Development of a new wind speed profile for large offshore wind turbines

- Recommended profile: Mechanical engineering, Energetic engineering
- Topics involved: Offshore wind, Aerodynamics, wind speed profiles
- Skills required or suggested: Matlab

Proposal description

In the analysis of the productivity of wind farms, it is a consolidated methodology to consider the wind speed at the level of the rotor hub, also called HHWS, Hub Height Wind Speed. This simplifying hypothesis allows to quickly estimate the Annual Energy Production and it is currently used by various software and numerical models on a commercial level[1]. However, the recent upscaling of turbines for offshore applications, whose size has far exceeded 15 MW, with a rotor diameter of over 200 m and a tower height of over 150 m, seriously undermines the validity of this hypothesis.

The aim of this activity is to develop a new wind profile which, unlike the HHWS, considers wind speeds at different heights, using database and experimental data as input data. Furthermore, the comparison between the newly developed methodology and the HHWS approach will be investigated.

Preliminary condition for carrying out the analyzes foresees the retrieval of wind speed and direction data at different heights: these data can be retrieved from historical soundings, from databases such as DHI or meteoblue, or experimental data from lidar. Subsequently, starting from the profiles thus generated, productivity will be analyzed in 2 sites considered using the in-house software Most.

The duration of the activity includes:

- Analysis of data from public and commercial databases for 2 or more selected sites;
- Analysis of the productivity of a FOWT using both the traditional HHWS methodology and a modified profile, ie considering different wind speeds at different heights. The model will be implemented on the in-house tool Most;
- Comparison between Most (modified profile) and OpenFast (HHWS).

[1] Ryu, G.H.; Kim, D.; Kim, D.-Y.; Kim, Y.-G.; Kwak, S.J.; Choi, M.S.; Jeon, W.; Kim, B.-S.; Moon, C.-J. Analysis of Vertical Wind Shear Effects on Offshore Wind Energy Prediction Accuracy Applying Rotor Equivalent Wind Speed and the Relationship with Atmospheric Stability. *Appl. Sci.* **2022**, *12*, 6949. https://doi.org/10.3390/app12146949