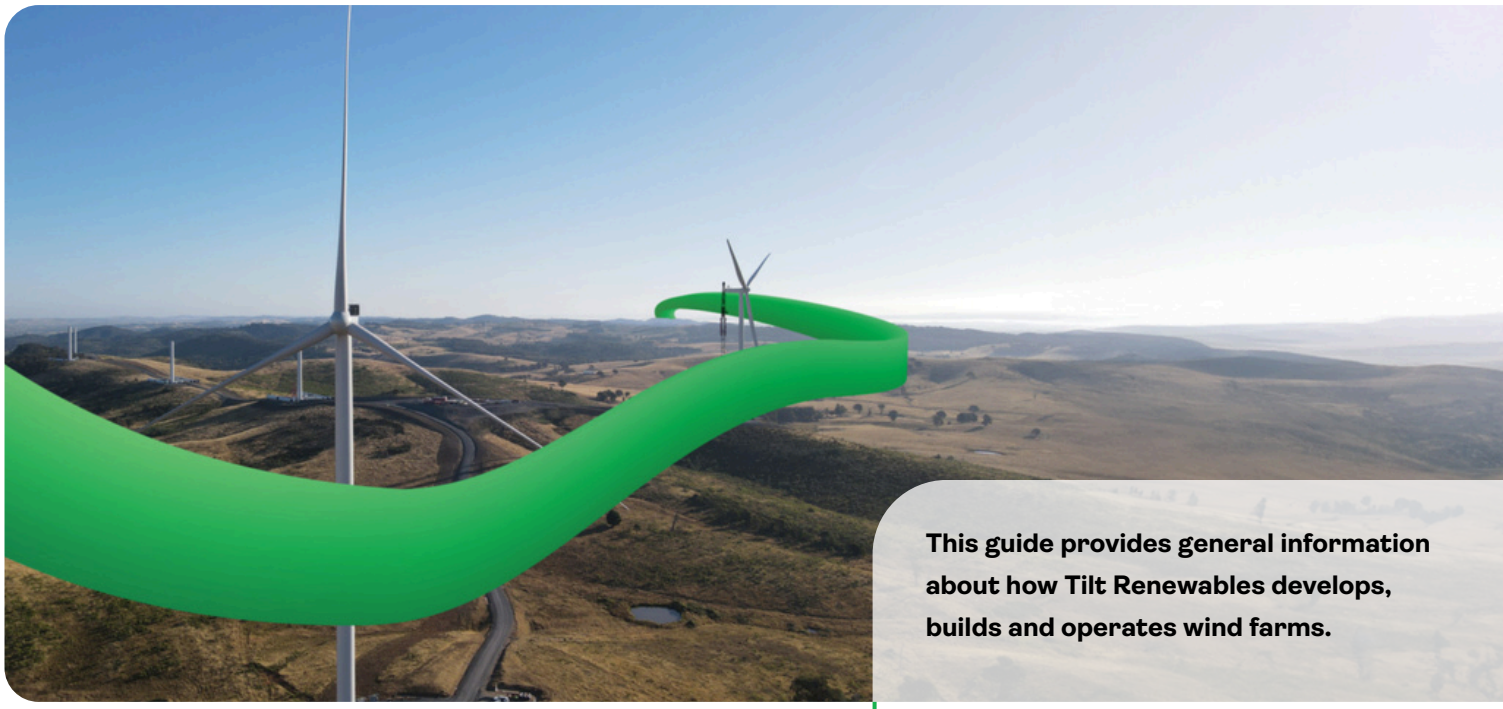
Wind Farm Fact Sheet

Frequently Asked Questions



This guide provides general information about how Tilt Renewables develops, builds and operates wind farms.

About *Tilt* Renewables

Tilt Renewables is an Australian owner, operator and developer of renewable energy and storage projects in Australia, for Australians. It is one of the largest owners of wind and solar generation in Australia.

We strive to be the leading investor in, and owner of, large-scale renewable generation in Australia. In doing so, we support the transition to a clean energy economy. To ensure we support regional Australia's prosperity through the energy transition, our project teams harness decades of industry experience and commitment to communities local to our project sites.

We currently have twelve operating assets, including nine wind farms across Queensland, New South Wales, Victoria and South Australia. We have a further seven projects in development and construction.

While our team of around 120 people is based across both our Melbourne and Sydney offices, you will find many of us out in the locations where our projects are proposed or operating, as we continue to build on our role as an active member of the communities and regions where we operate.

Tilt's Projects

Wind

5 in Development, 9 Operational

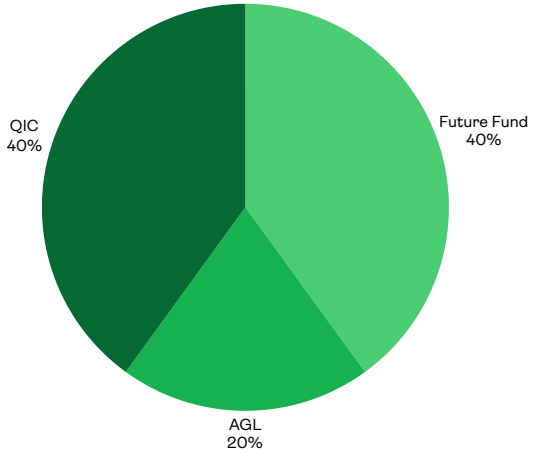
Solar

2 Operational

Battery

2 in Development, 1 Operational

Tilt's Owners



For more information, please visit: www.tiltrenewables.com or call us using: 1800 WE TILT (1800 938 458)

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Wind Energy

Wind Energy

Wind farms generate electricity from the naturally occurring power of the wind. Wind is an inexhaustible resource that is clean, reliable and affordable.

Turbines capture wind energy within the area swept by their blades. The spinning blades drive an electrical generator that produces electricity.

Most Australian states and territories are transitioning from traditional, emissions-intensive forms of energy generation to new, diverse renewable sources – including wind.

In 2023, renewable energy was responsible for 39.4 per cent of Australia's total electricity generation. Wind energy was 33.9 per cent of that renewable energy generation.

Do wind farms supply reliable energy? What if there is no wind or extreme weather stops the turbines from spinning?

Our wind farms connect into the National Electricity Market (also referred to as the grid). This is an interconnected system that covers Queensland, New South Wales, Australian Capital Territory, Victoria, Tasmania and South Australia. The grid is supplied by electricity from a large number of geographically and technologically diverse generators.

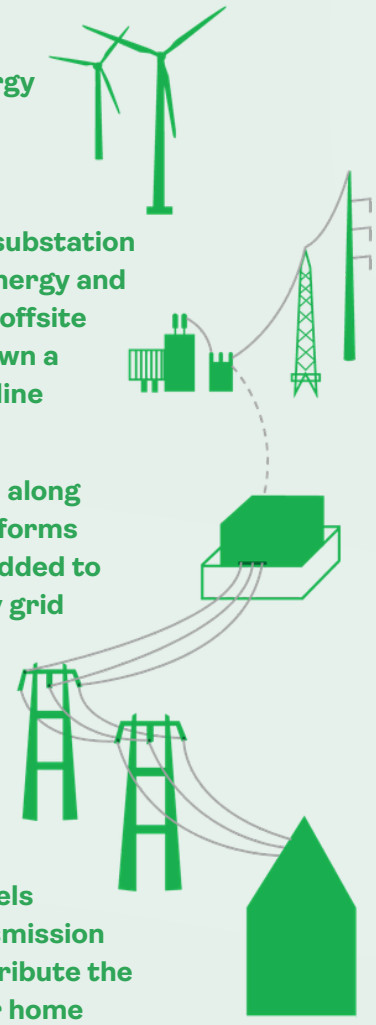
The Australian Energy Market Operator (AEMO) manages the system to ensure that a mix of generators and storage technologies are available to meet demand. If the wind is not blowing at one wind farm, generators in other regions or using other technologies will be available to meet demand.

In addition, batteries can be used to store energy and release energy when needed by consumers. This means that when the winds are blowing inconsistently across our wind farms, our stored energy in batteries can be released into the grid as needed. The combination of batteries and wind farms means that we can help keep grid stability and thus provide a reliable source of energy for Australians.

How is power measured?

Our operational wind farms range from 450 MW to 5 MW. The production of power over time is measured in megawatt- hours (MWh) or kilowatt-hours (kWh) of energy. Production of power at the rate of 1 MW for 1 hour equals 1 MWh of energy.

How wind energy works



Wind Turbines – Components

What are the parts of a wind turbine called?

BLADES
Wind turbines typically have three blades which are connected to a central hub and rotate the generator.
Each blade has its own automated pitch control system which adjusts the angle of the blade to optimise energy output and protects the turbine in a storm event.

GENERATOR
There are two types of wind turbine generator technologies, direct drive and generator/gearbox combinations. The advantage of direct drive technology is that no gearbox is required. The generator's rotor is mounted on the outside of the generator and can be seen located between the hub and nacelle.

NACELLE
The nacelle is the housing at the top of the tower which contains the turbine's electrical, control and cooling equipment and generator.

TOWERS
The tower of a wind turbine comes in a number of sections which are bolted together on site. The towers are tubular steel and are painted with a marine standard paint to protect the towers from harsh weather conditions. The tower base is fixed to a reinforced concrete foundation which is designed to ensure the turbines can withstand very strong wind speeds and seismic events.

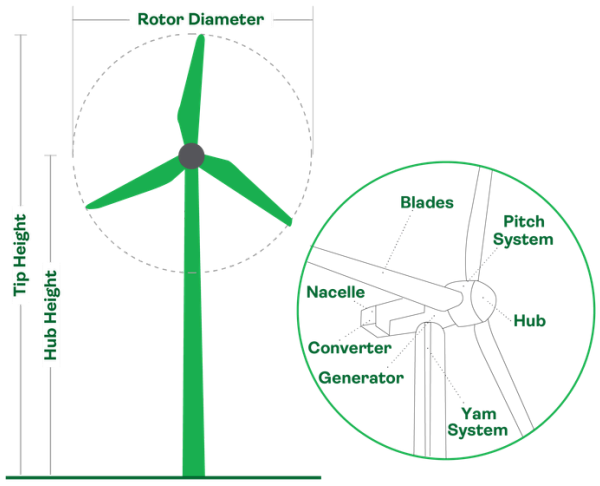


Figure 1: Wind turbine parts

How fast do blades turn?

Blades typically rotate at speeds between 5 - 17 rpm (rotations per minute). In each turn, the outer tip of the blade travels the furthest distance and can reach speeds of 300 kmph.

How much does a wind turbine cost?

These days a single wind turbine generator (WTG) costs approx. $7 - $12 million (for supply and install only). Cost increases as turbine size increases, though there are benefits to using fewer, larger turbines: complexity and construction of the overall farm site is greatly reduced with fewer and larger turbines.

What does maximum output mean?

A maximum power rating generally indicates the maximum amount of power that can be safely sustained without resulting in failure. Manufacturers measure the maximum, or rated, capacity of their wind turbines to produce electric power in megawatts (MW). One MW is equivalent to one million watts.

Wind farm Lifecycle

There are four key phases in a wind farm's lifecycle (see Figure 2). As a developer, owner and operator, Tilt Renewables is involved in all phases.

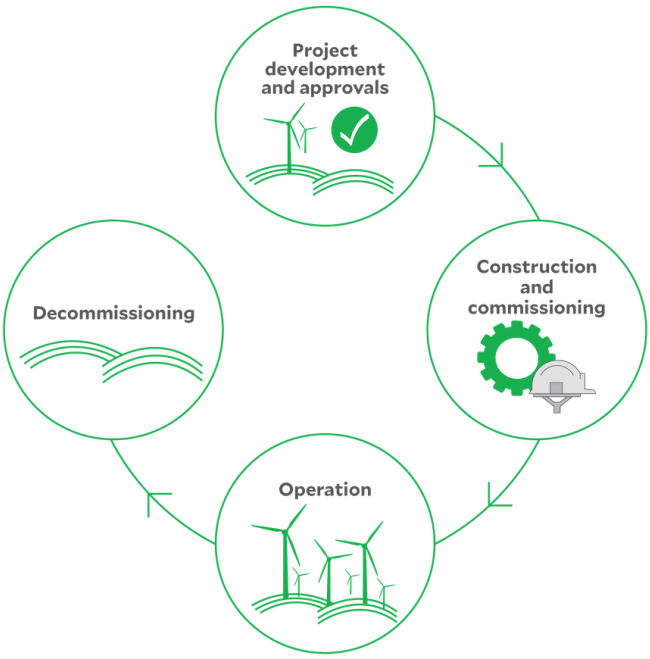


Figure 2: Lifecycle of a wind farm

Project Development & Approvals

Site Identification
- Site Visits
- Landowner Agreements

Monitoring
- Installation of Masts & LiDARs
- Development of Layout

Specialist studies
- Biodiversity
- Aboriginal Cultural Heritage
- Noise
- Shadow Flicker
- Risk (e.g. Bushfire)

Planning and Environmental Approvals
- State Development Approvals
- State and Federal Environmental Approvals
- Public Exhibition Periods

Management plans and consents
- Emergency and Bushfire
- Traffic and Construction
- Environment and waterways

Development

First Nations Partnership & Stakeholder and Community Engagement

Project development & approvals

From finding the right location to obtaining approvals and finalising a design – a lot of work goes into developing a wind farm. This can take a number of years. Key activities in wind farm development include:

- wind monitoring
- energy modelling
- feasibility studies
- grid connection impact study
- site investigations
- consultation with government, communities and industry
- establishing agreements with landholders
- planning and environmental studies and approvals
- design of wind farm and ancillary infrastructure
- design of road upgrades
- transport route planning
- investment decision and raising equity to fund the project
- procurement of contractors and turbines

What's involved in designing a wind farm?

Designs are developed and refined over time as more information becomes available, such as from site investigations and confirmation of planning requirements.

We look at a wide range of technical, community and environmental considerations, including:

- local topography
- geotechnical (ground) conditions
- proximity and connectivity to the grid
- safety
- relevant standards, guidelines and legislation
- stakeholder and community feedback
- constructability – whether the design is practical to build
- connections to local roads
- transport routes and access to the site
- potential environmental and heritage impacts
- operations and maintenance requirements
- ongoing productivity of the land
- project cost and value for money

Procurement
- Detailed design
- Geotechnical Studies
- Financial Investment Decision

Construction
- Road Upgrades
- Civil and electrical
- Installation of Turbines
- Commissioning

Operation
- Maintenance
- Servicing
- Environmental Compliance (e.g. bird and bat monitoring and noise monitoring)

Decommissioning
- Removal of Infrastructure
- Revegetation

What planning and environmental approval process is used for a wind farm project?

Depending on the wind farm size and location, local, state and/or federal government approvals may be required. Often we need approvals from all three levels for a project.

The Commonwealth Government uses the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to guide their assessment of Projects.

Each state has it's own legislation to guide the environmental approval process and consider potential environmental impacts and opportunities. We also consult with local councils on requirements specific to their local government area.

You can always contact your local, state or federal planning department to find out more about the approval process.

What environmental studies do you undertake to ensure impacts are identified and avoided or minimised?

Environmental studies are undertaken by independent experts to identify possible project impacts. We use these studies to inform decisions about design, planning and construction management. Studies typically undertaken for a wind farm project include:

- aviation
- electromagnetic interference (EMI)
- shadow flicker
- traffic and transport
- noise
- biodiversity
- Aboriginal cultural and European heritage
- landscape and visual

How do you involve communities in planning for, and decisions about, the wind farm?

We are committed to positive engagement practices and ongoing engagement throughout all stages of a project's life – from site selection through to decommissioning.

We engage with local councils, landholders, neighbours and surrounding communities as early as possible, keeping people informed and involving people in decisions that they are able to influence. We also encourage our community stakeholders to sign up to our project newsletters to make sure they stay up to date with projects as they progress.

Construction & Commissioning

Major project construction can be disruptive at times. At Tilt Renewables, we work closely with our contractors, neighbours, local councils and communities to plan and manage construction responsibly. Depending on the size of the wind farm and weather conditions, construction can take several years.

We are committed to reducing construction impacts on communities and the environment, and keeping people safe while we work. Some of the ways we do this include:

- working during standard construction hours wherever possible
- scheduling disruptive or noisy work at times when it will have the least impact
- monitoring and actively managing construction activities
- using well-maintained equipment and facility
- meeting requirements set out in planning conditions, legislation, industry standards and guidelines
- regular communication with neighbours and the community
- listening to feedback about how impacts could be minimized
- a strong safety culture and clear procedures

How long does it take to build a wind farm?

Construction timelines vary depending on the size of the wind farm and weather conditions. As a general guide, construction can take up to around three years.

How do you make sure construction is undertaken responsibly?

There are a range of requirements, standards and guidelines in place to ensure construction is well planned and effectively managed. Requirements are set by government authorities, developed as part of the planning process and built into the construction contract that Tilt Renewables has with the construction contractor(s). Management plans are developed to ensure all requirements are understood and addressed.

A Construction Management Plan (CMP) provides a 'guidebook' for workers on site. It sets out the approach to managing all aspects of construction including working hours, safety and security, biosecurity, water and dust management, noise and vibration controls and traffic.

An Environment Management Plan (EMP) identifies all potential impacts and the strategies and plans in place to manage impacts and meet requirements. It ensures that appropriate environmental management practices are followed.

We also listen to feedback and suggestions for how local impacts could be managed and minimised during construction. Input from communities and other stakeholders during a project's development can help inform construction and environmental requirements and mitigation measures.

What should I expect during construction?

TRAFFIC AND ROADS

Wind farm construction generates a lot of traffic when materials, machinery and turbines are being delivered to site. A Traffic Management Plan (TMP) is developed in consultation with road authorities and local communities to ensure that construction traffic is appropriately managed and uses approved roads only.

We use major highways and main roads where possible and local roads where necessary to access the construction site. Local roads may be upgraded before works begin so they are fit to carry trucks and oversize vehicles.

We work closely with our contractors to plan deliveries, coordinate with other road users and provide advance notice of any disruption. Oversize items are often moved at night to reduce traffic disruption.

WORKING HOURS

The Environment Protection Agency (EPA) in each state recommends standard construction hours. This is generally around 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays.

On occasions when we need to work outside these standard hours, we provide as much advance notice as possible and put measures in place to minimise disruption.

NOISE

Construction noise targets are set out in project planning approvals and guided by state or territory legislation. If construction activities on one of our projects is expected to exceed the noise targets at any time, we put mitigation measures in place to limit the impact on local residents as much as possible. This may include scheduling works so that noisier activities occur at times when they will have the least impact.

Using well maintained equipment and machinery, minimising noise from vehicle reversing beepers, turning off machinery that is not in use and putting speed limits in place to minimise engine noise, are some other measures used to reduce noise from our sites.

DUST

The most common way to keep dust down during construction is by spraying water.

Water trucks are used to wet down work areas and unsealed roads.

SOCIAL AND ECONOMIC

During construction, you may find more people and vehicles around town and on the road. Temporary accommodation such as motels and pubs may be fuller than normal. We work with local communities, councils and our contractors to reduce any inconvenience this causes and to ensure local towns get an economic boost through spending on accommodation, food and local goods and services.

SAFETY

Safety is our first priority. We work closely with our construction contractors and Health and Safety Management Plans (SMP) are developed to drive safe construction practices and ensure that potential risks are identified, mitigated and communicated to workers. All staff and contractors undertake mandatory training in safety and emergency procedures before starting work on site.

Construction & Commissioning

1

SITE PREPARATION

On the wind farm site, access tracks are built to connect turbine locations to internal and external access roads and supporting infrastructure to allow the delivery of components and servicing during the life of the wind farm.

Offsite, some local roads, highways or intersections may need to be upgraded for use by construction vehicles and oversize over-mass vehicles (OSOM). Some wind farms also have an onsite quarry, concrete batching plant or other temporary construction facilities which are set up at the start of construction to supply the project. Environmental protection measures are put in place prior to construction.

2

TURBINE FOUNDATIONS

A foundation is built to provide a secure footing for each wind turbine.

Typically, these are around 20 metres across and three metres deep.

A crane pad and assembly area, called a hardstand, are also constructed next to each foundation.

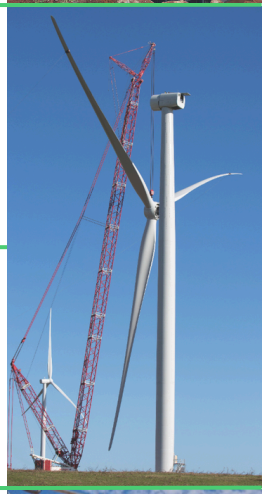
3

TURBINE ASSEMBLY

A wind turbine consists of a tower, a hub, three blades and a nacelle (the box housing the generator).

These parts are delivered separately, laid out in the assembly area, then lifted into place by a crane.

Each turbine takes around three or four days to erect.



4

SUPPORTING INFRASTRUCTURE

Supporting infrastructure such as substations, monitoring masts, operations buildings, Battery Energy Storage Systems (BESS) and transmission lines are built to allow the wind farm to operate and export electricity to the national grid.

5

ELECTRICAL CONNECTIONS

Underground electrical and fibre optic cables are installed to connect the wind turbines and carry electricity and control data to the substation.

Overhead transmission lines are constructed to connect the wind farm substation to the grid.

6

COMMISSIONING

After all supporting infrastructure has been built and tested, wind turbines are commissioned individually to start supplying electricity. Temporary infrastructure including construction buildings and construction access tracks are removed and the ground is rehabilitated.

How much water is required during construction and operations?

Water supply is a key matter of consideration on any major infrastructure project. Australia has a scarce water supply, and our environment, farmers and economy depend on the sustainable and equitable sharing of this resource.

For a wind farm water usage is largely contained to the construction period including for dust suppression measures and concrete production. Water use during operations on a wind farm is mostly limited to maintenance of access tracks.

Where does the water generally come from?

When developing our projects, we investigate various options in consultation with a local hydrologist. These options could consider the extraction of groundwater under a water access license and/or trading of groundwater access rights from existing water access licenses.

Rainwater tanks are usually located on site to service the water needs of the operational and maintenance facility (e.g., toilets and kitchen facilities).

We always look to implement a strategy with the least impact on local water suppliers.

How does water use compare between wind farms and other sources of energy?

Wind farms in comparison to many other non-renewable energy sources use significantly less water during construction and operation.

Coal and nuclear power plants require water to operate, while producing electricity from the wind does not. The water used during operation for wind farms is mostly limited to maintaining access roads.

For example, solar and wind power use approximately 10 litres of water per megawatt hour (L/MWh) compared to 1,254 L/MWh for average energy generation from black coal. This means that coal uses approximately 120 times the water to generate the same amount of electricity as solar or wind. [1]

How do you manage biosecurity on site?

Biosecurity management is essential to minimise impacts on biodiversity and ongoing farming operations. This is particularly important for host landholders, who typically continue to operate their properties alongside energy infrastructure.

The regular movement of vehicles, plant and equipment between properties, particularly during construction, has the potential to spread weeds and pathogens. To manage these risks, we work with landholders throughout the project lifecycle.

Typical biosecurity controls include ensuring all vehicles and equipment arrive on site clean and free of soil and organic matter, rehabilitation plans and targeted weed management of disturbed areas. Tilt has successfully managed construction on properties where livestock diseases are present under a Biosecurity Management Plan developed in partnership with the local regulator.

Source 1: apo.org.au/node/303605

Operation

Wind farms have an operational life of around 30 years. A small team based on site or in the region undertakes regular maintenance and monitoring.

Will I be able to hear the turbines?

Like almost anything that moves – the ocean, tractors, cars, the wind itself – wind turbines do create sound. The sound they make can be described as a cyclic whooshing or swishing sound. In most cases, it is possible to carry on a conversation at the base of a wind turbine without having to raise your voice. Noise can vary depending on the shape of the land, the position of the listener and the speed and direction of the wind. See Figure 3 for general guide on decibel levels.

Detailed noise studies are undertaken by specialist consultants who apply authorised environmental noise guidelines to measure noise levels during project development and post construction to ensure that noise will not negatively impact on local residents. We are required to meet strict noise requirements which are put in place through the planning process. We also monitor noise to ensure we are meeting our requirements during operation of the wind farm.

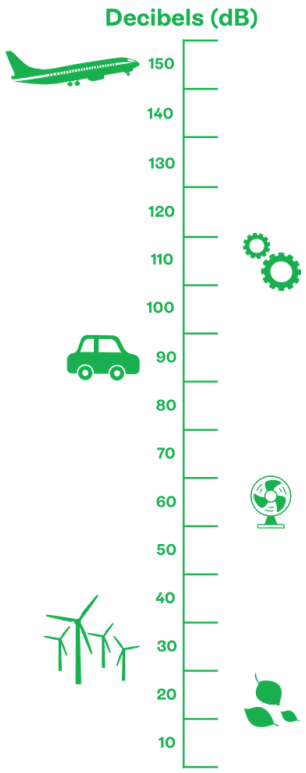


Figure 3: Decibel scale comparing the sound of wind farm at 1km distance to other sounds

Credit: New Zealand Wind Energy Association

What about infrasound?

Infrasound is sound whose frequency is below audible sound.

Numerous studies have been conducted into the level of infrasound produced by wind turbines. These studies confirm that the level of infrasound from wind turbines is no greater than the noise encountered from other natural and non-natural noise sources on a daily basis.

A study by the South Australian Environment Protection Authority into infrasound (Infrasound levels near wind farms and in other environments, January 2013) sets out the following key conclusions:

- the measured levels of infrasound from wind farms are well below the threshold of perception
- the measured infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep; and
- the characteristics of noise produced by wind farms are not unique and are common in everyday life.

Can farmers still work around wind turbines?

Rural activities, such as farming, can coexist with wind farms. After the completion of construction, farmers can continue normal farming operations around wind farm turbines. Typically, the turbines cover up to 3 per cent of the total wind farm project area.[1]

Do turbines get quieter or noisier the taller they go?

An increase in blade tip height, power output and rotor diameter of contemporary turbines does not translate into an increase in noise levels. Indeed, most contemporary turbines are quieter than their predecessors due to improvements in blade design and are more efficient in their conversion of wind power into electrical energy (as distinct to conversion into noise).

Ultimately, the final arrangement of turbines must remain below the applicable noise limits set by the relevant legislation and guidelines throughout the entire operational life of a project when assessed at each individual residence. The environmental noise assessments that are prepared for wind farms consider the noise emissions for each turbine, the cumulative effect of multiple turbines, their location relative to residences and the topographical and meteorological conditions, to arrive at a layout which is compliant with the noise limits.

Will the electromagnetic interference (EMI) affect my TV Reception?

All television broadcasts in Australia are now digital. Digital TV signals are generally much less susceptible to interference from wind farms than analogue signals, however, it is possible in areas of low signal strength.

Before construction, we study the existing television and radio reception strength in the area so that if a concern is raised, we can assess whether the wind farm is causing any issues.

We are happy to help any residents who experience TV reception issues after construction of the wind farm. There are solutions available to resolve any issues.

Do wind farms cause health problems?

The National Health and Medical Research Council (NHMRC) Statement: Evidence on Wind Farms and Human Health was released on 11 February 2015. The Statement provides advice to the community and to policy makers on this issue. After careful consideration and deliberation, NHMRC concludes that there is currently no consistent evidence that wind farms cause adverse health effects in humans.

In respect to health concerns, we design our wind farms to conform with the required standards which are in place to protect the health of the community. The National Energy Infrastructure Commissioner has also provided a good summary of their investigations into health concerns raised: https://www.aeic.gov.au/observations-and-recommendations/health-matters.

What is Shadow Flicker?

Shadow flicker results from the fluctuating light levels caused by intermittent (moving or changing) shadows. It occurs when the sun passes behind the rotating blades of a wind turbine. This casts an intermittent shadow on the area surrounding the wind turbine. Shadow flicker can cause annoyance when it affects a dwelling over an extended period of time. For all our projects we are required to do shadow flicker assessments and meet state requirements around shadow flicker impacts for nearby dwellings.

What is Wake and what is its impact?

Wake refers to pockets of reduced wind speed and a trail left behind each wind turbine (turbulence downstream of the turbine). In other words, wake is the air behind the turbine, where wind speed is reduced (because of the energy used to turn the rotor).

There is currently no conclusive evidence that wake from wind turbines is detrimental to the environment.

How significantly is birdlife impacted by wind turbines?

Wind farms have the potential to affect birds and bats through vegetation clearing and habitat loss. They can also be struck by the turbine blades and affected by low air pressure zones caused by the blades.

The potential impacts to bird and bat species from wind farms is considered significantly less than other human related sources such as collisions with buildings and cars, or being killed by cats. Millions of bird and bat deaths are caused by these sources, while estimates indicate that bird and bat deaths from wind turbines are approximately 1 to 3 fatalities per wind turbine per year. [2] Climate change is a key threat to many threatened bird and bat species and the benefit of renewable energy provides an opportunity to reduce the impacts of climate change to the overall population of these species.

Site selection and environmental assessments to understand the potential impacts to birds and bats are important steps in the development of a wind farm. Regulatory approval applications include evidence to support predictions of potential impacts and identification of appropriate mitigation and management measures to avoid and reduce these potential impacts.

During operations, we monitor impacts to bird and bats from wind farms, including using qualified ecologists and conservation dogs to detect impacted individuals. Adaptive management frameworks are implemented that require consideration of additional management and mitigation actions should impacts be identified through the monitoring program. Altering wind turbine cut-in speeds or temporary shut-down of wind turbines is generally considered a response of last resort where there is an identified ongoing impact and other mitigation measures fail to reduce the occurrence of impacts to relevant species.

Source: 2 Draft Wind Energy Guideline (shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com)

What if a wind turbine catches fire?

Experience has shown our wind farms pose low fire risk. The risk of fire at wind farms is very low due to:

- the location of turbines in relation to cleared construction pads which reduce available fuel load
- lightning protection devices are installed on every turbine, which in turn reduce ground strikes that might otherwise have started fires
- monitoring systems are installed in turbines to detect temperature increases and will automatically slow or shut down the turbine if the temperature or wind speed exceeds an assigned threshold
- any flammable elements are located high above the ground

Do we engage with emergency services?

Fire authorities are an important stakeholder and will be consulted as part of the development of the relevant management plans for a project. We have a long history of working with Fire Authorities and other emergency services at our wind farms and would provide them full use of our access tracks in the event of an emergency. We expect this would provide better access for emergency response than they currently have today.

For further information, please see our Fire Management at Wind Farms – Factsheet located in our publication section on our website: Publications — Tilt Renewables

Can aerial firefighting still occur?

Yes aerial firefighting can occur. Several fires in Australia have been fought with helicopters and fixed wing planes around wind farms. Our operations team are in direct contact with emergency services and can immediately halt the operation of the wind farm to allow safe aerial firefighting around the turbines.

What is the carbon payback period for a wind farm?

The carbon payback period is the length of time it takes a turbine to produce enough clean electricity to make up for the carbon emissions generated during manufacture. There are numerous studies that state that the payback time is between six to twelve months, which is not bad considering the typical 25-year lifespan of a wind turbine.

Do wind farms impact the value of land?

Several studies have been completed in recent years on property prices on land surrounding wind farms. These studies indicate that there is insufficient data to have a conclusive answer, though wind farms are unlikely to negatively impact on the value of surrounding land in an agricultural setting.

A 2016 Urbis study commissioned by the NSW Office of Environment and Heritage had similar findings and states that for rural properties used for primary production, there is no direct loss of productivity resulting from wind farms; therefore, they are unlikely to negatively impact the value of such properties. Likewise, a review of property resale analysis indicated that all of the properties examined demonstrated capital growth that aligned with the broader property market of the time.

Do any Tilt Renewables sites contain asbestos?

All Tilt Renewables' sites comply with national safety laws prohibiting the use of asbestos containing materials.

Recently, the wind industry was made aware that asbestos may have been used in brake pads used in the internal service lifts of some wind turbines. The brake pads are provided by third-party manufacturers.

We are engaging closely with the broader wind industry and regulators, who have also confirmed independent testing found no detection of airborne asbestos in any of the affected turbines. Lift motors and brake assemblies are fully enclosed and, as such, the overall risk of exposure remains low.

Tilt Renewables is working closely with our contractors to understand whether there is the potential for asbestos to be present on our sites. If there are components found we would replace them immediately and remediate the area if necessary.

Decommissioning

Tilt Renewables is responsible for rehabilitation and decommissioning. When a wind farm reaches the end of its life the site can be decommissioned, restoring the impacted area to its original condition. The wind farm operator may look to work with government and landholders to repower or upgrade the equipment and continue operating.

What happens to wind turbines at the end of their life?

There are several options for wind farms at the end of their life (on average this is after 25 - 30 years of life).

- extend the life of the wind turbine for longer than the design life
- partially repower the existing wind farm by overhauling, optimising or upgrading components, specifically the nacelle, rotor and blades.
- fully repower the wind farm, which effectively means decommissioning the old wind farm and building an entirely new facility.
- decommission the wind farm.

Repowering (or upgrading the equipment) usually requires new planning and environmental approvals and new agreements with landholders.

What is involved in the decommissioning phase?

Decommissioning a wind farm involves:

- dismantling and removing the wind turbines
- removing related infrastructure, such as buildings and overhead power lines
- revegetating roads and foundations.

Landholders can request that parts of the wind farm that continue to serve a purpose, such as buildings or access tracks, remain in place.

Who is responsible for decommissioning?

The wind farm owner is responsible for decommissioning. Requirements for decommissioning – such as rehabilitating the land – are set out in contracts with landholders and in planning approvals. Decommissioning is accounted for during the wind farm's planning and operation to ensure sufficient funding is available to cover the costs of removing infrastructure and undertaking rehabilitation works.

There are a handful of Australia's earliest wind farms that will soon come to the end of their operating life, and the industry has turned focus to how we can best recycle and dispose of retired wind turbines.

Can wind turbines be recycled?

A wind turbine is predominantly made of recyclable metals:

- steel
- aluminium
- copper
- cast iron.

Approximately 85–94 per cent of a wind turbine (by mass) is recyclable and can be recycled in Australia. This recovery rate is well above the national average for commercial and industrial streams in 2018–2019 (57 per cent) and exceeds the National Waste Policy Action Plan target of 80 per cent average resource recovery rate from all waste streams by 2030.[3]

Source 3: www.cleanenergycouncil.org.au/advocacy-initiatives/energy-transformation/wind-turbine-recycling

What happens to the non-recyclable parts of a wind turbine?

The biggest barrier to zero-waste turbines are the wind turbine blades. These are made of epoxy and composite materials such as fibreglass or carbon fibre (like areoplanes and sailing boats). Composite materials are currently difficult to recycle as the polymers used are 'cross-linked' in an irreversible process to obtain the desired material durability and strength while retaining a low weight.

The good news is that the recyclability of new composite material blades is being addressed. Wind turbine manufacturers are working towards developing new blades that can be recycled as part of their commitment to zero-waste turbines by 2040.

There are several innovative solutions being investigated for older blades including:

- sound barriers
- shredded fibreglass filling in cement production
- pedestrian bridges
- playground equipment
- geotechnical blocks for road strengthening
- use of resin to separate bonded composites to return materials' integrity for new applications.

There is lots of opportunity and focus on increasing the options for recycling blades so the wind industry can achieve 100 per cent circular economy.

Transmission lines

Transmission lines carry electricity from a wind farm to the electricity grid.

What influences the design of a transmission line?

There are many considerations which influence the design of a transmission line, including the size and location of the poles or towers. Key factors include:

- voltage (e.g. 66kV, 132kV, 220kV), number of circuits, conductor (the wires) type/size, security level and design life requirements
- line length, spans between poles/towers, changes in direction
- topography
- structural loads due to the weight, wind, earthquake risk, groundwater and other environmental factors
- electrical safety requirements
- communication and earthing requirements
- temperature limits and fluctuations
- existing infrastructure constraints
- land ownership and access (both public and private)
- native vegetation
- planning requirements
- areas of cultural heritage significance
- property configurations and dwelling locations
- road and traffic safety
- drainage
- fire safety

During the project development and approval phase, several transmission line routes may be investigated. This includes reviewing each option against potential environmental, planning, safety and social impacts, and consultation with landholders and communities who could be affected by the routes.

Can wind farm transmission lines go underground?

Yes, transmission lines can go underground, and in some cases it is the best solution, for example when you need to cross a very built up urban area. However, underground transmission lines have a much larger construction footprint than overhead lines. Laying underground cables requires digging wide and deep trenches throughout the entire route, and still requires above-ground infrastructure.

They also require much more significant excavation and truck movements during construction compared to overhead lines. This results in significantly more land disturbance, resulting in a much greater environmental, cultural heritage and land use impact, along with higher construction and maintenance costs and much less flexibility with the transmission line alignment.

There are also several temperature and electrical performance, ongoing maintenance, fault identification and resolution issues associated with underground trenching. Most importantly, and different to the 33 kV underground cabling within a wind farm, if there is a fault along a 330 kV (or higher) underground line, the entire wind farm is unable to export electricity to the grid, which would cause significant disruption to consumers, whereas a fault internal to the wind farm on 33 kV lines would only affect that particular turbine cluster.

Furthermore, above ground lines allow multiple projects to share a line and can be easily accessed for maintenance.

Can more than one wind farm share the same transmission line?

Yes, they can; however, for this to happen there needs to be significant coordination between developers upfront. There are many commercial, technical and regulatory considerations that require both wind farm operators to be fully committed to construction of the projects at or around the same time to allow full coordination and agreement on the transmission line contractor, design, construction and operational contracts.

What do the transmission towers and power poles look like?

There are different types of poles and towers on a wind farm site to connect the wind farm with the electricity grid. The type and size of the structure used depends on the powerline's voltage and the location of the wind farm in the electrical network.

Transmission towers are large steel structures used to carry high voltage power lines.

Power poles can be made from steel, wood and/or concrete, and are used to carry low voltage power lines to homes and businesses.

Figure 4 shows different types of transmission towers.

Can transmission lines pose a safety risk?

All transmission lines are designed to meet or exceed design and safety standards. Bushfires from power lines and other incidents causing the lines to fail are major concerns and critical risks for network operators. While these risks cannot be eliminated entirely, the power lines are equipped with fast-acting protection systems designed to prevent injury to people, damage to property and grass or bushfire.

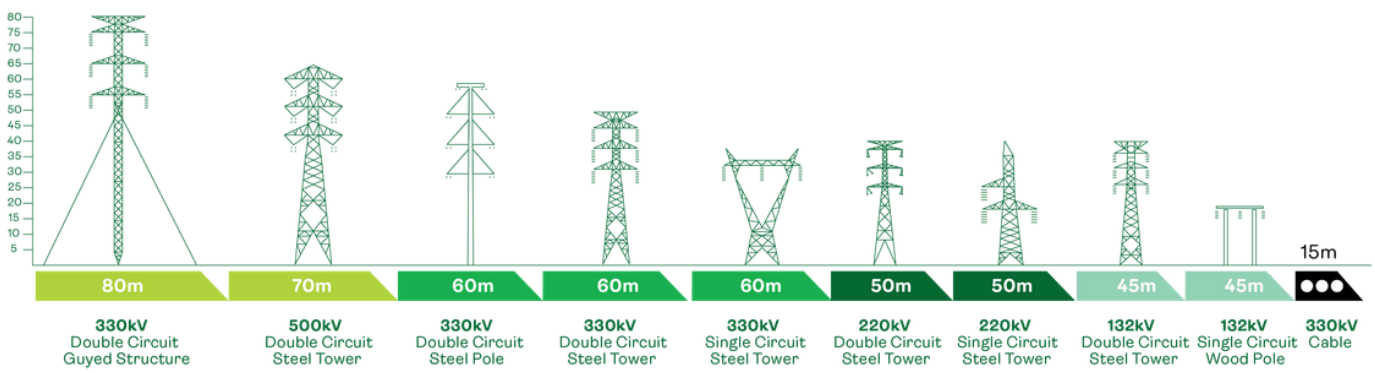
The transmission network service provider will apply electricity industry best practice to the maintenance of the transmission line (e.g. clearing vegetation under the transmission line) and ensure all electricity safety and bushfire mitigation regulations are met.

Once the transmission line is built, it will be managed in accordance with the relevant electricity safety standard.

Who builds, owns and maintains the transmission lines?

Transmission Network Service Providers (e.g. AusNet Services in Victoria and TransGrid in New South Wales) are usually responsible for transmission lines. In some instances, the transmission lines can be privately owned and operated.

Figure 4: Types of Transmission Towers



Wind Farm Benefits

As the ultimate owner and operator of our development projects we have a long-term vision for every project and work hard to build strong relationships with residents, businesses and organisations.

What economic benefits can a wind farm create for local community?

Local economic benefits can include:

- boost to the local and regional economy and local businesses
- jobs during construction and operation
- training, skills development and education programs
- creation of community funds for local initiatives
- direct payments to landholders and neighbours
- provision of a drought-proof and post-retirement income stream for farmers

What local jobs do wind farms create during construction?

The types of jobs created during construction include:

- Domestic scale electricians
- Transport operators
- Competent machine operators
- General labourers
- Quarriers
- Concrete suppliers
- Accommodation providers
- Local pubs, hotels, food service providers

We are committed to employing local people and buying local wherever possible.

How many ongoing jobs are there during operation?

This varies by the size and location of the wind farm. There is usually a small team based on site or in the region who are responsible for day-to-day management of the site and regular maintenance.

How can I find out about employment opportunities?

We're always on the look out to build new working relationships in the industry.

You can register your business on our Goods & Services Register by hovering over the QR code below.

Tilt Renewables, as the owner of the wind farm project, will not typically be directly employing workers, this will be done by our delivery partners and contractors (and their sub-contractors).

How do you share benefits with local communities?

We are committed to being a positive contributor to the communities where we work and are proud of our record of providing support to communities that makes a real difference.

Through partnerships with councils and local groups, and consultation with the community, we develop benefit sharing programs that address important social, economic and environmental needs in the region. Some of our current benefit sharing programs include:

- training and skills development programs
- scholarships and other education programs
- community funds to support social and environmental initiatives
- conservation programs
- mental health and social inclusion programs
- employee volunteering
- neighbour benefit programs
- local jobs and procurement of local goods and services.

You can read more about our benefit sharing program on our website.

Have a question for us?

How do you keep people informed about construction activities?

Depending on the wind farm location, community and community preferences, we use a range of different tools to keep people up to date. These include:

- website – dedicated project page
- meetings, phone calls, emails and/or letters to anyone directly affected
- regular newsletters
- construction updates – via email or text message
- fact sheets
- information displays in nearby towns – community noticeboards
- drop-in information sessions
- webinars
- presentations to community groups and organisations

How do I raise concerns or ideas about the wind farm?

Feedback is always welcome. If you have any concerns or local knowledge that could help, please get in contact. We have a dedicated 1800 number (1800 938 458) and dedicated project email addresses so you can get in touch with us anytime.

You can find our Complaints Handling Procedure on our website, or we can send you a copy on request.

You can sign up for project updates by hovering over the QR code below.

Questions?

If you have any questions, get in touch by calling: 1800 WE TILT (938 458)
Email: info@tiltrenewables.com | Web: www.tiltrenewables.com
Postal Address: PO Box 16080 Collins St West , Melbourne Vic 8007