

# WIND ENERGY STUDENT FACT SHEET



## HOW IS ELECTRICITY MADE?

- Electricity is made by a machine called a generator. Generators convert mechanical energy into electrical energy.
- We use electricity for everything from lighting homes and streets to powering factories, schools and shops.
- Wind turbines generate electricity by using the power in the wind.
- Electricity can also be made using water, geothermal steam, fossil fuels and even waste!
- A wind turbine may look like a fan, but instead of using electricity to make wind, wind turbines capture the energy in the wind to make electricity. See picture below.
- As the wind blows across the blades of a turbine, it creates lift – like how an airplane takes off and flies – and turns the blades.
- As the blades turn, they spin a shaft attached to a generator. It is the generator that produces electricity. If you are curious about electricity and how it is generated, go to: <http://science.howstuffworks.com/electricity.htm>

### THE FOUR KEY PARTS OF A MODERN WIND TURBINE



## WHAT IS A WIND FARM?

- A wind farm is a group of wind turbines that are located together. A wind farm makes electricity and feeds it into the power system.
- New Zealand has 19 wind farms. The largest wind farm has 134 wind turbines, the smallest has one.
- These wind farms produce about 6% of our electricity each year – that's enough electricity to power 320,000 homes.
- To find out where these wind farms are, go on line to [windenergy.org.nz/nz-wind-farms/nz-wind-farms](http://windenergy.org.nz/nz-wind-farms/nz-wind-farms) and use the interactive map. Can you find the closest wind farm to your school?

## ALL ABOUT WIND TURBINES

- Most turbines have three or two blades, which rotate around a central hub to drive a generator housed in the nacelle.
- Blades are made from materials such as fibreglass, carbon fibre or wood laminates. They are designed to withstand the force of strong winds.
- The nacelle is the large housing at the top of the tower. It contains the generator and other important components such as the gearbox and control equipment.
- The tower sits in a steel reinforced concrete foundation.
- The foundation ensures the turbine can withstand very strong winds. It is always below ground level and so cannot be seen.

- New Zealand wind farms

Shaded areas on the map indicate the windiest parts of New Zealand





## HOW MUCH POWER DOES A WIND TURBINE MAKE

- The amount of electricity that a wind turbine makes depends on two things:
  - the speed of the wind.
  - the size of the wind turbine.
- The energy in the wind increases with the wind speed - when the wind's speed doubles, the energy it contains increases by eight. This means a wind turbine will produce more electricity when the wind is stronger.
- Larger turbines can capture more of the wind's energy and so make more electricity. The picture on the left is of a 660 kilowatt wind turbine. It stands about 64 metres high and has blades that are 23.5 metres long. It generates around 2,500 megawatt hours of electricity in a year. The long blade on the truck is for a 3 megawatt wind turbine, pictured on the right. This larger turbine stands 110 metres tall - that is taller than a rugby field is long! Each blade is 45 metre long. The larger turbine generates about 11,000 megawatt hours of electricity a year. That is almost four times as much as the smaller turbine generates.

## WHAT IF THE WIND DOESN'T BLOW?

- New Zealand is a windy country – a wind turbine here will produce electricity for about 90% of the time.
- Wind energy works well with New Zealand's existing hydro resources. If we use wind's energy when it is available, then we can save the water stored in our hydro lakes. This stored water gives us more choices for generating electricity.
- We can:
  - save the water to use another day – perhaps when low levels of wind generation or water inflows are expected.
  - use the water to meet fluctuations or daily peaks in demand.
  - use hydro instead of thermal generation to meet normal levels of demand.

- Wind farms will generate electricity in wind speeds that are between about 5 metres per second (18 kilometres per hour or a gentle breeze) and about 25 metres per second (90 kilometres per hour or a gale).
- If the wind gets any faster than about 25 metres per second, the turbines will automatically shut down and turn their blades out of the wind. They do this to prevent damage.

## IS NEW ZEALAND SUITED TO WIND FARMS?

- New Zealand is very well suited to wind farms as it has a long coastline and its position in the ocean (in an area known as the Roaring Forties) means that it has fairly strong winds throughout the year. The map on the previous page shows areas where the wind is particularly strong.
- Wind farms tend to be located on hills and ridges as this is usually where the wind speeds are highest.
- Do you know somewhere that is particularly windy?

## THE ENERGY WE CAN GENERATE FROM NEW ZEALAND'S WIND

- In theory there is enough energy in the wind blowing over New Zealand to be able to generate more than three times the amount of electricity we use each year.
- But we won't be able to generate that much electricity from wind because there are lots of windy areas like national parks, native forest areas and towns where you wouldn't want to build a wind farm.
- If you want to build a wind farm, you need the permission of the local council. The council will go through a decision making process to decide if the wind farm is ok to build in the proposed location. To make a decision, the council will consider both the positive and negative effects of a proposal.

## BENEFITS OF WIND FARMS

- The wind is free and renewable
- Wind energy doesn't need mining for fuel or transport of the fuel to the power station.
- Wind farms do not create any carbon dioxide or any other polluting gases or particles when they generate electricity.
- Wind farms don't use water, which is wanted for many other uses such as irrigation, recreation and conservation.
- Wind is one of the most economical sources of new large-scale electricity generation.



## BENEFITS CONTINUED ...

- A wind farm creates a new income stream for the farmers who own the land around it.
- Increasing use of wind and other renewables reduces the amount of fossil fuels used for making electricity.
- Wind farms are efficient: did you know that within three to six months a wind turbine will generate more energy than was needed to make it and construct it?

## CAREFULLY MANAGING WINDFARMS

- Did you know that wind farms can also have many other effects that must be carefully managed?

### Sound

- Wind turbines are machines, so they create sound. There are rules about how loud a wind farm can be, which means that the level of sound from a wind farm, when heard from a nearby house or school, will be very low. Did you know that visitors to wind farm can stand under a wind turbine and talk to each other without raising their voices?

### Birds and Ecology

- A few years ago, some wind farms in the USA and Europe created serious problems for birds because they were built on the flight path of migratory birds.
- Now days, a developer will study the birds and other native animals and plants at a wind farm site before wind turbines can be built. By putting in this effort to understand the site's ecology, the problems that happened overseas can be avoided. The effect of the wind farm on the site's ecology influences the decision to grant permission for a wind farm.

### Views

- Wind turbines are big, so you can see them from a long way. Wind farm developers usually prepare photos simulations to show how a wind farm will look. How people feel about seeing a wind farm is a personal judgement.

### Farming

- There may be significant disruption to farming activities during the construction of a wind farm, but once a wind farm is constructed, its turbines, roads and associated buildings typically use 1 to 3% of the land area in a wind farm. The remaining land can continue to be farmed.

### Traffic

- Wind turbines are big, and a lot of people work on a wind farm, so moving people and equipment in and around the site has to be carefully planned.

## 2015 ELECTRICITY GENERATION

**Renewable** **80.8%**

- Wind = 5.4%
- Geothermal = 17.2%
- Hydro = 56.6%
- Other = 1.6%

**Thermal** **19.2%**

- Coal = 4.1%
- Gas = 15.1%