## 1 Project Title

Predicting Wind Turbine Power Output

## 2 Team Members

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## 3 Project Details

### 3.1 Project Objective

The objective of this project is to use elements such as weather, pressure, wind speed, and other environmental or operational factors to help predict the amount of wind power produced by a wind turbine. This objective will be useful in real-world scenarios, as we progress towards more sustainable energy resources, and the accurate predictions of power output can help wind energy evolve, maintain, and expand.

The Day-Ahead Energy Market is a financial platform where participants buy and sell electricity at binding prices set for the following day. The Independent System Operator (ISO) develops a daily schedule based on bids and offers from market participants, with offers accepted when they match or are below the hourly Locational Marginal Price (LMP) at the given location, subject to system conditions. This market allows participants to protect themselves from price volatility in the Real-Time Energy Market by locking in prices ahead of the operational day. [FAQs: Day-Ahead Energy Market—Commitment, Scheduling, and Dispatch (iso-ne.com)](https://www.iso-ne.com/participate/support/faq/da-market-commitment)

For energy companies to be profitable, accurate forecasting of their day-ahead generation is crucial. Overcommitting to high energy production can force them to buy energy at higher prices if they fall short, while under-committing leads to lost profit opportunities due to unutilized capacity. Therefore, precise generation commitments are key to maximizing profits.

The challenge is further complicated by the unpredictability of renewable energy sources like wind and solar. Machine learning can help by leveraging weather forecasts, turbine data, and other relevant factors to predict next-day wind generation. This provides the market trade team with data-driven forecasts, enabling more informed bids and improving the company's chances of maximizing profits.

### 3.2 Datasets

This dataset is from Kaggle and can be found here:<https://www.kaggle.com/c/ml-2023-vub-wind-power/overview>

• What is the data and where you obtain it?  
• How was the data collected?  
• What will be the features and labels you will use?  
• How many examples for training, validation, and testing?

### 3.3 Machine Learning Algorithm

For this project, we plan to use regression-based machine learning models, as the goal is to predict wind power generation in kilowatts (KW) or megawatts (MW), which is in any case a continuous numerical value. Regression models are well-suited for this type of problem because they often perform well at predicting continuous outcomes based on input features like weather data, turbine characteristics, and environmental factors.

The specific regression model we select, whether linear regression, decision trees, random forests, or more complex models like gradient boosting or neural networks will be determined during the modeling phase based on performance metrics and computational efficiency. Our initial focus is on models that can handle non-linearity in the data, given the complex relationship between weather conditions and wind power generation. Ultimately, the best-performing model will be chosen to ensure the most accurate and reliable predictions.

### 3.4 Expected Outcomes

The expected outcome of this project is to develop a machine learning model capable of accurately predicting wind power generation for the day ahead. These predictions will enable energy companies to make informed decisions in the Day-Ahead Energy Market, improving the accuracy of their generation commitments, minimizing financial risks, and ultimately maximizing profitability.

By providing more precise forecasts, the project will also contribute to the broader goal of optimizing renewable energy resources, supporting the transition to a more sustainable energy grid.