



PROPOSED 2022 ANCILLARY SERVICE METHODOLOGY AND PRELIMINARY QUANTITIES

ERCOT Staff

PDCWG
SEPTEMBER 08, 2021

Stakeholder Discussion Timeline

- ✓ August 11, 2021 – PDCWG (Current Methodology)
- ✓ August 23, 2021 – WMWG (Current Methodology)

- September 08, 2021 – PDCWG (Proposed Methodology)
- September 22, 2021 – WMWG (Proposed Methodology)

- October 13, 2021 – PDCWG (Proposed Methodology)
- October 21, 2020 – OWG (Proposed Methodology)
- October 25, 2021 – WMWG (Proposed Methodology)

- November 03, 2021 - WMS
- November 04, 2021 - ROS
- November 17, 2021 - TAC

- December 14, 2021 - BoD

Summary of Feedback from August Meeting

- **Regulation**

- Frequency profile particularly through mid-day and sunset hours has noticeable drags. Understand underlying drivers for exhaustion of Regulation.
- Review GTBD parameters and Regulation deployment parameters in LFC.

- **RRS**

- Continue using the 2800 MW floor for peak hours.
- Assess if changes to Load dampening factor in RRS studies are needed to account for changing load composition (motor load vs electronic load).

- **Non-Spin**

- Consider using an intra-day forced outage methodology that reasonably represents variations in intra-day changes in forced outage.
- Share Non-Spin deployment data. *{included in last slide}*

Discussion Scope

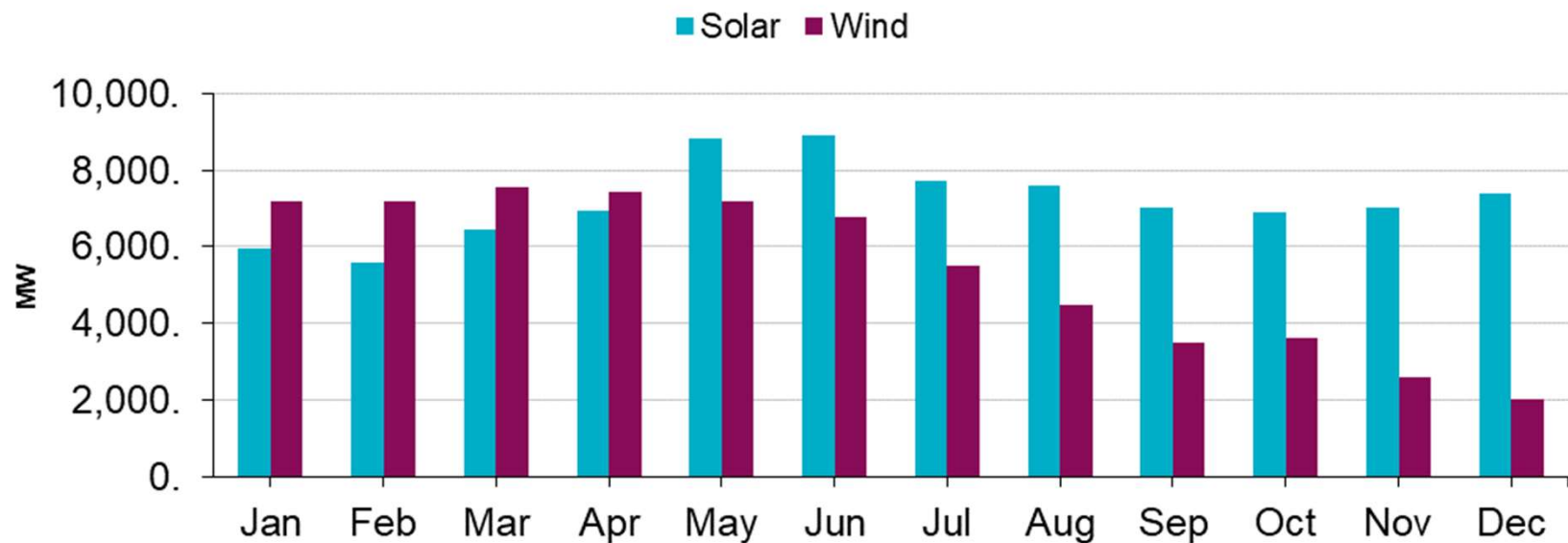
- ERCOT is not recommending any changes to the methodology used for computing Regulation Service requirements for 2022.
- ERCOT is recommending one change in the methodology used for computing Responsive Reserve Service (RRS) requirements for 2022 for the peak hours.
- ERCOT is recommending changes in the methodology used for computing Non-Spinning Reserve Service (Non-Spin) requirements for 2022 to include the highest net load forecast error within an operating hour and account for intra-day changes in thermal resource availabilities (due to forced outages).
- The Ancillary Service (A/S) quantities for 2022 contained in this presentation are based on the methodology that was approved in December 2020.
 - The quantities for 2022 reflect moving forward the historic data on which these are based, unless otherwise noted.
 - Spreadsheets that contain the associated quantities for January through July of 2022 have been posted on the meeting page for this meeting.
- ERCOT is seeking stakeholder feedback on these proposed changes for the 2022 A/S Methodology.

Regulation Service Methodology

- ERCOT is not proposing any change to the methodology used to compute the minimum Regulation Service requirements for 2022.
 - ERCOT will continue to monitor the intra-hour net load ramps and will tune ERCOT's Generation Applications in EMS when necessary to meet established frequency control related performance criteria.
- The preliminary Regulation quantities for January 2022 through July 2022 in subsequent slides have been computed using current methodology (2020 and 2021 five-minute net load variability), updated Wind Adjustment tables and the proposed Solar Adjustment tables.

Projected Increase in IRR Capacity

**Projected Increase in IRR Installed Capacity in 2022
(As of May 31, 2021)**



Regulation Exhaustion

Reg-Up

Month	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
Jan	4.0%	0.8%	0.0%	0.5%	0.0%	0.0%	0.0%	1.9%	0.8%	0.3%	0.5%	0.0%	0.8%	0.0%	1.3%	0.3%	0.8%	0.5%	0.0%	2.4%	2.4%	3.0%	3.0%	1.6%
Feb	4.5%	2.7%	0.3%	1.8%	2.1%	0.3%	0.3%	2.4%	2.4%	0.9%	0.3%	0.3%	0.3%	1.2%	2.7%	0.3%	0.0%	1.5%	0.6%	2.7%	6.3%	5.1%	7.4%	5.1%
Mar	3.0%	3.8%	1.7%	1.9%	1.3%	0.3%	0.0%	1.1%	0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.5%	2.7%	0.3%	1.6%	5.9%	1.6%	3.0%	1.9%	3.5%
Apr	2.8%	0.8%	0.8%	0.8%	0.8%	0.6%	0.3%	0.6%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	0.3%	0.0%	0.0%	1.9%	4.4%	0.3%	0.0%	5.8%	3.1%
May	3.8%	1.6%	3.8%	3.0%	1.1%	0.3%	0.0%	0.5%	0.0%	0.3%	0.0%	0.0%	0.3%	0.0%	0.3%	0.8%	0.8%	0.0%	0.5%	4.6%	4.3%	0.0%	3.8%	3.2%
Jun	0.3%	0.3%	1.9%	1.1%	0.0%	0.0%	1.4%	2.5%	0.6%	0.0%	0.0%	0.3%	1.1%	0.0%	2.2%	2.5%	3.3%	3.3%	3.9%	17.2%	8.6%	2.5%	5.8%	2.5%
Jul	2.4%	2.7%	3.2%	1.6%	1.1%	0.0%	0.0%	0.5%	0.0%	0.0%	1.1%	0.3%	0.3%	1.1%	0.8%	2.4%	2.7%	1.9%	5.1%	29.8%	10.5%	3.0%	4.6%	9.4%

Reg-Down

Month	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
Jan	3.0%	4.3%	16.9%	9.1%	5.1%	3.0%	4.8%	0.5%	1.1%	0.8%	0.5%	0.0%	1.3%	0.5%	0.5%	1.3%	5.4%	3.8%	3.5%	1.9%	0.3%	0.3%	0.3%	1.3%
Feb	8.6%	15.5%	11.0%	12.8%	15.5%	6.0%	11.9%	1.8%	10.1%	3.6%	2.7%	4.5%	5.1%	6.5%	9.8%	8.0%	6.5%	2.1%	9.5%	9.8%	6.5%	0.0%	1.2%	7.1%
Mar	2.7%	6.7%	0.8%	9.4%	10.5%	8.1%	7.5%	0.8%	5.9%	2.7%	0.5%	1.1%	1.3%	1.3%	3.8%	1.9%	0.8%	0.0%	1.9%	3.8%	2.4%	2.4%	0.8%	3.2%
Apr	3.6%	6.1%	8.6%	6.4%	12.2%	4.2%	6.4%	6.4%	12.5%	6.9%	5.0%	4.7%	3.1%	2.5%	2.8%	1.1%	0.6%	0.3%	0.6%	2.2%	1.7%	0.6%	0.0%	0.6%
May	1.6%	2.2%	6.5%	7.0%	4.3%	5.4%	3.5%	11.8%	3.0%	1.3%	0.3%	2.7%	2.4%	0.3%	0.0%	0.5%	0.3%	0.0%	0.0%	0.0%	2.2%	0.5%	0.0%	0.0%
Jun	0.8%	1.9%	4.2%	7.2%	9.7%	6.1%	5.8%	18.9%	18.3%	1.4%	10.3%	12.2%	5.6%	0.0%	3.1%	6.4%	3.1%	1.4%	1.4%	0.6%	3.6%	0.3%	0.3%	0.0%
Jul	0.5%	1.6%	3.2%	7.0%	11.3%	10.5%	10.5%	17.2%	20.7%	5.9%	13.4%	4.8%	12.1%	8.1%	7.3%	10.8%	8.1%	3.2%	1.3%	0.5%	4.8%	0.3%	0.0%	0.0%

Net Load Ramps vs Netload Ramp Forecast in GTBD

Average Net-Load 5 min Ramp

Month	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
Jan	-66	-28	-4	47	102	180	227	93	-81	-65	-107	-59	-54	-47	-35	32	169	288	-12	-97	-88	-108	-160	-129
Feb	-41	-27	2	52	98	170	187	39	-92	-54	-79	-75	-43	-31	-13	15	83	208	57	-121	-90	-106	-100	-73
Mar	-92	-38	2	37	85	191	213	47	-36	-50	-9	8	23	15	0	14	36	57	113	56	-115	-183	-204	-164
Apr	-143	-63	-29	16	66	149	195	61	18	-16	35	50	73	74	49	55	36	21	10	90	-56	-231	-243	-186
May	-147	-87	-16	14	75	145	155	42	27	79	116	114	123	115	84	51	11	-69	-93	-7	-43	-225	-252	-205
Jun	-220	-123	-56	3	50	134	122	104	109	224	266	256	221	165	88	30	-23	-79	-118	-54	-123	-324	-335	-295
Jul	-219	-131	-67	-8	49	125	87	95	87	201	310	298	229	153	69	23	-28	-79	-86	-17	-101	-325	-342	-316

Average Net-Load 5-min Ramp Forecast Error

Positive: Actual NL > Forecast NL, Under-dispatch

Negative: Actual NL < Forecast NL Over-dispatch

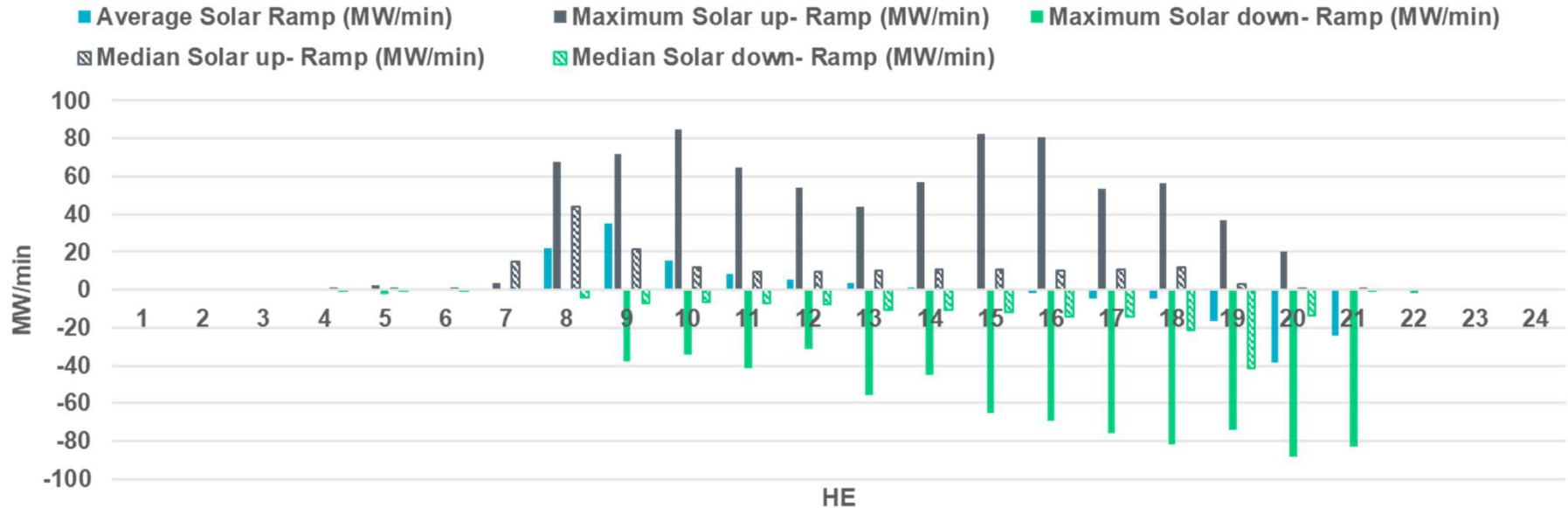
Month	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
Jan	-2	-2	-9	-9	-16	-37	-24	72	-102	-49	-25	3	-2	-9	8	30	116	106	-7	-31	-12	7	2	2
Feb	-4	-16	-33	-9	-44	-83	-68	29	-77	12	14	22	17	19	20	11	40	114	-4	-56	-11	9	16	6
Mar	-3	13	15	17	6	-11	-2	17	-119	-83	-32	-14	-6	-11	-6	6	28	68	111	57	-16	-7	10	12
Apr	-6	1	8	14	8	9	30	-10	-114	-82	-48	-36	-23	0	5	14	17	34	85	110	-4	-25	-1	12
May	7	4	12	14	17	11	23	-82	-101	-47	-28	-21	1	5	11	26	29	19	69	140	14	-16	-4	7
Jun	-7	1	16	8	10	6	52	-15	-64	4	22	17	13	16	-11	-29	-6	-26	-8	86	-11	-35	-6	1
Jul	-15	-3	8	9	4	8	32	-3	-78	3	54	50	36	4	-31	-28	-35	-38	-30	95	-20	-49	-25	-14

Solar Ramps Forecast

Error = PSRR Forecast - Actual

Month	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
Jan	0	0	0	0	0	0	0	-7	-138	-69	-19	-5	-2	-4	4	20	105	111	4	0	0	0	0	0
Feb	0	0	0	0	0	0	0	-28	-137	-46	-14	-13	4	2	8	14	47	126	36	0	0	0	0	0
Mar	0	0	0	0	0	0	0	-43	-161	-66	-1	-16	1	-6	-1	3	22	69	119	81	0	0	0	0
Apr	0	0	0	0	0	0	0	-39	-134	-50	-25	-29	-19	-2	7	12	24	46	87	115	8	0	0	0
May	-0	0	0	0	0	0	-2	-102	-120	-42	-49	-42	-20	-13	6	23	30	44	85	164	39	0	0	0
Jun	0	0	0	0	0	1	25	-52	-74	1	8	8	10	7	7	-9	1	-14	-6	94	30	-1	0	0
Jul	0	0	0	0	0	0	22	-21	-104	3	17	12	2	-2	-11	-13	-11	-19	-7	105	33	-1	0	0

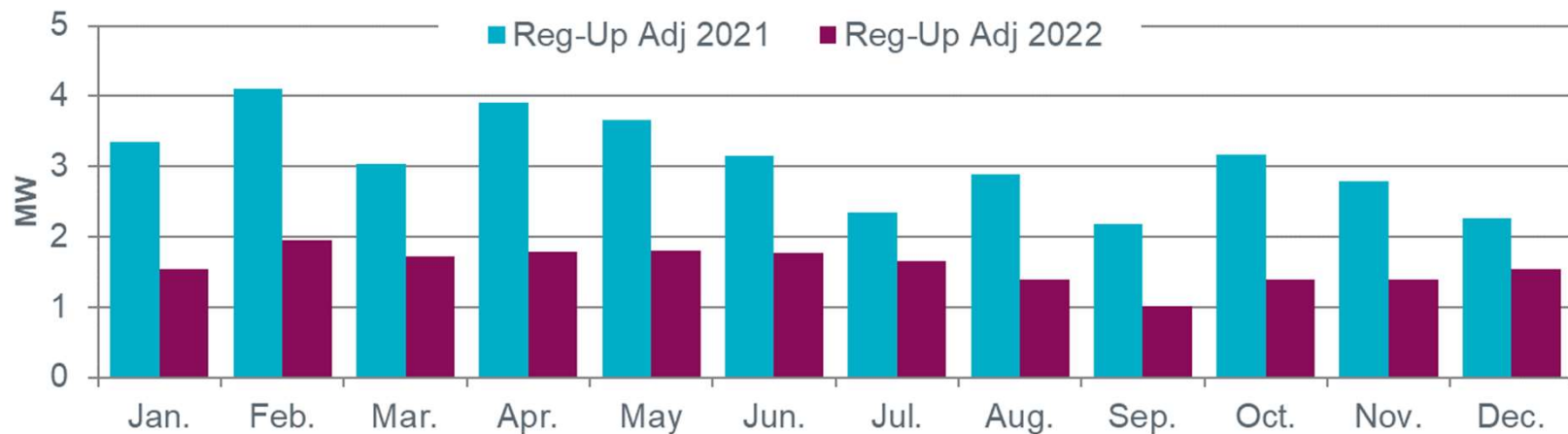
Solar Ramps July 1, 2021 – August 18, 2021



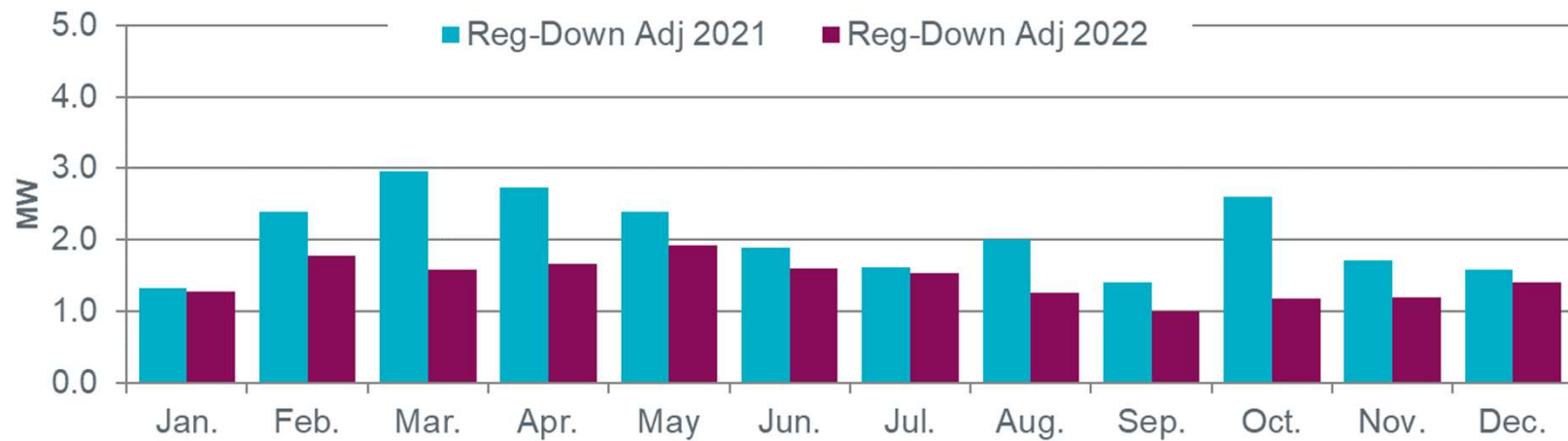
Wind Adjustment Tables - 2022

- Wind Adjustment Tables track incremental MWs of Regulation needed to account for additional variability per 1000 MW increase in installed wind capacity.

Reg-Up Adjustment per 1000 MW increase in Wind Installed Capacity



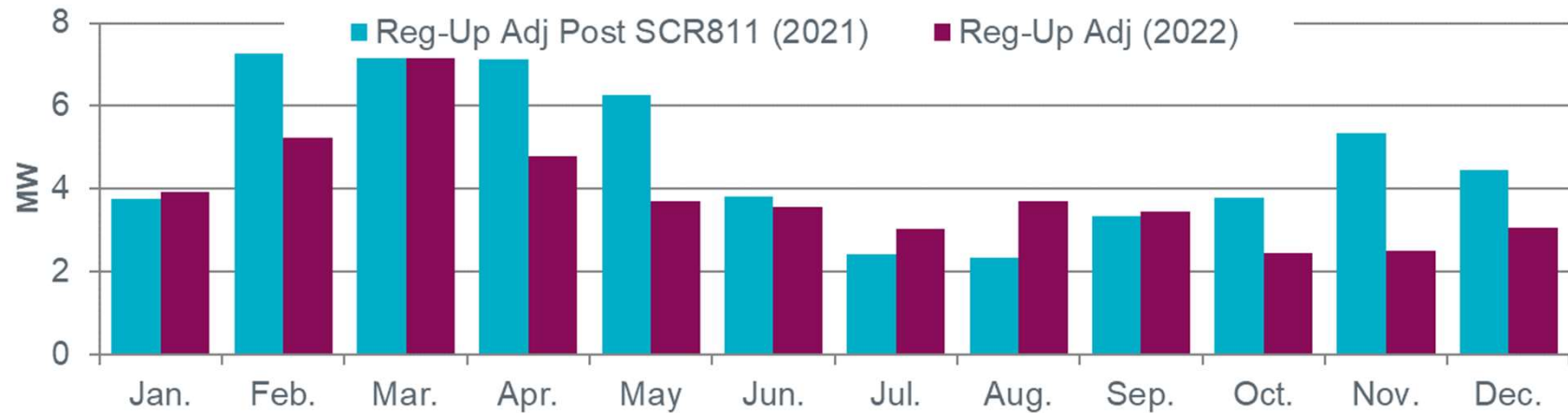
Reg-Down Adjustment per 1000 MW increase in Wind Installed Capacity



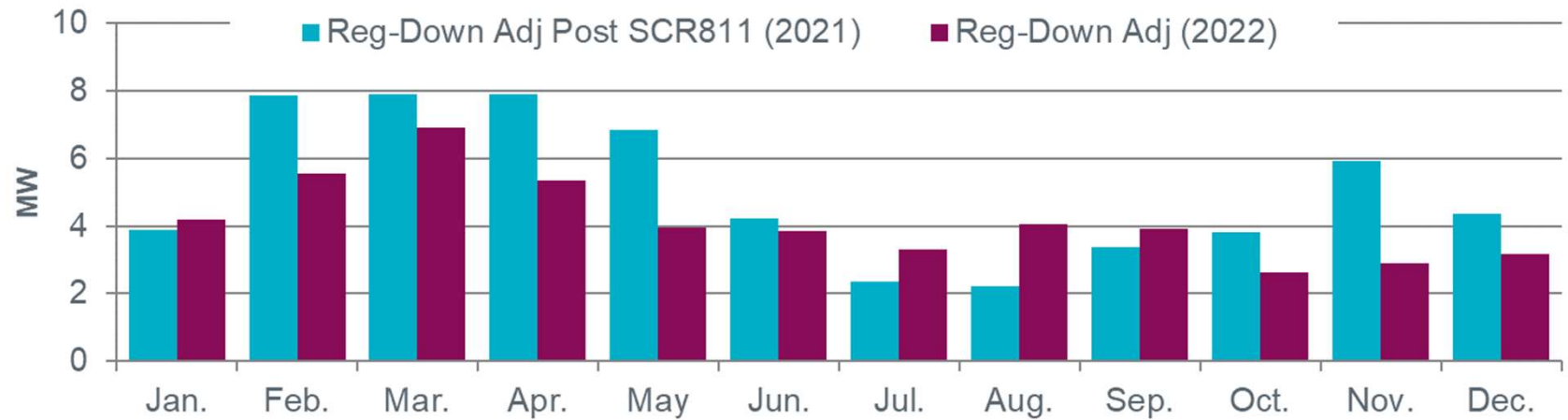
Solar Adjustment Tables - 2022

- Solar Adjustment Tables track incremental MWs of Regulation needed to account for additional variability per 1000 MW increase in installed solar capacity.

Reg-Up Adjustment per 1000 MW increase in Solar Installed Capacity

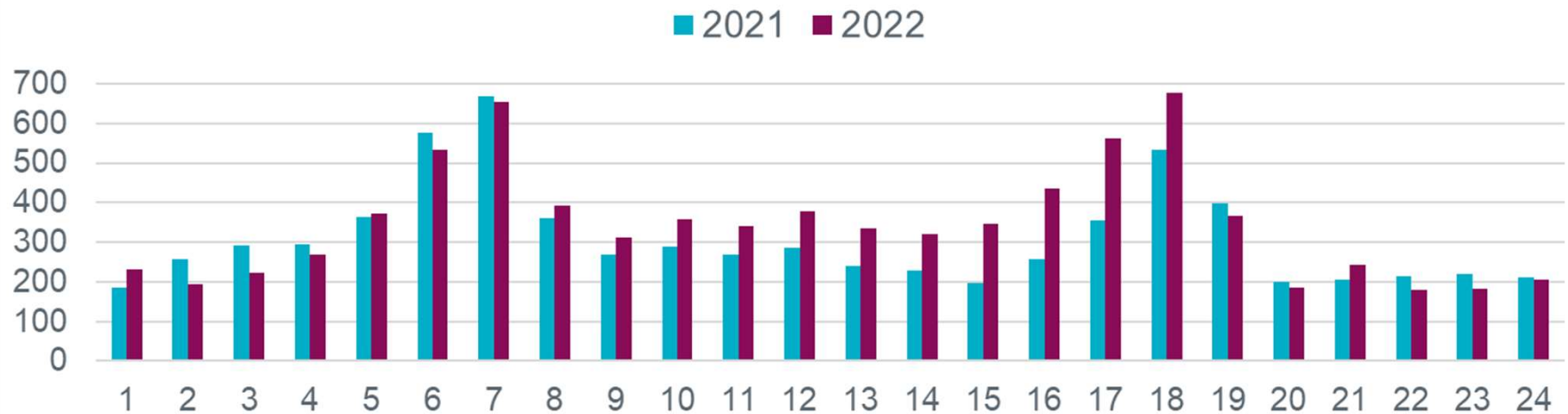


Reg-Down Adjustment per 1000 MW increase in Solar Installed Capacity

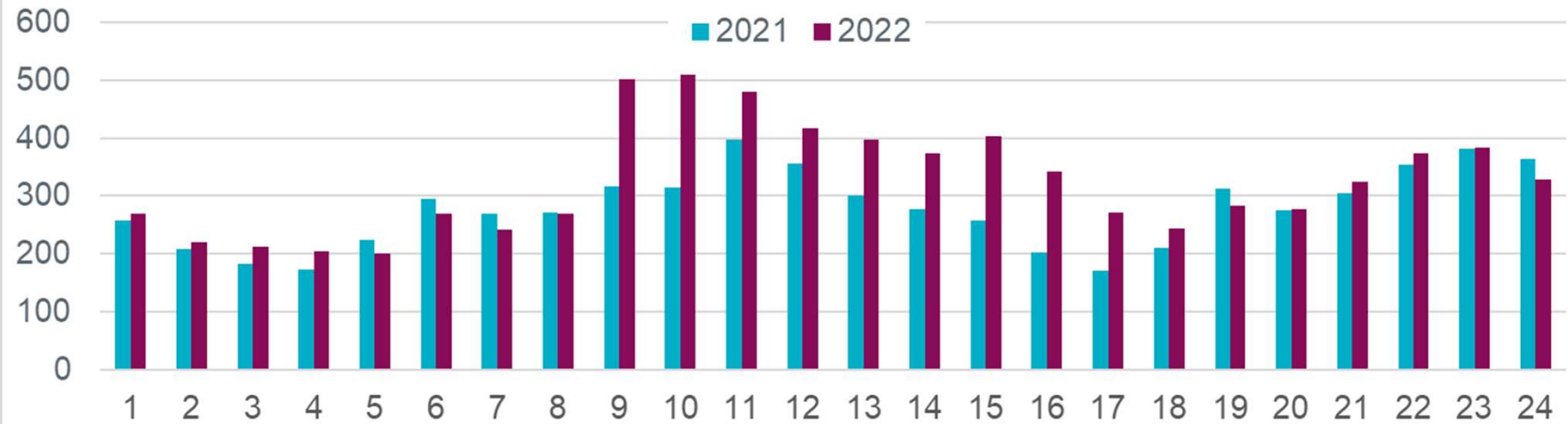


Regulation January

Regulation Up Requirement Comparison for January

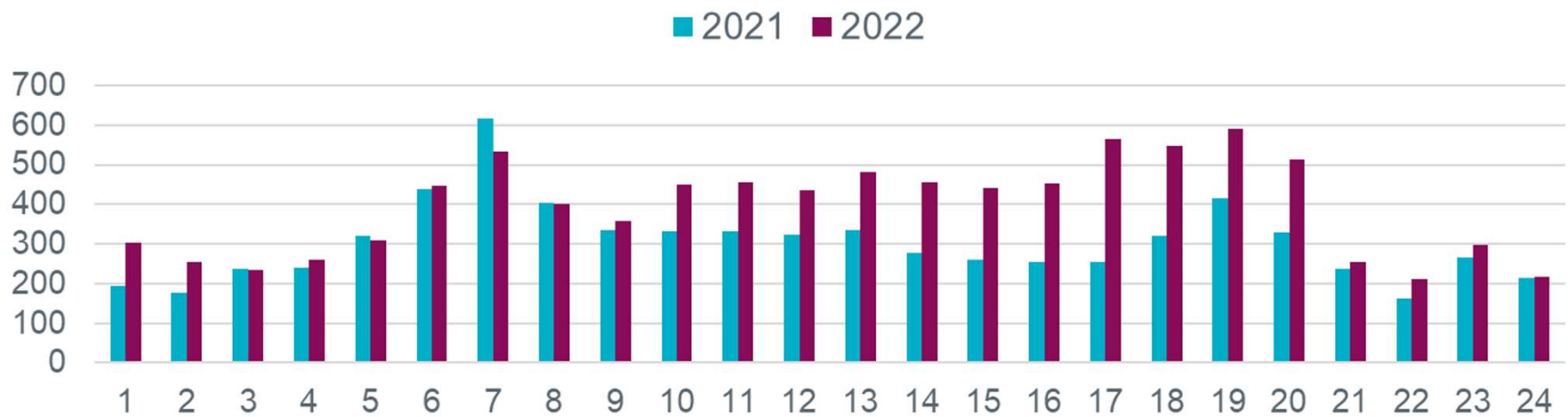


Regulation Down Requirement Comparison for January

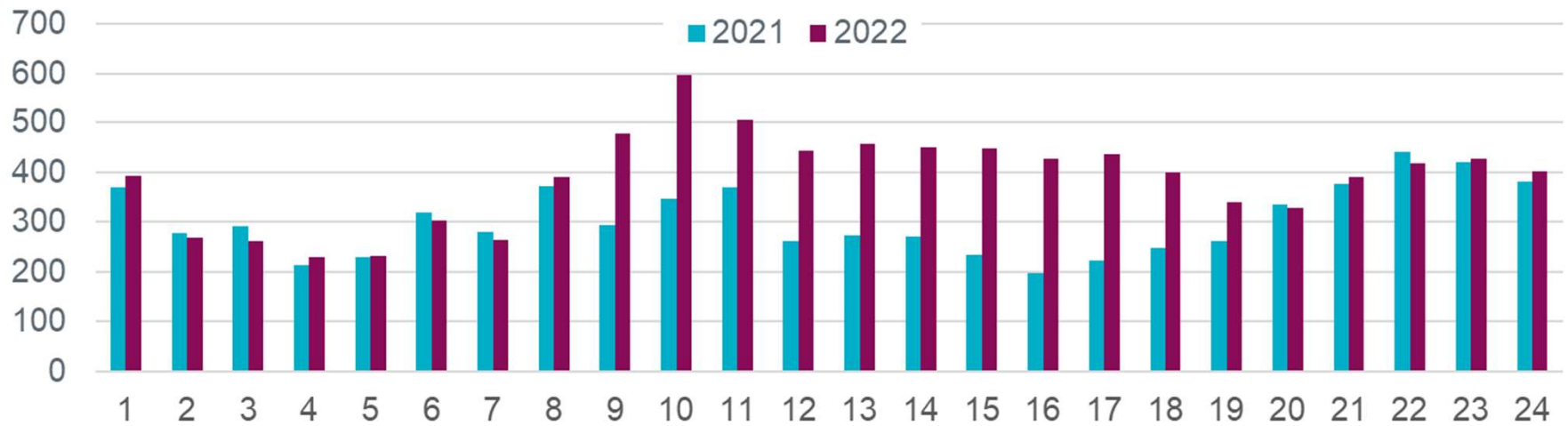


Regulation Up March

Regulation Up Requirement Comparison for March

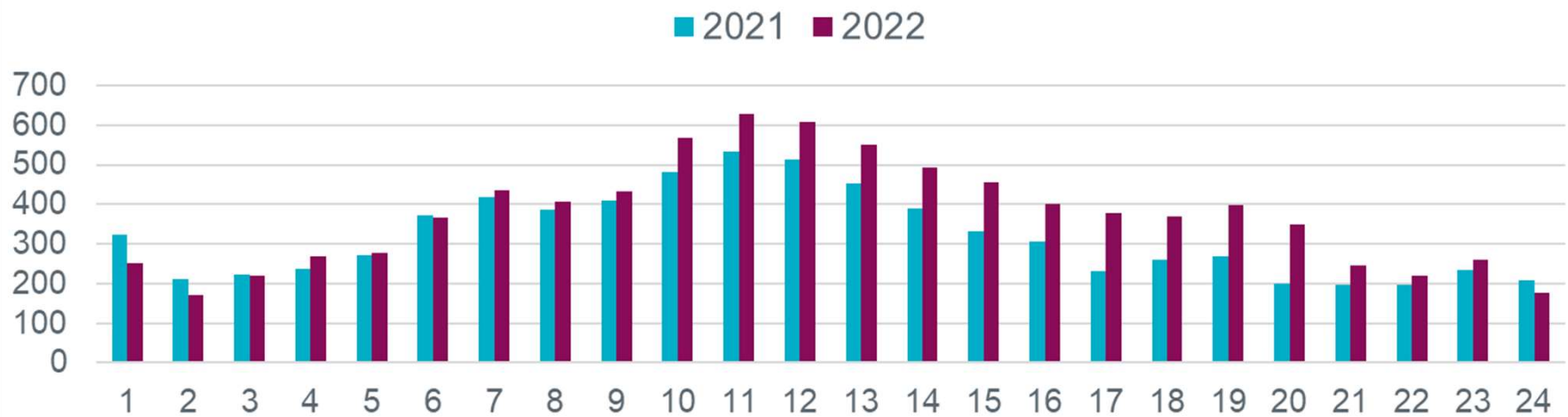


Regulation Down Requirement Comparison for March

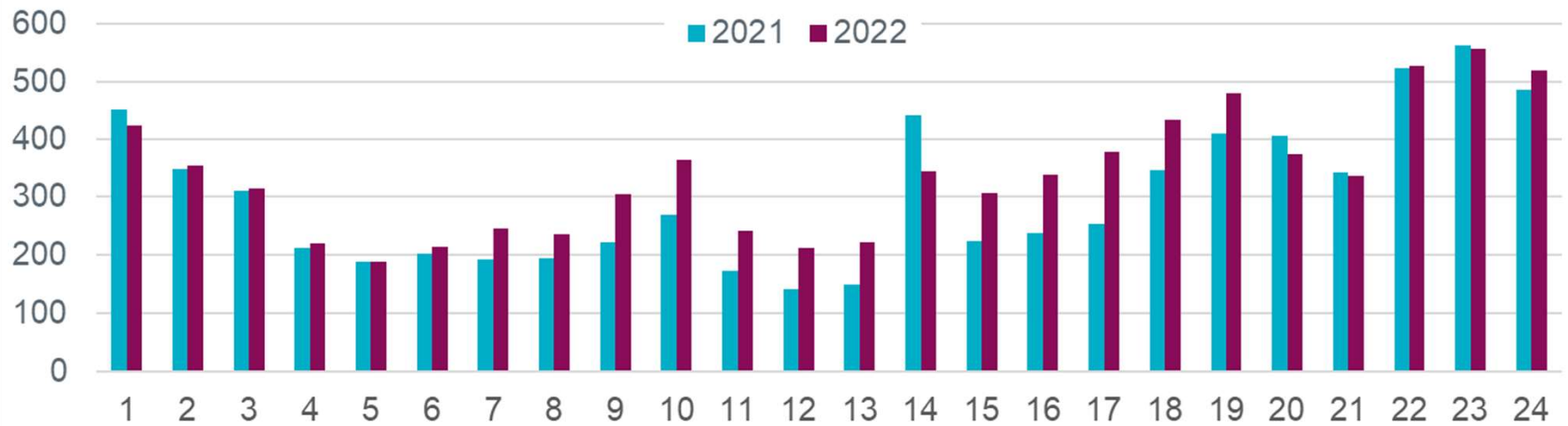


Regulation Up June

Regulation Up Requirement Comparison for June

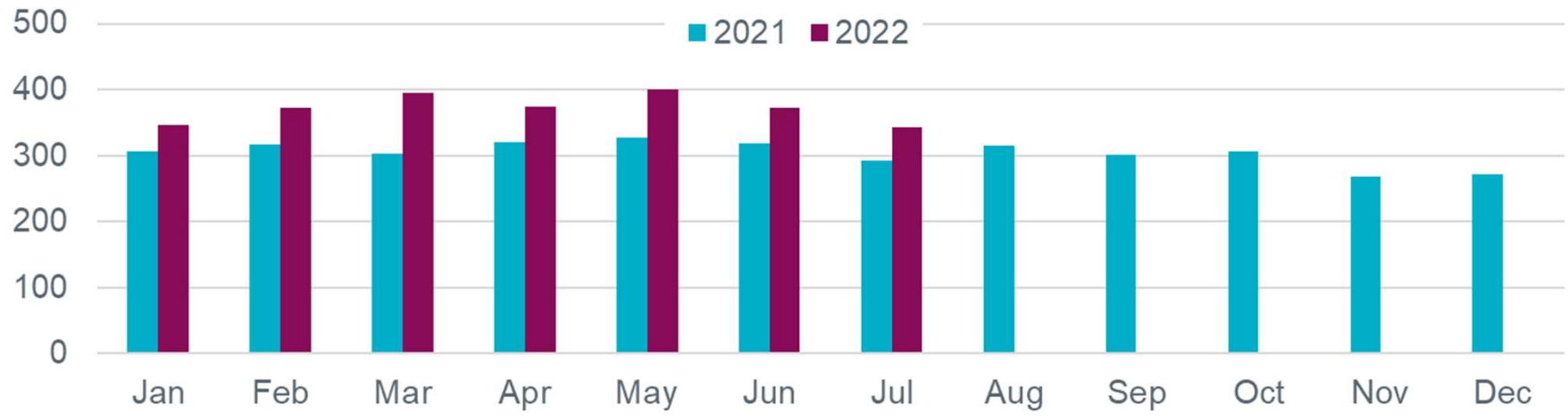


Regulation Down Requirement Comparison for June

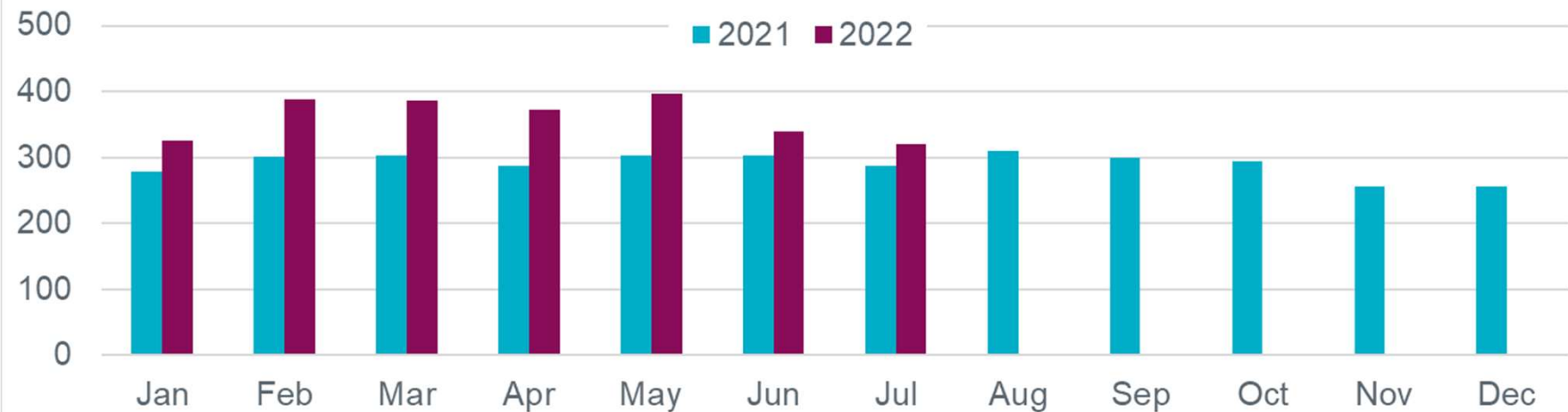


Average Regulation Comparison

Average Regulation Up Requirement Comparison



Average Regulation Down Requirement Comparison

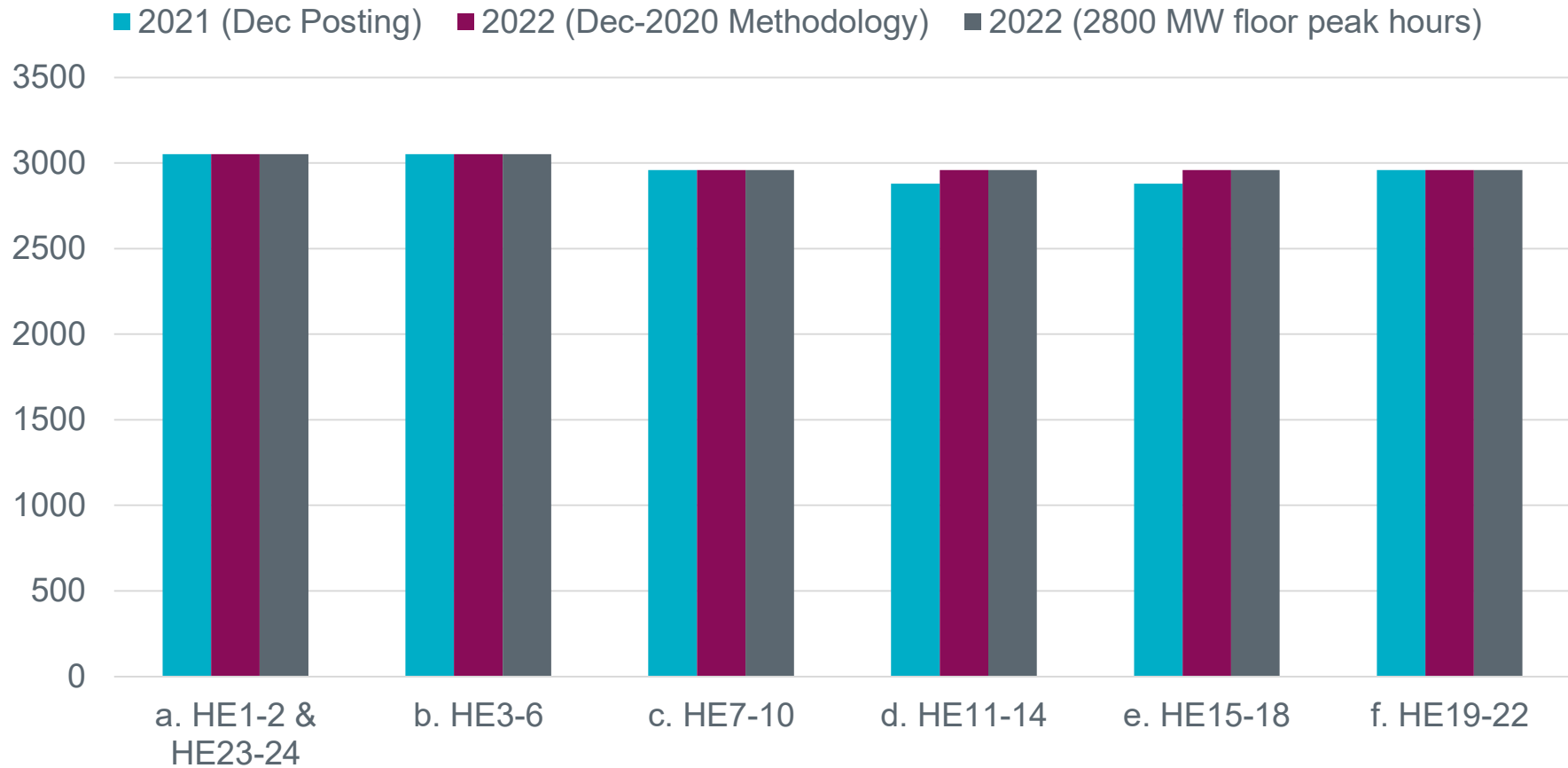


Responsive Reserve Service (RRS) Methodology

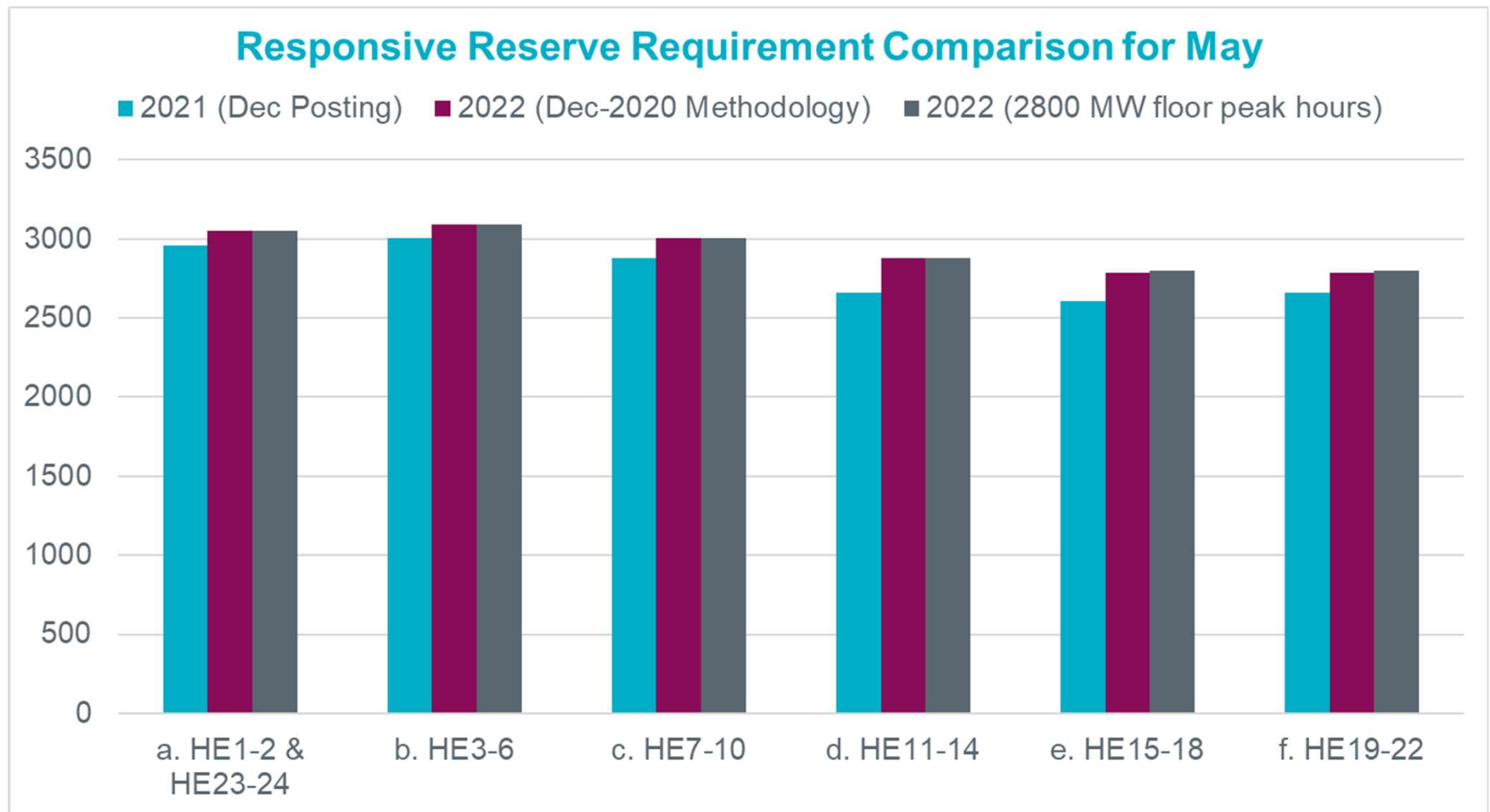
- ERCOT is proposing one change to the methodology used to compute the minimum RRS requirements for 2022.
 - A floor of 2800 MW will be applied to RRS quantities during the peak. During the peak hour, this additional RRS will help maintain a larger operating margin.
- The preliminary RRS quantities for January 2022 through July 2022 in subsequent slides have been computed using 2020 and 2021 system inertia conditions and updated RRS table.
 - The RRS table tracks RRS requirements for different inertia conditions. This table was updated for 2021 to use a minimum RRS-PFR limit of 1420 MW.

RRS January

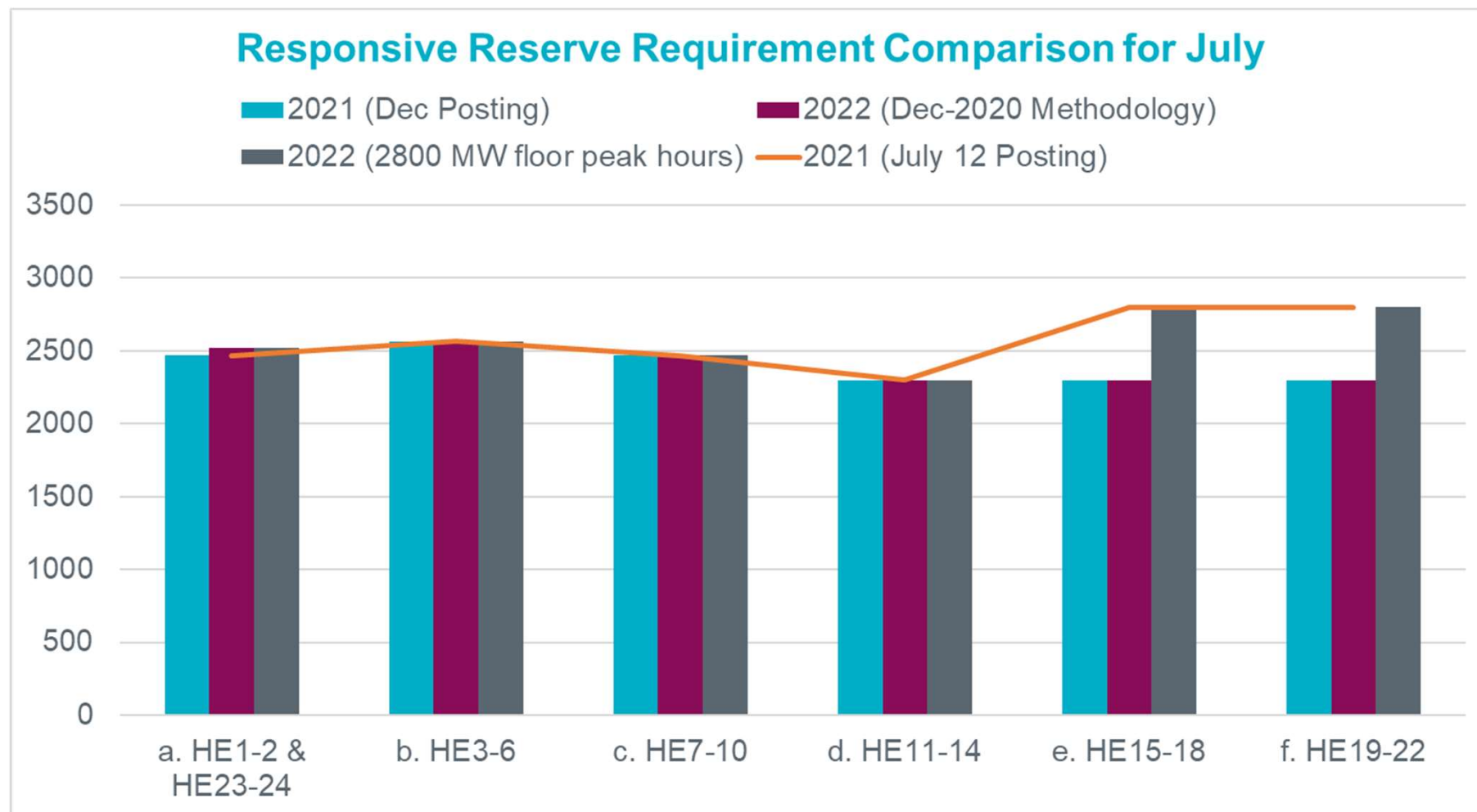
Responsive Reserve Requirement Comparison for January



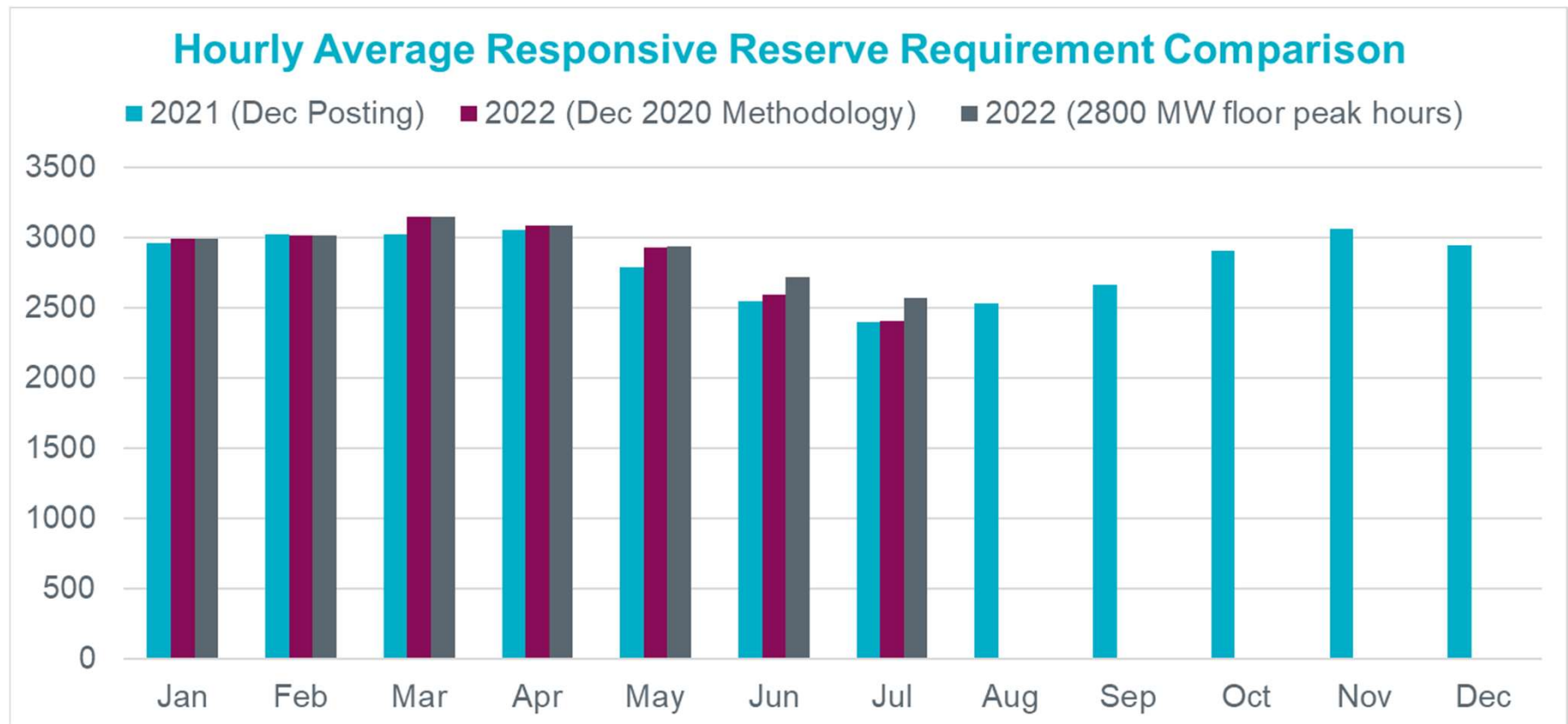
RRS May



RRS July



Hourly Average RRS Comparison



Non-Spinning Reserve Service Methodology

- ERCOT is proposing the following changes to the methodology used to compute minimum Non-Spin requirements in 2022
 - Update the hourly net load forecast uncertainty calculation to use
 - the 6 Hours-Ahead net load forecast, and
 - the highest 5-min net load within the hour
 - Change percentile coverage to vary between 85th and 95th. The applicable coverage for any hour will continue to be based on risk of net load up ramp in the hour
 - Build a table that tracks historical intra-day variations in thermal resource availabilities due to Forced Outages and use it to incrementally increase Non-Spin quantities.
- ERCOT will continue the practice of monitoring the weather near Real Time and may procure up to an additional 1,000 MW of Non-Spin for Operating Hours that are identified as having an increased potential of high forecast variability that may cause a higher net load during these hours.
- The preliminary Non-Spin quantities for January 2022 through July 2022 in subsequent slides have been computed using current methodology (2019, 2020 and 2021 Net load and Net load Forecast), updated Wind Over-Forecast Error Adjustment table and the proposed Solar Over-Forecast Error Adjustment table.

Drivers for the methodology changes

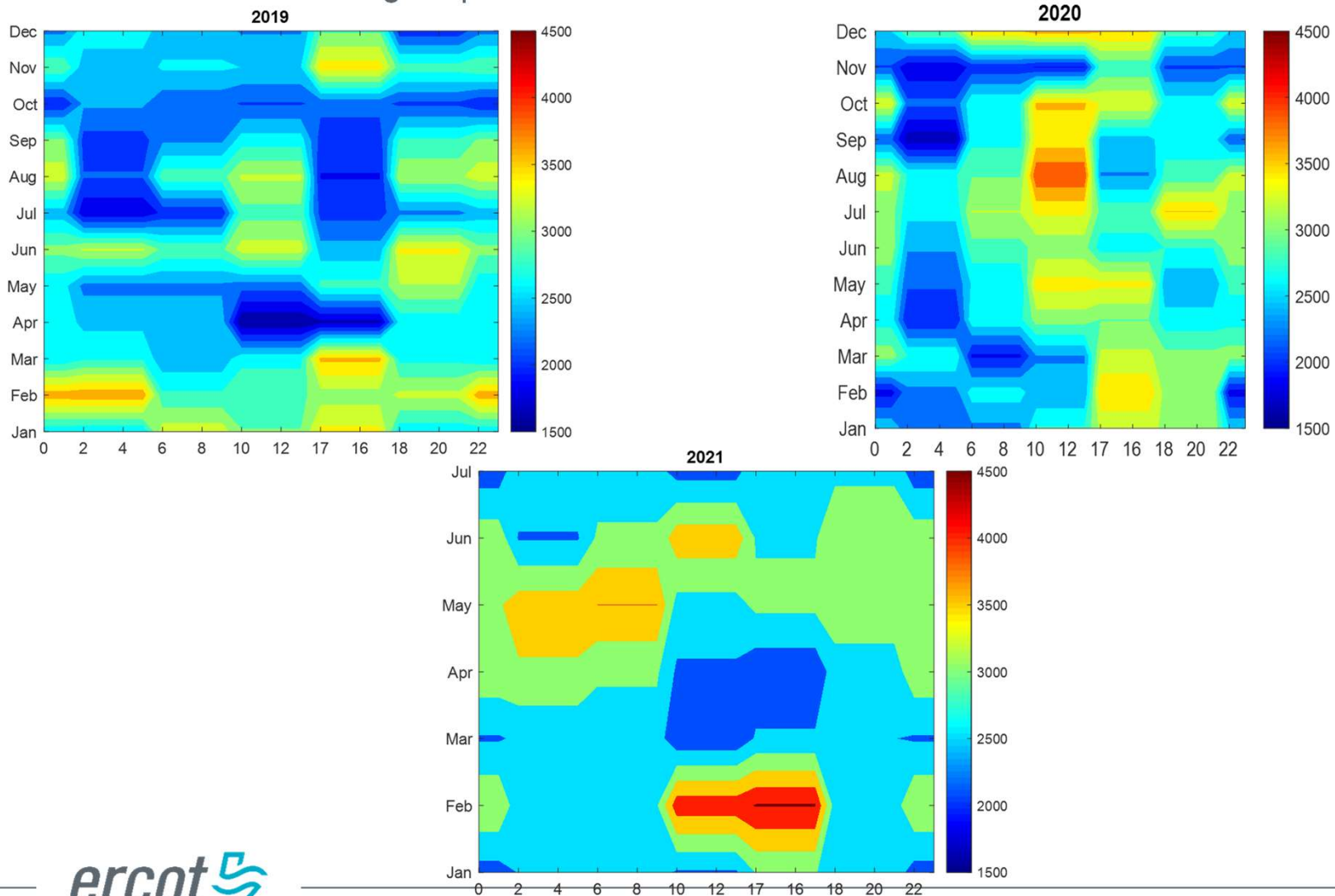
- **3 Hours Ahead vs. 6 Hours Ahead:** On tighter days in Summer months generally units with 6 hours+ lead times tend to be available for RUC; these lead time tend to double during winter when units available for RUC are typically “cold”. Since forecast uncertainties tend to be a bit higher further away from the operating hours, using 6-hours ahead forecast errors allows to better reflect this risk in the computed Non-Spin quantities.
- **Hourly Average vs. Max 5-min Net load:** Intra-hour net load patterns due to load/wind/solar can be vastly different even with same hourly average values. By using the highest 5-min net load within the hour, the largest net load forecast error for the hour will be used in determining Non-Spin quantities.



- **75th to 95th vs. 85th to 95th Percentile Coverage:** Larger net load forecast errors have been observed during off peak hours. This change captures the increased risk for off peak hours in the Non-Spin methodology.
- **Intra-day Forced Outage table:** This table will help account for increased capacity needs following forced outages of thermal resources within an operating day.

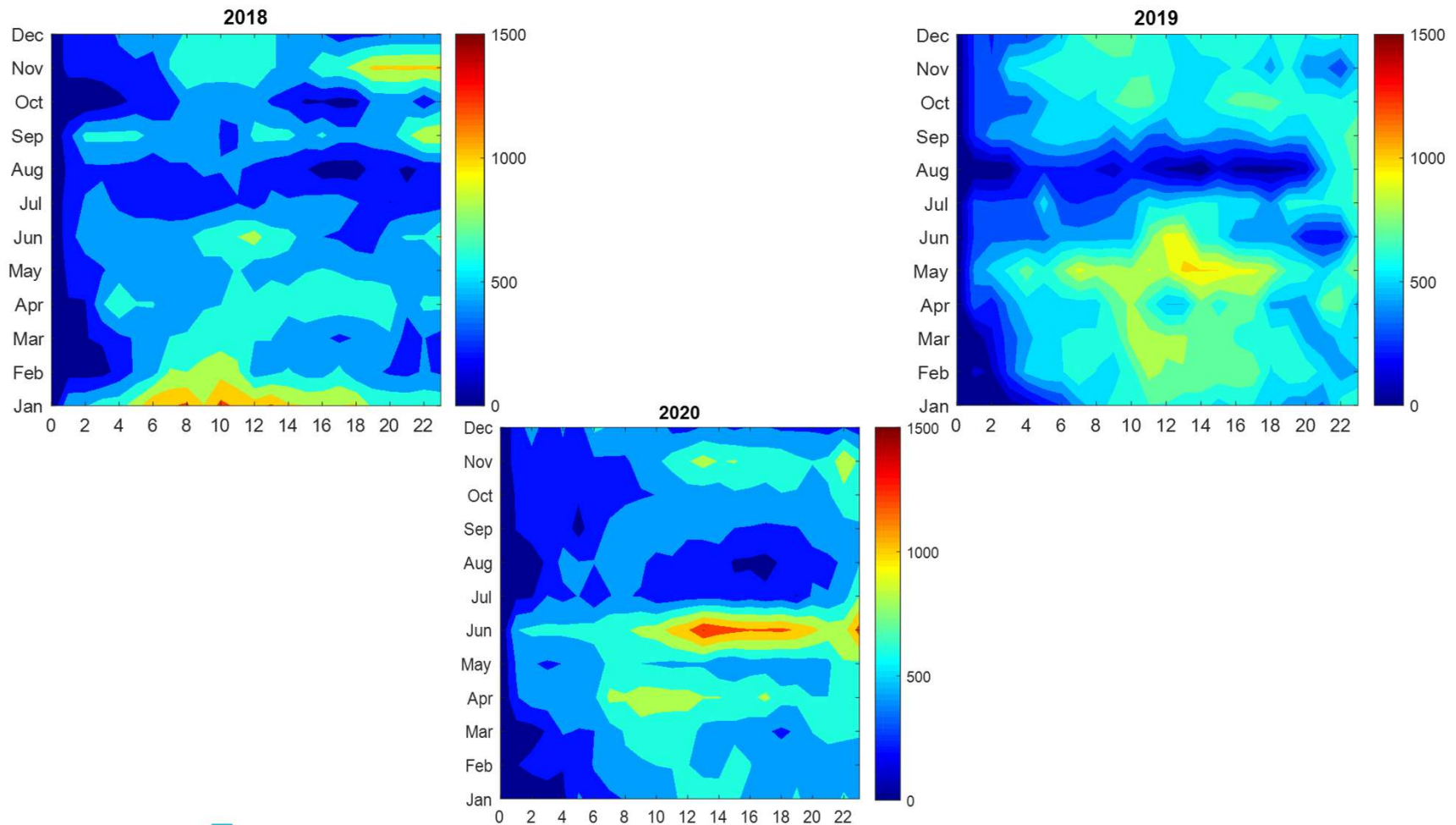
Trends in 6HA Net Load Forecast Error

- As years progress, an increase in magnitude of the 6 Hours-Ahead net load forecast error can be observed during off peak hours



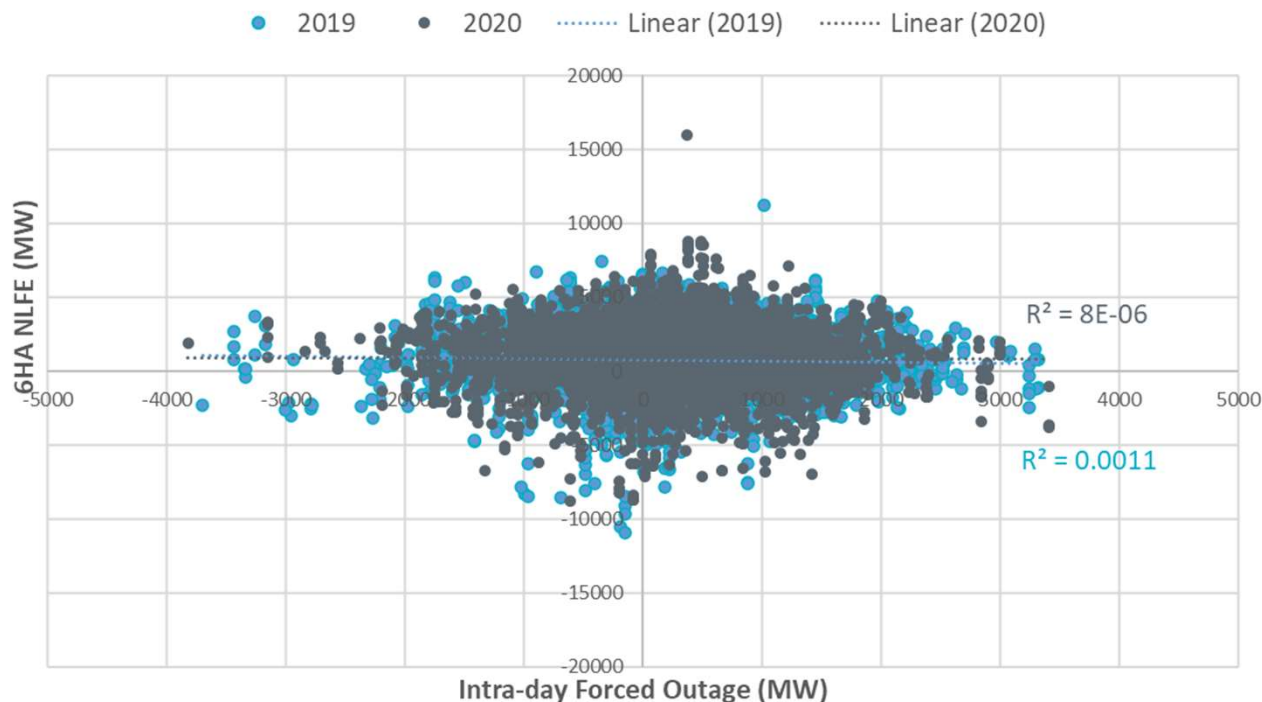
Intra-Day Forced Outage Rate

- For 2018, 2019 and 2020, the heat maps below show the 75th percentile of the maximum accumulated forced outage on thermal units (excluding IRR and PUN) since midnight for every hour in each month.



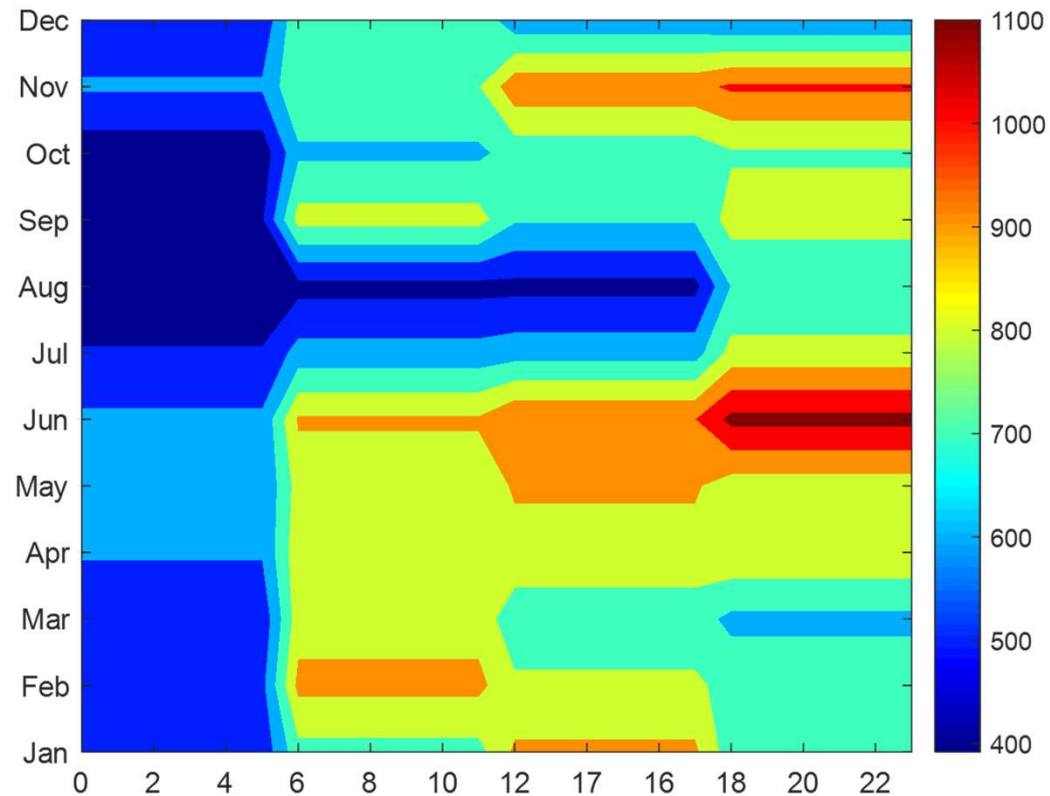
Intra-Day Forced Outage Rate vs Net Load Forecast Error

- For every hour in 2019 and 2020, the plot below tracks the maximum accumulated forced outage on thermal units (excluding IRR and PUN) since midnight as a function of 6 Hour-Ahead net load forecast error for the hour.
 - The largest accumulated intra-day forced outage is ~3,500 MW and the largest 6 Hour-Ahead net load forecast error is ~15,000 MW.
- As can be observed, extreme intra-day forced outages and highest net load forecast error do not tend to occur at the same time.



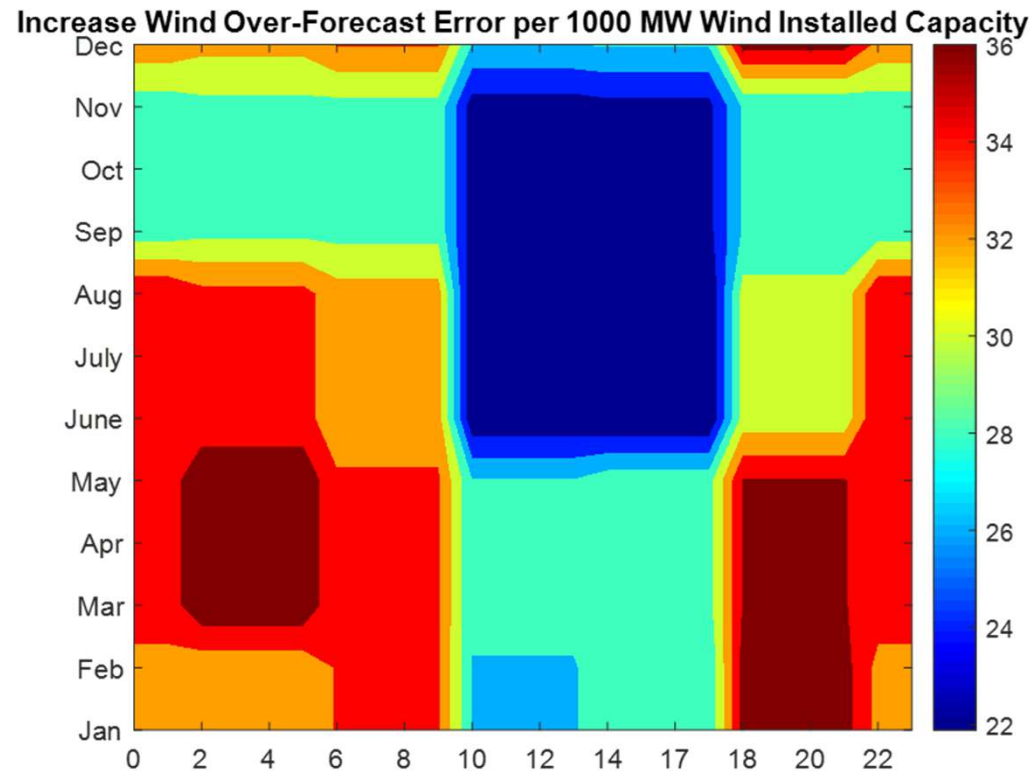
Proposed Intra-Day Forced Outage Table 2022

- The proposed Intra-Day Forced Outage table has been built using 75th percentile of the maximum accumulated forced outage in a 6-hour block for each month in 2018, 2019, 2020.
 - For the purposes of building this table, a conservative 75th percentile coverage is recommended due to the observation that the extreme forced outages tend to not occur at the same time as the highest net load forecast error.



Wind Over-Forecast Error Adjustment Table 2022

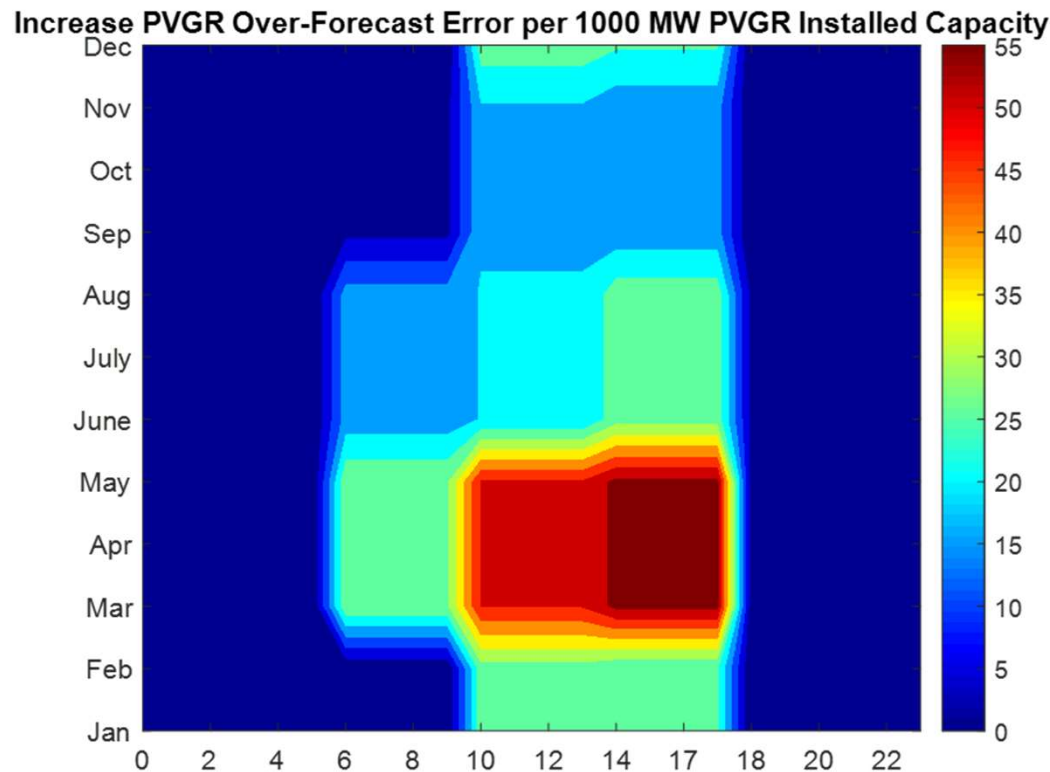
- Wind Over-Forecast Error Adjustment Table track estimated increase in wind over forecast error per 1000 MW increase in installed wind capacity.



Max: 39 MW per 1000 MW additional Wind capacity
Mean: 31 MW per 1000 MW additional Wind capacity

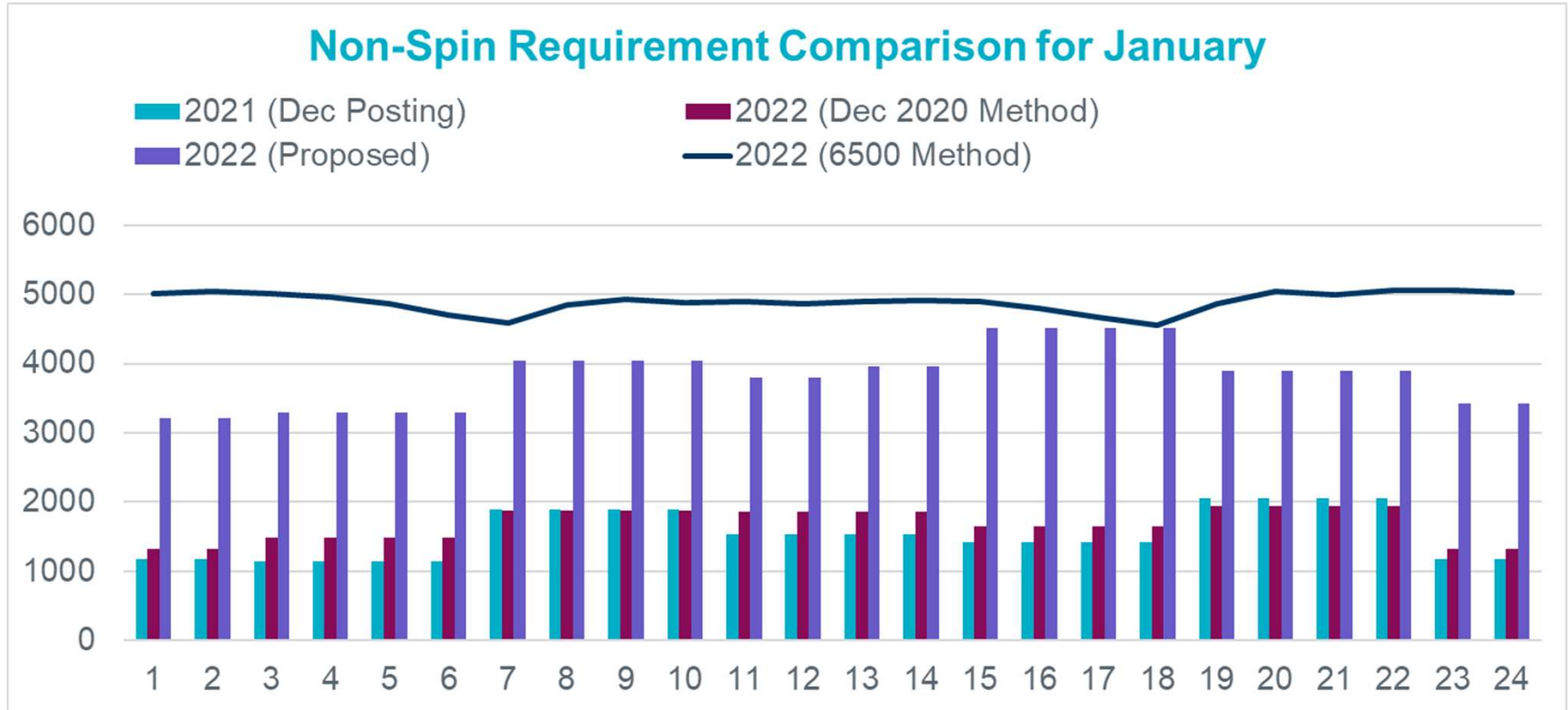
Solar Over-Forecast Error Adjustment Table 2022

- Solar Over-Forecast Error Adjustment Table track estimated increase in solar over forecast error per 1000 MW increase in installed solar capacity.

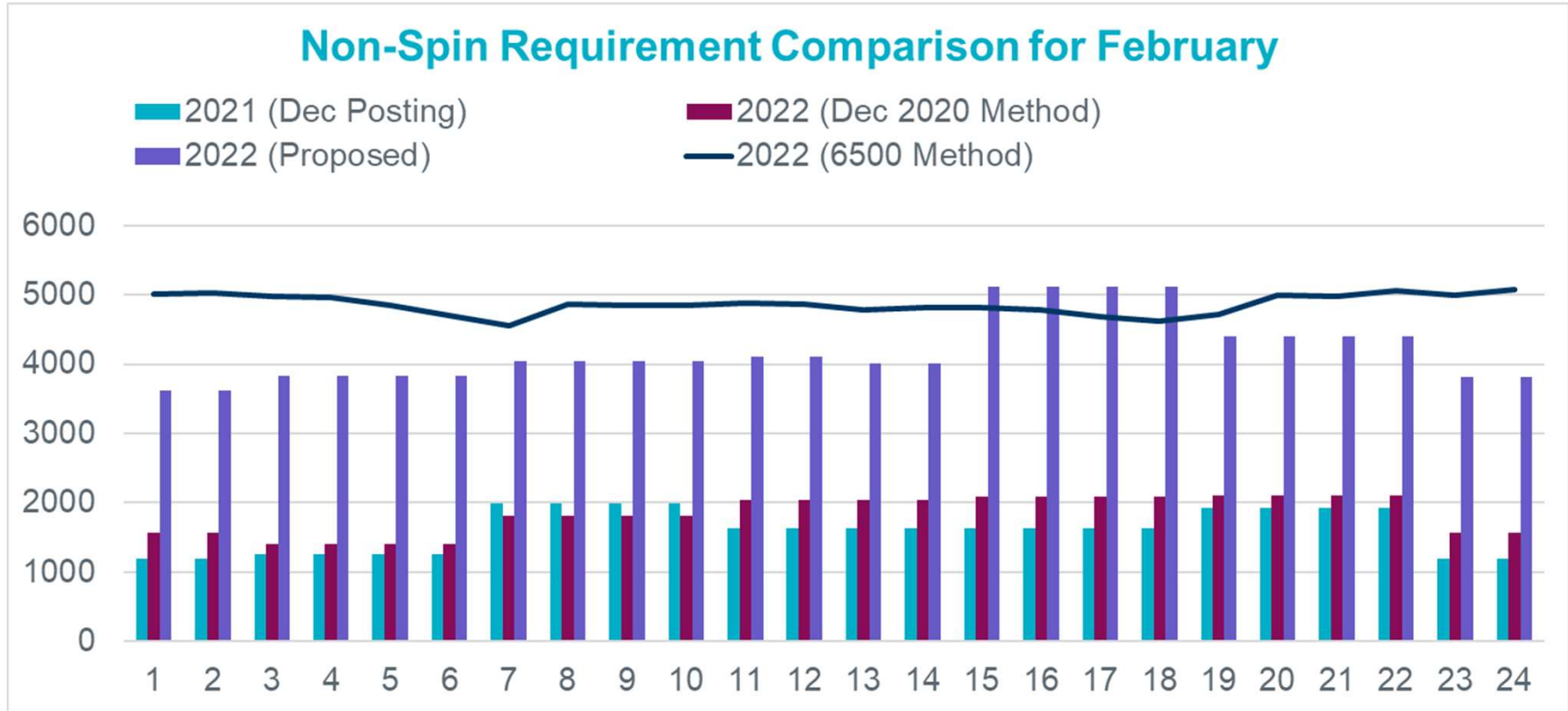


Max: 56 MW per 1000 MW additional solar capacity
Mean: 13 MW per 1000 MW additional solar capacity

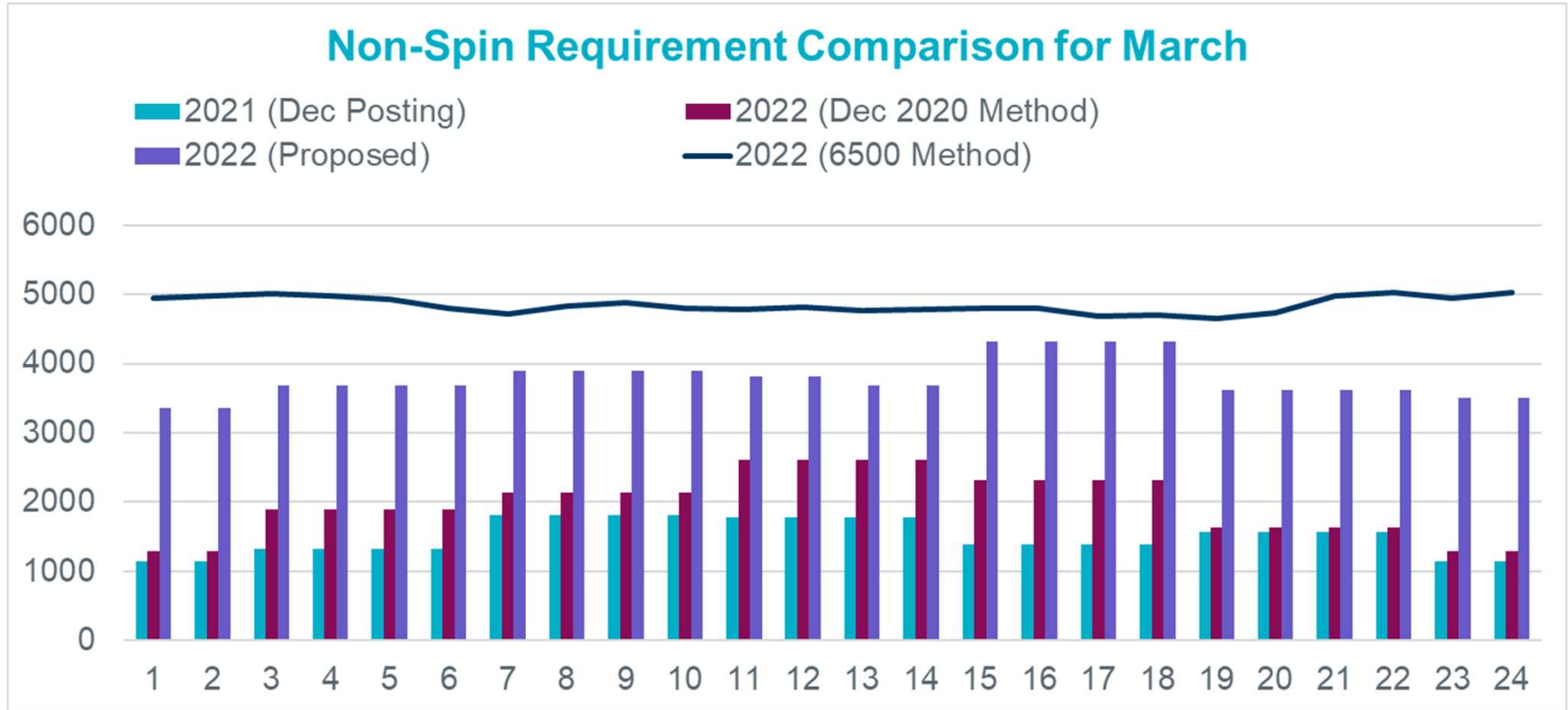
Non-Spin January



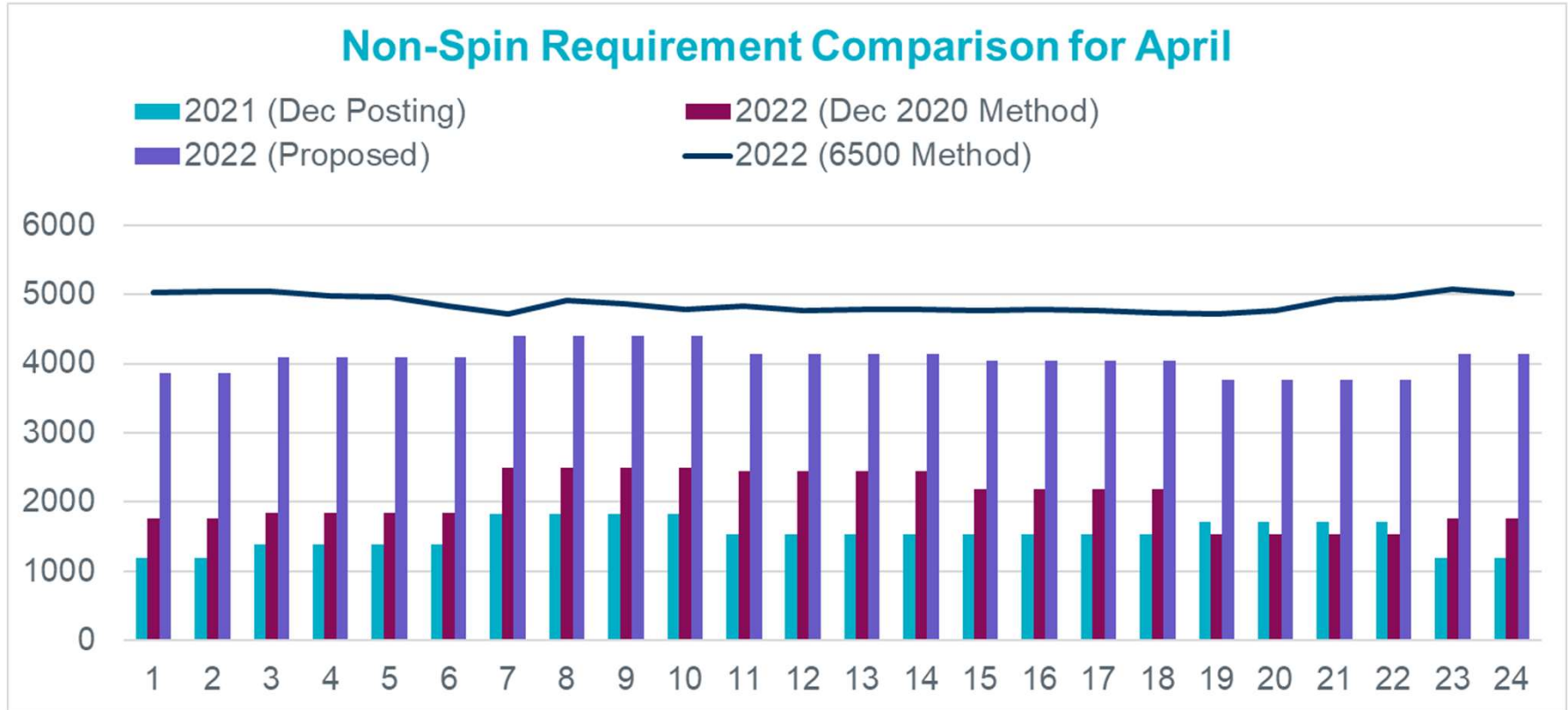
Non-Spin February



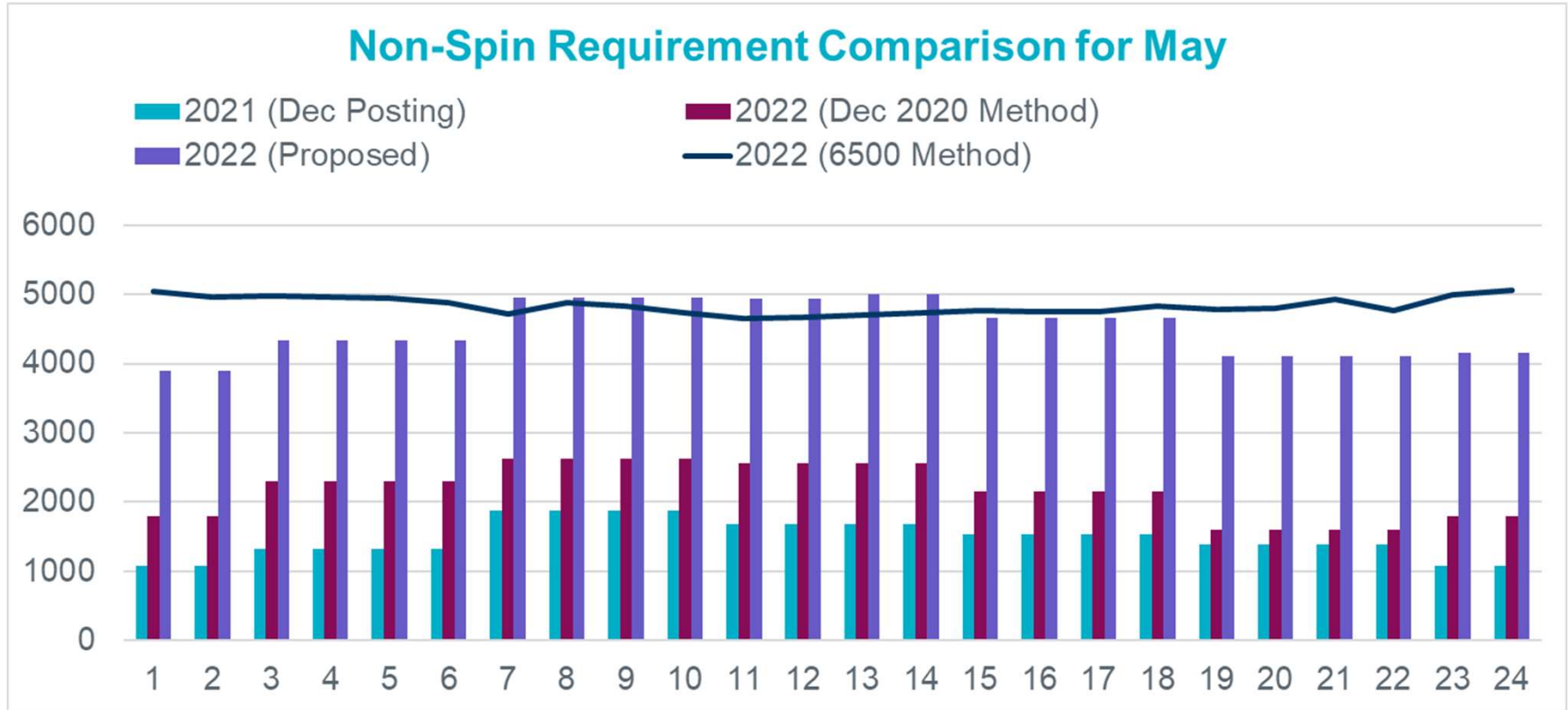
Non-Spin March



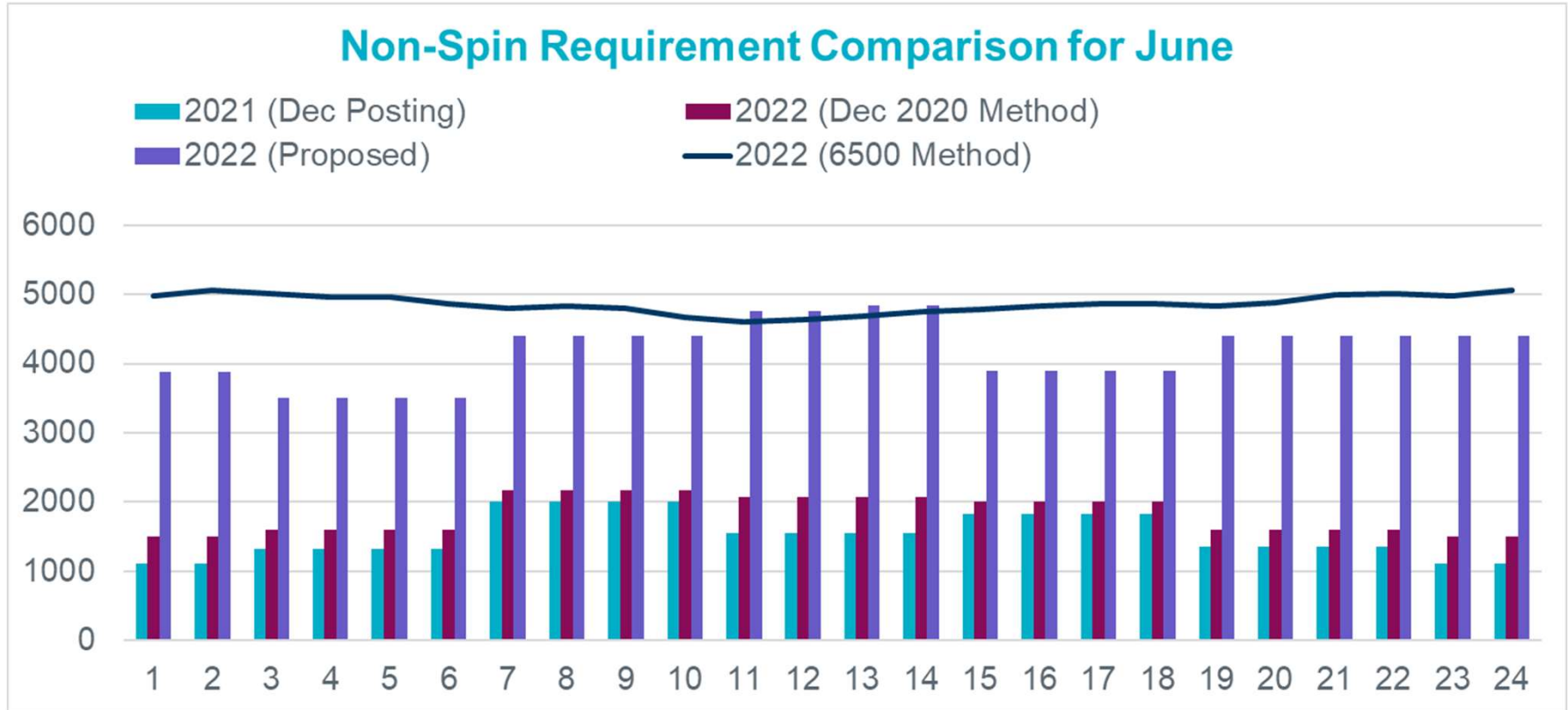
Non-Spin April



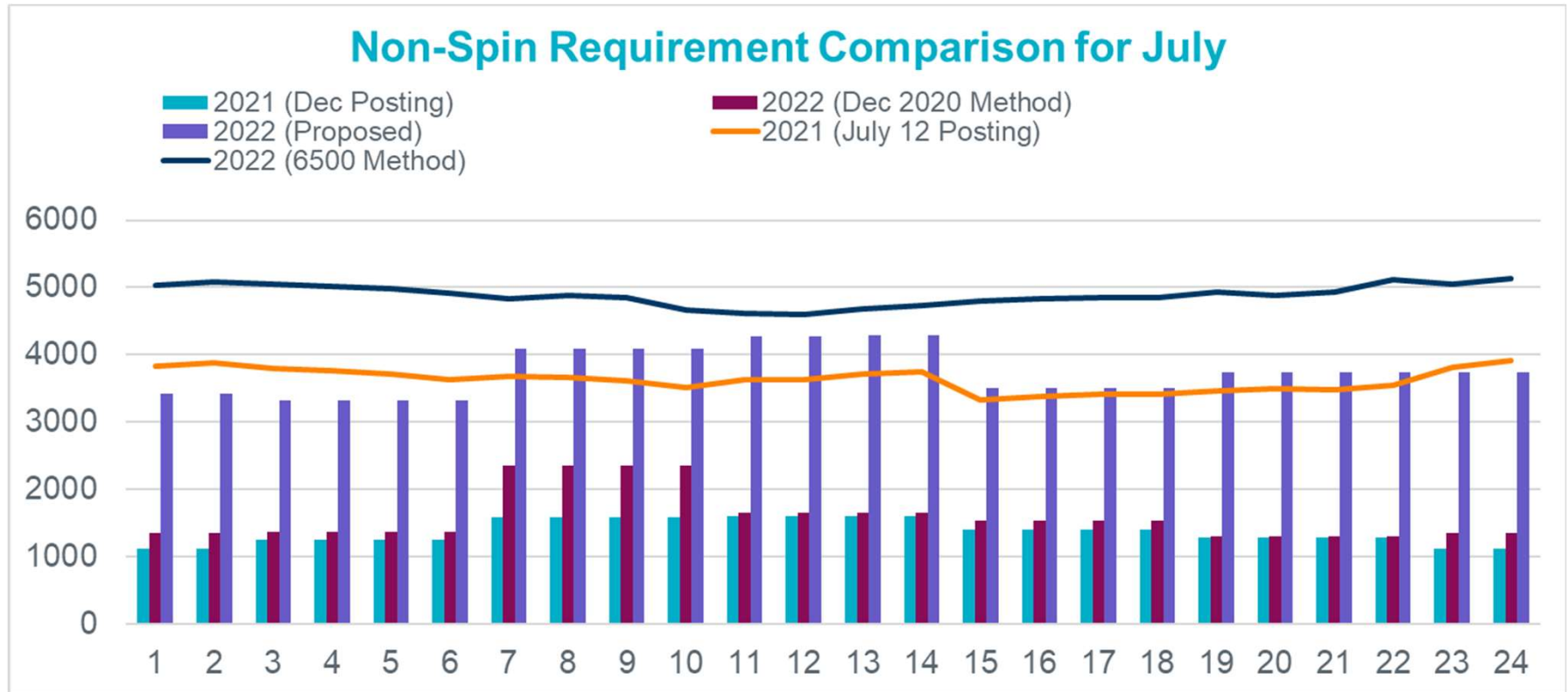
Non-Spin May



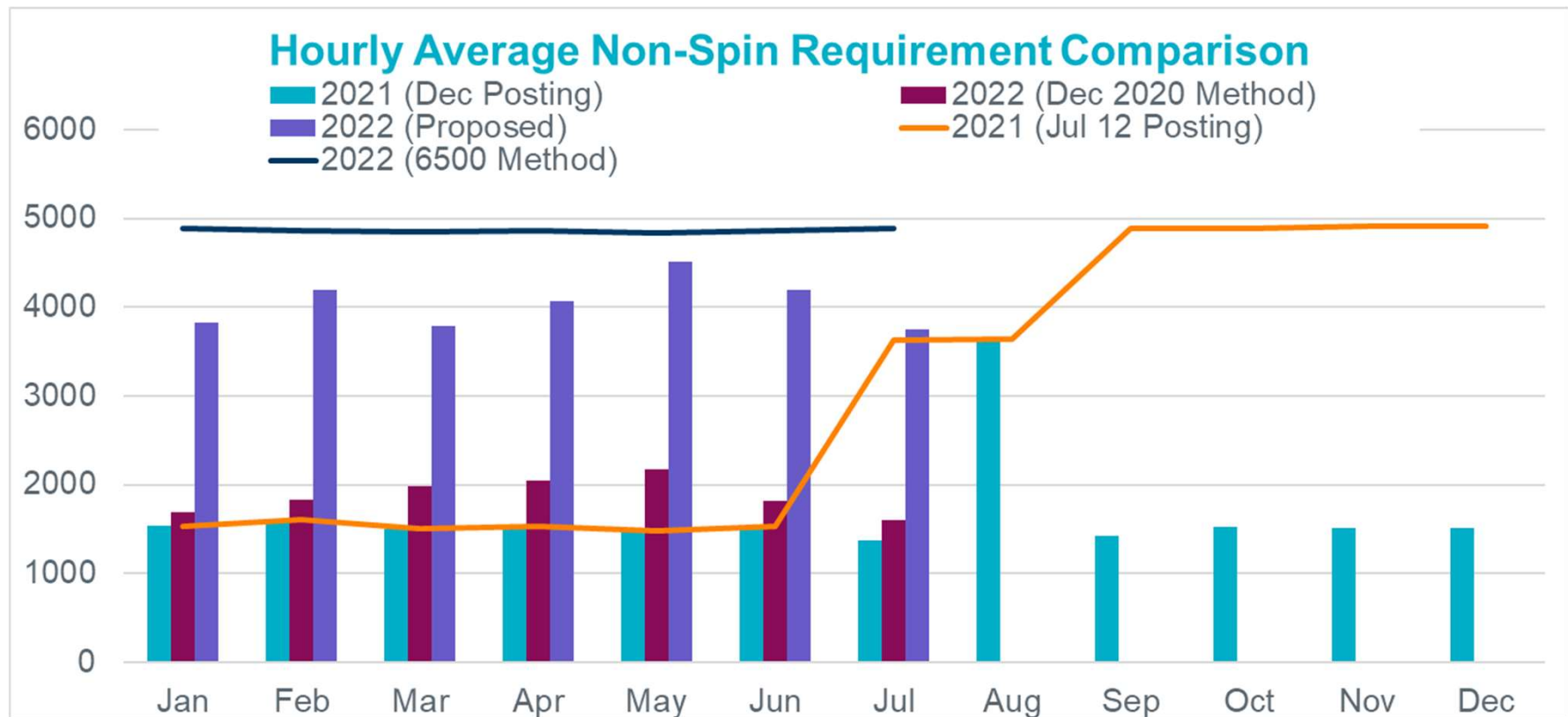
Non-Spin June



Non-Spin July



Hourly Average Non-Spin Comparison



DISCUSSION

Monthly Non-Spin Deployment 2019 through 2021*

- Deployment of Non-Spin from online Resources with an Energy Offer Curve is considered as a standing Non-Spin deployment Dispatch Instruction for the duration of the Operating Hour.
- Table below contains summary of monthly offline Non-Spin deployments

YEAR	MONTH	DAY	MAXIMUM MW DEPLOYED	TOTAL DURATION (HR)
2019	September	22	74	0.03
2019	October	5	305	1.22
2019	December	22	115	3.54
2020	February	3	145	4.50
2021	February	13	324	3.81
2021	February	14	149	0.72
2021	February	15	389	24.00
2021	February	16	422	24.00
2021	February	17	379	24.00
2021	February	18	537	24.00
2021	February	19	372	10.15
2021	April	11	523	1.23
2021	April	13	375	3.55
2021	June	13	696	4.63
2021	June	14	512	2.06