



SPP UNCERTAINTY FORECAST

PROBABLISTIC FORECASTING

*Working together to responsibly and economically
keep the lights on today and in the future.*



SouthwestPowerPool



SPPorg



southwest-power-pool

UNCERTAINTY RESPONSE TEAM

OVERVIEW

SOURCES OF UNCERTAINTY



URT FUNCTIONS

URT serves to Detect,
Evaluate, & Plan

Detect Potential Issues

- Daily evaluations flag uncertainty risks for the next 7 days
- Staff available on-call 24x7

Evaluate Risk

- Weather conditions
- Load levels
- Wind forecast
- Generator outages

Develop Mitigation Plans in Advance

- Long-lead unit commitments
- System advisories
- Generator outage denials/reschedules

UNCERTAINTY EVALUATIONS

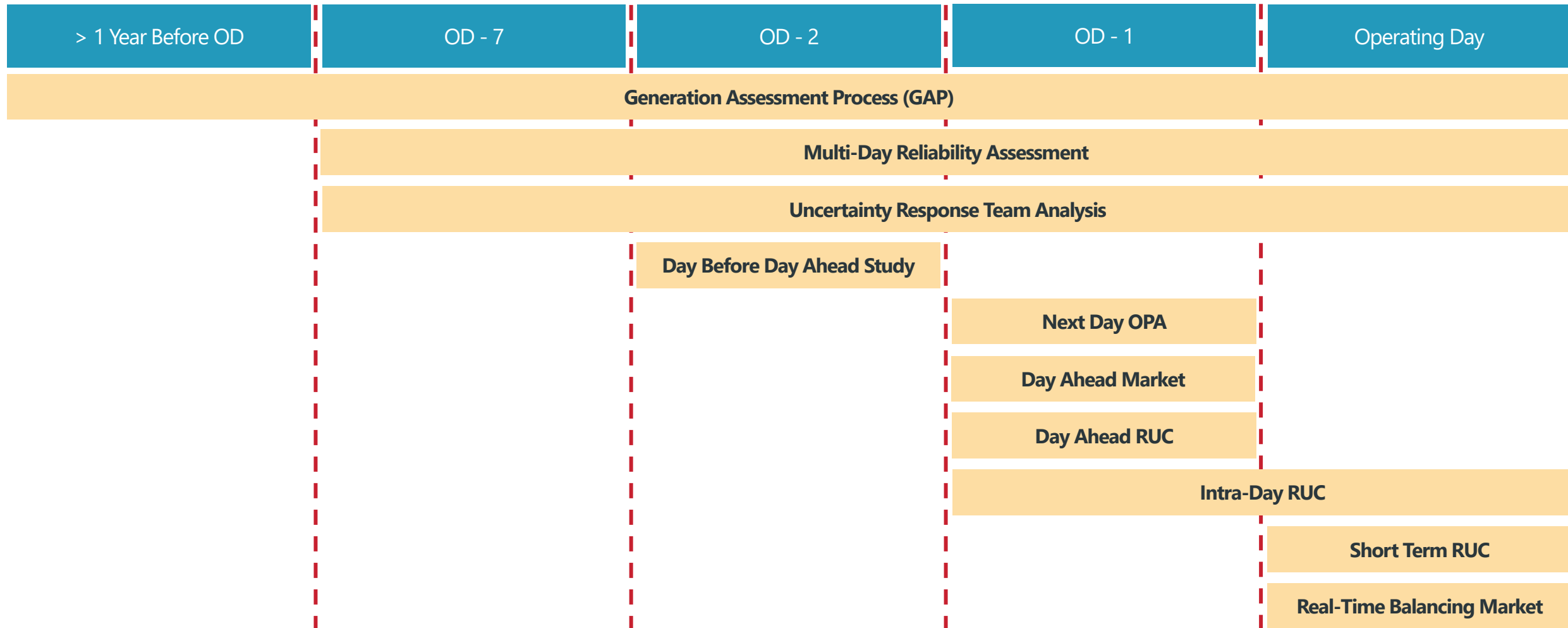
Uncertainty capacity evaluations performed for next 7 days

Assessment done on all horizons

Uncertainty factors: load, wind, & resource error

Uncertainty error applied to available online/offline capacity over each horizon

OPERATIONAL STUDIES & ANALYSIS

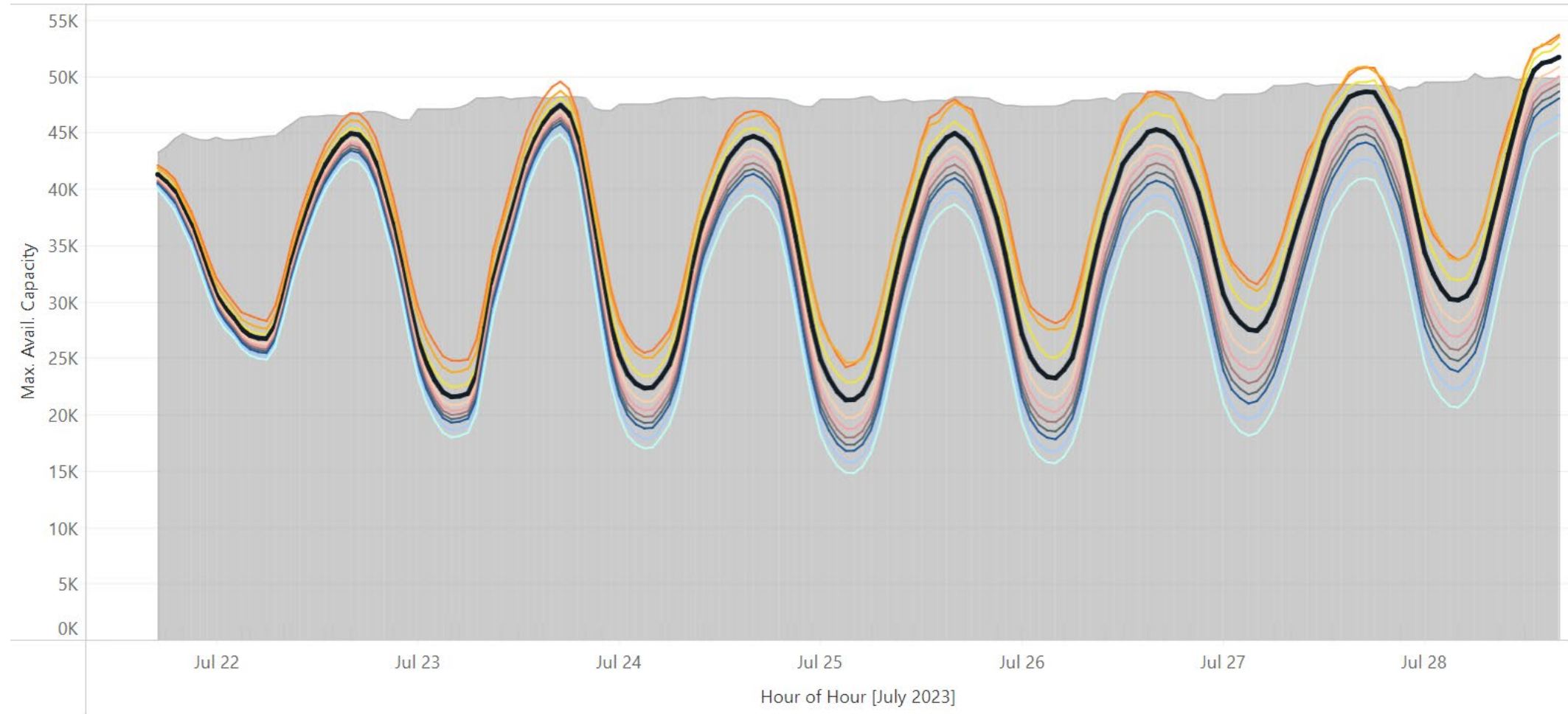


*Timeline represents when studies or analysis are performed relative to the Operating Day

CAPACITY VS NET LOAD UNCERTAINTY

Capacity vs Uncertainty

Run Time: 7/21/2023 4:00:00 PM

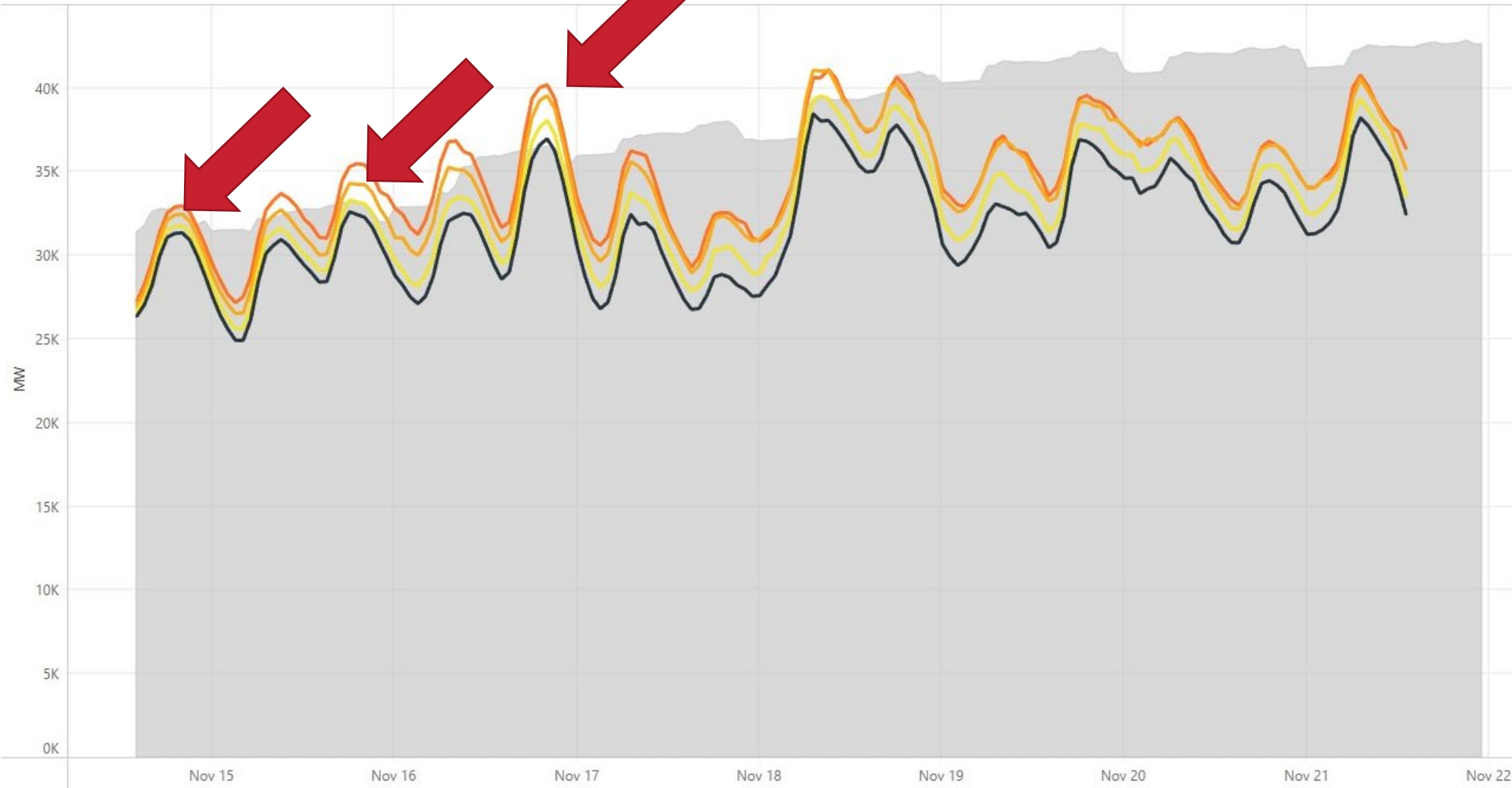


Available Capacity vs Uncertainty - 11/14/2022 1:00:00 PM

Load Risk: RiskType=2 - by Forecasted Temperature

Outage Risk: RiskType=6 - by Forecasted Temperature - No WWE

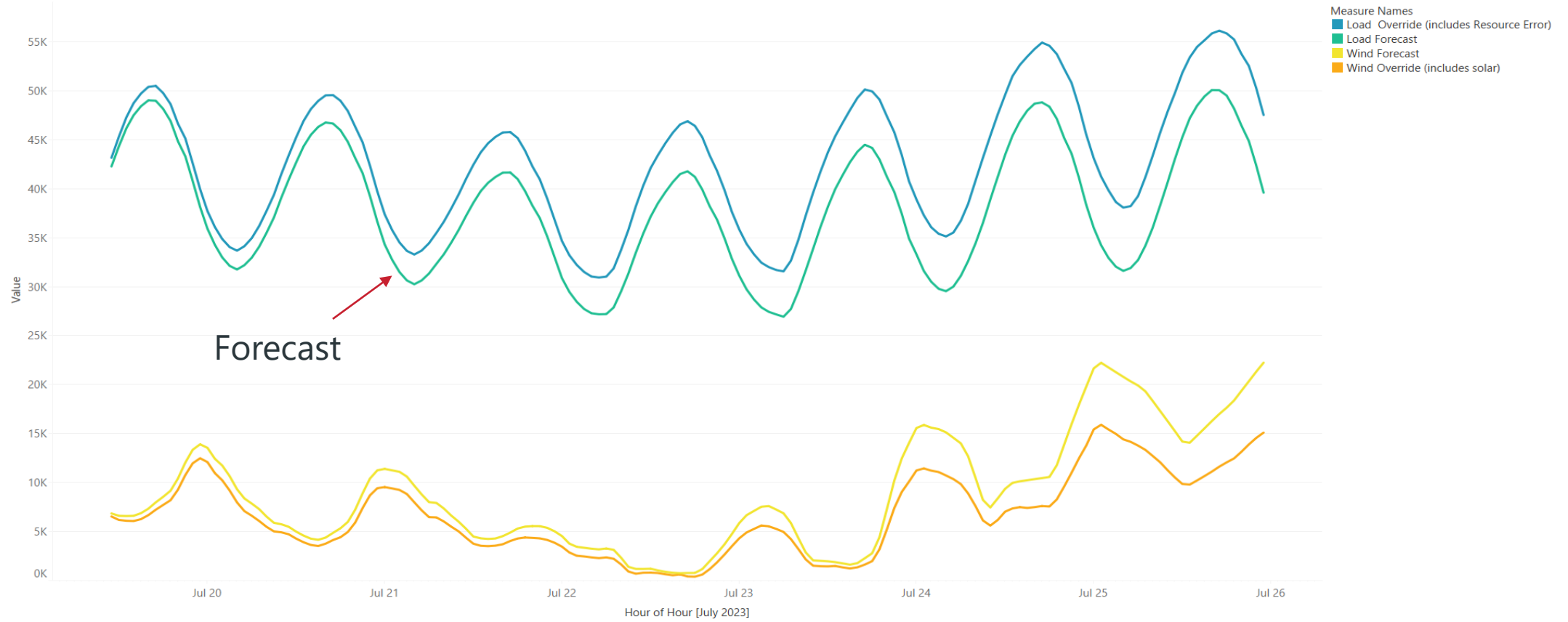
Wind Risk: RiskType=1 - (Normal-only) by Forecasted Capacity Factor



SCALED LOAD & WIND FORECASTS

Scaling

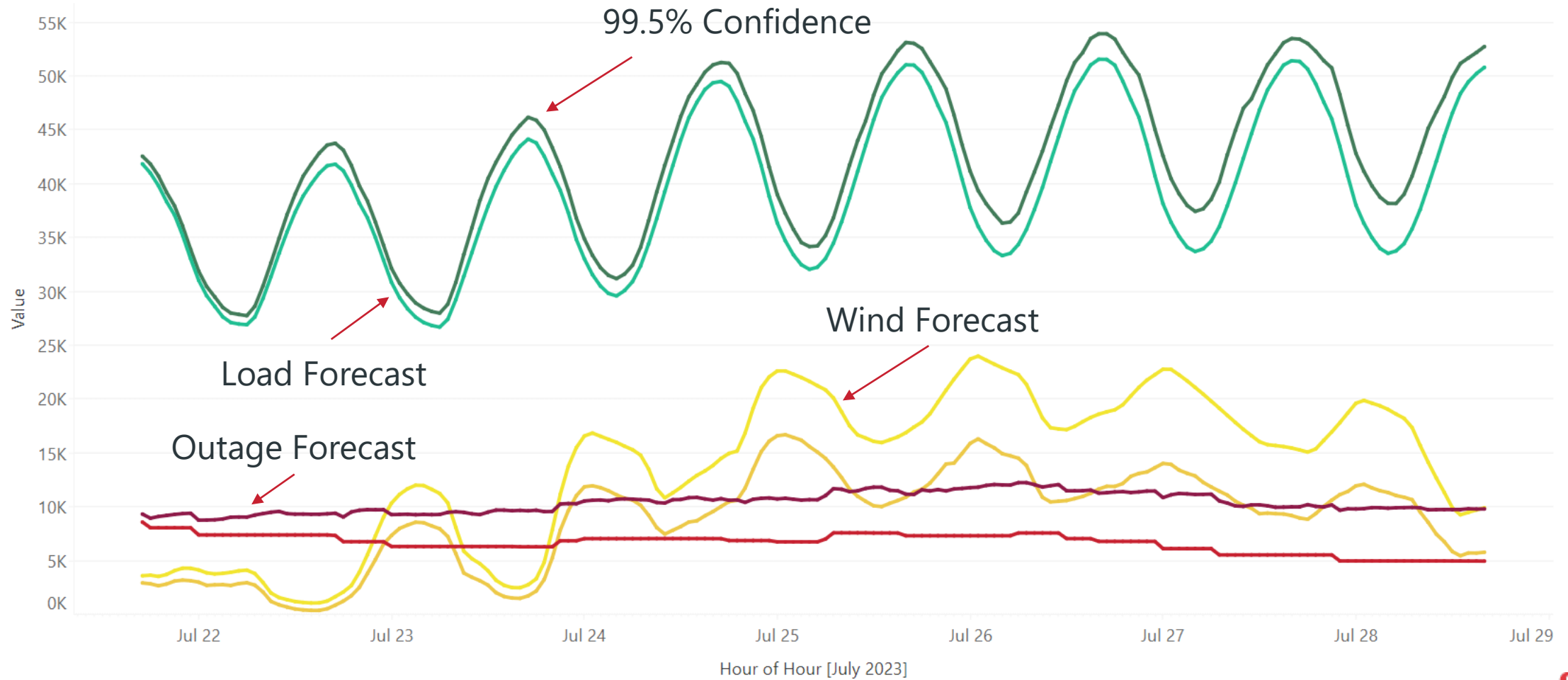
Forecast Run Time: 7/19/2023 10:00:00 AM



ERROR FORECAST BY CONFIDENCE INTERVAL

Error Trends

Forecast Run Time: 7/21/2023 4:00:00 PM



HIGH RISK SCENARIO REPORT

Horizon Based Capacity Utilization (Market Only w/Reserves):

Percentile	Fri, Jan-12-2024	Sat, Jan-13-2024	Sun, Jan-14-2024	Mon, Jan-15-2024	Tue, Jan-16-2024	Wed, Jan-17-2024	Thu, Jan-18-2024
50th	0.71	0.79	0.95	1	0.99	0.71	0.7
75th	0.74	0.84	1.01	1.07	1.08	0.77	0.77
80th	0.74	0.86	1.02	1.08	1.1	0.78	0.8
85th	0.75	0.87	1.02	1.09	1.12	0.79	0.82
90th	0.76	0.89	1.04	1.1	1.14	0.82	0.84
95th	0.77	0.91	1.07	1.14	1.15	0.91	0.93
97.5th	0.78	0.93	1.1	1.17	1.18	0.95	0.98
99th	0.8	0.98	1.13	1.19	1.21	0.97	1.01
99.5th	0.83	1	1.14	1.18	1.2	0.97	1.01
99.97th	0.85	0.98	1.11	1.18	1.18	0.92	1.02

Horizon Based Capacity Utilization (Reliability Included w/Reserves) :

Percentile	Fri, Jan-12-2024	Sat, Jan-13-2024	Sun, Jan-14-2024	Mon, Jan-15-2024	Tue, Jan-16-2024	Wed, Jan-17-2024	Thu, Jan-18-2024
50th	0.7	0.77	0.9	0.95	0.94	0.68	0.67
75th	0.72	0.81	0.96	1.02	1.04	0.74	0.74
80th	0.73	0.83	0.97	1.03	1.05	0.75	0.77
85th	0.73	0.84	0.98	1.04	1.07	0.77	0.78
90th	0.74	0.85	0.99	1.05	1.09	0.79	0.81
95th	0.76	0.88	1.02	1.09	1.1	0.88	0.89
97.5th	0.77	0.89	1.05	1.12	1.13	0.91	0.93
99th	0.79	0.94	1.08	1.14	1.16	0.94	0.97
99.5th	0.81	0.96	1.09	1.12	1.15	0.94	0.96
99.97th	0.84	0.95	1.06	1.13	1.13	0.89	0.98

URT PROCESS

ERROR FORECASTING

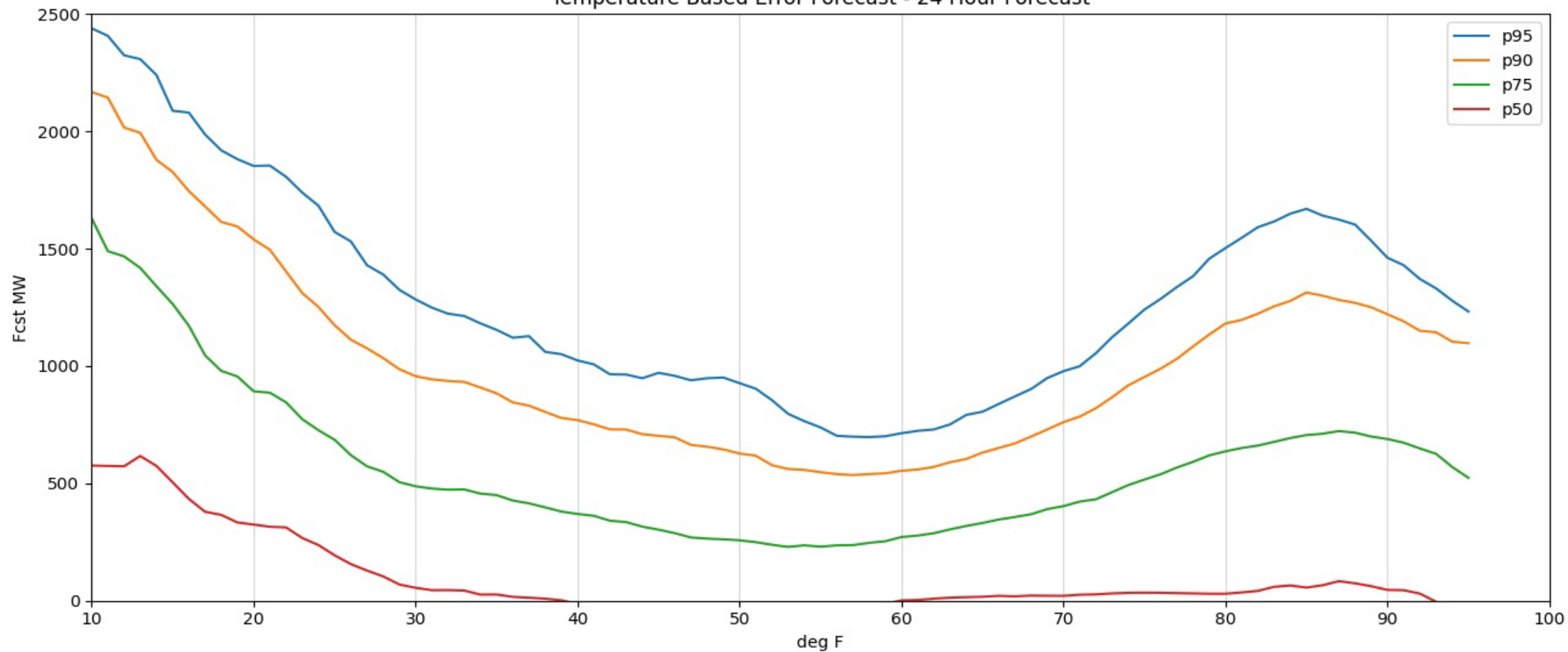
TEMPERATURE FORECAST

Temperature Assessment:

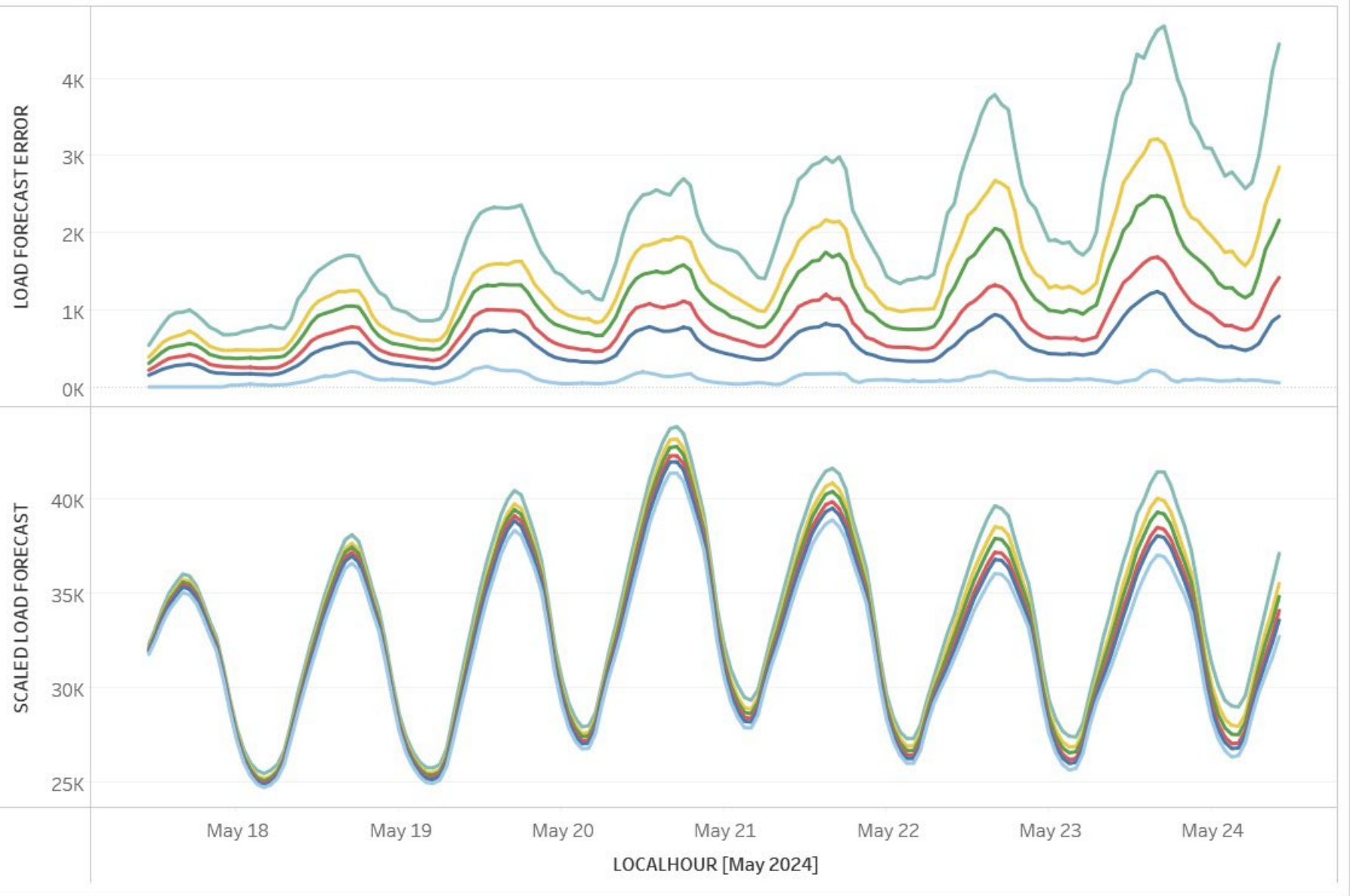
Region	City	Fri, Jul-21-2023	Sat, Jul-22-2023	Sun, Jul-23-2023	Mon, Jul-24-2023	Tue, Jul-25-2023	Wed, Jul-26-2023	Thu, Jul-27-2023
North	Aberdeen, SD	85/56	90/58	93/59	96/65	96/68	99/67	95/67
	Jamestown, ND	82/56	86/60	88/60	90/62	90/67	90/67	88/64
	Rapid City, SD	82/52	88/61	95/66	95/69	95/71	94/67	92/68
	Sioux Falls, SD	83/59	88/60	90/62	94/67	95/71	98/71	95/71
	Williston, ND	85/55	88/58	96/62	95/63	96/68	90/63	86/61
Central	Dodge City, KS	76/63	85/60	93/64	96/69	97/73	97/73	96/73
	Hays, KS	79/62	87/61	92/64	95/69	97/72	96/72	96/72
	Kansas City, MO	81/67	84/62	87/65	92/69	96/73	98/77	98/79
	Lincoln, NE	84/63	87/64	92/64	96/70	98/74	98/76	98/74
	Manhattan, KS	84/66	89/63	93/65	98/70	101/75	102/78	103/78
	North Platte, NE	82/57	90/61	95/62	98/68	100/71	98/70	97/69
	Omaha, NE	83/62	87/64	91/64	96/68	98/73	99/76	97/75
	Springfield, MO	87/70	85/60	86/64	92/67	95/70	96/73	96/74
	Wichita, KS	87/66	85/63	89/66	92/69	94/72	95/76	95/75
South	Amarillo, TX	90/66	88/61	96/65	99/70	101/74	99/74	98/72
	Fort Smith, AR	93/81	88/68	91/67	95/70	97/72	98/74	97/74
	Lawton, OK	91/74	90/66	96/65	102/70	104/75	103/77	102/76
	Lubbock, TX	96/72	91/66	98/68	101/72	102/75	101/74	99/73
	Mc Alester, OK	90/76	85/67	90/66	94/71	97/75	96/76	95/76
	Oklahoma City, OK	88/74	85/63	90/66	96/69	99/74	98/77	98/76
	Shreveport, LA	99/78	92/78	93/73	96/74	97/76	97/77	96/78
	Tulsa, OK	89/71	86/64	91/68	95/71	98/74	98/77	98/78

TEMPERATURE AND ERROR FORECAST

Temperature Based Error Forecast - 24 Hour Forecast

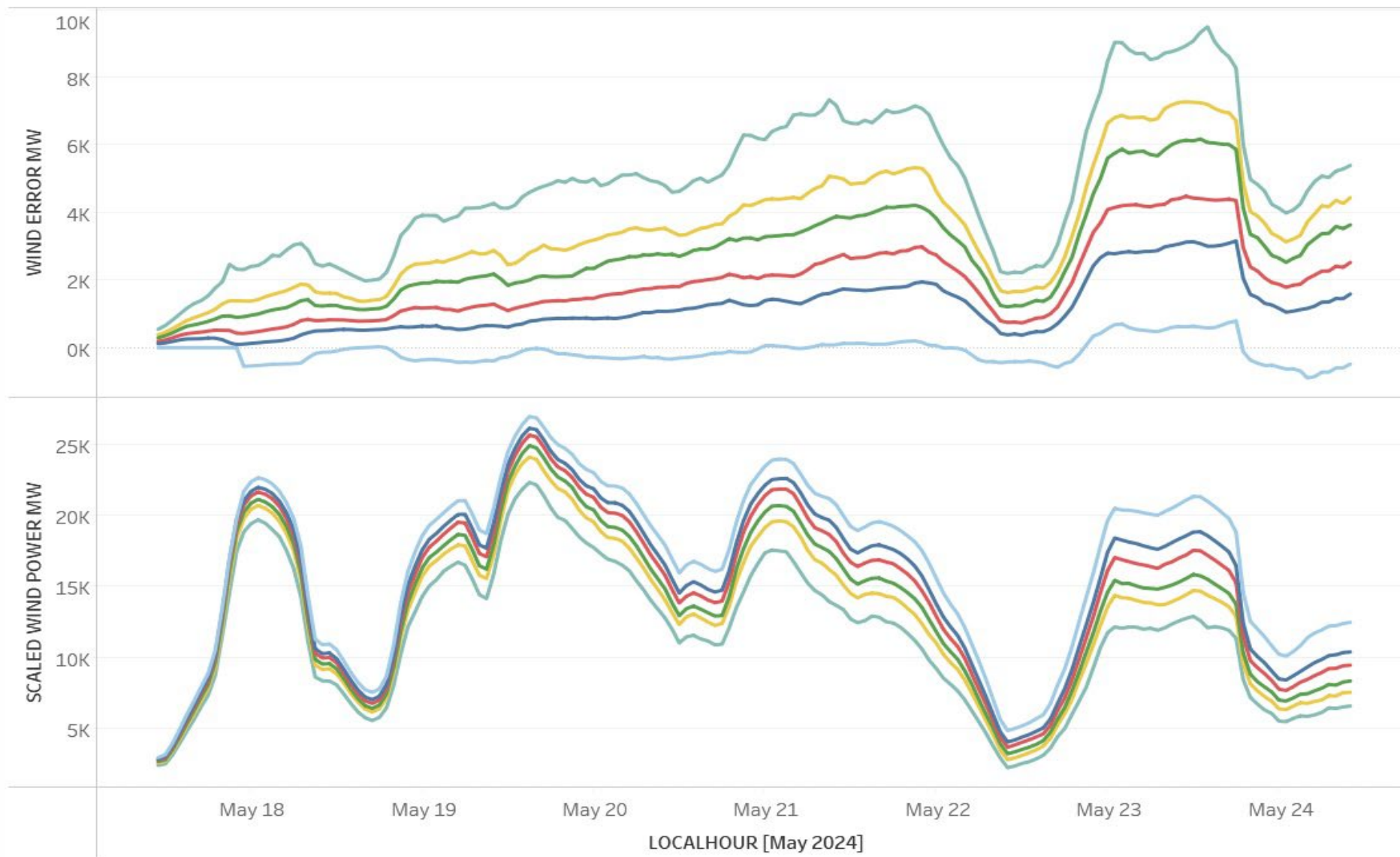


Load Error Forecast

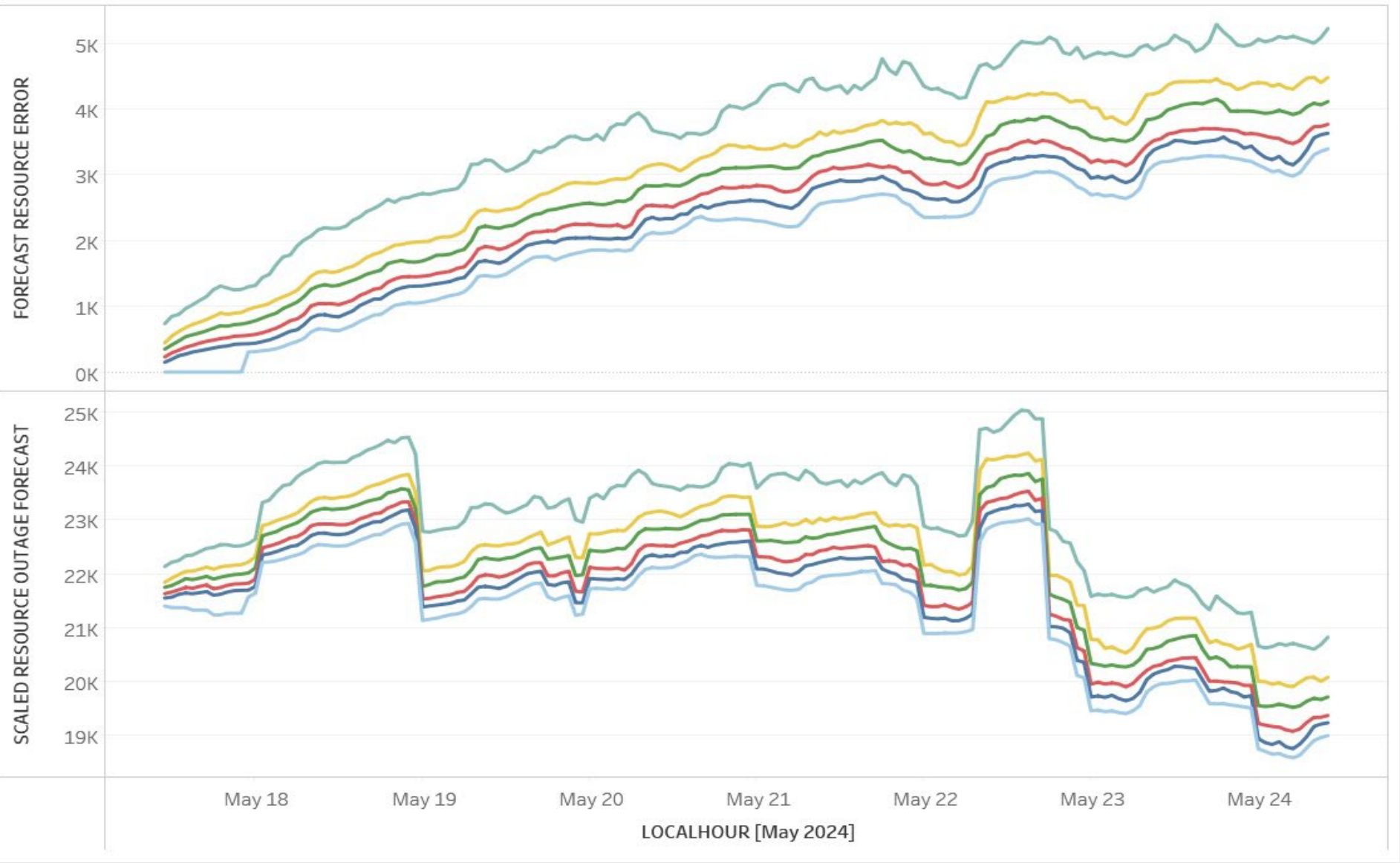


PVALUE	
0.5	
0.7	
0.8	
0.9	
0.95	
0.99	

Wind Error Forecast



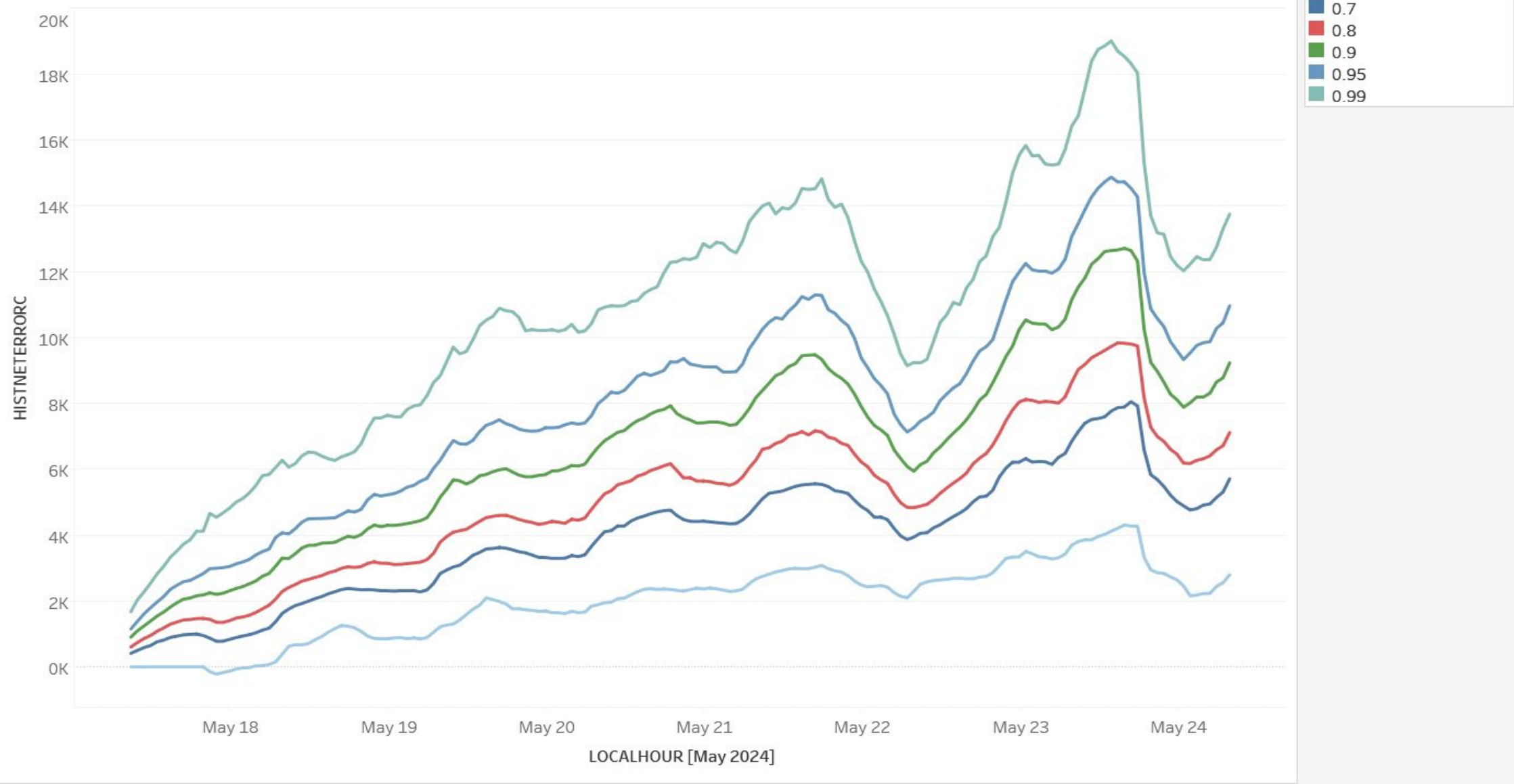
Resource Error Forecast



PVALUE

- 0.5
- 0.7
- 0.8
- 0.9
- 0.95
- 0.99

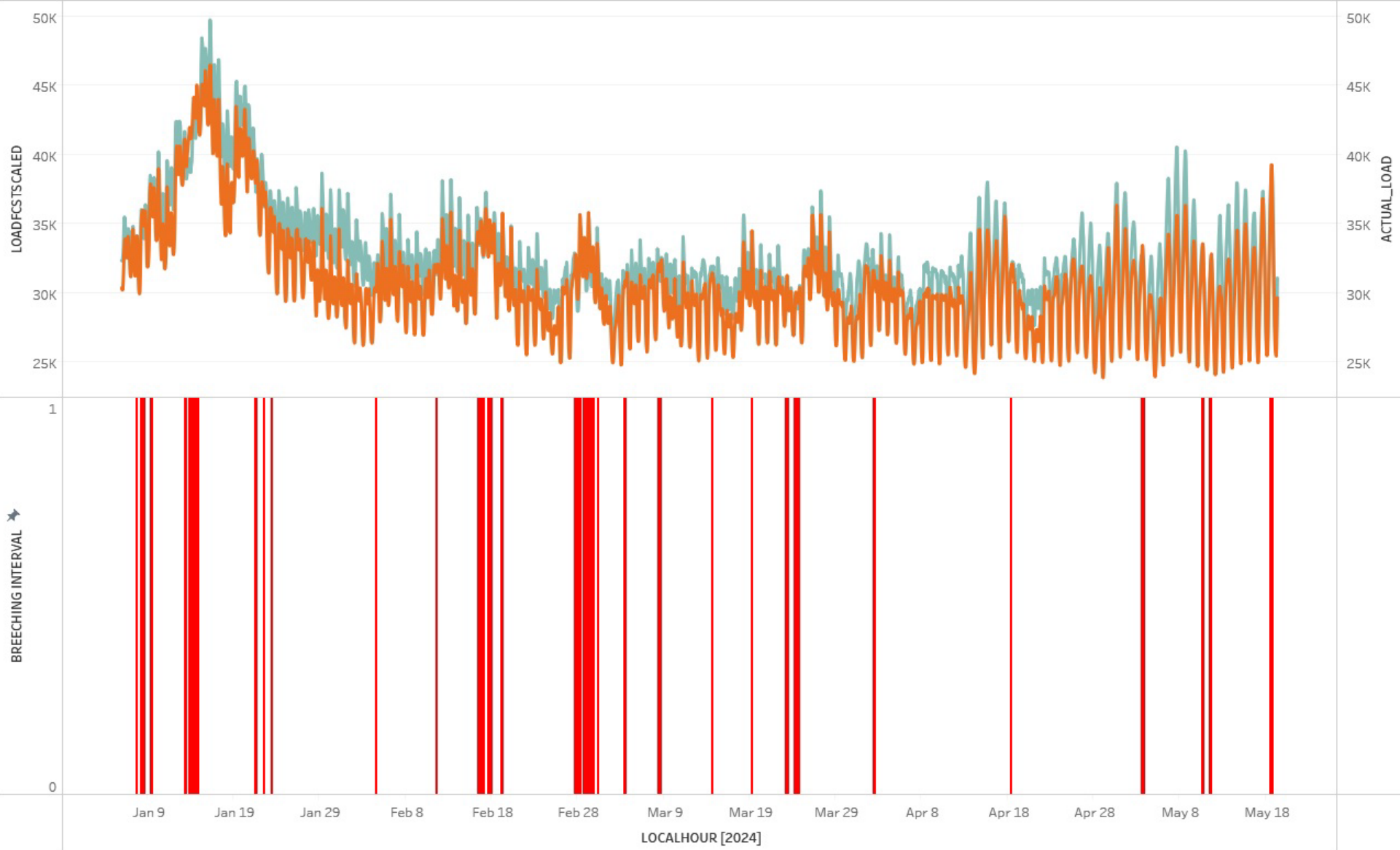
Coincident Net Error Forecast



VERIFICATION EXAMPLE

ERROR FORECASTING

120 Hour Load Error Forecast p 0.99



RUNTIME
1/1/2024 7:00:00 5/19/2024 4:00:00

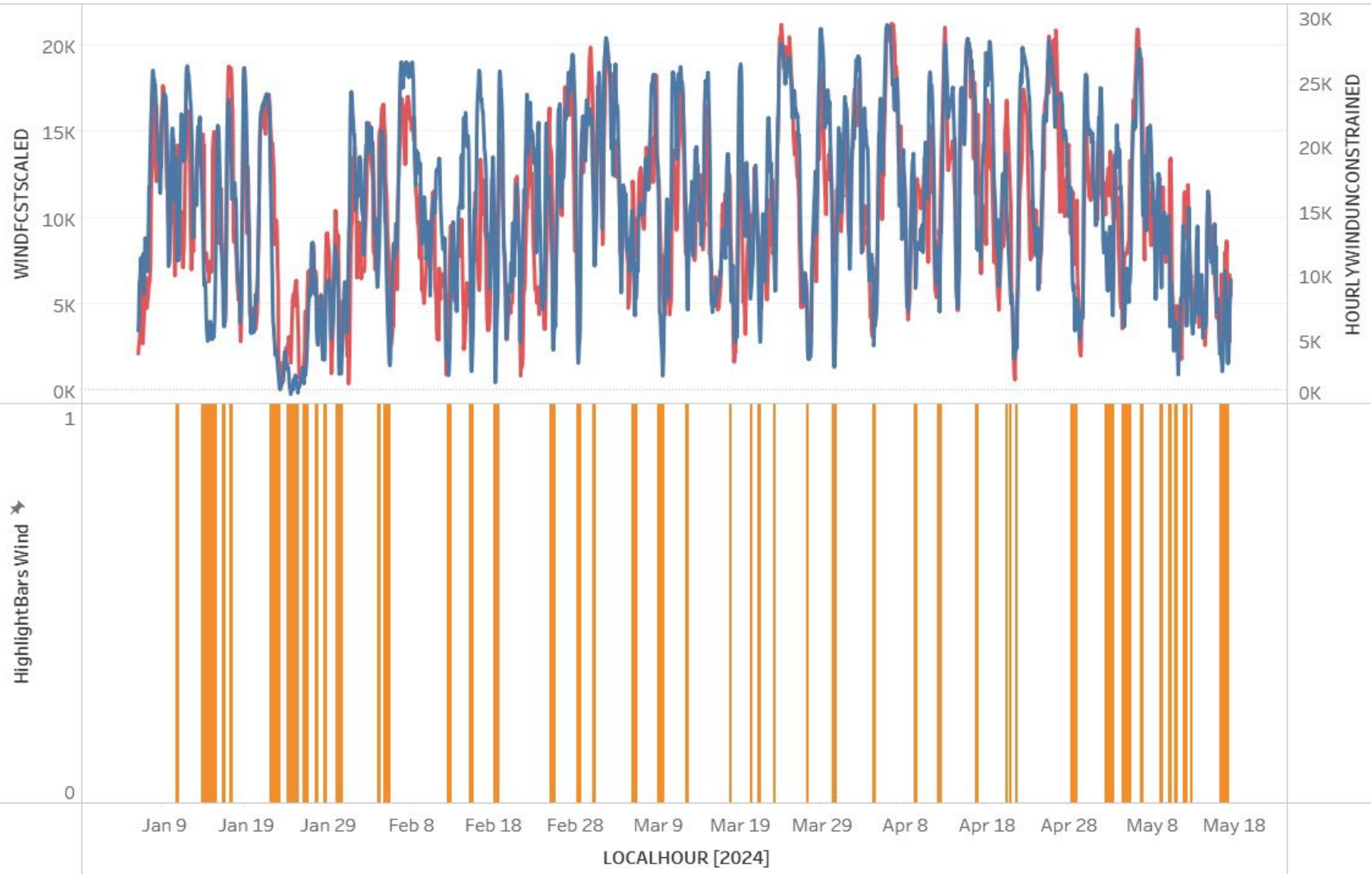
PVALUE
0.99

Horizon
120

FORECAST PVALUE
0.99

Measure Names
ACTUAL_LOAD

120 Hour Wind Error at 0.99 confidence



MKTHOUR (Custom SQL Quer...

1/2/2024 7:00:00 / 5/17/2024 11:59:5

Horizon

120

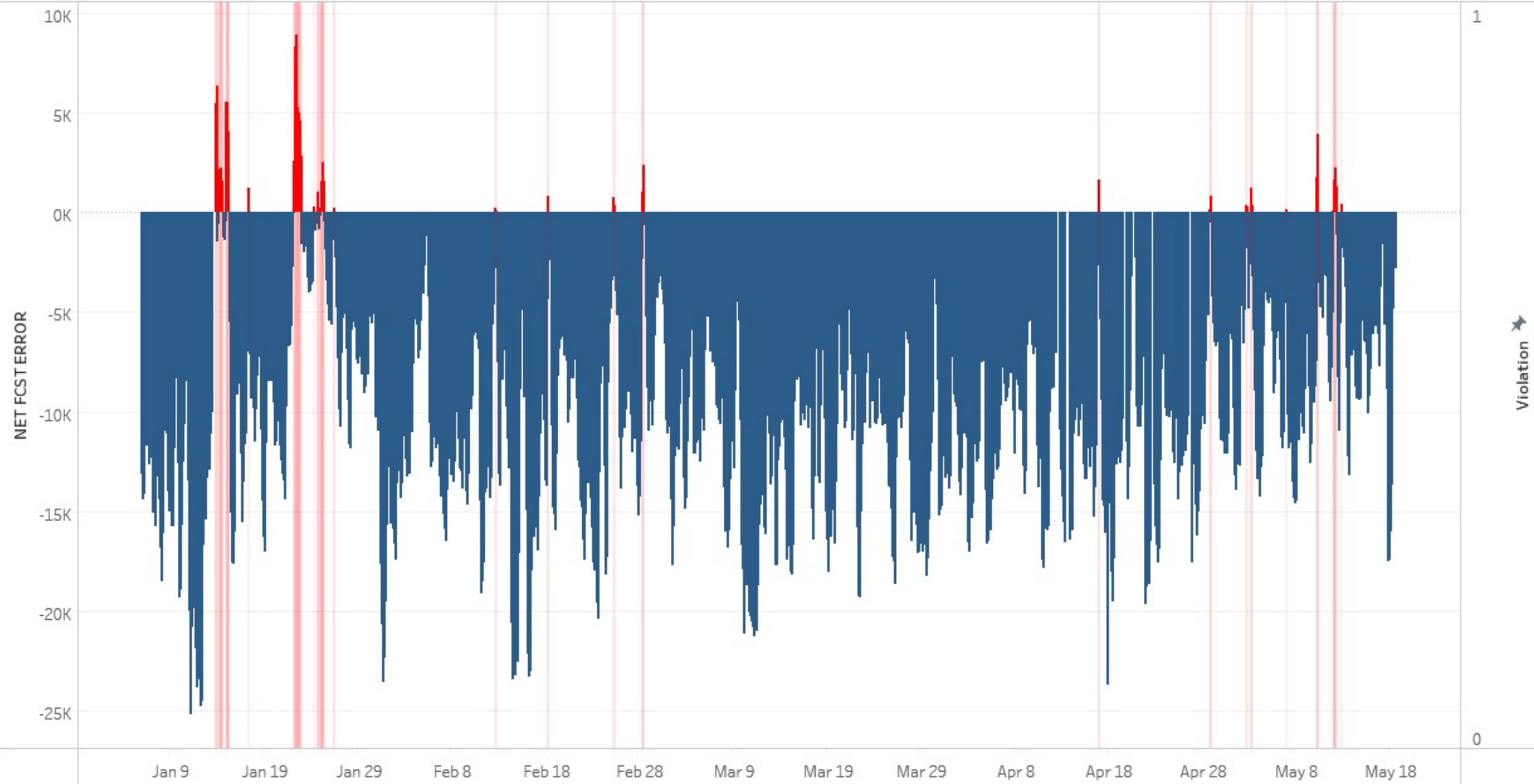
PVALUE

0.99

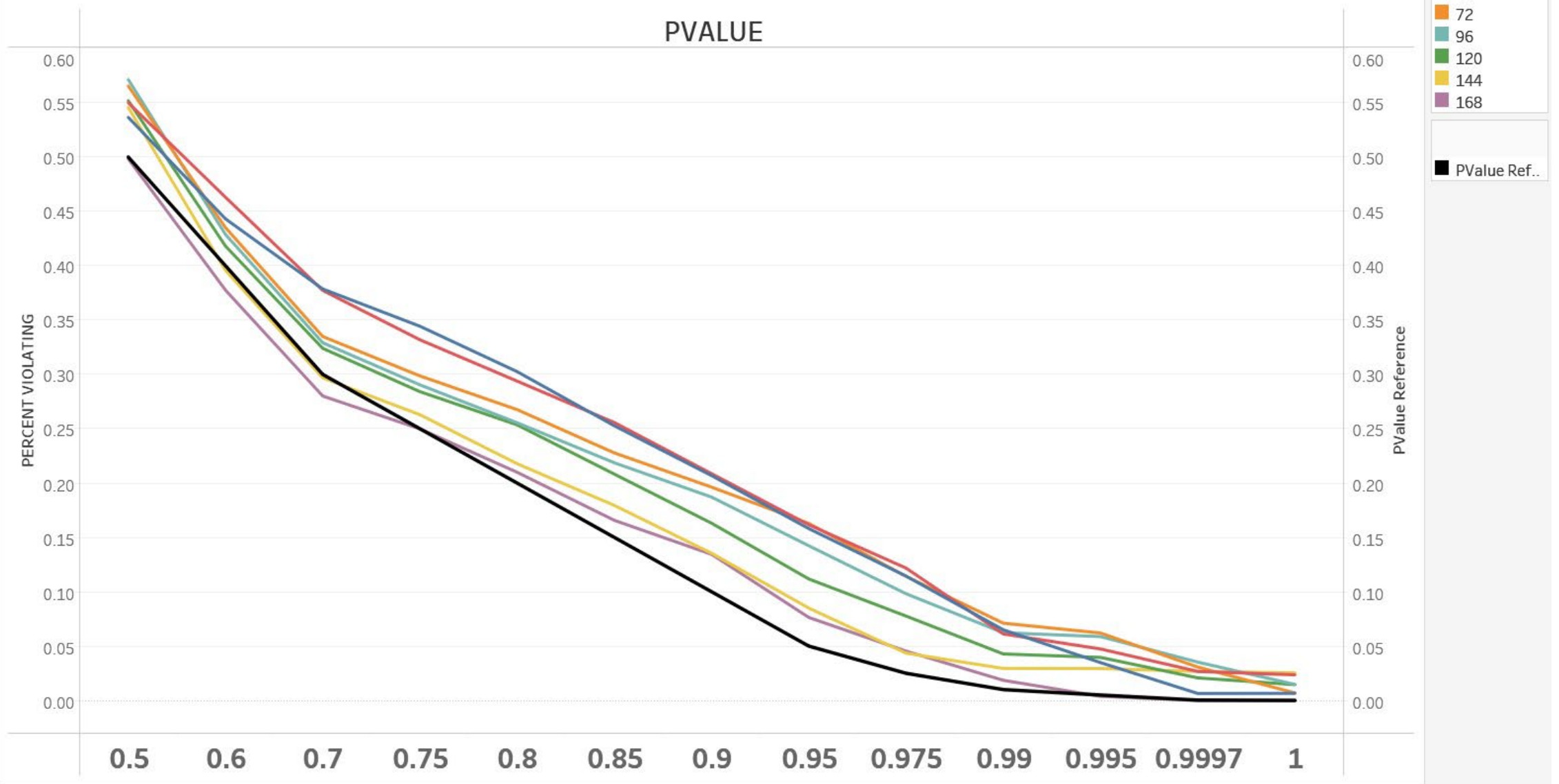
PVALUE, Measure Names

- 0.99, ACTUAL WIND
- 0.99, SCALED WIND FCST
- 0.99, VIOLATION

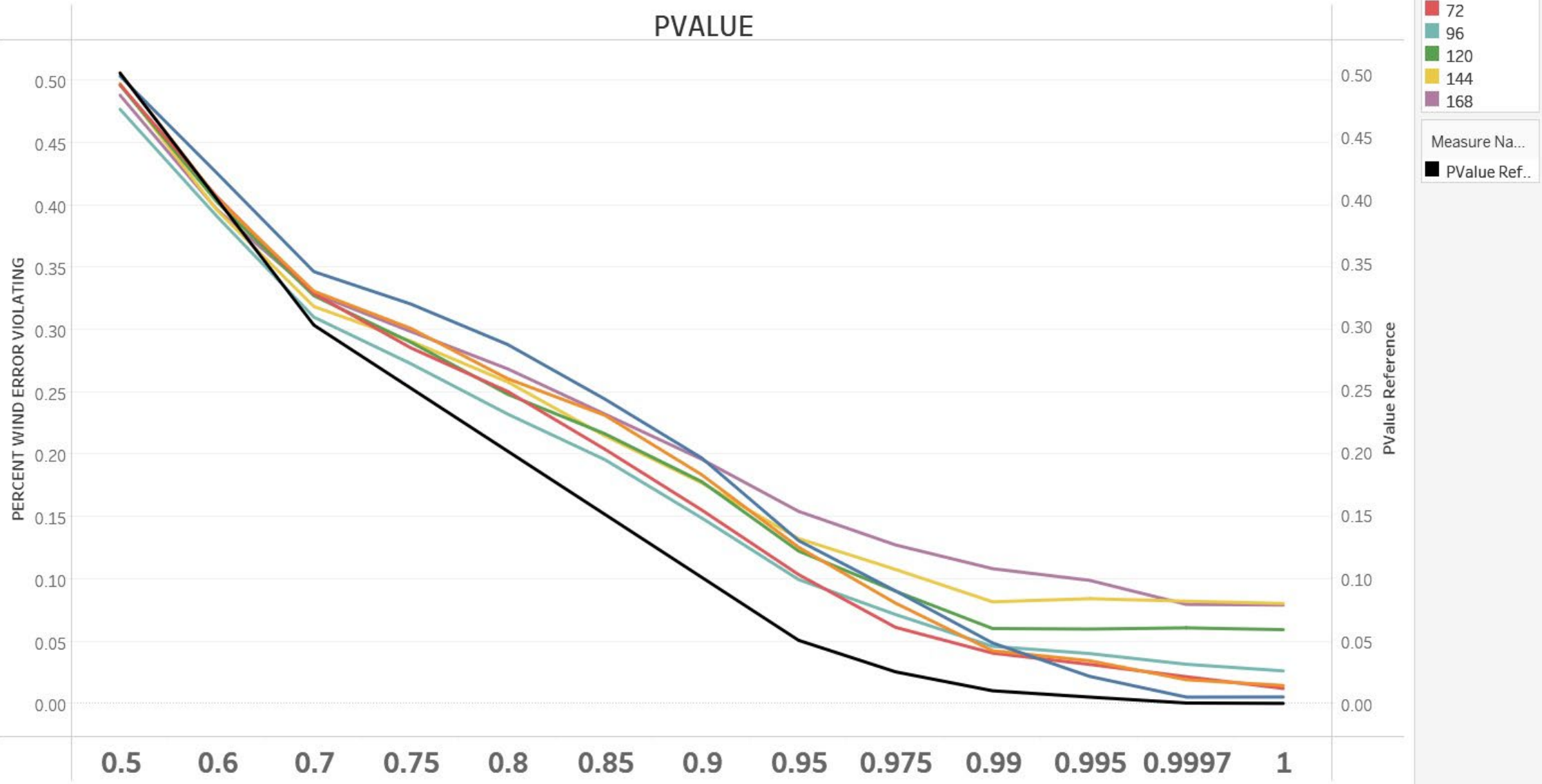
120 HOUR NET ERROR p 0.99



LOAD ERROR VALIDATION 2/1/24 - 5/1/24

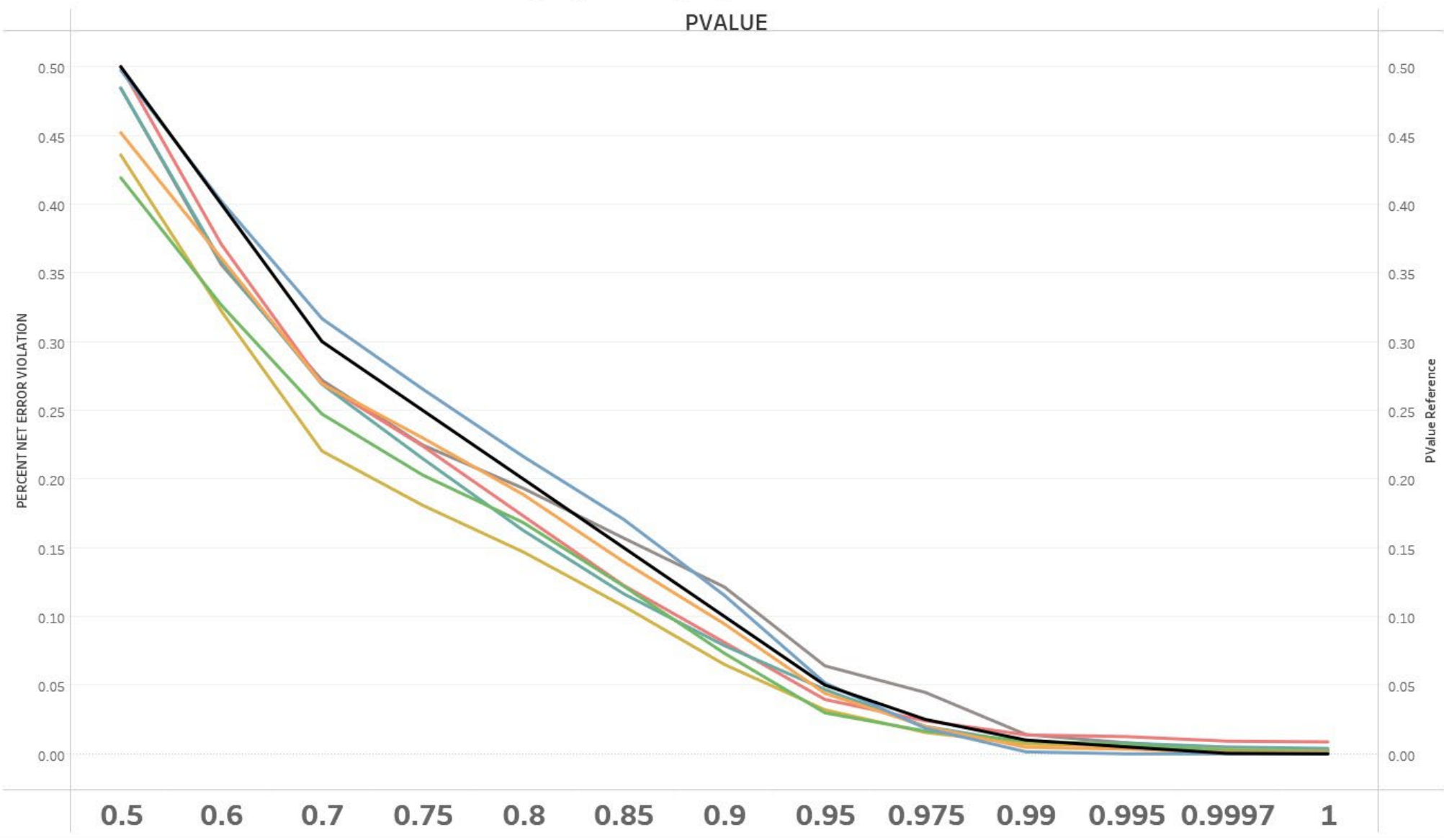


WIND ERROR VALIDATION 2/1/24-5/1/24



NET ERROR VALIDATION 2/1/24-5/1/24

PVALUE



Horizon, Measure Na...

24 hr, PERCENT NE..

48 hr, PERCENT NE..

72 hr, PERCENT NE..

96 hr, PERCENT NE..

120 hr, PERCENT N..

144 hr, PERCENT N..

168 hr, PERCENT N..

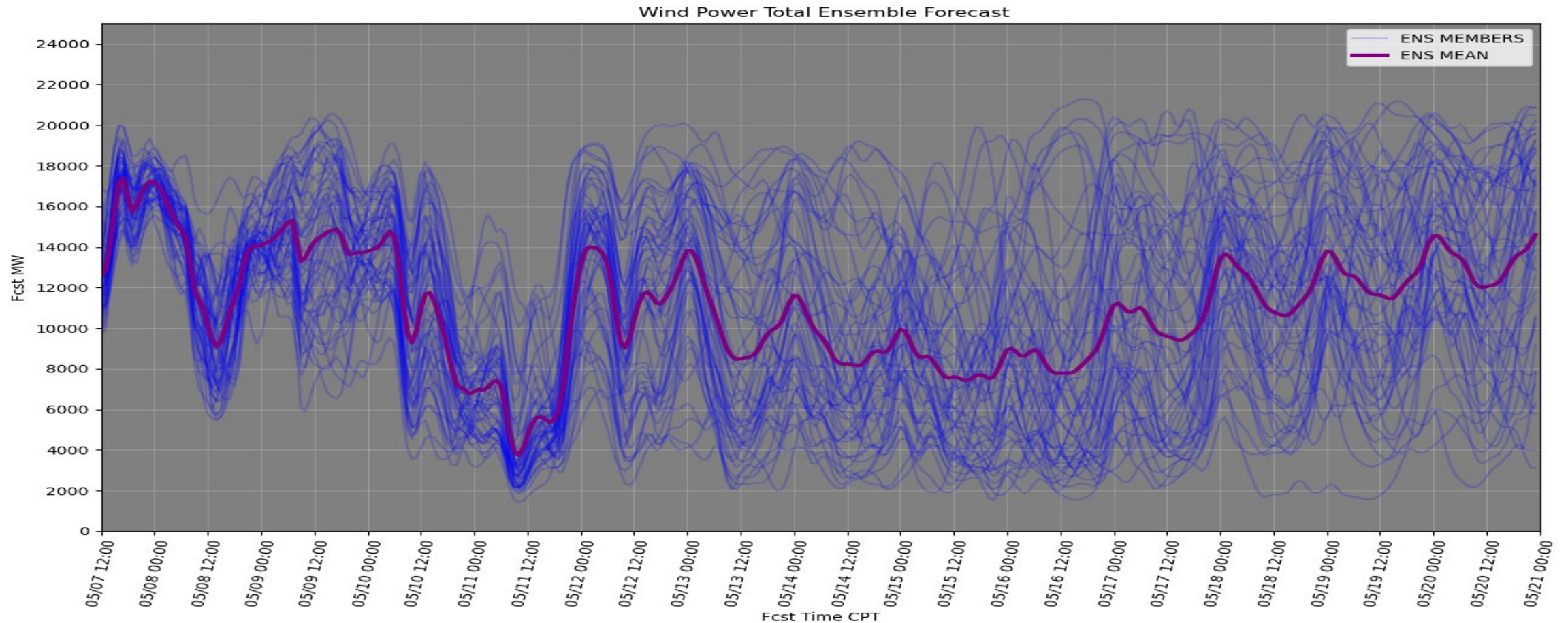
Measure Names

PValue Reference

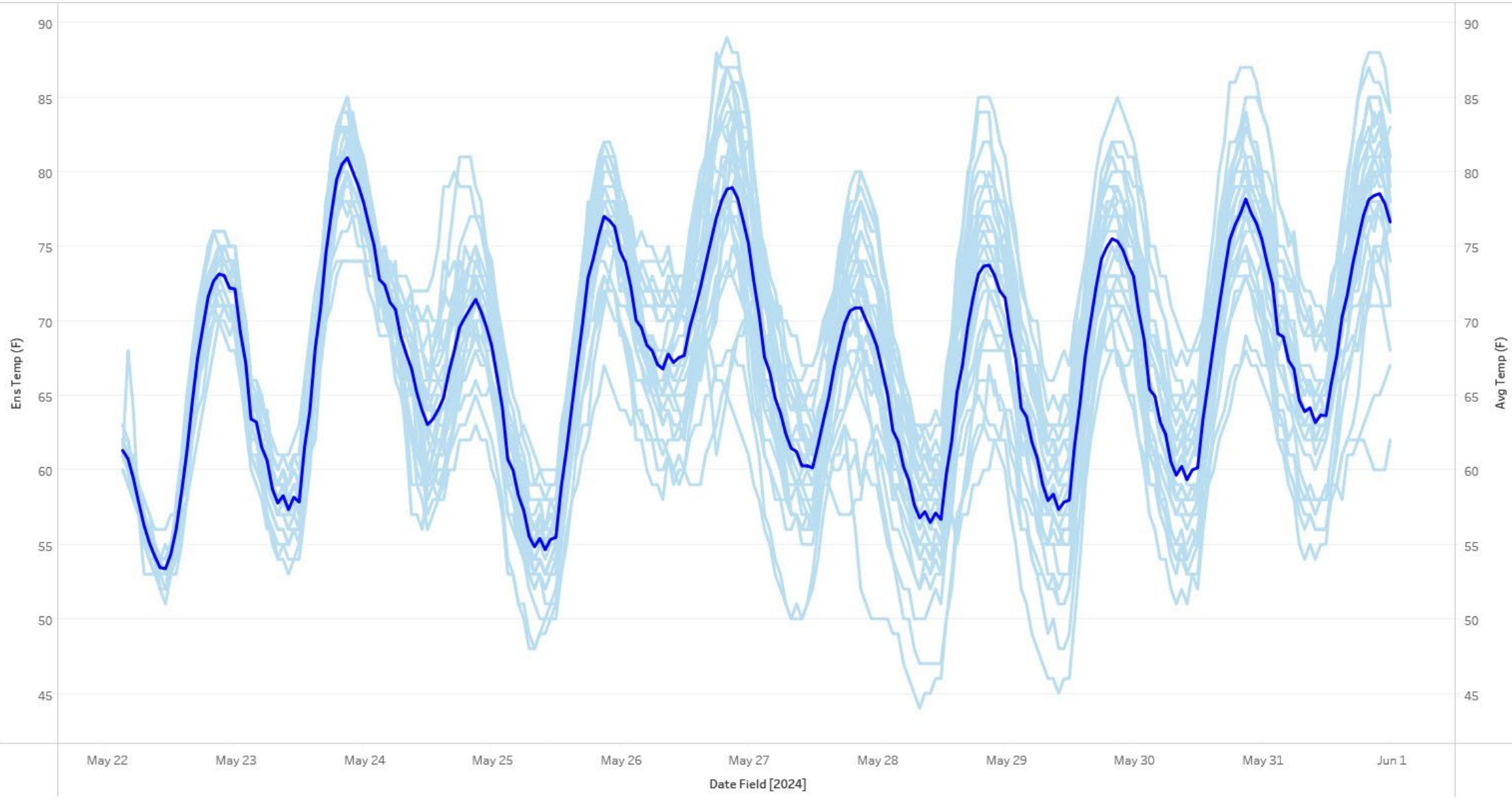
ENSEMBLE

ERROR FORECASTING

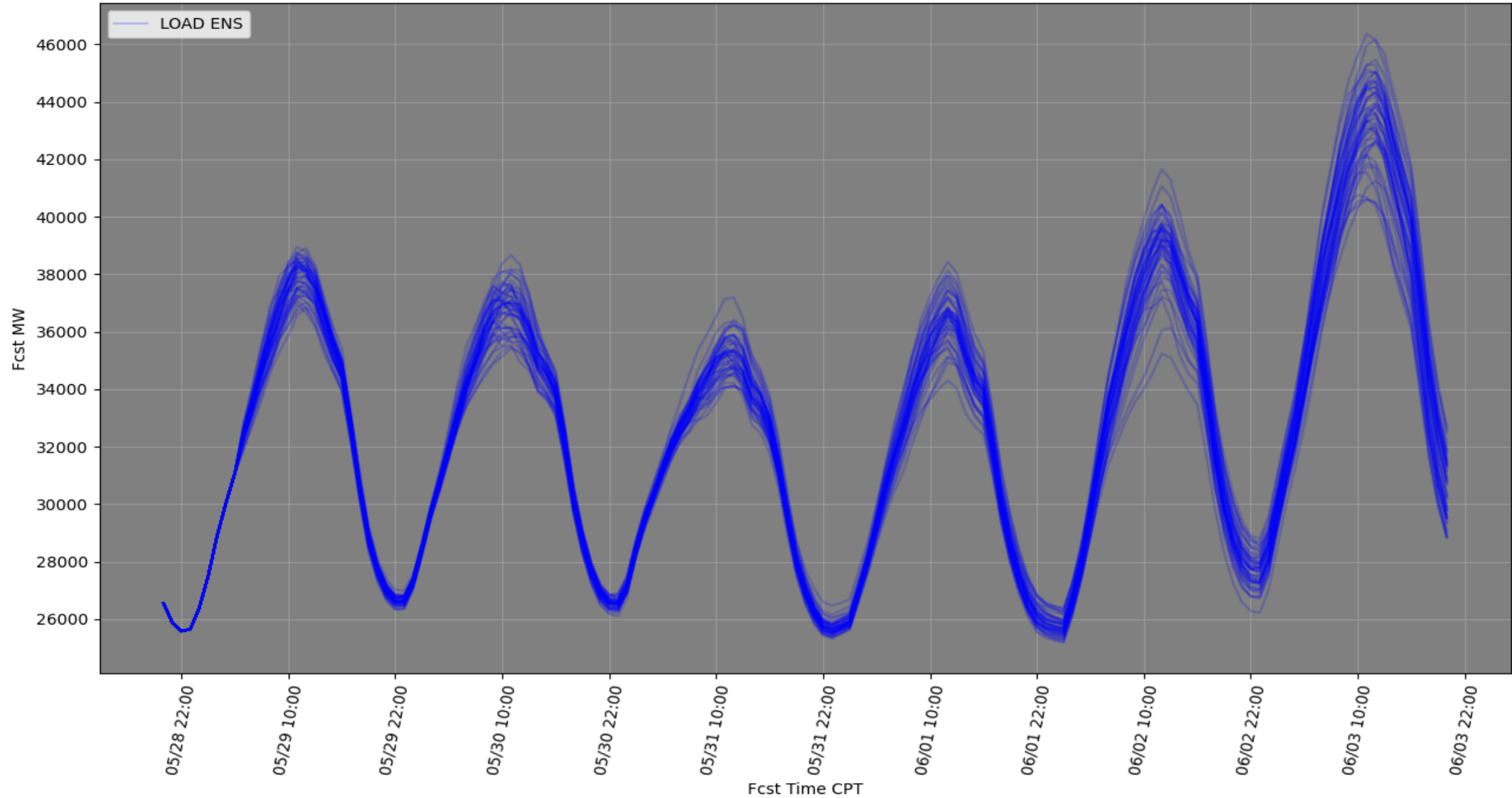
WIND POWER FORECAST ECMWF ENSEMBLE



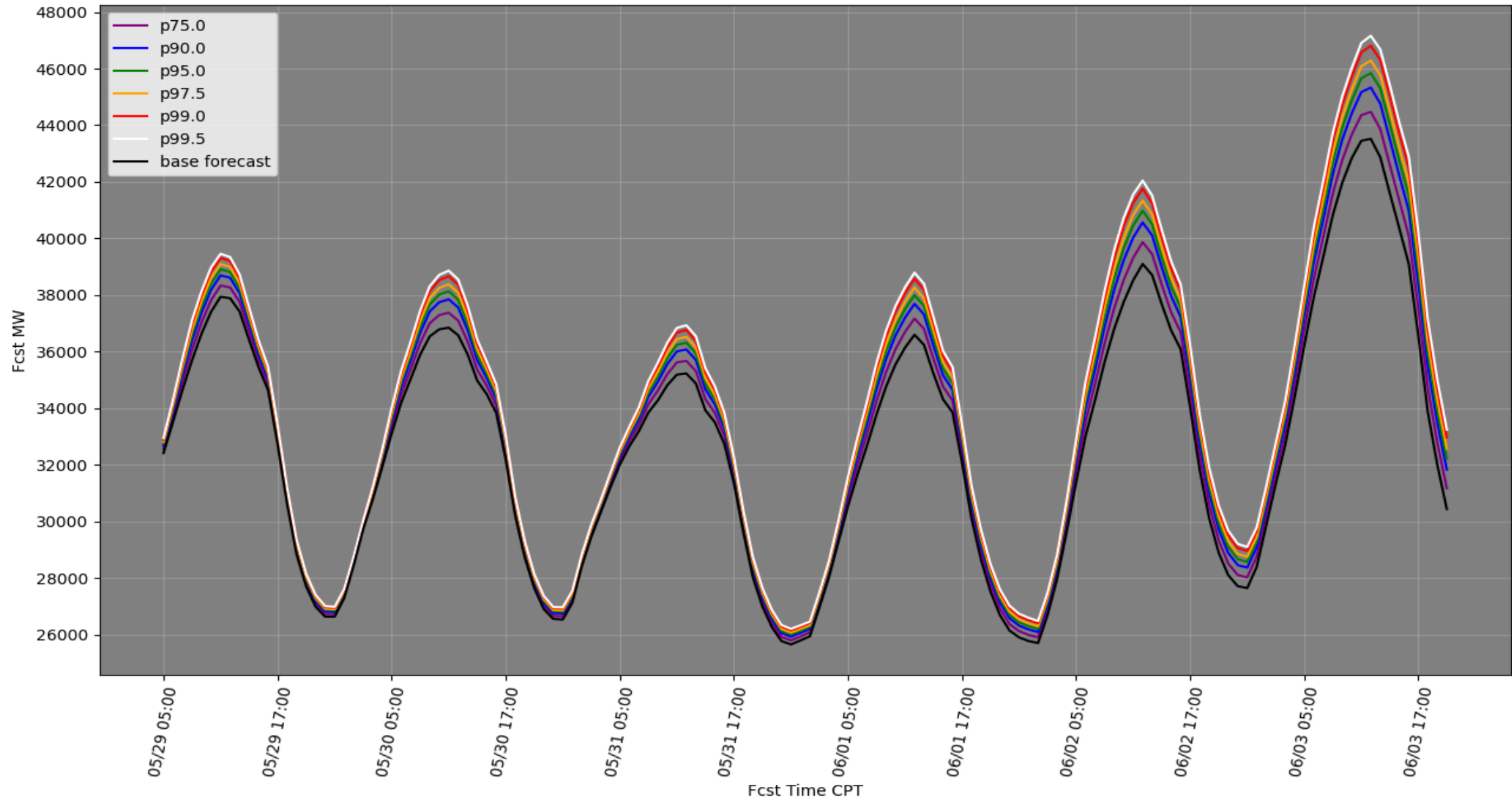
Kansas City GEFS Temperature Forecast



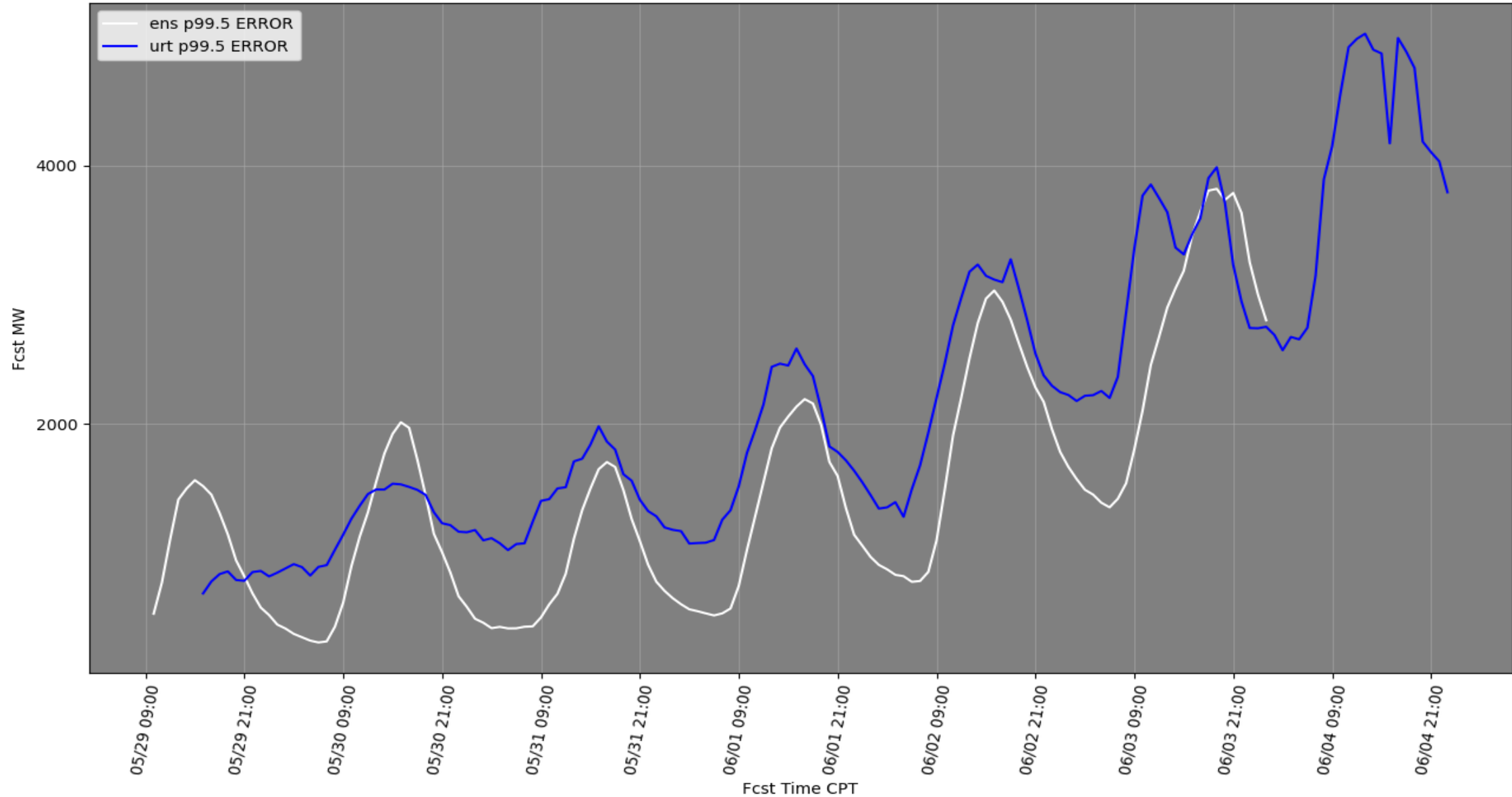
Ensemble Load Forecast



Probabilistic Load Forecast



Historical vs Ensemble Load Error Forecast



ENSEMBLE ERROR ADVANTAGES

- Can be used with historical error to identify time horizons of above or below average confidence
- Captures uncertainty based on spread of underlying inputs (i.e. Temperature, wind, cloud cover...)
- No historical data required for confidence intervals



JEFF BASKIN

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Southwest Power Pool

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