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Justus Purat & Alexander Kammeyer  
Software Project Distributed Systems

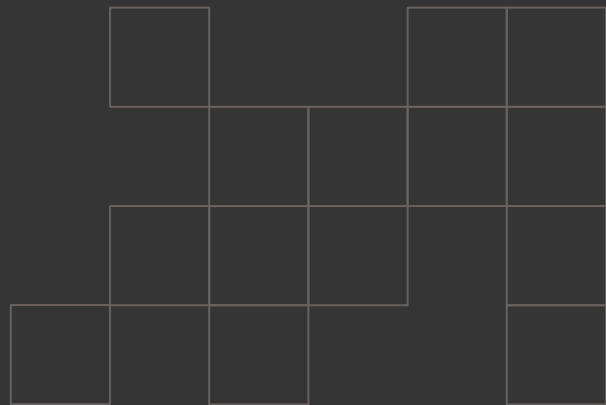
# Consumption Data Forecast for HPC Systems

Sprint 3

M. Ch	M. Karn
A. Er	Y. Kaya
A. Huth	M. Zent

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Institute for Computer Science, FU Berlin



# 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



Lag Llama  
Updates

# Time Series Foundation Model

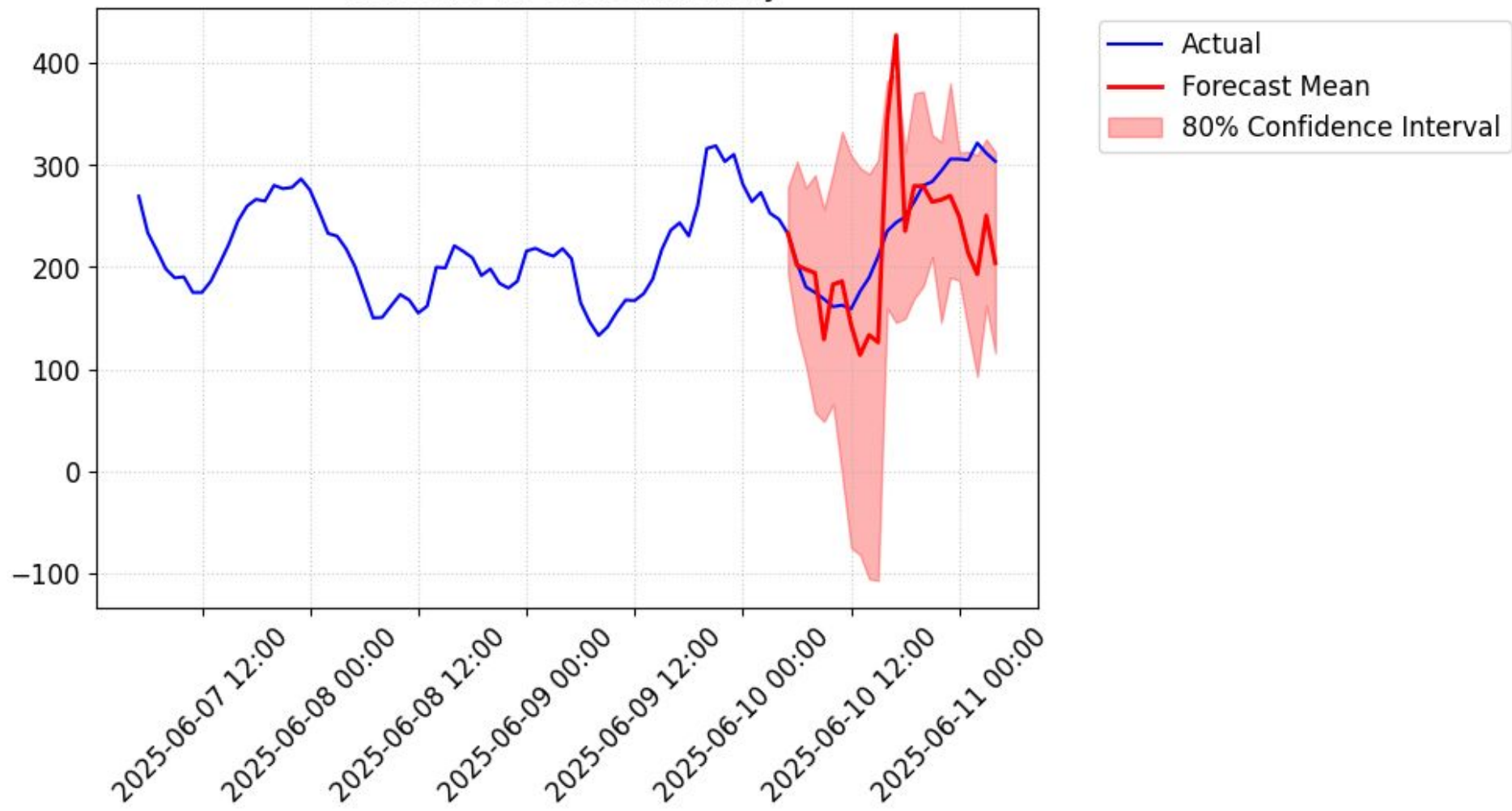
Pretrained - 352 M Parameters

- 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

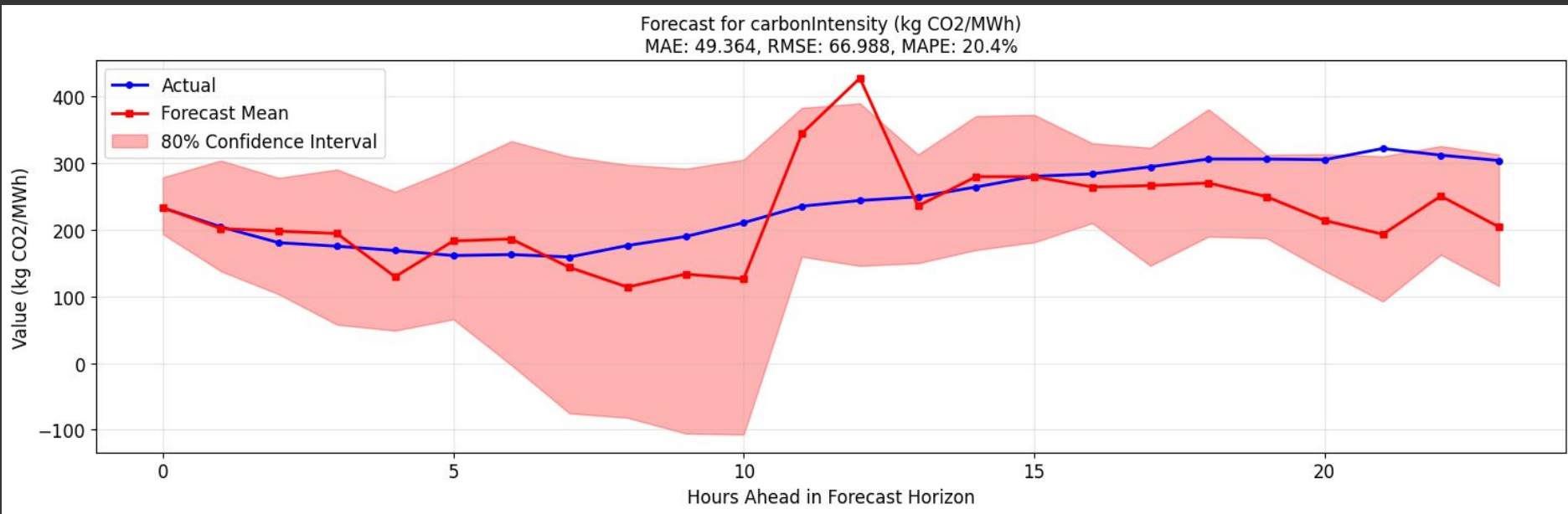
Target: **Carbon Intensity**

Method: **Zero Shot Learning**

Forecast for carbonIntensity



# Carbon Intensity Forecast



# Lag Llama Updates

Mean Absolute Error

19.35 kg CO<sub>2</sub>/MWh

Root Mean Squared Error

25.11 kg CO<sub>2</sub>/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