

WIND

WHAT IS WIND ENERGY?

Wind is air on the move. Each air molecule has kinetic energy because it is moving. The energy of the wind is the combined kinetic energy of all of the molecules. The wind is a free and renewable source of energy, and it is the world's fastest-growing electricity resource.

HOW IS ELECTRICITY GENERATED FROM WIND?

Electricity companies catch the energy of the wind using wind turbines. A 'wind farm' will often contain many identical turbines. When the wind flows through the blades of a turbine, they rotate and spin, powering a rotor inside a generator and producing electricity. Each turbine works independently. The electricity flows through cables in the turbine, flows down the turbine tower and combines with the energy from the other wind turbines in the wind farm before entering the local electricity network or the national grid, which provides power to New Zealand.

WHAT'S INSIDE A WIND TURBINE?

Each wind turbine has four key parts.

Foundation

The foundation holds the turbine in place in the ground. A wind turbine has to have a strong foundation to handle strong winds and support the overall height and the length of the blades.

Tower

Generation equipment is kept in the tower. The tower raises the blades and generation equipment high above the ground into the smoother, stronger wind currents. Access to the nacelle and rotor is through the tower.

Nacelle

The nacelle is the heart of the turbine, where the generator, gearbox and rotor are held. The generator inside the nacelle is used to convert the wind energy into electrical energy.

Blades

Most wind turbines have three blades that are attached to the rotor. The longer the blades and the faster the wind speed, the higher the possible output power. The blades are tested thoroughly to ensure that they will handle the most severe weather conditions expected at the wind farm.



RENEWABLE ENERGY AT HAU NUI WIND FARM, WAIRARAPA
SOURCE: GENESIS ENERGY



ARE WIND TURBINES SAFE?

Each wind turbine has an internal computer system that monitors the direction and speed of the wind. The system automatically sets itself to operate at a safe level. If the wind speed exceeds a safe level or if there is any damage to the turbine, the computer will shut the turbine down automatically, usually by twisting the blades into the wind so they don't turn the turbine.

WHAT ARE THE ADVANTAGES OF WIND ENERGY

- Wind energy is a renewable resource, so it will never run out.
- Wind energy has little direct effect on the environment, as there are no greenhouse gas or heat emissions or other pollutants.
- Modern turbines with capacities of up to 1 MW mean that wind farms of between 100 and 150 MW are practical. These are comparable with many existing hydro and geothermal power stations in New Zealand.
- Turbines can be serviced and repaired individually without the need to close down an entire wind farm.
- Once a wind farm has been constructed, the land can still be used for other purposes, such as farming or agriculture.

WHAT ARE THE DISADVANTAGES OF WIND ENERGY?

Wind farms tend to be highly visible and cover large areas, usually on ridges or hilltops. Some people dislike seeing large numbers of turbines on the horizon and some complain that they are noisy.

HOW IS WIND ENERGY USED IN NEW ZEALAND?

Wind energy plays a significant, growing role in energy generation for New Zealand. By the end of 2009, there were seven main wind farms in operation in New Zealand. Combined, these wind farms have a capacity of nearly 500 MW.

In addition, there are several smaller wind farms and individual turbines, and more wind farms are under construction.

ACTIVITIES

ACTIVITY ONE

Divide the class into groups. Assign each group one of the seven main wind farms in operation in New Zealand.

- Hau Nui
- Horseshoe Bend
- Tararua
- Te Āpiti
- Te Rere Hau
- West Wind
- White Hill

The teacher displays a large map of New Zealand on the wall and labels the wind farms. Groups research their assigned wind farm, find out why the site was chosen and present this information back to the class. For example:

Hau Nui wind farm, south-east of Martinborough in the Wairarapa, is ideally located to capture the wind currents that are funnelled and accelerated through the nearby Cook Strait and over the Rimutaka Ranges. The wind farm has 15 turbines and a capacity of 8.65 MW, which provides enough energy for around 4,200 homes in the Martinborough area and, depending on demands and output, as far north as Greytown.

ACTIVITY TWO

WIND ENERGY QUIZ

Students answer the following questions.

- How long have wind turbines been available as an energy source?
- Before wind turbines were invented, how did people use wind to generate electricity?
- Why is wind energy a good choice for environmental management?
- What is kinetic energy?



ACTIVITY THREE

BUILD A MODEL WIND TURBINE

Here are some websites and publications showing how to build devices that use the energy of the wind.

- Make an Anemometer (Energy Quest – California Energy Commission).
An activity that shows students how to make an anemometer, which is a device that tells you how fast the wind is blowing.
<http://www.energyquest.ca.gov/projects/anemometer.html>
- Make Your Own Wind Winch (Solar Schools)
<http://www.solarschools.net/resources/pdf/make%20your%20own%20wind%20winch.pdf>
- Ministry of Education. 2004. 'Windmills and Waterwheels'. Building Science Concepts (Book 54). Wellington: Learning Media.

SUPPORTING RESOURCES

- New Zealand Wind Energy Association: www.windenergy.org.nz
- Ministry of Economic Development: www.med.govt.nz
- Energy Efficiency and Conservation Authority: www.eeca.govt.nz
- Genesis Energy: www.genesisenergy.co.nz