Problem Statement

The primary objective of this project is to develop an effective predictive model for wind turbine energy generation within a 2-week timeline. Utilizing data sourced from an operational wind turbine's SCADA system in Turkey, recorded at 10-minute intervals throughout the year 2018, the project aims to create a robust predictive model. This model will be deemed successful if the predictions closely align with the real data, achieving an accuracy rate of 90% or more. Key variables, including Date/Time, LV ActivePower (kW), Wind Speed (m/s), Theoretical_Power_Curve (KWh), and Wind Direction (°), will be crucial in achieving this level of precision. The success criteria emphasize the importance of providing accurate and reliable predictions to contribute to a comprehensive understanding of factors influencing wind turbine performance and enhancing overall energy production efficiency.

Context

The focus on predicting wind turbine energy generation is driven by the overarching goal of improving energy production efficiency and sustainability. By developing an accurate predictive model, we aim to contribute to a deeper understanding of the factors influencing wind turbine performance. This initiative aligns with the broader mission of advancing renewable energy sources and optimizing their utilization.

The significance of this project lies in its potential to enhance our ability to harness wind energy effectively. By accurately forecasting energy generation, we can inform strategic decision-making in the placement and operation of wind turbines, ultimately contributing to the advancement of clean and sustainable energy solutions. The project's outcomes have the potential to impact the renewable energy sector positively, promoting more efficient and reliable wind turbine performance.

Criteria for success

The success of this project will be determined by the accuracy and reliability of the predictive model in forecasting wind turbine energy generation. The key criteria for success include achieving a prediction accuracy rate of 90% or more, as measured against the real data. The model's ability to closely align its predictions with actual energy generation values within a 2-week timeline will be the primary indicator of success. This high level of accuracy is crucial for providing valuable insights into the factors influencing wind turbine performance and, by extension, improving overall energy production efficiency.

Scope of solution space

The focus of this business initiative is exclusively on developing a predictive model for wind turbine energy generation. The project's key components include the analysis and utilization of data collected from an operational wind turbine's SCADA system in Turkey. Specific variables, such as Date/Time, LV ActivePower (kW), Wind Speed (m/s), Theoretical_Power_Curve (KWh), and Wind Direction (°), will be the primary focus. The objective is to create a robust model within a 2-week timeline that accurately forecasts energy generation, with a particular emphasis on achieving a prediction accuracy rate of 90% or more. The exclusive concentration on these elements aims to contribute to a comprehensive understanding of factors influencing wind turbine performance, driving advancements in renewable energy efficiency.

Constraints

The accuracy and reliability of the predictive model heavily depend on the quality of the available data. Incomplete or inaccurate data could lead to biased or less reliable predictions.

Stakeholders

Renewable Energy Engineers
Project Managers
Decision-Makers and Executives

Data sources

Date/Time: Time-stamped data to analyze patterns, trends, and variations in wind turbine performance over different periods.
LV ActivePower (kW): Real-time data on the power generated by the wind turbine, serving as a crucial indicator of its efficiency and performance.
Wind Speed (m/s): Information on wind speed at the hub height of the turbine, allowing for the examination of how variations in wind speed impact power generation.
Theoretical_Power_Curve (KWh): Theoretical power values provided by the turbine manufacturer, serving as a benchmark to assess the actual power generated against the expected values.
Wind Direction (°): Data on wind direction at the hub height of the turbine, enabling the analysis of directional influences on turbine efficiency.

Data Link:
https://www.kaggle.com/datasets/berkerisen/wind-turbine-scada-dataset?select=T1.csv

I will find relationship between LV ActivePower (kW) and other parameters(Wind Speed (m/s), Theoretical_Power_Curve (KWh) and Wind Direction (°)).

Making a Linear Regression Model and KNN model to Predict Wind Turbine Energy Generation.