

Sustainable Places 2020

Short-Term Electric Demand Forecasting for the Residential sector: Lessons Learned from the RESPOND H2020 project

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01

**RESPOND H2020
PROJECT**



RESPOND

Integrated demand Response Solution towards energy Positive Neighbourhoods

- Change user Consumption Habits
 - Reduce Demand Peaks
 - Maximize Renewable Energy exploitation
- Make accurate energy demand forecast
 - Make suggestions to modify consumption

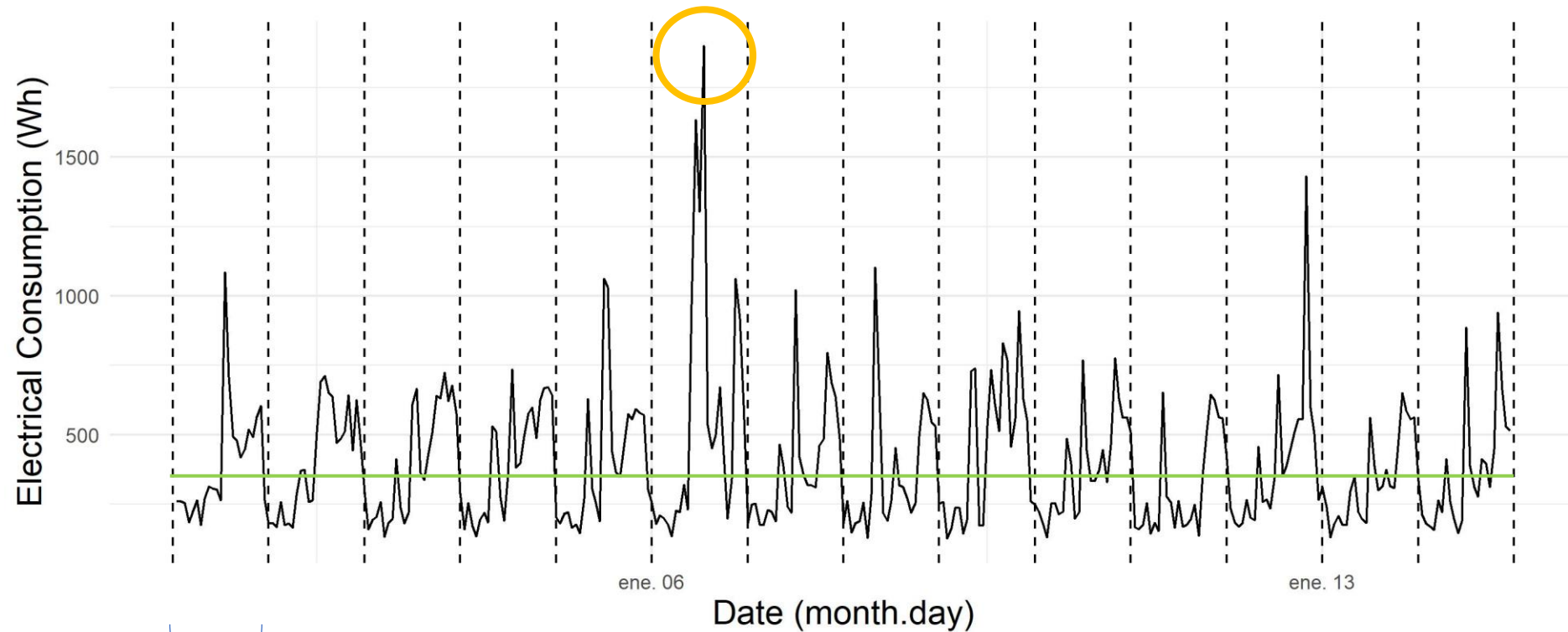


DATA AVAILABILITY

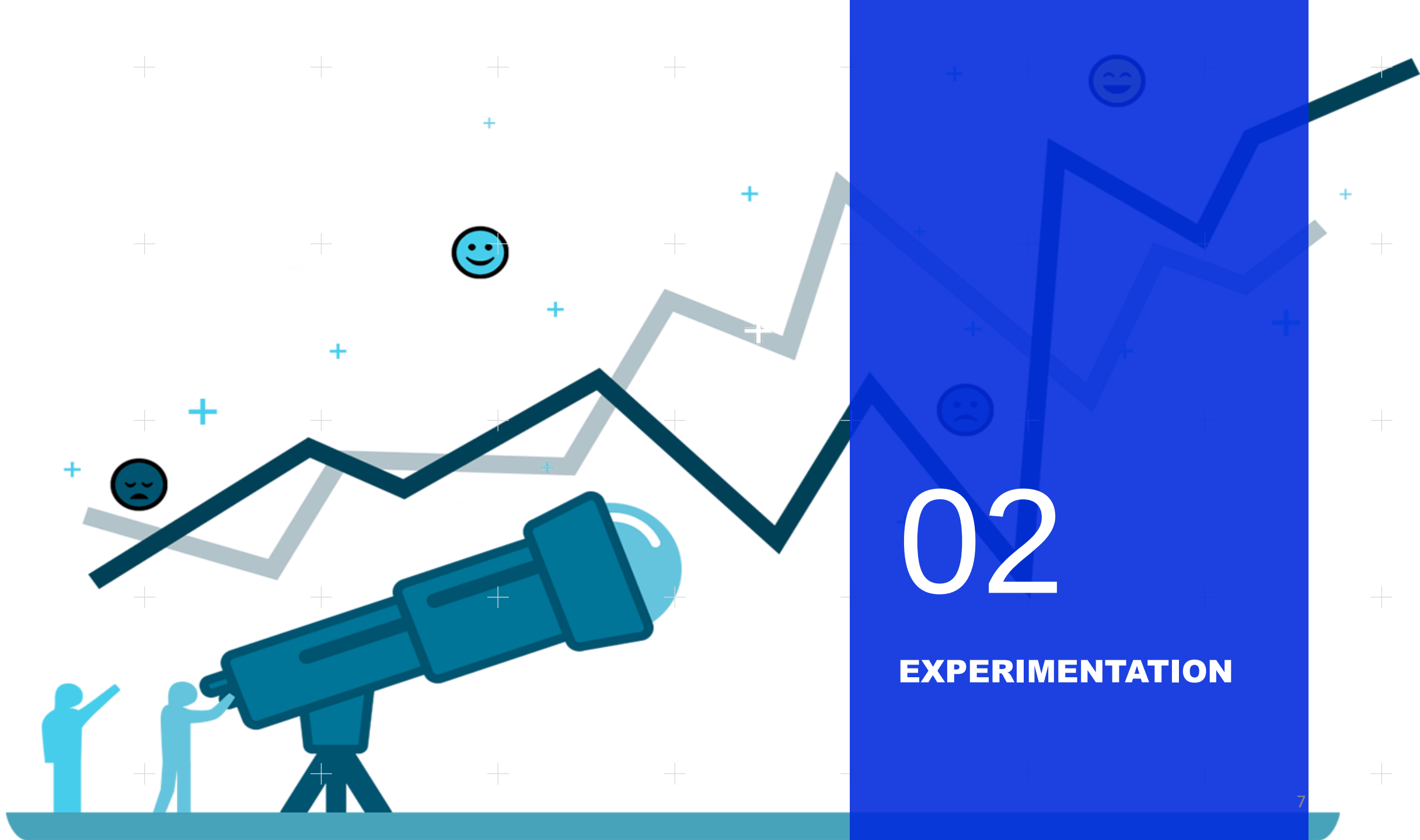


EUROPEAN PILOT SITES





1 day = 24 points



02

EXPERIMENTATION

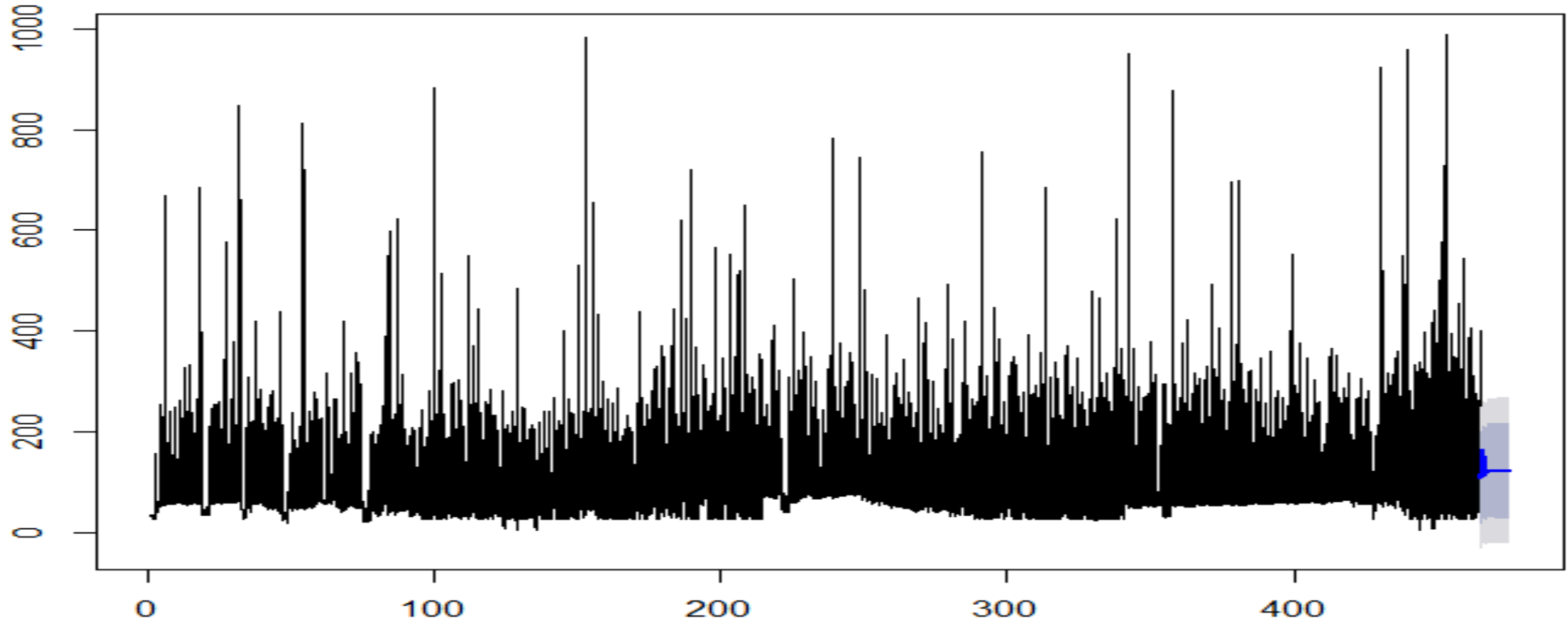
Error metric

- To measure the quality of forecast T values.
- Forecast values $\hat{y}_t$, where $t = 1, \dots, T$
- Actual values y_t , where $t = 1, \dots, T$
- Root Mean Square Error (RMSE):

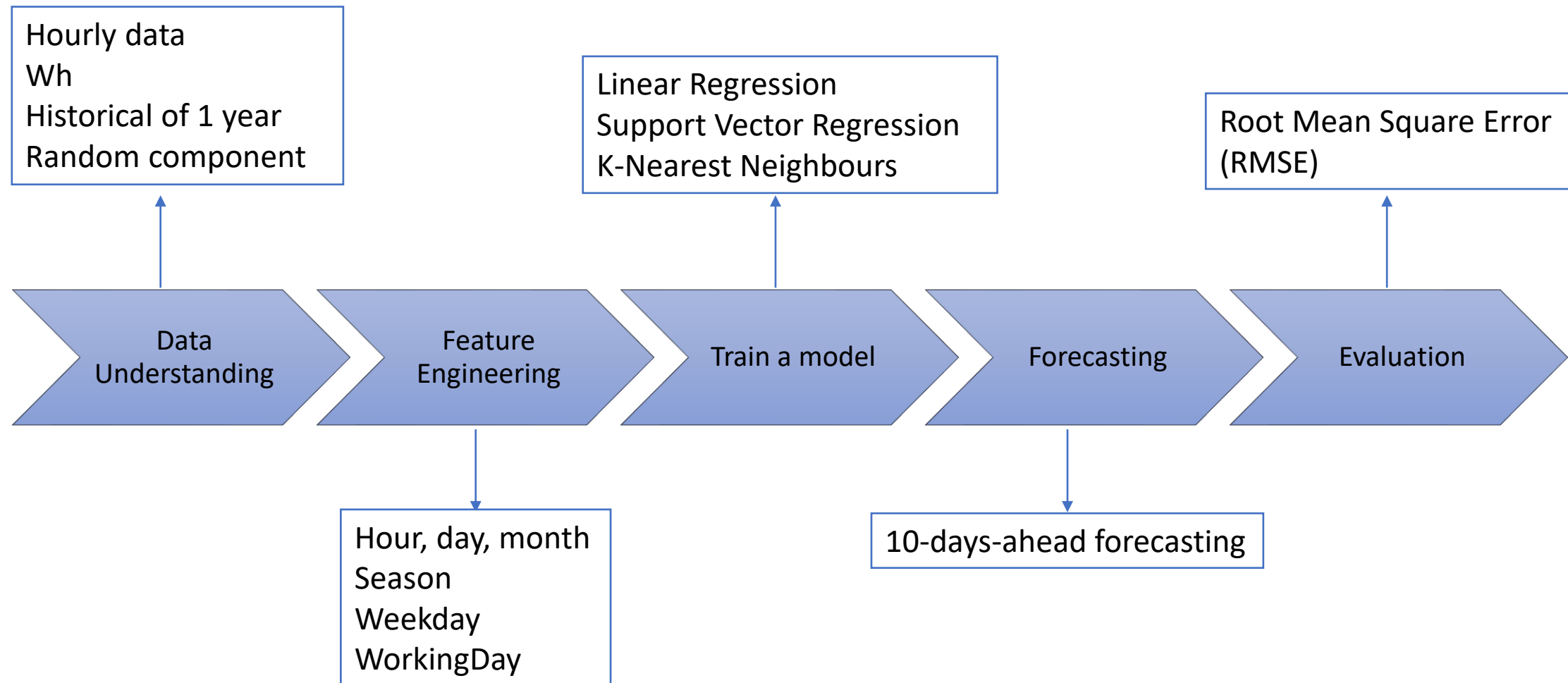
$$RMSE(y_t, \hat{y}_t) = \sqrt{\frac{\sum_{t=1}^T (y_t - \hat{y}_t)^2}{T}}$$

ARIMA and SARIMA

Forecasts from ARIMA(0,1,1)(0,0,2)[24]



Machine Learning Models



Trigonometric Transformations

$$\text{Hour} = \{0, 1, 2, \dots, 23\}$$

$$d(x = 0, x = 1) = 1$$

$$d(x = 1, x = 2) = 1$$

...

$$d(x = 23, x = 0) \neq 1$$

$$\text{Month} = \{1, 2, \dots, 12\}$$

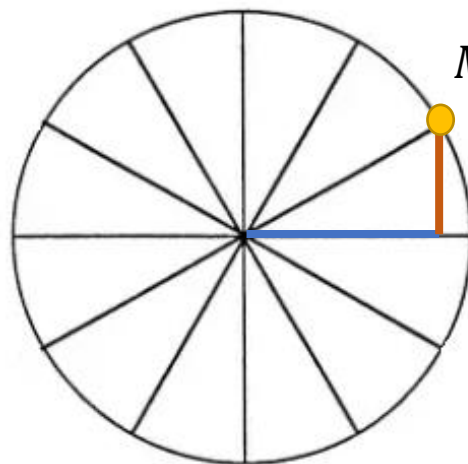
$$d(x = 1, x = 2) = 1$$

$$d(x = 2, x = 3) = 1$$

...

$$d(x = 12, x = 1) \neq 1$$

$$P(\text{Month}) = 12$$



$$\text{Month} = 1 \Rightarrow \cos \frac{2\pi}{12} + i \sin \frac{2\pi}{12}$$

$$\cos \frac{2\pi x}{12} + i \sin \frac{2\pi x}{12}, \quad x \in [1, 12]$$

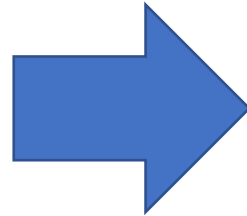
Feature Engineering

✗ Hour

- Day

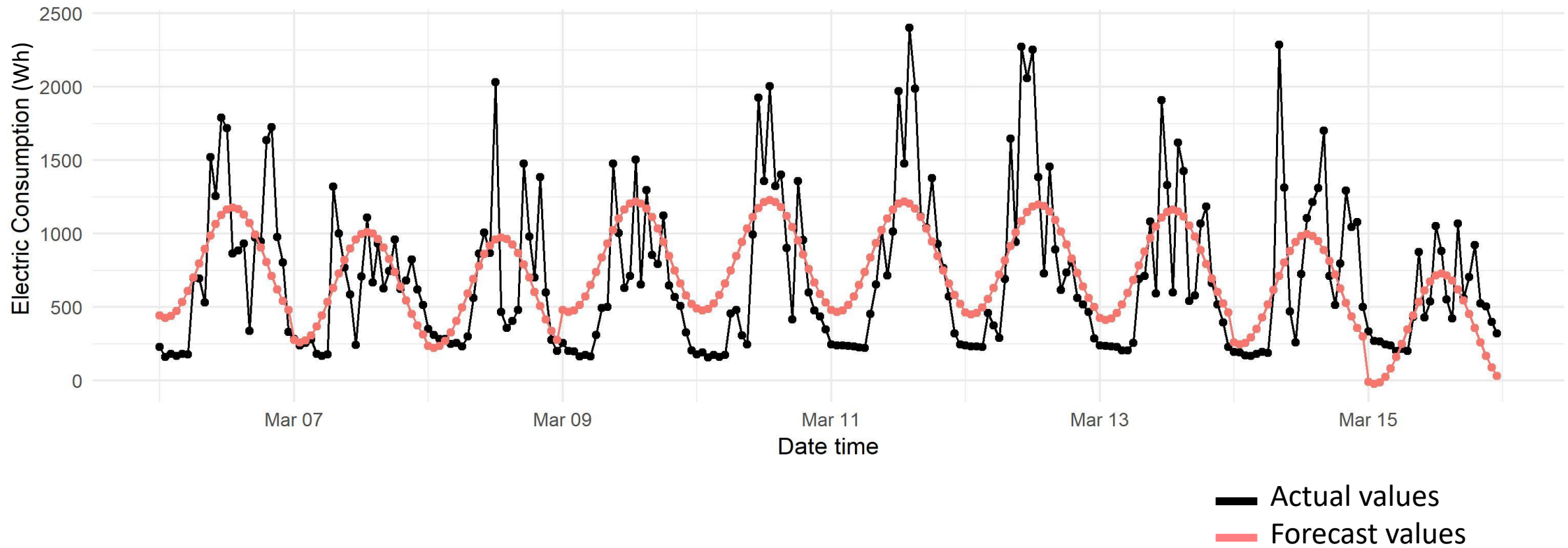
✗ Month

- Season
- Weekday
- WorkingDay

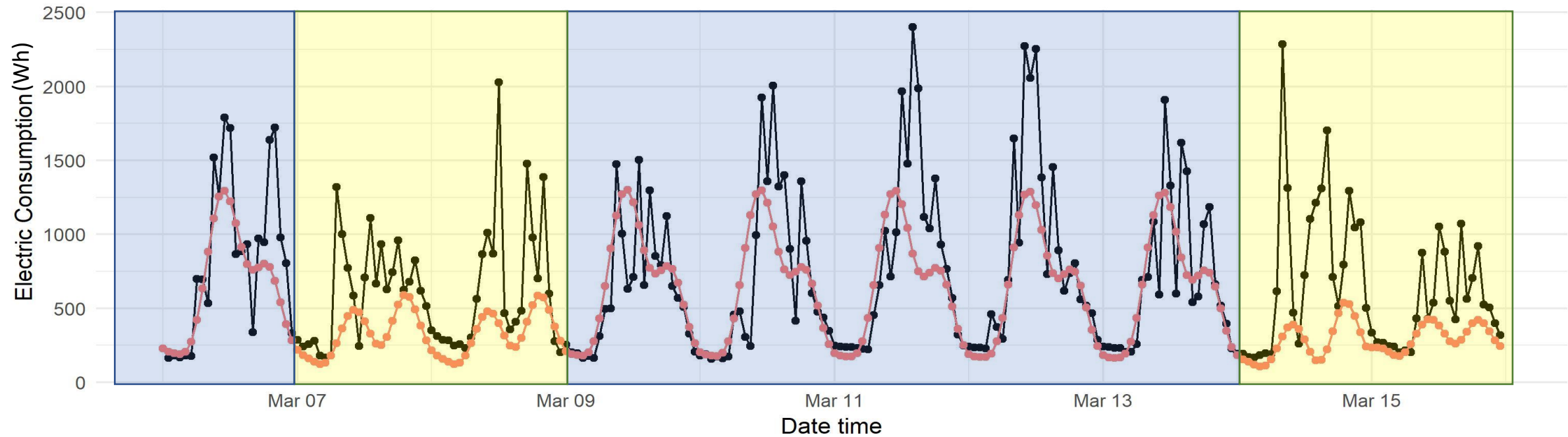


- sinHour
- cosHour
- Day
- sinMonth
- cosMonth
- Season
- Weekday
- WorkingDay

Linear Regression

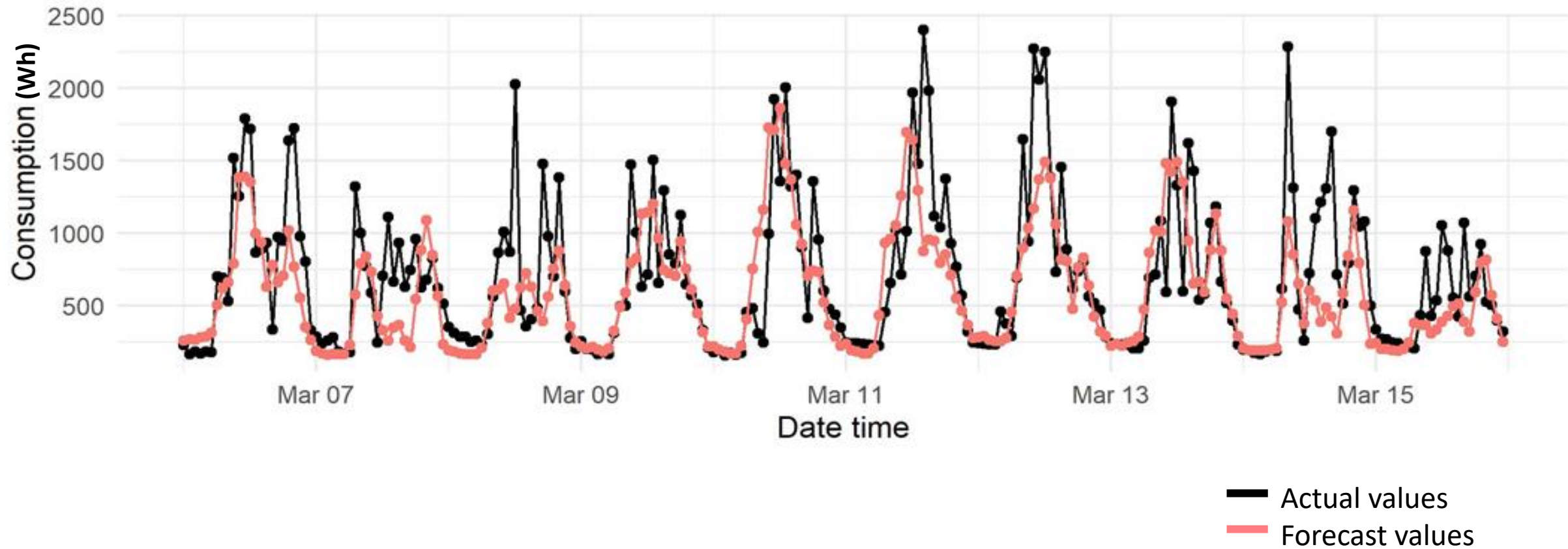


Support Vector Regression



— Actual values
— Forecast values

K-Nearest Neighbours



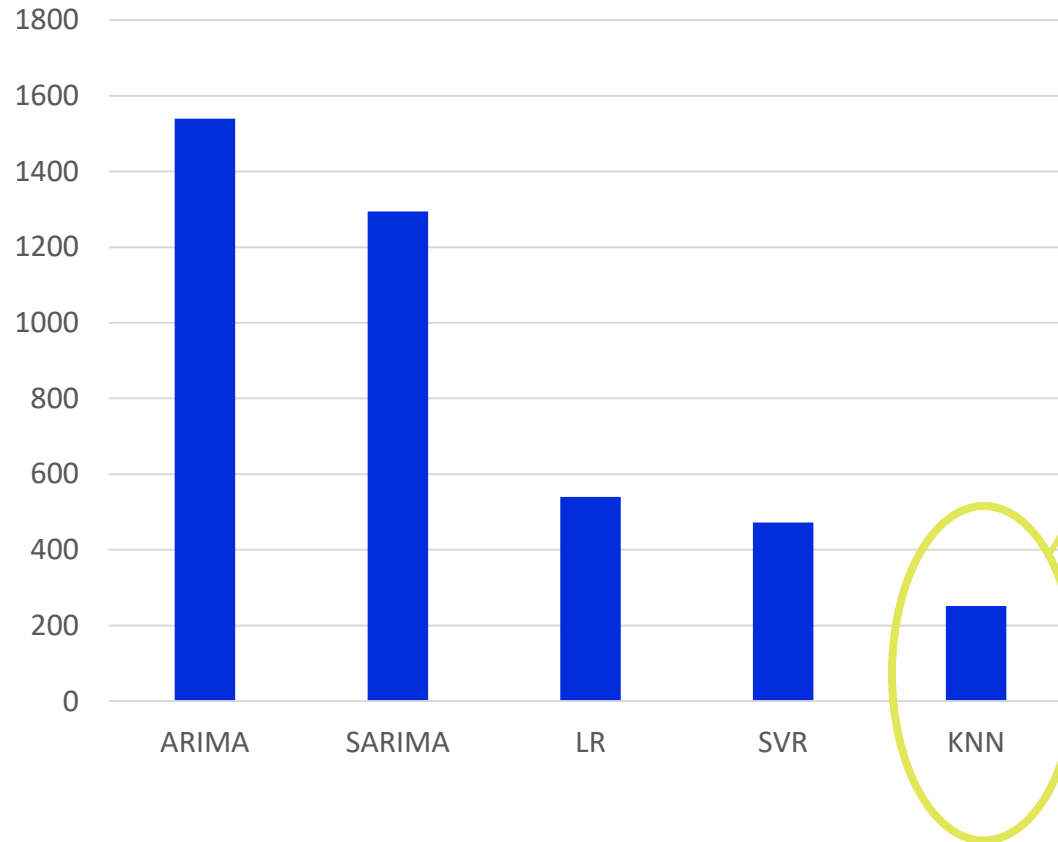


03

LESSONS LEARNED

SUMMARY RESULTS

RMSE



- RMSE between 156 Wh and 439 Wh
- Less time spent
- Patterns are not repeated
- Negative values avoided



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