



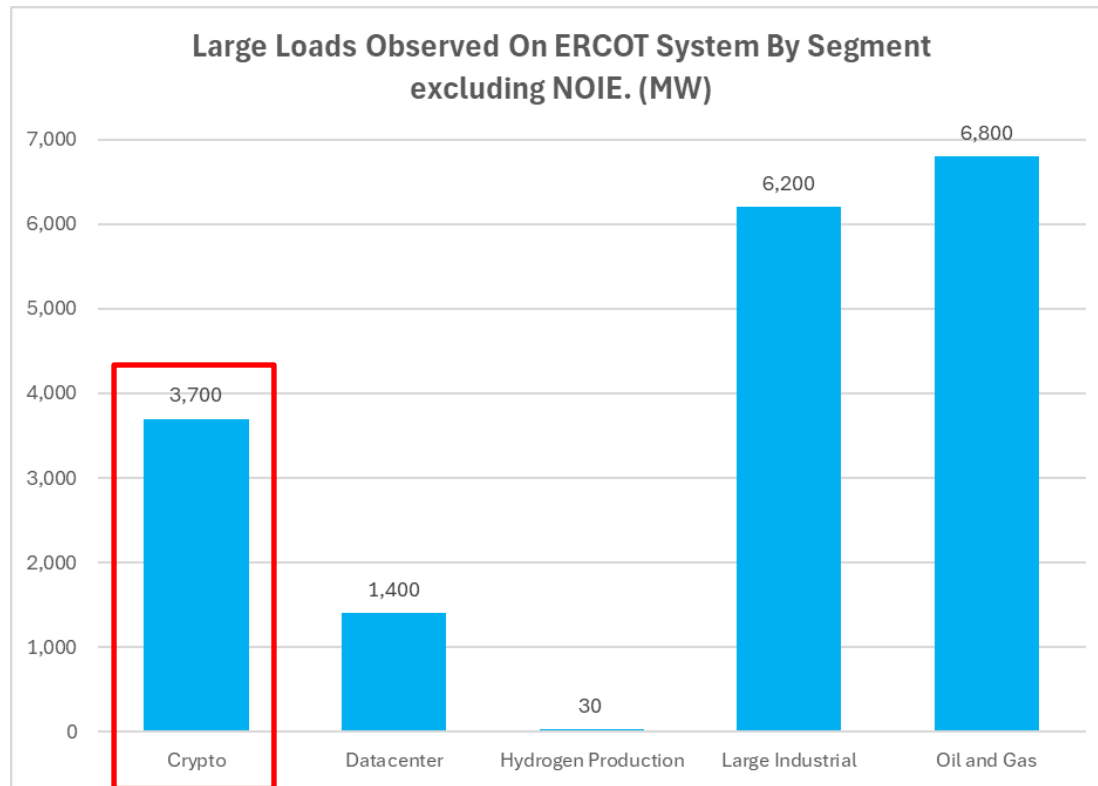
ERCOT Forecasting Large Load Behavior in Operations

Luke Butler

Manager, Resource Forecasting and Analysis

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Current Large Loads by Segment



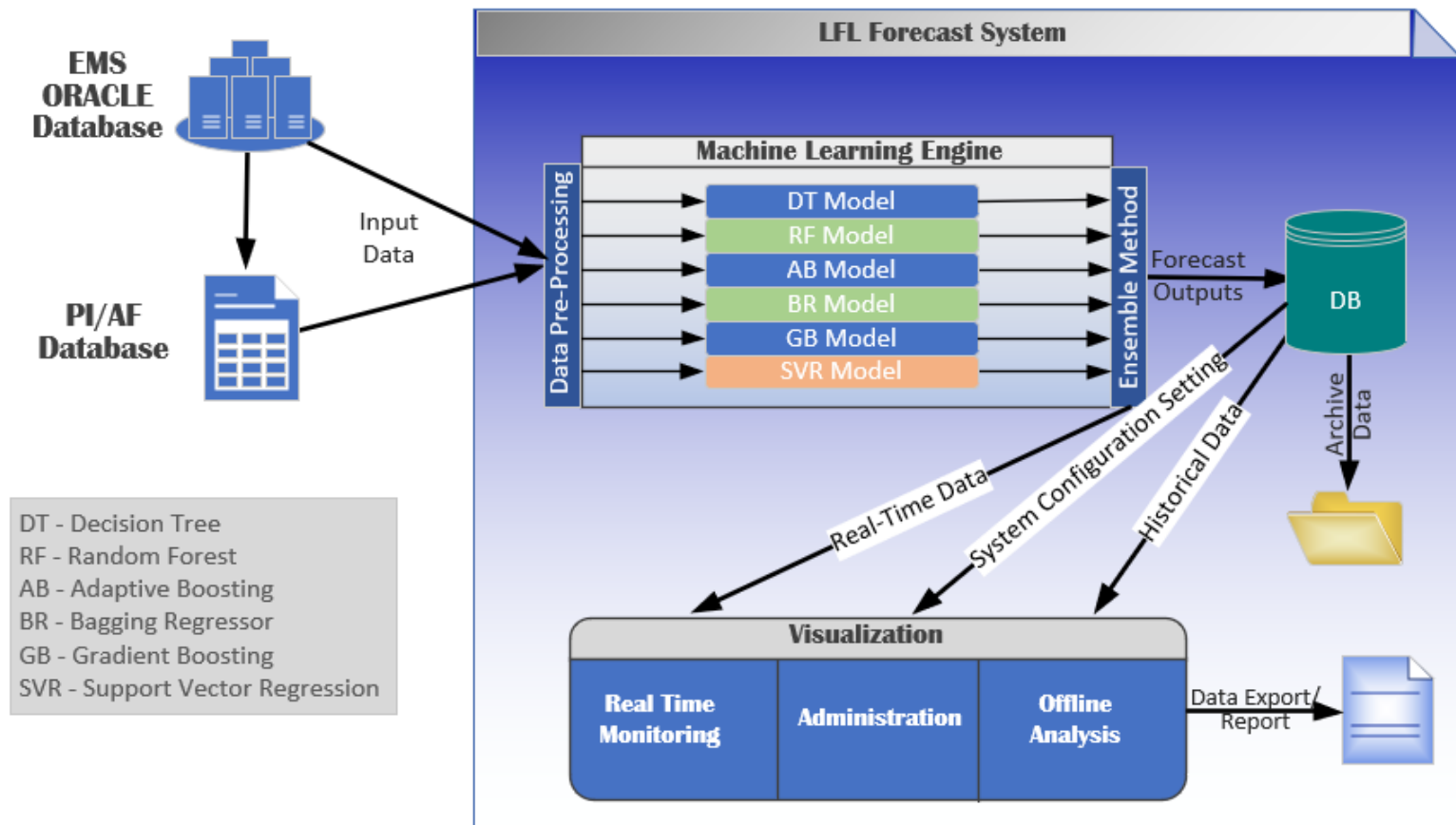
Large Load Type	Current Observed MW
Crypto	3,700
Datacenter	1,400
Hydrogen Production	30
Large Industrial	6,200
Oil and Gas	6,800
Unknown NOIE Demand	23,954

Currently Energized Datacenters(Non-NOIE)	
Approved MW	2,805
Highest MW Observed	1,397
Highest Utilization	50.20%



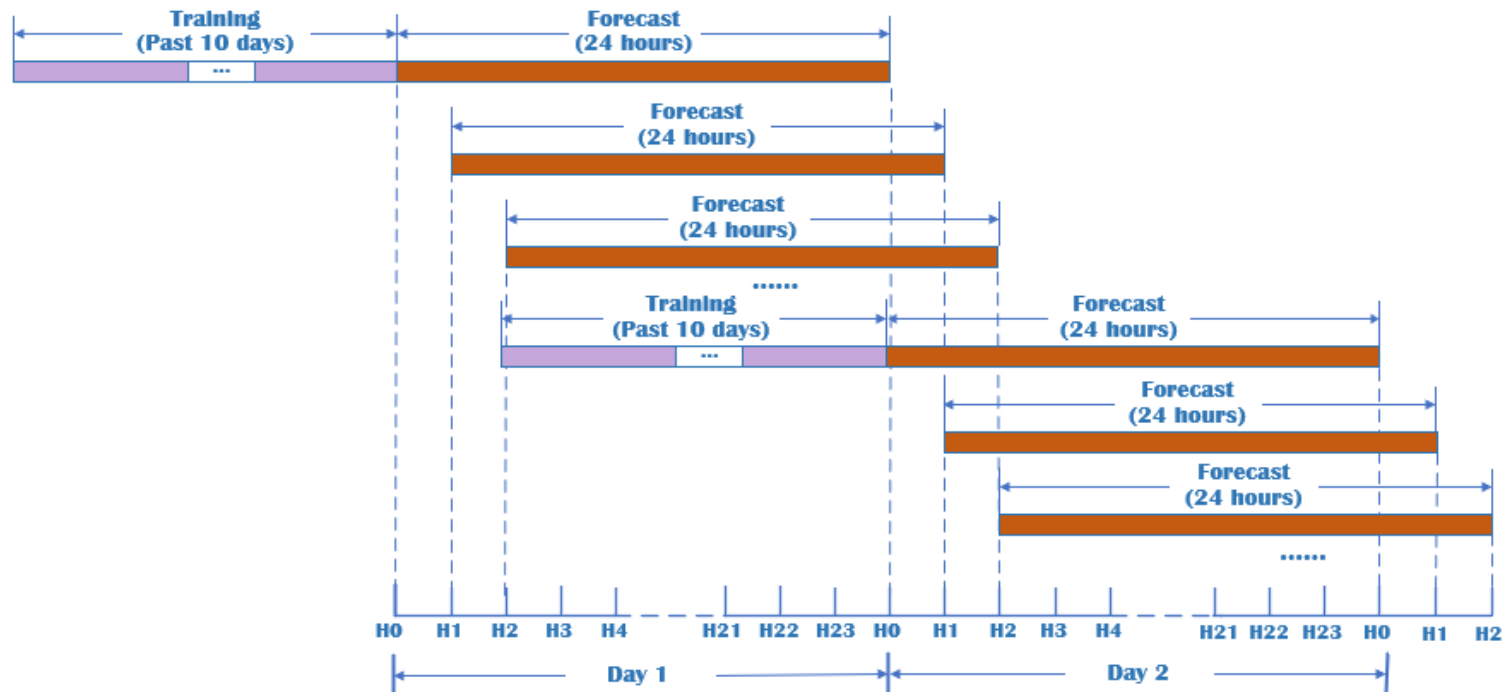
Large Flexible Load (LFL) Forecasting with Machine Learning

ERCOT has developed a machine learning-based forecast system for LFLs, predominately large crypto-mining loads, for the operations horizon.

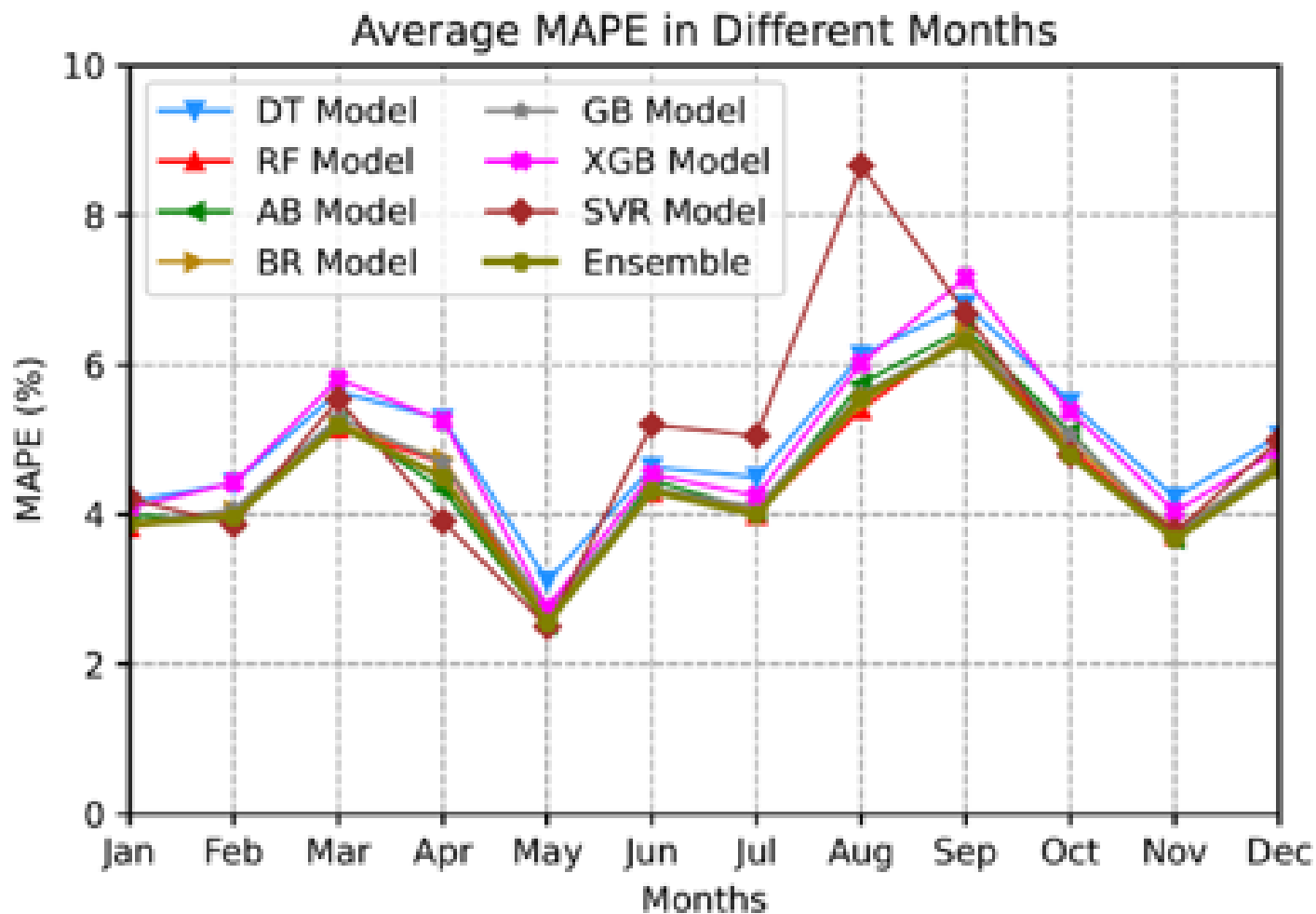


LFL Forecast Timeline

- ML Models are trained at beginning of each day.
- Provide forecast for:
 - next 2 hours (in 5-minute interval and update every 5-minute)
 - next 24 hours (in 1-hour interval and update every 1 hour)
 - most recent update extended hourly forecast for next 168 hours (7 days)



LFL Forecast Performance



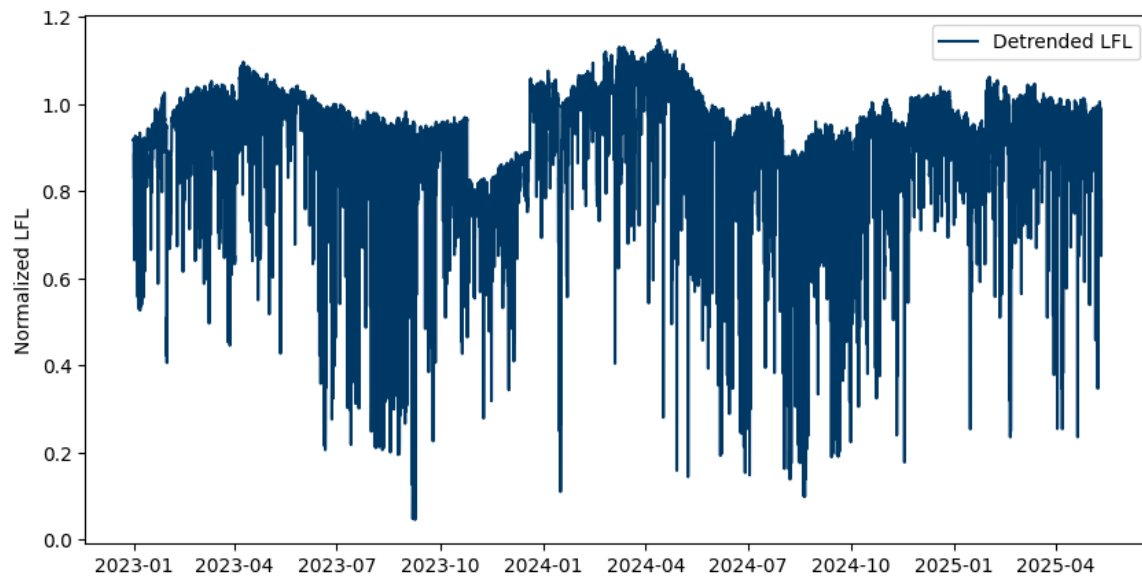
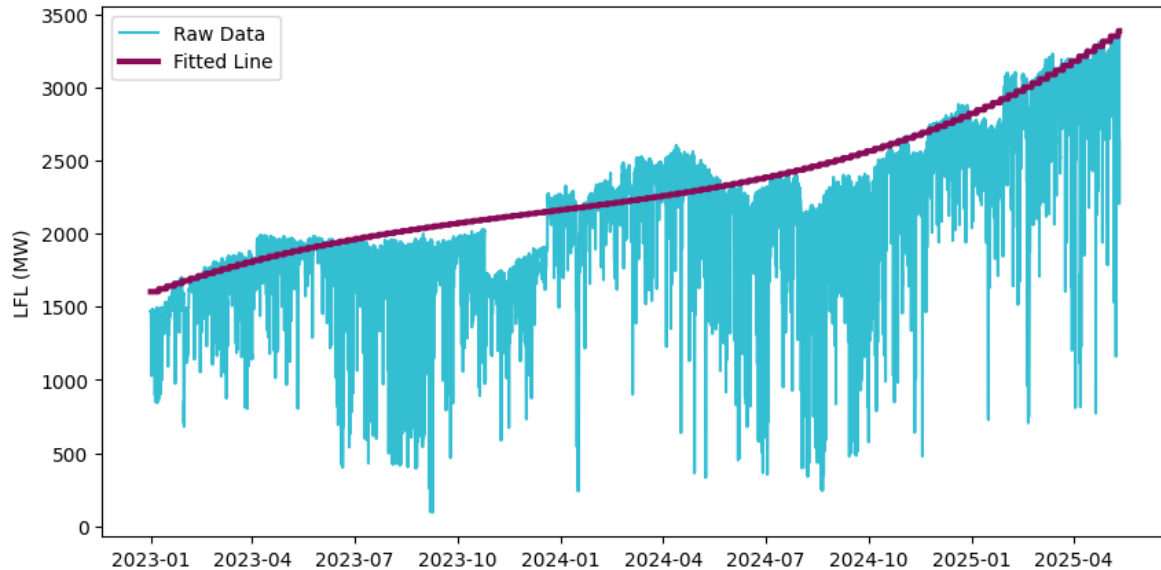
Lessons Learned using ML Models for LFL Forecasting

- LFL response differs by season:
 - In June through September, dramatic reductions can start earlier in afternoon due to Four Coincident Peak (4CP) response.
 - In non-summer (non-4CP) months, usually minor variation during day-time hours, but potential for high response during high net-load periods, primarily solar ramp down hours, due to tighter conditions and price spikes.
- Use multiple machine learning models and ensemble methods (such as bagging, boosting, and weighted averaging) to improve prediction accuracy.
- Accurate forecast of energy price information can improve LFL prediction accuracy.
- Deep learning models can provide accurate prediction on some extreme weather situations.

LFL Forecasting – Statistical Model

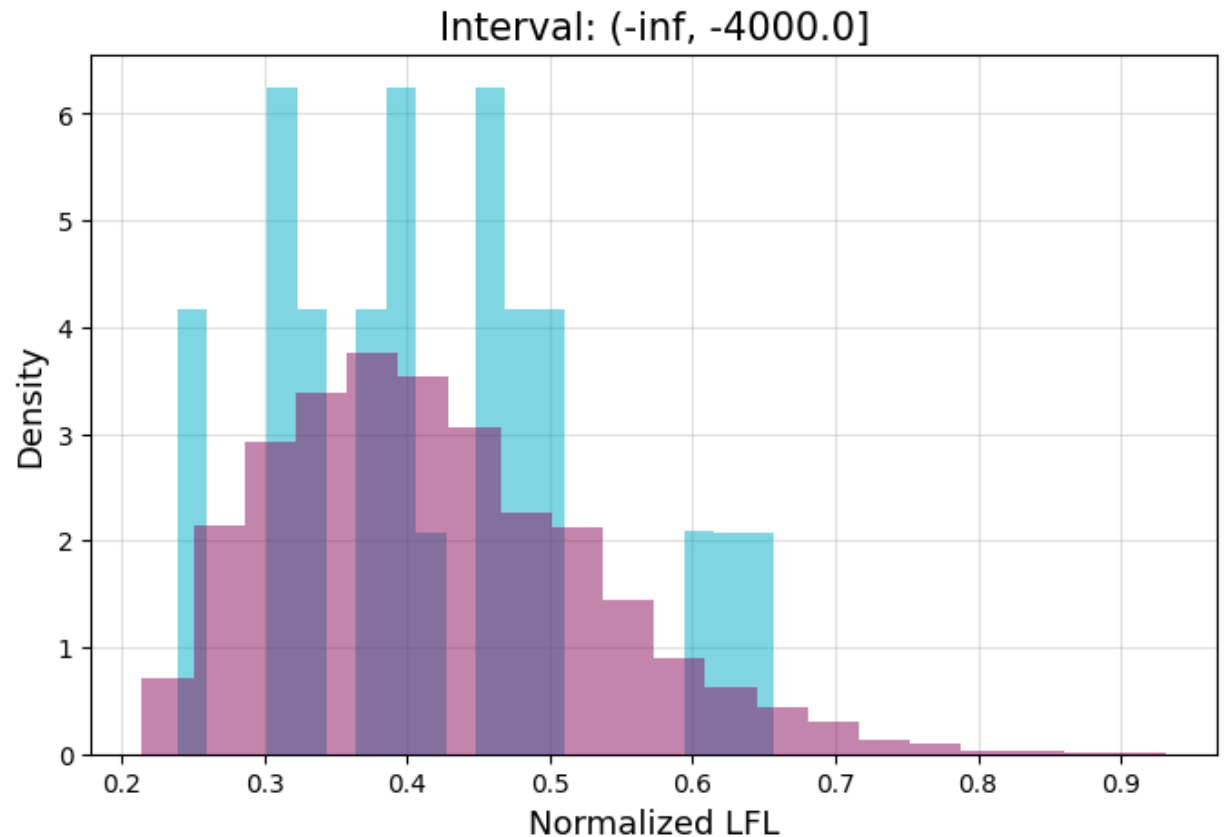
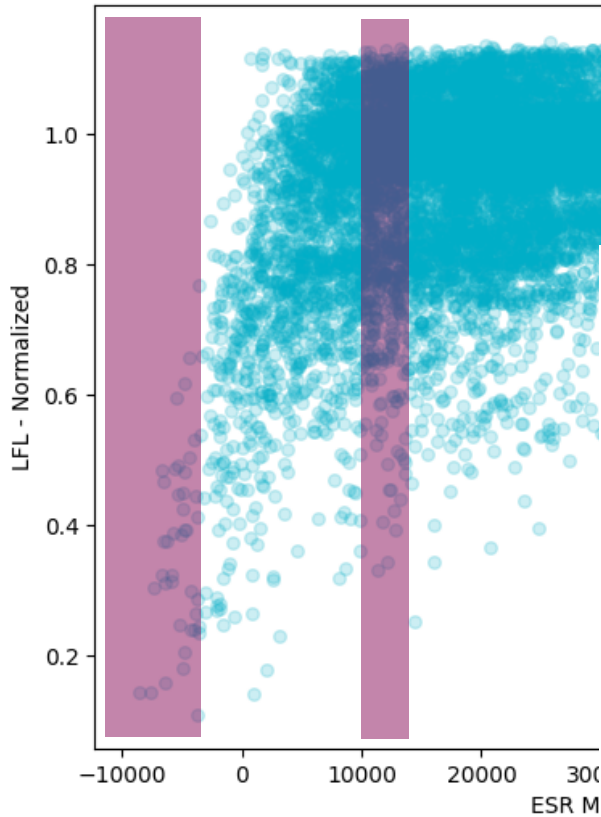
- Growing demand leads to growing reduction
- “Installed capacity” is calculated for normalization
- Buckets of Energy Storage Resource (ESR) margin is created with historical LFL responsive

ESR margin = Thermal capacity + solar + wind – forced outage – planned outage – load



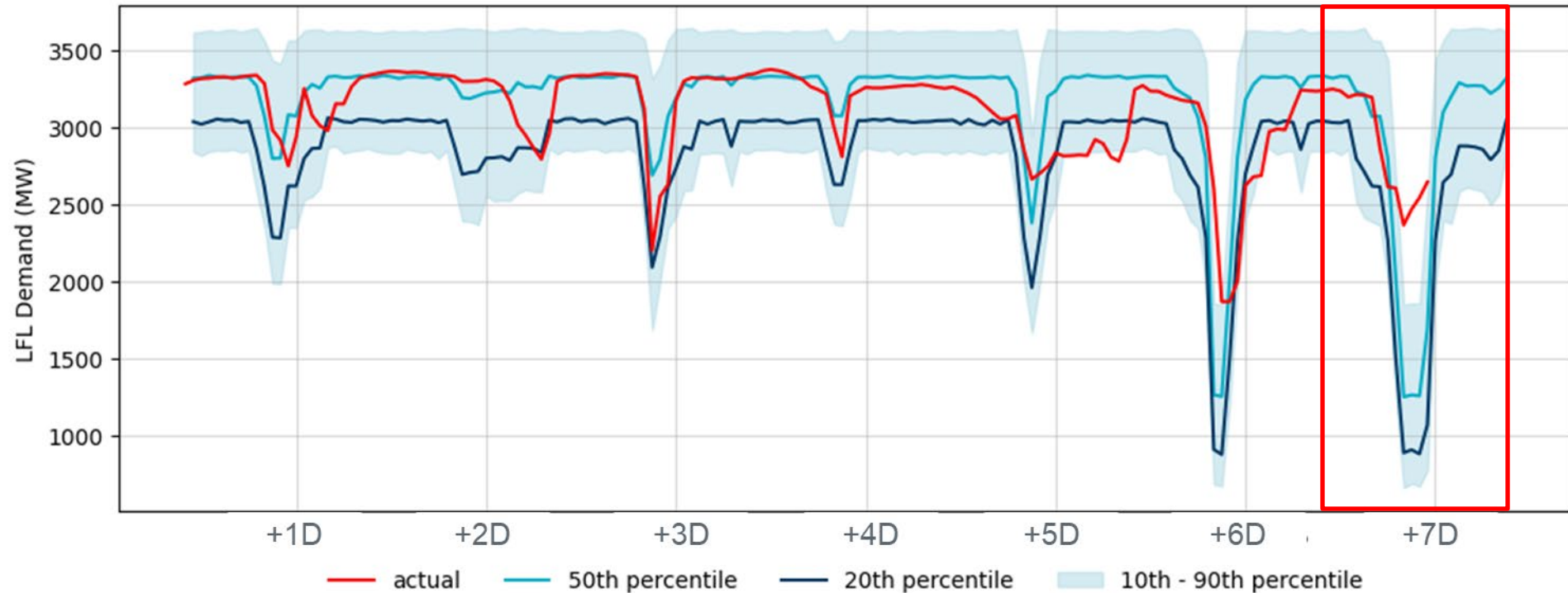
LFL Forecasting – Statistical Model

- January 2023 – May 2025
- 4CP months vs non-4CP months



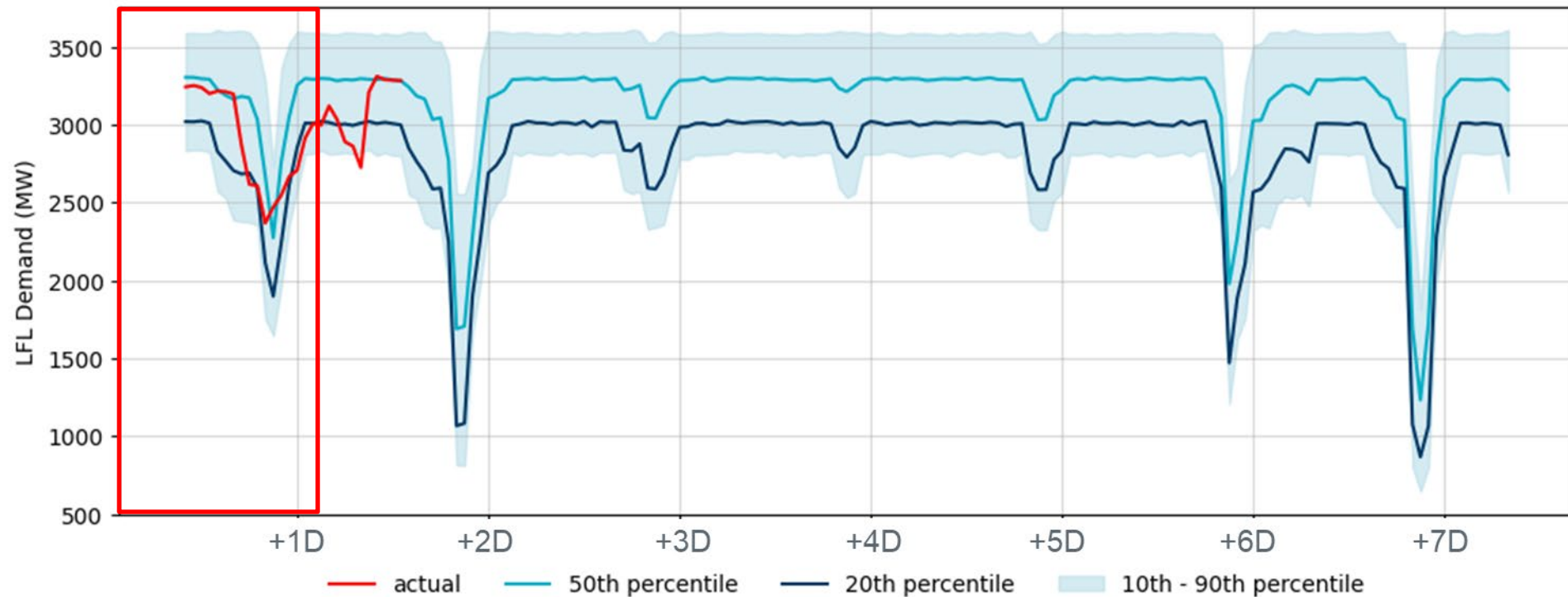
LFL Forecasting - Results

- Apply multiplier based on recent LFL magnitude
- ESR margin calculated using probabilistic forecasts for wind, solar, load, and forced outages
- Example 168-hour snapshot:

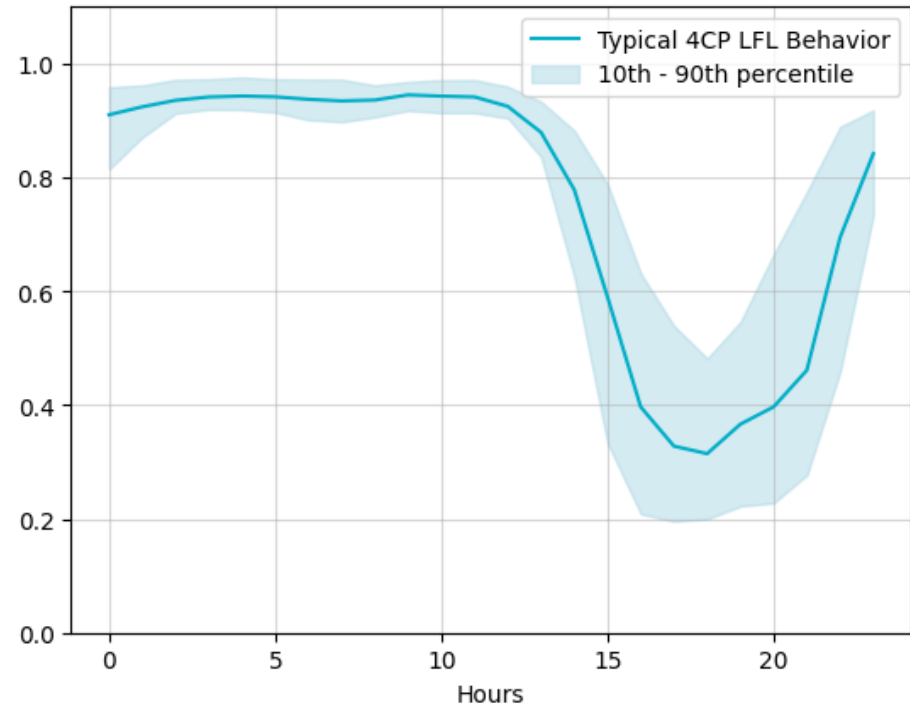
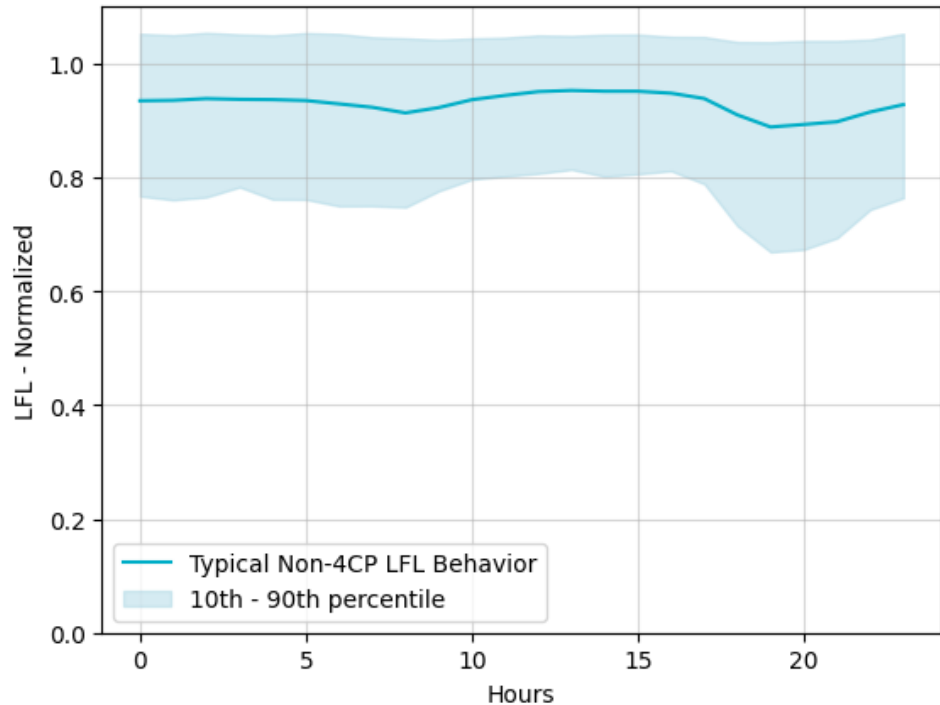


LFL Forecasting – Results (Cont'd)

As expected, forecast performance improves as forecast horizon reduces.

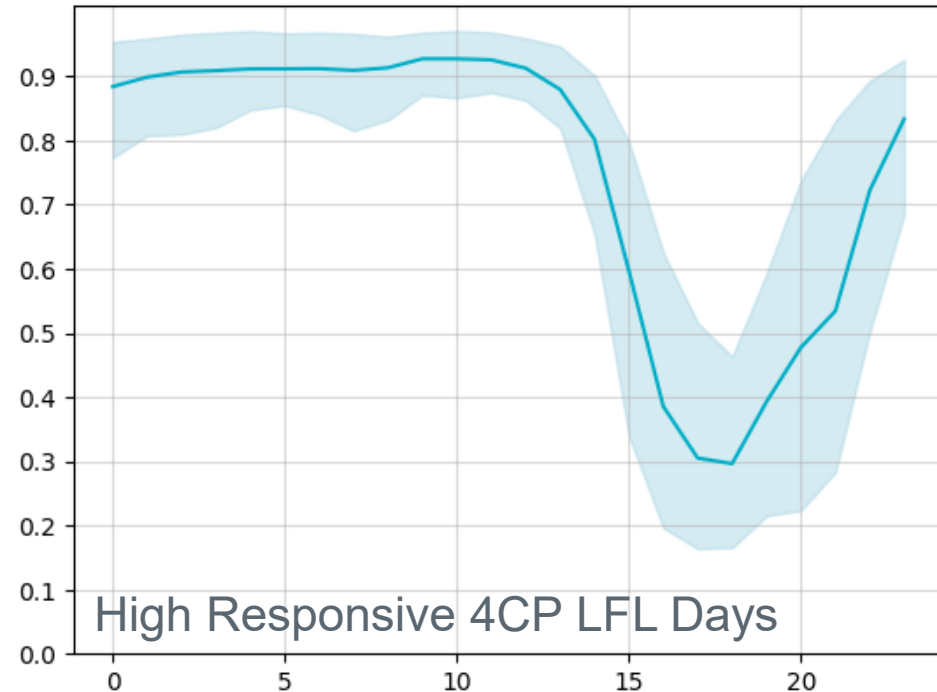
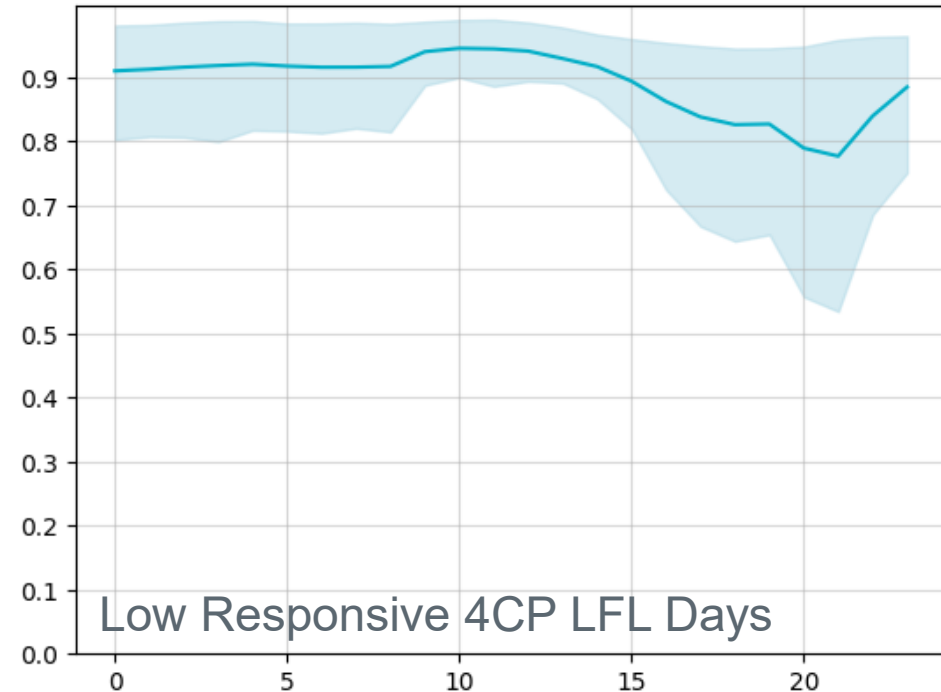


LFL Forecasting – 4CP



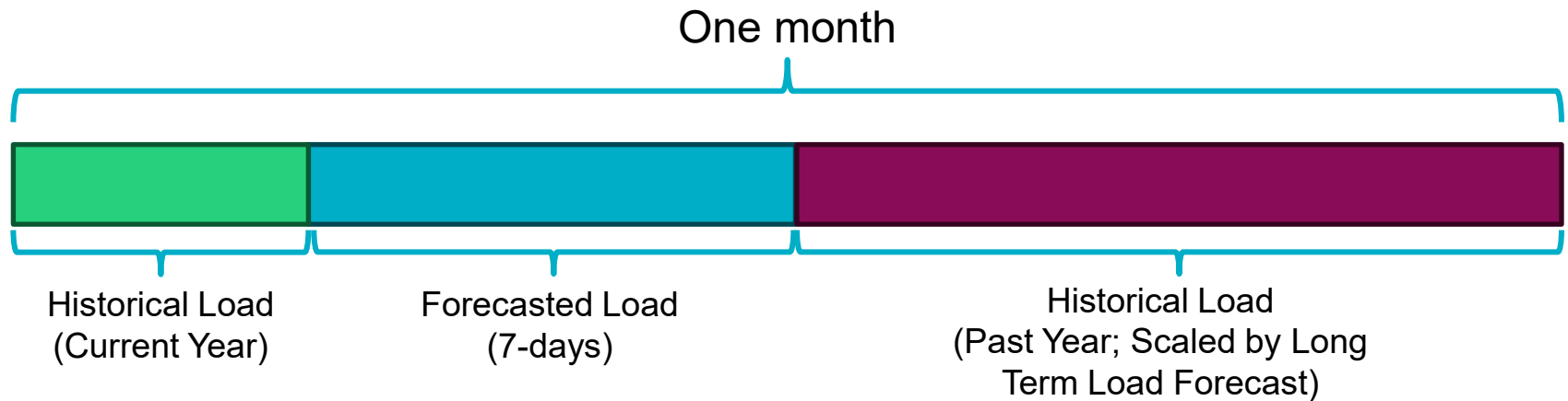
- Typically, LFLs show 4CP avoidance behavior
- However, if a day during a 4CP month is not expected to be a high demand day, LFLs show less reduction
 - Therefore, 4CP behavior can be further separated into two distinct groups – highly responsive days and low responsive days

LFL Forecasting – 4CP (Cont'd.)



- During 4CP months, the reduction behavior is not always consistent
- Therefore, 4CP prediction should predict when the market *thinks* 4CP will occur, not necessarily true 4CP intervals
- The high responsive historical 4CP days are used to fit a new distribution

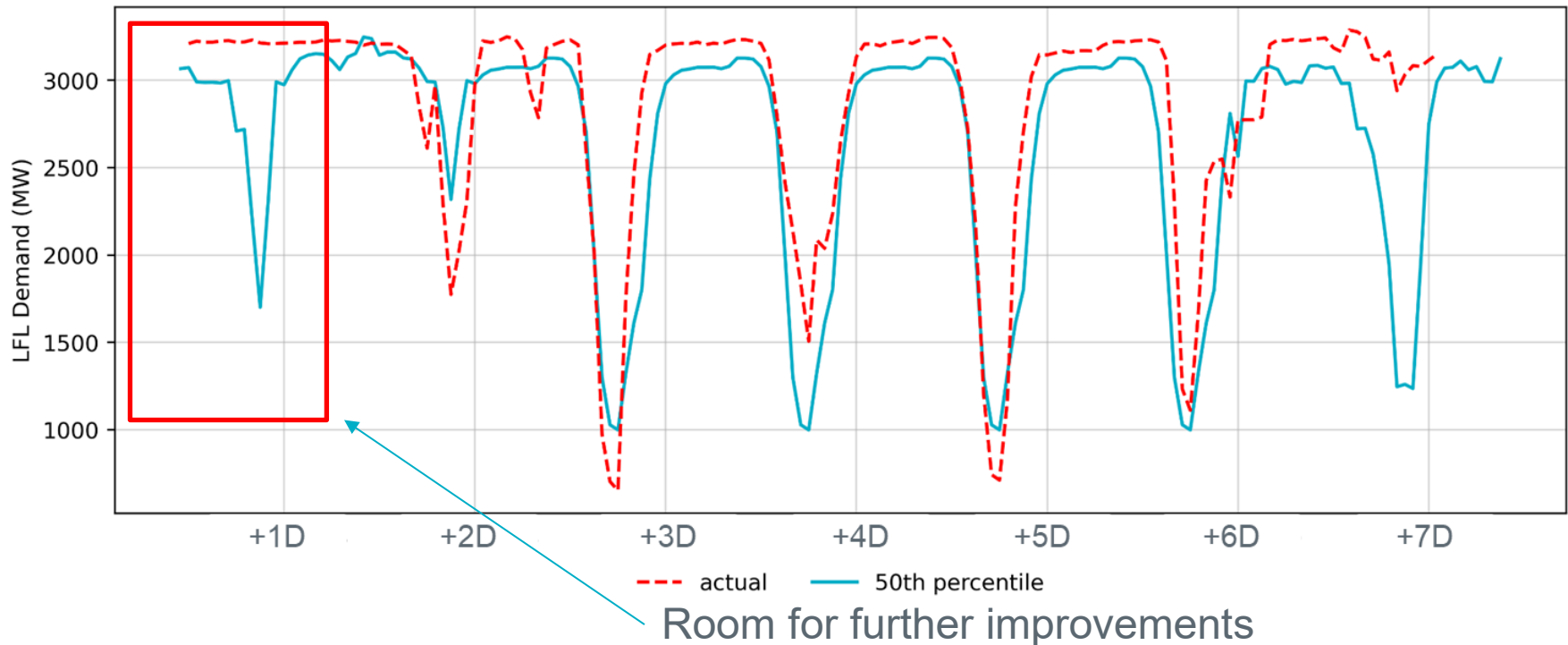
4CP Prediction



- For 4CP prediction, we combine actual load from current month/year, the latest load forecast, and the historical demand from the previous year
 - Historical load is scaled using long term load forecast¹ to account for growth in demand
 - The highest 11 load days are calculated from this window
- After the LFL forecast has been generated, if any of the days in the forecast horizon is one of the top 11 days, a new demand curve is generated from the responsive 4CP distribution for that day

LFL Forecasting 4CP Results and Next Steps

Example 168-hour snapshot forecast considering 4CP response:



Next Steps

- Further refine methodology for both non-4CP and 4CP months
- Examine on high error days to understand the underlying cause
- Include model in operations tools for situational awareness



Questions?