



# Markets Report

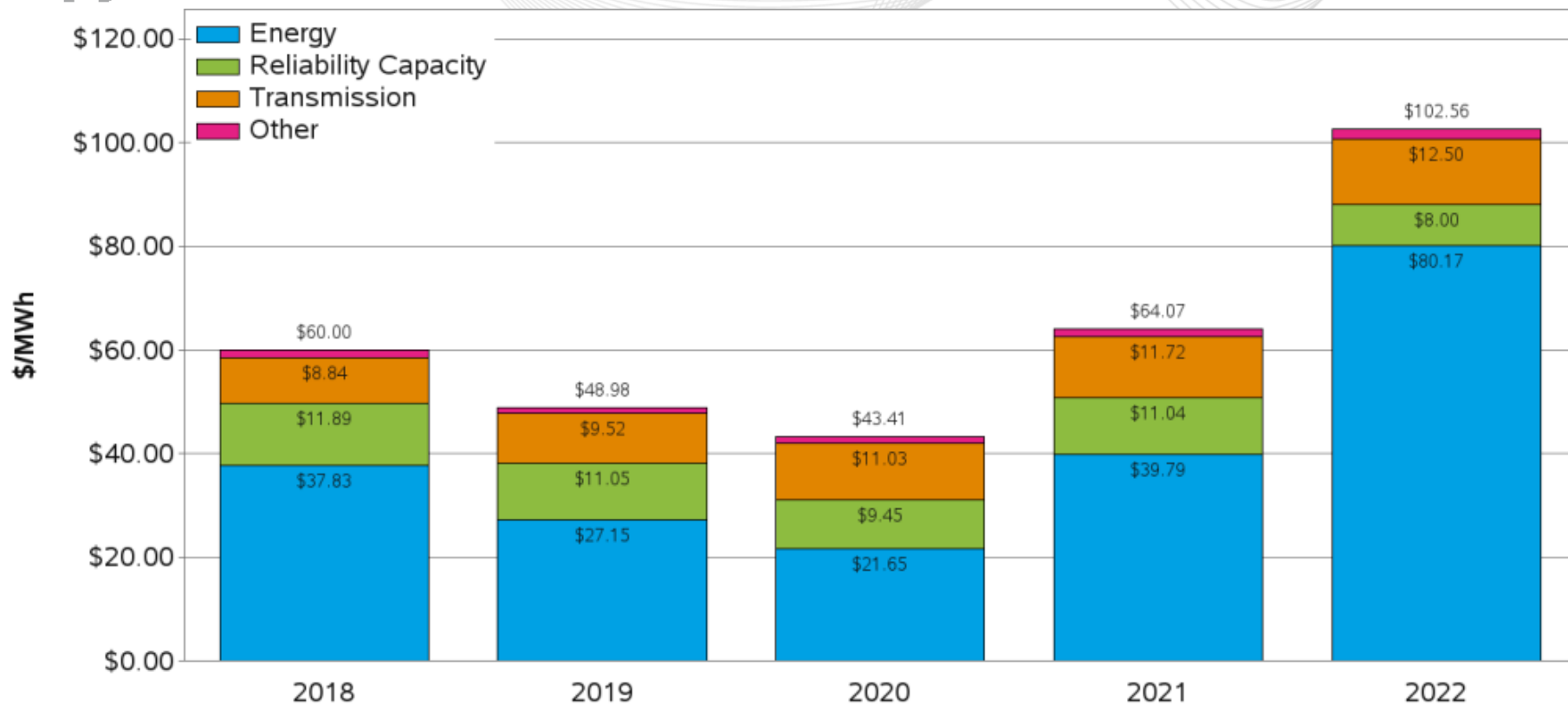
MC Webinar

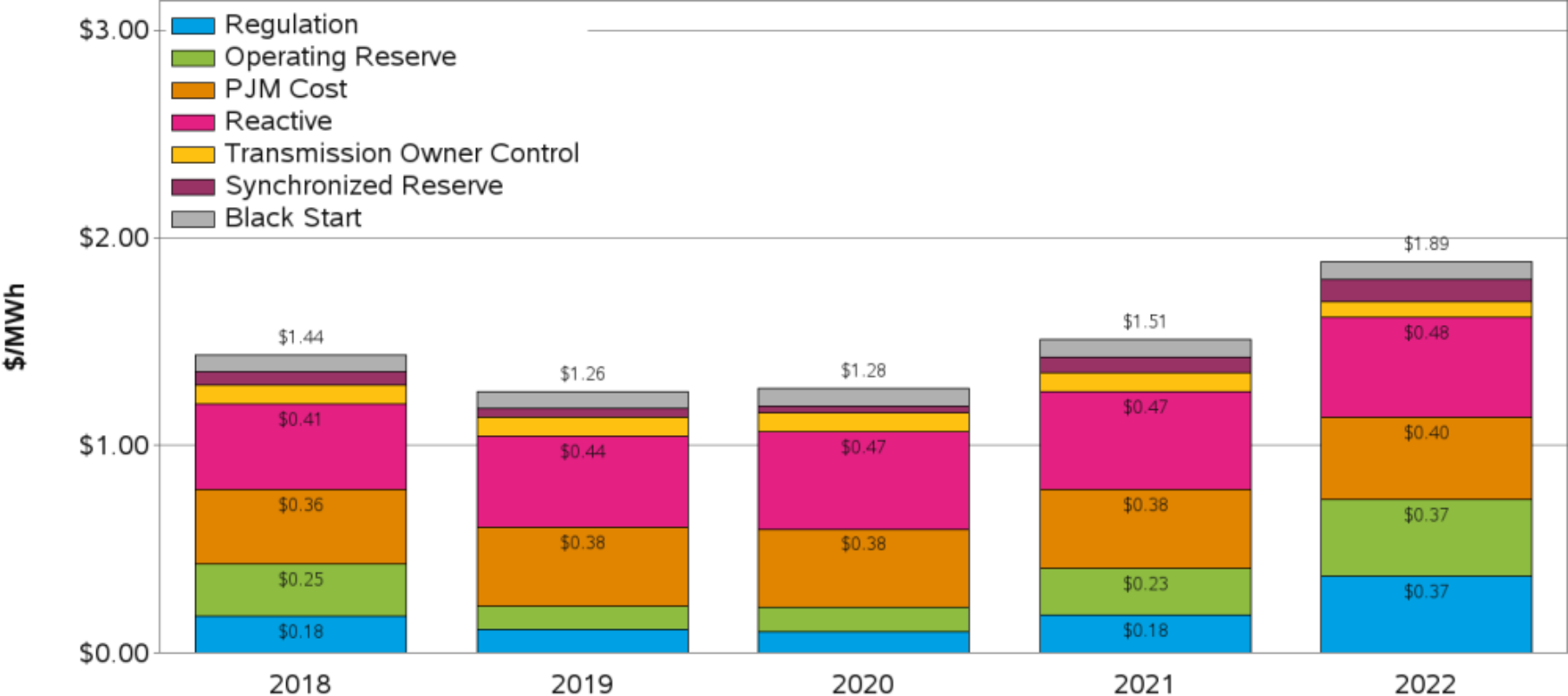
January 23, 2023

- PJM Wholesale Cost 2022 is \$102.56/MWh, up from full-year 2021 costs of \$64.07/MWh. (Slides 5 & 6)
- Slides pertaining to weather conditions, in addition to slides showing average fuel prices, generation on-line fuel mixes, and System Marginal Prices have been combined into a **Market Conditions** section. (Slides 8- 20)
- In December, temperatures were above average for most of the month. Thus , the sum of Heating and Cooling Degree Days was also above its historic average. (Slides 8-10)
- Energy use was also above its historic average for December. (Slides 8-10)
- In December, uplift exceeded \$800,000 on thirteen days. (Slides 25 & 26)

- Load-weighted average LMP for 2022 is \$71.88/MWh: (Slides 34-36)
  - December 2022 was \$142.30/MWh, which is higher than December 2021 (\$38.90/MWh) and December 2020 (\$25.50/MWh).
- There were 207 5-minute intervals that experienced shortage pricing in December. (Slides 34-51)
- FTR revenue adequacy for the month of December is 100% and the 2022-2023 Planning Year is currently funded at 100%. (Slides 69-72)
- Congestion values have been trending upwards since October. (Slide 70)
- Regulation and Synchronized Reserve market costs increased in late December due to Winter Storm Elliott. (Slides 91-92)

# Markets Report



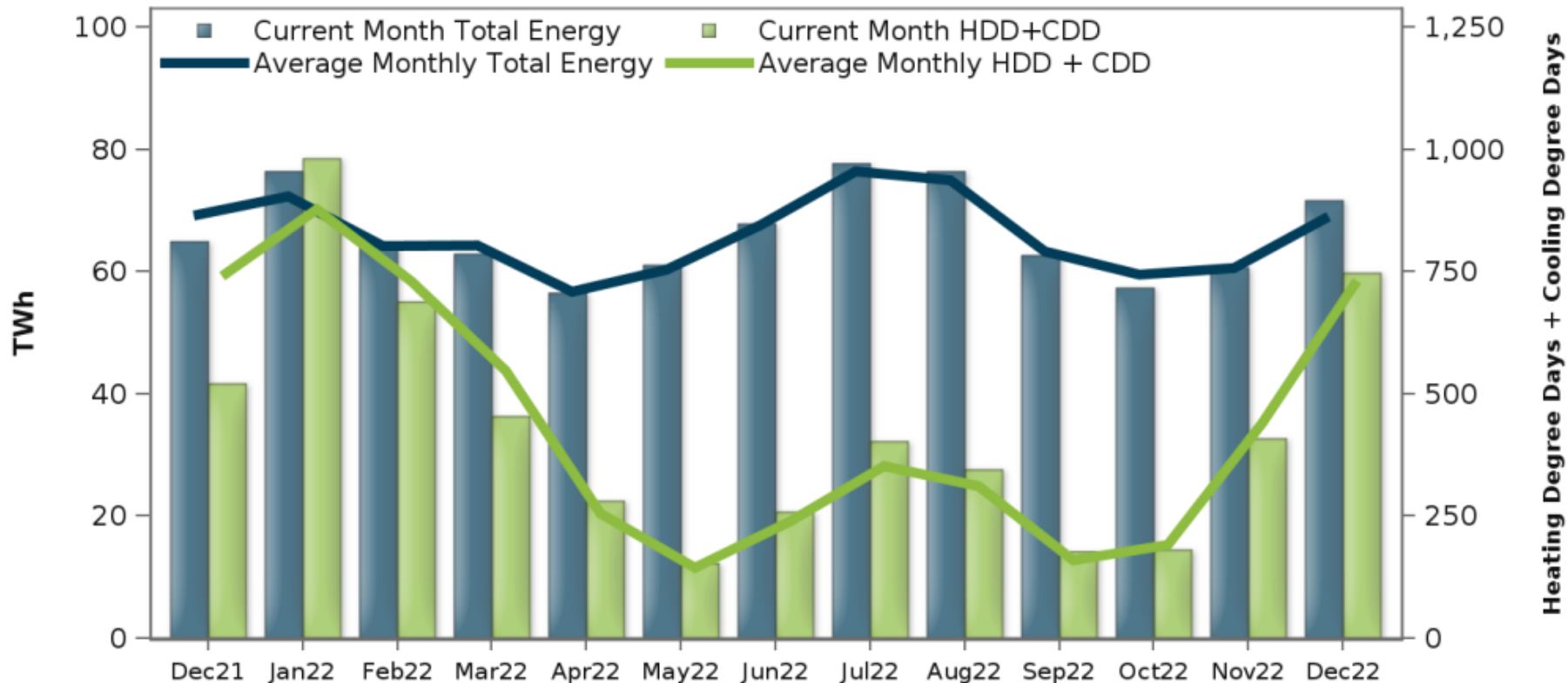


# Market Conditions

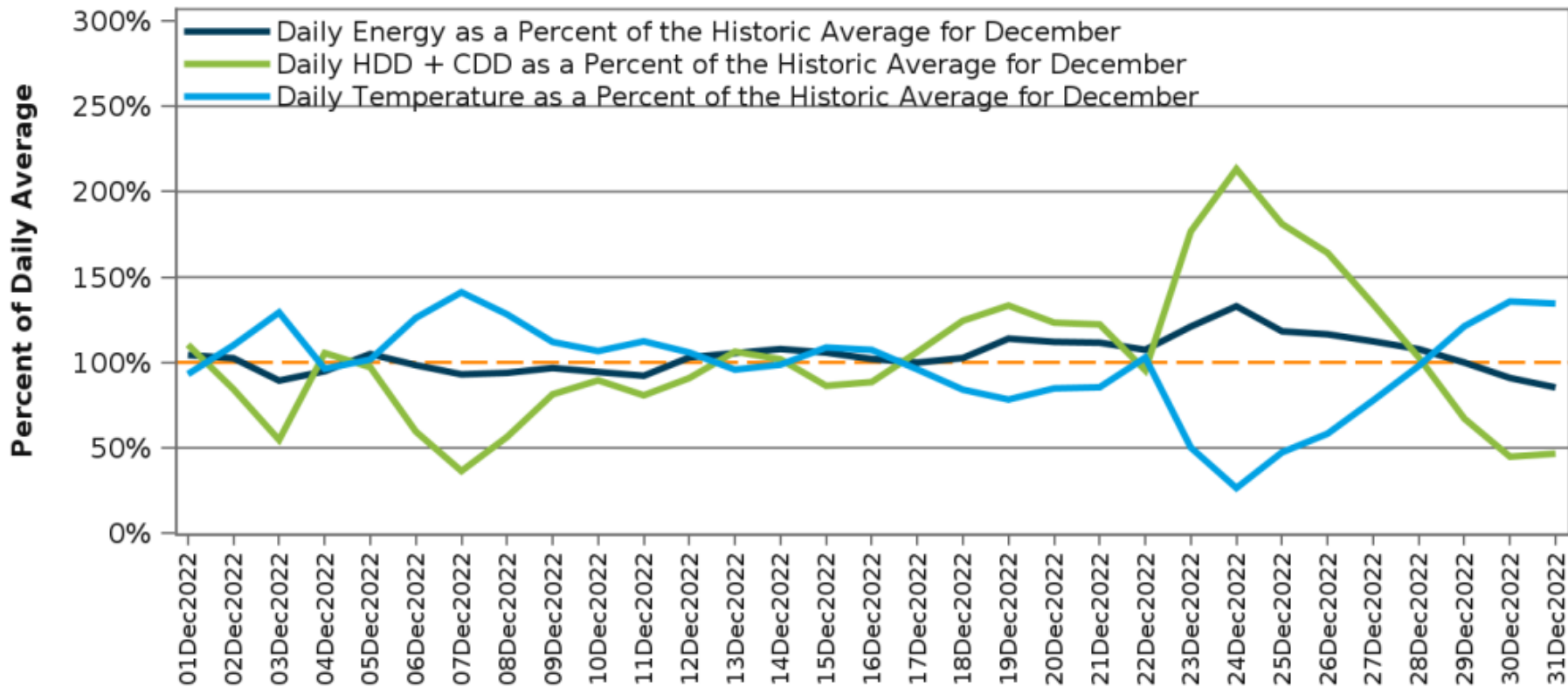
- The weather parameter shown in the following slide is a monthly sum of daily Heating Degree Days (HDD) and Cooling Degree Days (CDD).
- Degree days represent a deviation from a baseline temperature, in this case 60 degrees for HDD and 65 degrees for CDD. As temperatures get more extreme, colder or hotter, either HDDs or CDDs, respectively, will increase.
- Typically, winter months will only record HDDs, while summer months will only record CDDs. Shoulder months may have both HDDs and CDDs.
- Degree Days are calculated using a daily load weighting that weights values from stations in each TO zone according to the zonal contribution to the RTO peak on that day.
- Average values use data from 1998 to the most recent complete year, in this case, 2020. Averages include load data for all of TO zones in the current RTO footprint.

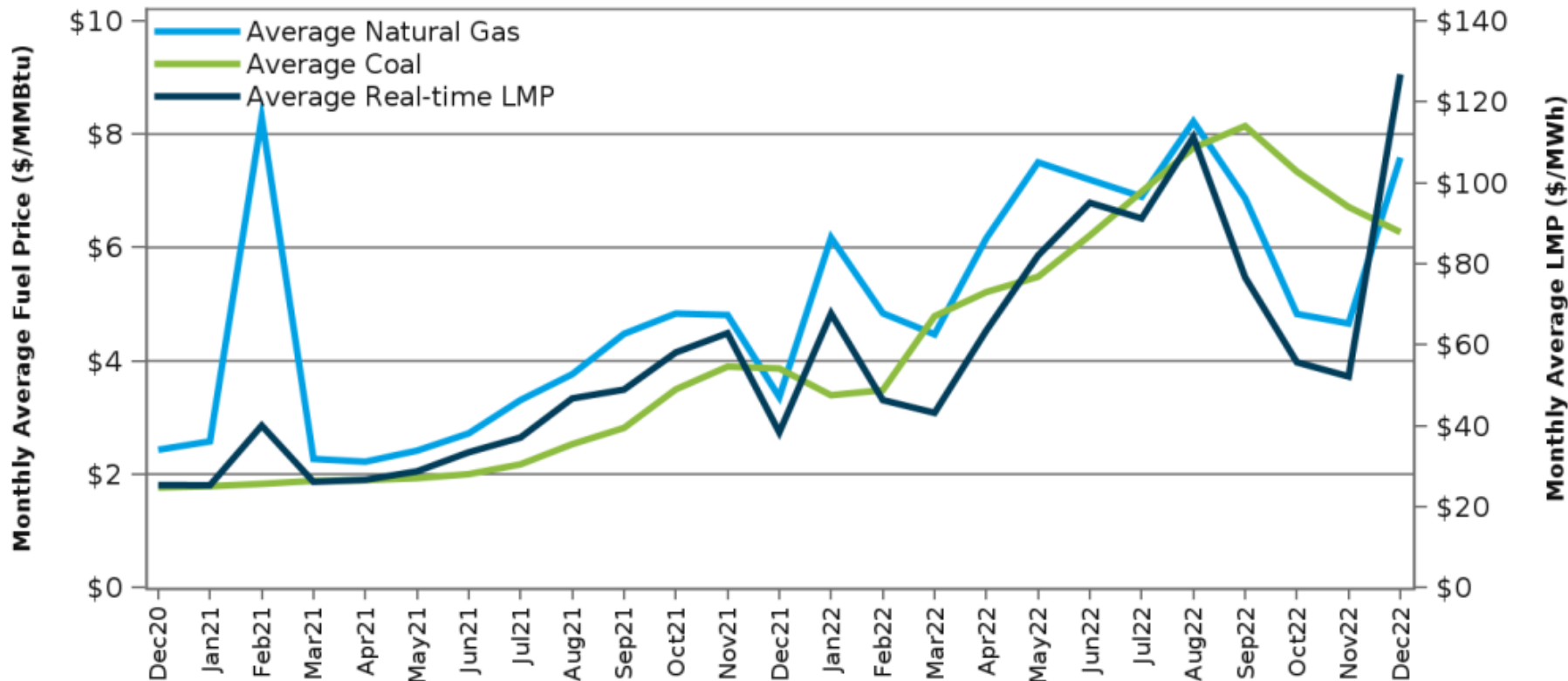


# Historic Average Weather and Energy versus Current Month

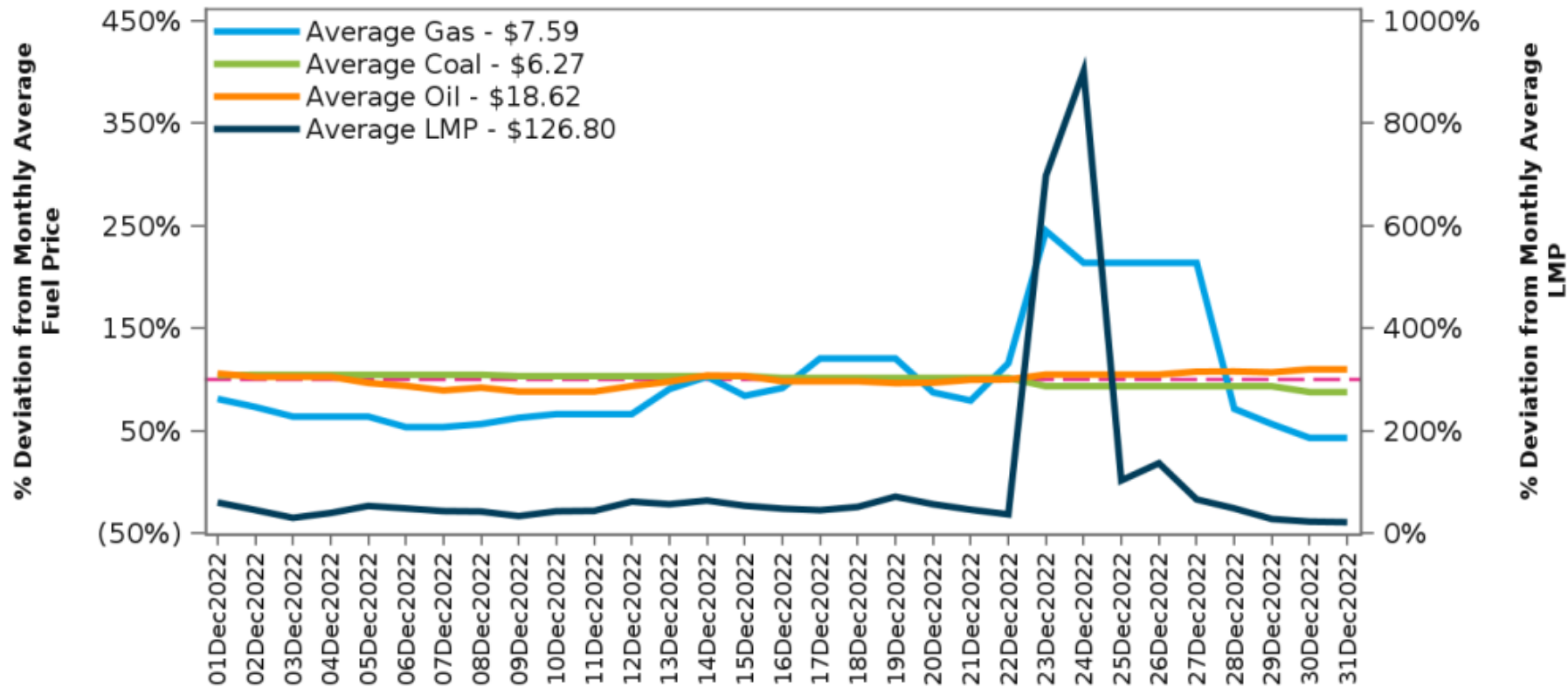


# Historic Average Weather and Energy versus Current Month - Daily





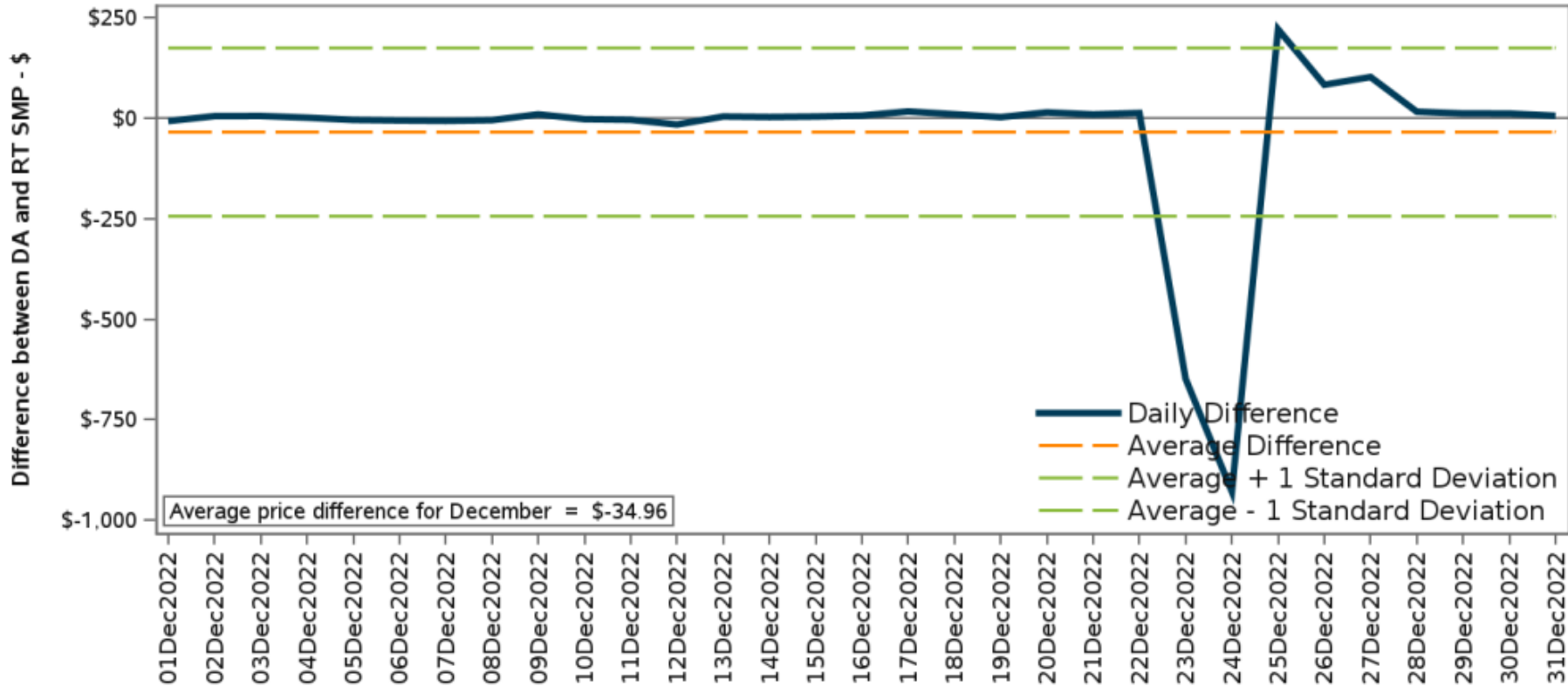
Fuel Price Source: S&P Global Platts



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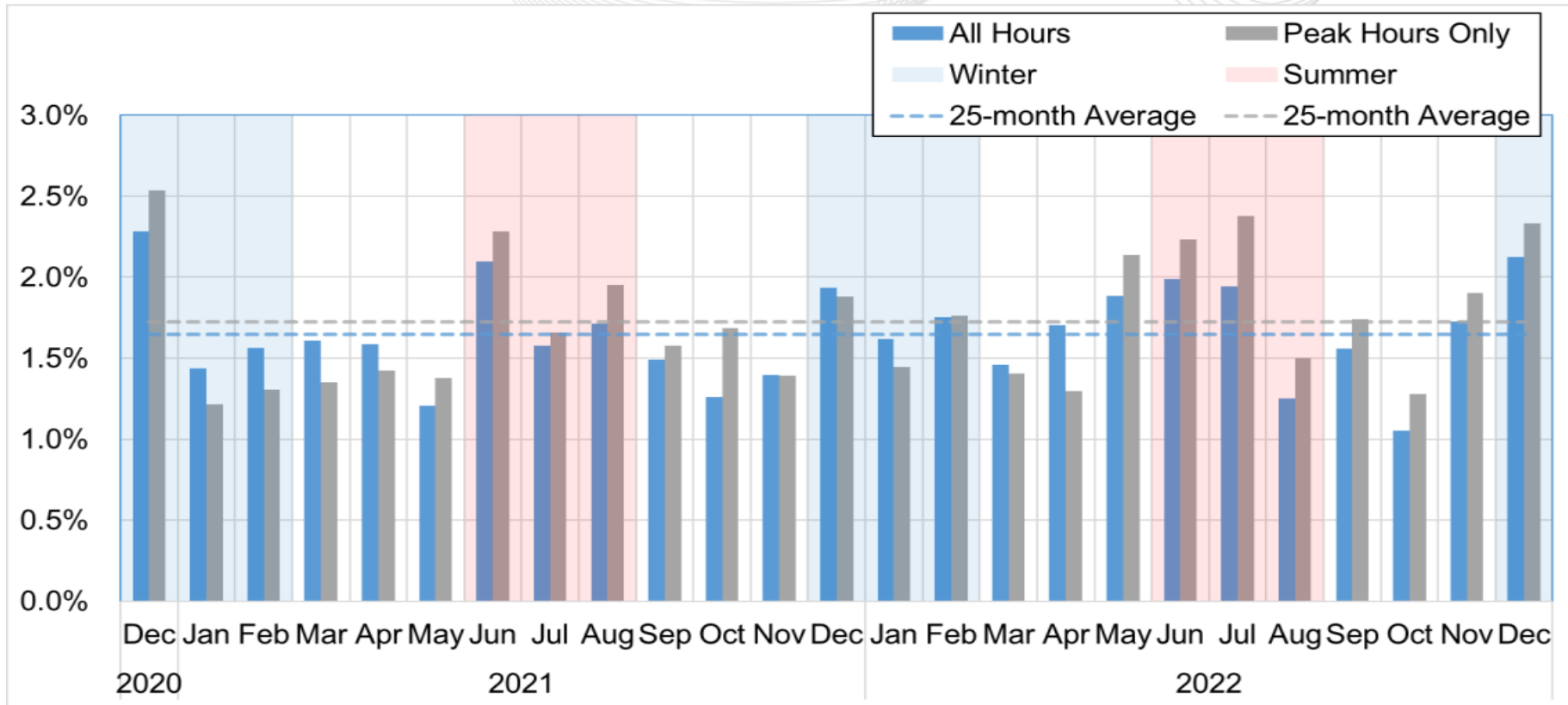


# Daily Difference Between Day-Ahead and Real-Time System Marginal Prices

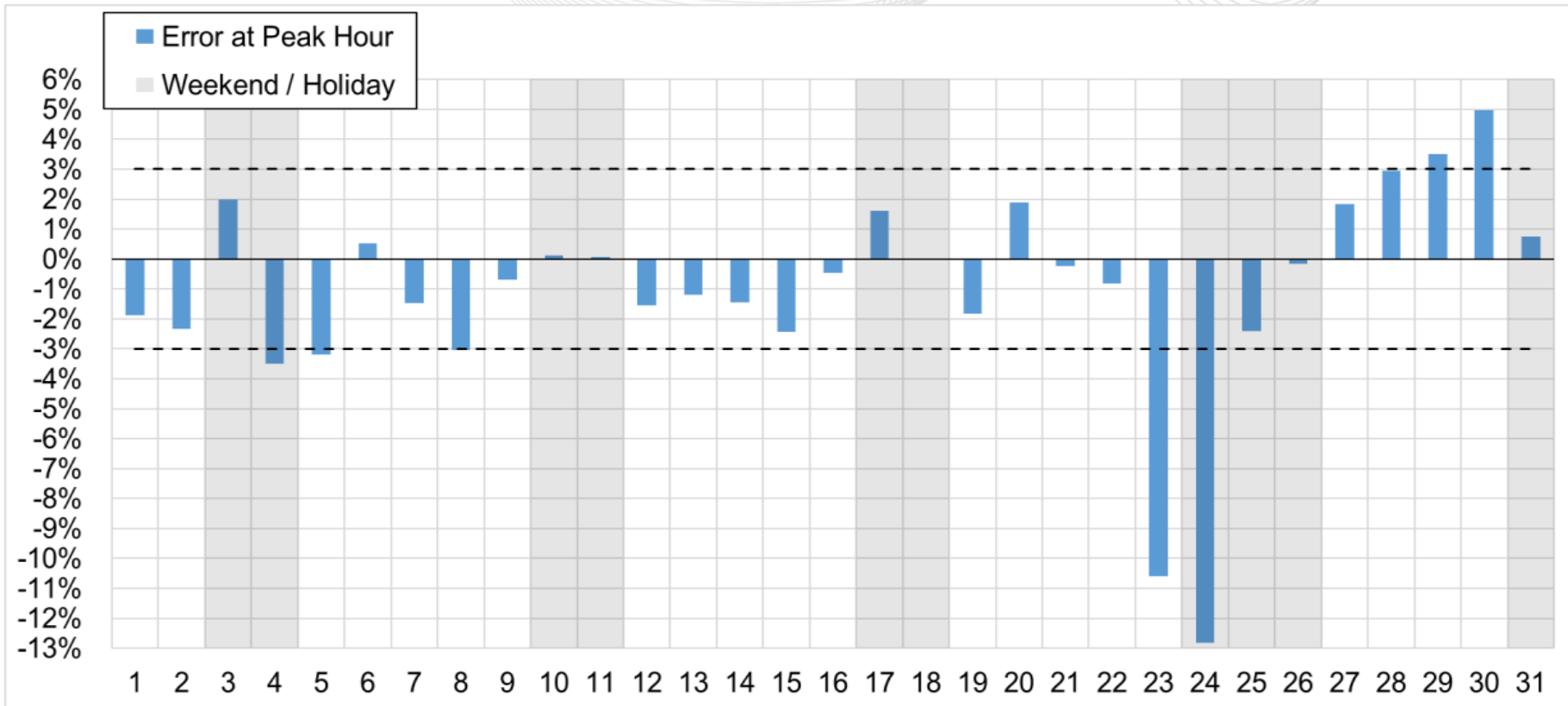


Positive values represent days when the DA daily average price was higher than RT. Negative values represent days when the DA price was lower.

# Load Forecast Error - Monthly Absolute Error, 10:00 Forecast



# Load Forecast Error - December Daily Peaks, 10:00 Forecast



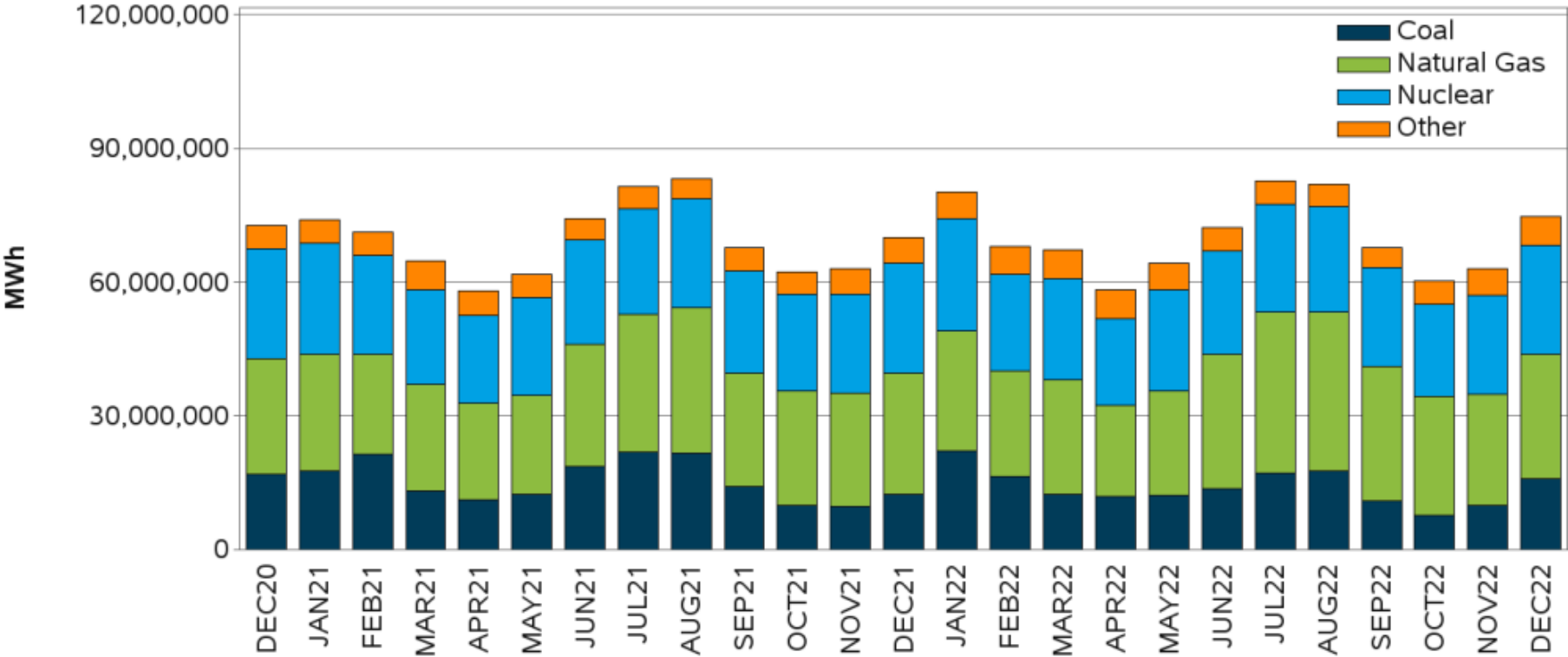
- PJM prepares a day-ahead load forecast at 10:00 am for use by our members.
- This forecast is not used to clear the day-ahead market and is not utilized for the reliability tools that run subsequent to the day-ahead market.

*Near the beginning of the month, load peaks were under-forecasted on the evening of Dec. 4<sup>th</sup> and morning of Dec. 5<sup>th</sup>, as temperatures dropped following an unusually warm day on Dec. 3<sup>d</sup>. The peak was also under-forecasted on Dec. 8<sup>th</sup>, following another temperature drop, as models continued to adapt to December load behavior.*

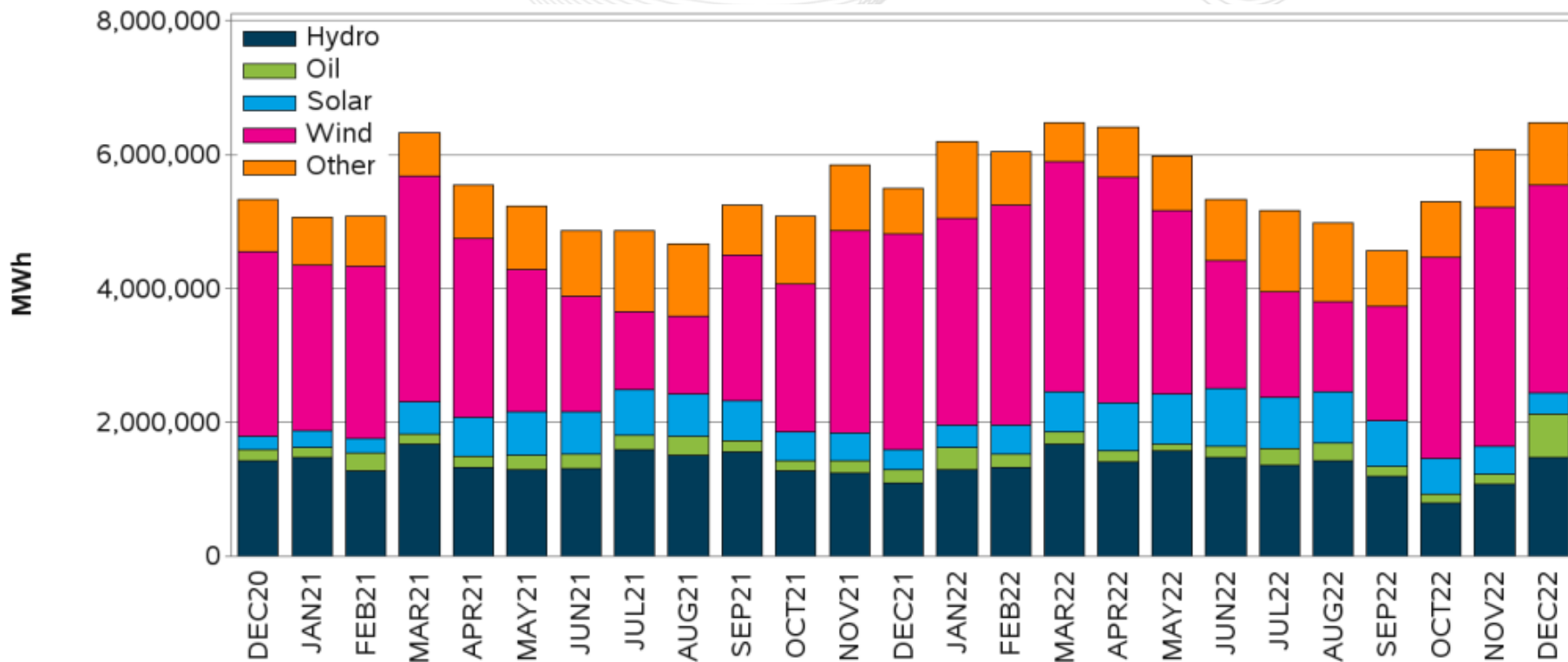
*While load forecasts performed well during the middle of the month, significant under-forecasting occurred on Dec. 23<sup>rd</sup> and 24<sup>th</sup> during Winter Storm Elliott. Temperatures plummeted on the 23<sup>rd</sup> and remained in the single digits for much of the 24<sup>th</sup>. These extreme weather conditions combined with uncertainty about holiday impacts on load caused the forecast error.*

*On Dec. 29<sup>th</sup> and 30<sup>th</sup>, load was over-forecasted, as temperatures came in warmer than forecasted and lingering holiday impacts resulted in reduced morning peaks.*

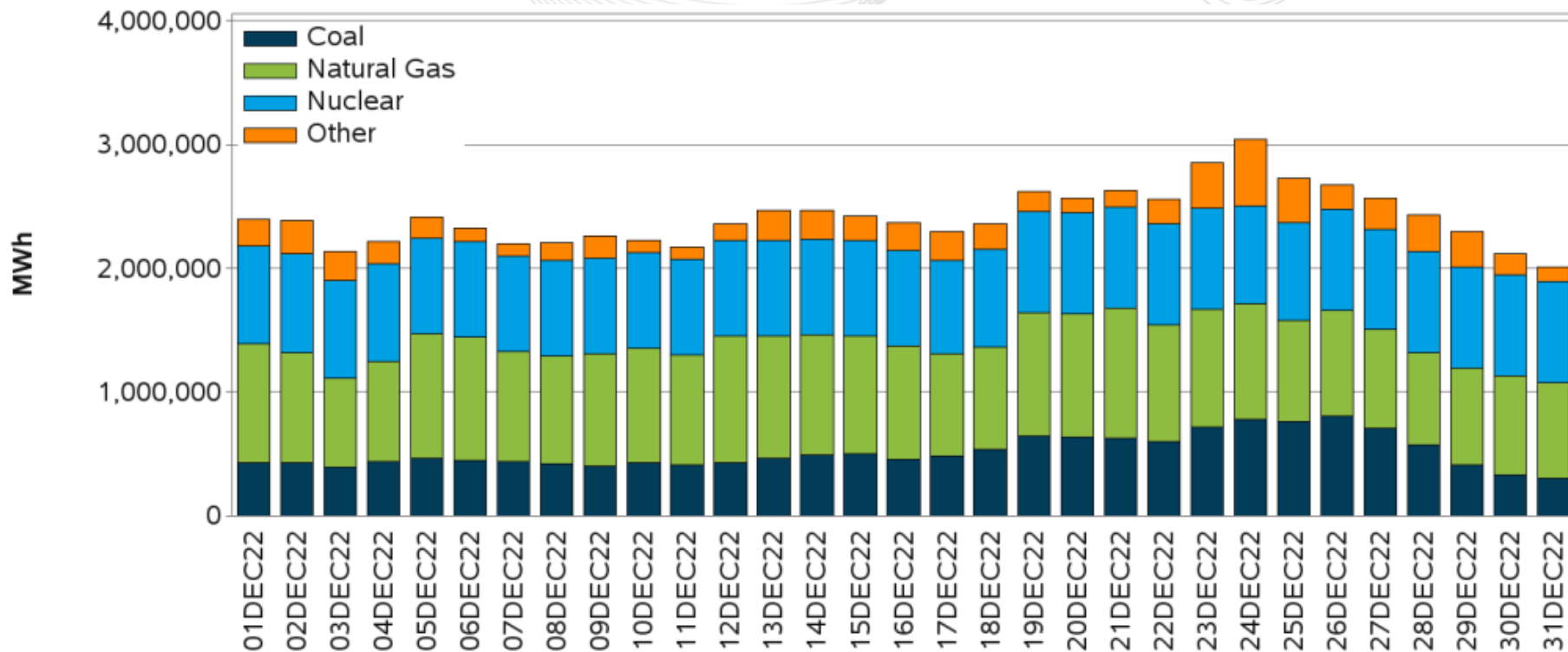




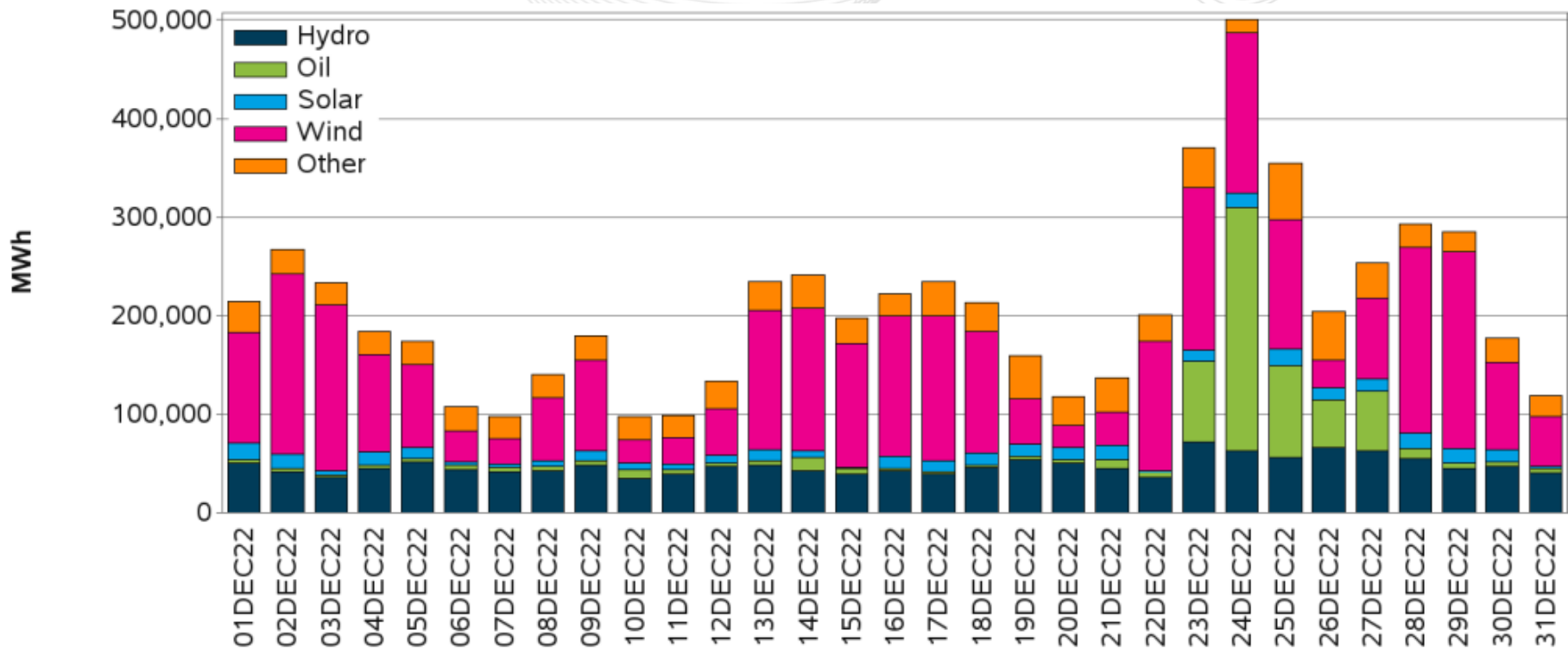
'Other' includes Hydro, Oil, Solar, Wind, and Other



'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables

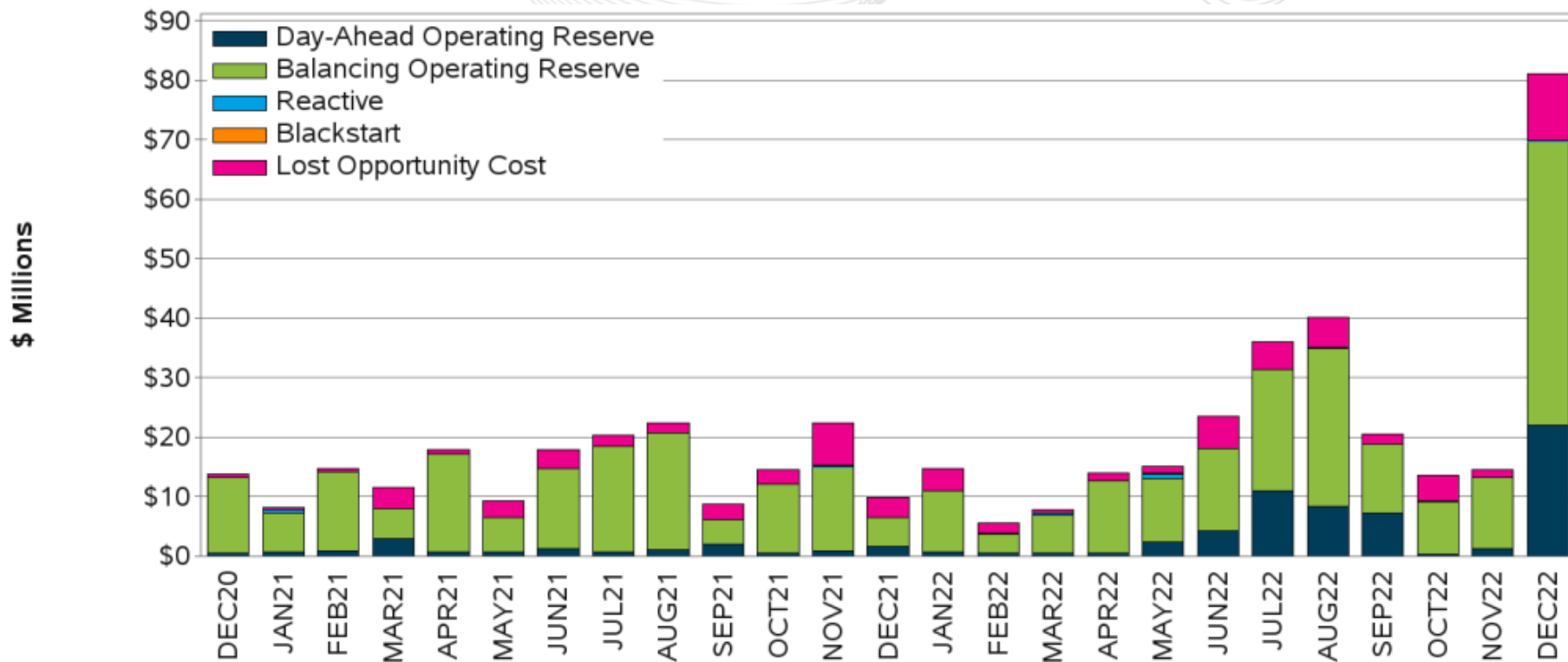


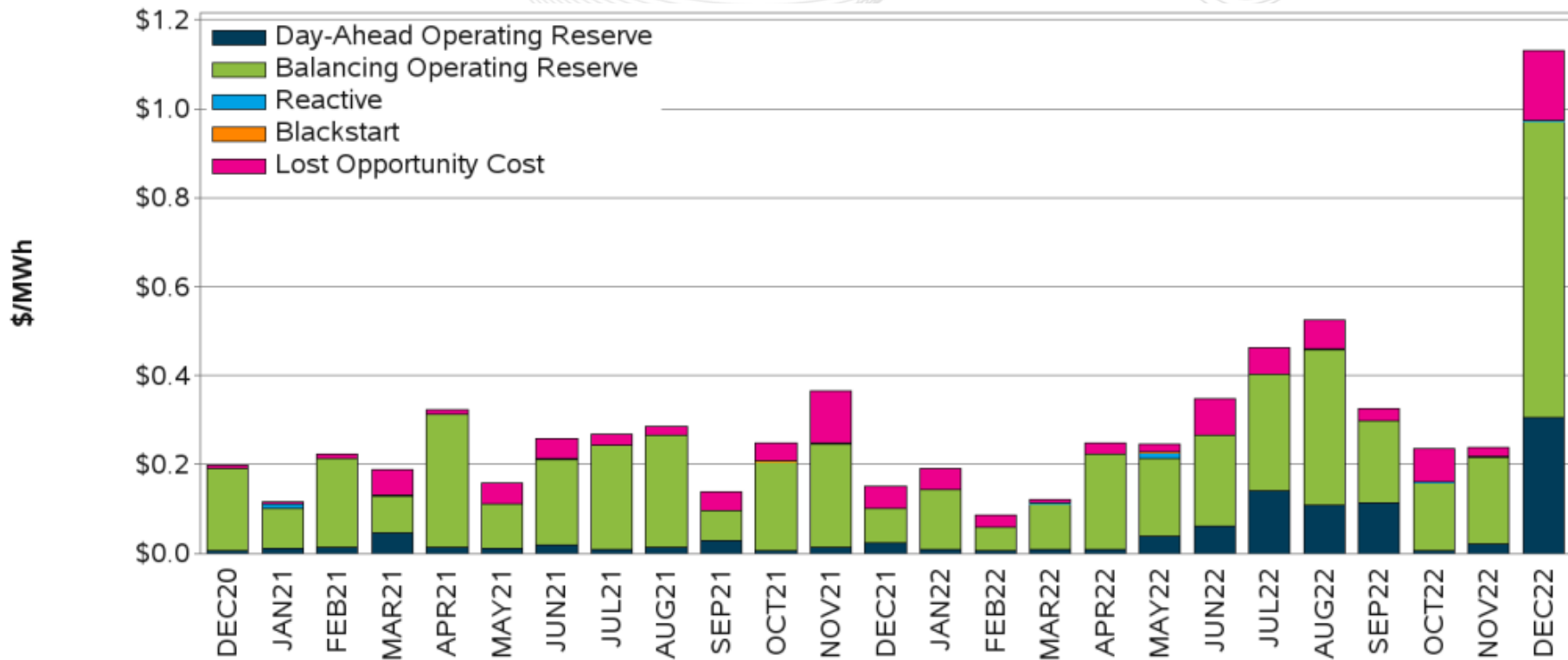
'Other' includes Hydro, Oil, Solar, Wind, and Other

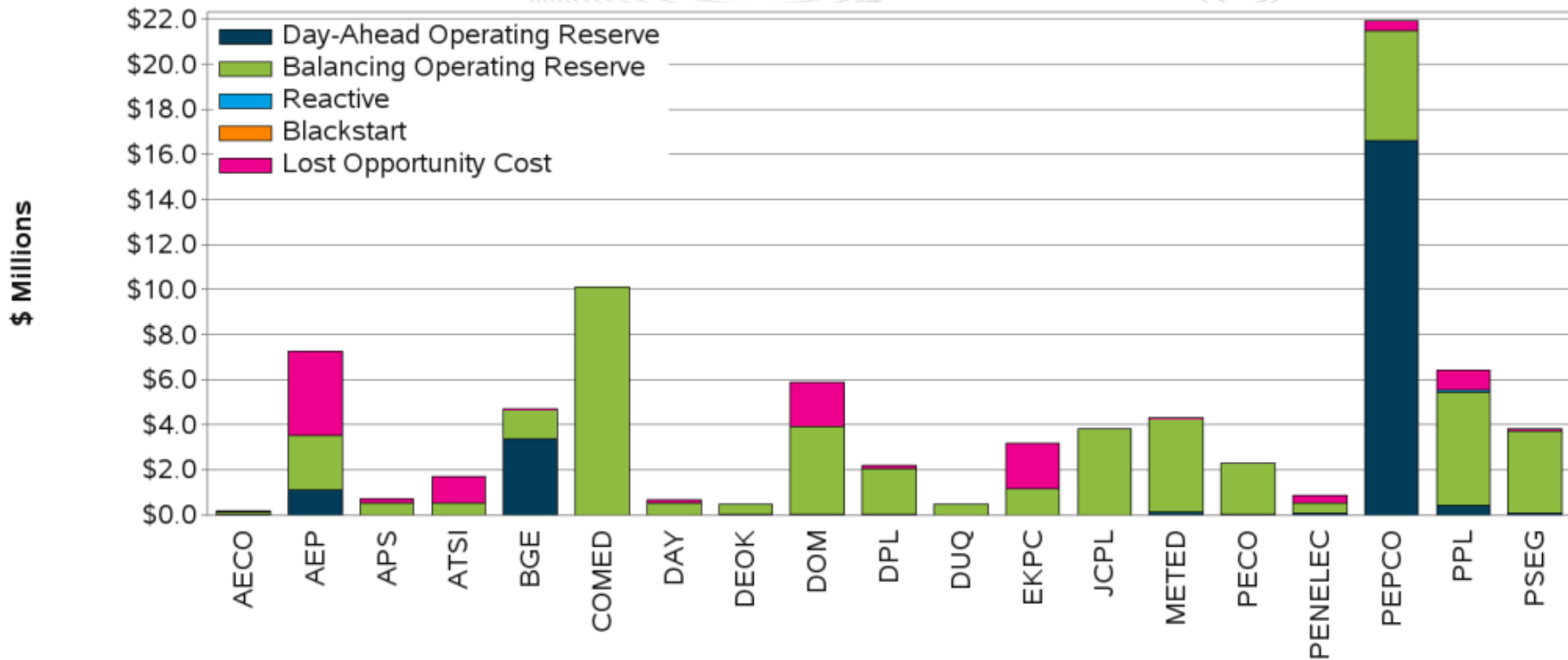


'Other' includes Flywheels, Multiple Fuels, Storage, and Other Renewables

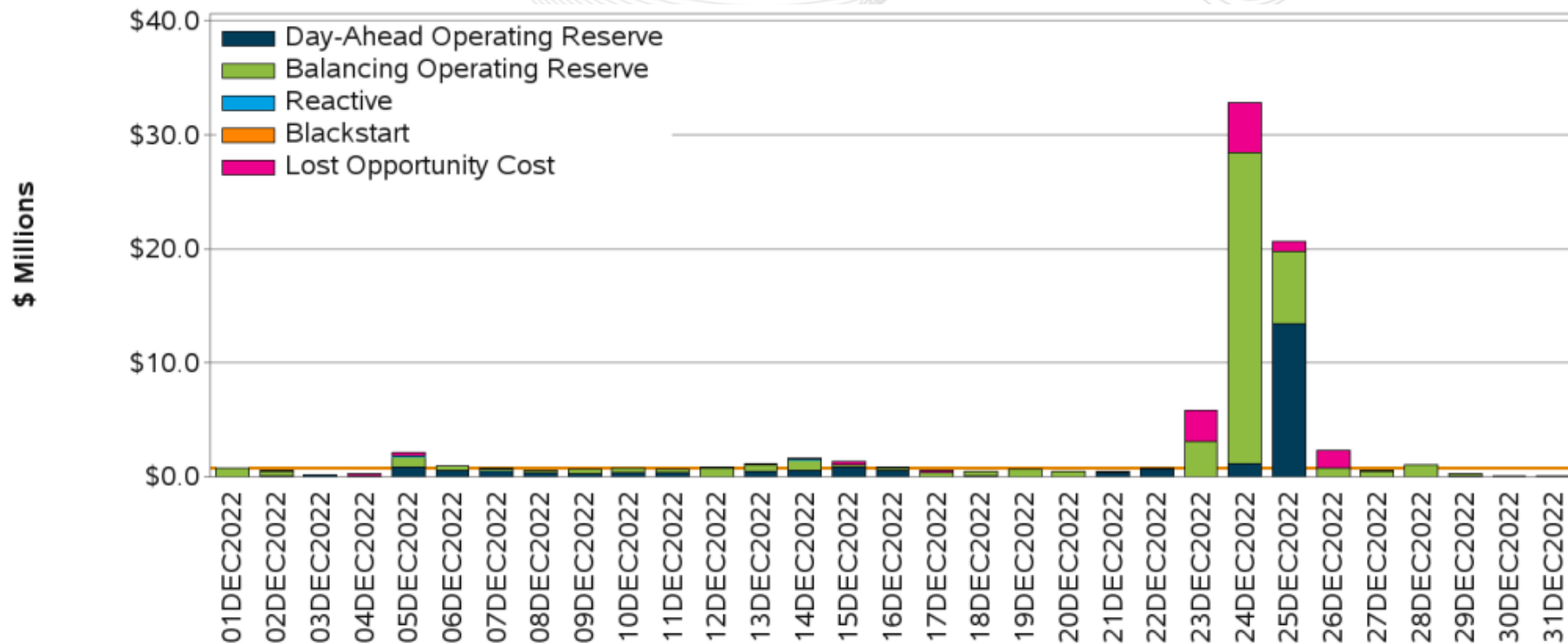
# Operating Reserve (Uplift)

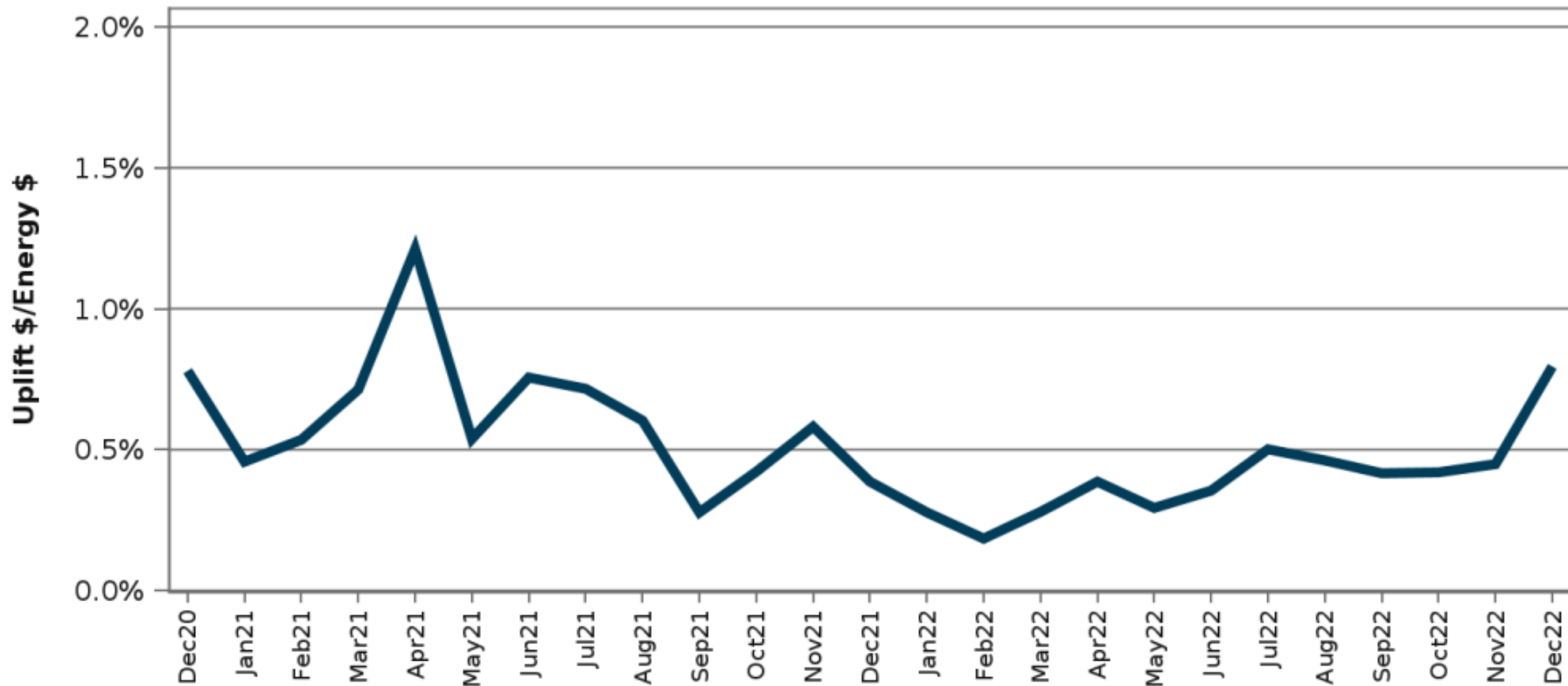










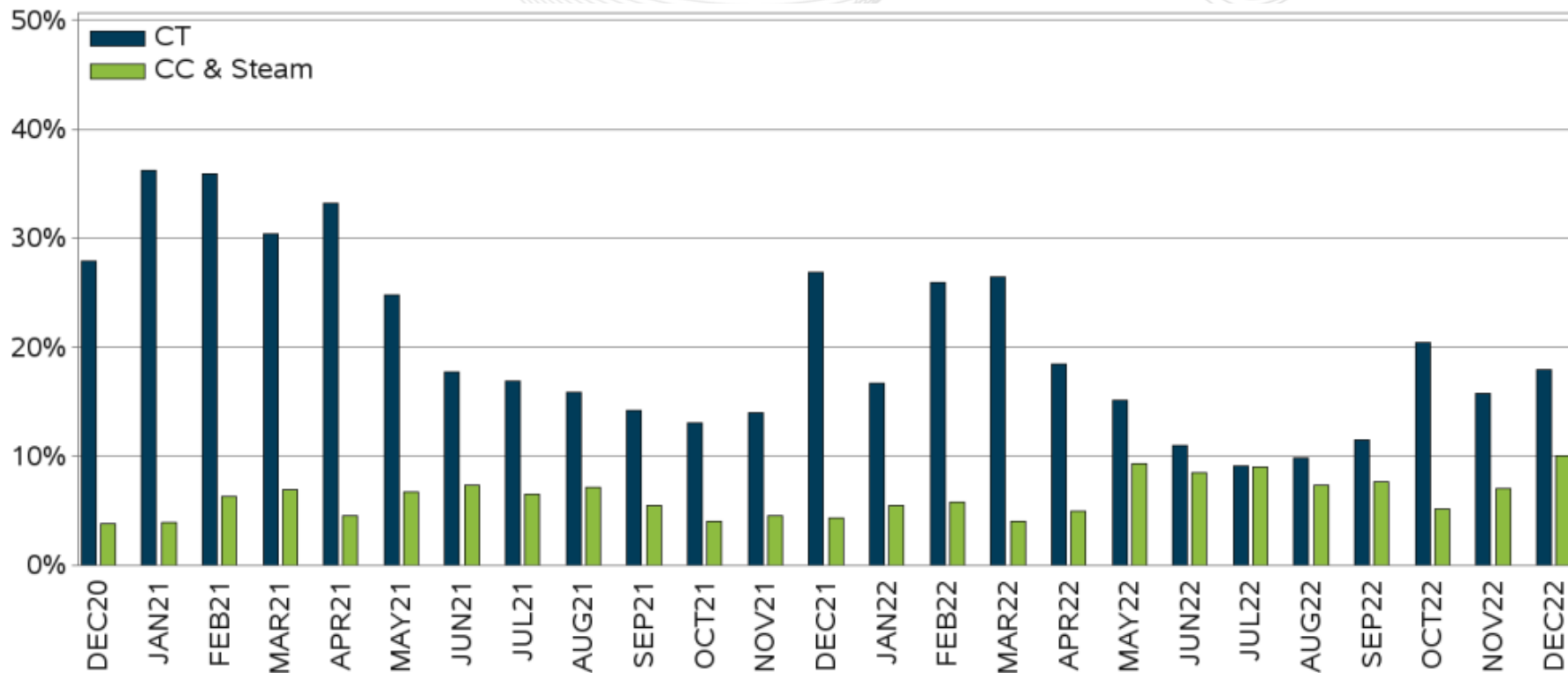


- In December, uplift exceeded \$800,000 on 13 days -
- Contributing factors to uplift were:

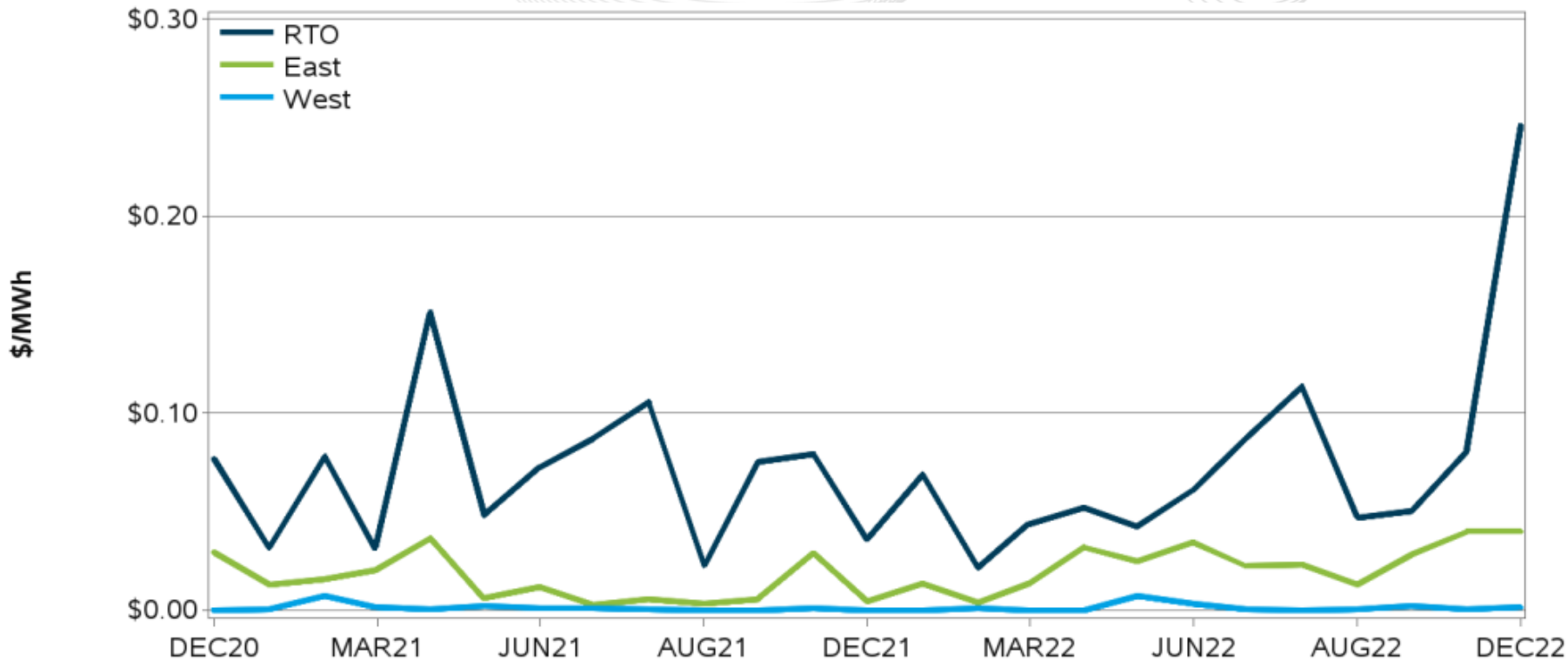
*December was a challenging month. Outside of the Winter Cold Events, localized congestion caused the need to run CTs longer, which attributed to most of the BOR. For DA OR, reliability needs required the commitment of more steam units to support north to south flows. As for the Winter Cold Events around Christmas, the bulk of the uplift was from steam units that were committed to address capacity needs and the uncertainty in forecasts.*

- More information on Uplift can be found on the PJM website at [Drivers of Uplift](#)

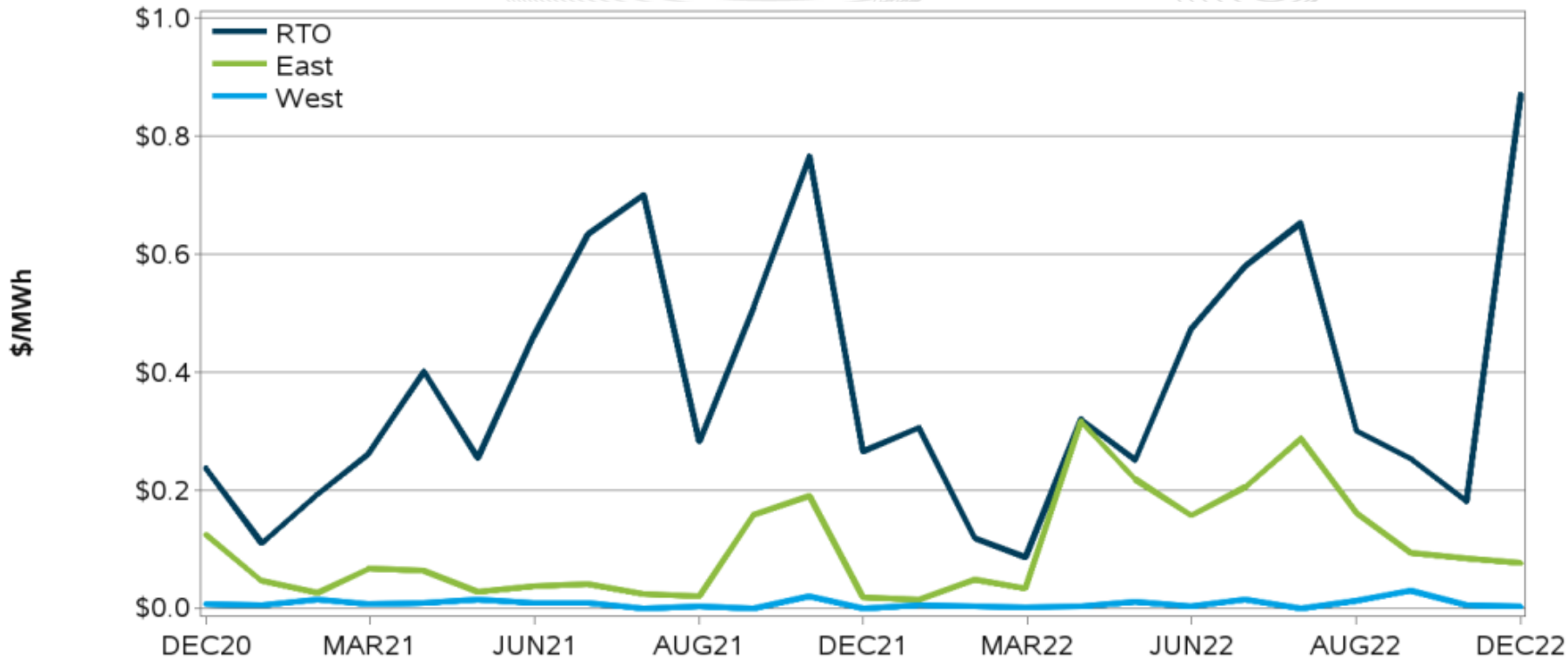
# Percent of Total CT, CC and Steam Hours with LMP < Offer



- Beginning in December 2008, the daily Balancing Operating Reserves (BOR) rate was replaced with six different BOR rates: RTO BOR for Reliability Rate, RTO BOR for Deviations Rate, East BOR for Reliability Rate, East BOR for Deviations Rate, West BOR for Reliability Rate, West BOR for Deviations Rate.
- Reliability rates are charged to all real-time load and exports, whereas deviation rates, as before, are charged only to real-time deviations. RTO rates are charged to the whole footprint, whereas East and West rate adders are charged based on location.

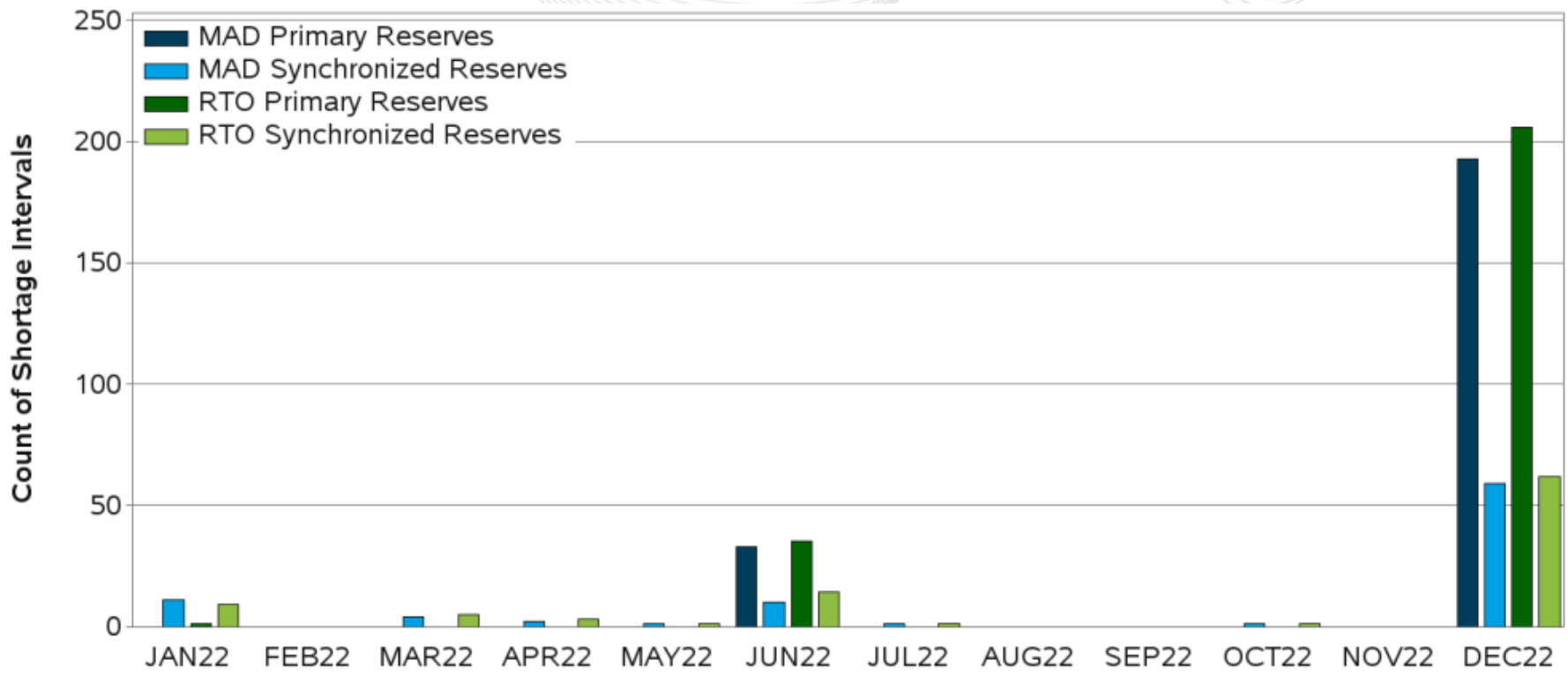


# Deviations Balancing Operating Reserve Rates



# Energy Market LMP Summary







## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	16:30 - 16:35	RTO Primary Reserves; MAD Primary Reserves	\$969.47	\$1,106.20
Friday, December 23, 2022	16:35 - 16:40	RTO Primary Reserves; MAD Primary Reserves	\$969.47	\$1,106.20
Friday, December 23, 2022	16:40 - 16:45	RTO Primary Reserves; MAD Primary Reserves	\$969.47	\$1,106.20
Friday, December 23, 2022	16:45 - 16:50	RTO Primary Reserves; MAD Primary Reserves	\$1,041.13	\$1,106.20
Friday, December 23, 2022	16:50 - 16:55	RTO Primary Reserves; MAD Primary Reserves	\$2,183.10	\$1,106.20
Friday, December 23, 2022	16:55 - 17:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.48	\$1,106.20
Friday, December 23, 2022	17:00 - 17:05	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.22	\$3,700.00
Friday, December 23, 2022	17:05 - 17:10	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.19	\$3,700.00
Friday, December 23, 2022	17:10 - 17:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,703.13	\$3,700.00
Friday, December 23, 2022	17:15 - 17:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.62	\$3,700.00
Friday, December 23, 2022	17:20 - 17:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.89	\$3,700.00



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	17:25 - 17:30	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.89	\$3,700.00
Friday, December 23, 2022	17:30 - 17:35	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.89	\$3,700.00
Friday, December 23, 2022	17:35 - 17:40	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.80	\$3,700.00
Friday, December 23, 2022	17:40 - 17:45	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.08	\$3,700.00
Friday, December 23, 2022	17:45 - 17:50	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.31	\$3,700.00
Friday, December 23, 2022	17:50 - 17:55	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.94	\$3,700.00
Friday, December 23, 2022	17:55 - 18:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.28	\$3,700.00
Friday, December 23, 2022	18:00 - 18:05	RTO Primary Reserves; MAD Primary Reserves	\$2,057.71	\$2,006.40
Friday, December 23, 2022	18:05 - 18:10	RTO Primary Reserves; MAD Primary Reserves	\$1,932.10	\$2,006.40
Friday, December 23, 2022	18:10 - 18:15	RTO Primary Reserves; MAD Primary Reserves	\$1,932.10	\$2,006.40



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	18:15 - 18:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Primary Reserves	\$2,362.56	\$2,006.40
Friday, December 23, 2022	18:20 - 18:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Primary Reserves	\$2,362.56	\$2,006.40
Friday, December 23, 2022	18:25 - 18:30	RTO Primary Reserves; MAD Primary Reserves	\$1,914.48	\$2,006.40
Friday, December 23, 2022	18:30 - 18:35	RTO Primary Reserves; MAD Primary Reserves	\$1,981.97	\$2,006.40
Friday, December 23, 2022	18:35 - 18:40	RTO Primary Reserves; MAD Primary Reserves	\$1,981.97	\$2,006.40
Friday, December 23, 2022	18:40 - 18:45	RTO Primary Reserves; MAD Primary Reserves	\$1,996.42	\$2,006.40
Friday, December 23, 2022	18:45 - 18:50	RTO Primary Reserves; MAD Primary Reserves	\$1,802.42	\$2,006.40
Friday, December 23, 2022	18:50 - 18:55	RTO Primary Reserves; MAD Primary Reserves	\$1,802.42	\$2,006.40
Friday, December 23, 2022	18:55 - 19:00	RTO Primary Reserves; MAD Primary Reserves	\$2,010.20	\$2,006.40
Friday, December 23, 2022	19:00 - 19:05	RTO Primary Reserves; MAD Primary Reserves	\$1,977.14	\$2,677.96
Friday, December 23, 2022	19:05 - 19:10	RTO Primary Reserves; MAD Primary Reserves	\$1,978.39	\$2,677.96
Friday, December 23, 2022	19:10 - 19:15	RTO Primary Reserves; MAD Primary Reserves	\$2,235.51	\$2,677.96
Friday, December 23, 2022	19:15 - 19:20	RTO Primary Reserves; MAD Primary Reserves	\$2,081.58	\$2,677.96



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	19:20 - 19:25	RTO Primary Reserves; MAD Primary Reserves	\$2,039.82	\$2,677.96
Friday, December 23, 2022	19:25 - 19:30	RTO Primary Reserves; MAD Primary Reserves	\$2,314.98	\$2,677.96
Friday, December 23, 2022	19:30 - 19:35	RTO Primary Reserves; MAD Primary Reserves	\$2,395.71	\$2,677.96
Friday, December 23, 2022	19:35 - 19:40	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.88	\$2,677.96
Friday, December 23, 2022	19:40 - 19:45	RTO Primary Reserves; MAD Primary Reserves	\$2,337.60	\$2,677.96
Friday, December 23, 2022	19:45 - 19:50	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.08	\$2,677.96
Friday, December 23, 2022	19:50 - 19:55	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.11	\$2,677.96
Friday, December 23, 2022	19:55 - 20:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.22	\$2,677.96
Friday, December 23, 2022	20:00 - 20:05	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.22	\$2,335.70
Friday, December 23, 2022	20:05 - 20:10	RTO Primary Reserves; MAD Primary Reserves	\$2,325.29	\$2,335.70
Friday, December 23, 2022	20:10 - 20:15	RTO Primary Reserves; MAD Primary Reserves	\$2,330.76	\$2,335.70



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	20:15 - 20:20	RTO Primary Reserves; MAD Primary Reserves	\$2,125.60	\$2,335.70
Friday, December 23, 2022	20:20 - 20:25	RTO Primary Reserves; MAD Primary Reserves	\$2,060.56	\$2,335.70
Friday, December 23, 2022	20:25 - 20:30	RTO Primary Reserves; MAD Primary Reserves	\$2,048.08	\$2,335.70
Friday, December 23, 2022	20:30 - 20:35	RTO Primary Reserves; MAD Primary Reserves	\$2,096.94	\$2,335.70
Friday, December 23, 2022	20:35 - 20:40	RTO Primary Reserves; MAD Primary Reserves	\$2,128.19	\$2,335.70
Friday, December 23, 2022	20:40 - 20:45	RTO Primary Reserves; MAD Primary Reserves	\$2,340.39	\$2,335.70
Friday, December 23, 2022	20:45 - 20:50	RTO Primary Reserves; MAD Primary Reserves	\$2,304.07	\$2,335.70
Friday, December 23, 2022	20:50 - 20:55	RTO Primary Reserves; MAD Primary Reserves	\$2,302.23	\$2,335.70
Friday, December 23, 2022	20:55 - 21:00	RTO Primary Reserves; MAD Primary Reserves	\$2,302.23	\$2,335.70
Friday, December 23, 2022	21:00 - 21:05	RTO Primary Reserves; MAD Primary Reserves	\$2,384.42	\$2,382.34
Friday, December 23, 2022	21:05 - 21:10	RTO Primary Reserves; MAD Primary Reserves	\$2,384.42	\$2,382.34
Friday, December 23, 2022	21:10 - 21:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.33	\$2,382.34
Friday, December 23, 2022	21:15 - 21:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.49	\$2,382.34



# Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Friday, December 23, 2022	21:20 - 21:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.49	\$2,382.34
Friday, December 23, 2022	21:25 - 21:30	RTO Primary Reserves; MAD Primary Reserves	\$1,775.86	\$2,382.34
Friday, December 23, 2022	21:30 - 21:35	RTO Primary Reserves; MAD Primary Reserves	\$1,887.05	\$2,382.34
Friday, December 23, 2022	21:35 - 21:40	RTO Primary Reserves; MAD Primary Reserves	\$1,877.57	\$2,382.34
Friday, December 23, 2022	21:40 - 21:45	RTO Primary Reserves; MAD Primary Reserves	\$1,781.40	\$2,382.34
Friday, December 23, 2022	21:45 - 21:50	RTO Primary Reserves; MAD Primary Reserves	\$1,786.45	\$2,382.34
Friday, December 23, 2022	21:50 - 21:55	RTO Primary Reserves; MAD Primary Reserves	\$1,818.67	\$2,382.34
Friday, December 23, 2022	21:55 - 22:00	RTO Primary Reserves; MAD Primary Reserves	\$1,816.93	\$2,382.34
Friday, December 23, 2022	22:00 - 22:05	RTO Primary Reserves; MAD Primary Reserves	\$1,770.96	\$717.53
Friday, December 23, 2022	22:05 - 22:10	RTO Primary Reserves; MAD Primary Reserves	\$1,690.47	\$717.53
Friday, December 23, 2022	22:10 - 22:15	RTO Primary Reserves	\$675.08	\$717.53
Friday, December 23, 2022	22:30 - 22:35	RTO Primary Reserves	\$629.27	\$717.53
Friday, December 23, 2022	22:45 - 22:50	RTO Primary Reserves	\$544.86	\$717.53



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	0:15 - 0:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$2,246.55	\$1,931.54
Saturday, December 24, 2022	0:20 - 0:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.37	\$1,931.54
Saturday, December 24, 2022	0:25 - 0:30	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,384.23	\$1,931.54
Saturday, December 24, 2022	0:30 - 0:35	RTO Primary Reserves; MAD Primary Reserves	\$2,371.60	\$1,931.54
Saturday, December 24, 2022	0:35 - 0:40	RTO Primary Reserves; MAD Primary Reserves	\$1,257.26	\$1,931.54
Saturday, December 24, 2022	0:50 - 0:55	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$1,768.21	\$1,931.54
Saturday, December 24, 2022	0:55 - 1:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$2,069.68	\$1,931.54
Saturday, December 24, 2022	1:55 - 2:00	RTO Primary Reserves; MAD Primary Reserves	\$1,150.55	\$1,378.57
Saturday, December 24, 2022	2:00 - 2:05	RTO Primary Reserves; MAD Primary Reserves	\$1,755.01	\$2,832.61
Saturday, December 24, 2022	2:05 - 2:10	RTO Primary Reserves; MAD Primary Reserves	\$1,755.01	\$2,832.61
Saturday, December 24, 2022	2:10 - 2:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$1,739.87	\$2,832.61





## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	2:15 - 2:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.19	\$2,832.61
Saturday, December 24, 2022	2:20 - 2:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.97	\$2,832.61
Saturday, December 24, 2022	2:25 - 2:30	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.95	\$2,832.61
Saturday, December 24, 2022	2:30 - 2:35	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.21	\$2,832.61
Saturday, December 24, 2022	2:35 - 2:40	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.72	\$2,832.61
Saturday, December 24, 2022	2:40 - 2:45	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.94	\$2,832.61
Saturday, December 24, 2022	2:45 - 2:50	RTO Primary Reserves; MAD Primary Reserves	\$1,755.95	\$2,832.61
Saturday, December 24, 2022	2:50 - 2:55	RTO Primary Reserves; MAD Primary Reserves	\$1,100.63	\$2,832.61
Saturday, December 24, 2022	2:55 - 3:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.00	\$2,832.61
Saturday, December 24, 2022	3:00 - 3:05	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.15	\$3,179.56



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	3:05 - 3:10	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.02	\$3,179.56
Saturday, December 24, 2022	3:10 - 3:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,704.42	\$3,179.56
Saturday, December 24, 2022	3:15 - 3:20	RTO Primary Reserves; MAD Primary Reserves	\$2,516.47	\$3,179.56
Saturday, December 24, 2022	3:20 - 3:25	RTO Primary Reserves; MAD Primary Reserves	\$2,575.06	\$3,179.56
Saturday, December 24, 2022	3:25 - 3:30	RTO Primary Reserves; MAD Primary Reserves	\$2,599.58	\$3,179.56
Saturday, December 24, 2022	3:30 - 3:35	RTO Primary Reserves; MAD Primary Reserves	\$2,602.40	\$3,179.56
Saturday, December 24, 2022	3:35 - 3:40	RTO Primary Reserves; MAD Primary Reserves	\$2,388.14	\$3,179.56
Saturday, December 24, 2022	3:40 - 3:45	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.10	\$3,179.56
Saturday, December 24, 2022	3:45 - 3:50	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.10	\$3,179.56
Saturday, December 24, 2022	3:50 - 3:55	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,295.63	\$3,179.56
Saturday, December 24, 2022	3:55 - 4:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.18	\$3,179.56



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	4:00 - 4:05	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.83	\$3,659.69
Saturday, December 24, 2022	4:05 - 4:10	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.16	\$3,659.69
Saturday, December 24, 2022	4:10 - 4:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.79	\$3,659.69
Saturday, December 24, 2022	4:15 - 4:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.44	\$3,659.69
Saturday, December 24, 2022	4:20 - 4:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.48	\$3,659.69
Saturday, December 24, 2022	4:25 - 4:30	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.48	\$3,659.69
Saturday, December 24, 2022	4:30 - 4:35	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.48	\$3,659.69
Saturday, December 24, 2022	4:35 - 4:40	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.92	\$3,659.69
Saturday, December 24, 2022	4:40 - 4:45	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,708.04	\$3,659.69



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	4:45 - 4:50	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.96	\$3,659.69
Saturday, December 24, 2022	4:50 - 4:55	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,222.74	\$3,659.69
Saturday, December 24, 2022	4:55 - 5:00	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,707.89	\$3,659.69
Saturday, December 24, 2022	5:00 - 5:05	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.11	\$2,866.59
Saturday, December 24, 2022	5:05 - 5:10	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.23	\$2,866.59
Saturday, December 24, 2022	5:10 - 5:15	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,685.74	\$2,866.59
Saturday, December 24, 2022	5:15 - 5:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,705.75	\$2,866.59
Saturday, December 24, 2022	5:20 - 5:25	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,706.75	\$2,866.59
Saturday, December 24, 2022	5:25 - 5:30	RTO Primary Reserves; MAD Primary Reserves	\$2,249.80	\$2,866.59
Saturday, December 24, 2022	5:30 - 5:35	RTO Primary Reserves; MAD Primary Reserves	\$1,925.19	\$2,866.59



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	5:35 - 5:40	RTO Primary Reserves; MAD Primary Reserves	\$2,145.68	\$2,866.59
Saturday, December 24, 2022	5:40 - 5:45	RTO Synchronized Reserves; RTO Primary Reserves; MAD Primary Reserves	\$2,632.02	\$2,866.59
Saturday, December 24, 2022	5:45 - 5:50	RTO Primary Reserves; MAD Primary Reserves	\$2,429.45	\$2,866.59
Saturday, December 24, 2022	5:50 - 5:55	RTO Primary Reserves; MAD Primary Reserves	\$2,429.45	\$2,866.59
Saturday, December 24, 2022	5:55 - 6:00	RTO Primary Reserves; MAD Primary Reserves	\$2,139.37	\$2,866.59
Saturday, December 24, 2022	6:00 - 6:05	RTO Primary Reserves; MAD Primary Reserves	\$1,100.00	\$1,177.99
Saturday, December 24, 2022	6:05 - 6:10	RTO Primary Reserves; MAD Primary Reserves	\$1,170.50	\$1,177.99
Saturday, December 24, 2022	6:10 - 6:15	RTO Primary Reserves; MAD Primary Reserves	\$752.38	\$1,177.99
Saturday, December 24, 2022	6:15 - 6:20	RTO Primary Reserves; MAD Primary Reserves	\$1,085.36	\$1,177.99
Saturday, December 24, 2022	6:20 - 6:25	RTO Primary Reserves; MAD Primary Reserves	\$1,791.29	\$1,177.99
Saturday, December 24, 2022	6:25 - 6:30	RTO Primary Reserves; MAD Primary Reserves	\$1,791.01	\$1,177.99
Saturday, December 24, 2022	6:30 - 6:35	RTO Primary Reserves; MAD Primary Reserves	\$1,638.63	\$1,177.99
Saturday, December 24, 2022	6:35 - 6:40	RTO Primary Reserves; MAD Primary Reserves	\$1,050.71	\$1,177.99



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	6:40 - 6:45	RTO Primary Reserves; MAD Primary Reserves	\$1,088.01	\$1,177.99
Saturday, December 24, 2022	6:45 - 6:50	RTO Primary Reserves; MAD Primary Reserves	\$1,035.54	\$1,177.99
Saturday, December 24, 2022	6:50 - 6:55	RTO Primary Reserves; MAD Primary Reserves	\$801.26	\$1,177.99
Saturday, December 24, 2022	6:55 - 7:00	RTO Primary Reserves; MAD Primary Reserves	\$869.06	\$1,177.99
Saturday, December 24, 2022	7:00 - 7:05	RTO Primary Reserves; MAD Primary Reserves	\$992.78	\$1,794.75
Saturday, December 24, 2022	7:05 - 7:10	RTO Primary Reserves; MAD Primary Reserves	\$1,250.98	\$1,794.75
Saturday, December 24, 2022	7:10 - 7:15	RTO Primary Reserves; MAD Primary Reserves	\$1,756.04	\$1,794.75
Saturday, December 24, 2022	7:15 - 7:20	RTO Primary Reserves; MAD Primary Reserves	\$1,841.30	\$1,794.75
Saturday, December 24, 2022	7:20 - 7:25	RTO Primary Reserves; MAD Primary Reserves	\$1,863.83	\$1,794.75
Saturday, December 24, 2022	7:25 - 7:30	RTO Primary Reserves; MAD Primary Reserves	\$1,863.83	\$1,794.75
Saturday, December 24, 2022	7:30 - 7:35	RTO Primary Reserves; MAD Primary Reserves	\$1,863.83	\$1,794.75
Saturday, December 24, 2022	7:35 - 7:40	RTO Primary Reserves; MAD Primary Reserves	\$2,040.90	\$1,794.75
Saturday, December 24, 2022	7:40 - 7:45	RTO Primary Reserves; MAD Primary Reserves	\$1,842.95	\$1,794.75
Saturday, December 24, 2022	7:45 - 7:50	RTO Primary Reserves; MAD Primary Reserves	\$1,986.90	\$1,794.75



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	7:50 - 7:55	RTO Primary Reserves; MAD Primary Reserves	\$2,159.82	\$1,794.75
Saturday, December 24, 2022	7:55 - 8:00	RTO Primary Reserves; MAD Primary Reserves	\$2,123.34	\$1,794.75
Saturday, December 24, 2022	8:00 - 8:05	RTO Primary Reserves; MAD Primary Reserves	\$2,021.03	\$2,085.34
Saturday, December 24, 2022	8:05 - 8:10	RTO Primary Reserves; MAD Primary Reserves	\$2,592.18	\$2,085.34
Saturday, December 24, 2022	8:10 - 8:15	RTO Primary Reserves; MAD Primary Reserves	\$3,471.69	\$2,085.34
Saturday, December 24, 2022	8:15 - 8:20	RTO Primary Reserves; MAD Primary Reserves	\$3,094.56	\$2,085.34
Saturday, December 24, 2022	8:20 - 8:25	RTO Primary Reserves; MAD Primary Reserves	\$1,996.35	\$2,085.34
Saturday, December 24, 2022	8:25 - 8:30	RTO Primary Reserves; MAD Primary Reserves	\$2,194.59	\$2,085.34
Saturday, December 24, 2022	8:30 - 8:35	RTO Primary Reserves; MAD Primary Reserves	\$1,911.30	\$2,085.34
Saturday, December 24, 2022	8:35 - 8:40	RTO Primary Reserves; MAD Primary Reserves	\$1,783.22	\$2,085.34
Saturday, December 24, 2022	8:40 - 8:45	RTO Primary Reserves; MAD Primary Reserves	\$1,700.67	\$2,085.34
Saturday, December 24, 2022	8:45 - 8:50	RTO Primary Reserves; MAD Primary Reserves	\$1,399.14	\$2,085.34
Saturday, December 24, 2022	8:50 - 8:55	RTO Primary Reserves; MAD Primary Reserves	\$1,454.92	\$2,085.34
Saturday, December 24, 2022	8:55 - 9:00	RTO Primary Reserves; MAD Primary Reserves	\$1,463.89	\$2,085.34



## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	9:00 - 9:05	RTO Primary Reserves; MAD Primary Reserves	\$1,718.72	\$1,326.09
Saturday, December 24, 2022	9:05 - 9:10	RTO Primary Reserves; MAD Primary Reserves	\$2,107.13	\$1,326.09
Saturday, December 24, 2022	9:10 - 9:15	RTO Primary Reserves; MAD Primary Reserves	\$2,022.81	\$1,326.09
Saturday, December 24, 2022	9:15 - 9:20	RTO Primary Reserves; MAD Primary Reserves	\$1,740.06	\$1,326.09
Saturday, December 24, 2022	9:20 - 9:25	RTO Primary Reserves; MAD Primary Reserves	\$1,317.87	\$1,326.09
Saturday, December 24, 2022	9:25 - 9:30	RTO Primary Reserves; MAD Primary Reserves	\$1,082.76	\$1,326.09
Saturday, December 24, 2022	9:30 - 9:35	RTO Primary Reserves; MAD Primary Reserves	\$1,039.92	\$1,326.09
Saturday, December 24, 2022	9:35 - 9:40	RTO Primary Reserves	\$988.33	\$1,326.09
Saturday, December 24, 2022	9:40 - 9:45	RTO Primary Reserves; MAD Primary Reserves	\$1,092.20	\$1,326.09
Saturday, December 24, 2022	9:45 - 9:50	RTO Primary Reserves; MAD Primary Reserves	\$932.01	\$1,326.09
Saturday, December 24, 2022	9:50 - 9:55	RTO Primary Reserves; MAD Primary Reserves	\$925.37	\$1,326.09
Saturday, December 24, 2022	9:55 - 10:00	RTO Primary Reserves; MAD Primary Reserves	\$980.55	\$1,326.09
Saturday, December 24, 2022	10:00 - 10:05	RTO Primary Reserves; MAD Primary Reserves	\$1,083.68	\$954.41
Saturday, December 24, 2022	10:05 - 10:10	RTO Primary Reserves; MAD Primary Reserves	\$1,080.54	\$954.41





## Shortage Pricing - December

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	10:10 - 10:15	RTO Primary Reserves; MAD Primary Reserves	\$1,090.57	\$954.41
Saturday, December 24, 2022	10:15 - 10:20	RTO Primary Reserves; MAD Primary Reserves	\$994.20	\$954.41
Saturday, December 24, 2022	10:20 - 10:25	RTO Primary Reserves; MAD Primary Reserves	\$784.06	\$954.41
Saturday, December 24, 2022	10:25 - 10:30	RTO Primary Reserves; MAD Primary Reserves	\$785.99	\$954.41
Saturday, December 24, 2022	10:30 - 10:35	RTO Primary Reserves	\$695.90	\$954.41
Saturday, December 24, 2022	10:35 - 10:40	RTO Primary Reserves; MAD Primary Reserves	\$773.40	\$954.41
Saturday, December 24, 2022	10:40 - 10:45	RTO Primary Reserves; MAD Primary Reserves	\$1,027.14	\$954.41
Saturday, December 24, 2022	10:45 - 10:50	RTO Primary Reserves; MAD Primary Reserves	\$1,041.46	\$954.41
Saturday, December 24, 2022	10:50 - 10:55	RTO Primary Reserves; MAD Primary Reserves	\$1,046.27	\$954.41
Saturday, December 24, 2022	10:55 - 11:00	RTO Primary Reserves; MAD Primary Reserves	\$1,078.73	\$954.41
Saturday, December 24, 2022	11:00 - 11:05	RTO Primary Reserves; MAD Primary Reserves	\$1,053.20	\$844.16
Saturday, December 24, 2022	11:05 - 11:10	RTO Primary Reserves; MAD Primary Reserves	\$1,045.50	\$844.16
Saturday, December 24, 2022	11:10 - 11:15	RTO Primary Reserves; MAD Primary Reserves	\$1,052.53	\$844.16
Saturday, December 24, 2022	11:15 - 11:20	RTO Primary Reserves; MAD Primary Reserves	\$847.21	\$844.16



## Shortage Pricing - December

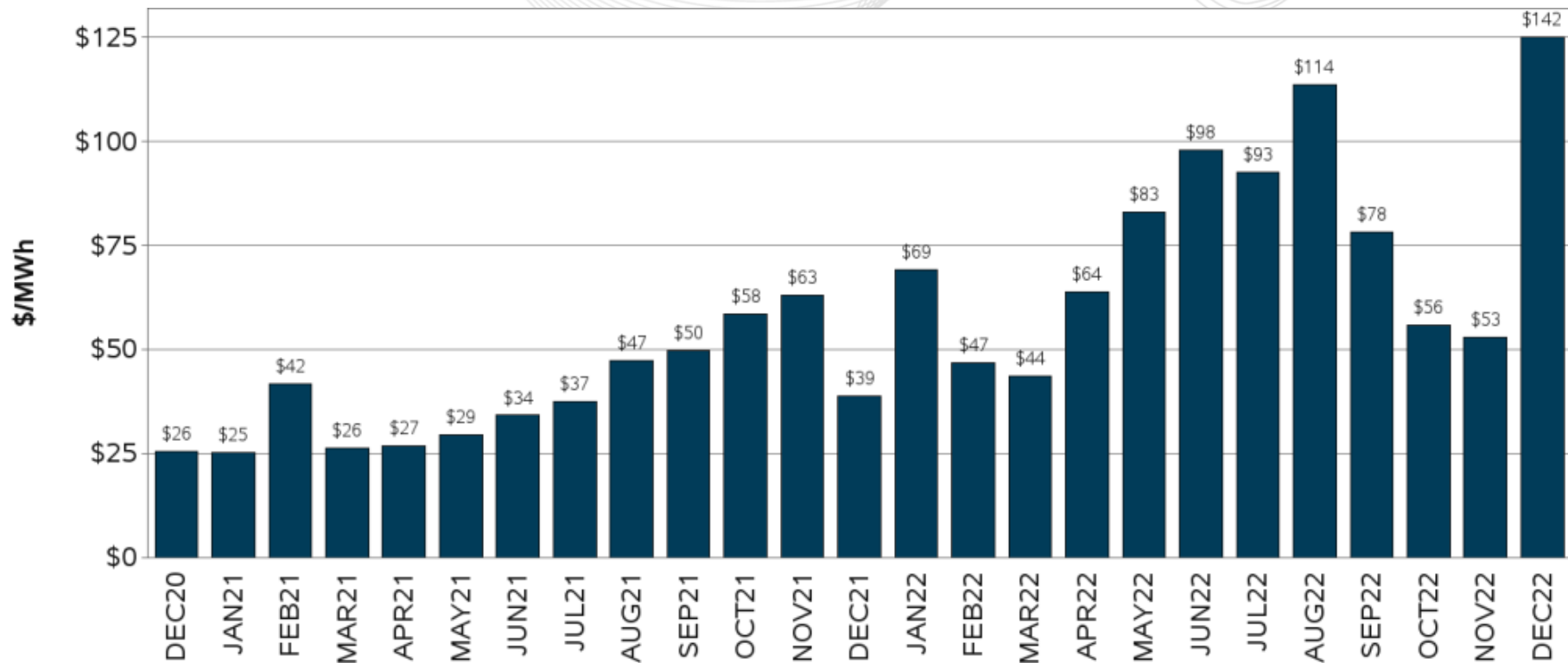
Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Saturday, December 24, 2022	11:20 - 11:25	RTO Primary Reserves; MAD Primary Reserves	\$760.13	\$844.16
Saturday, December 24, 2022	11:25 - 11:30	RTO Primary Reserves; MAD Primary Reserves	\$852.99	\$844.16
Saturday, December 24, 2022	11:30 - 11:35	RTO Primary Reserves; MAD Primary Reserves	\$857.98	\$844.16
Saturday, December 24, 2022	11:35 - 11:40	RTO Primary Reserves	\$735.22	\$844.16
Saturday, December 24, 2022	11:40 - 11:45	RTO Primary Reserves; MAD Primary Reserves	\$772.13	\$844.16
Saturday, December 24, 2022	11:45 - 11:50	RTO Primary Reserves	\$766.79	\$844.16
Saturday, December 24, 2022	11:50 - 11:55	RTO Primary Reserves	\$627.71	\$844.16
Saturday, December 24, 2022	11:55 - 12:00	RTO Primary Reserves	\$787.14	\$844.16
Saturday, December 24, 2022	12:00 - 12:05	RTO Primary Reserves	\$888.71	\$506.00
Saturday, December 24, 2022	12:05 - 12:10	RTO Primary Reserves; MAD Primary Reserves	\$804.30	\$506.00
Saturday, December 24, 2022	12:10 - 12:15	RTO Primary Reserves	\$612.84	\$506.00
Saturday, December 24, 2022	12:15 - 12:20	RTO Primary Reserves	\$750.54	\$506.00
Saturday, December 24, 2022	16:00 - 16:05	RTO Primary Reserves	\$954.63	\$618.63
Saturday, December 24, 2022	16:15 - 16:20	RTO Primary Reserves	\$676.06	\$618.63

Date	5-Minute Interval	Reserve Penalty Factors	5-Minute Interval SMP	Hourly Integrated SMP
Sunday, December 25, 2022	4:35 - 4:40	MAD Primary Reserves	\$345.05	\$180.29
Monday, December 26, 2022	0:15 - 0:20	RTO Synchronized Reserves; RTO Primary Reserves; MAD Synchronized Reserves; MAD Primary Reserves	\$3,703.36	\$552.51

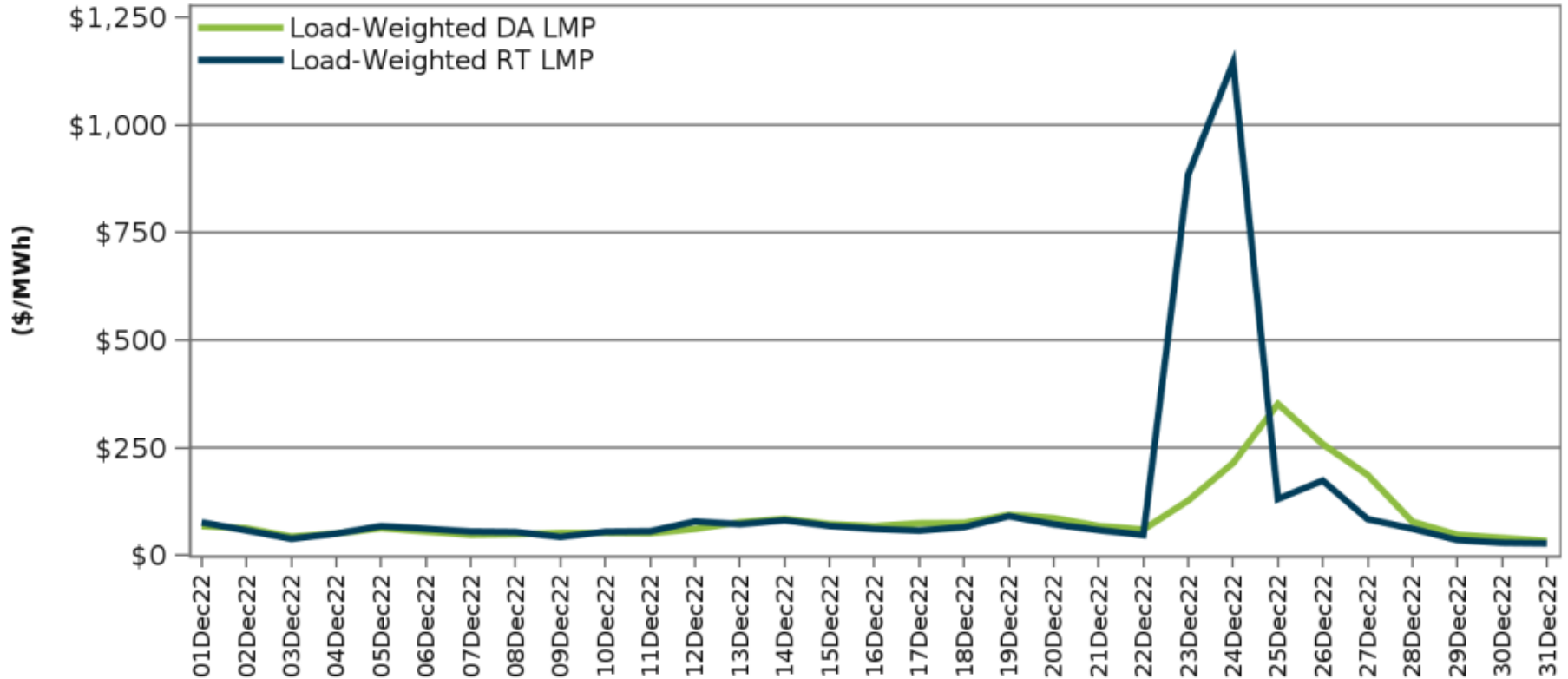
Information on constraints and shadow prices can be found here:

[http://dataminer2.pjm.com/feed/rt\\_marginal\\_value](http://dataminer2.pjm.com/feed/rt_marginal_value)

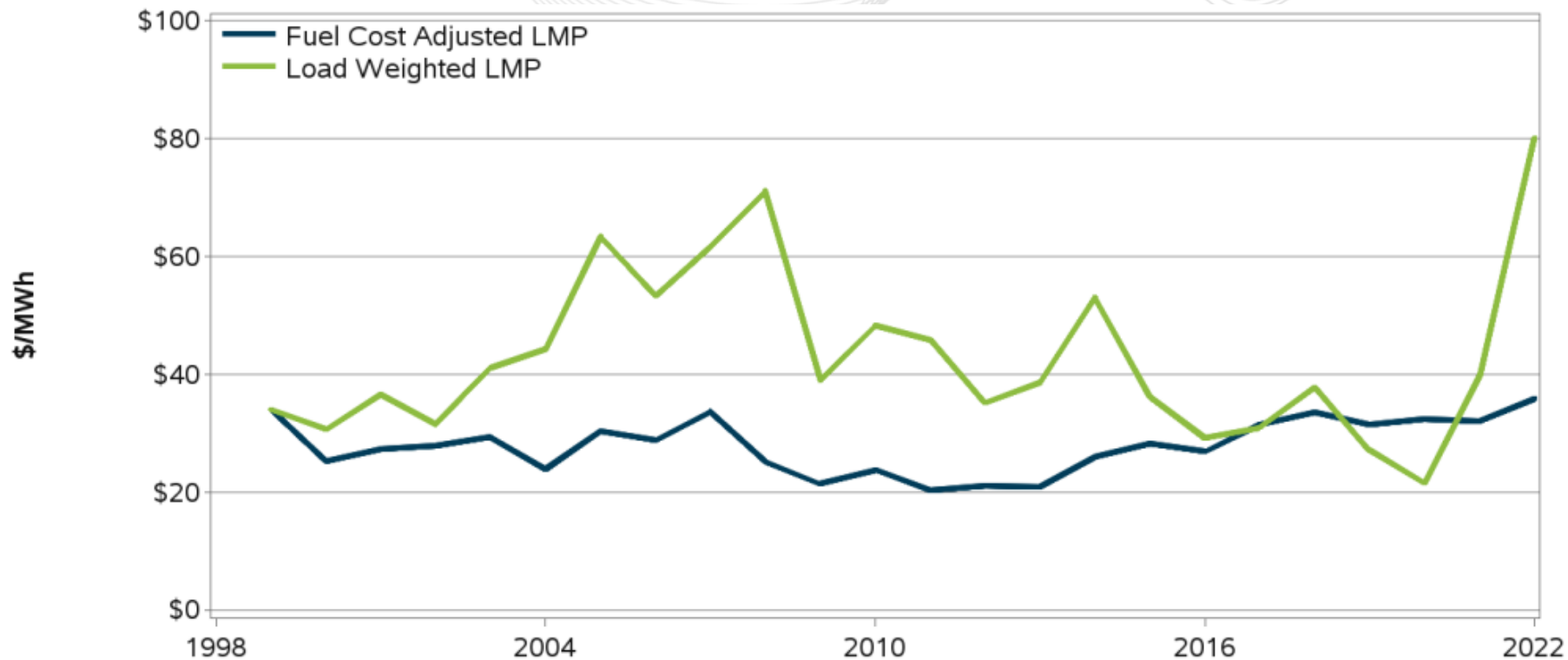
# Monthly Load-Weighted Average Real-time LMP

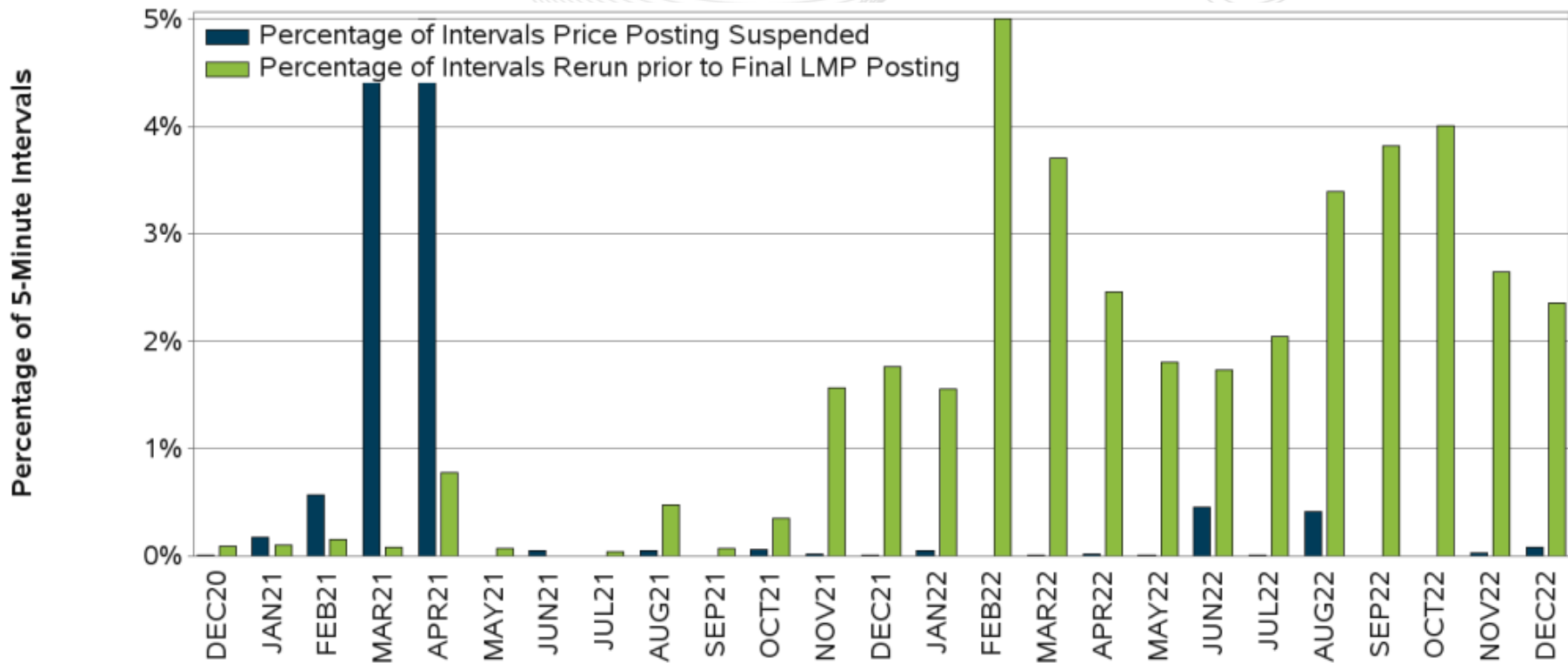


# Daily Load-Weighted Average DA & RT LMP



# Fuel Cost Adjusted LMP (Referenced to 1999 Fuel Prices)





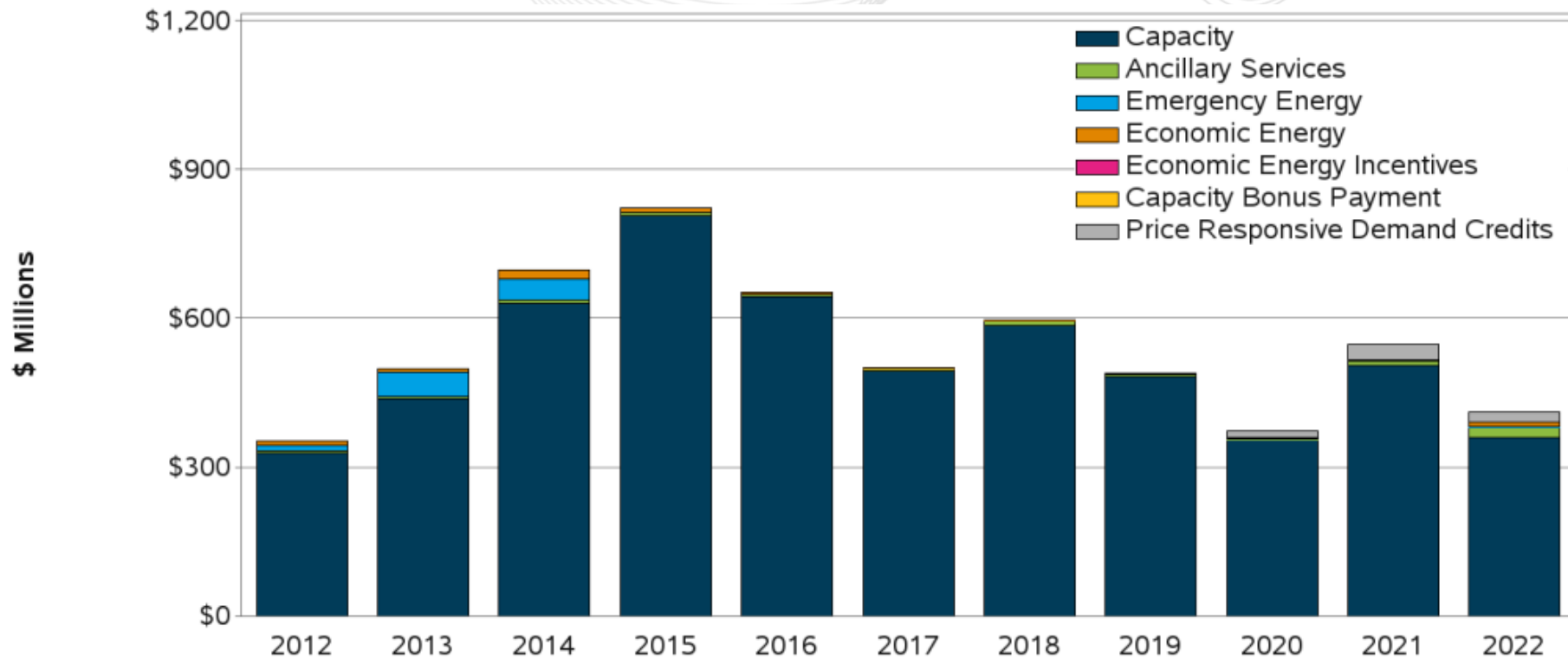
Spikes seen in March and April 2021 are incorrect and due to a software bug which has since been fixed.

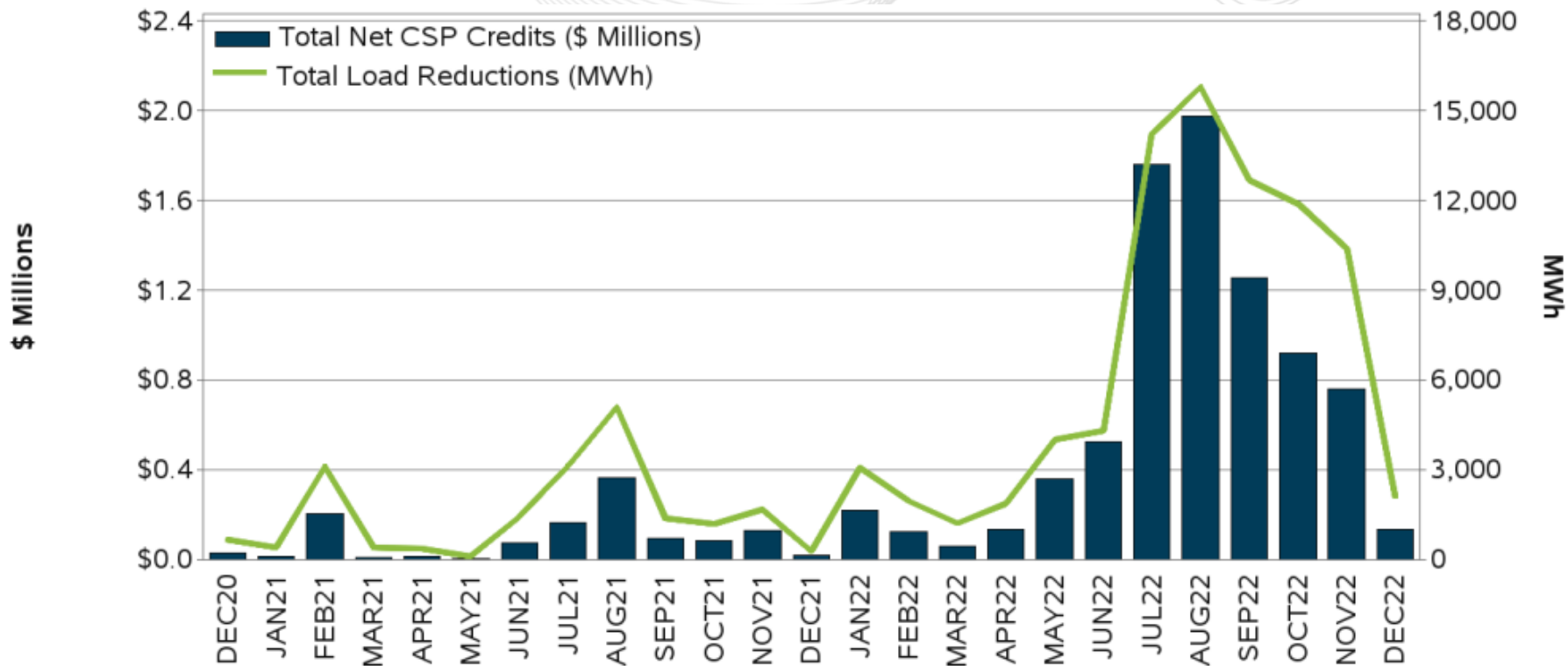
# Energy Market

# Demand Response Summary



# Demand Side Response Estimated Revenue

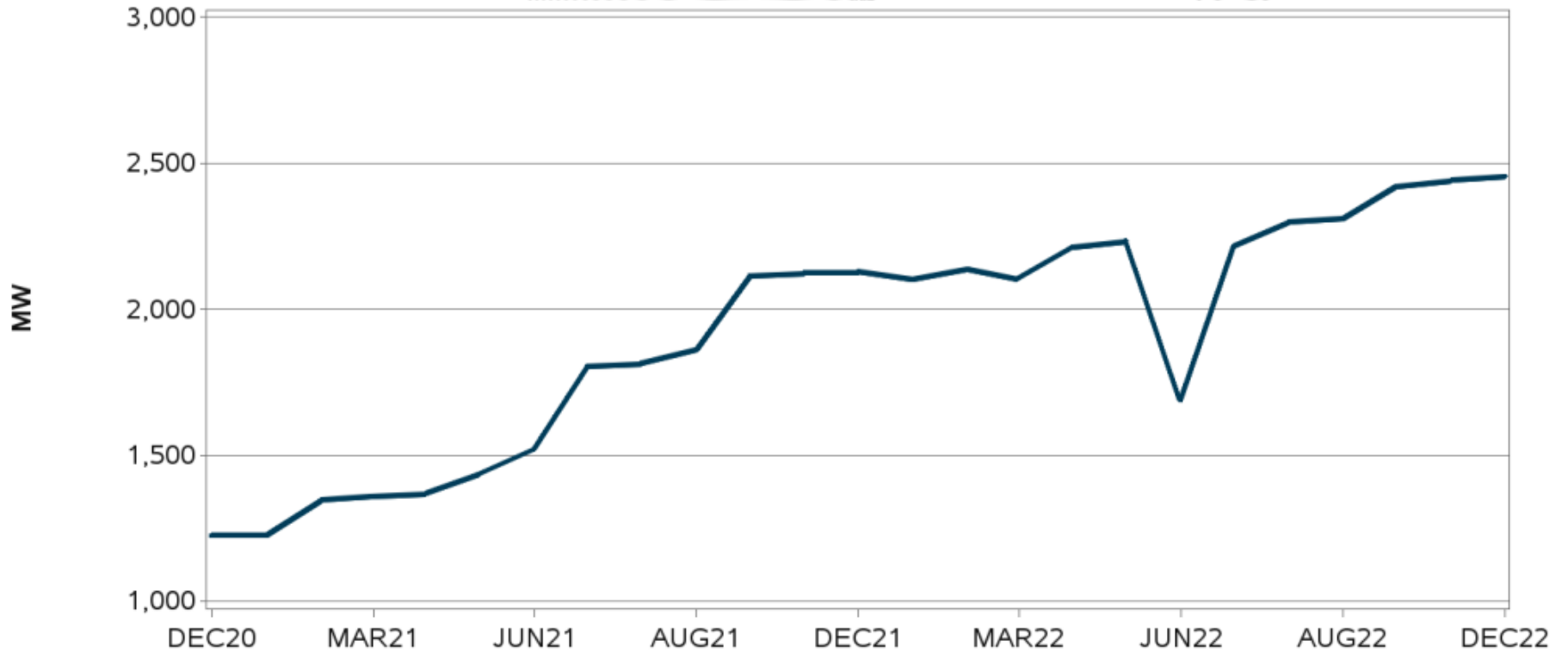




\*Data for the last few months are subject to significant change due to the settlement window.



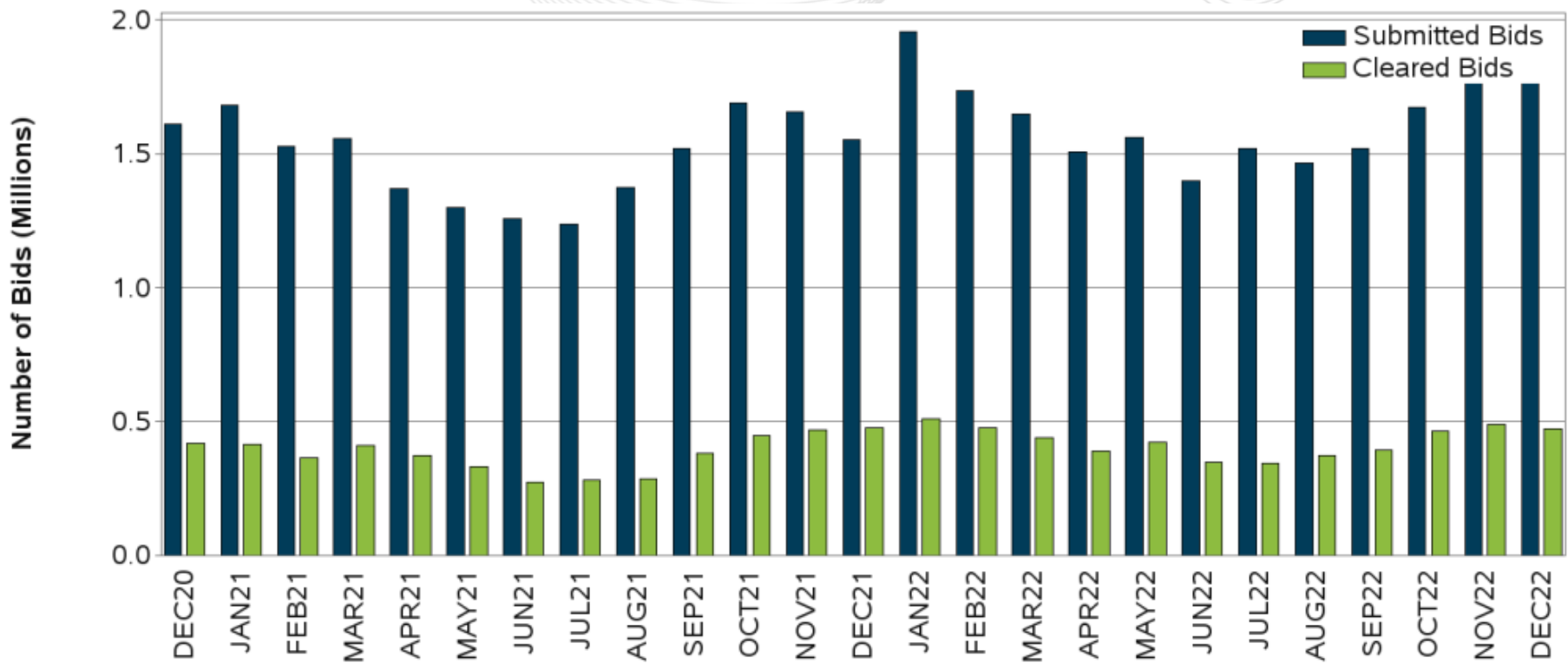
# Total Registered MW in PJM's Economic Demand Response



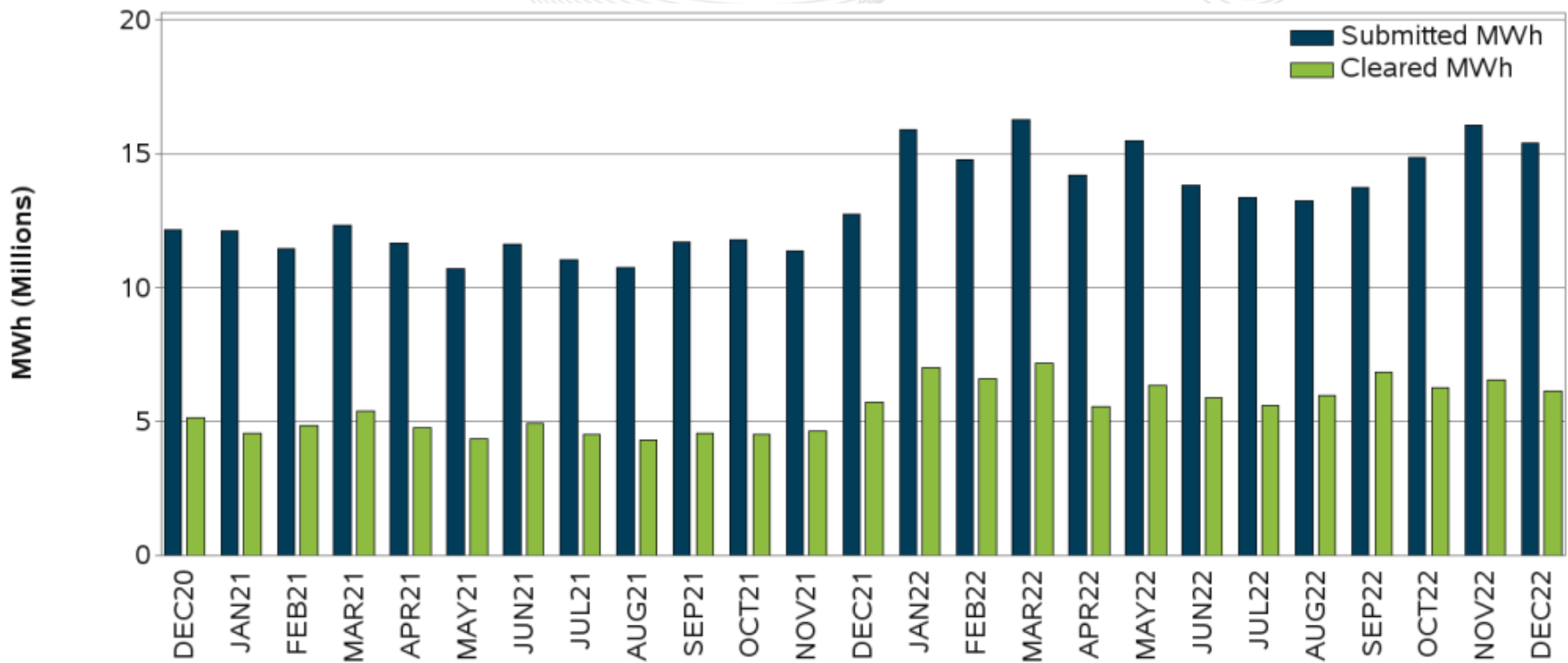
# Energy Market

## Virtual Activity Summary

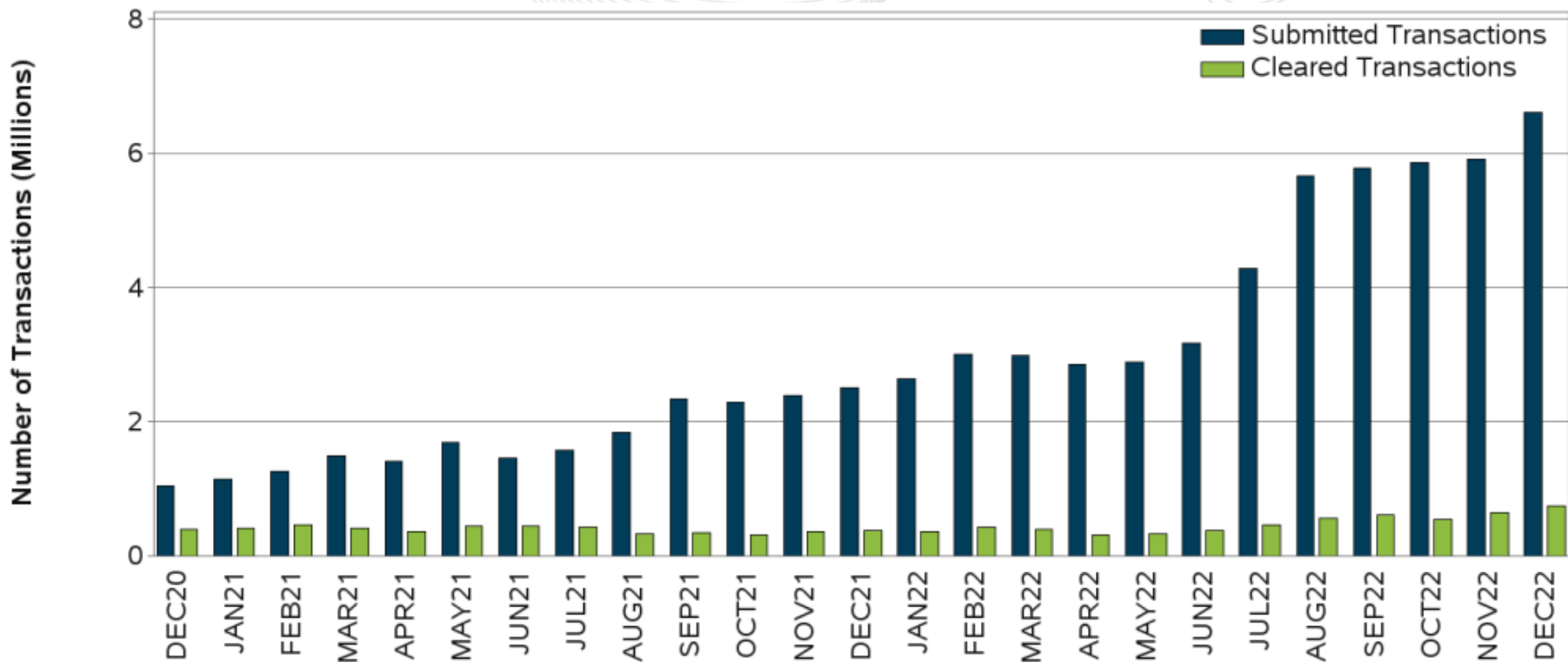
- The following six charts depict trends in submitted and cleared virtual and up-to-congestion transactions, in terms of number and volume, into the PJM Energy Market. The first two of these charts show the submitted and cleared increment and decrement bids (virtual transactions or virtuals) and they are the same as what was previously being presented in this report. The two charts after them display the trends in submitted and cleared up-to-congestion transactions into the PJM Energy Market. The last two of these six charts combine the virtual and up-to-congestion transactions and show the sum of these two categories.
- To clarify what a bid or transaction is, please consider the following example: An offer (increment, decrement or up-to-congestion) of 10 MW, valid for eight hours for a given day, is captured in the charts as eight submitted bids/transactions and 80 submitted MWh. If this offer fully clears for three of the hours it was submitted for, it shows in the charts as three cleared bids/transactions and 30 cleared MWh.



# Virtual Bids (INCs & DECs) - Total Volume

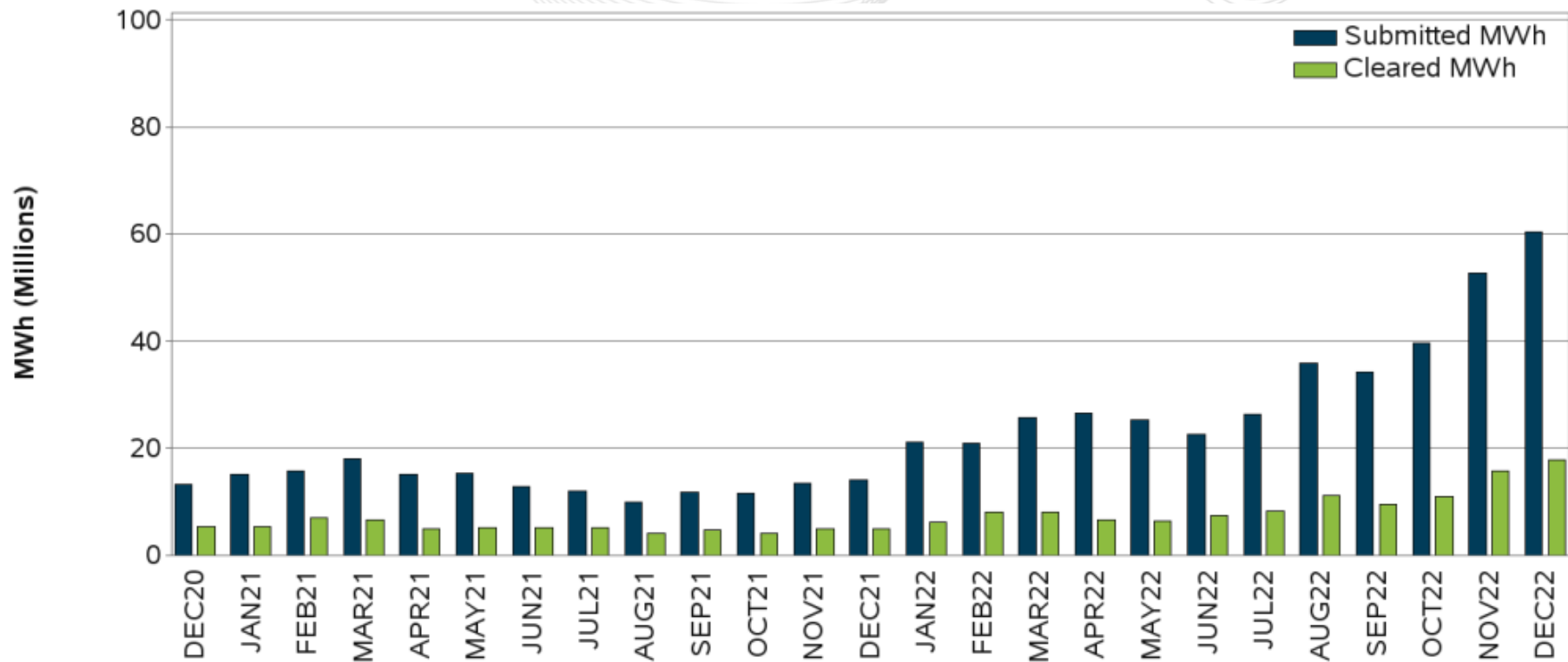


# Up-To-Congestion Transactions - Total Number

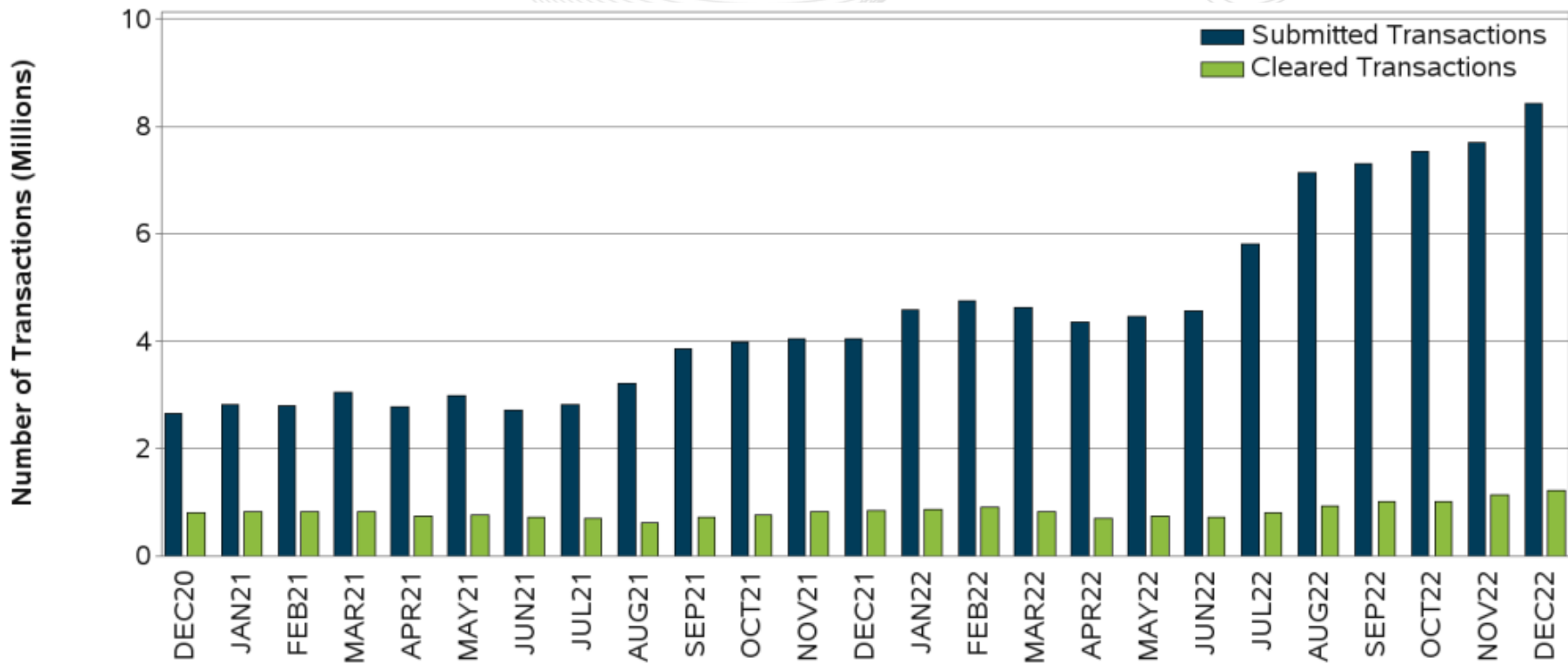




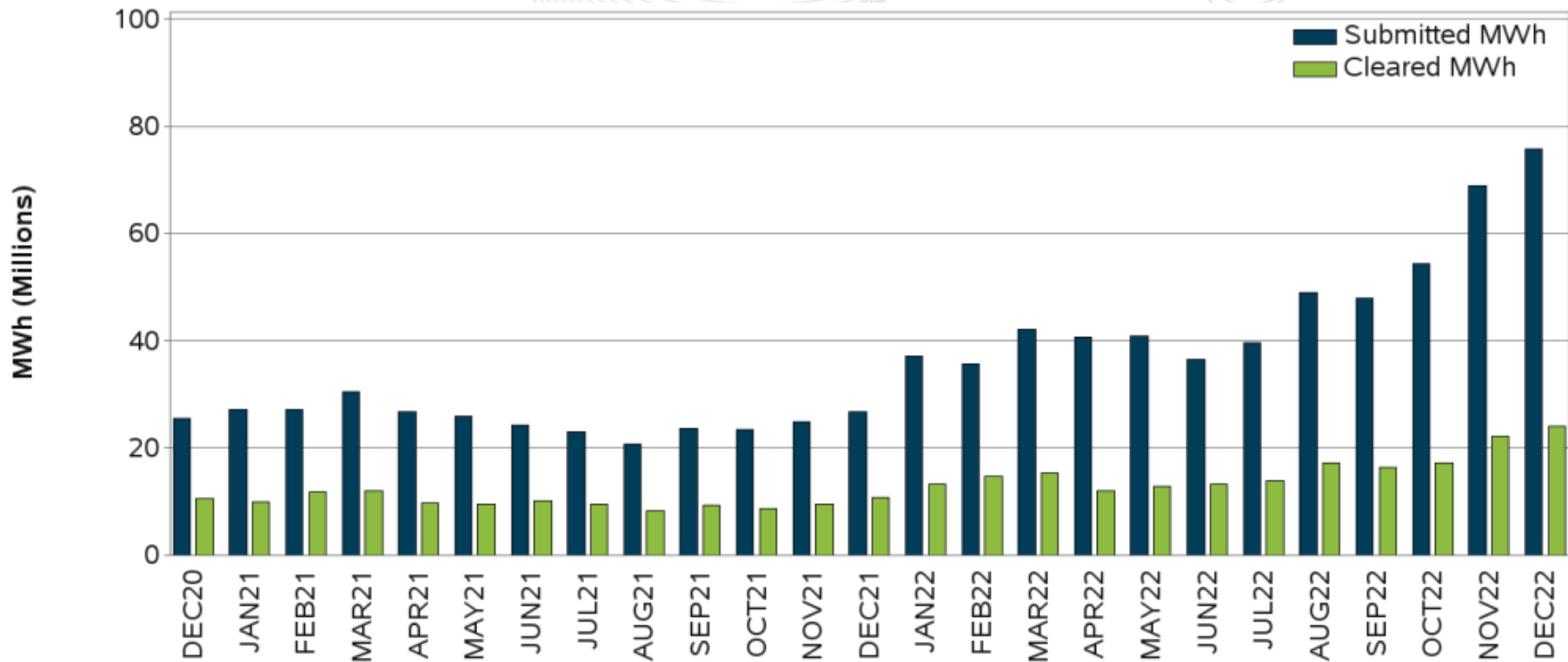
# Up-To-Congestion Transactions - Total Volume



# INCs, DEC and Up-To-Congestion Transactions - Total Number



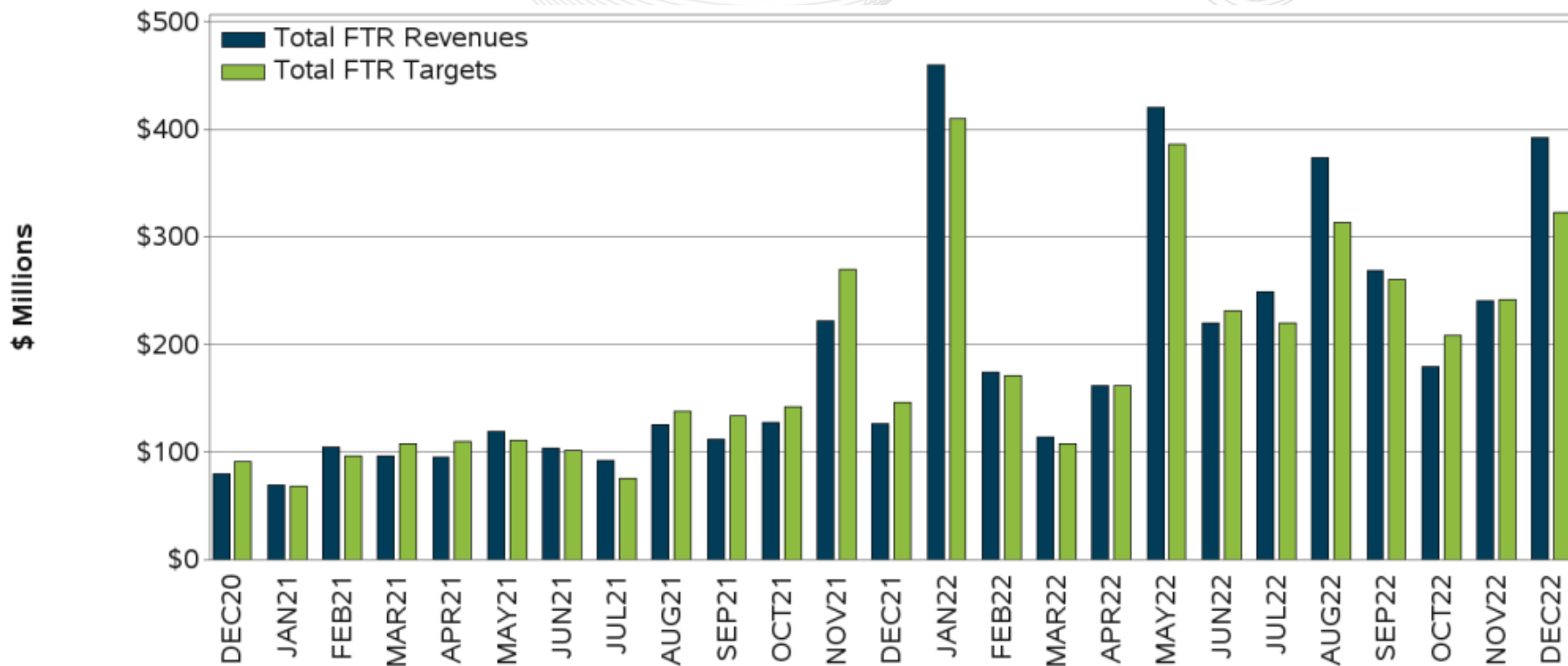
# INCs, DEC and Up-To-Congestion Transactions - Total Volume

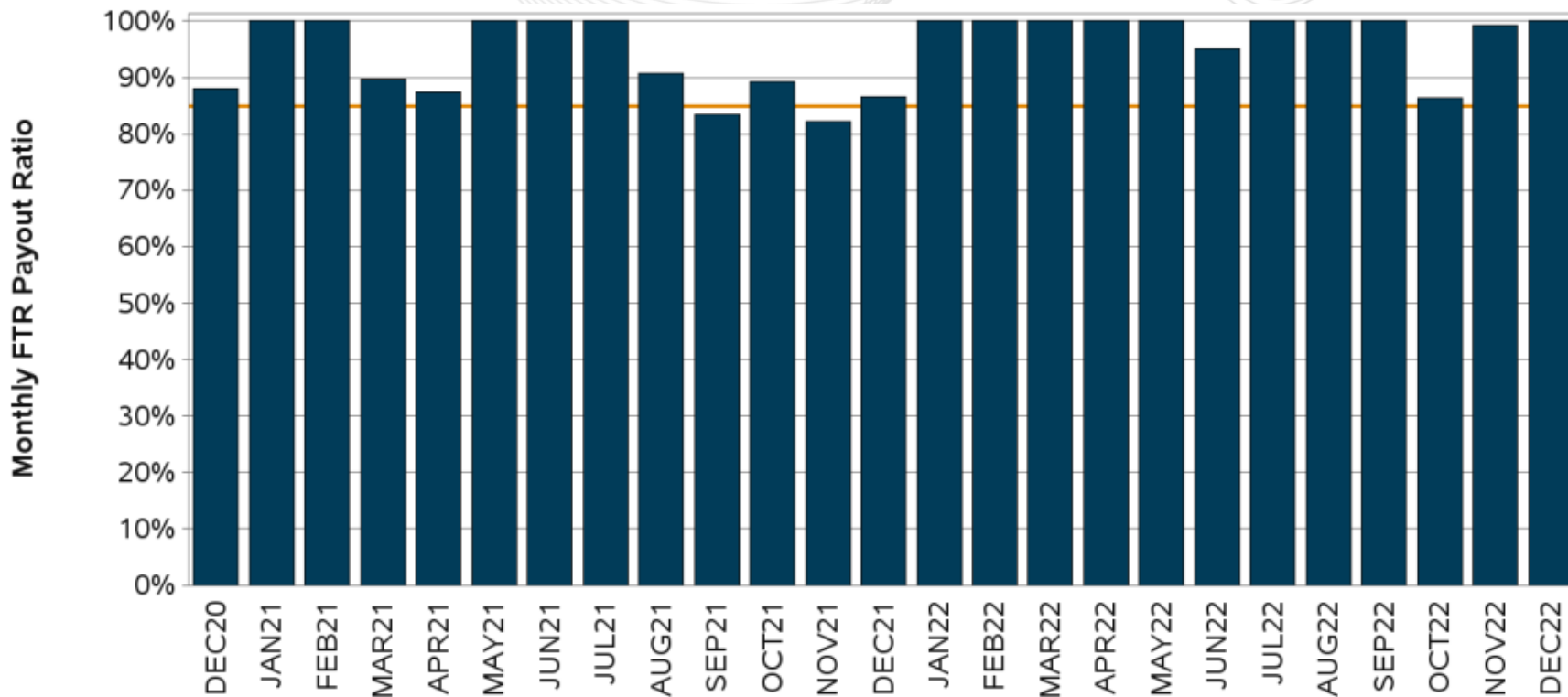


# Energy Market

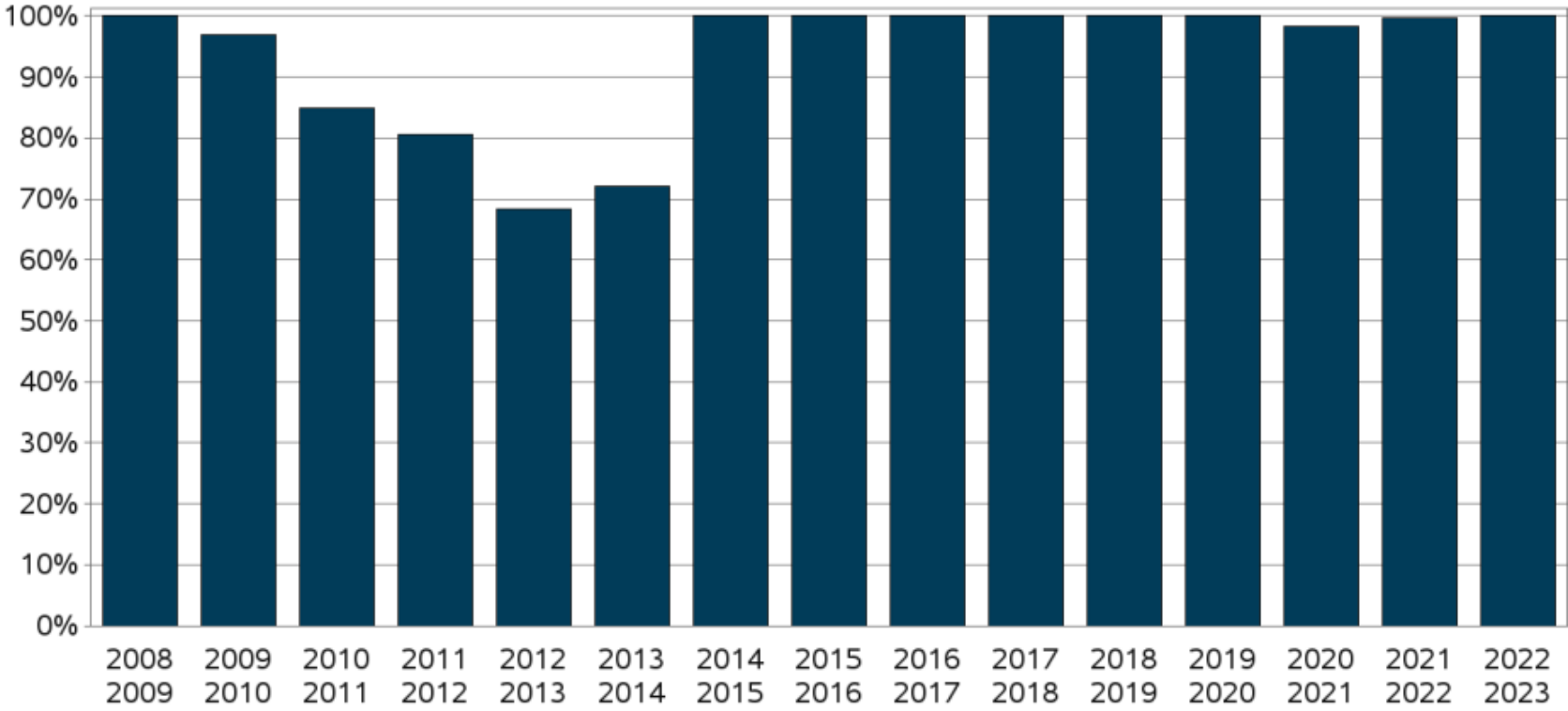
# Congestion and FTR Summary

Period	Surplus / Underfunding	Payout Ratio
December 2022	\$69,667,251	100%
2022	\$227,650,711	100%
2022/2023	\$133,544,690	100%





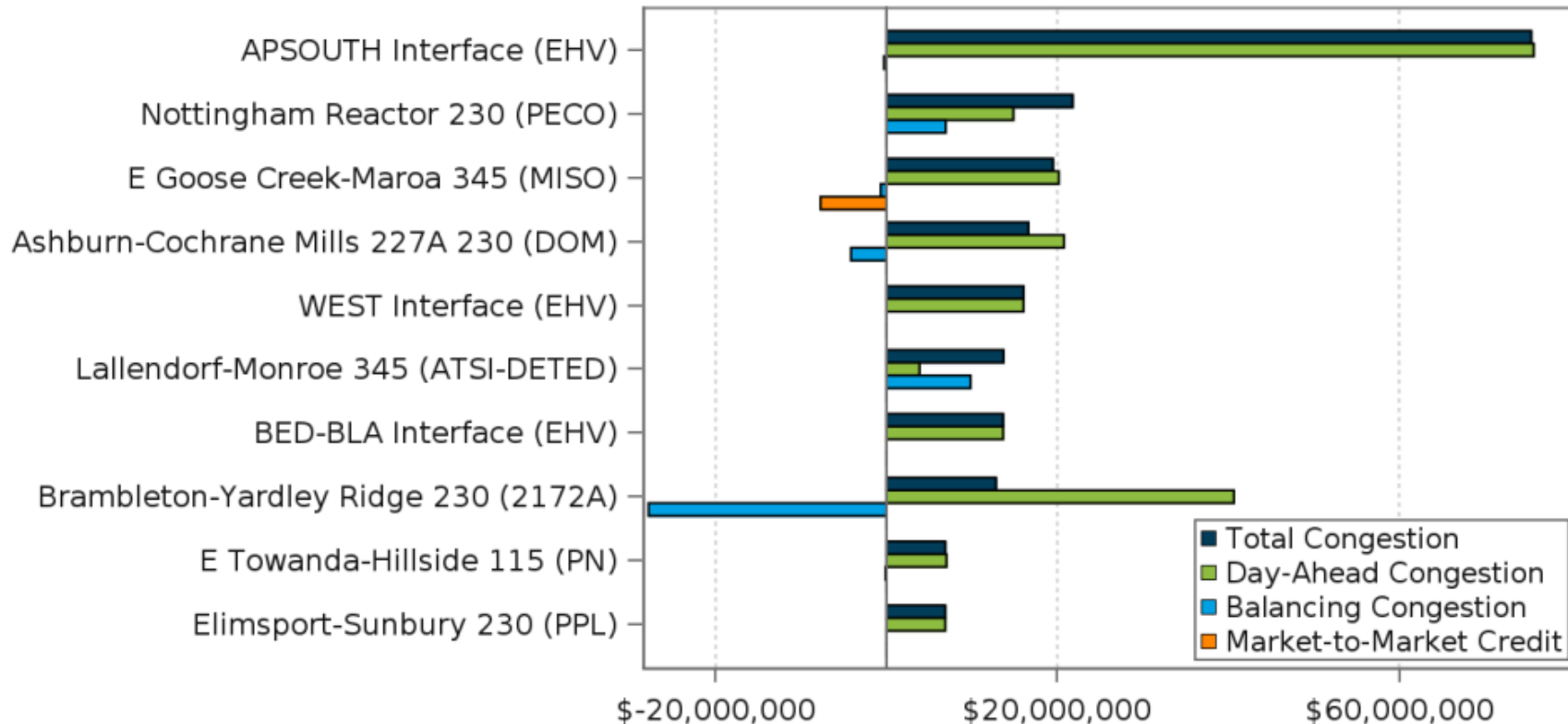
Planning Period FTR Payout Ratio





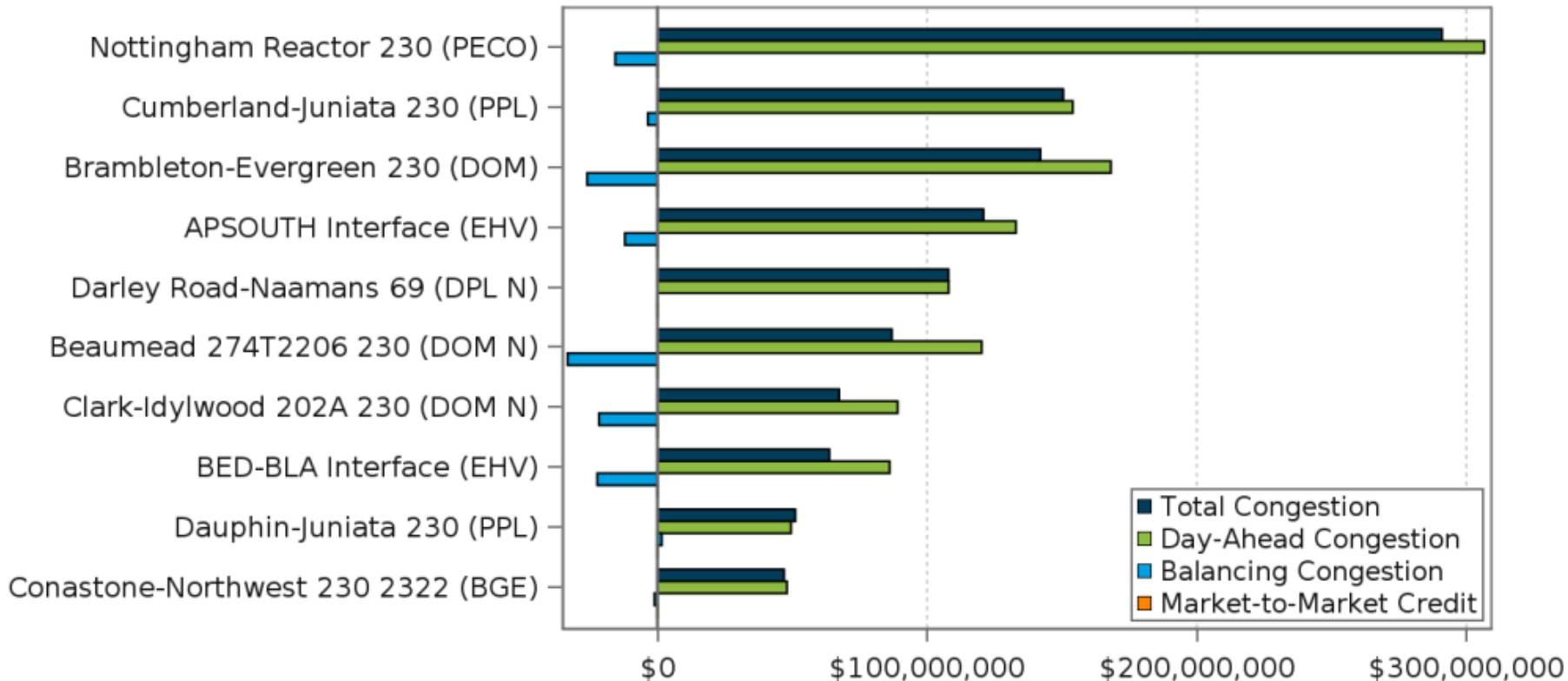


# Ten Most Heavily Congested Transmission Facilities - Overall, December



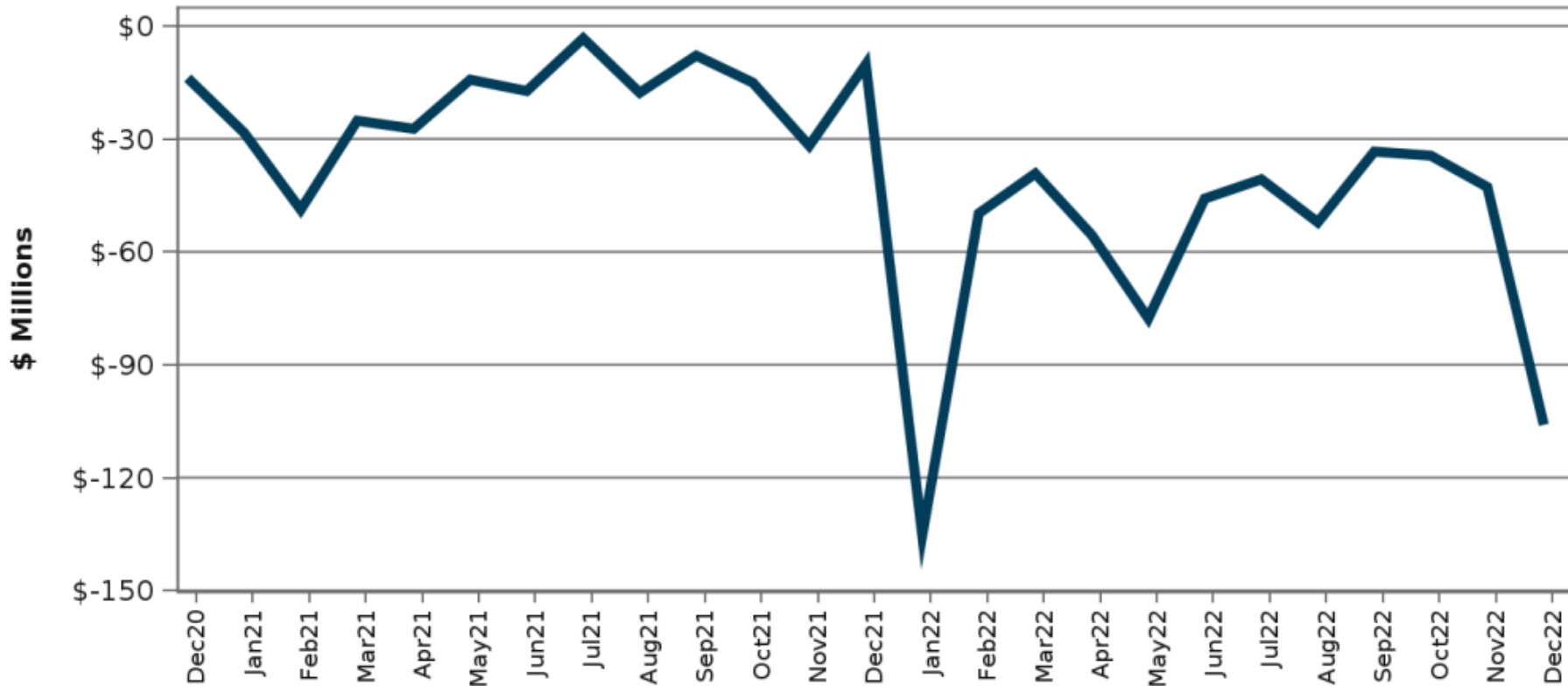
The ten most heavily congested facilities account for 64% of total congestion for December.

# Ten Most Heavily Congested Transmission Facilities - Overall, 2022



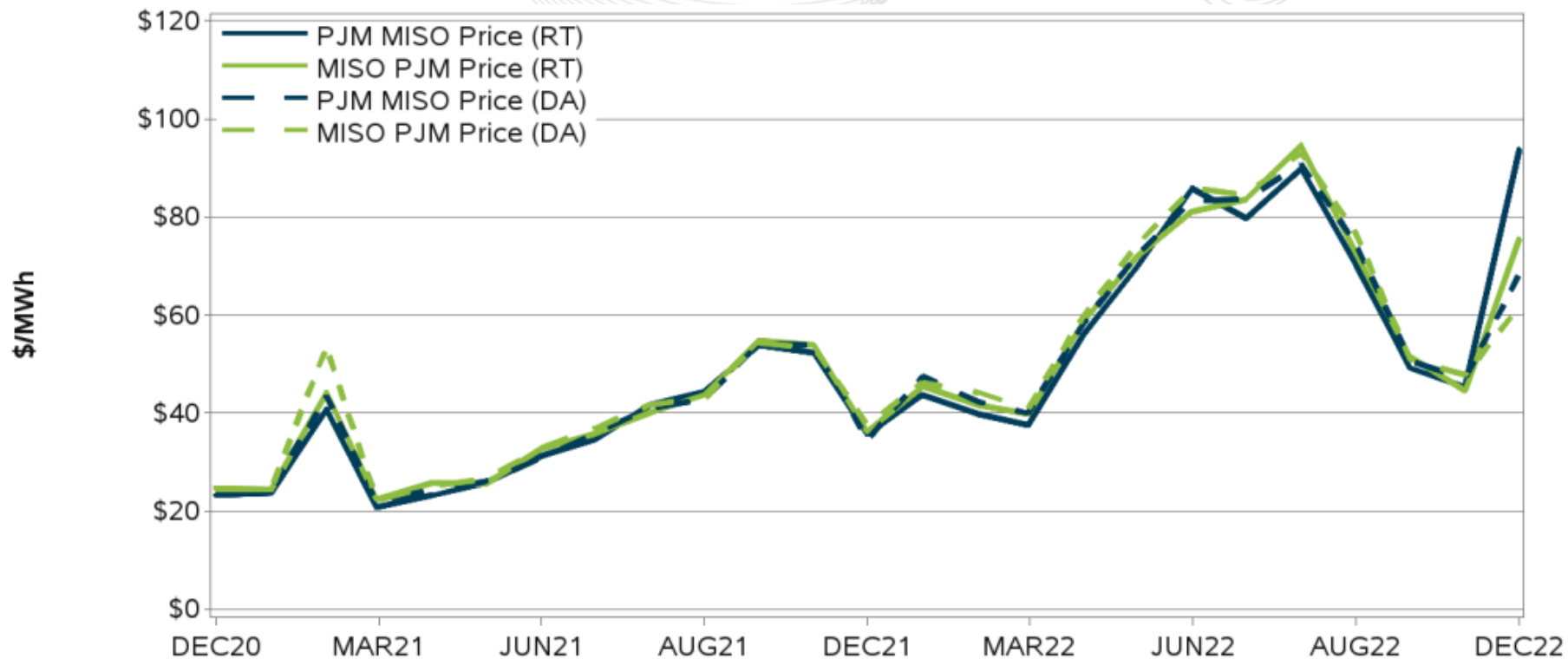
The ten most heavily congested facilities account for 45% of total congestion for 2022.

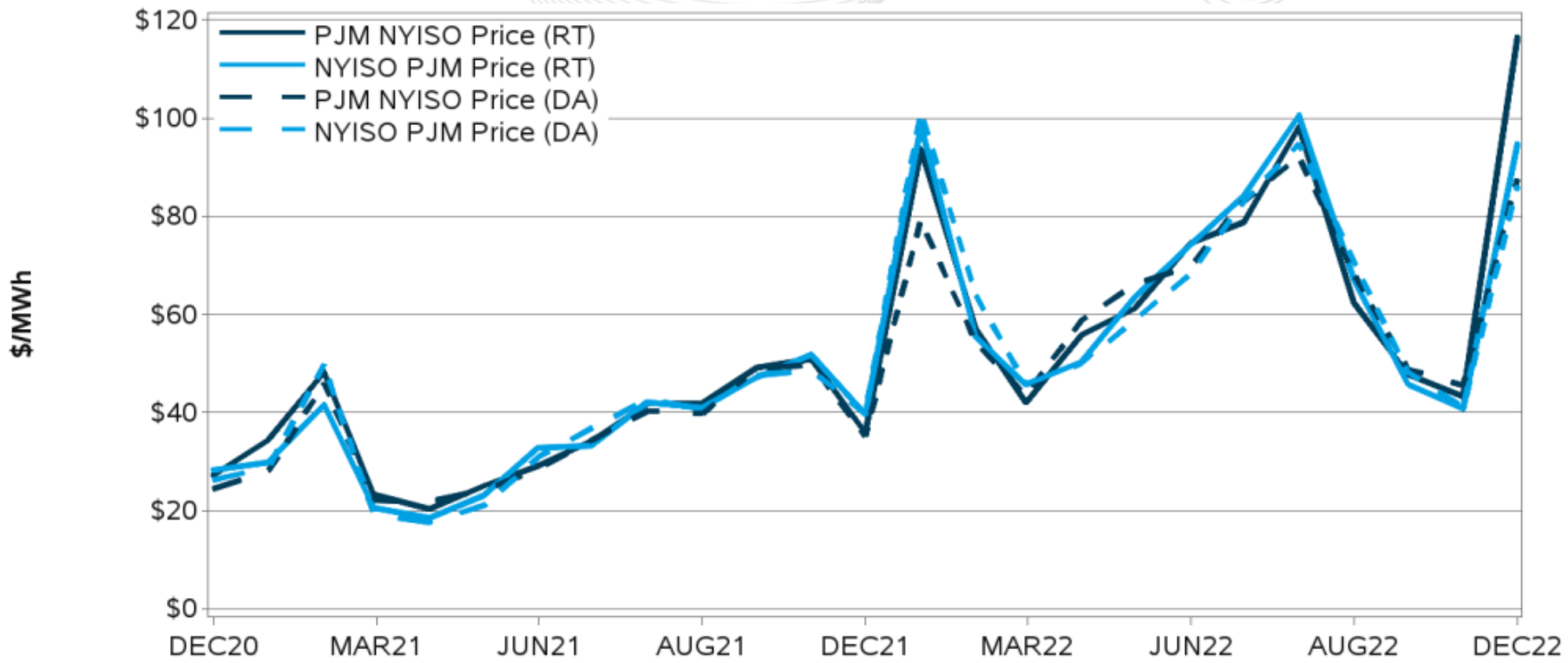
# Balancing Congestion Charge Revenues (BLI 2215)



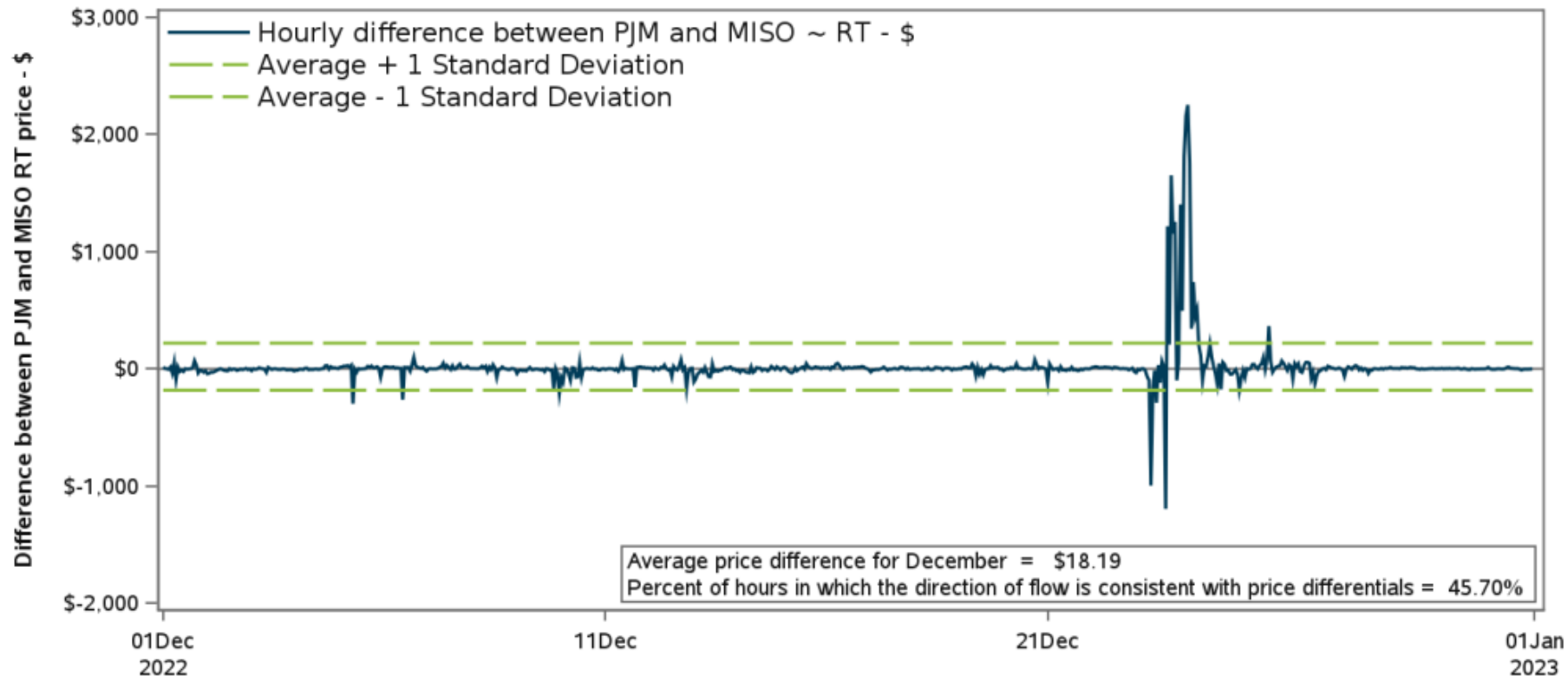
# Energy Market

# Interchange/Seams Summary



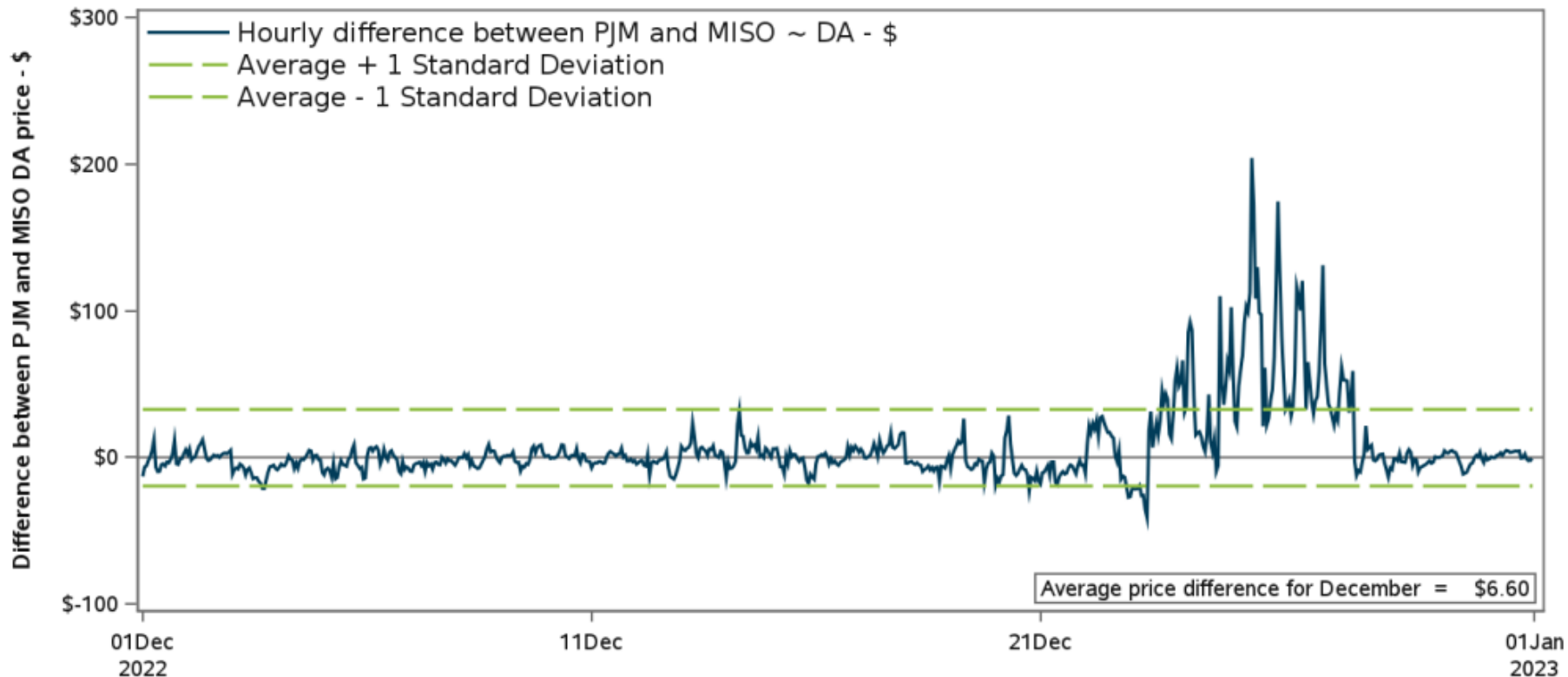


# Hourly Difference Between PJM and MISO Real-Time Prices



Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

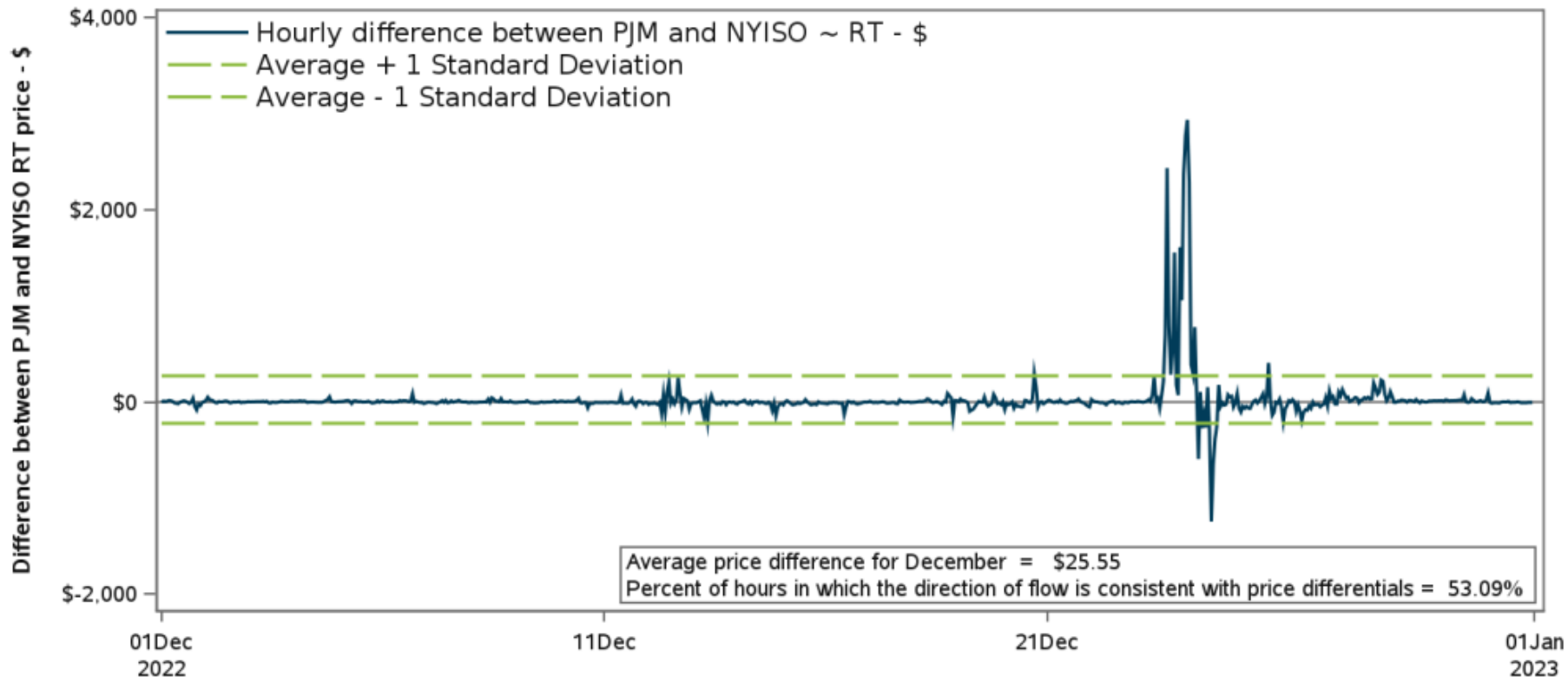
# Hourly Difference Between PJM and MISO Day-Ahead Prices



Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

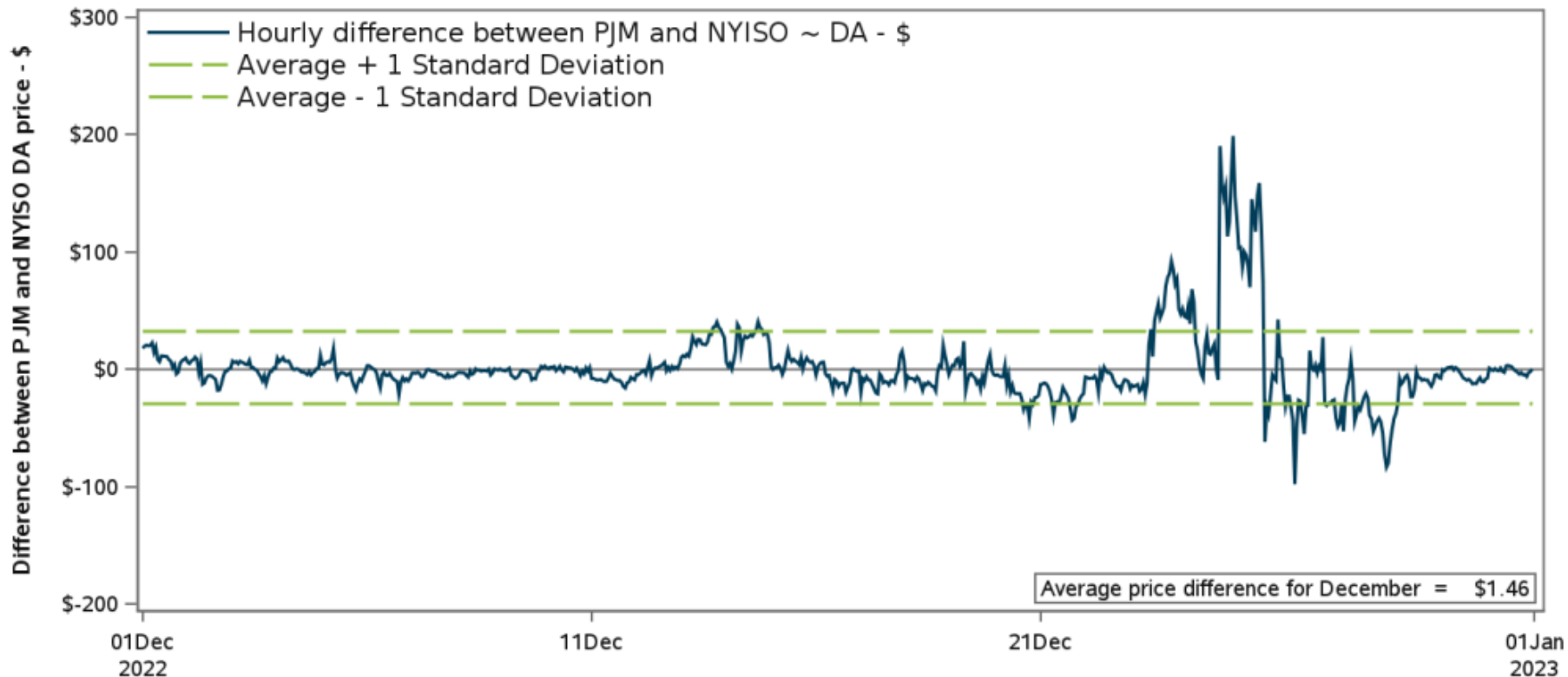


# Hourly Difference Between PJM and NYISO Real-Time Prices

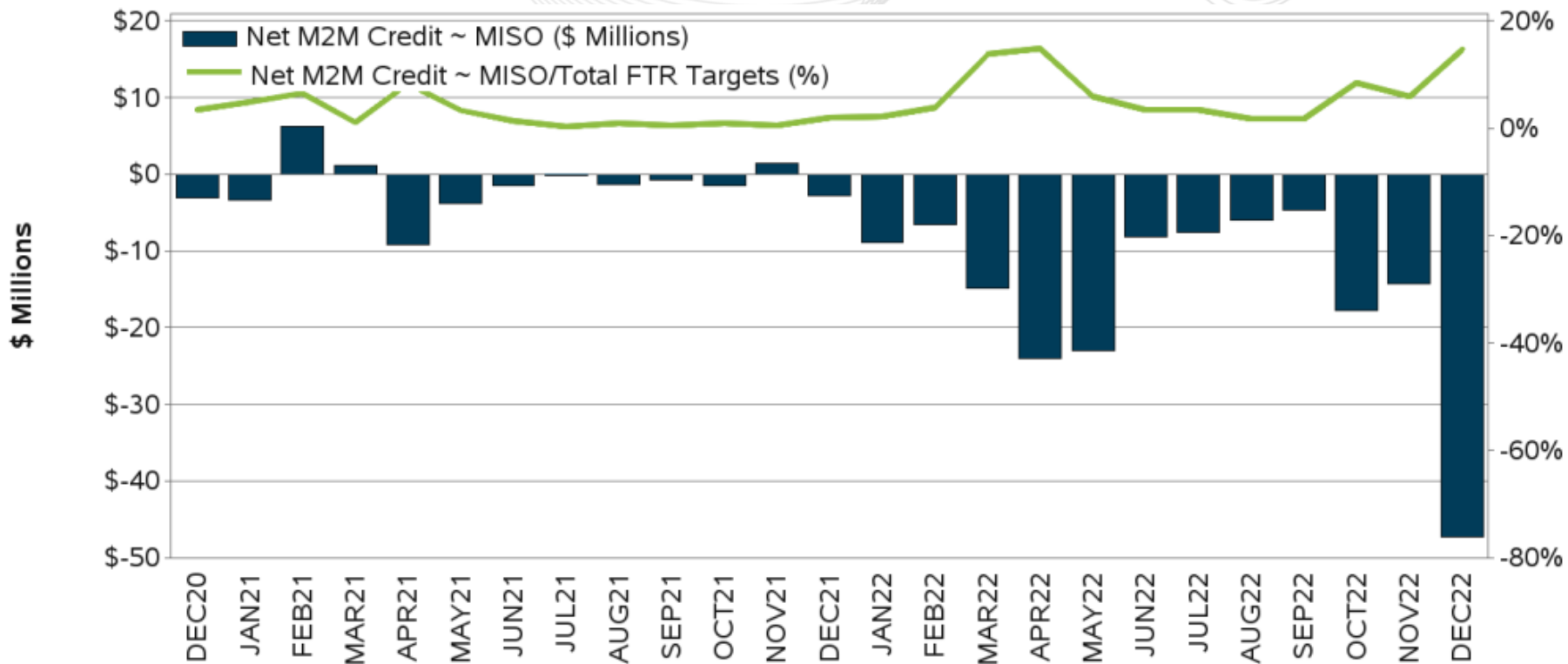


Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

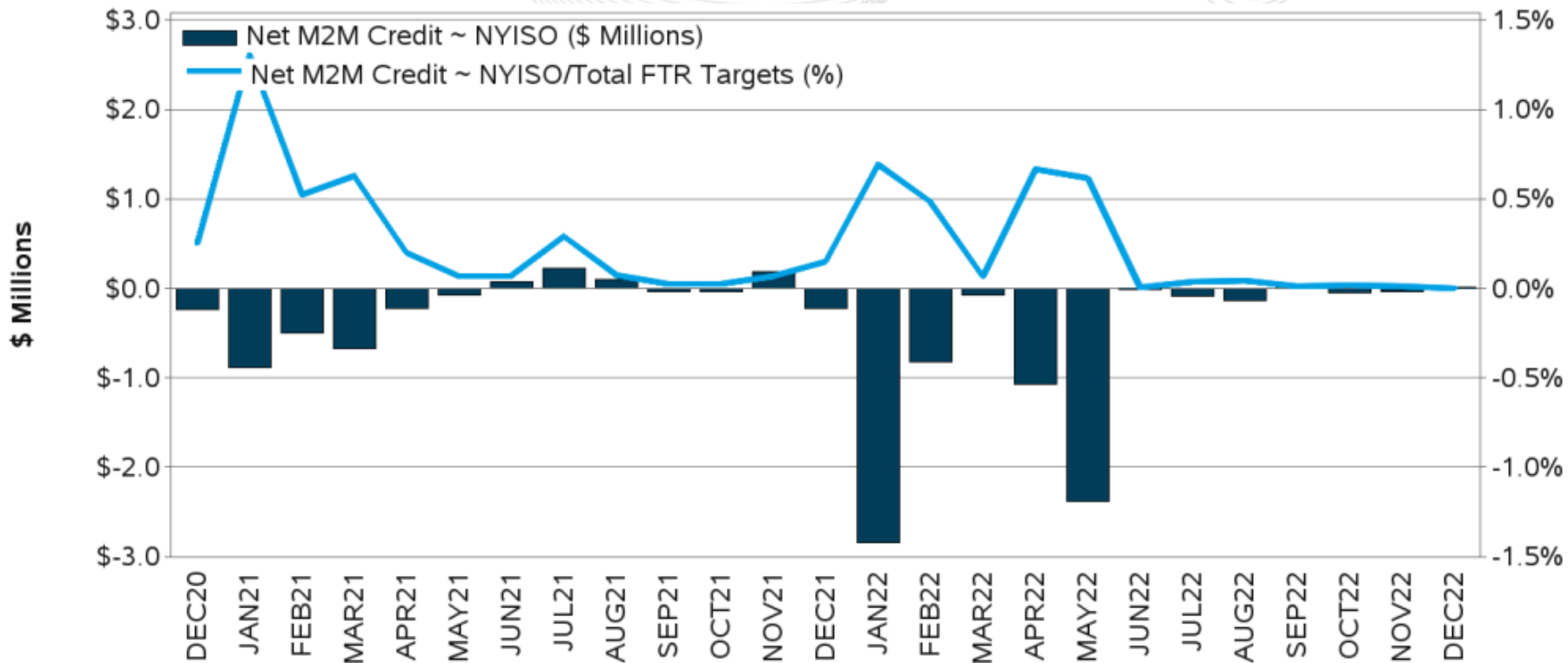
# Hourly Difference Between PJM and NYISO Day-Ahead Prices



Positive values represent hours when the PJM price was higher. Negative values represent hours when the PJM price was lower.

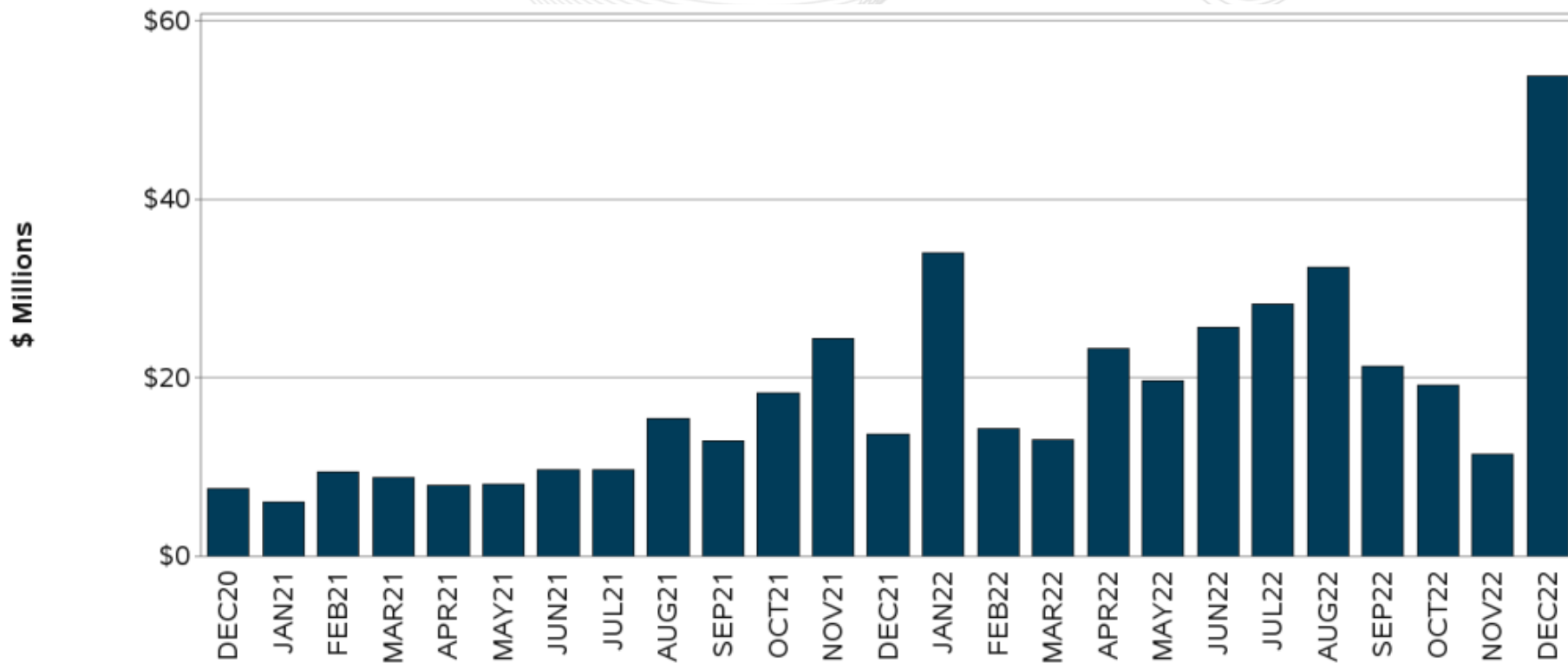


Negative M2M Credit represents PJM payment to MISO

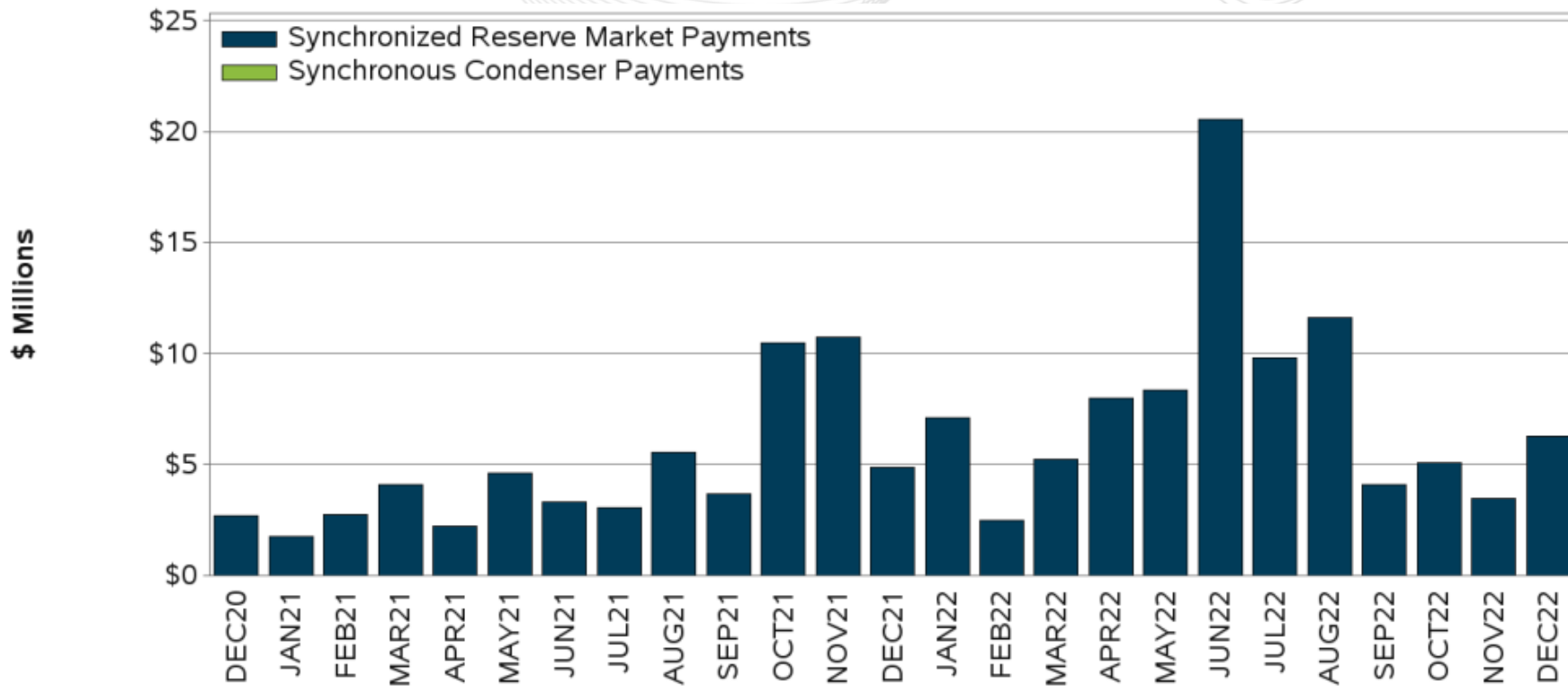


Negative M2M Credit represents PJM payment to NYISO

# Ancillary Service Market Summary

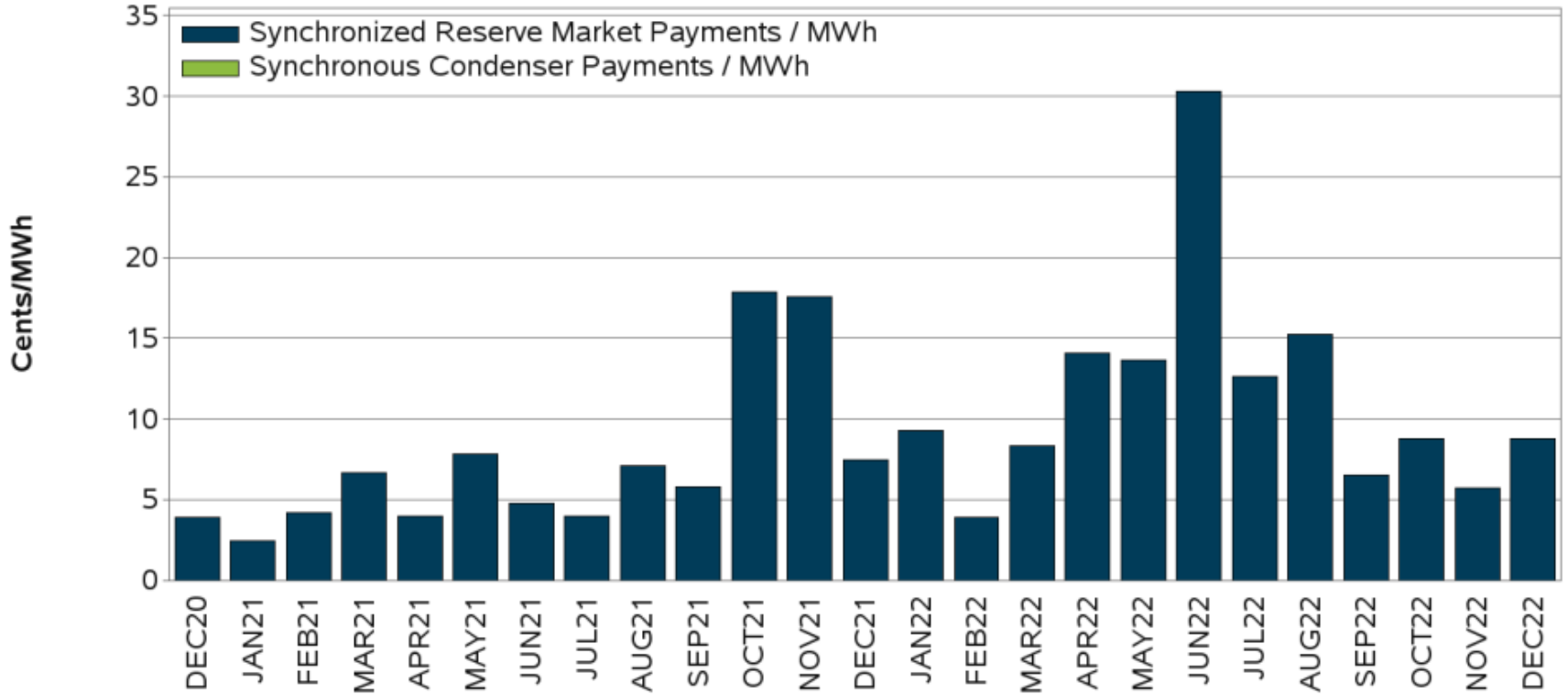


# Synchronized Reserve and Synchronous Condenser Costs

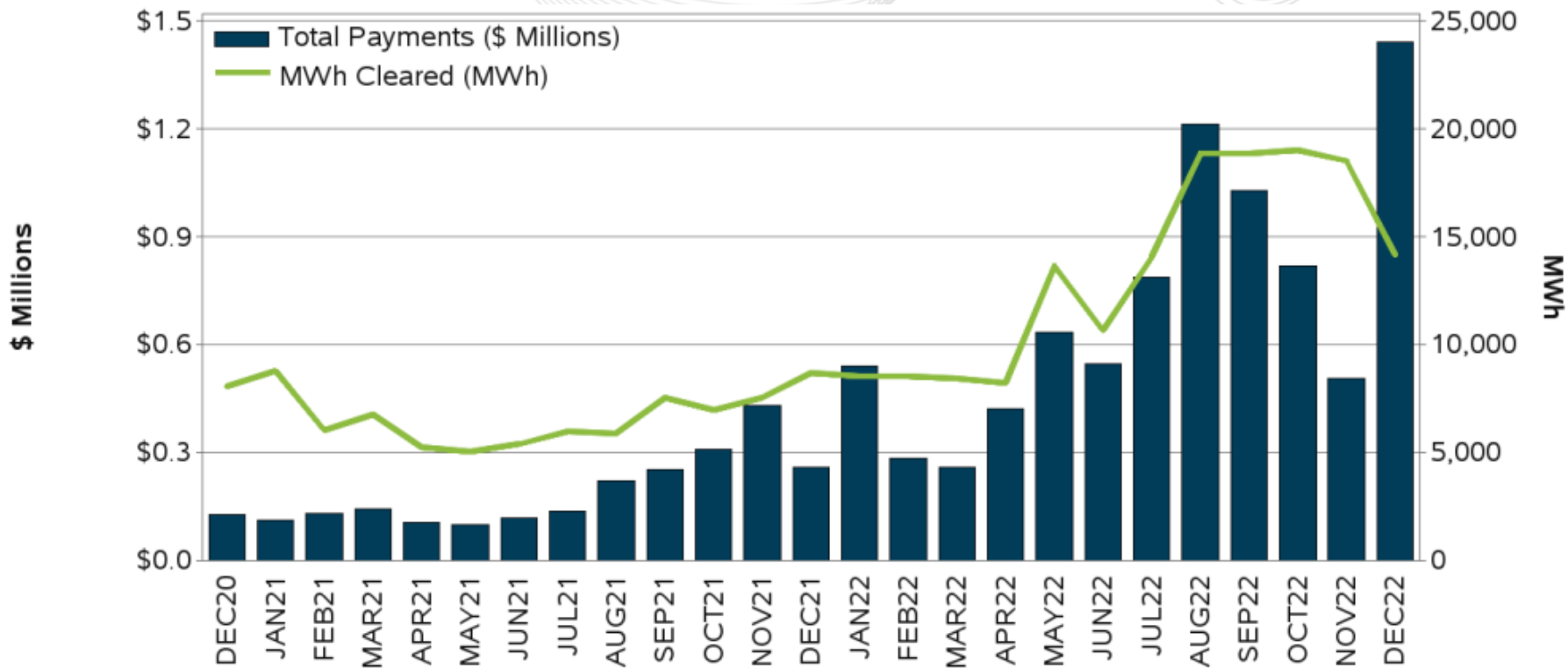




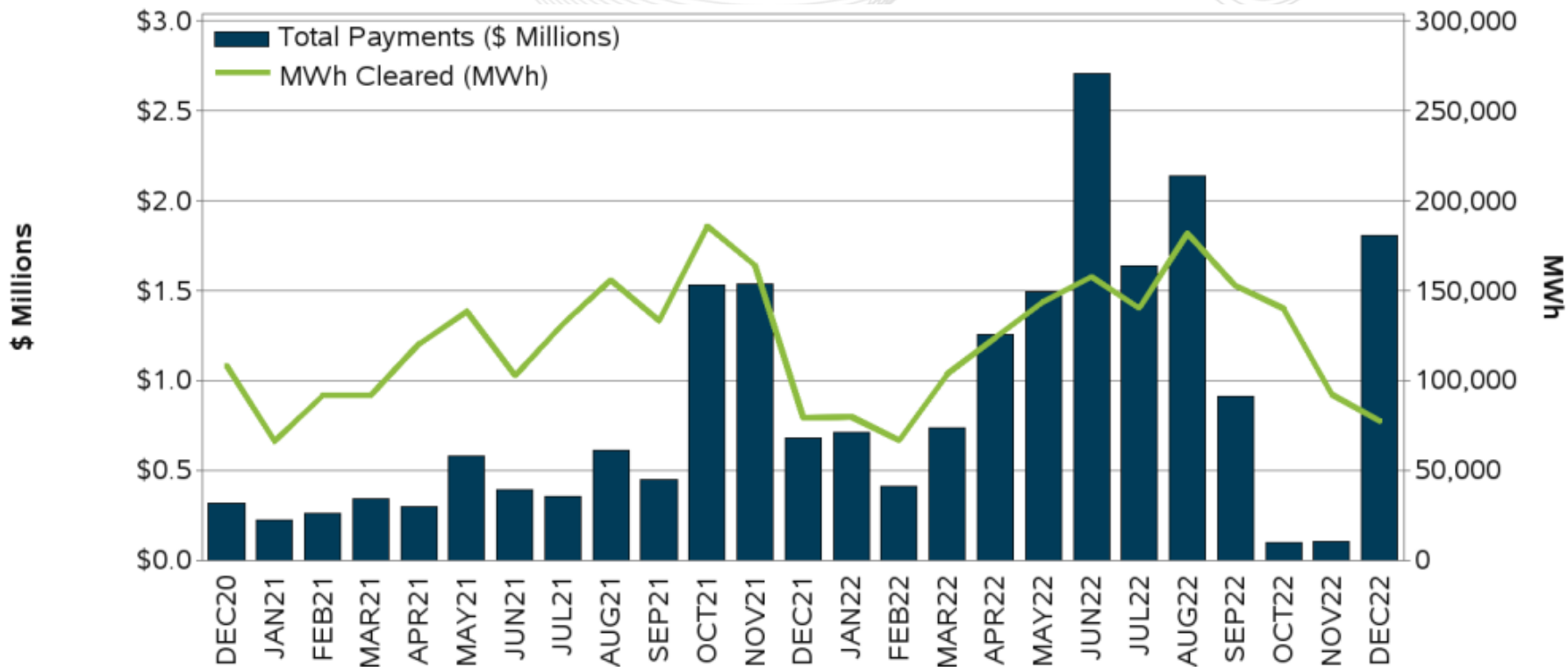
# Load-Adjusted Synchronized Reserve and Synchronous Condenser Costs

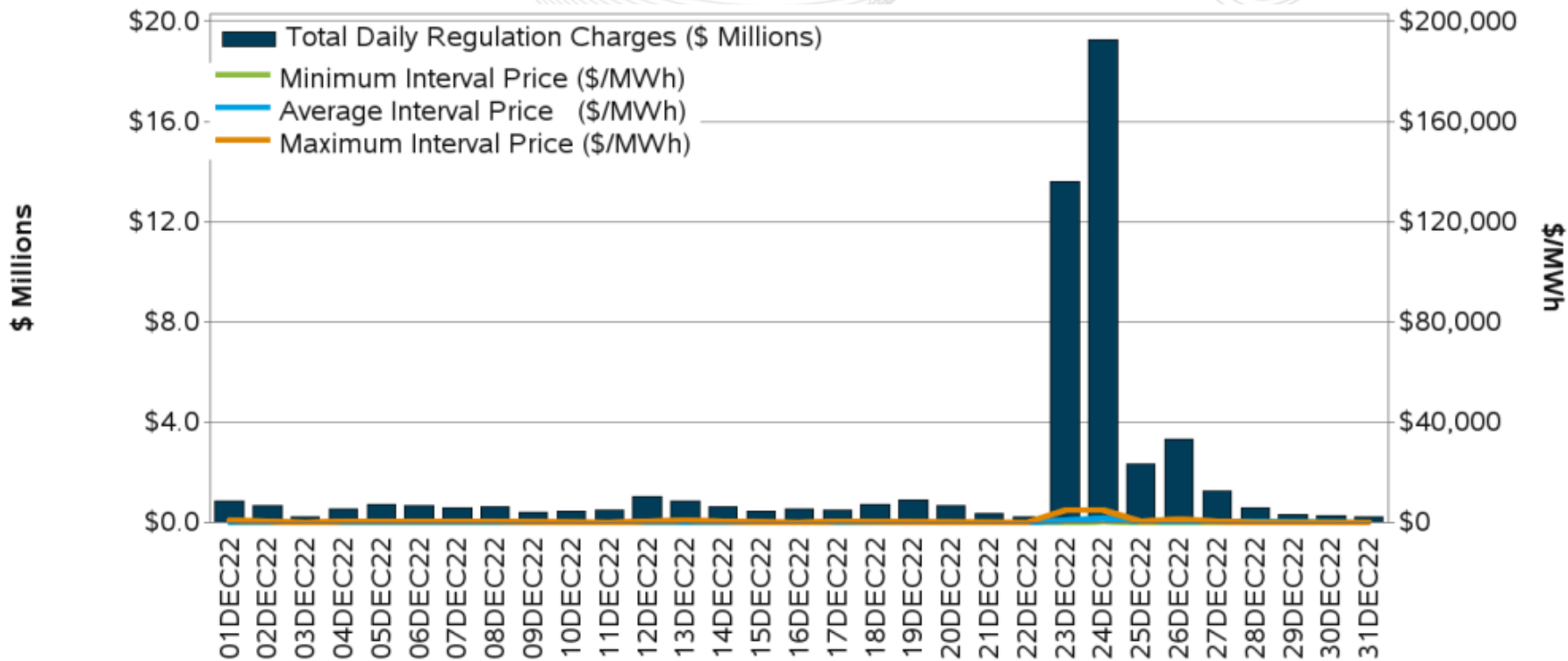




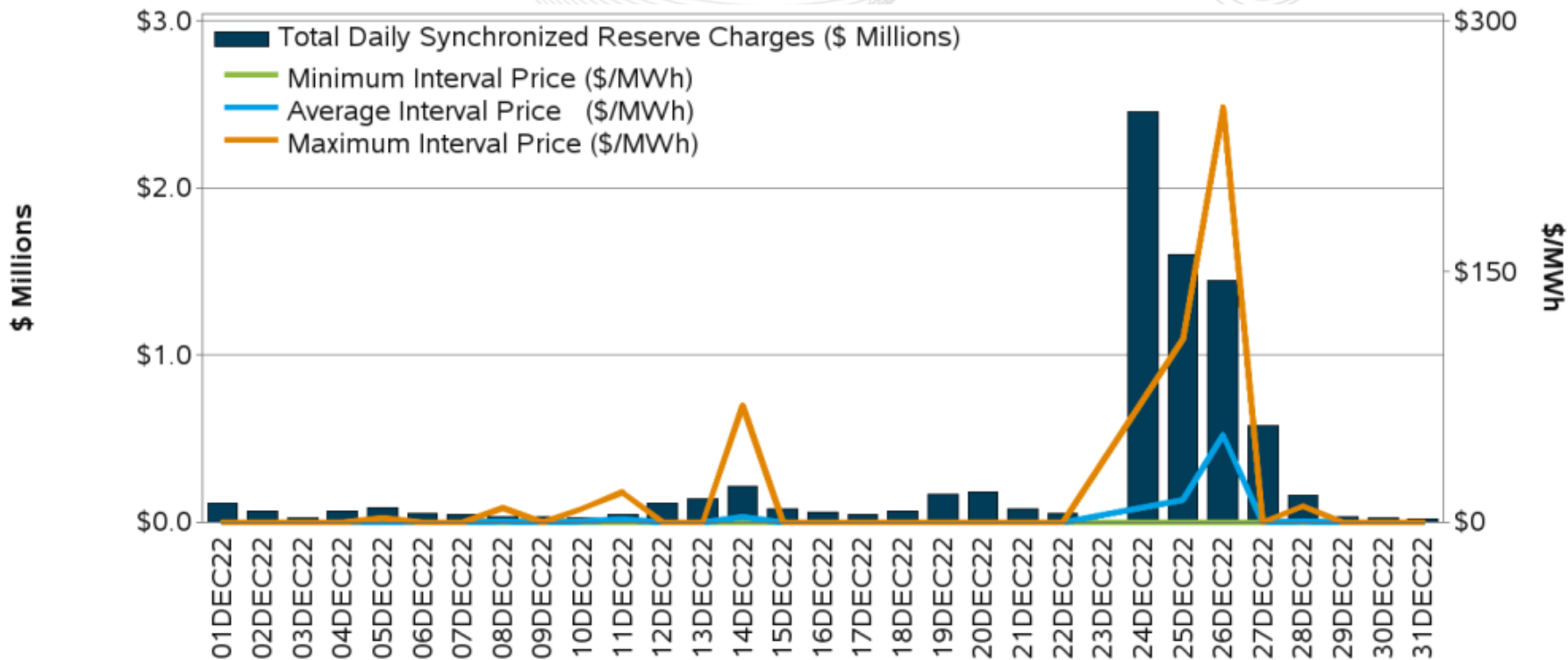


# DR Participation in PJM Synchronized Reserve Markets





# Synchronized Reserve Market Daily Prices and Charges



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