Renewable Forecasting Education

December 5, 2024

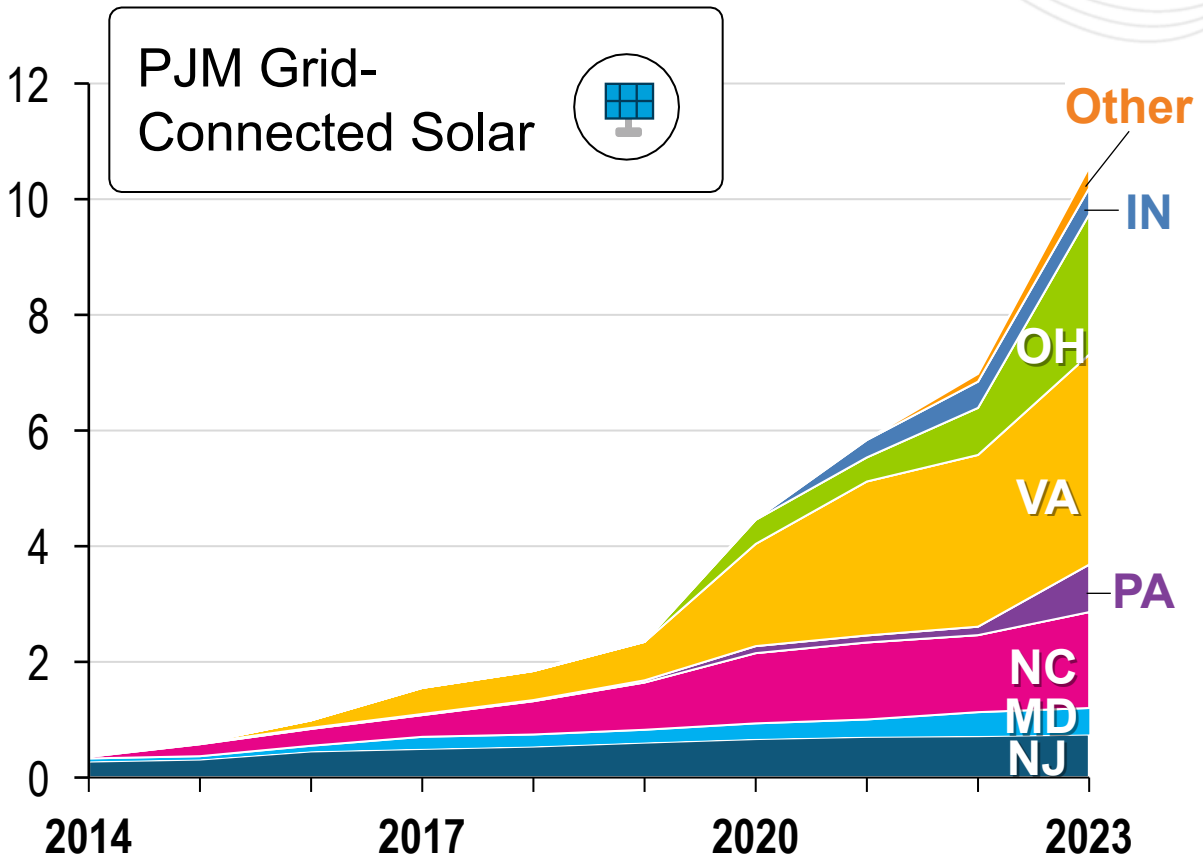
Michael Stewart

Joseph Mulhern

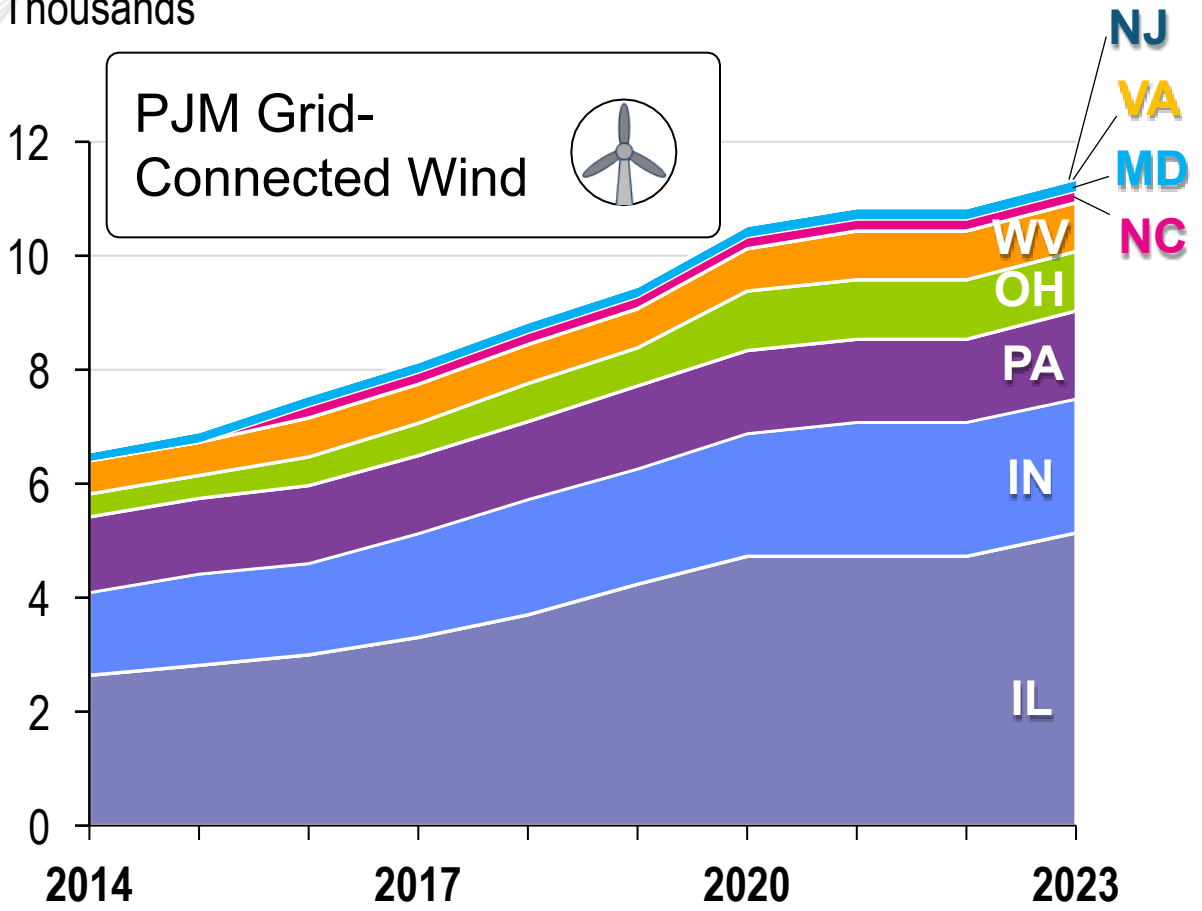
PJM © 2024

Ten Years of Renewable Growth in PJM

Installed Capacity (MWDC)
Thousands



Installed Capacity (MWAC)
Thousands



As of April 2024 | Source: GATS

PJM © 2024

Renewable Forecast Input

Weather Forecast

- Global and regional forecasts

Dynamic Data

- MW/MVAR output
- Meteorological Data
- Outage/Derate

Static Data

- MFO
- AC/DC Installed Capacity
- Locational Longitude /Latitude
- Panel Manufacturer and model
- Extreme Cold Operating Capability

PJM © 2024

Forecast Development Process

Interconnection Coordination

PJM and members
- Set up static data
- Set up real-time data

Activation of Forecast

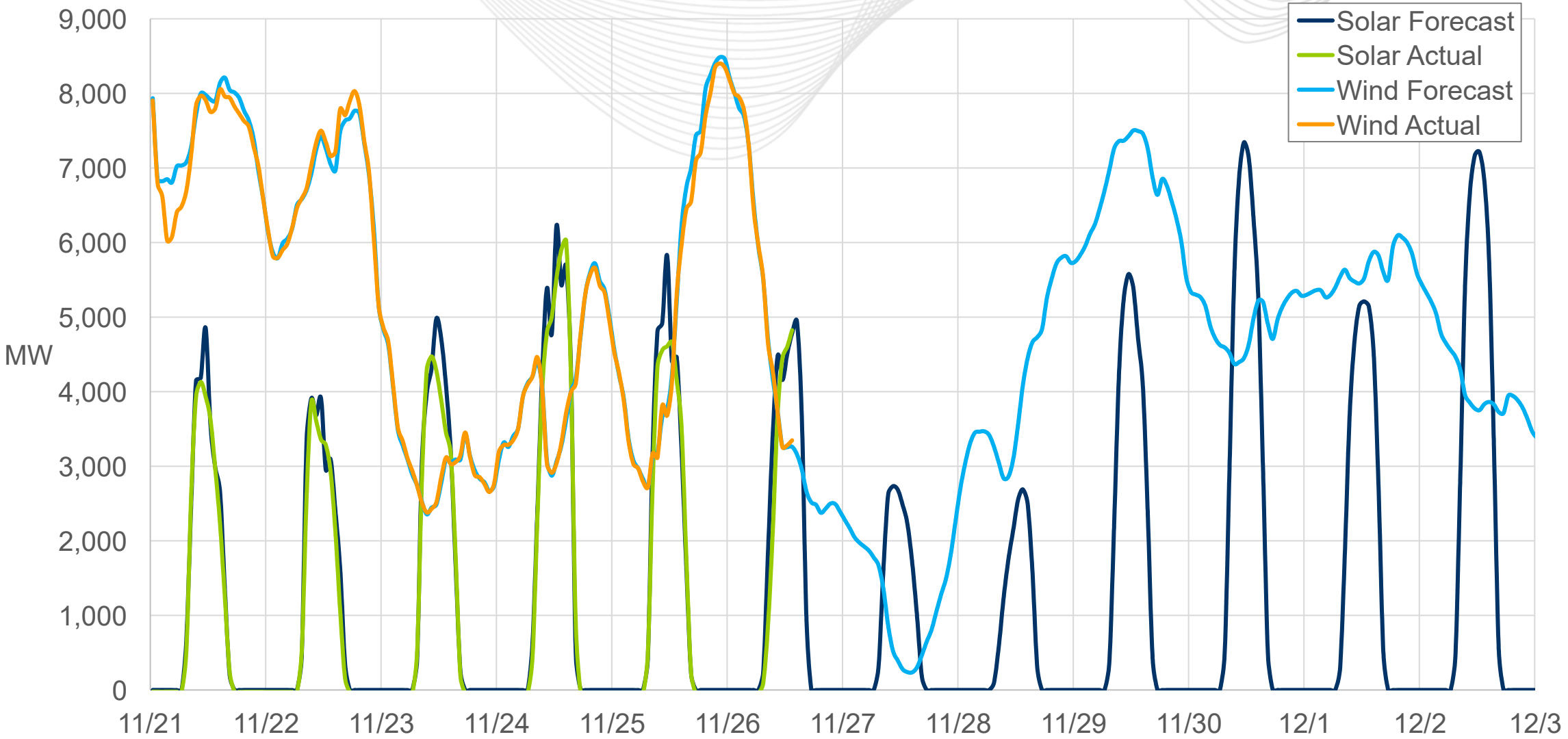
- PJM accounts for new forecasts in systems
- PJM works with renewable vendor to produce forecasts

Monitor Forecast

- PJM monitors health of new forecast
- PJM incorporates forecast into overall metrics

PJM © 2024

RTO Solar and Wind – Actuals and Forecasts



PJM © 2024

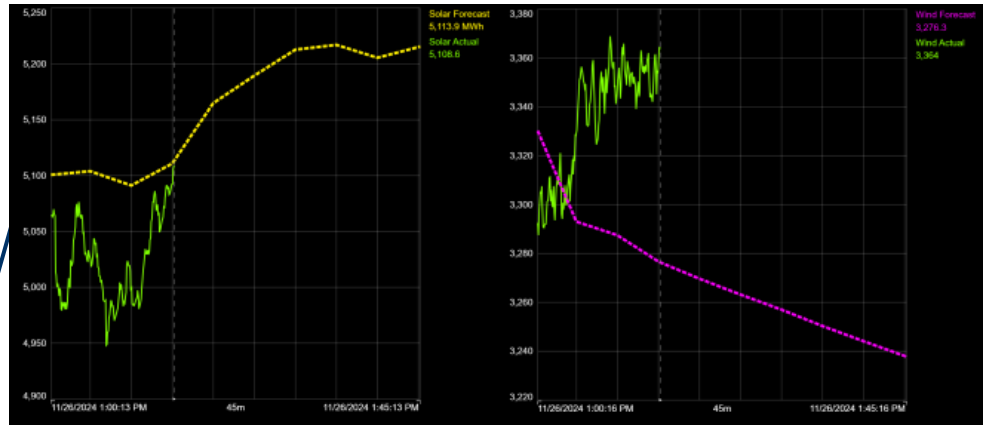
Downstream Consumption

ITSCED

Long Lead Tool

Day Ahead Scheduling Reserve tool

Control Room Visualization



PJM © 2024

Renewable Forecast Metrics

Performance Metric	Description	Uses
Daily RTO-wide Solar and Wind Performance	Single error value measured in MW for all hours in the day	Day-to day situational awareness and development of forecast
Daily RTO-wide Solar and Wind Performance at Peak Only	Error value measured in MW for peak hour only	Input into day-ahead scheduling reserves
Rolling 5-7 Day RTO-wide Solar and Wind Performance	Actuals compared to forecast for wind and solar with error measured in MW	Longer horizon situational awareness of renewable performance
Daily Zonal Solar and Wind Performance	Single error value measured in MW for all hours in the day by PJM zone	Understanding of zonal impact on RTO total
Daily Zonal Solar and Wind Performance at Peak Only	Error value measured in MW for peak hour only by PJM zone	Understanding of zonal impact on RTO total for day-ahead scheduling reserves input
Rolling 5-7 Day Zonal Solar and Wind Performance	Actuals compared to forecast for wind and solar with error measured in MW by Zone	Forecast accuracy relative to overall output
Daily Data Quality Tracking	Individual unit tracking of forecast data	Detects bad data/ data quality issues

PJM © 2024

What Causes Renewable Forecast Error?

Weather forecast error

Sudden changes in weather

Data Quality

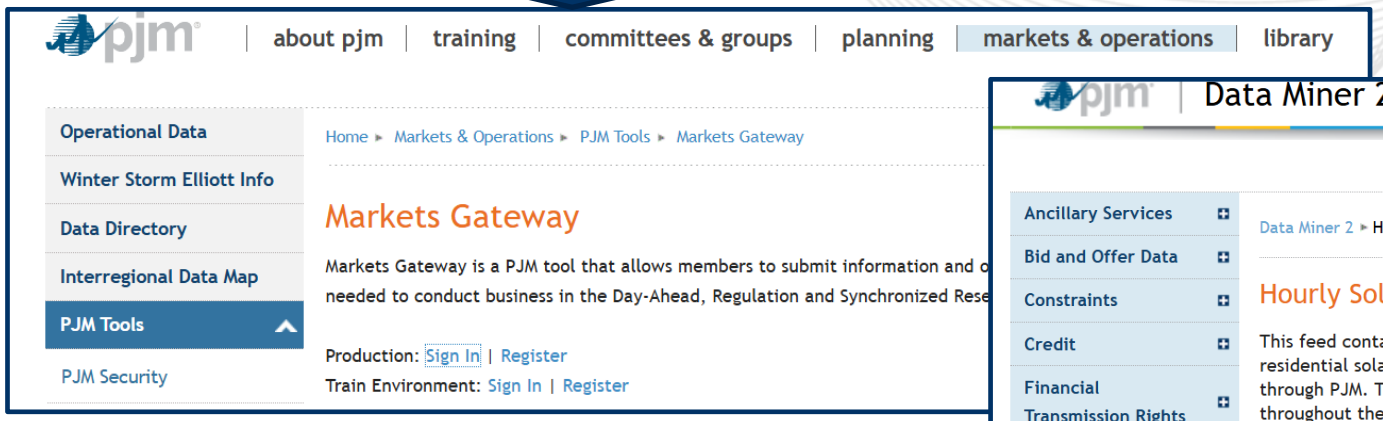
Extreme Weather (snow, icing)

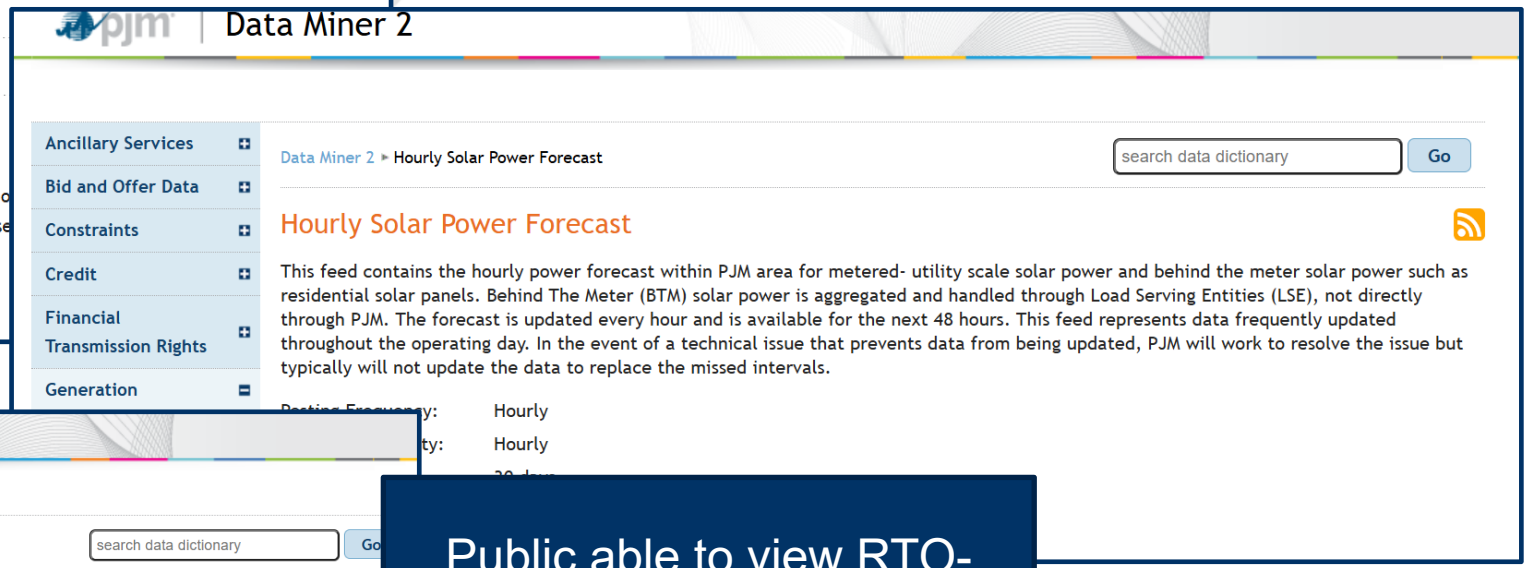
Accurate Outage Reporting

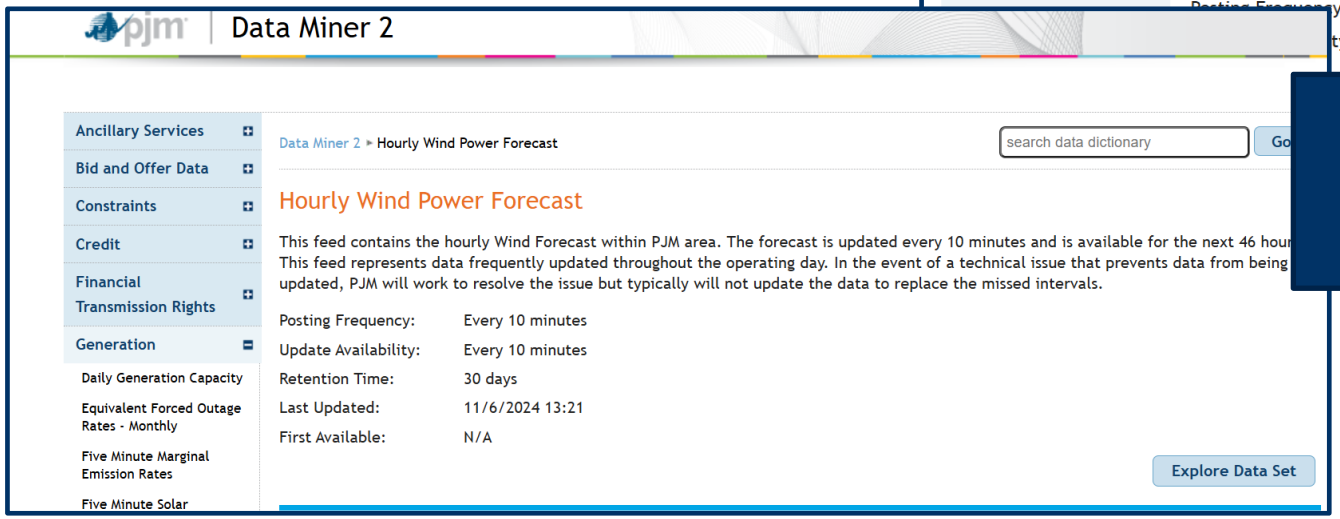
PJM © 2024

Renewable Forecast Posting

Members able to view their unit's PJM forecast



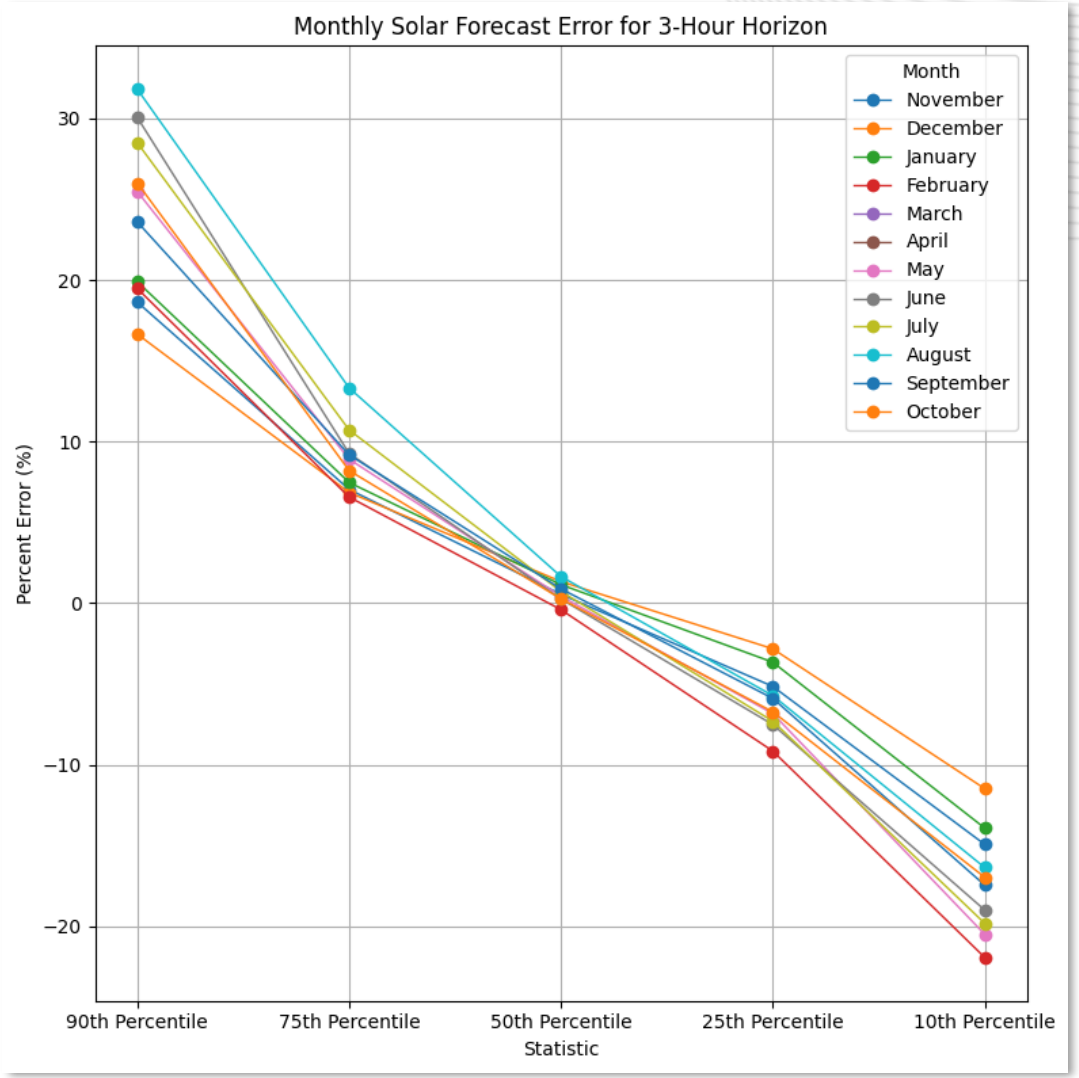


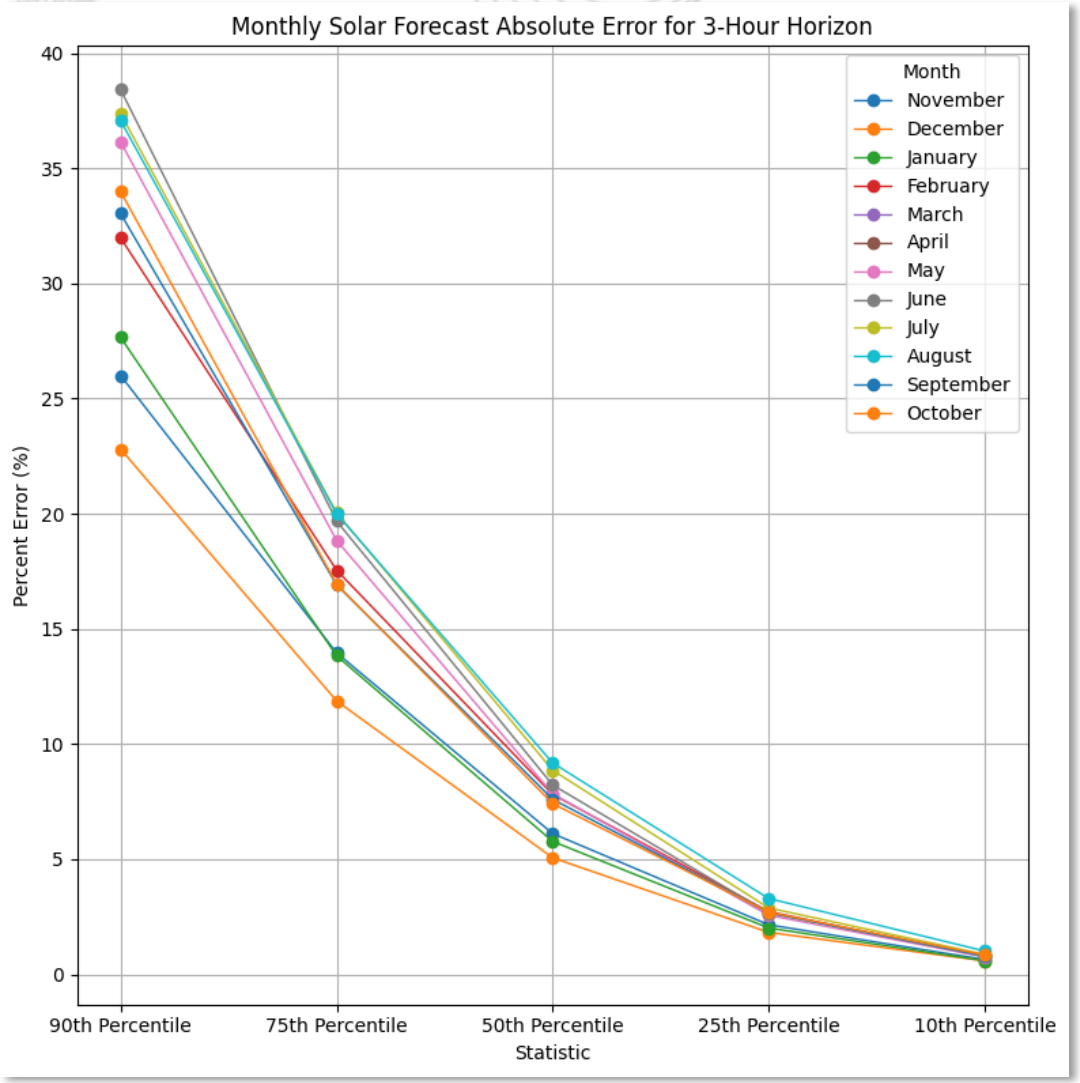


Public able to view RTO-wide Aggregate Forecast

PJM © 2024

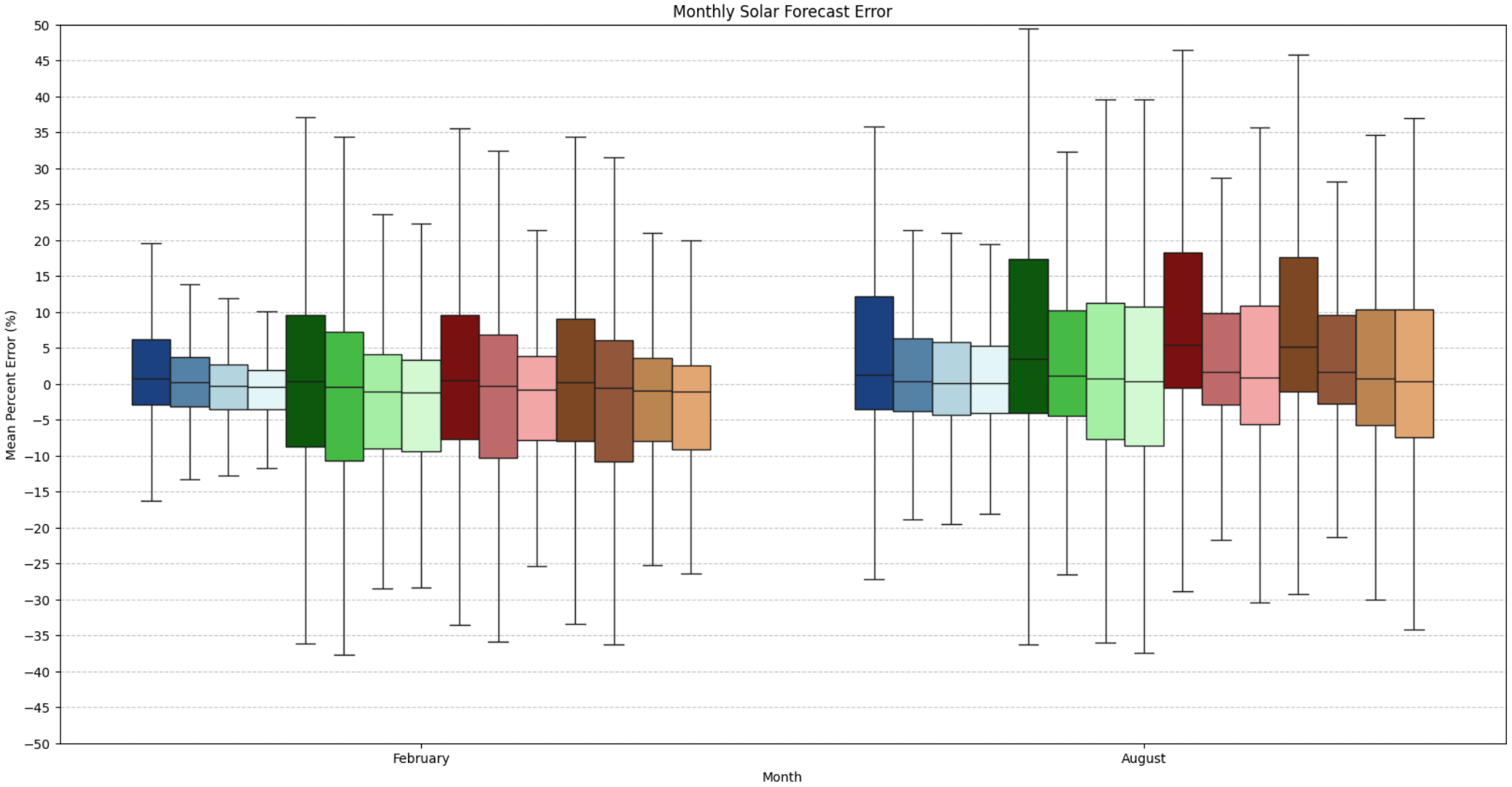
Monthly Solar Forecast Error for 3-Hour Horizon *(11/1/2023-10/31/2024)*





PJM © 2024

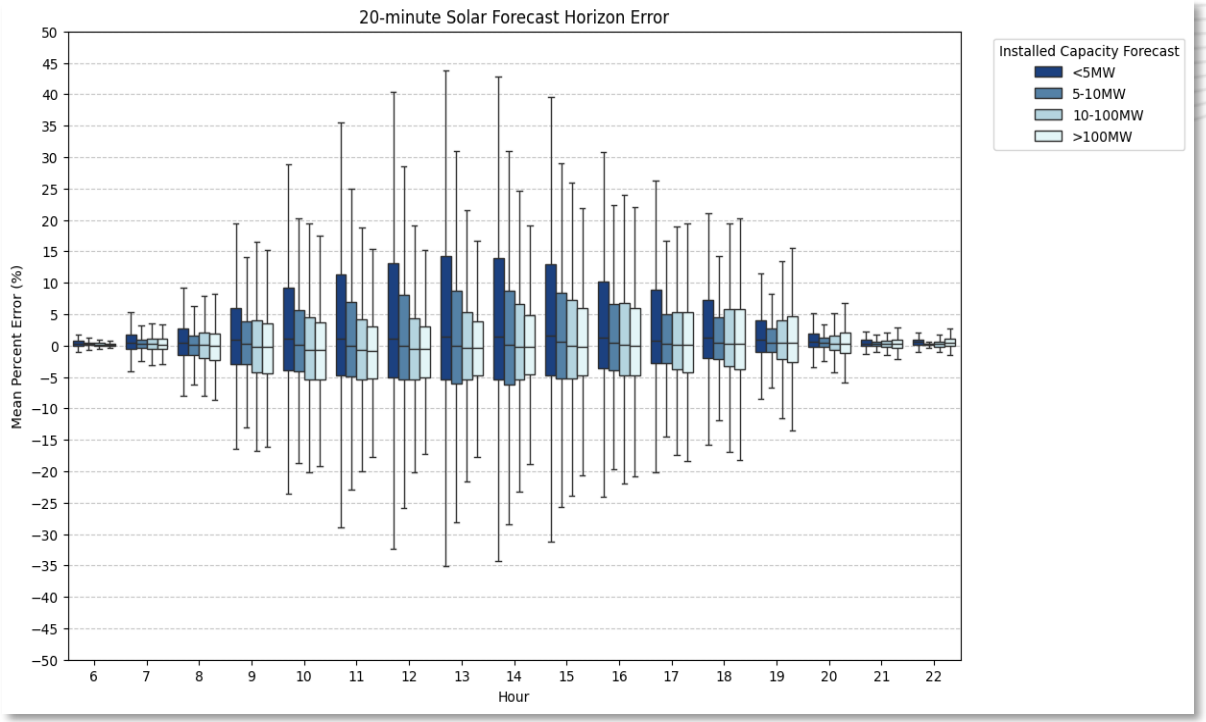
Monthly Error Comparison by Capacity/Horizon



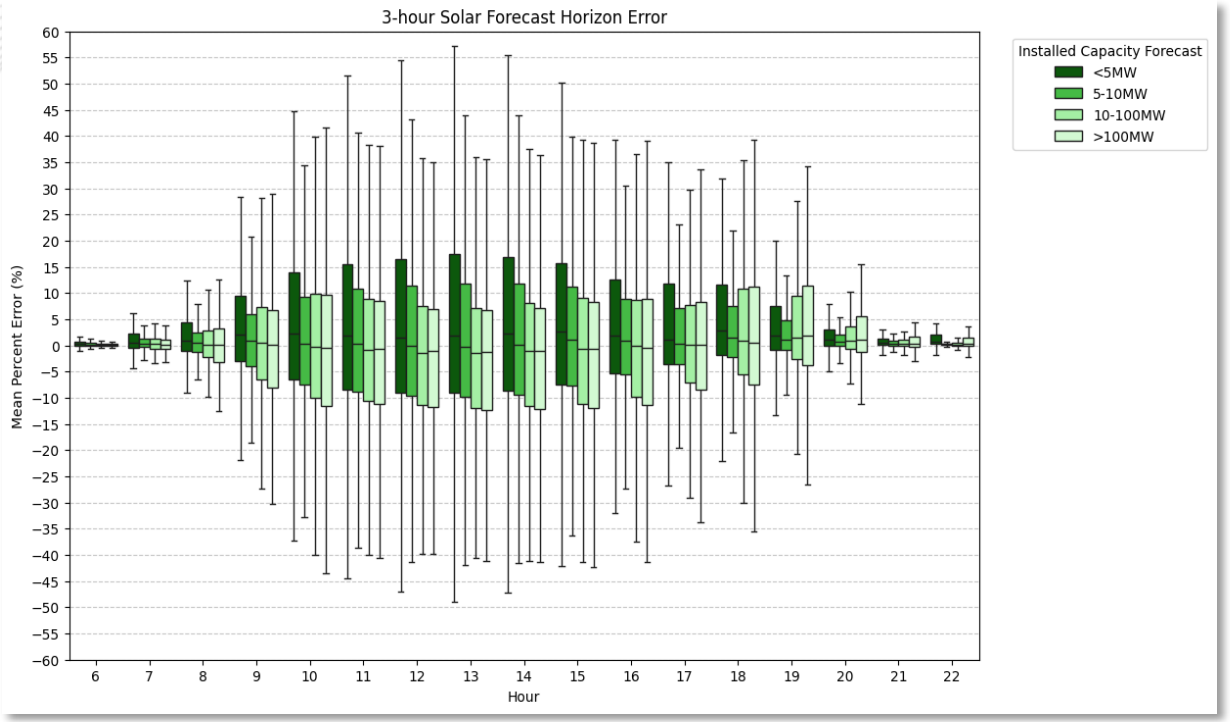
- Higher variance of error in summer month
- More likely to over-forecast in summer month

PJM © 2024

Real-time Hourly Error by Capacity/Horizon *(11/1/2023-10/31/2024)*



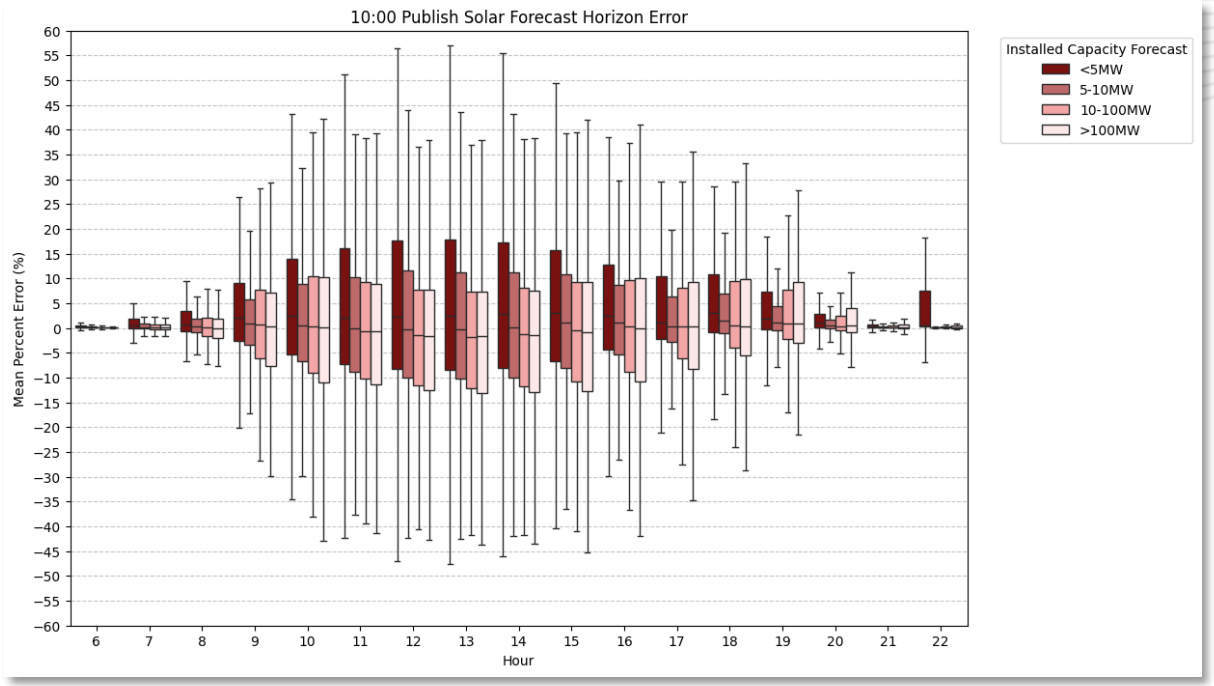
- Higher error/variance for smaller units

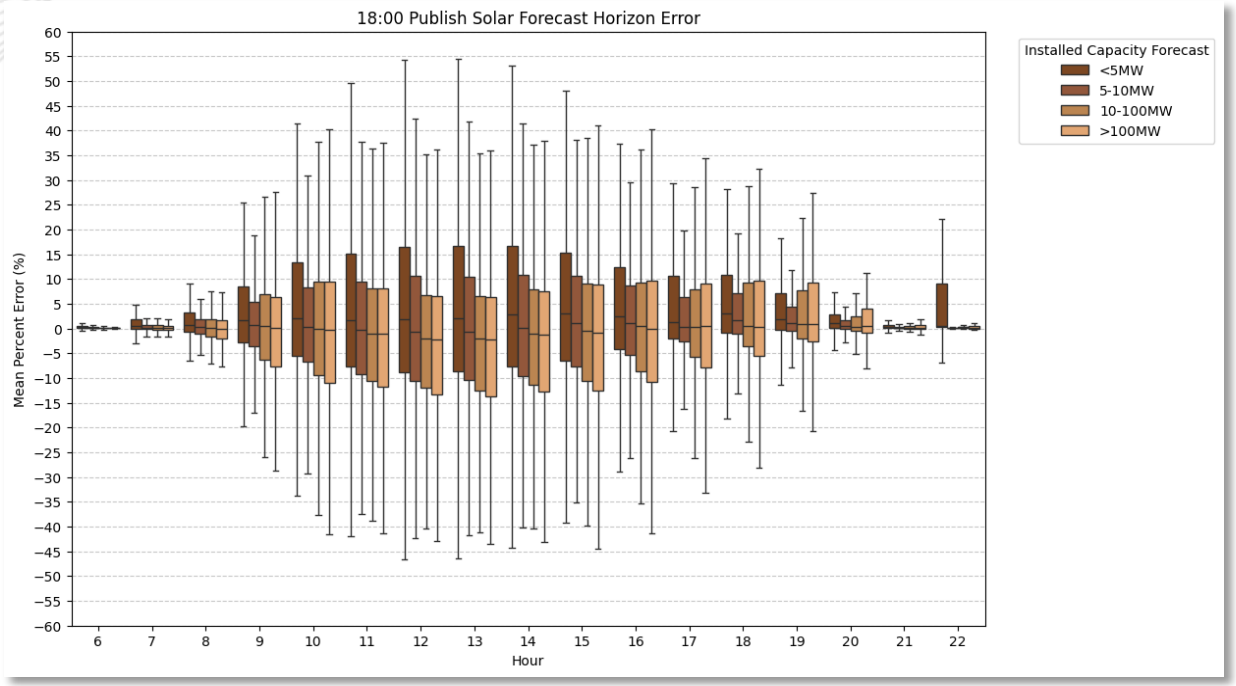


- Higher variance for further out horizon

PJM © 2024

Day-Ahead Hourly Error by Capacity/Horizon *(11/1/2023-10/31/2024)*





- Higher error/variance for smaller units

- Marginal accuracy gain by 18:00 publish, mainly for larger units

PJM © 2024

Contact

Presenter/SME:

Joseph Mulhern,
joseph.mulhern@@pjm.com

Michael Stewart,
michael.stewart@pjm.com

Short-Term Forecasting,
ForecastApplicationSupport@pjm.com

Renewable Forecasting Education

Member Hotline

(610) 666-8980

(866) 400-8980

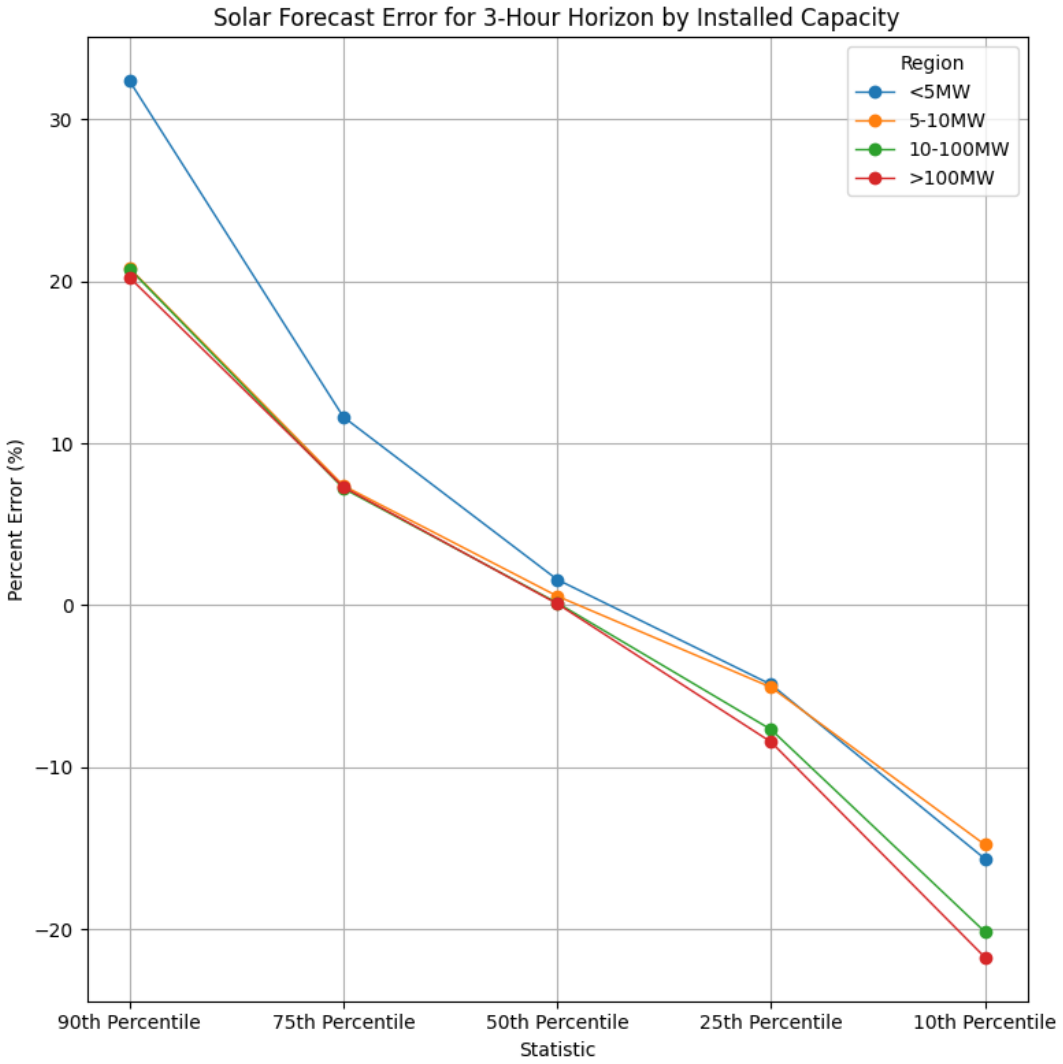
custsvc@pjm.com

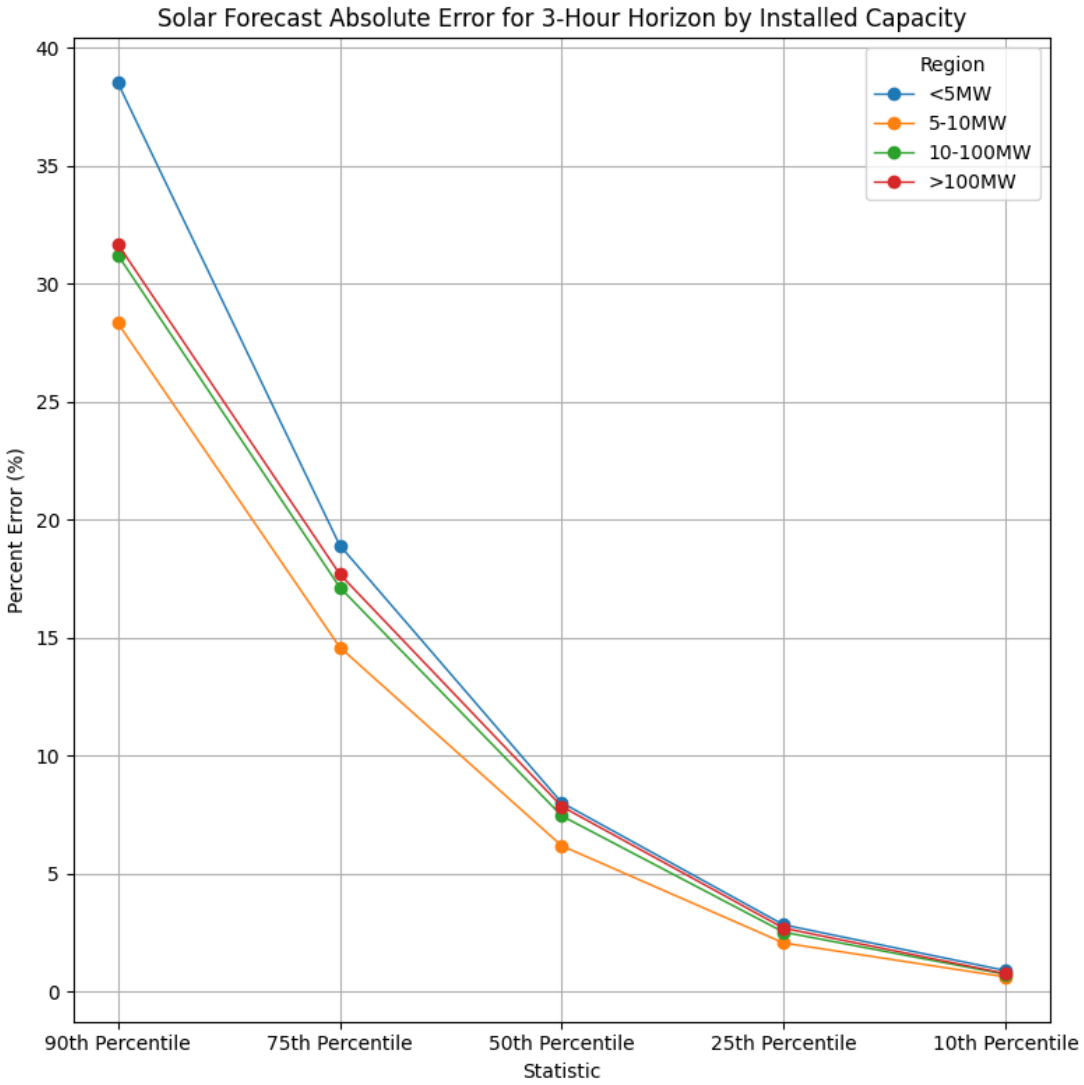
PJM © 2024

Appendix

PJM © 2024

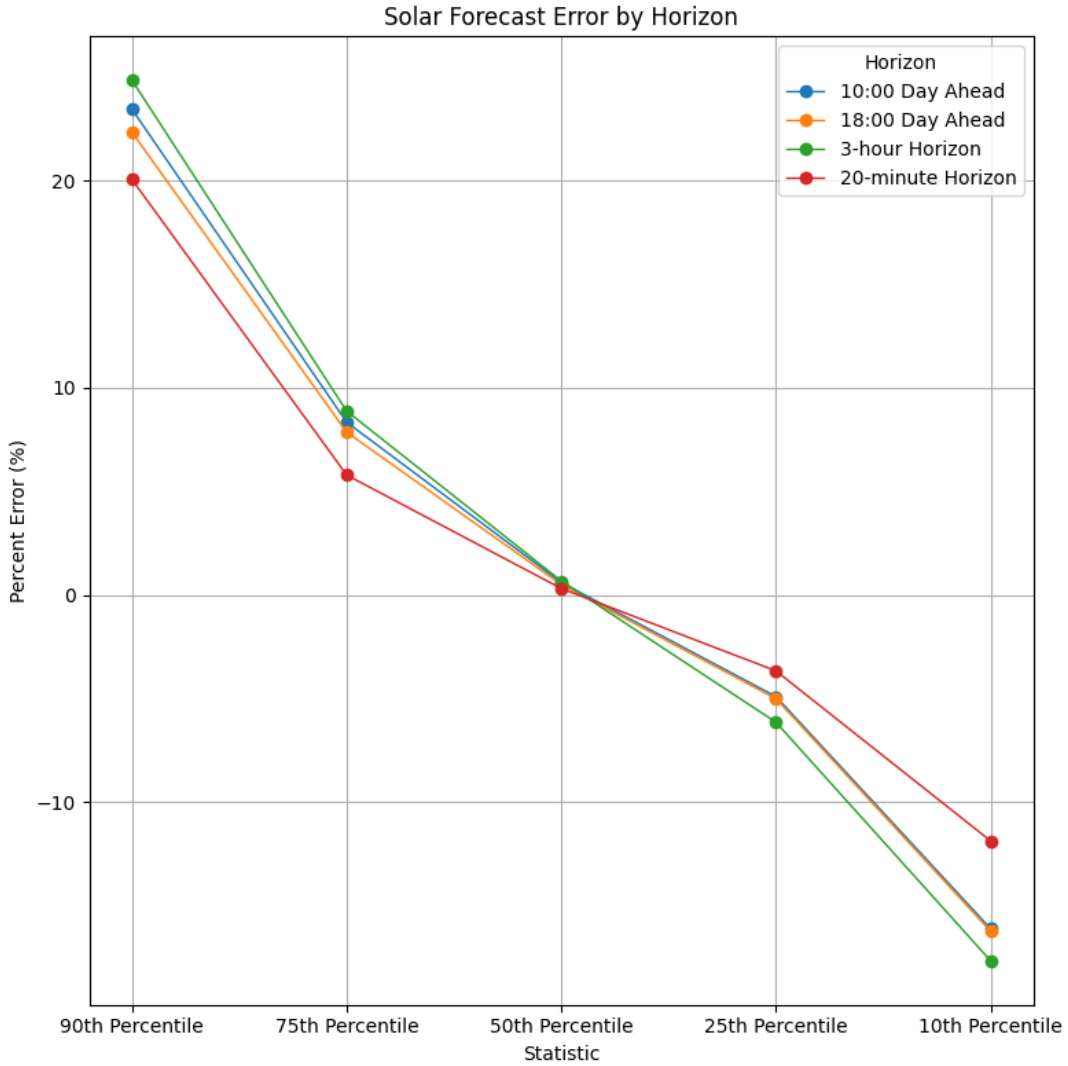
Solar Forecast Error for 3-Hour Horizon *(11/1/2023-10/31/2024)*

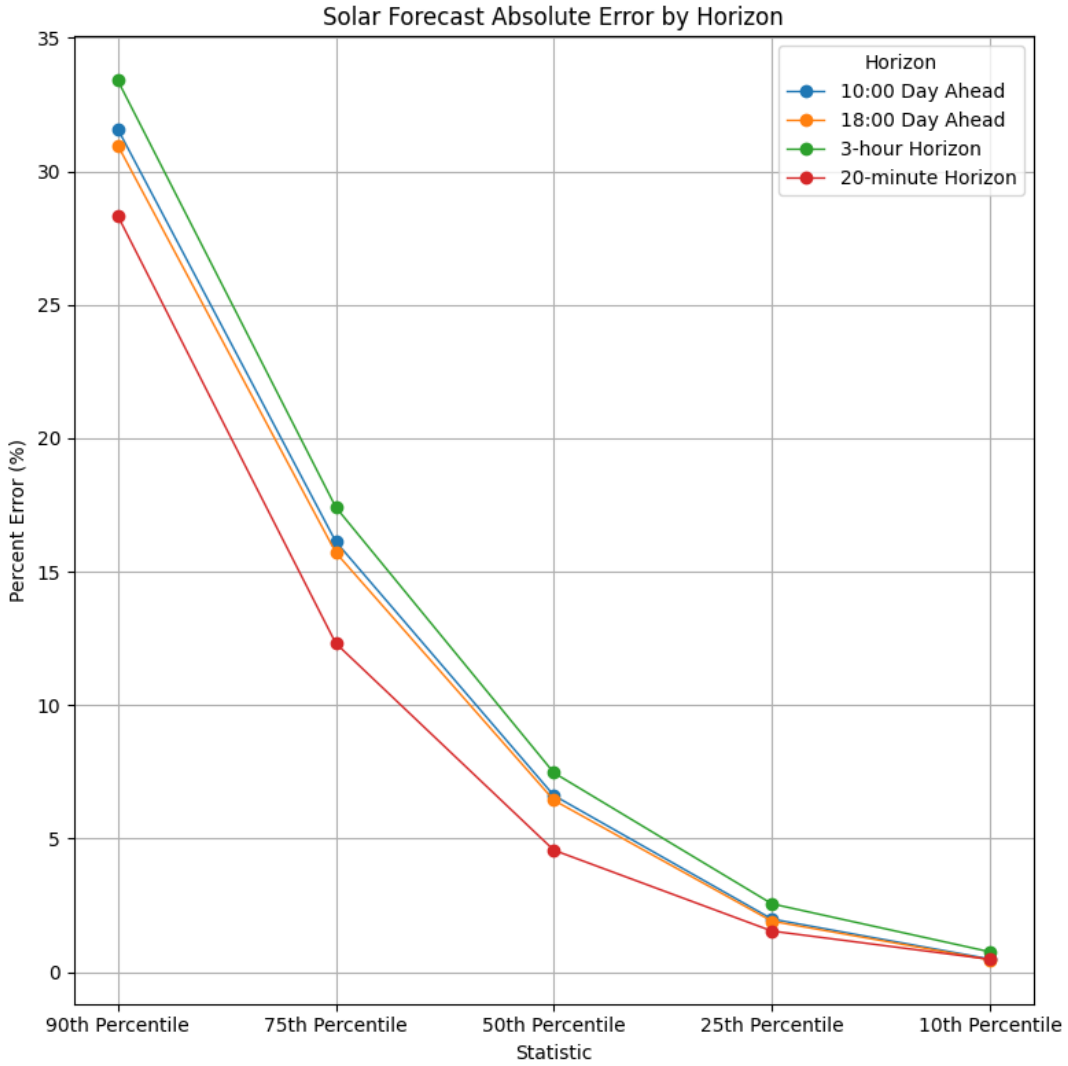




PJM © 2024

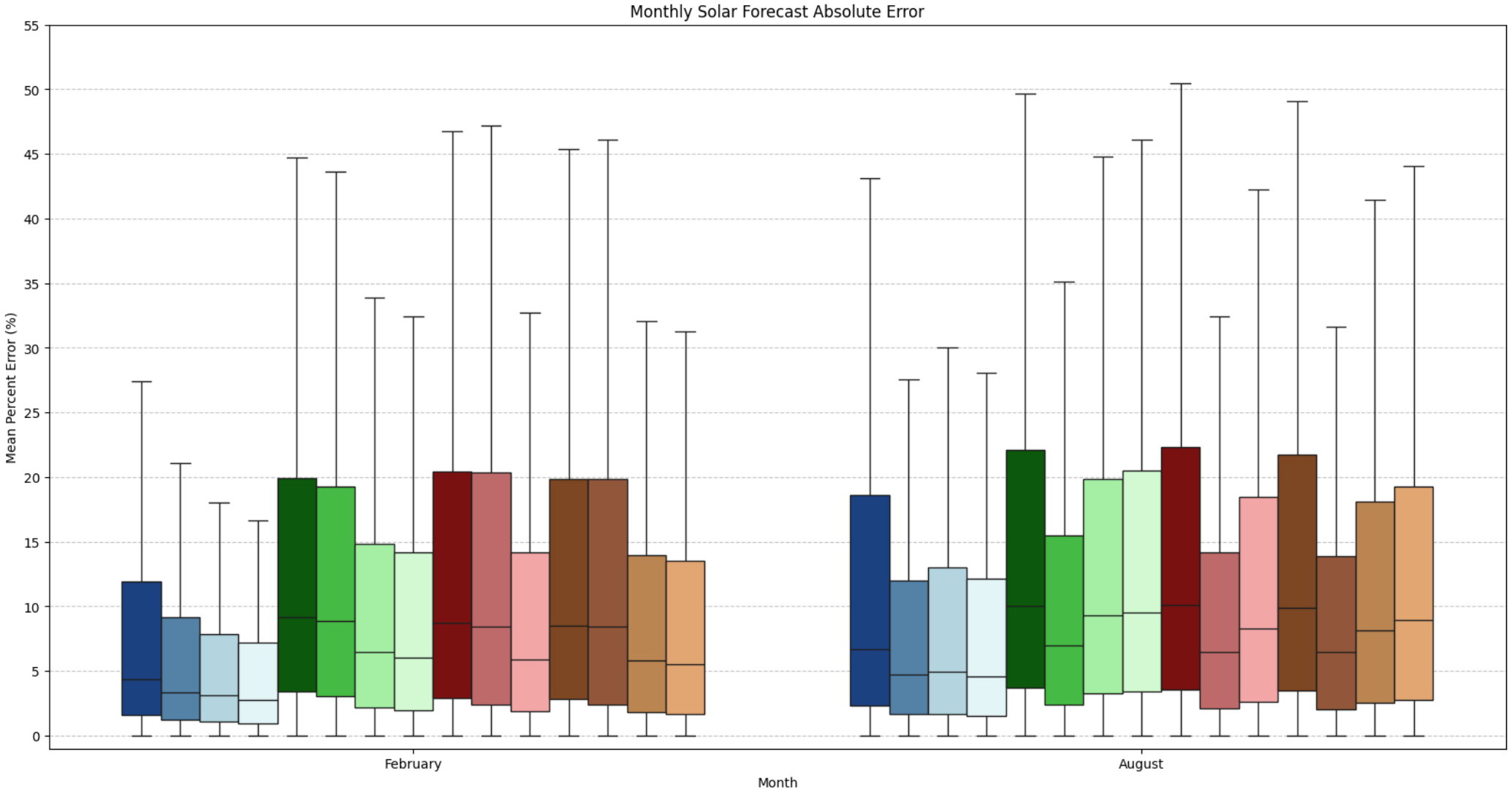
Solar Forecast Error for All Horizons *(11/1/2023-10/31/2024)*





PJM © 2024

Monthly Absolute Error Comparison by Capacity/Horizon



- Higher variance of error in summer month

PJM © 2024

Solar Forecast Error for 3-Hour Horizon *(11/1/2023-10/31/2024)*

Mean Percent Error	<5MW	5-10MW	10-100MW	>100MW
90th Percentile	32.36%	20.81%	20.77%	20.23%
75th Percentile	11.62%	7.38%	7.21%	7.29%
50th Percentile	1.58%	0.56%	0.14%	0.09%
25th Percentile	-4.90%	-5.07%	-7.68%	-8.45%
10th Percentile	-15.66%	-14.79%	-20.17%	-21.74%

Mean Absolute Percent Error	<5MW	5-10MW	10-100MW	>100MW
90th Percentile	38.52%	28.33%	31.22%	31.68%
75th Percentile	18.91%	14.59%	17.13%	17.69%
50th Percentile	8.00%	6.17%	7.44%	7.84%
25th Percentile	2.82%	2.05%	2.51%	2.68%
10th Percentile	0.88%	0.61%	0.72%	0.75%

- <5MW resources more over-forecast due to telemetry requirements
- Overall error consistency among other groupings of resources

PJM © 2024

Solar Forecast Error for All Horizons *(11/1/2023-10/31/2024)*

Mean Percent Error	10:00 Day Ahead	18:00 Day Ahead	3-hour Horizon	20-minute Horizon
90th Percentile	23.45%	22.34%	24.85%	20.06%
75th Percentile	8.34%	7.86%	8.88%	5.79%
50th Percentile	0.60%	0.50%	0.67%	0.31%
25th Percentile	-4.91%	-5.01%	-6.15%	-3.67%
10th Percentile	-16.12%	-16.24%	-17.67%	-11.88%

Mean Absolute Percent Error	10:00 Day Ahead	18:00 Day Ahead	3-hour Horizon	20-minute Horizon
90th Percentile	31.59%	30.98%	33.41%	28.34%
75th Percentile	16.13%	15.72%	17.42%	12.32%
50th Percentile	6.62%	6.44%	7.47%	4.57%
25th Percentile	1.99%	1.91%	2.56%	1.54%
10th Percentile	0.49%	0.46%	0.76%	0.48%

- 20-minute horizon features highest accuracy
- Gain marginal accuracy between day-ahead publishes
- 3-hour horizon leads to increase in error between day-ahead and real-time

PJM © 2024