

Wind farms explained

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Throughout history, wind has been used to move grain mills or push the vessels that sailed the seas. However, it was not until well into the 19th century that the first wind turbines capable of generating electricity from the wind were made. Currently, the high potential of wind energy and its strategic value place it as one of the renewable sources called to play a decisive role among the technologies that will allow us to achieve a climate-neutral European economy by 2050.

A wind farm, also known as a wind park, is an area of several square kilometers that houses an array of wind turbines to harness the winds from land or sea and generate electricity, which is fed into the grid for consumption.

These wind turbines work according to a very simple principle, making the most of the wind's force, which in this case acts as a source of primary energy. By spinning its blades, it produces kinetic energy and a generator then converts this kinetic energy into electrical energy.

The amount of energy that a wind farm can produce depends on the location, the size of the turbines, and the length of their blades. The capacity of wind turbines has been increasing over time, thanks to the research and development in this field. In 1985, the most common turbine model had a capacity of 0.05 megawatts (MW) and a rotor diameter of 15 meters. The large wind energy projects currently have a turbine capacity greater than 5 MW.

The continuous advances in the manufacturing and design of wind turbines, combined with the improvement in infrastructures, have managed to notably reduce the costs of wind energy and have reaffirmed its position as a key driver in the energy transition. According to WindEurope, in 2021 European wind farms generated 437 terawatt-hours (TWh) of electricity, covering 15% of demand on average, although in several countries it surpassed 20% of electricity coverage, such as in Portugal (26%), Spain (24%), and Germany (23%).

A wind turbine consists of a tower, nacelle, and a rotor on its upper part with multiple blades, pointed in the direction of the wind. The propellers turn around a horizontal axle that acts on an electricity generator. Renewable energy produced by each wind turbine is transported to ground level through underground electrical cables that carry it to the transformer of the wind power plant, tasked with redistributing it to supply the electric grid and meet the energy needs of homes and companies.

The operation of a wind turbine depends on a very simple mechanism. The rotor, activated by the wind, transmits its movement to a high-speed axle. This multiplier transforms the slow movement of the blades (between 18 and 25 revolutions per minute) into a faster rotation (up to 1,800 revolutions per minute) capable of driving the electric generator. The latter will be tasked with transforming the mechanical energy received into electrical energy. Wind turbines are classified generally according to the direction of the axle:

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Recently, a new bladeless wind turbine model, easy to install and maintain, has been launched, which adapts quicker to the changes in wind direction. The device consists of a cylinder that oscillates when the wind hits it. The movement of the cylinder generates mechanical energy that, in turn, is transformed into electricity thanks to an alternator.

Once the generator transforms the kinetic energy it receives into electricity, a transformer is used to raise the voltage (from 20 KV to 66 KV) and be able to transport the current through the wind farm. In this way, the energy is transmitted by medium voltage cables to the substation. Once there, it is converted into high voltage current (above 132 KV). Then, a power transmission line is laid that transfers the electricity to the installations connected to the distribution grid. The latter will be tasked with transporting the electricity to companies and homes.

They are currently the most common. They are located on land no less than 3 kilometers from the coast and feed on terrestrial air currents. The advantage that this location offers is its easy accessibility and proximity to the electric grid.

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