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Software Project Distributed Systems

Consumption Data Forecast for HPC Systems

Sprint 3

M. Ch

A. Er

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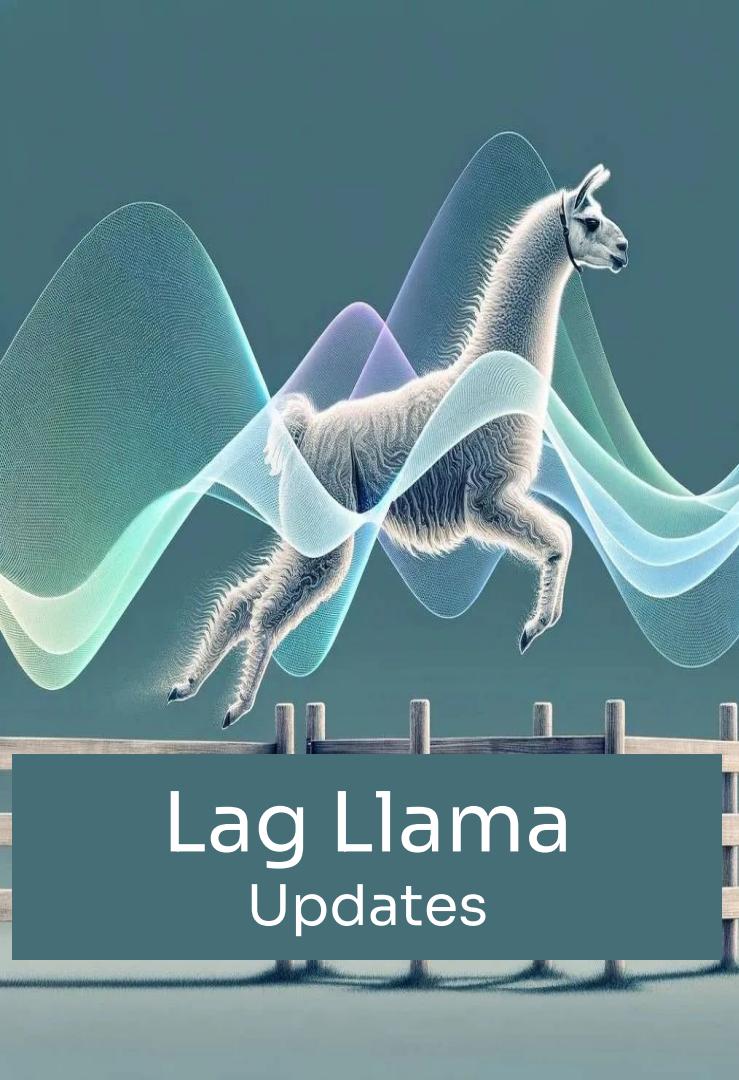
M. Karn

Y. Kaya

M. Zent

Previous Timeline

	Energy Price	CO2	Dates
Sprint 1	Data prep & EDA; benchmark ARIMA	Data prep & EDA; energy-mix analysis	30 April – 14 May
Sprint 2	Train ML models (TimesFM, XGB); feature engineering	Train ML models; incorporate external regressors	14 May – 28 May
Sprint 3	Develop LSTM; hyperparameter tuning	Time-series cross-validation; tune ML and simple RNN models	28 May – 11 June



Time Series Foundation Model

Pretrained - 352 M Parameters

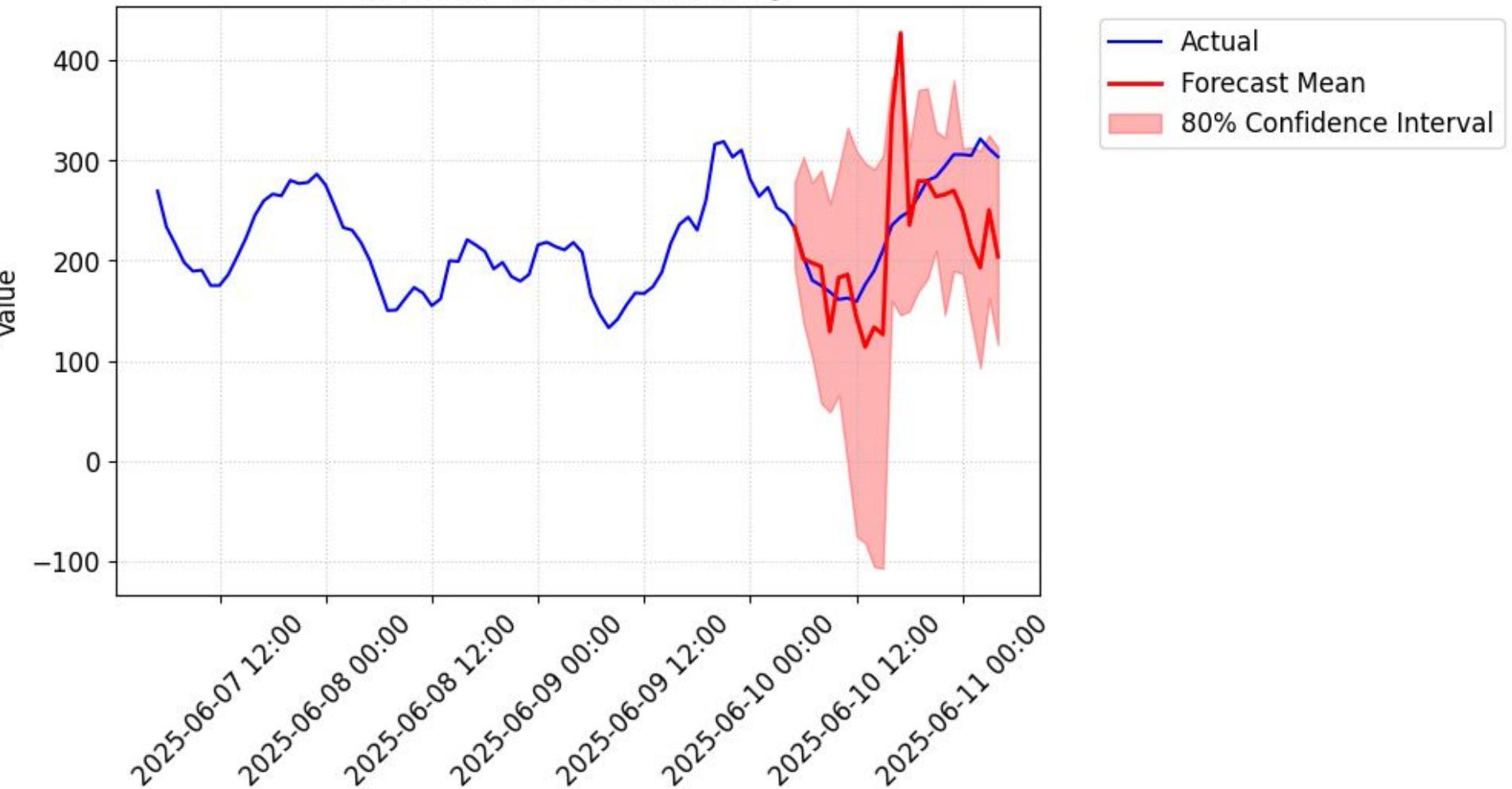
- Training Data: 3,067 time points (about 4 months of hourly data)
- Validation Data: 657 time points (about 1 month) - used to tune the model
- Test Data: 658 time points (about 1 month) - used to evaluate final performance

Target: Carbon Intensity

Method: Zero Shot Learning

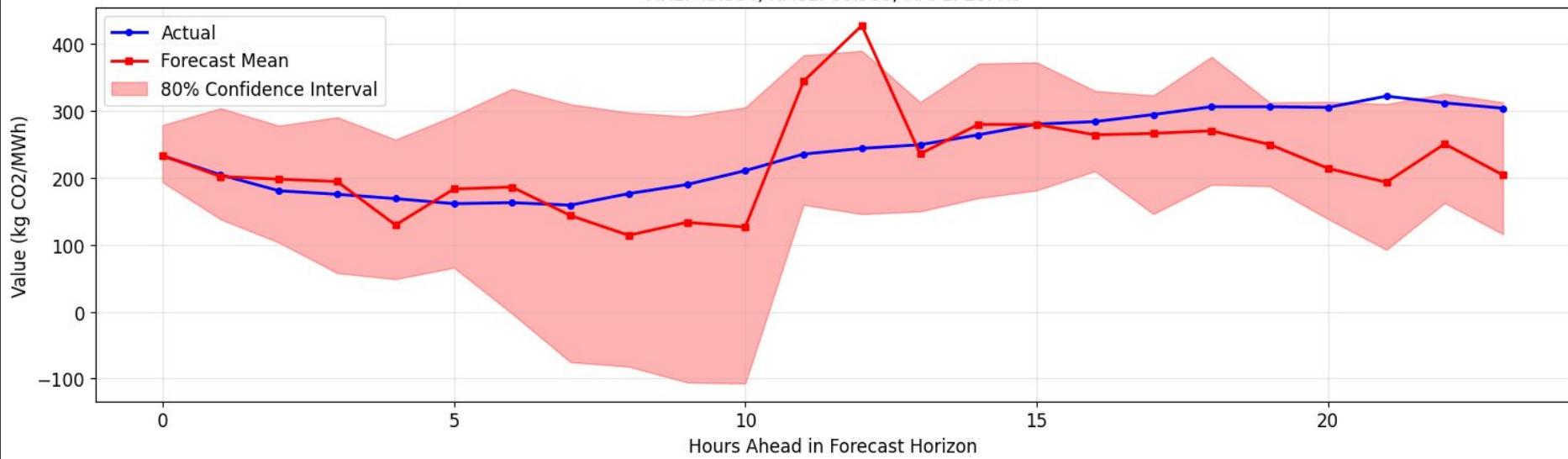
Lag Llama
Updates

Forecast for carbonIntensity



Carbon Intensity Forecast

Forecast for carbonIntensity (kg CO₂/MWh)
MAE: 49.364, RMSE: 66.988, MAPE: 20.4%



Lag Llama Updates

Mean Absolute Error

19.35 kg CO₂/MWh

Root Mean Squared Error

25.11 kg CO₂/MWh

Mean Absolute Percentage Error

9.4%

Forecast Results & Future Development

- Starting CO2 Intensity: 232.75 kg CO2/MWh
- Ending CO2 Intensity: 204.06 kg CO2/MWh
- 24-Hour Change: -28.69 kg CO2/MWh
(-12.3%)

- Directly Forecast Key Variables
- Fine Tuning Approach
- Leverage GPU Acceleration
- Combination with LSTM or Prophet

Outlook

- Data Preprocessing
 - Feeding the auto-analyzed and correspondingly pre-processed data into the prediction models
- Improve the Models
 - Include Max Pooling Layers in LSTM
 - Predict price values multiple hours into the future
- Making decisions about models
 - Moving forward with LSTM and Lag Llama models
- Start to write the Report

Thank You