

Wind Energy Power Analysis

For Turkey Ministry of Energy and Natural Resources

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Capstone Project
GitHub QR code

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Relevance

- Temperature is causing problems across the world
- The UN Climate Change initiative focused on limiting global warming to 1.5°C by the end of this century, signaling the 'beginning of the end' of the fossil fuel era.
- It necessitates a dramatic shift towards green , clean and renewable energy.

Source

- https://en.wikipedia.org/wiki/Wind_power_in_Turkey
- <https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era>



Executive Summary

Project Overview

Analyze and forecast wind energy power output

Project Objective

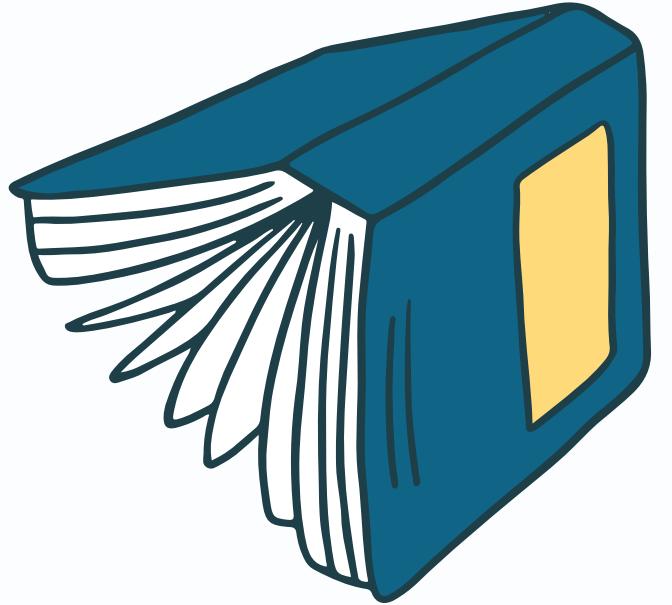
To enhance Turkey's wind energy system's efficiency, sustainability

Bottom Line

The best model achieves mean absolute error of 13%.



Data Overview



Source:

- Taken from a wind turbine's Scada system that is working and generating power in Turkey.
- The Systems measure and save data's like wind speed, wind direction, generated power etc. for 10 minutes intervals.



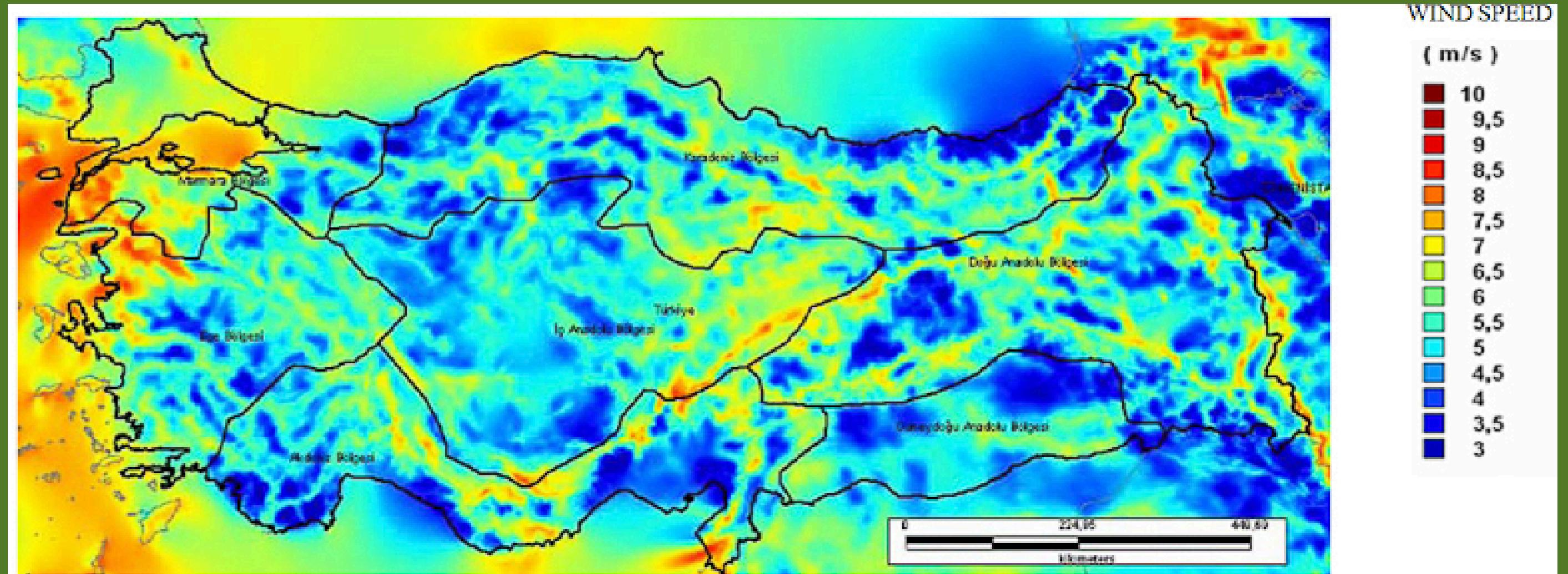
Limitations:

- Data includes only 2018
- High variability or volatility in data



The Distribution of Average Wind Speed in 50 m. of Elevation Above Ground

Turkey is among the four countries with the highest offshore wind energy potential, according to a Global Wind Energy Council (GWEC) report.

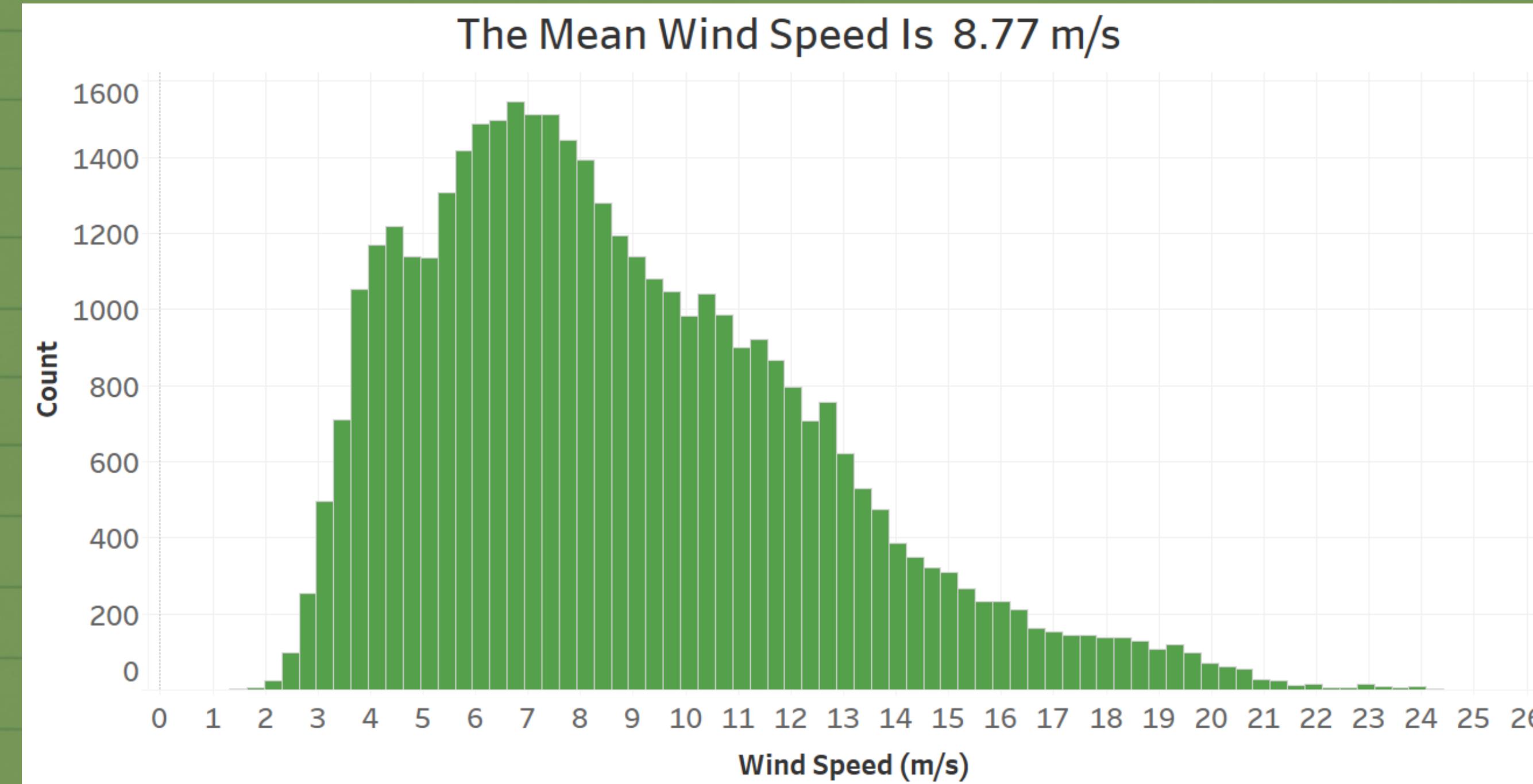


Source

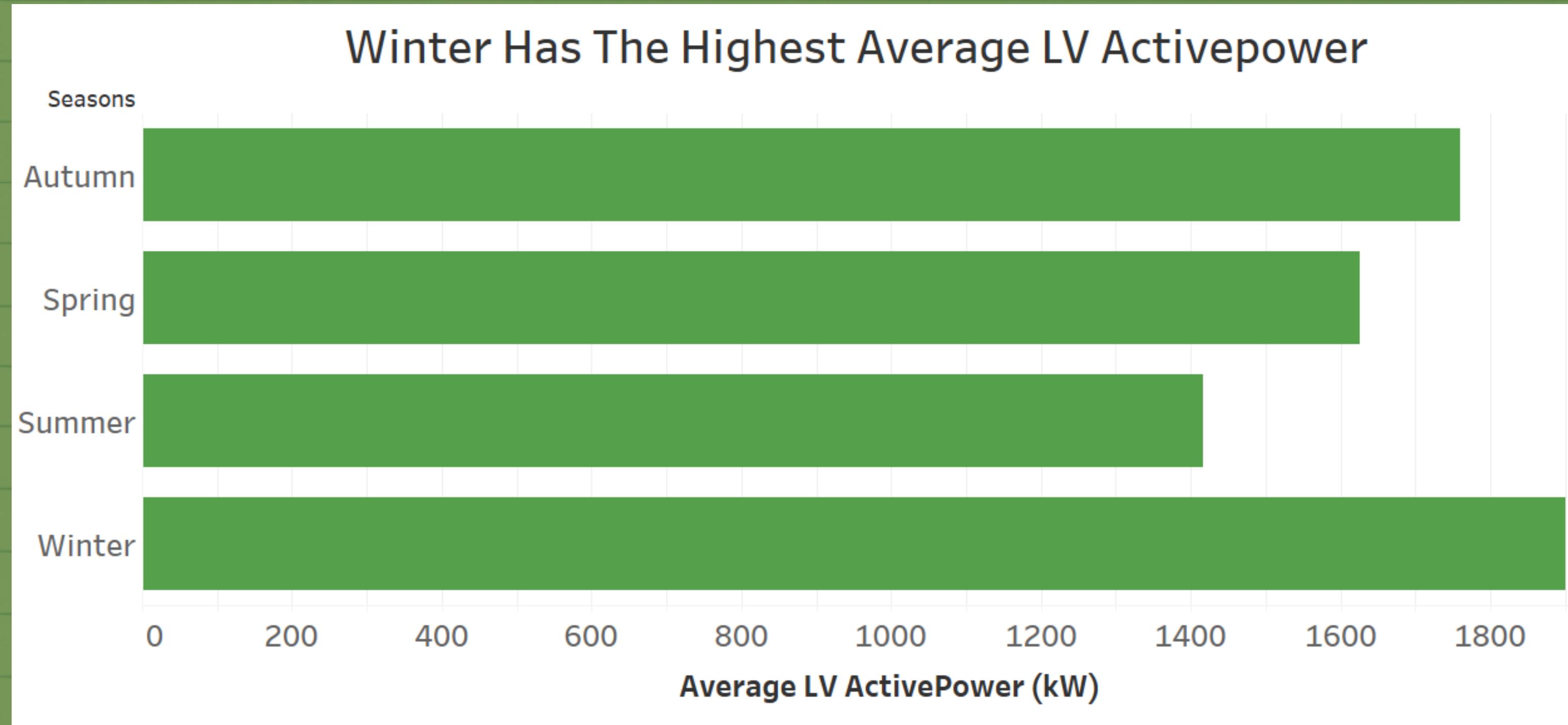
- <https://journals.openedition.org/echogeographie/12457?lang=en>
- <https://www.dailysabah.com/business/energy/turkey-among-4-nations-with-high-offshore-wind-energy-potential-gwec>

Analysis

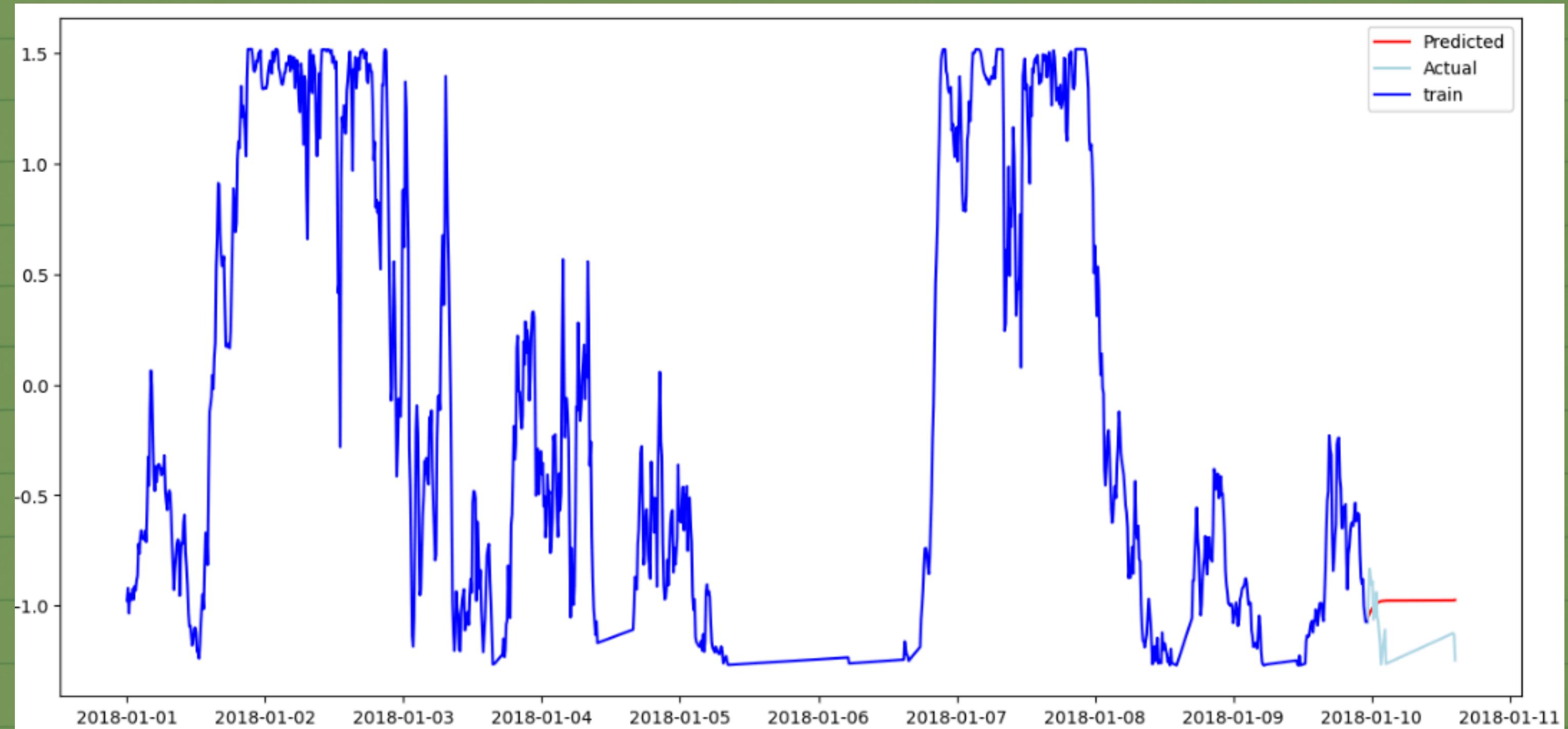
Wind Speed has a
Skewed-right
Distribution



Winter Has The Highest Average LV Activepower



The ARIMA Time series model has a mean absolute error of 13%.



Recommendations

Backup Power

Reduce the standby use of fossil fuel.

Planning

Provides valuable insights for future planning

Efficiency

Allows for the maximization of wind energy.



Next Steps

Data

Multiple years data needed to capture seasonal and yearly trends.



Advanced Model

To effectively handle long-term dependencies and non-linear patterns

- RNN
- LSTM
- CNN

Design Optimization

On the size and swept area of turbine blades.



Questions?

Thank You !!