Analyzing the Predictive Models' Performance with ENTSO-E Carbon Intensity

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Background: Projecting carbon intensity over time allows us to better understand the trends in energy generation and the adoption of green energy source. However, different predictive models are suitable for predicting different types of data. Therefore, it is important to understand the predictive models' performance with carbon intensity data that has different characteristics in magnitude and variation.

Project Workflow

Data Selection & Cleaning

25 regions, from 2017 – 2023

ENTSO-E data: transparency.entsoe.eu

Fill missing time data and energy sources

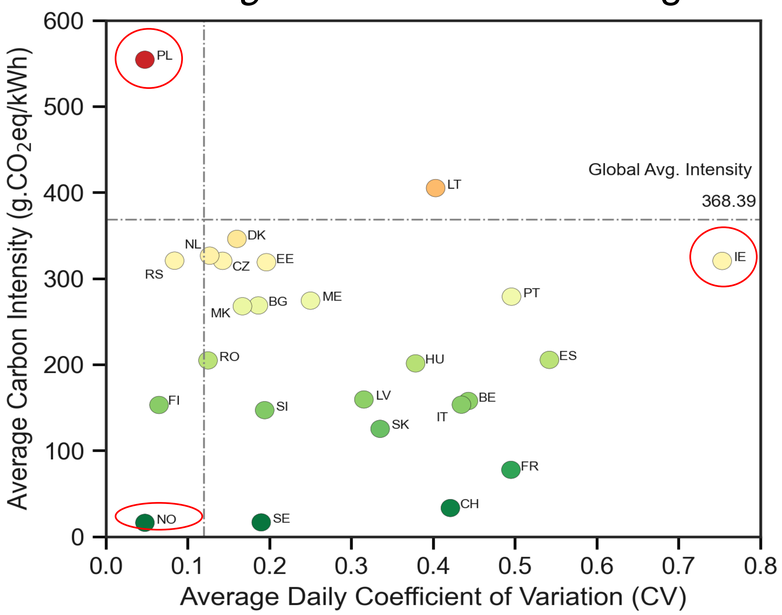
Calculate CO_2 Intensity

Calculate the average carbon intensity from different energy sources

$$CI_{avg} = \frac{\sum_i (c_i \cdot w_i)}{\sum_i w_i}$$

Region Selection

Different *magnitude* and *variation* regions



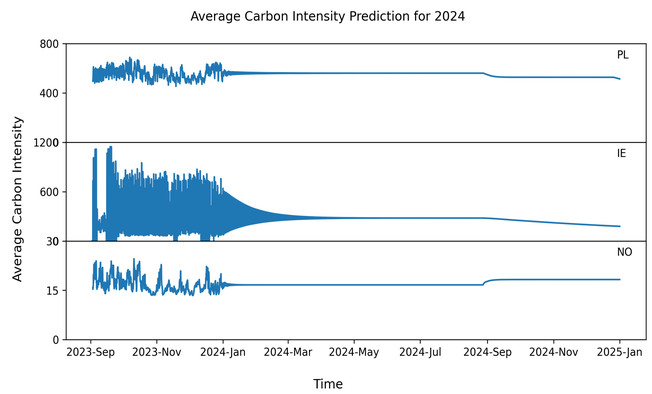
Prediction

Auto Regression (**AR**): A linear model that that assumes that the current value of a time series is a function of its past values.

Prophet: An additive model where trends are determined by seasonality, including that of holidays.

Predictive Models Results

Auto Regression



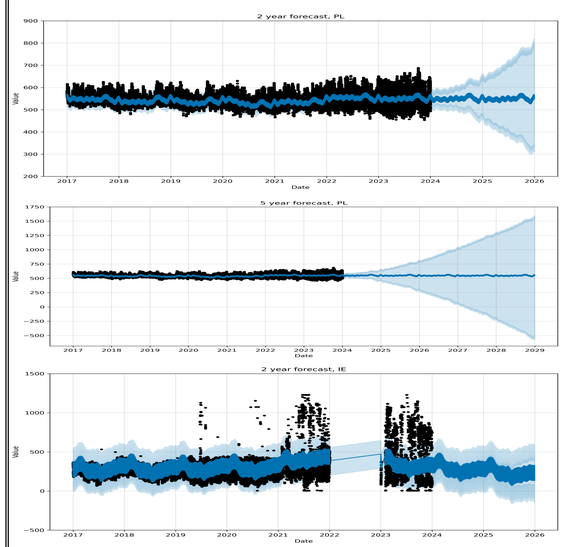
Use 120 days to predict the next 120 days to construct 2024 carbon intensity data

Interval Used on Model Predicting Average Carbon Intensity on PL	Mean Squared Error (RMSE)
30 days	123.39
60 days	105.35
120 days	43.55
150 days	148.24

\+ Model suitable for short-term prediction

\- Results converges to a constant value over time

Prophet

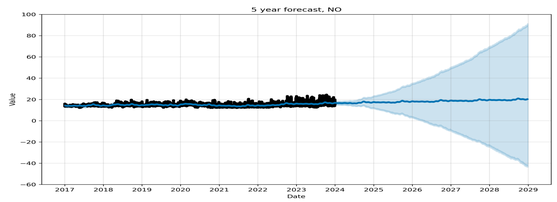


Use the data from 2017 to 2023 to predict the next 2 and 5 years

\+ Can predict into the far future

\- Uncertainty increases as the prediction range increases

\- May not be very flexible in complex time series data



Auto Regression	Prophet
+ Simple & efficient	+ Considers seasonal trends
+ Forecasts reoccurring patterns	+ Able to do large prediction range
- Has trouble with noisy data	- Data must be in a specified format
- Only suitable for short-term	- Limited parameter tuning