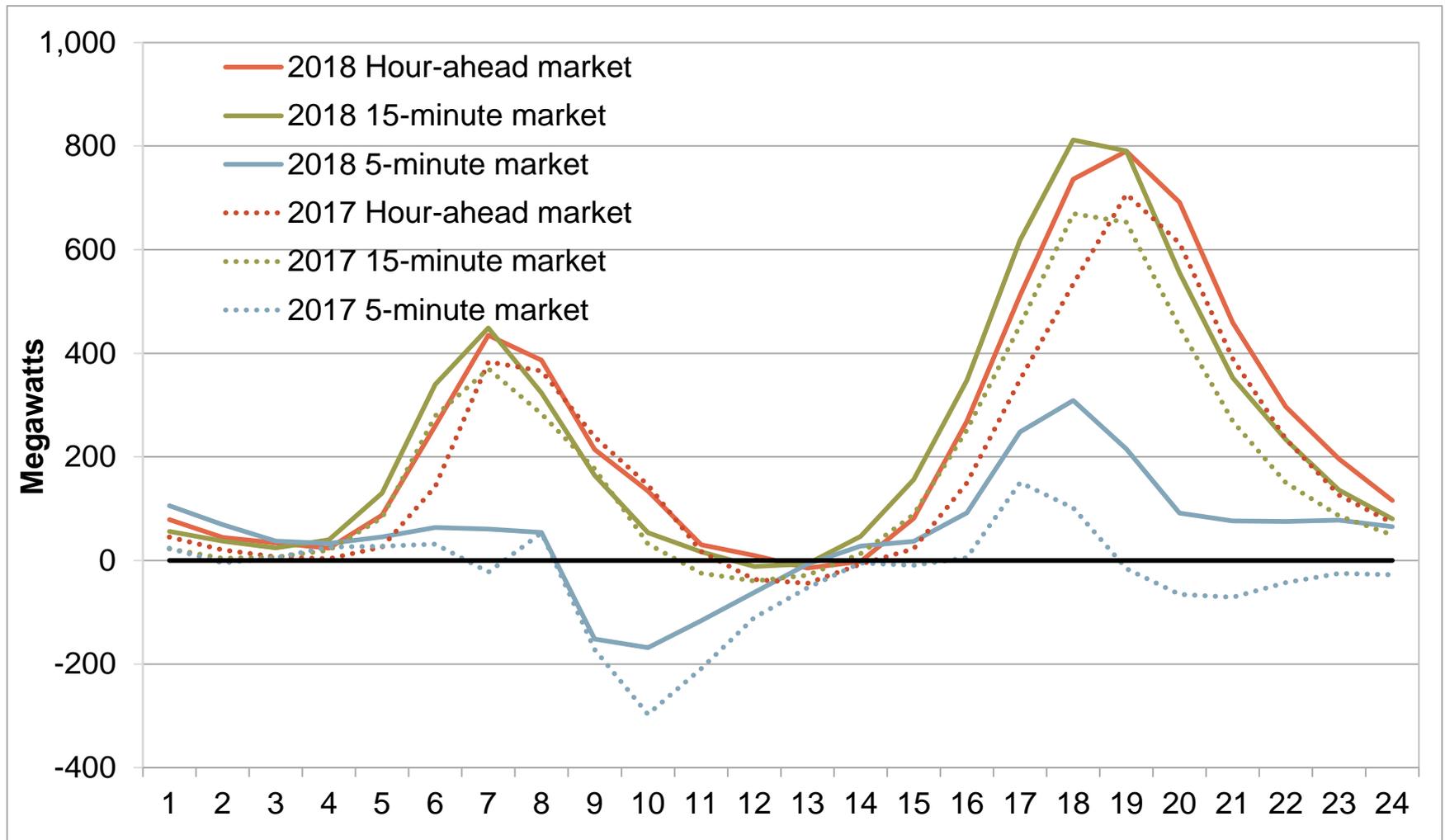
Estimated Q4 15-minute market congestion imbalances (top 10 constraints)

Constraint	Estimated imbalances (million \$)	Binding in FMM	Total hours in quarter			Avg DA limit (MW)	Avg limit change (MW)
			w/ lower FMM limit	w/o lower FMM limit	w/o DA limit		
7750_D-ECASCO_OOS_CP6_NG	(\$8.7)	236	172	39	25	263	(34)
MALIN500	(\$3.4)	96	46	50	0	2,096	(485)
MIGUEL_BKs_MXFLW_NG	(\$3.0)	63	54	2	7	1,340	(187)
OMS_6451207_TRACY-LOSBANOS	(\$2.8)	228	176	40	12	1,300	(320)
24016_BARRE_230_24154_VILLAPK_230_BR_1_1	(\$1.5)	28	24	0	4	1,259	(244)
ADLANTO-SP_ITC	(\$1.0)	53	23	30	0	791	(440)
7750_D-VISTA1_OOS_CP6_NG	(\$0.5)	12	12	0	0	310	(90)
30515_WARNERVL_230_30800_WILSON_230_BR_1_1	(\$0.4)	74	17	22	35	347	(10)
OMS6355729TL50003_NG	(\$0.4)	8	8	0	0	435	(130)
24016_BARRE_230_25201_LEWIS_230_BR_1_1	(\$0.4)	4	1	0	3	1,410	(354)

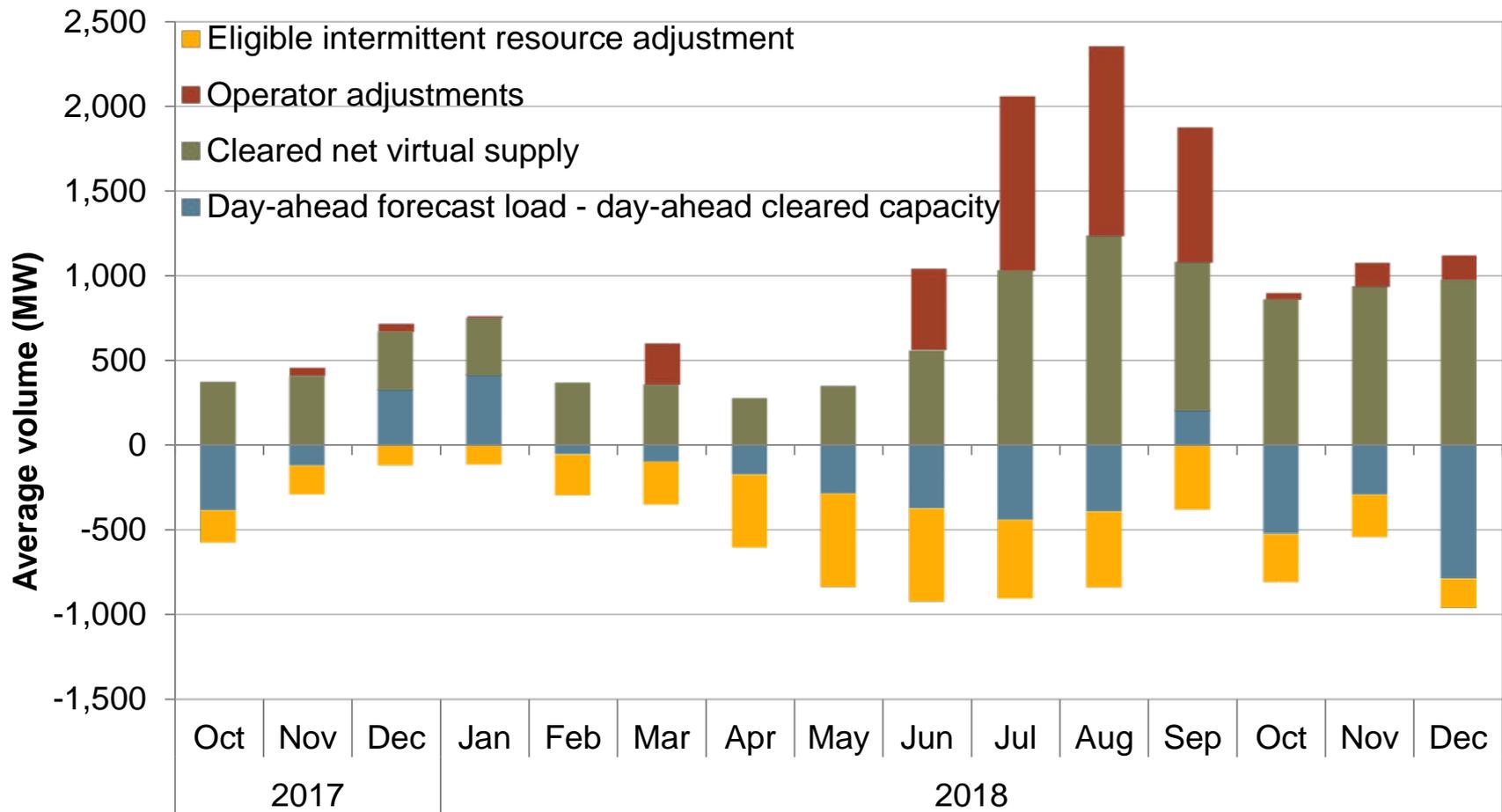
Monthly flexible ramping payments by balancing area



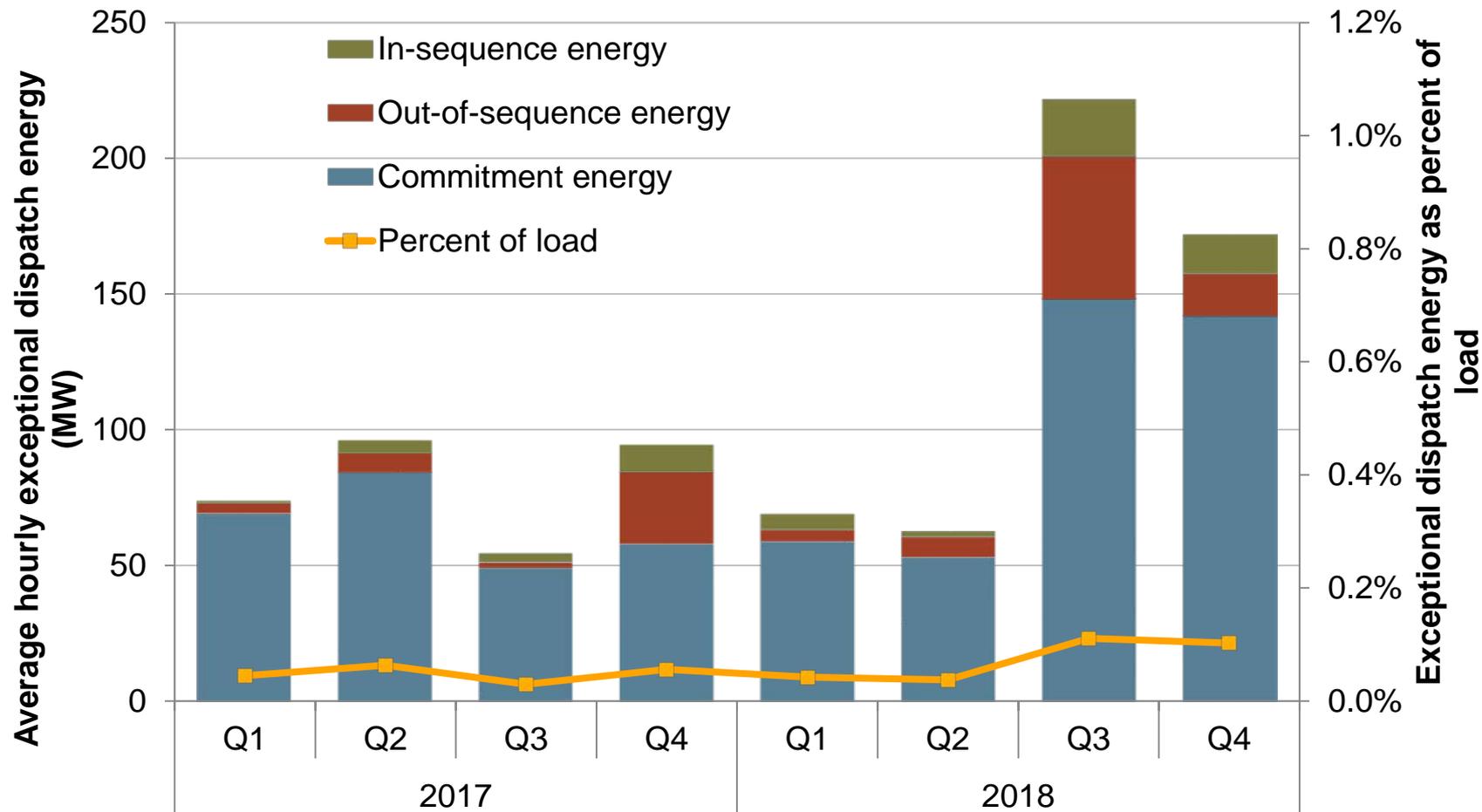
Average hourly load adjustment (Q4 2018 – Q4 2017)



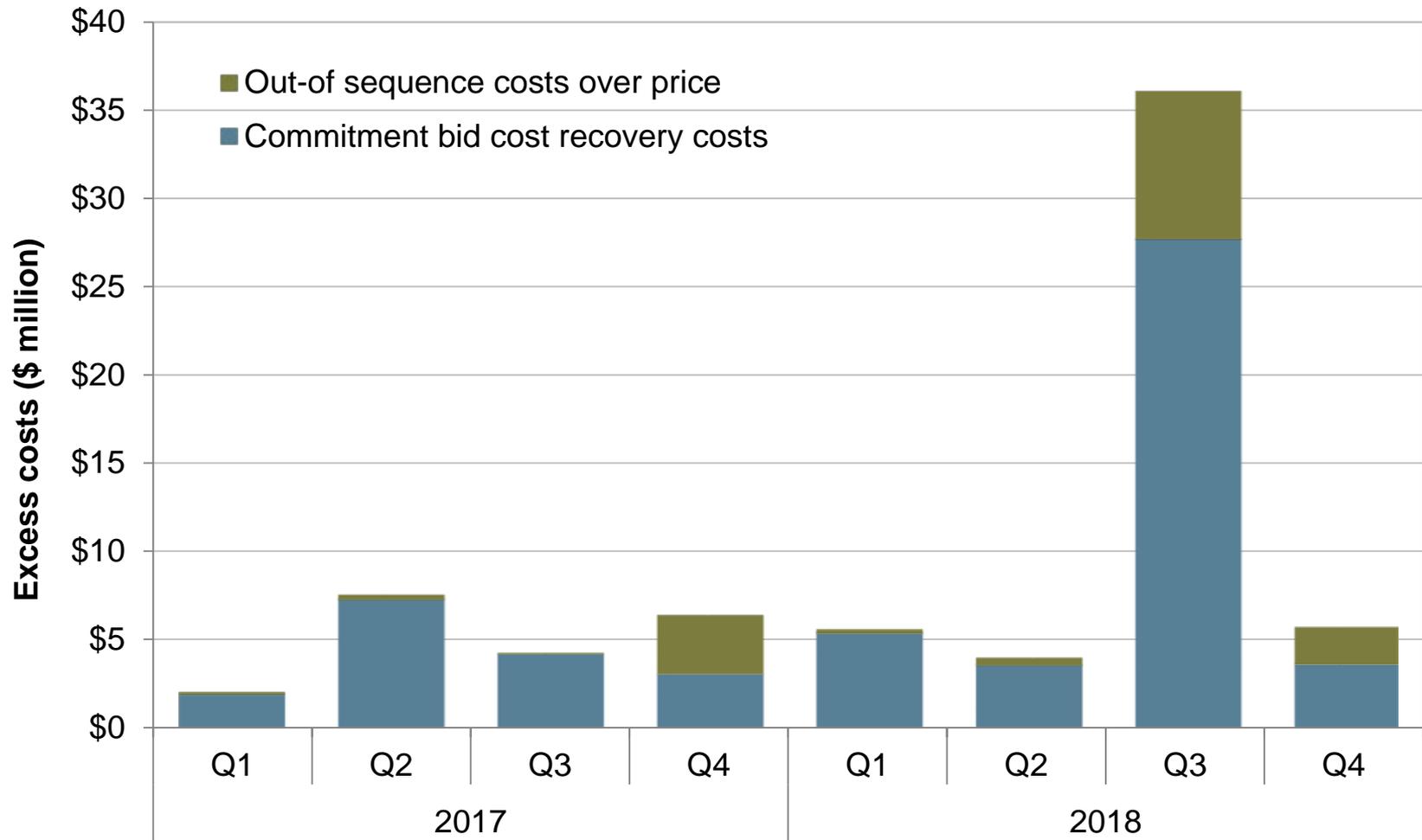
Determinants of residual unit commitment procurement



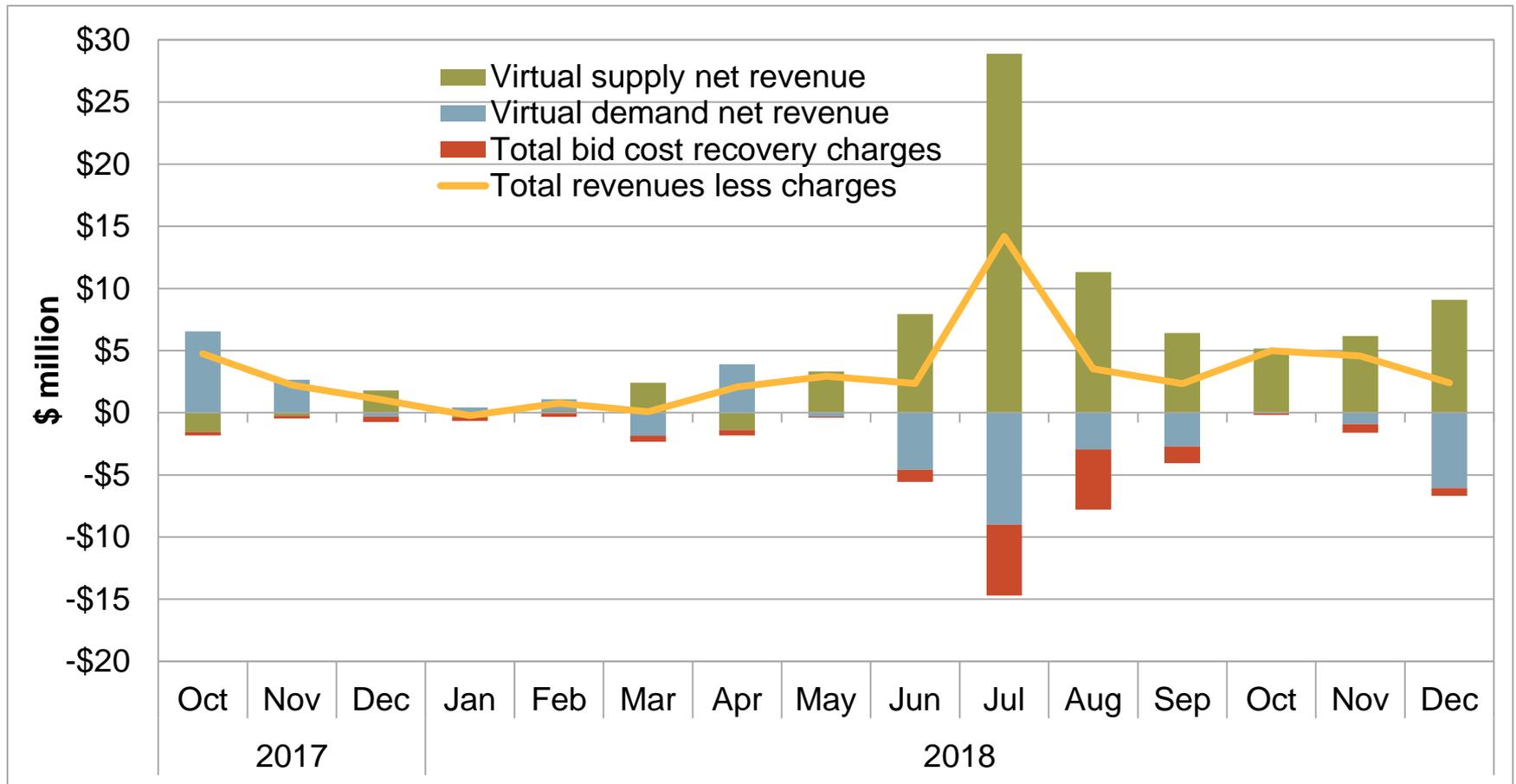
Average hourly energy from exceptional dispatch



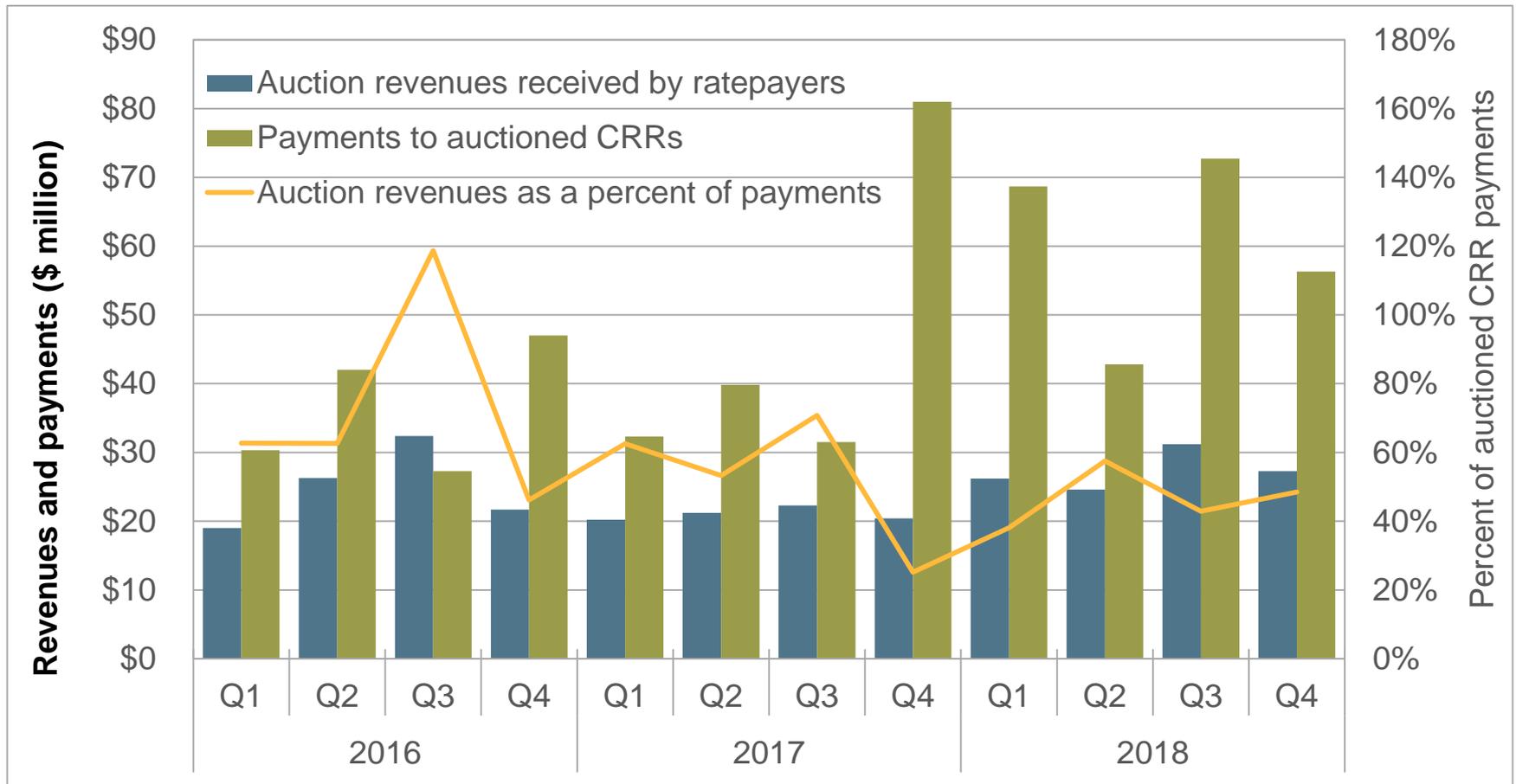
Above market exceptional dispatch cost by type



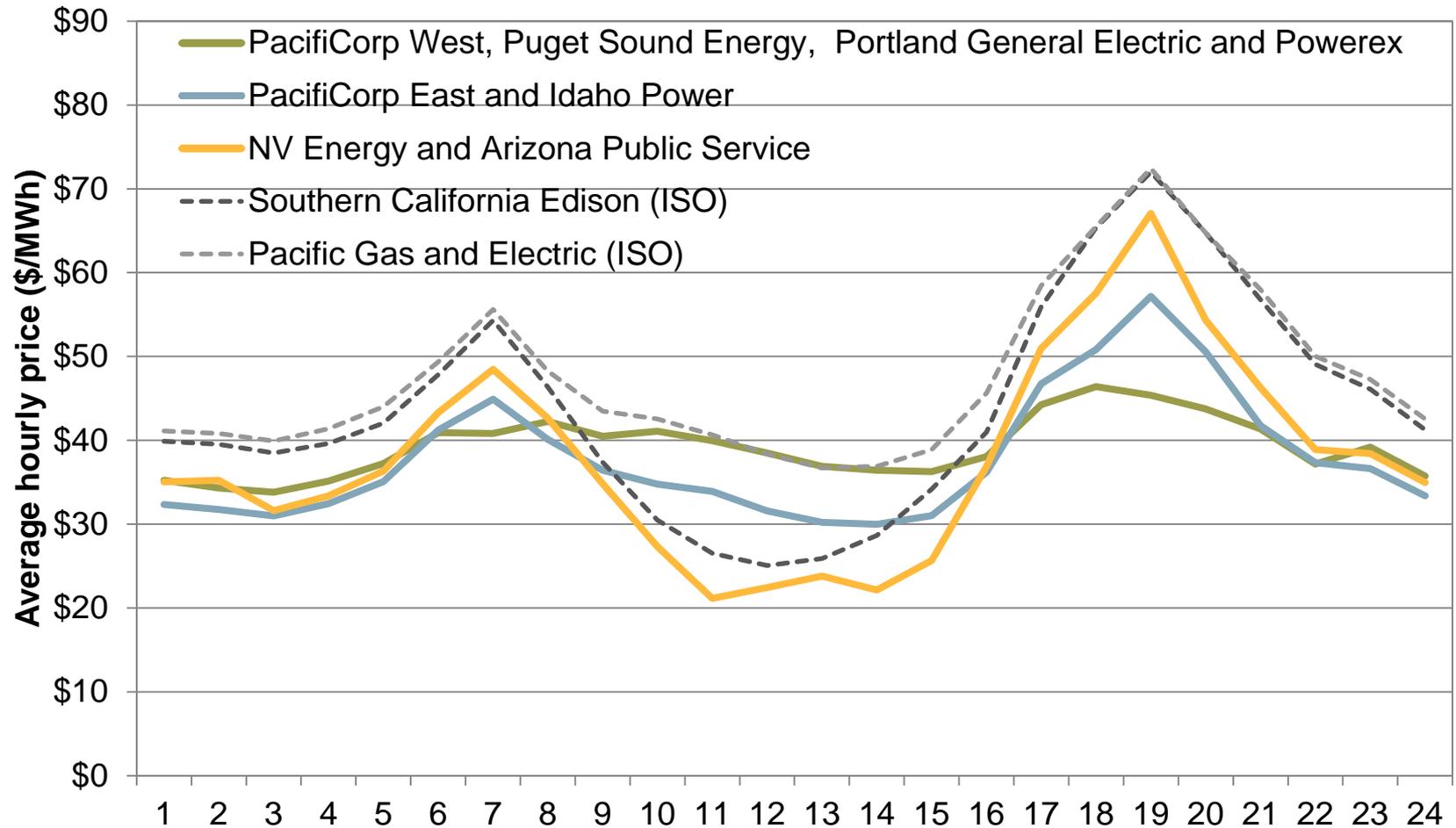
Convergence bidding revenues net of bid cost recovery charges decreased to \$12 million.



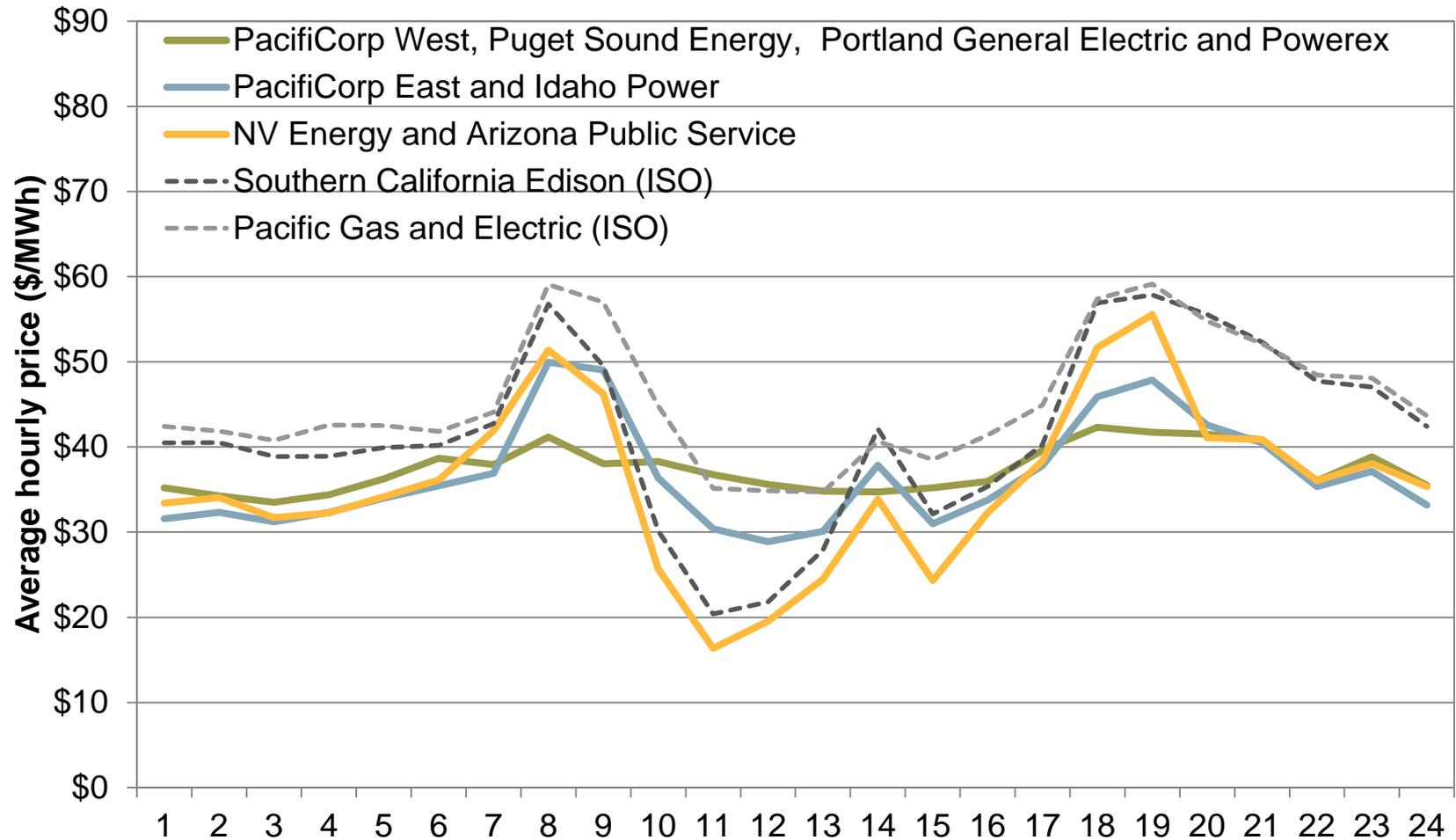
CRR payments to non-load-serving entities exceeded auction revenues by \$29 million in Q4, making total losses of \$131 million in 2018



Hourly 15-minute EIM prices (October - December)



Hourly 5-minute EIM prices (October - December)



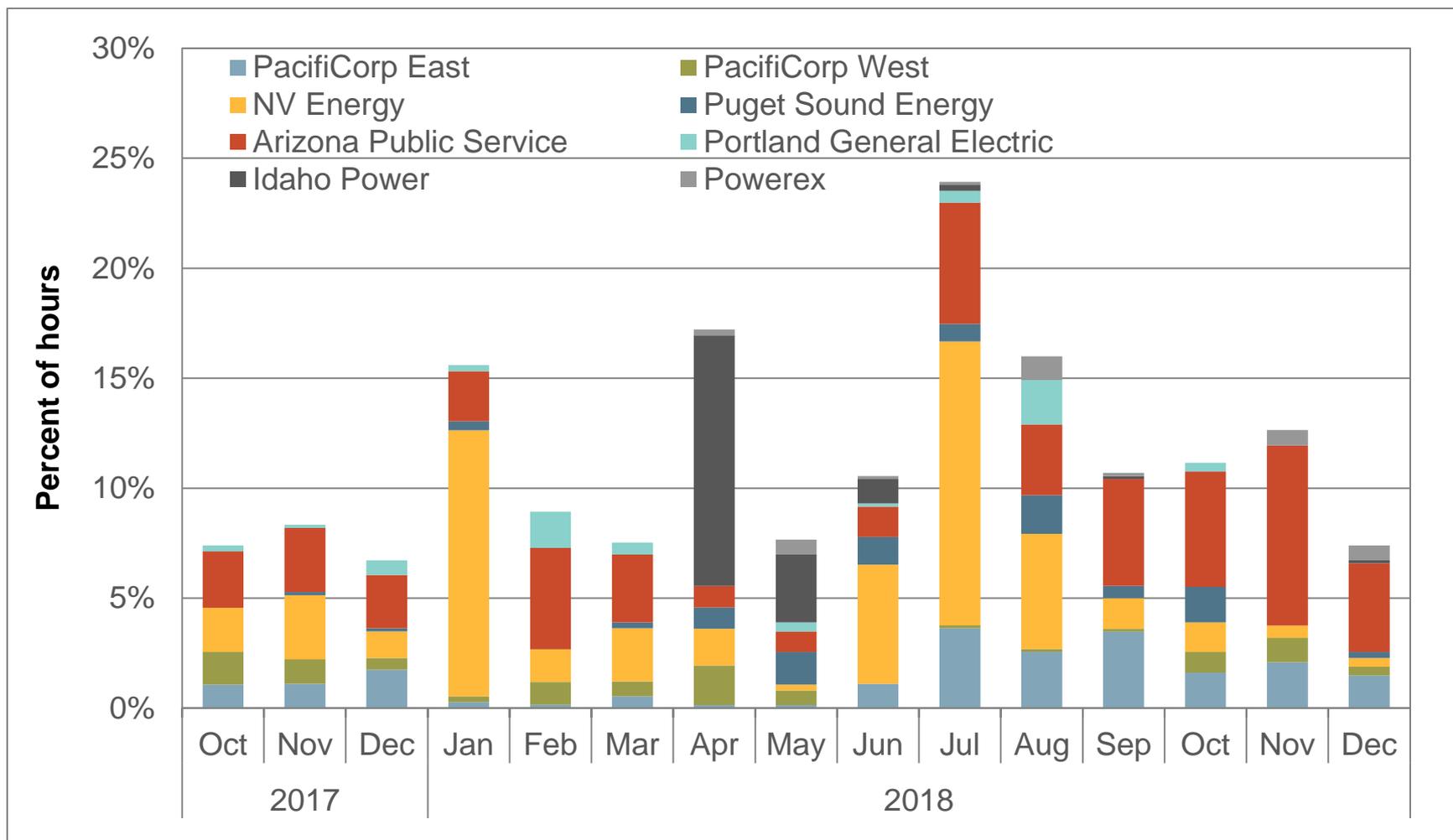
Frequency of congestion in the energy imbalance market (October – December)

	15-minute market		5-minute market	
	Congested toward ISO	Congested from ISO	Congested toward ISO	Congested from ISO
NV Energy	3%	1%	3%	0%
Arizona Public Service	6%	4%	2%	2%
PacifiCorp East	9%	1%	5%	0%
Idaho Power	3%	6%	1%	6%
PacifiCorp West	25%	3%	17%	3%
Portland General Electric	25%	3%	17%	4%
Puget Sound Energy	25%	11%	17%	8%
Powerex	22%	40%	8%	37%

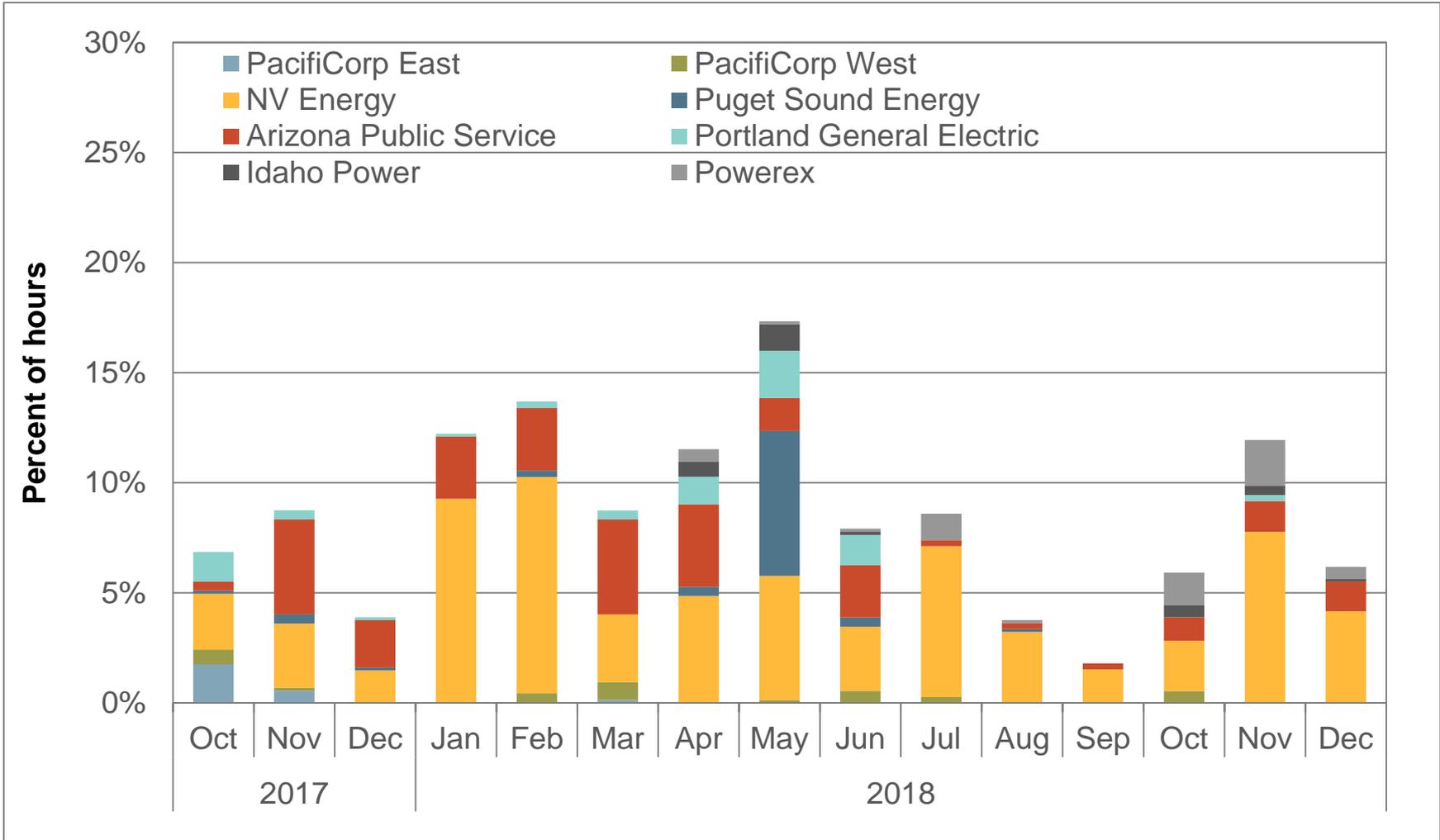
Frequency of internal congestion within energy imbalance market areas.

	2014	2015	2016	2017				2018			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
15-minute market (FMM)											
PacifiCorp East	0.1%	0.9%	1.2%	16.1%	4.3%	5.1%	47.6%	14.9%	4.5%	9.1%	33.1%
PacifiCorp West	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.6%
NV Energy		0.0%	0.1%	10.3%	1.8%	7.6%	5.8%	0.5%	0.9%	1.1%	2.6%
Puget Sound Energy				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Arizona Public Service				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.9%
Portland General Electric							0.0%	0.0%	0.0%	0.0%	0.0%
Powerex									0.0%	0.0%	0.0%
Idaho Power									0.0%	0.0%	0.2%
5-minute market (RTD)											
PacifiCorp East	0.0%	0.8%	1.2%	17.1%	3.3%	4.5%	46.1%	14.7%	3.9%	8.5%	29.2%
PacifiCorp West	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
NV Energy		0.0%	0.1%	11.7%	1.6%	7.1%	5.6%	0.4%	0.9%	0.7%	1.9%
Puget Sound Energy				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Arizona Public Service				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%
Portland General Electric							0.0%	0.0%	0.0%	0.0%	0.0%
Powerex									0.0%	0.0%	0.0%
Idaho Power									0.0%	0.0%	0.2%

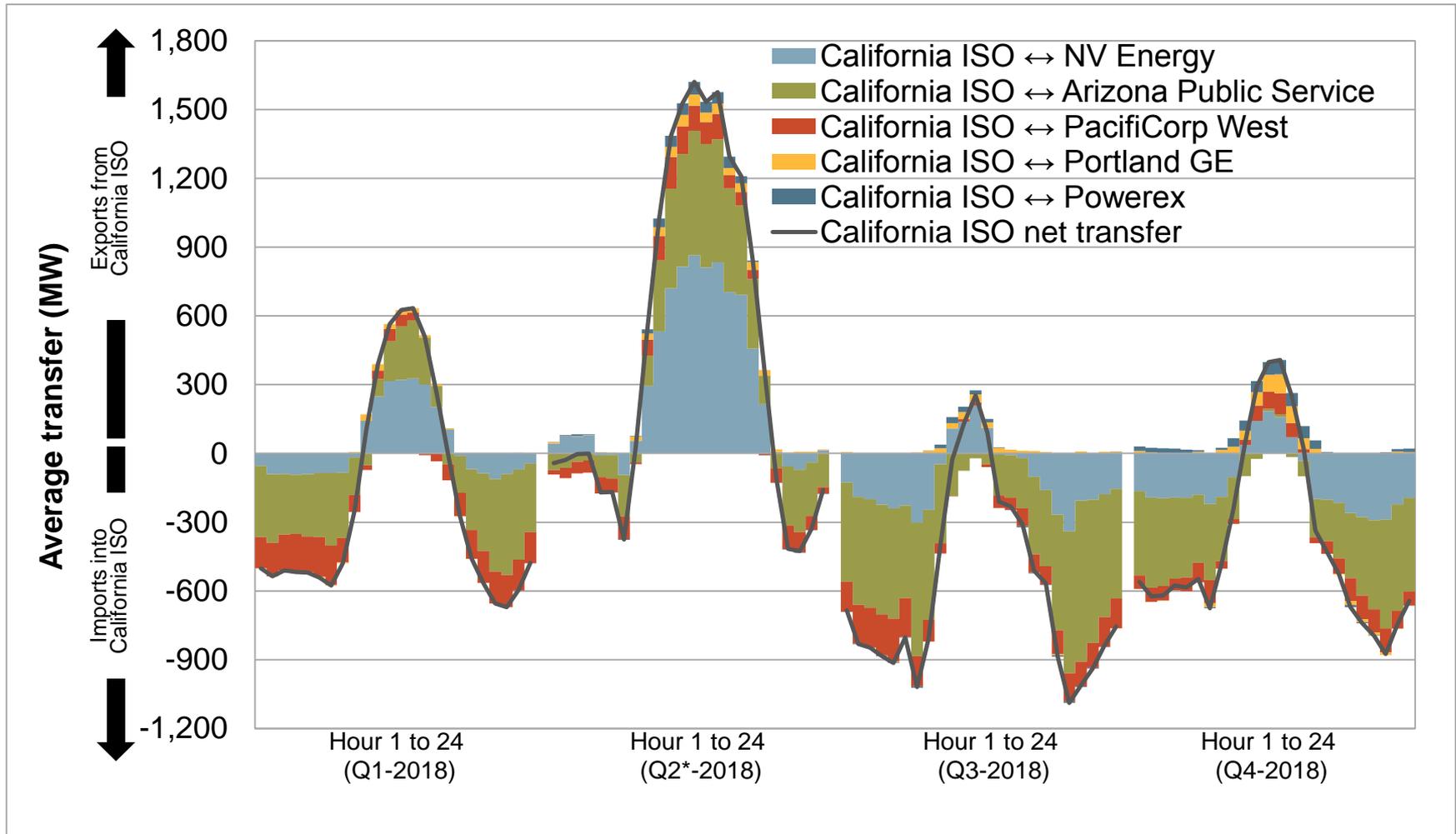
Frequency of upward failed sufficiency tests by month



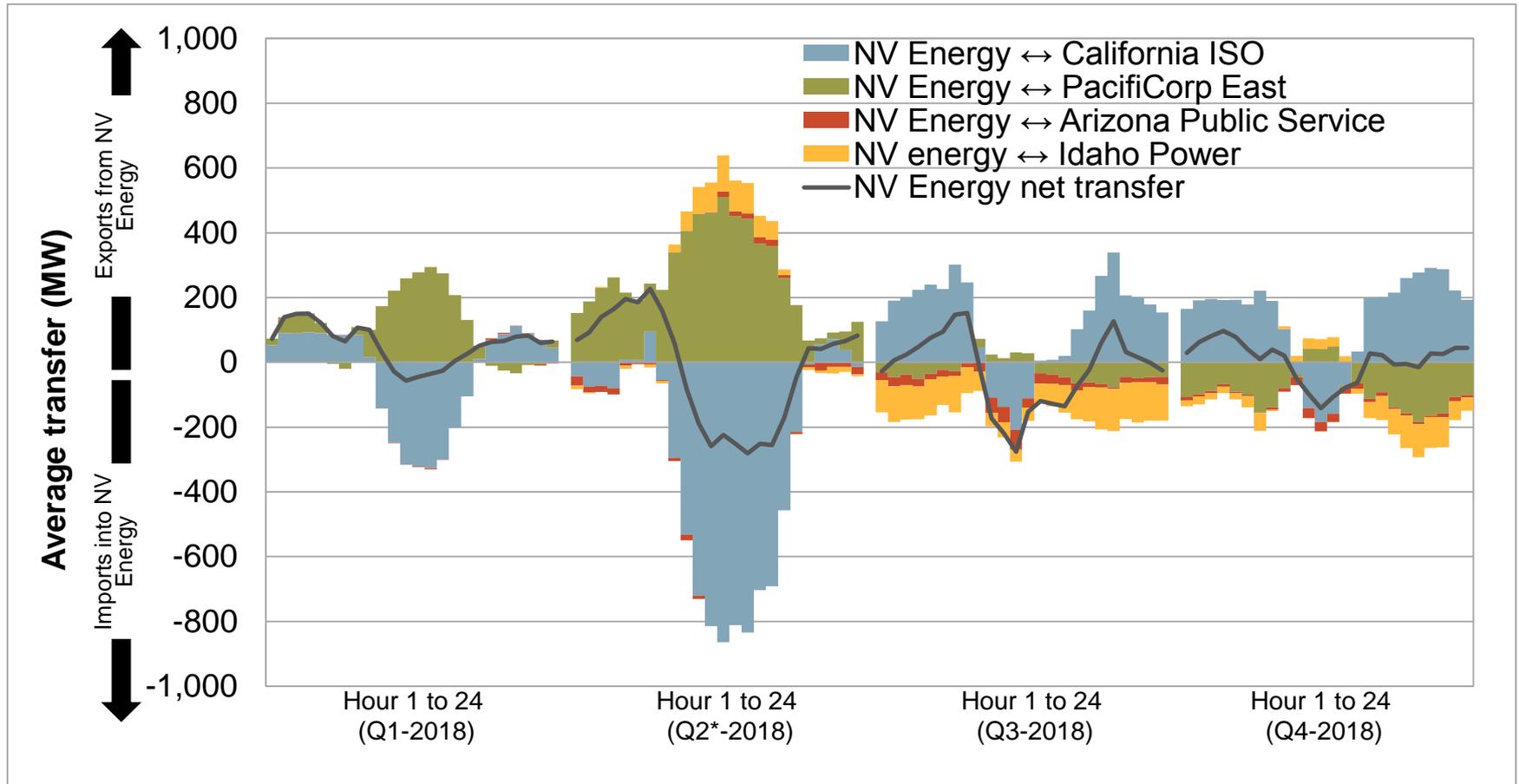
Frequency of downward failed sufficiency tests by month



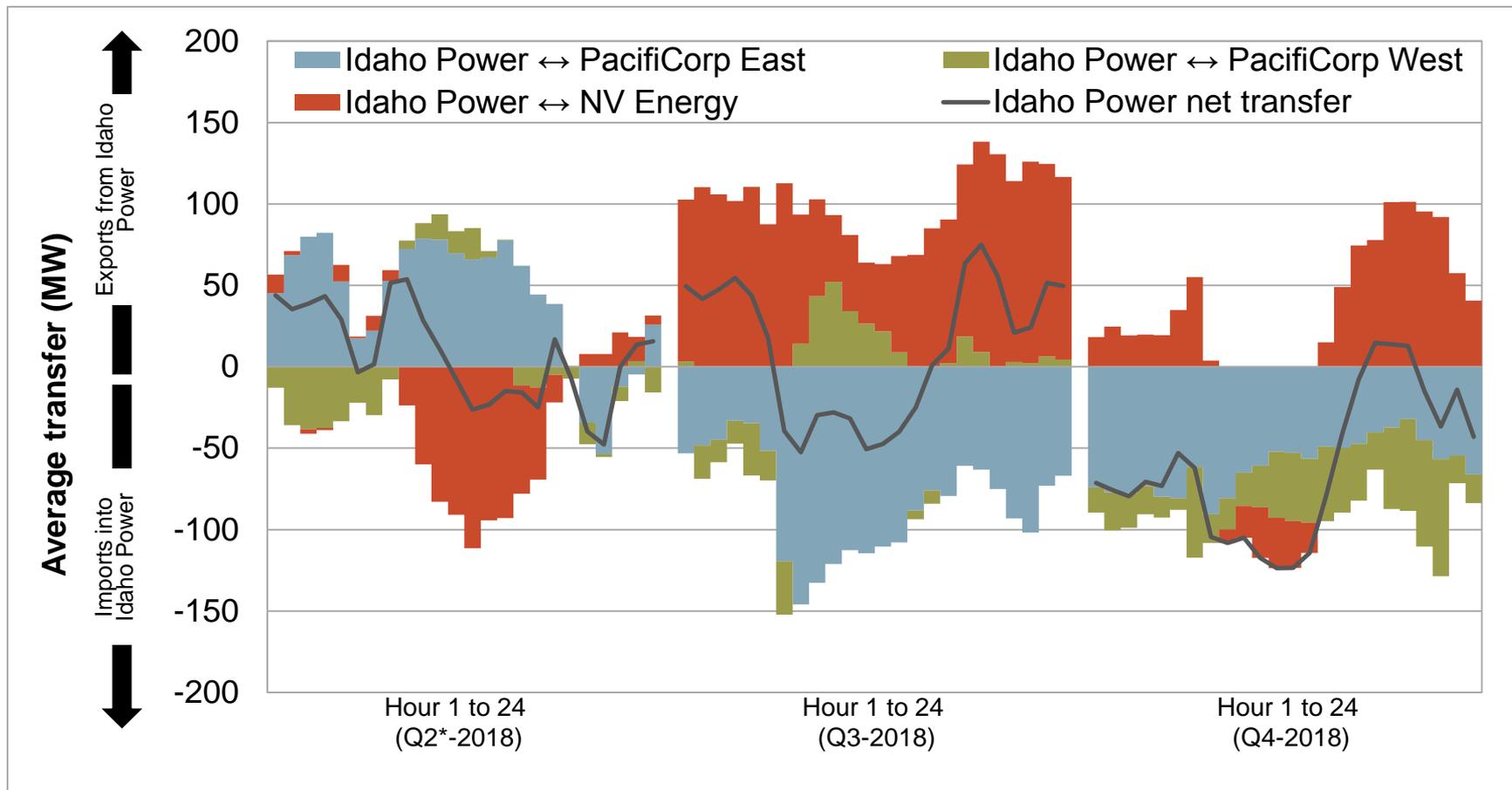
California ISO average hourly 15-minute transfer



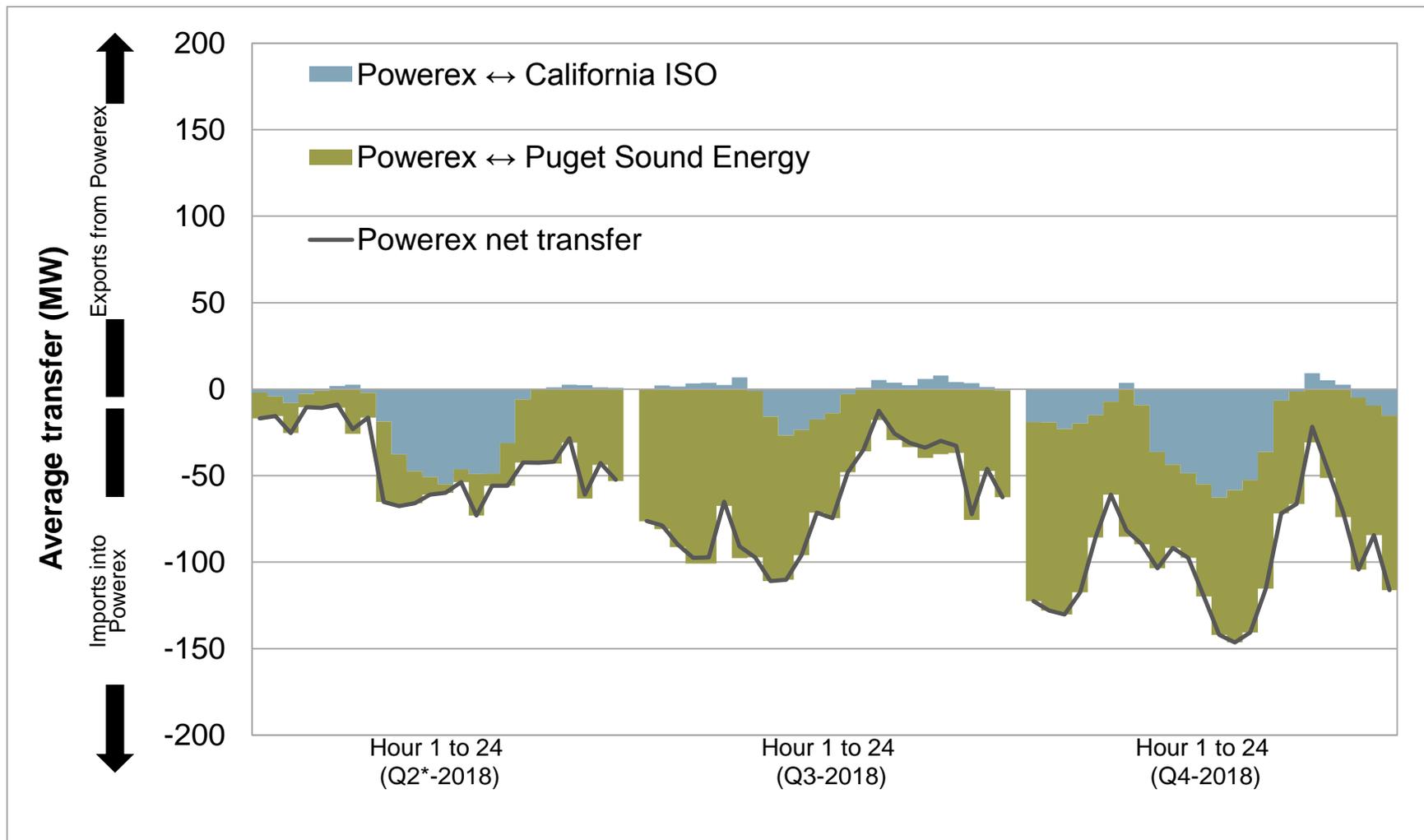
NV Energy average hourly 15-minute transfer



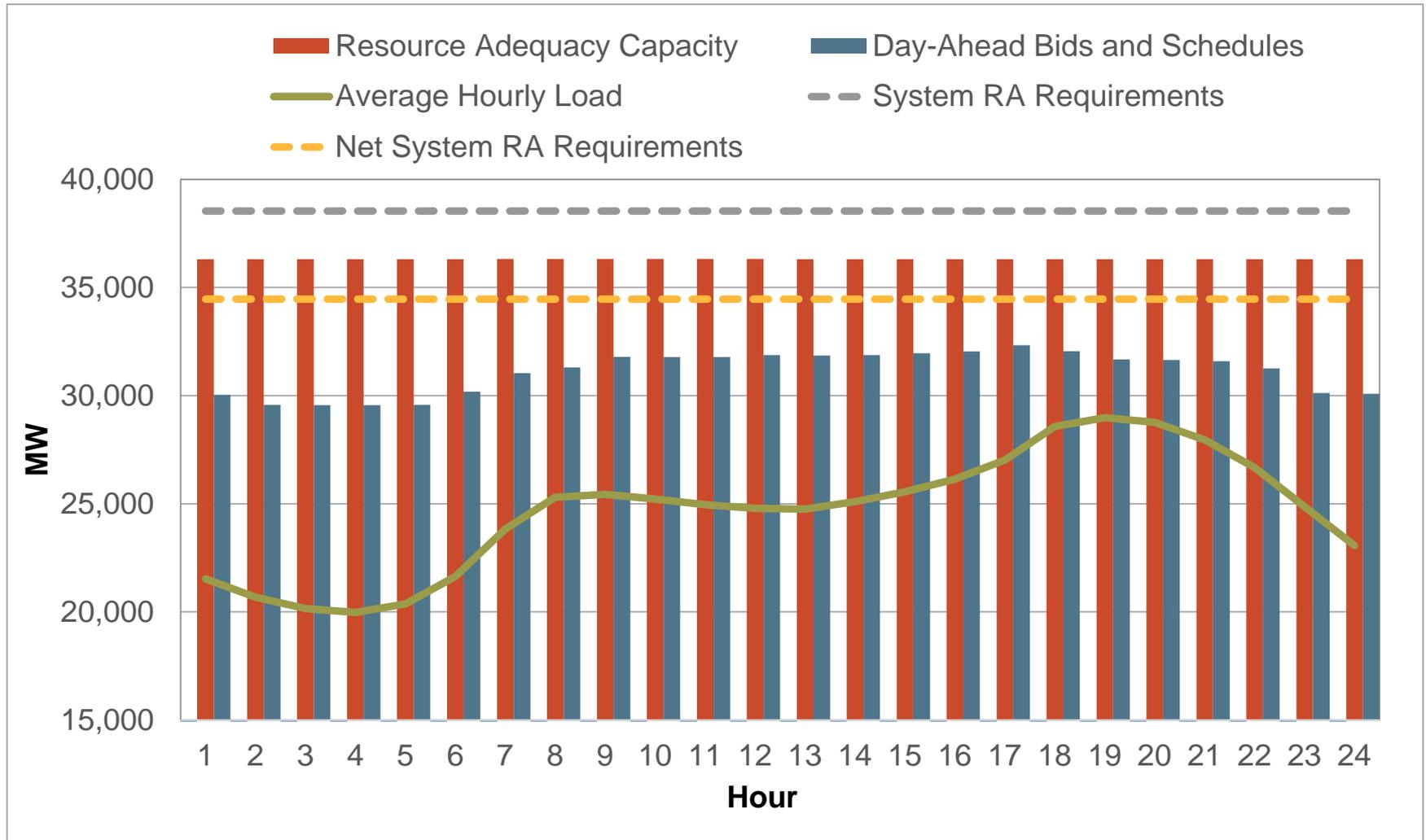
Idaho Power average hourly 15-minute transfer



Powerex average hourly 15-minute transfer



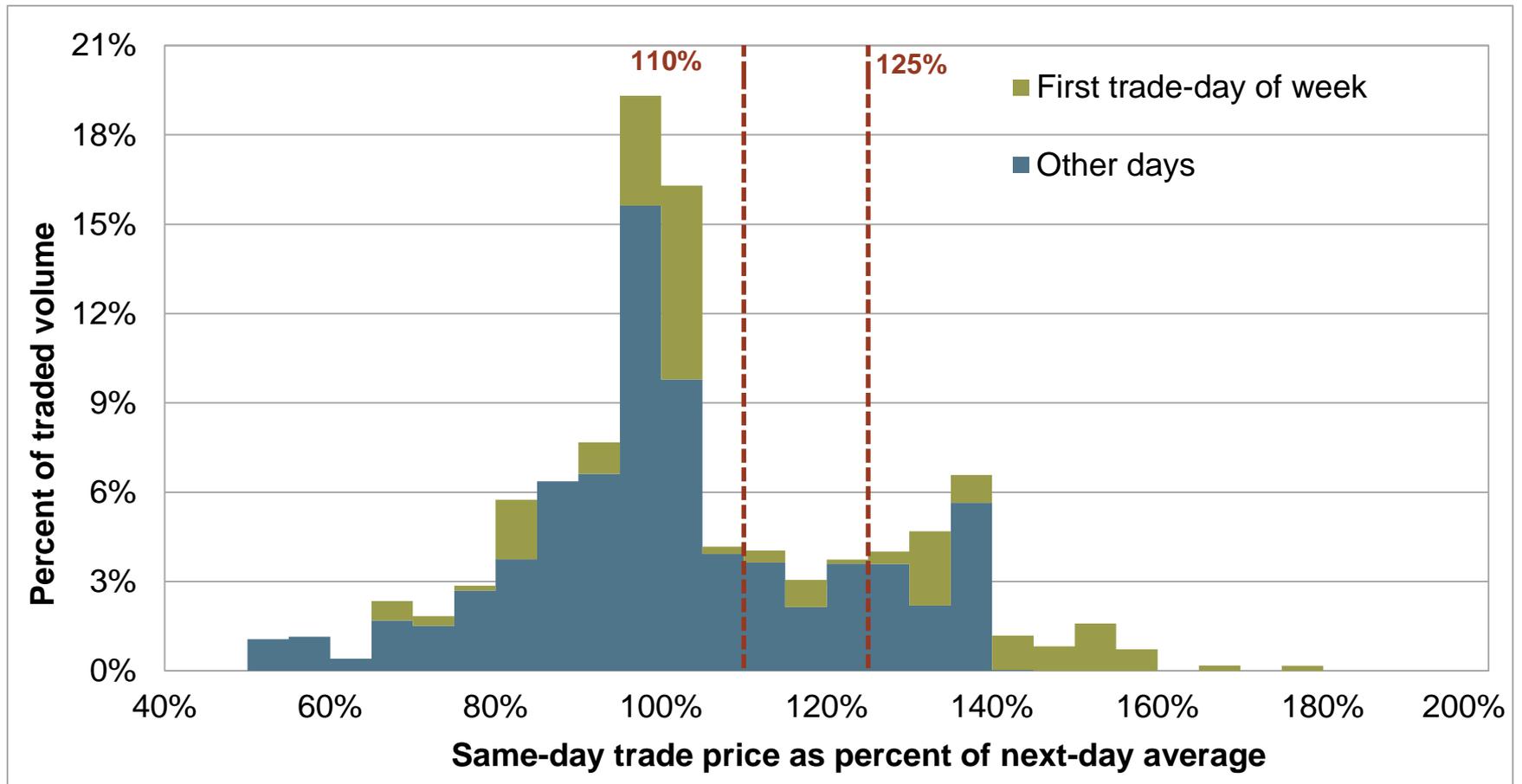
Average hourly load and resource adequacy capacity



Average system resource adequacy capacity and availability (non-holiday weekdays)

Resource type	Total resource adequacy capacity (MW)	Day-ahead market				Real-time market			
		Adjusted for outages		Bids and self-schedules		Adjusted for outages/availability		Bids and self-schedules	
		MW	% of total RA Cap.	MW	% of adjusted RA Cap	MW	% of total RA Cap.	MW	% of adjusted RA Cap
Must-Offer:									
Gas-fired generators	17,671	16,733	95%	16,729	100%	10,893	62%	10,641	98%
Other generators	1,480	1,389	94%	1,387	100%	1,389	94%	1,362	98%
Imports	2,532	2,381	94%	1,882	79%	1,226	48%	1,019	83%
Subtotal	21,683	20,503	95%	19,998	98%	13,508	62%	13,022	96%
Other:									
Use-limited gas units	5,548	4,836	87%	4,624	96%	4,333	78%	3,938	91%
Hydro generators	3,852	3,307	86%	2,813	85%	3,307	86%	2,877	87%
Nuclear generators	1,910	1,883	99%	1,863	99%	1,883	99%	1,839	98%
Solar generators	1,051	1,021	97%	398	39%	987	94%	419	42%
Wind generators	620	610	99%	327	54%	610	99%	354	58%
Qualifying facilities	1,177	1,095	93%	852	78%	985	84%	795	81%
Other non-dispatchable	460	449	98%	227	51%	438	95%	311	71%
Subtotal	14,618	13,201	90%	11,104	84%	12,543	86%	10,533	84%
Total	36,301	33,704	93%	31,102	92%	26,051	72%	23,555	90%

Same-day trade prices compared to next-day index (October - December)



Same-day prices as a percent of updated same-day averages (October - December)

Also updating allowed gas prices used in the day-ahead market to reflect prevailing next-day gas prices in Q4

