

Wind Farm Basics

What Is A Wind Farm?

“Wind Farm” is the name used for any group of adjacent wind turbine generators that are connected electrically. This includes vehicle access tracks, underground cabling for electrical interconnection and communications, and the switchyard at the point of connection to the grid. In Australia, wind farms have been built with between 1 and 60 wind turbines.

Each wind turbine acts independently, generating from the available wind resource. The electricity flows through common cabling out into the grid. The turbines are usually arranged to maximise use of the wind available and placed sufficiently far apart to avoid interference with one another.

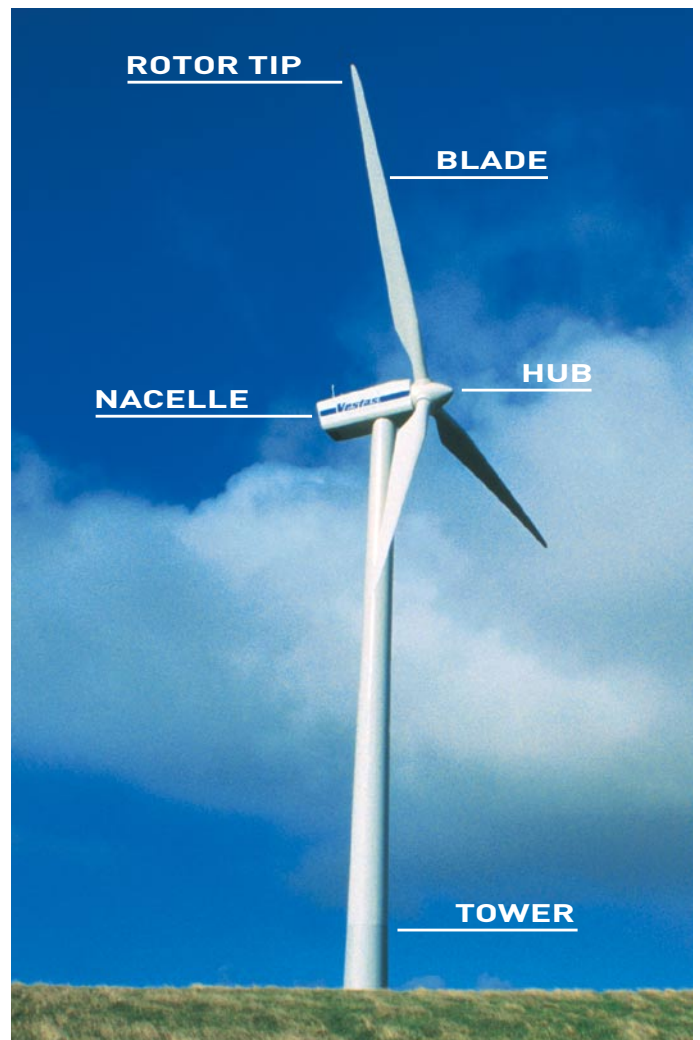
Wind farms produce electricity directly from a natural, clean and sustainable energy resource. This technology is now the world’s fastest growing electrical generation source and Australia is beginning to see more wind farms proposed due to their environmental benefits.

Every development is different and site specific issues and local planning controls ultimately determine the design and layout of a wind farm. To provide a benchmark approach, AusWEA has published “Best Practice Guidelines for Grid Connected Wind Energy Projects in Australia” www.auswea.com.au.

What Is A Wind Turbine Generator?

A wind turbine generator consists of a foundation, tower, nacelle and a rotor (three blades mounted on a central hub). The foundation is typically a thick slab of reinforced concrete 12m wide and 3m deep. This is buried in the ground, allowing stock to graze right up to the tower. The nacelle rests on a large bearing which allows the whole machine to be driven by motors into the prevailing wind direction.

Whereas early wind generators overseas were built on lattice towers, in Australia only enclosed tubular steel towers are used. Towers are typically coloured white or light grey as these colours have been found to create the least visual impact. Internal ladders provide access to the nacelle which contains the drive-train, gearbox, generator and controlling equipment. Wind turbines for today’s wind farms cost up to \$3M each.



How Do Wind Generators Work?

The rotor turns a generator inside the nacelle, converting some of the wind's energy to electricity. As wind speed increases, more energy is delivered to the wind turbine's rotor. This energy is extremely sensitive to wind speed - doubling the wind speed gives eight times the energy.

Wind turbine generators deal with these huge variations in power using several aerodynamic strategies that regulate the power captured by the rotor.

Wind Speed (m/s)	Wind Speed (km/h)	Operating Strategy
<4	<14	machine shut down – not worth wear and tear
4– 12	14 - 45	output increases steadily with increasing wind speed
12 – 25	45 – 90	output remains steady and excess energy “spilled” from rotor
> 25	>90	machine shutdown for self protection

Blade Speed and Materials

The blades of grid connected wind generators range between 25 and 50 meters long and typically sweep to about half way down the tower. Depending on the size and design of the machine, the rotor will turn at between 10 and 25 revolutions per minute. From a distance this rotation seems quite slow and stately. Up close the strength, flexibility and speed of the rotor blades is revealed.

The blades are made from advanced composite materials that have high strength and are light weight and flexible. The maximum blade tip speed is about 215 km/h and it is quite normal to see the blades flex backward several metres under the enormous pressure of the wind.

Integrated lightning protection systems ensure the blades can withstand a direct strike without serious damage. In Australia towers are nearly always steel, whereas in Europe concrete towers are also used.

Where Are Wind Farms Sited?

Wind farms are usually sited where there is a good wind resource, access to transmission lines, local community support and plenty of open land available. Typically, the

best wind resources in Australia are in coastal regions or inland at higher altitudes. Wind farms are unlikely to be built offshore in Australia in the near future because of the extraordinarily high cost of offshore construction. Nonetheless, in Europe offshore wind farms have become economically viable because of higher energy prices.

How Much Energy Does A Wind Turbine Produce?

This depends on the size of the machine and the wind resource. Typically each wind turbine can produce enough energy to meet the needs of up to 1,000 homes, saving several thousand tonnes of CO2 emissions per year.

How Do The Costs Add Up?

Wind power and other renewables are economically viable in Australia because the Federal Government, like many governments in the world, is encouraging the uptake of renewable energy through legislated measures. The Mandatory Renewable Energy Target (MRET) requires that a certain amount of the energy sold by Australian retailers be from renewables such as wind and solar.

Currently wind energy costs around twice as much as energy from coal generation, but the cost of wind power and other renewables is falling. Importantly, the cost of fossil fuel based energy does not factor in environmental costs and should these be imposed in the future (as seems likely), the gap between wind and fossil fuel based energy will close rapidly. In more remote parts of Australia where fuel costs are higher (eg because of transport of diesel), wind energy can be cheaper than fossil fuel based generation.

Where Can I See A Wind Farm?

Wind farm locations can be found by visiting the Australian Wind Energy Association's web site www.auswea.com.au. Most wind farms have viewing areas with informative displays, some with self guided or commercial tours. Some of the larger wind farms have “virtual tours” on their web sites.

Please remember that most wind farms in Australia are located on private property. You should keep to the path and designated visitors' area and not enter private property unless invited.