

Low wind wind turbine

Some time ago, I came across the existence (at least on paper) of wind turbines designed for locations with extremely low wind speeds, known as extreme low wind turbines. I discovered them through a project being developed by DTU (Technical University of Denmark) and Vestas.

These types of wind turbines do not represent a revolution in concept, as they still feature the familiar horizontal axis and three blades. However, they have a particularity: they are designed and optimized to harness extremely low wind speeds, even below the current industry standards.

Considering that the power generated by a wind turbine is proportional to the cube of the wind speed, installing wind turbines in locations with low wind speeds may not seem like a good business at first glance.

Moreover, the LCOE (Levelized Cost of Energy) becomes a less meaningful parameter for this type of machines. To assess its profitability, one must analyze how much revenue is generated during electricity production, as the specific moment (and market price at that moment) is key for revenue. There is a shift from LCOE to VOE (Value of Energy).

Their cut-out speed occurs at around 12-13 m/s. The power generated at low winds is much higher than in conventional wind turbines. This is achieved by using extremely long blades.

For instance, DTU's study compares a conventional wind turbine with a power output of 3.4 MW and a rotor diameter of 130 meters to a LowWind turbine with the same power output of 3.4 MW but a larger rotor diameter of 208 meters, resulting in a power density of 100 W/m² (compared to the 256 W/m² of the conventional turbine).

Regarding the cut-out speed, which might appear as a disadvantage at first glance, it has its advantages from a design perspective: since the wind turbine withstands lower winds, the mechanical loads are reduced, allowing for some optimizations in the mechanical design. Lighter and more flexible blades and towers can be used, along with different orientation systems. There is even a proposal for using downwind turbines (see image below).

In summary, beyond their ability to be located in areas with lower wind resources, what is truly distinctive in these type of wind turbines is primarily their low cut-out speed and the reduction of loads, which enables optimization in their design. In addition to higher generation at low winds, of course.

While not necessarily going to such extremes, nowadays the market is showing that low-wind and low-power-density wind turbines are becoming increasingly prominent.

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Competitiveness of a low specific power, low cut-out wind speed wind turbine in North and Central Europe towards 2050 Initial performance and load analysis of the LowWind turbine in comparison with a conventional turbine

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