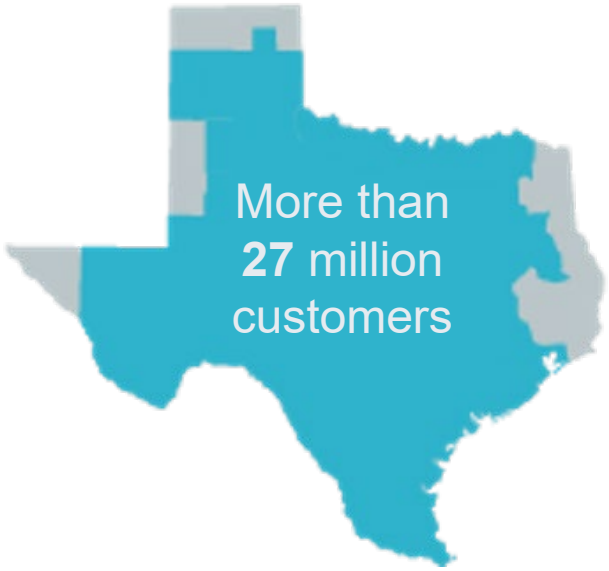
Updates on

Probabilistic Near-term Uncertainty & Risk Assessments

Riaz Khan
Operations Engineer, Sr.
Resource Forecasting & Analysis, ERCOT

ESIG 2025 Forecasting and Markets Workshop
Nashville, TN
June 25, 2025

ERCOT Facts



85,508 MW

Record peak demand
(August 10, 2023)

105,000+ MW

Expected capacity for
Summer 2025 peak demand

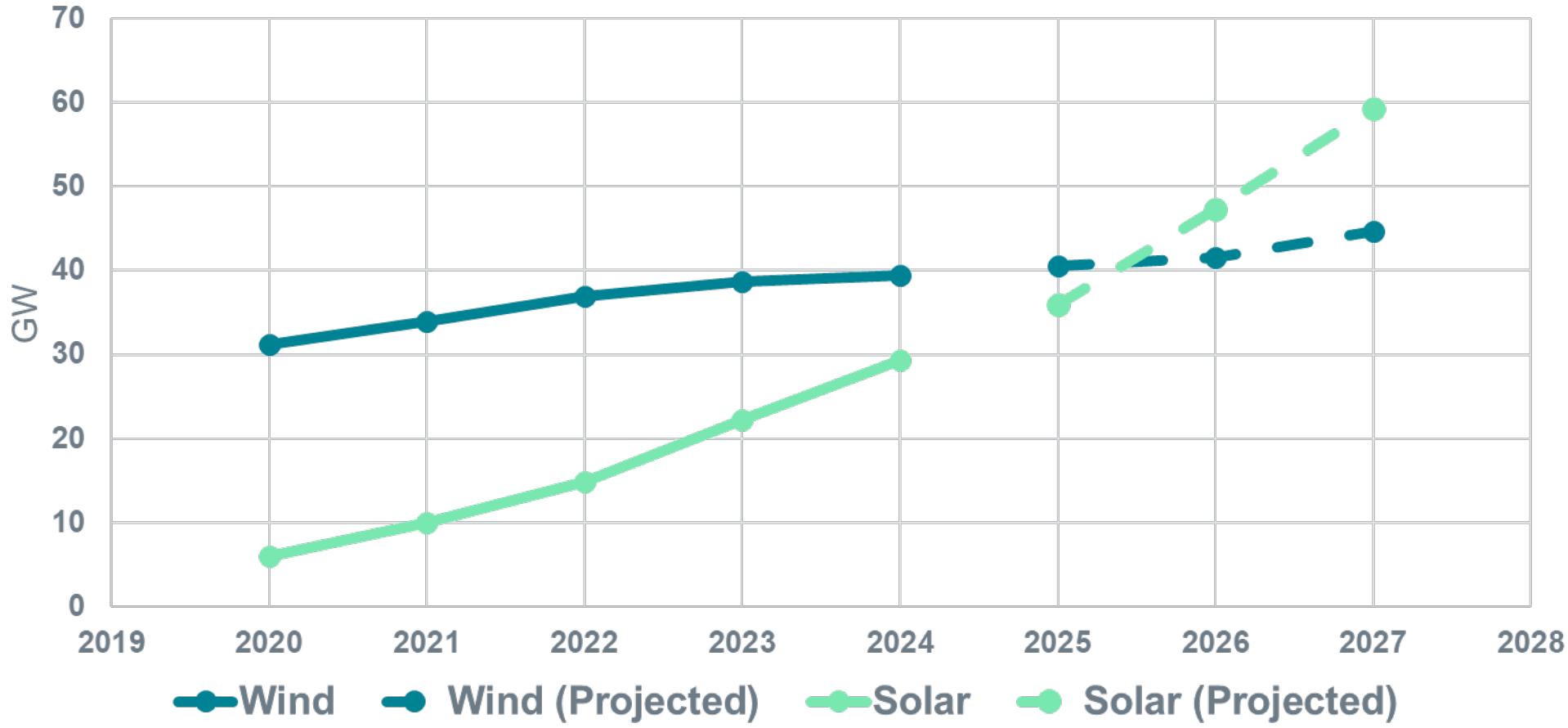
(May 2025 CDR)

$3.8 billion

Transmission projects
endorsed in 2024

	Installed Capacity (MW)	Record Generation (MW)
Wind	39,781	28,550
Solar	30,586	27,071

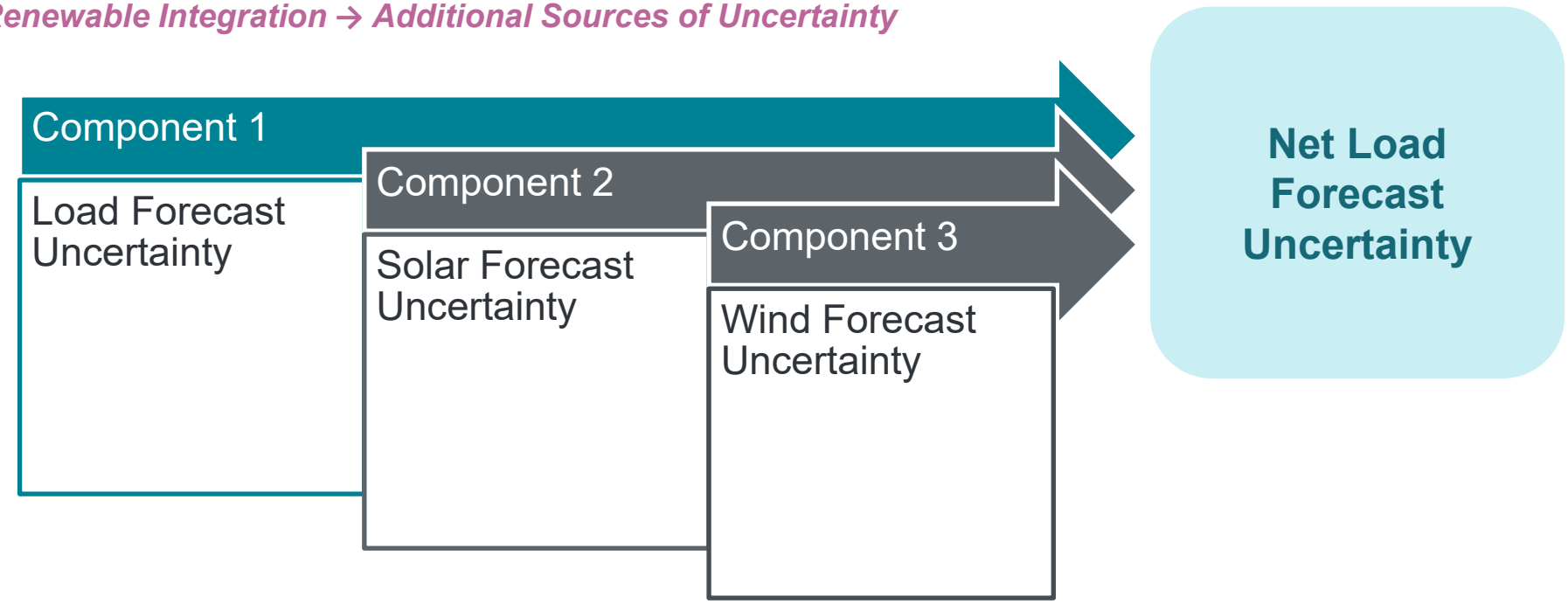
IRR Installed Capacity



Key Takeaway: Solar and Wind have grown significantly in the recent years, and are projected to grow in the coming years

Renewable Impacts Net Load Uncertainty

Renewable Integration → Additional Sources of Uncertainty



- Wind and solar power generation are dependent on weather conditions, leading to fluctuating output.
- As the wind and solar portfolio grows, the associated uncertainty also rises.
- Increased variability makes it more challenging to accurately forecast the net load, complicating grid management and planning.

Load, IRR Forecasts

Weather Forecast
Raw forecasts tied to different numerical models provided by the vendors

Load Forecast

- Load forecast models are developed by ERCOT
- Different forecasts are tied to specific weather models
- Final model is picked based on the history, model performance, and weather conditions

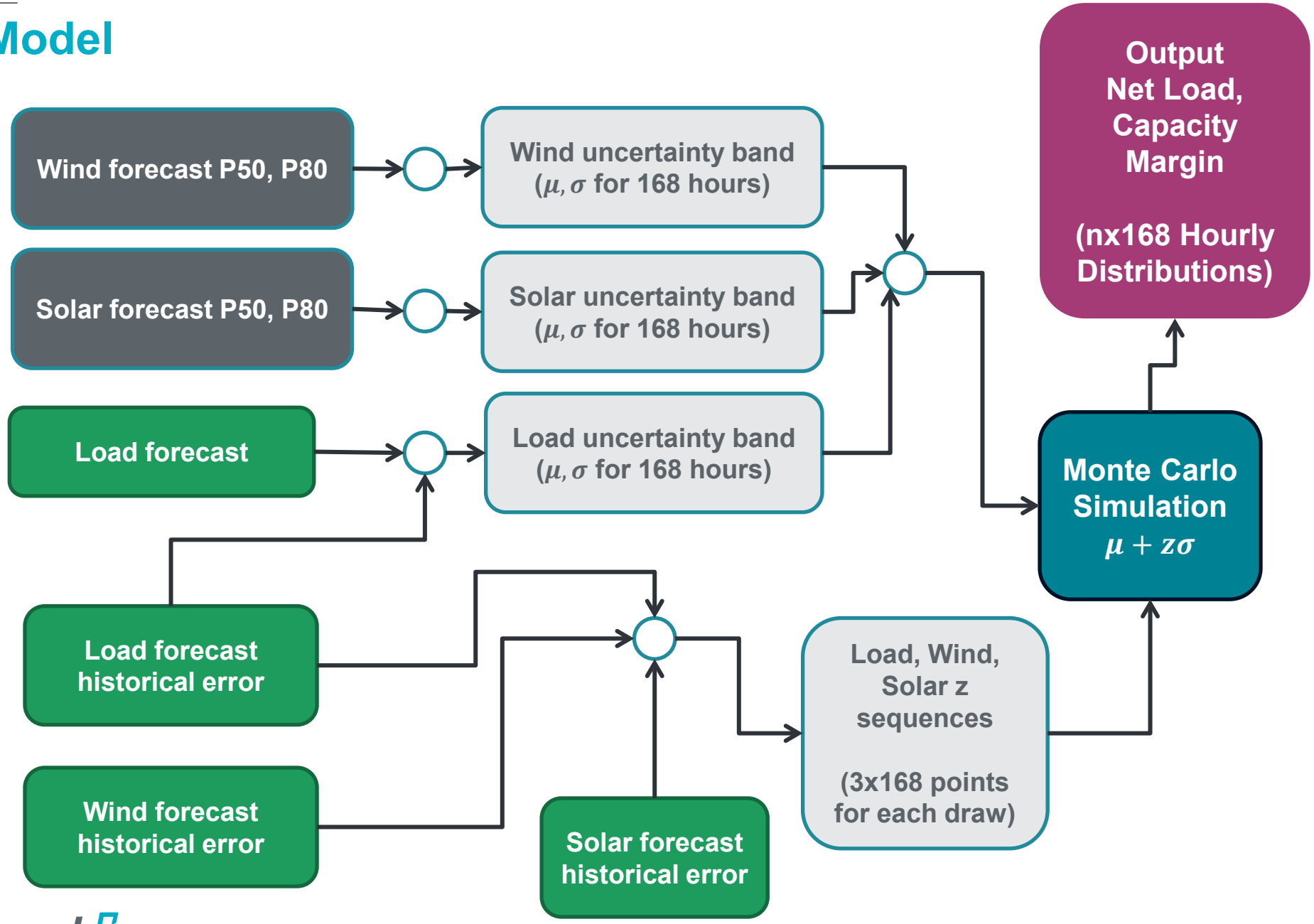
Solar Forecast

- Two vendors
- POE50 and POE80 forecasts
- Extreme weather forecasts
- Probabilistic forecasts (POE50, 85, 90, 95, 98, 6 hours)

Wind Forecast

- Two vendors
- POE50 and POE80 forecasts
- Extreme weather forecasts
- Probabilistic forecasts (POE50, 85, 90, 95, 98, 6 hours)

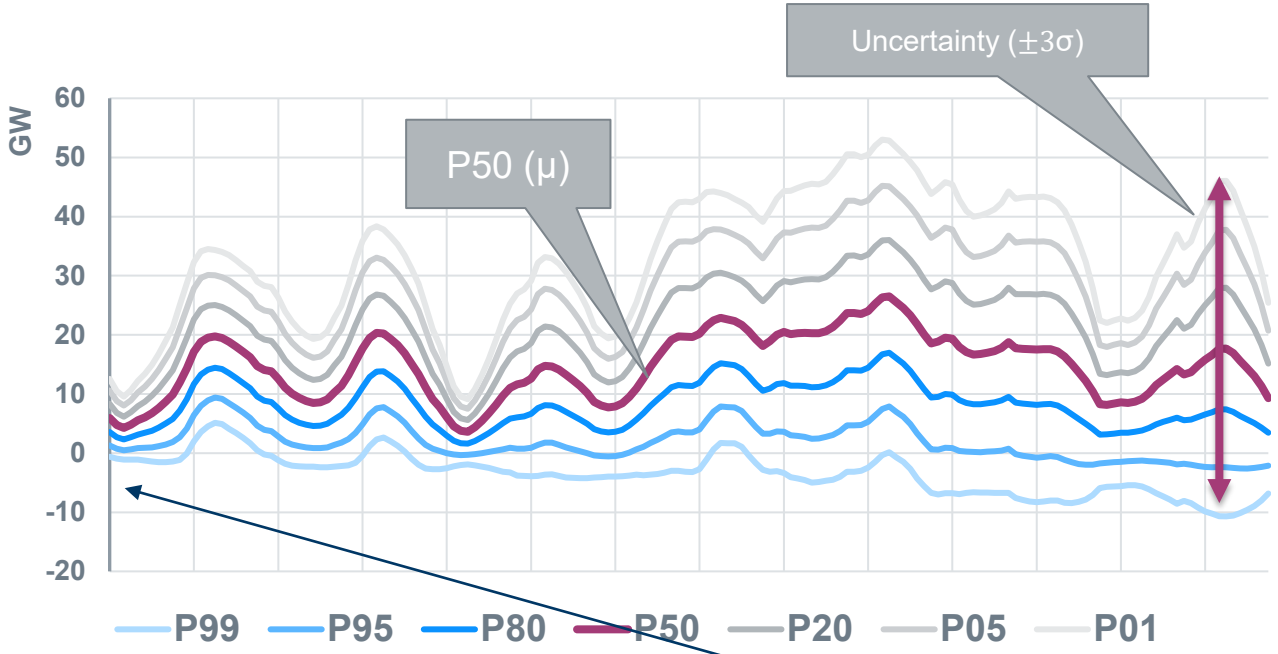
PCAT Model


Wind forecast P50, P80
Wind uncertainty band (μ, σ for 168 hours)
Solar forecast P50, P80
Solar uncertainty band (μ, σ for 168 hours)
Load forecast
Load uncertainty band (μ, σ for 168 hours)
Load forecast historical error
Wind forecast historical error
Solar forecast historical error
Load, Wind, Solar z sequences
(3x168 points for each draw)
Monte Carlo Simulation $\mu + z\sigma$
Output Net Load, Capacity Margin
(nx168 Hourly Distributions)

Uncertainty Buildup

168-hour forecast

- P50 forecast
- Uncertainty predicted from vendors (standard deviation)



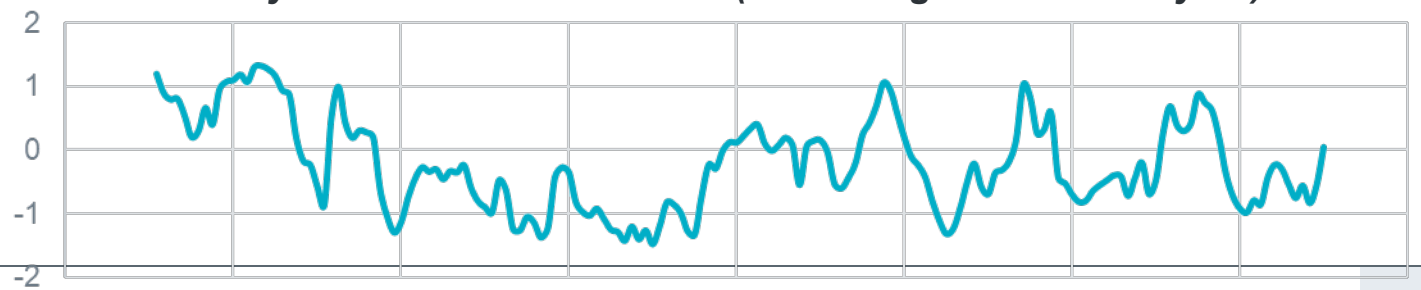
Historical forecast error

- How much uncertainty we have compared to the P50 forecast (z-score)

If start point is Aug. 15th at 10 AM

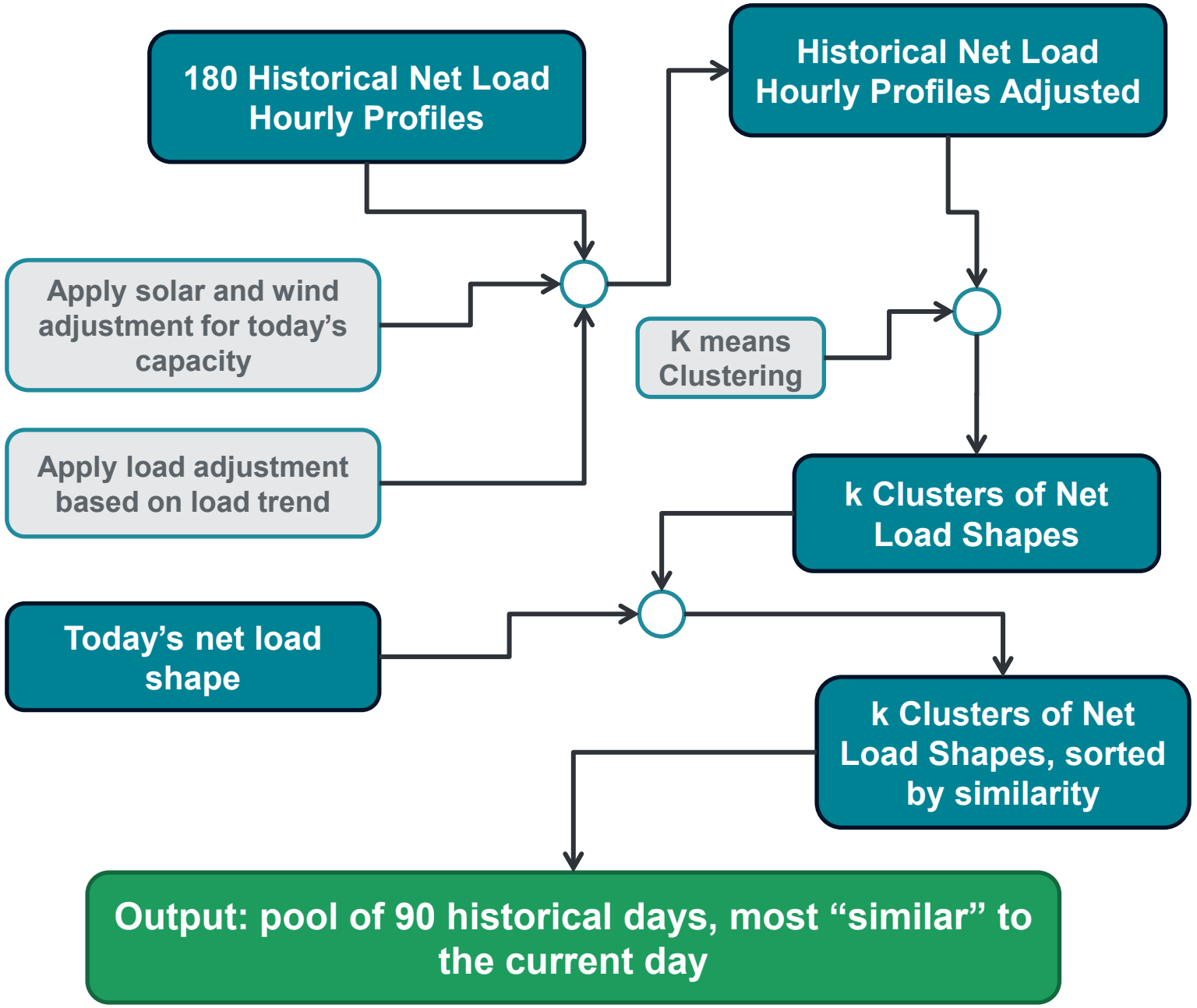
± 30 days from the day for past 3 years

3 years of historical z score (more weights on recent year)



Similar Day Approach

- To preserve seasonal and temporal characteristics of wind, solar, and load forecasts, similar day approach is used to narrow the sampling pool
- Cluster three years of historical forecasts based on net load pattern while considering look-ahead horizon

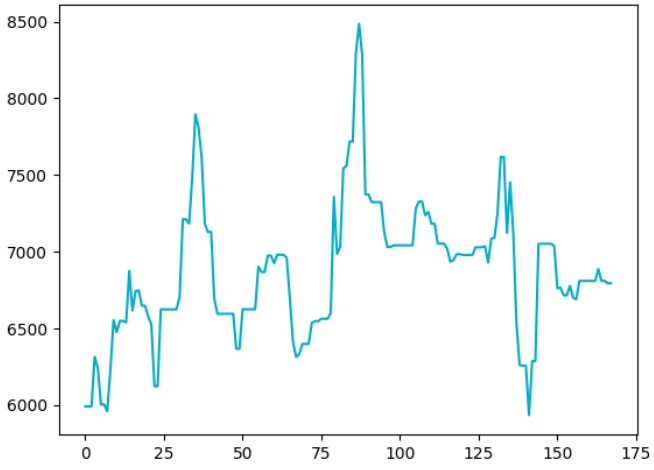


seven independent clustering for seven days

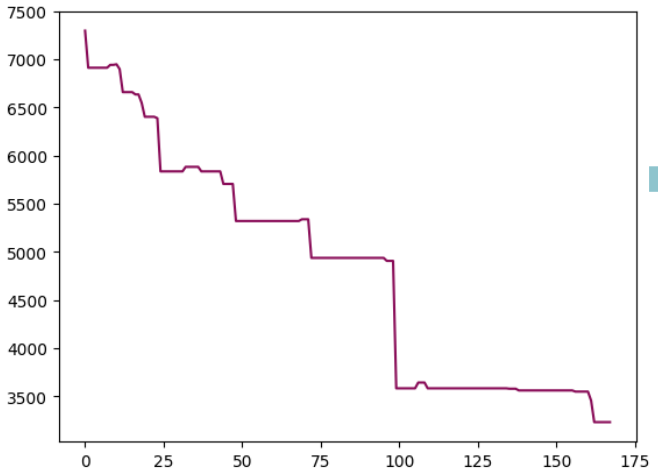
Forced Outage Integration

1. Historical forced outage from the past three years
2. Get data ± 1 month from current month and of the same hour
    1. Including current month for a total of three months
3. Further filtering for forced outage magnitude in comparison to current forced outage amount
    1. ± 1250 MW as the starting point, if the sample pool has less than 90 days, loosen threshold until 90 days is reached
4. Random sample from the sample pool during MC simulation
    1. Randomly draw one day
    2. Get current snapshot view of forced outage for the next 168-hours
    3. Obtain maximum outage between the random draw and the snapshot forced outage

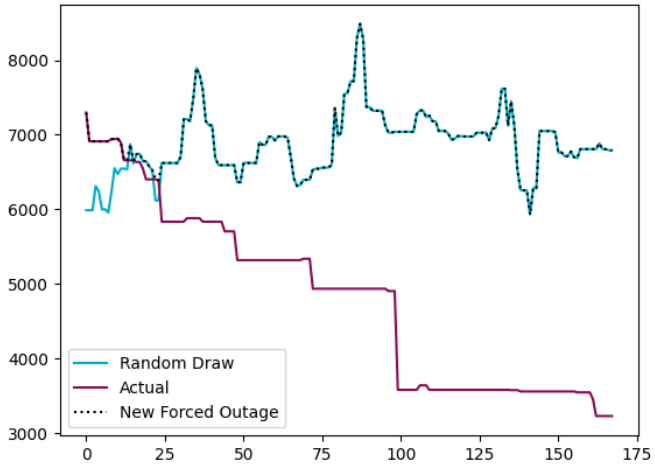
Random Draw



Snapshot Forced Outage

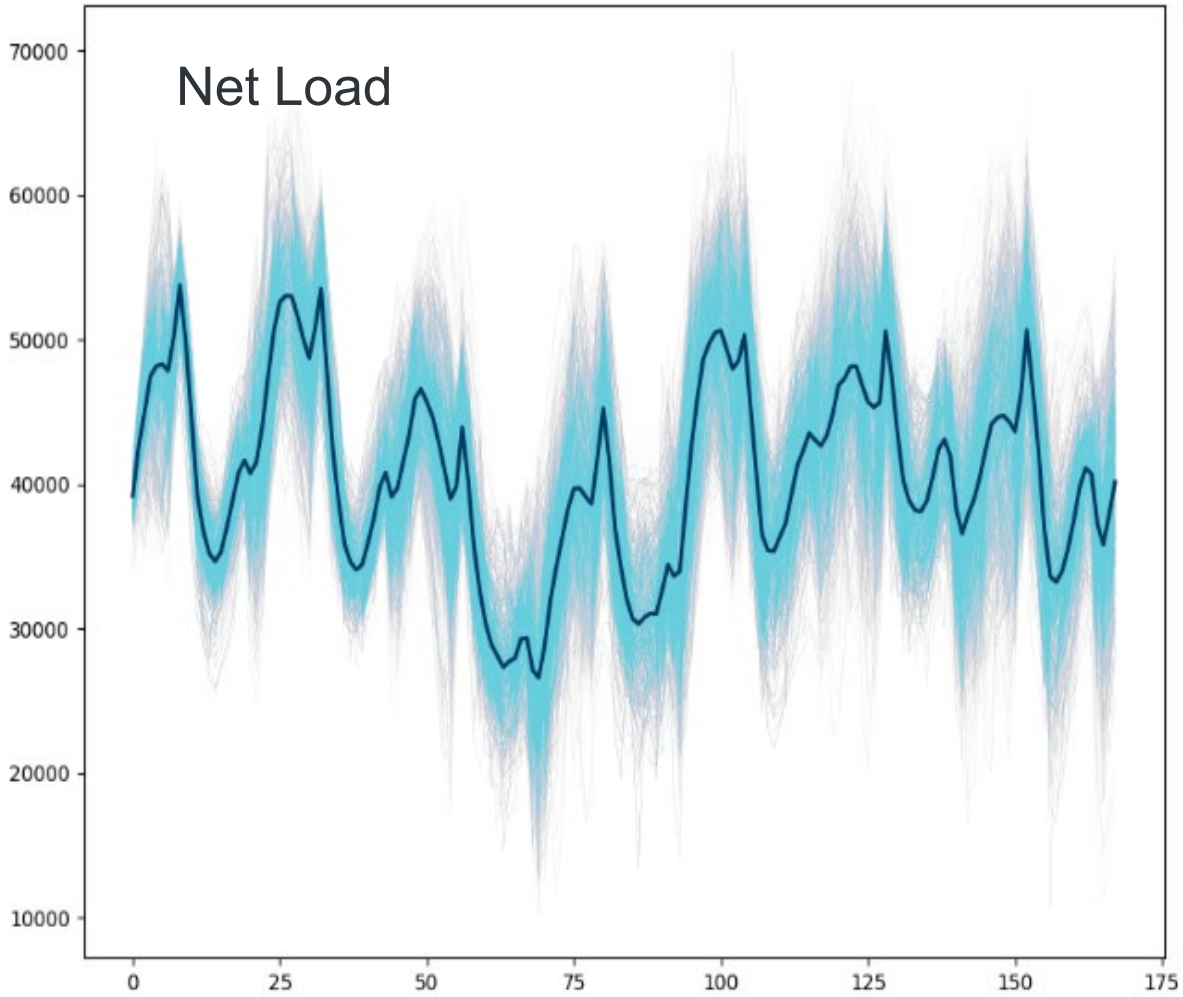


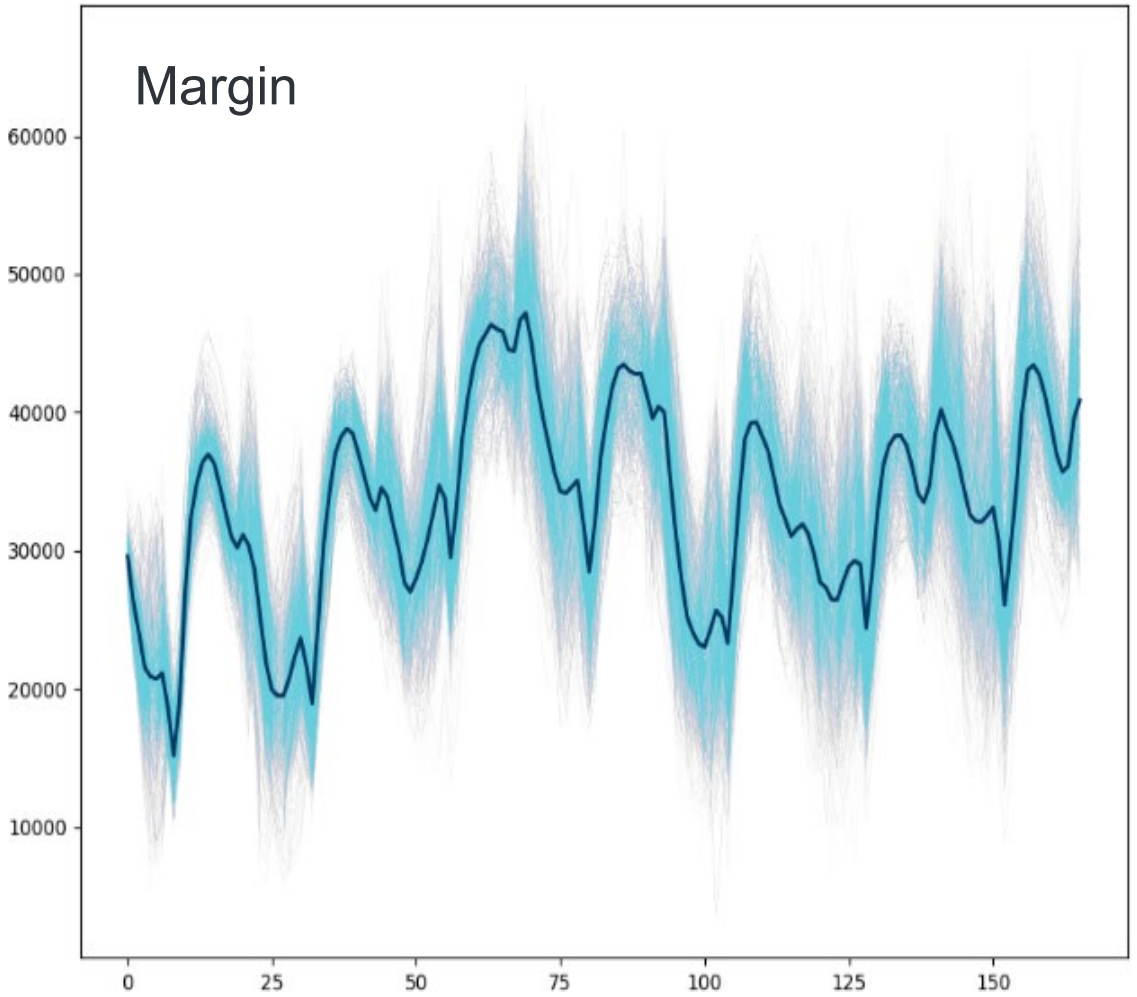
New Outage



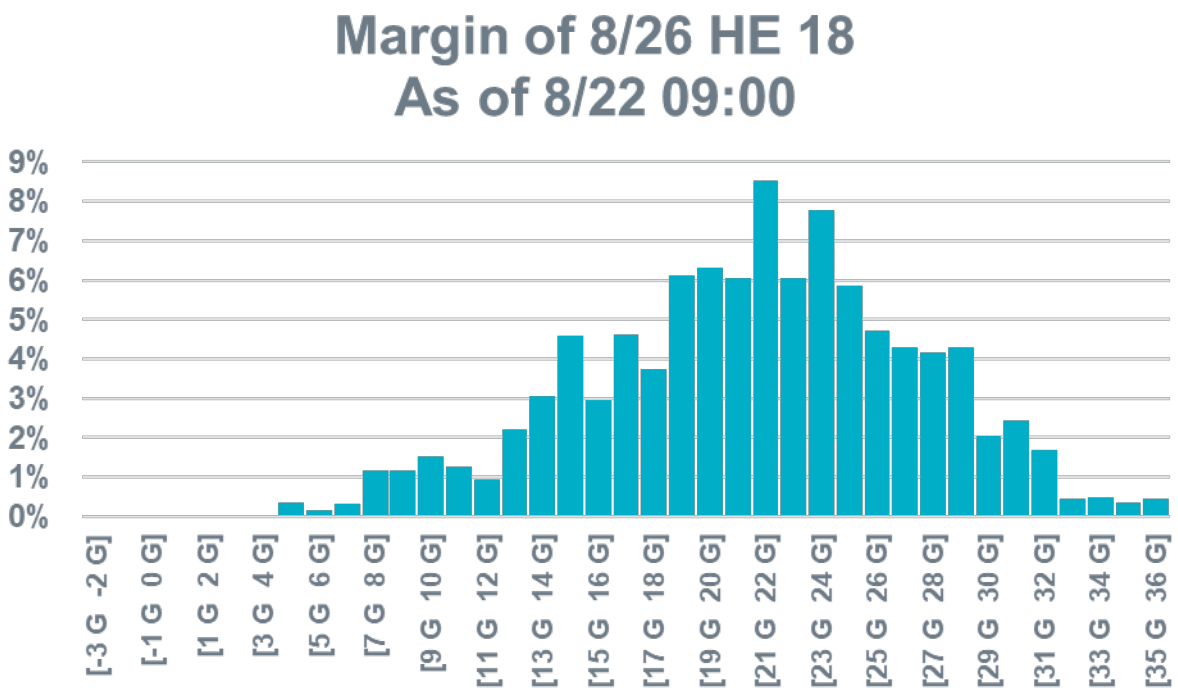
For longer look ahead horizons, the actual historical forced outage falls around the 62nd percentile*

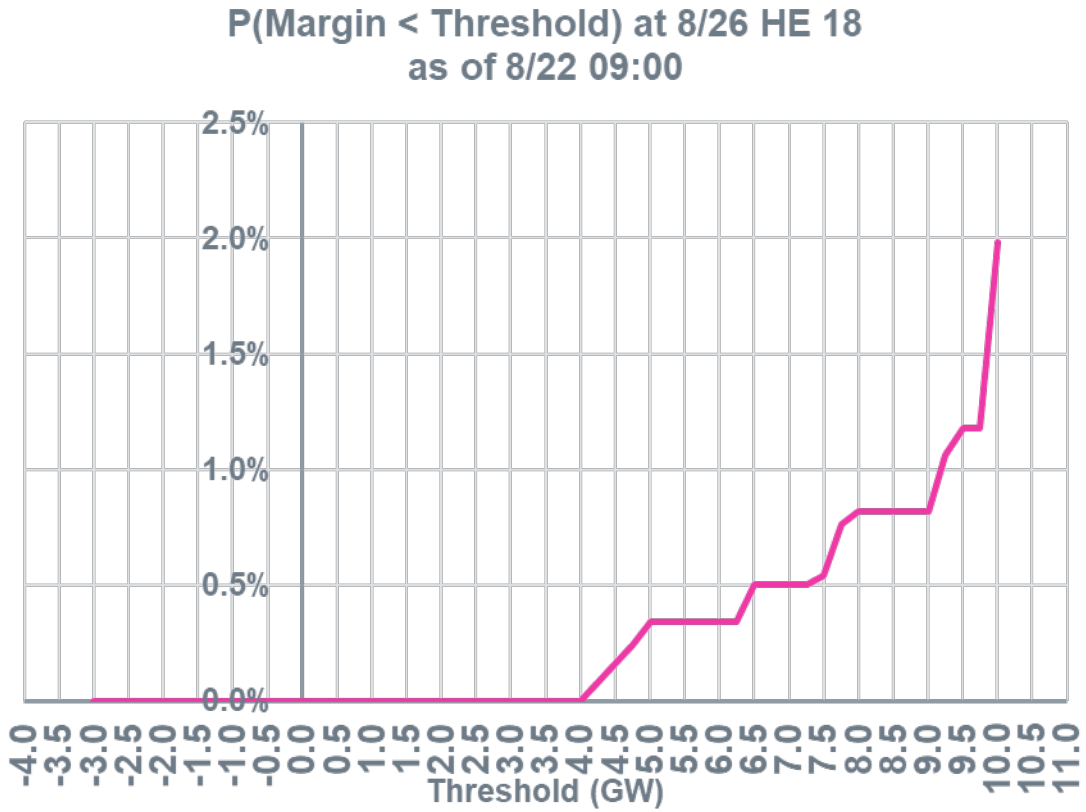
PCAT Model Output – Uncertainty Bands



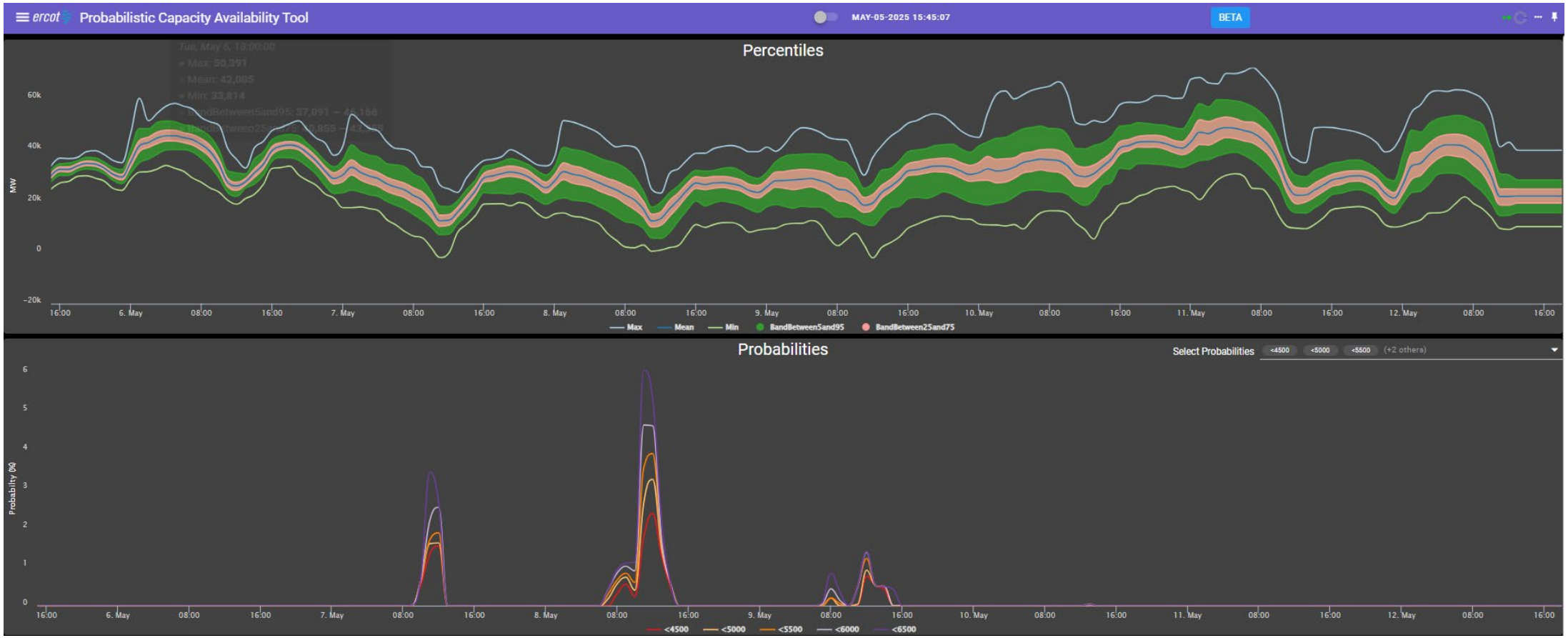


MC Simulation Results





Implementation



Next Steps

Achievement between summer 2024 – summer 2025

- Integrated the sim-day feature
- Implemented in the production
  - Visual dashboard in progress
- Included forced outage

Next Steps

- Account for other uncertainty components (e.g., batteries, price responsive resources)
- Apply sim-day individually to the net load components (Load, Wind, Solar)
- Explore other methods for calculating forced outage uncertainty
  - Aggregation of units
  - ML approach
  - Include weather variables
- Calculate probabilities of deploying AS (ECRS/Non-Spin)
- Historical analysis on acceptable risk level