

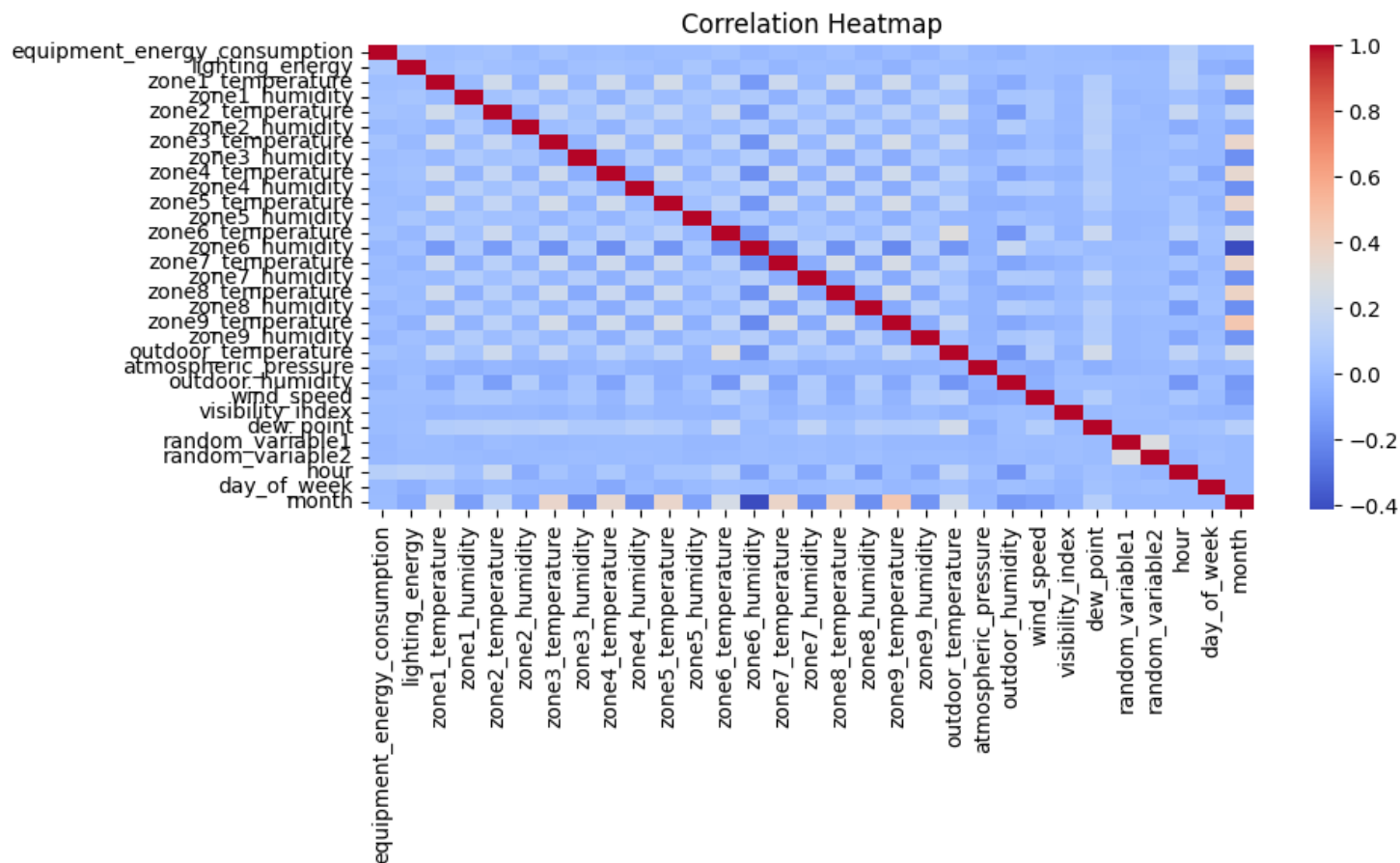
# Smart Factory Energy Report

## 1. Approach

The objective was to predict the energy consumption of factory equipment using time series sensor data. The workflow included preprocessing, exploratory data analysis (EDA), feature engineering, and training of regression models including Random Forest and XGBoost with hyperparameter tuning via GridSearchCV.

## 2. Key Insights from the Data

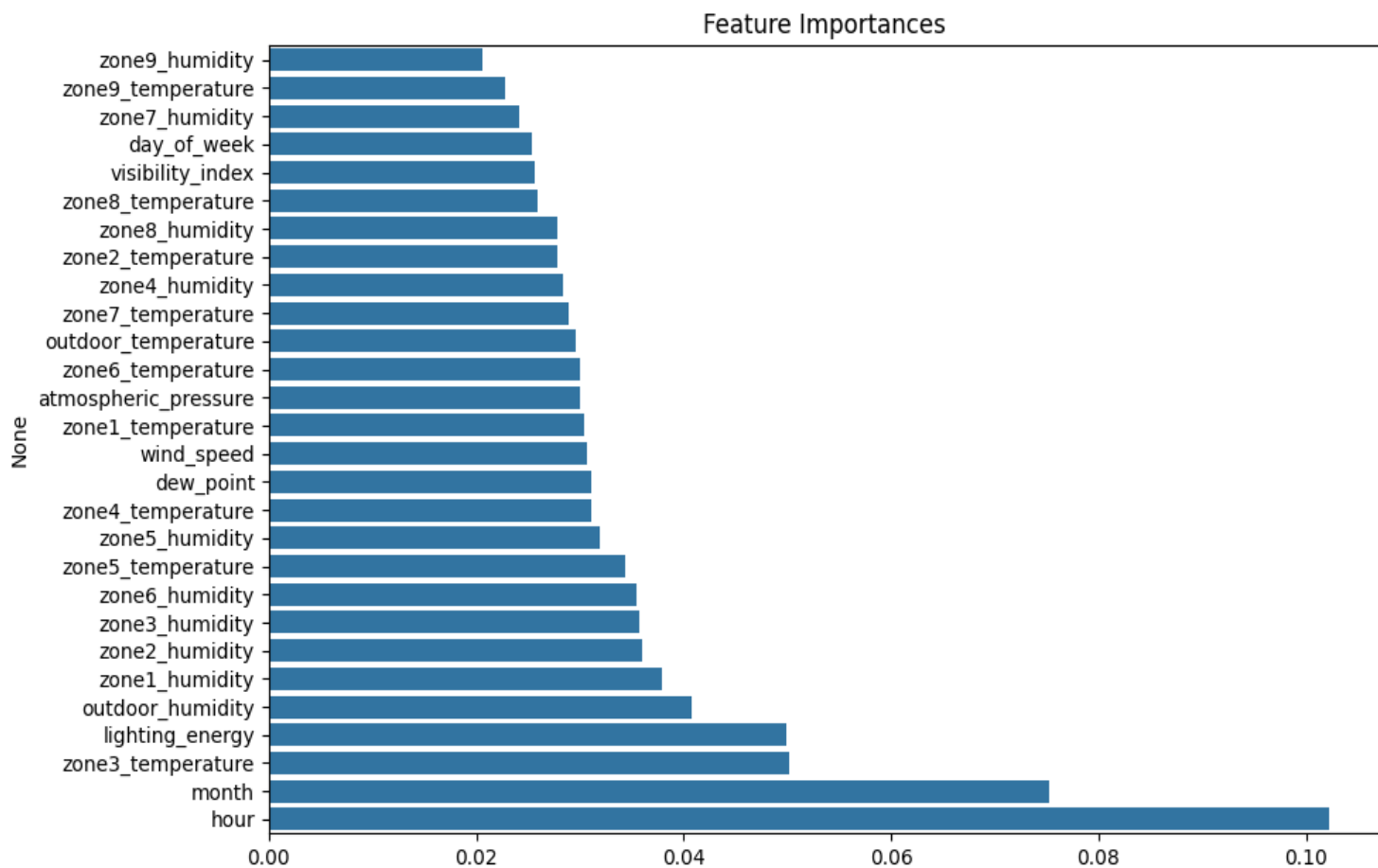
- Strong correlations exist between certain zone temperatures/humidity and equipment energy consumption.
- Time features (hour, day of week, month) show daily and seasonal energy usage patterns.
- Random variables were not useful and excluded from modeling.
- Heatmap and feature importances provided additional insight into sensor relevance.



### 3. Model Performance

The Random Forest and tuned XGBoost models were evaluated using MAE, RMSE, and R2 metrics. XGBoost performed slightly better:

- Random Forest R2
- XGBoost R2 (Cross-validated)
- MAE and RMSE values confirmed reasonable prediction accuracy.



## 4. Recommendations

- Optimize indoor temperature and humidity in key zones to reduce energy demand.
- Adjust production schedules based on time-of-day trends to avoid peak consumption periods.
- Install predictive monitoring systems using trained models for real-time energy optimization.
- Use external weather forecasts to proactively manage HVAC and production plans.