



Use of Probabilistic Forecasts in Operational Risk Assessment

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Future Changes in ERCOT Grid

GENERATION INSTALLED CAPACITY GROWTH

2024	23,414 MW	2024	38,998 MW
2027	49,369 MW	2027	41,319 MW
Solar		Wind	
2024	6,302 MW	2024	68,052 MW
2027	19,381 MW	2027	68,794 MW
Storage		Gas	

Total Transmission Connected IBRs (Wind, Solar, and Storage) could exceed 81 GW in 2024 and 124 GW in 2027

DRIVERS FOR INCREASES IN POWER DEMAND

- Population Growth
- Economic Growth
 - Texas has attracted major employers like Samsung, Tesla, Amazon, Google, and Oracle
- Electrification
 - Increased use of electronic devices that require charging
 - Electric vehicles (EVs) ([Brattle Study](#))
 - Electric heating
- Oil & Gas Load Growth
 - By 2030, load in the Permian Basin alone will nearly double to over 10,000 MW
 - Demand expected to come from (1) new facilities and (2) existing facilities converted from backup generation to ERCOT grid connection
- Large Flexible Load Growth
 - ~4,479 MW now. Tracking 40,858 MW in various stages of development
 - Cryptocurrency mining, Data centers

Capacity Availability Tool (CAT) Project

- ERCOT currently uses a deterministic approach for supply/demand risk assessment, determining capacity margin based on specific forecasts.
- As the load and supply portfolio evolves, shifting to a probabilistic approach is essential to account for growing uncertainty.
- ERCOT is developing a project (CAT project) to assess capacity margin using a probabilistic approach for up to seven days (168 hours).
 - Currently in the prototype stage
 - Aims for testing in summer 2024
- Long term vision is to implement in production environment with appropriate IT support and to use the tool to support operations decisions.
- In future, we look forward to incorporating battery, price responsive.

CAT Model

Input

- Hourly COP Data
- Hourly Load Forecast Data
- Hourly Solar Forecast Data
- Hourly Wind Forecast Data

Extras

- Energy Storage Resources SOC Forecast
- Price Responsive Demand Forecast

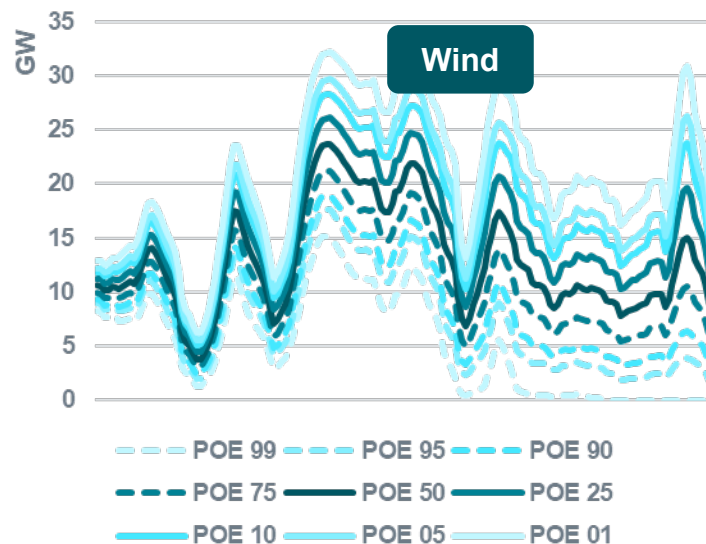
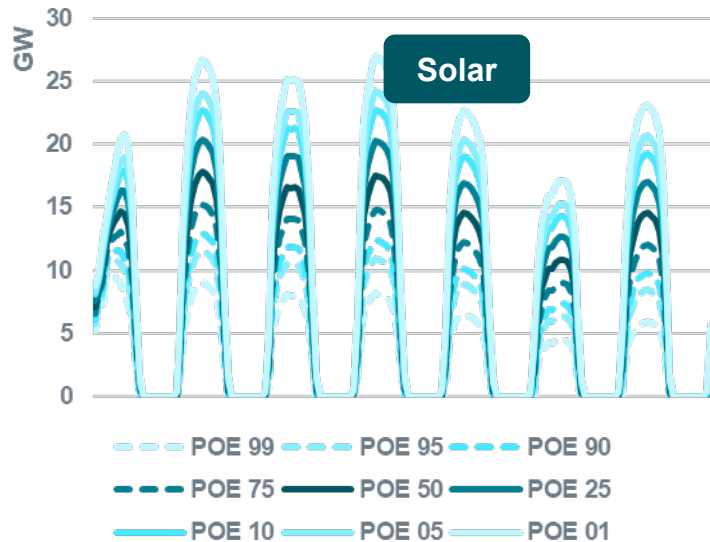
Process

- Calculate uncertainty for load, solar and wind forecast
- Apply the forecast uncertainty for the forecast period (168 hours) with information from history
- Create distribution of net load forecast (*net load = total load – solar – wind*) using Monte Carlo (MC) simulation
- Determine forecasted capacity margin distribution from COP data and MC output

Output

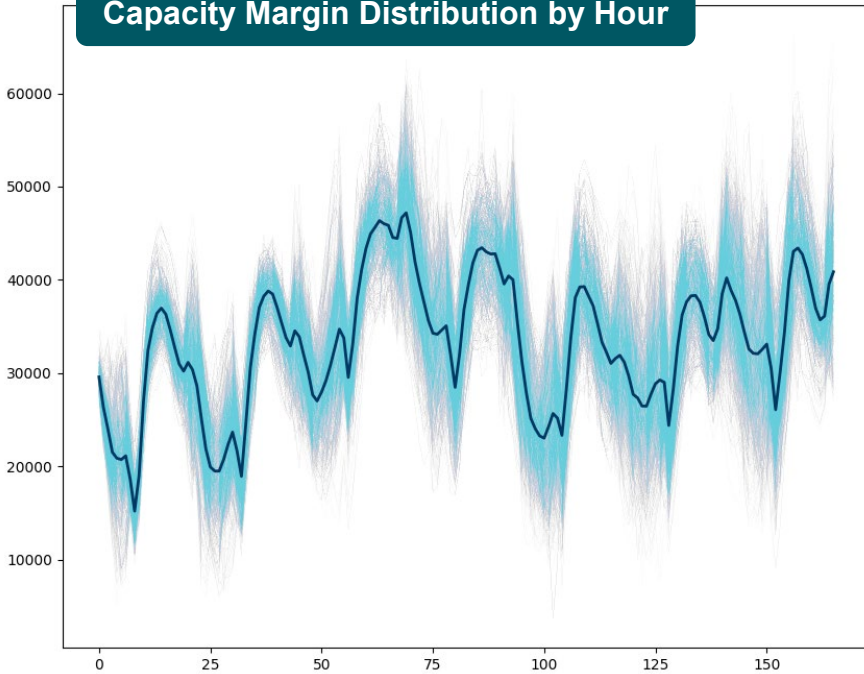
- Event Occurrence Probability – hourly probability of capacity margin falling below certain threshold (168 hours)
- Statistics on forecasted capacity margin (min, max, average, median, k^{th} percentile, etc.)

CAT Inputs



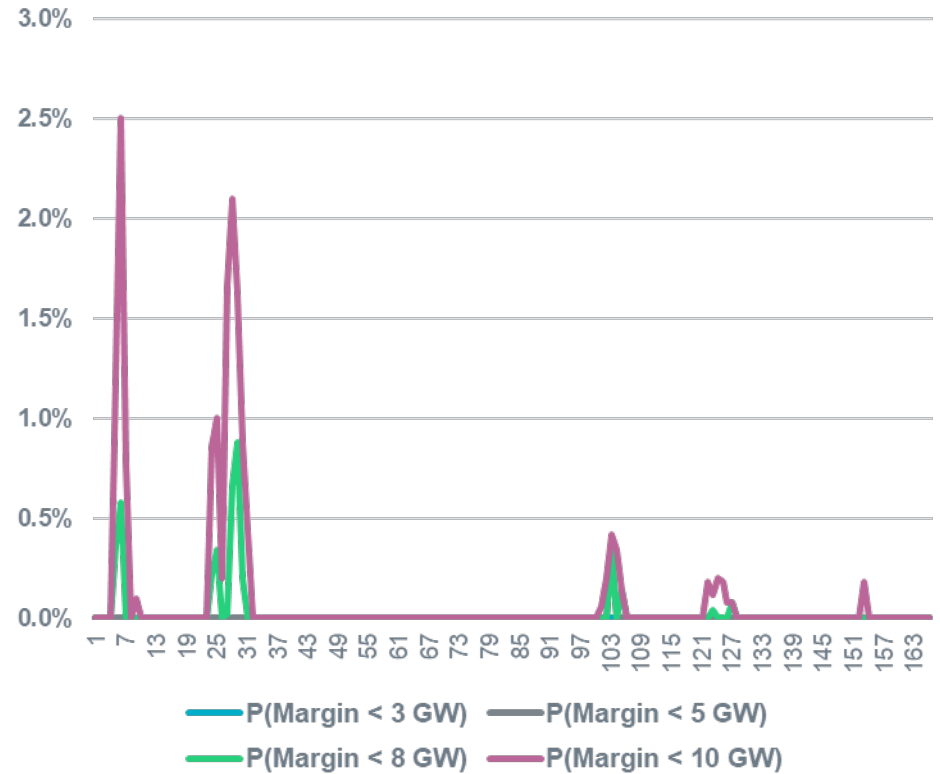
CAT Outputs

Capacity Margin Distribution by Hour



Capacity margin distribution is derived from net load distribution and COP data

Probability of Margin Below Certain Threshold



Challenges

- The actual basis distribution of the forecast is unknown.
 - *Normal distribution is assumed.*
- Error patterns are not straightforward to predict for the forecast window.
 - *Error patterns are gathered from the historical data.*
- Possible cross-correlation and auto-correlation between and within forecast components exist.
 - *Implicitly preserved by strategically sampling from historical data.*
- Load and solar/wind capacity is dynamic.
 - *Managed by normalizing the values.*

Questions?