

# Introduction to Wind Energy

## Wind Energy

The sun has a lot to do with creating winds. Winds above continents and oceans occur because of temperature differences around the world. Some places, especially those near the Equator, receive far more direct sunlight than those closer to the Earth's north and south poles. As a result, the air from the surrounding areas warms up and then rises. Cooler air from the surrounding area rushes in to fill the space left by the rising air, creating a surface wind.



Air is constantly on the move. In some places, especially along coastlines and in mountains, it provides a highly reliable source of mechanical energy. Humans have invented an amazing array of devices that can harness the energy of the wind and put it to practical use.

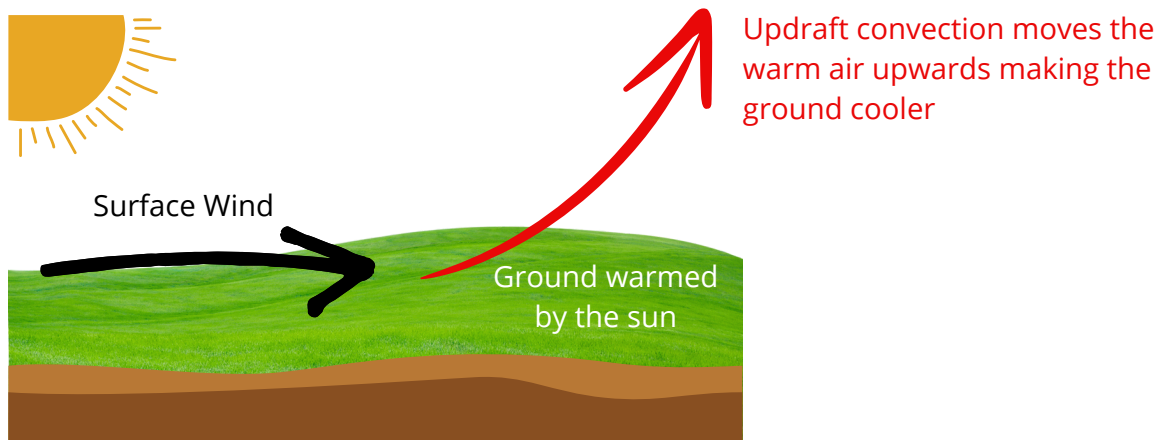


Figure 1. Movement of surface winds when sun warmed air rises and cooler air rushes in to fill the space left behind.

## Capturing Wind Energy

### Sails

One of the oldest uses of wind energy is transportation. The first primitive sails were made from woven mats held aloft by wooden poles or human hands. Modern sailboats have very efficient sails and masts constructed from strong, lightweight materials such as Kevlar (the material used in bulletproof vests) and titanium. They work like aircraft wings to generate forces that pull the boat in the desired direction.



Traditional sails used to propel the boat forwards. Source: Mike Bird. Retrieved from Prexel: <https://www.pexels.com/photo/white-and-black-sail-boat-on-ocean-996328/>

### Windmills

Long before the invention of electricity, early wind turbines did very useful work. Windmills were used in many places in Europe over the last several centuries to turn heavy granite disks called millstones. The millstones were used to crush dry grains such as wheat, barley, and corn to make flour or meal.



A millstone used to make flour.

The Netherlands is famous for its windmills. In truth, most of these structures are not mills at all, but water pumps. The Dutch created new farmland along the coast by building dikes around low-lying estuaries and mudflats and pumping out all the seawater. The “windmills” provided a steady supply of mechanical energy to lift seawater into the canals, allowing the new farmland to dry out.



Retrieved from Pixabay:  
<https://pixabay.com/photos/kinderdijk-dutch-netherlands-3354198/>

In the past, windmills were common on farmsteads across Canada. They were often used to pump water from wells to watering troughs for cattle and to generate electricity at the farmhouse. When rural areas finally received electricity, many of these windmills fell into disuse and disrepair. However, small windmills are becoming popular once again for bringing water to livestock.

## Generating Electricity

One of the most popular uses of wind turbines is to generate electricity. To make electricity, the shaft of the turbine must be connected to an electrical generator. Through gearboxes, the generator converts the mechanical energy of the spinning turbine shaft into electricity. Generators are small and light enough that they can be housed under an aerodynamically designed cover at the top of the pole or tower. Wires running down the tower carry electricity to the grid, batteries or other appliances where it is stored, and/or used.

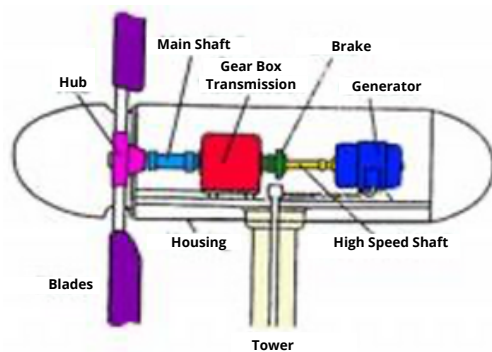


Figure 2. Components of a wind turbine to conduct electricity. Adapted from Australian Renewable Energy Website.

Electricity is now being generated on a commercial scale at large installations called “wind farms” in several places around the world. Wind farms consist of rows of towers, sometimes 90 metres high, equipped with giant wind turbines for producing electricity. In Canada, the first commercial wind farm was built in southern Alberta near the town of Cowley, in a region famous for its strong, steady winds. Commercial wind farms have also been established in Germany, Denmark, the United States, Spain and India. Denmark and Germany have pioneered the development of commercial wind power, one of their fastest-growing industries.



Example of a commercial wind farm on land.



Some companies are now installing wind farms in shallow waters near coastlines in small countries with little available land area. These “offshore wind farms” are a promising new source of electricity. Toronto Hydro is installing such a turbine offshore on Lake Ontario.



Example of a commercial wind farm on shallow waters.

Commercial wind energy is one of the most economical sources of new electricity available today. Wind turbines can be set up quickly and cheaply compared with building new coal-fired generating stations or hydroelectric facilities. Modern wind generating equipment is efficient, highly reliable, and becoming cheaper to purchase. The environmental impact of large wind turbines is negligible compared with an open pit coal mine or a reservoir, and during their operation produce no air pollution. Because of these factors, wind energy is recognized as the world's fastest-growing new energy source.

Small highly efficient wind turbines are becoming popular as a source of electricity for rural homes. The cost of installing one comes close to that of putting up poles, overhead power lines and other equipment necessary to connect to the electrical grid. The advantage is that the homeowner owns the generating equipment and is freed from paying monthly electrical bills!

Small, lightweight turbines such as the one shown to the right are available to make electricity for single homes.



Bergy Wind Power.



### Did you know?



- Wind energy has the potential to generate 18 times more energy than the current global electricity demand.