

# Frequently Asked Wind Energy Questions

## How does a wind turbine make electricity?

The simplest way to think about this is to imagine that a wind turbine works in exactly the opposite way to a fan. Instead of using electricity to make wind, like a fan, turbines use the wind to make electricity.

Almost all wind turbines producing electricity consist of rotor blades that rotate around a horizontal hub. The hub is connected to a gearbox and generator, which are located inside the nacelle. The nacelle is the large part at the top of the tower where most of the electrical components are located. Some turbines do not have a gearbox, and operate using a direct drive system.

Most wind turbines have three blades that face into the wind; the wind turns the blades round, this spins the shaft, which connects to a gearbox to speed up the revolutions, and a generator where the electricity is made. A generator is a machine that produces electrical energy from mechanical energy, as opposed to an electric motor, which does the opposite!

## Are wind turbines noisy?

It is possible to stand underneath a turbine and hold a conversation without having to raise your voice. When it is very windy, the noise of the wind masks the noise made by wind turbines.

There are two potential sources of noise from wind turbines: **Mechanical noise** from the gearbox or generator, and **aerodynamic noise** from the rotor blades. Mechanical noise has virtually disappeared from modern wind turbines. This is due to better engineering with more concern about avoiding vibrations. Other technical improvements include: elastically dampened fastenings and couplings of the major components in the nacelle, and to a certain extent sound insulation. Finally, the basic components themselves, including gearboxes, have developed considerably over the years. Modern wind turbine gearboxes use "soft" gearwheels, i.e. toothed wheels with hardened surfaces and relatively elastic interiors.

Aerodynamic noise i.e. the "swish" sound of the rotor blades passing the tower of a wind turbine primarily arises at the tip and back edge of the rotor blade. The sound increases slightly with an increase in rotational speed. Aerodynamic noise has been cut dramatically during the past ten years due to the better design of the rotor blades (particularly blade tips and back edges).

## Do wind turbines frighten livestock?

Wind farming is popular with farmers, because their land can continue to be used for growing crops or grazing livestock. Wind turbines do not disturb sheep, cows, horses or any other livestock.

Sheep are grazing around the base of the wind turbine towers at the wind farms at Crookwell, and Blayney, NSW. Cows habitually graze around the base of the towers at the Windy Hill wind farm, Queensland.

## Does wind farming affect tourism?

There is no evidence to suggest that wind farms deter tourists. Indeed, many wind farms are themselves tourist attractions. The Esperance wind farms in Western Australia are adjacent to the Great Ocean Drive (formerly known as the Tourist Loop), a well-promoted tourist drive. The wind farms are highlighted as one of the attractions for visitors. The Esperance region attracts 150,000 visitors each year and a large percentage of these will visit the turbines. The Tourist Bureau directs visitors to the wind farms and includes them in their information and visitor guides. Road counters have been put across Wind farm Rd, the access road to the site, measuring 80 cars/day.

A road counter was installed at the Windy Hill wind farm in Far North Queensland, and has recorded on average 75 cars per day, with a total of approximately 30,000 cars in the first three months. A local bus company runs a tour called *Walks, Wind and Waterfalls* that includes a visit to the turbines. Other local businesses benefit from the wind farm as well. The local Ravenshoe cricket team uses a wind turbine as their logo!

An open day held at the Crookwell wind farm in New South Wales was attended by 500 people. This was only advertised in the local area and was an opportunity for the local residents to receive information and tour through the site. The Visitor Information Centre in Crookwell is aware of people travelling specifically to look at the wind farm, both as individuals and as organised groups.

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### How safe is wind energy?

Wind energy is one of the safest energy technologies. Wind energy leaves no harmful emissions or residue in the environment.

Wind energy has a proven safety record. No member of the public has ever been injured by wind energy or wind turbines anywhere in the world, despite the fact that there are now over 35,000 operational wind turbines. Paul Gipe wrote this in his book *'Wind Energy Comes of Age'* in 1995 and it remains true to this day.

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### What are wind turbines made of?

The towers are mostly tubular and made of steel, generally painted light grey or white because these are the colours which are most conspicuous under the majority of lighting conditions. The finish is matt, to reduce light reflection. Some towers may also be made of concrete.

The blades are made of glassfibre re-inforced polyester or wood-epoxy.

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### How long does it take for a turbine to 'pay back' the energy used to manufacture it?

The comparison of energy used in manufacture with the energy produced by a power station is known as the 'energy balance'. It can be expressed in terms of energy 'pay back' time, i.e. the time needed to generate the equivalent amount of energy used in manufacturing the wind turbine or power station.

The average wind farm in Australia will pay back the energy used in its manufacture within 3 to 5 months, and over its lifetime a wind turbine will produce well over 50 times more energy than was used in its manufacture. This compares favourably with coal-fired power stations that deliver only a third of the total energy used in construction and fuel supply over its lifetime.

If fuel is used in the calculation, fossil fuel or nuclear stations never achieve an energy pay back.

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### I want to visit a wind farm, where is the nearest one to me?

The first wind farm to become operational in South Australia is the Starfish Hill development near Cape Jervis. This 34.5MW wind farm was commissioned in mid 2003. There is also a single 150kW wind turbine operating at Cooper Pedy. Several other wind farm projects are at the planning and feasibility stage, including several being developed by Wind Prospect.

Codrington wind farm near Port Fairy, Victoria, was commissioned in June 2001, and at present is the next closest operational wind farm to people living in South Australia.

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### What happens when it is blowing a gale?

Quite simply, the turbines shut down. There are two main methods for controlling the power output from the rotor blades. The angle of the blades can be actively adjusted by the machine control system. This is known as pitch control. This system has built-in braking, as the blades become stationary when they are fully "feathered".

The other method is known as stall control. Since it is the inherent properties of the blade that determine power output; there are no moving parts to adjust. The twist and thickness of the rotor blade vary along its length in such a way that turbulence occurs behind the blade whenever the wind speed becomes too high. This turbulence causes some of the wind's energy to be shed, minimizing power output at higher speeds. Stall controlled machines may also have brakes on the blade tips to bring the rotor to a stand still if the turbine needs to be stopped for any reason. Wind turbines can also be shut down and re-started by remote control.

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### How much space do wind turbines require?

The wind is a diffuse form of energy, in common with many sources of renewable energy. A typical wind farm of ten turbines might extend over an area of 1 square kilometre, but only 0.5% to 1% of the land area would be taken out of use, the remainder can be used for other purposes, such as grazing or cropping.

As a general rule, turbines are best placed over three times their rotor diameter apart, i.e. if the rotor diameter is 66 metres, then the appropriate spacing between each turbine at a wind farm would be at least 200 metres in any direction.

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### **What happens when the wind stops blowing?**

When the wind stops blowing, electricity continues to be provided by other forms of generation, but turbines do not produce electricity during a period of no wind. Our electricity system is mostly made up of large coal and gas-fired power stations, and the system has to be able to cope if one of these large plants goes out of action. It is possible to have up to 10% of the country's needs met by intermittent sources such as wind energy, without having to make significant changes to the way the system operates. More can be accommodated, but extra storage capacity or spinning reserve would be necessary, which would have cost implications.

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### **How long do wind turbines last?**

A wind turbine typically lasts around 25 years. During this time, as with a car, some parts may need replacing. Also like a car, wind turbines need to be serviced, and this generally occurs twice a year.

The very first of the mass-produced wind turbines, from a well-established Danish wind turbine manufacturing company, celebrated its 20th birthday in May 2000. This Vestas 30kW machine has operated steadily, and so far, none of the major components have had to be replaced.

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### **What happens when a wind farm is taken down/decommissioned?**

The way that a planning authority wishes to have a wind farm decommissioned should be covered by clauses in the development approval documents. These clauses typically require all visible traces of the wind farm to be removed. This takes care of the turbines. Service tracks, if there are any, could be removed, although it may be best for the farmer to leave them. Obviously each case is different, depending on the size and geography of the development. Wind developers will then comply with these clauses.

The concrete bases could be removed, but it may be better to leave them under the ground, as this causes fewer disturbances. If so, they would be covered with soil, stone or other indigenous material, and the site returned as closely as practicable to the original condition.

Compared to the problems associated with decommissioning a gas, coal or nuclear power station, decommissioning a wind farm is relatively straightforward and easy.

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### **How much does it cost to make electricity from the wind?**

Wind energy is one of the cheapest of the renewable technologies. It is competitive with new coal-fired power stations and cheaper than nuclear power. The cost of wind energy varies according to many factors. The average for a new wind farm in a good location is about 8-10 cents per unit, which compares favorably with the current price South Australians pay for power of 17-19 cents per unit. Technological progression is continually pushing the price down. Furthermore, if some of the components (e.g the towers) can be made locally, then the price can be lower.

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### **Can wind farms affect mobile, marine & television communications?**

Turbines placed nearby or in the path of the signal source can affect mobile, marine and television communications. However, at the planning and development stage of a wind energy project, all the relevant communication authorities must be consulted to determine any potential interference problems. If it is determined that there would be an affect on marine communications for example, then individual wind turbines would be re-located elsewhere to avoid interference. There may be instances where local television reception is affected, but good planning in the design stage can mitigate this.

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### **What affect do wind farms have on land and property values?**

While the Ten Mile Lagoon wind farm site near Esperance, WA, is surrounded by a nature reserve, the Salmon Beach wind farm also at Esperance, has been encroached upon by highly sought after residential properties.

The general consensus among local real estate agents was that property prices next to the turbines have stayed the same or increased after installation. The properties in that area are one-acre blocks, some directly across the road from the crown land where the turbines are located. In 2001 blocks were selling for \$250-300,000.

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### Why don't we put all the turbines out to sea?

It is more expensive to construct offshore wind farms, although the price is coming down in European situations. The stronger winds generally found at sea means more electricity can be generated, but at a greater cost. The first offshore wind farm was commissioned in Europe in the mid 90's.

There are no offshore wind farms in Australia, and it is unlikely to become economic here for at least 10 to 20 years.

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### Can wind turbines create a fire risk?

The risk of fire at wind farms, or the risk of fire damage to wind turbines is very low, as a result of:

- The height of wind turbine towers above the ground;
  - The lack of vegetation around the base of the turbine towers;
  - The fact that the high-voltage connections are usually underground;
  - Access tracks act as firebreaks and provide firefighting access;
  - Lightning protection devices installed on every wind turbine; and
  - Dedicated monitoring systems that detect temperature increases in the turbines and shut them down when the threshold temperature is reached.
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### Can lightning damage wind turbines?

If a wind turbine is struck by lightning, the lightning will always take the route with the best conductivity, i.e. the least resistance. Most modern turbines are equipped with total lightning protection in the form of a special 'lightning route' through the turbine. Lightning is led from the tip of the blade, down to the blade hub from where it is led through the nacelle and the tower down to the ground. Very simple – and extremely effective.

Though wind turbines are not often struck by lightning, the taller the turbine tower, the greater the chance of it happening. No matter how effectively a turbine is protected, it is impossible to completely eliminate the risk of a wind turbine being struck.

Therefore, it is not a question of avoiding lightning, but more a question of controlling and conducting it through the turbine and tower construction – and thus minimise possible damage to the turbine, and therefore, risk of fire as a result of lightning strike.

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### How strong does the wind have to blow for the wind turbines to work?

Wind turbines start operating at wind speeds of about 4 metres per second (around 8 knots) and reach maximum power output at around 15 metres per second (around 30 knots). At very high wind speeds, i.e. gale force winds of about 25+ metres per second (50 knots), most wind turbines shut down.

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### How popular is wind energy?

Wind energy is one of the most popular energy generation technologies. Opinion surveys undertaken at Crookwell and Blayney townships, revealed 66% and 75% of respondents respectively (80 people at each town), were either supportive or very supportive of the wind farm proposals prior to construction. These approval percentages increased to 89% support after 2 years of operation at Crookwell, and 100% support during construction at Blayney. A public opinion survey conducted as part of the Troubridge Point Wind Farm Public Exhibition revealed 98% of people (out of 110 respondents) were in favour, or not opposed to the wind farm proposal. An open day held in July 2001 at the Codrington wind farm in Victoria attracted 6,500 people.

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