UNIVERSITÉ PARIS 1
PANTHÉON SORBONNE

Machine Learning Project: Energy Consumption Forecasting

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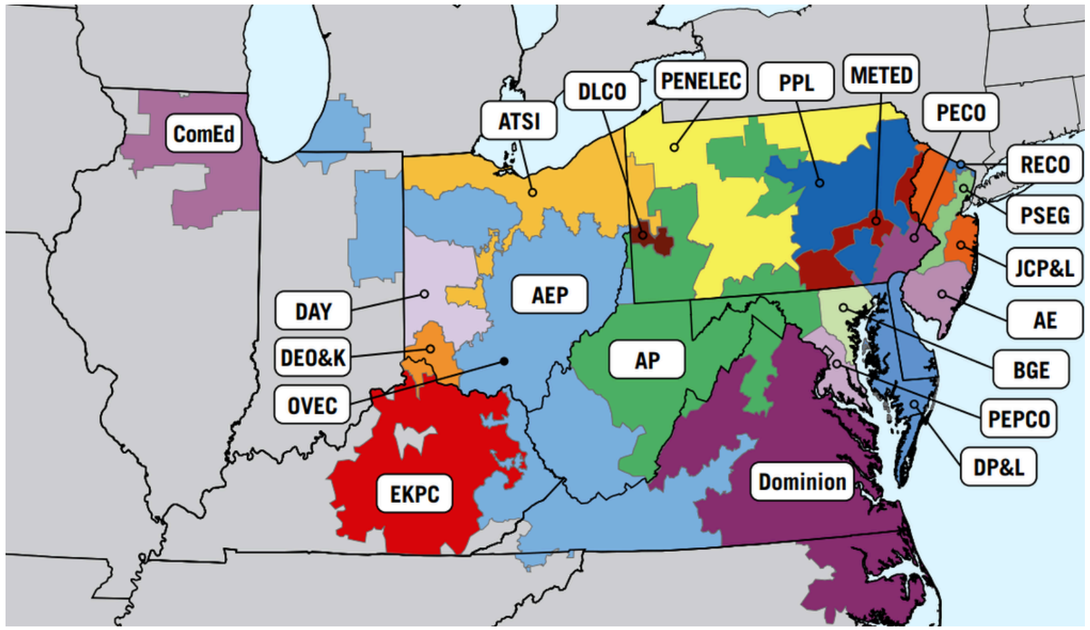
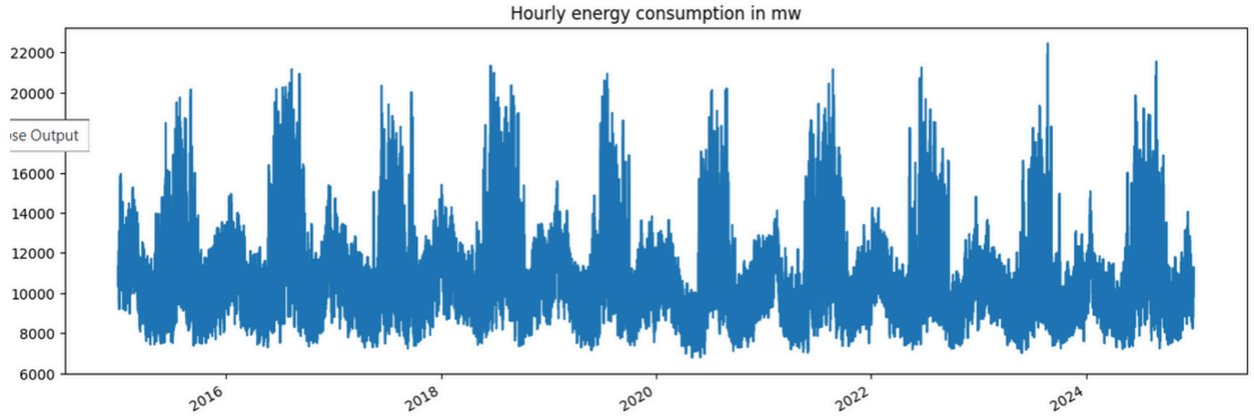
Project Objectives:
- Identify patterns and trends in energy usage on hourly data for Commonwealth Edison (CE), the largest electricity provider in Illinois, serving Chicago and its surrounding areas.
- Develop a model to forecast future energy consumption in CE area based on historical data.
- Evaluate the model's performance.

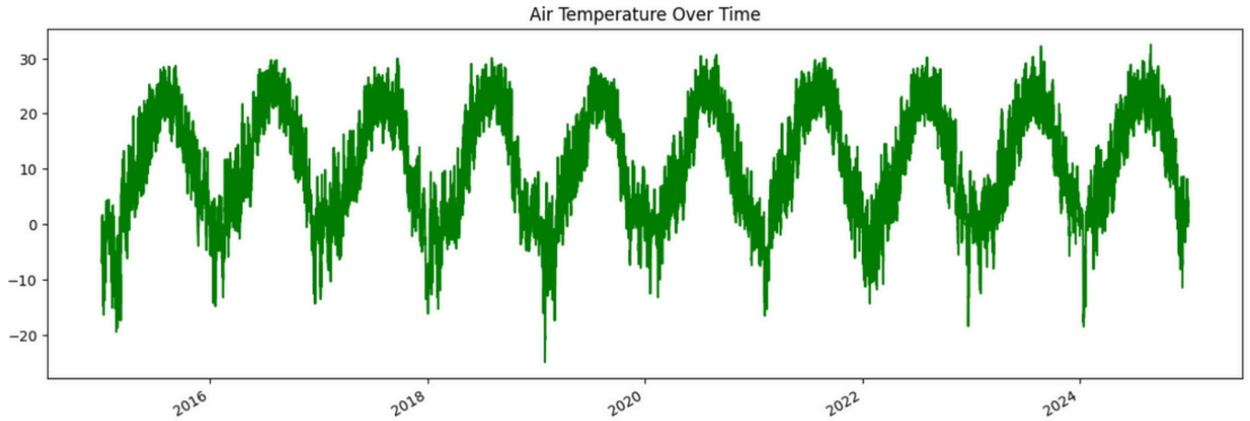
Data Sources:

- PJM for ComEd (Illinois) for 2015 - 2024 (hourly data): https://dataminer2.pjm.com/feed/hrl_load_metered
- NASA Power Project: https://power.larc.nasa.gov

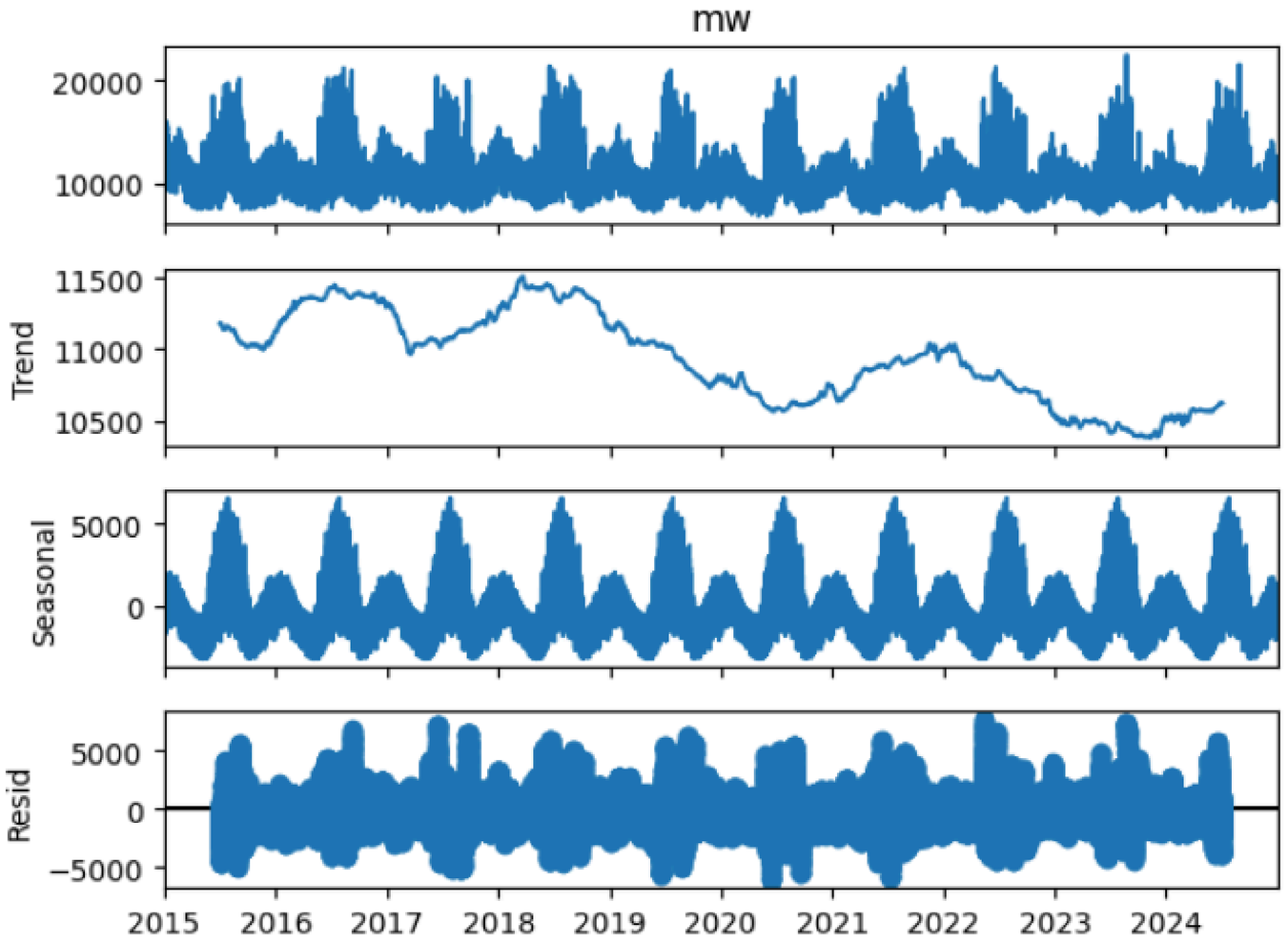
About the data



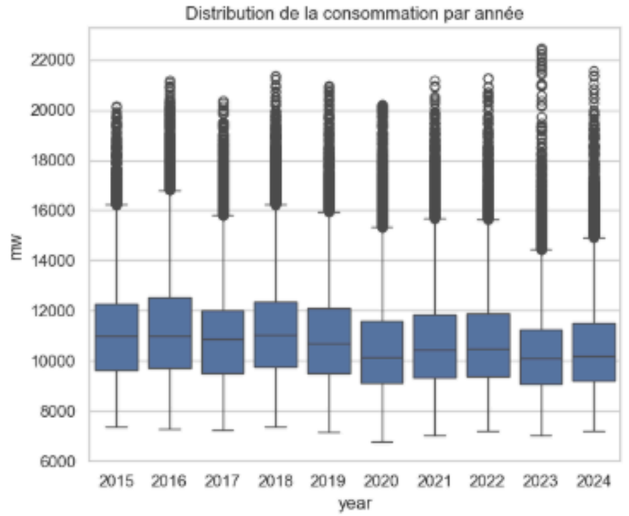


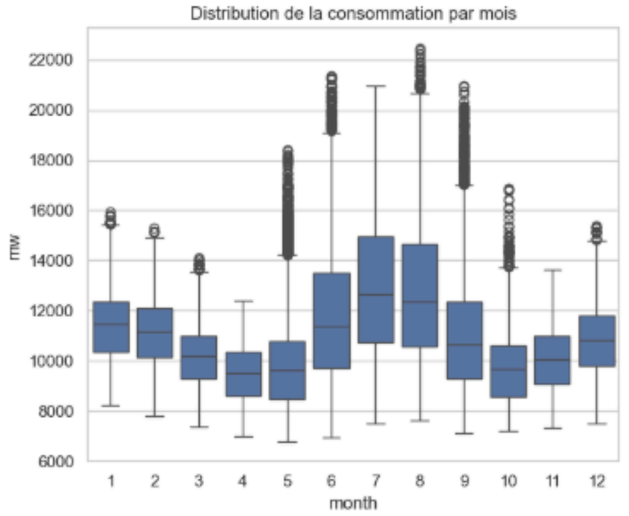


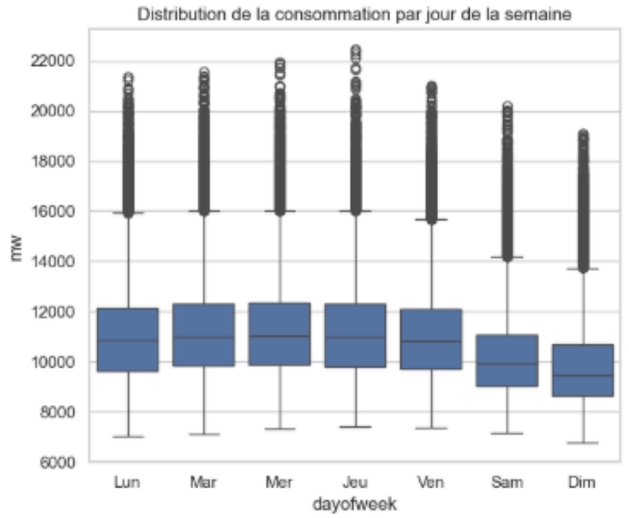
Seasonality and Trend

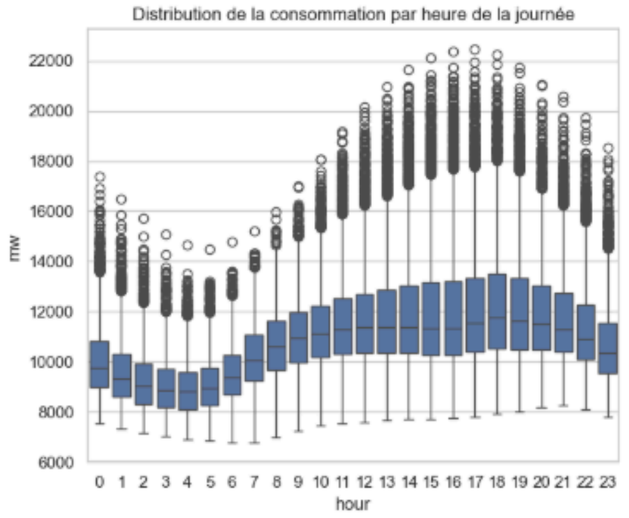


Distribution

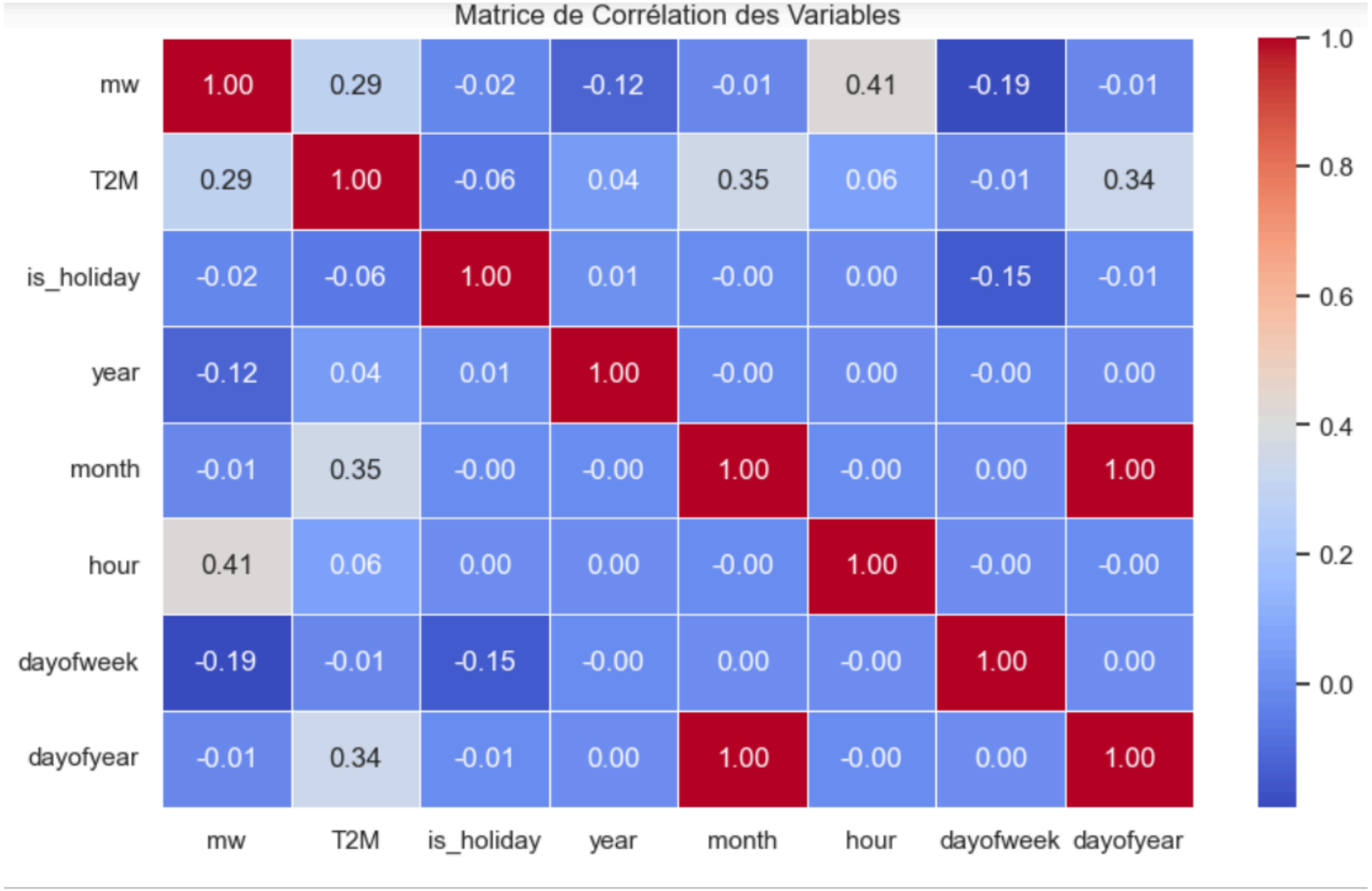




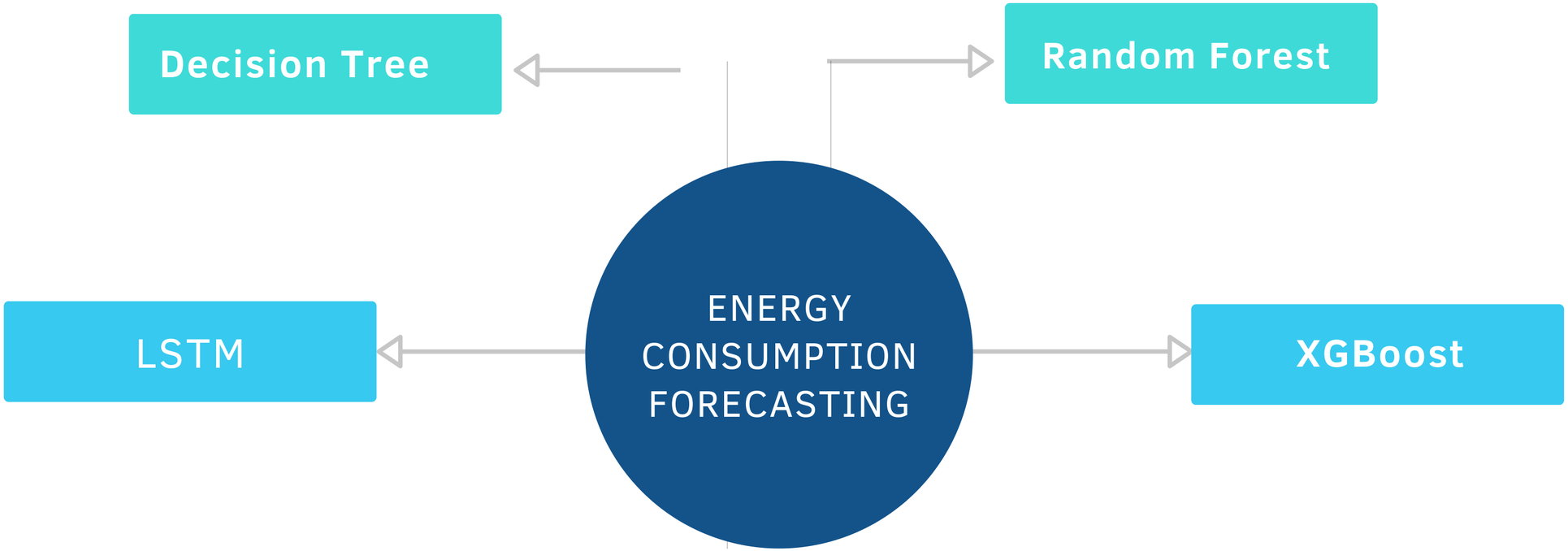




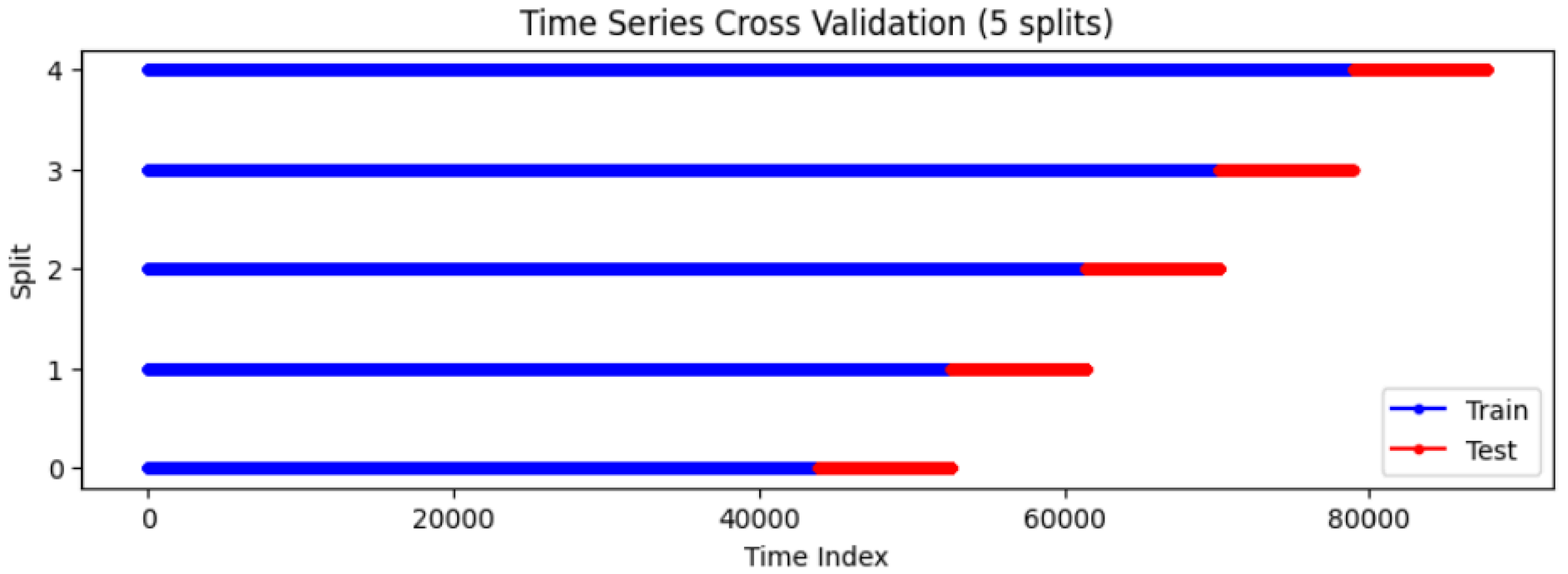
Matrice corrélation



Models ang angorithms used

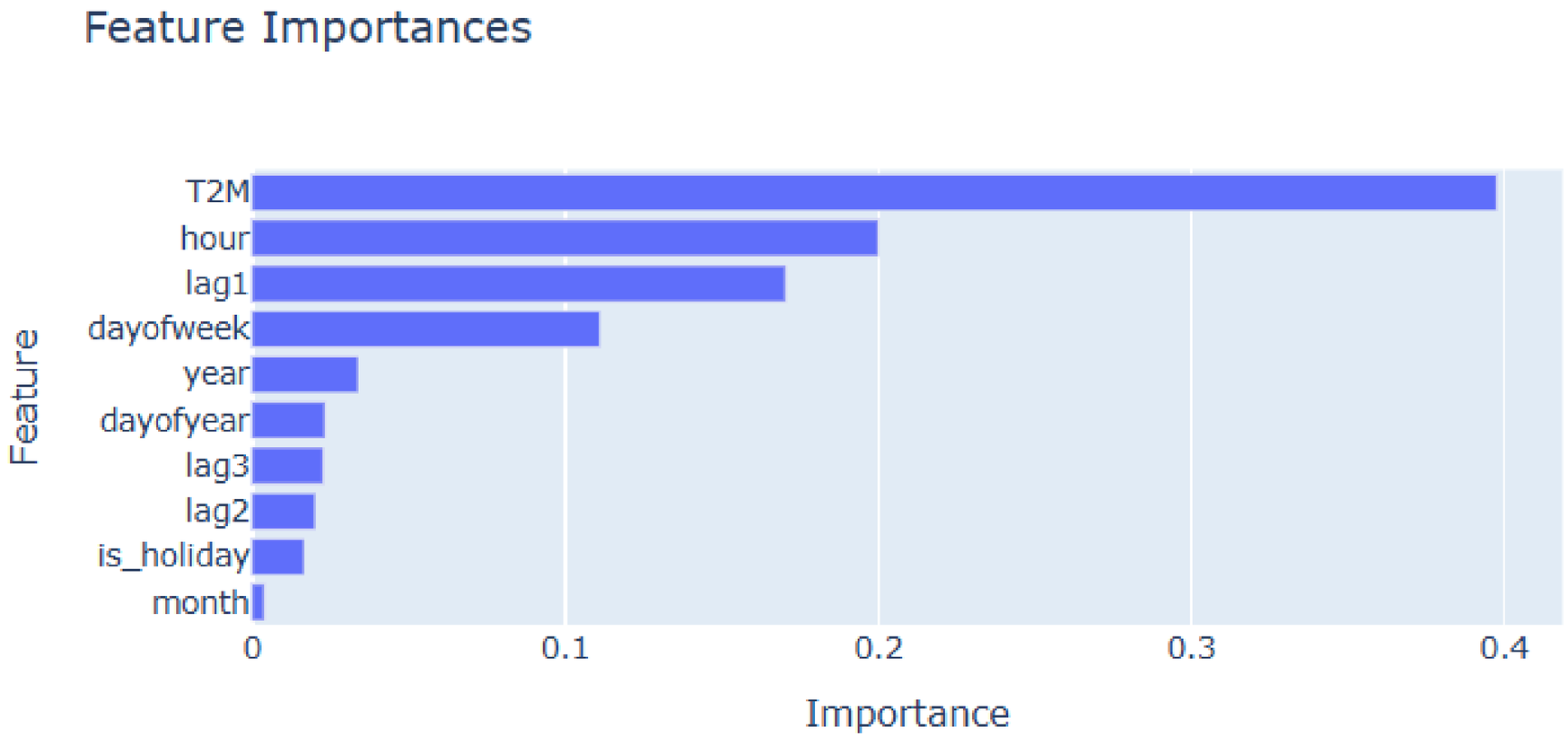


Time Series Cross Validation

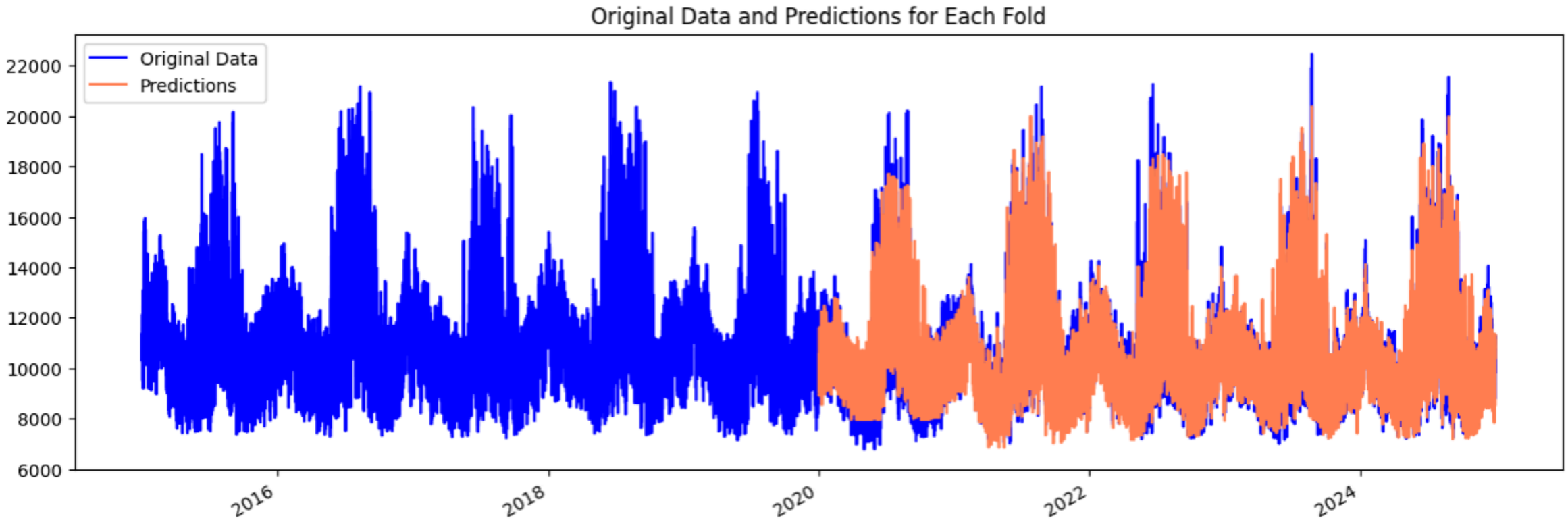


XGBoost. Choice of hyperparameters with Grid_Search

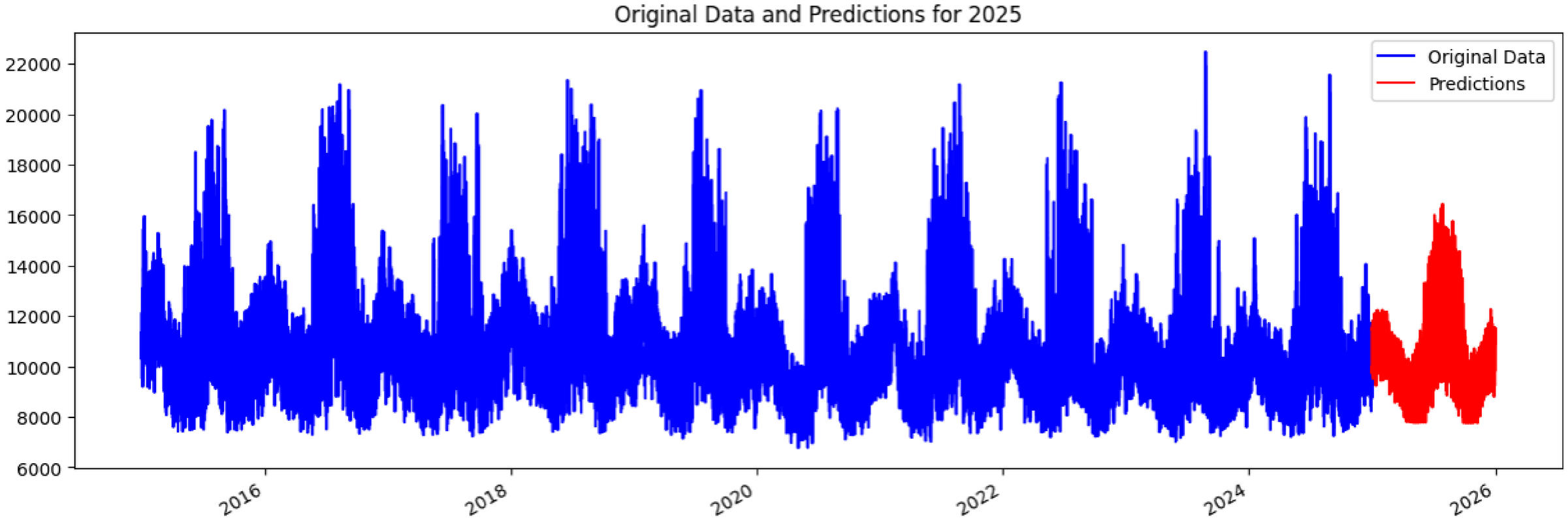
	learning_rate	max_depth	n_estimators
Fold 0	0,1	3	200
Fold 1	0,1	3	200
Fold 2	0,1	3	200
Fold 3	0,1	3	200
Fold 4	0,1	3	500


Feature Importances
T2M
hour
lag1
dayofweek
year
dayofyear
lag3
lag2
is_holiday
month
Feature
0
0.1
0.2
0.3
0.4
Importance

Predictions for each fold (XGBoost)



Forecast for 2025 (XGBoost)



Models Metrics

Decision Tree	Random Forest	LSTM	XGBoost
MAE = 617.2 RMSE = 874.6 MAPE = 0.06 R2 = 0.83	MAE = 546.5 RMSE =762.9 MAPE = 0.05 R2 = 0.86	MAE = 0.0102 RMSE =0.0357 MAPE = R2 = 0.88	MAE = 534.0 RMSE = 756.7 MAPE = 0.049 R2 = 0.87

CONCLUSION

According to out forecast for 2025, there is a growth in energy comsumption in winter months (related to heating) and even higher growth in summer months (related to air conditioning). Energy provider should take it into concideration.

Energy provider should also take into consideration, that there is an increase in energy consumption in the morning and in the evening, in order to ensure uninterrupted electricity supply and regulate power.