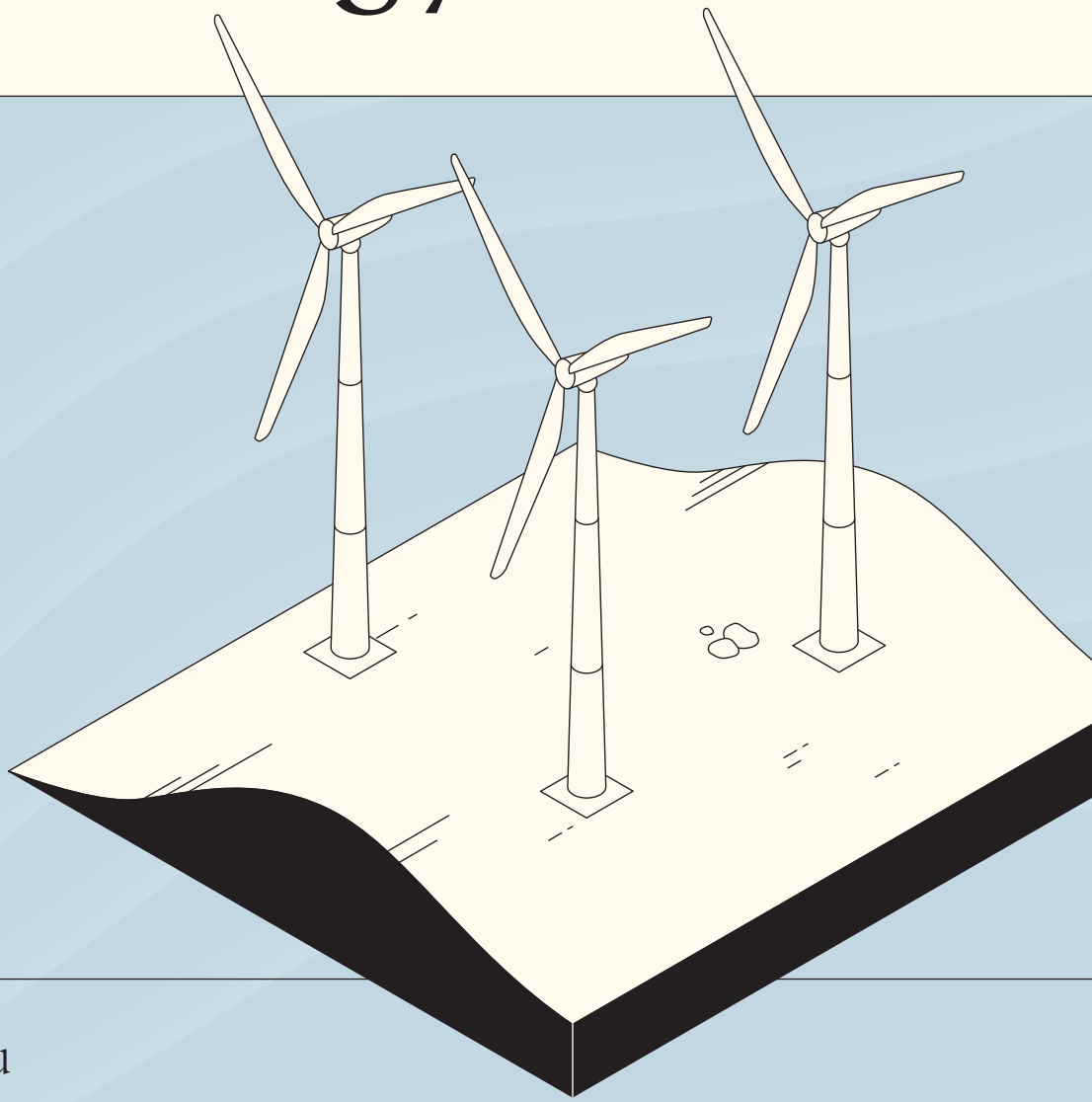
avenis energy

AN AVENIS GUIDE TO

Wind Energy



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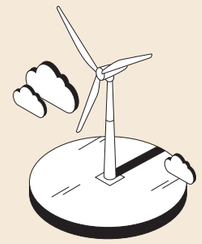


In Australia, wind energy has become a major contributor to our electric power supply – and there are increasing opportunities to become involved in its generation. We've created this guide to help answer some commonly asked questions about wind energy, and the steps involved with developing and operating a wind farm.

This guide is brought to you by Avenis Energy, an Australian-owned renewable energy developer. We work with landowners and local communities to develop high quality renewable energy projects that are good for landowners, good for communities and good for the country. Our mission: to accelerate the transition of the Australian electricity market for a more sustainable tomorrow.

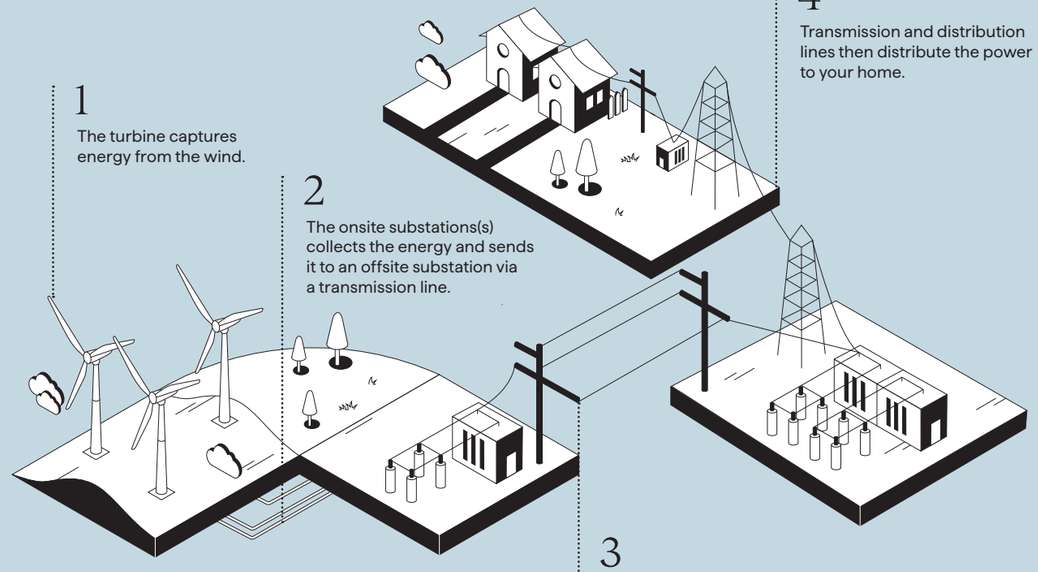
How do wind farms work?

As Australia continues to transition to renewable energy, wind farms are playing an increasingly important role. The power of wind is unlimited, clean and reliable – and by harnessing this energy through wind farms, we can generate electricity that's affordable and sustainable.

The most noticeable feature of a wind farm are generally its turbines: tall towers with spinning blades. Essentially, turbines capture wind energy within the area covered by their blades, with their spinning motion driving an electrical generator to produce electricity, which is then transmitted to the grid. A wind farm will generally have multiple turbines, each of which will cost in excess of $5 million for supply and installation alone.

Wind turbines rotate at speeds ranging from 12 to 25 meters per second – and many modern turbines operate at variable speeds, adjusting in response to changing wind conditions to optimise efficiency.

How energy works



Features of a wind turbine

BLADES

Three blades are attached to a central hub that drives the generator. Each blade is equipped with an automated pitch control system, which adjusts its angle to maximise energy production and safeguard the turbine during inclement weather.

GENERATOR

These can be direct drive or generator/gearbox combinations. The main advantage of direct drive technology is that it eliminates the need for a gearbox. In this design, the generator's rotor is mounted externally, positioned between the hub and the nacelle.

NACELLE

A compartment located at the top of the tower that houses the turbine's electrical, control, generator, and cooling systems.

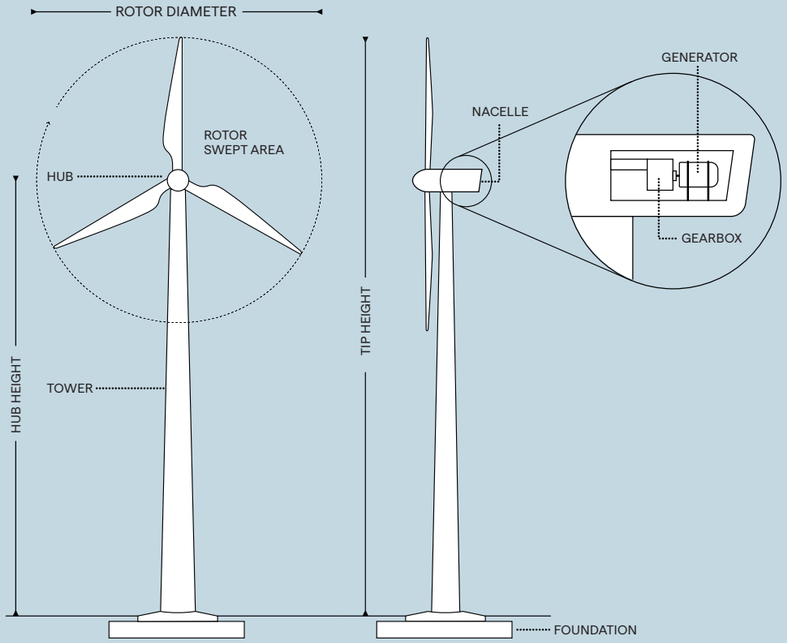
TOWERS

Made from tubular steel and coated with protective paint to withstand harsh weather, towers are constructed in multiple sections that are bolted together on-site. The tower base is anchored to a reinforced concrete foundation, engineered to endure strong winds and seismic activity for decades of operation.

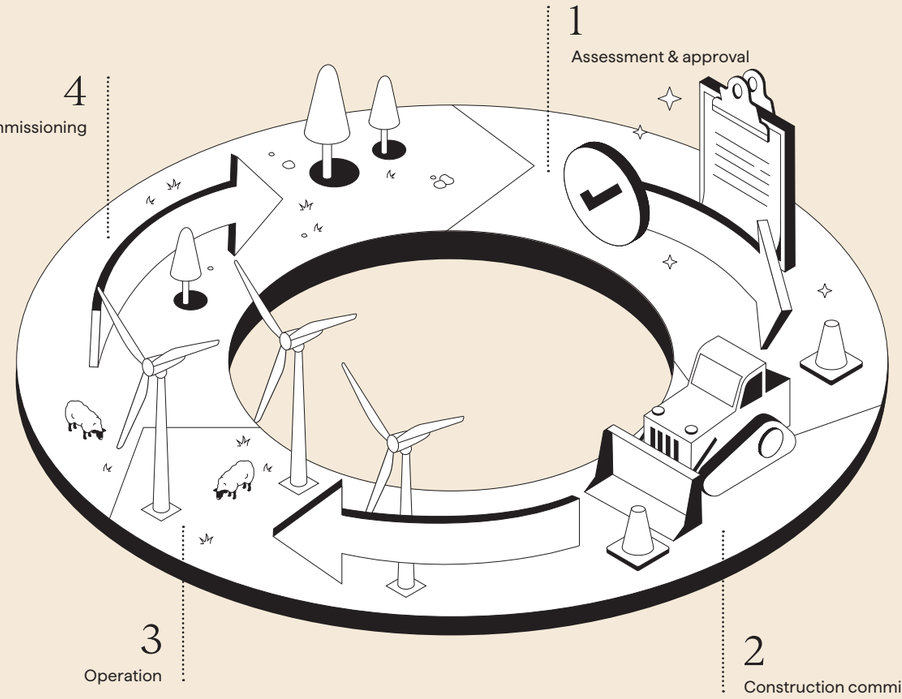
NOTE

The amount of electricity a turbine can produce (its maximum capacity) is measured in megawatts (MW). Generating power at the rate of 1 MW for 1 hour equals 1 megawatt hour (MWh) of energy. To put this in context, an average Australian household uses about 6 MWh of electricity per year. A modern 6MW turbine would typically provide clean energy to power 3,000 homes.

Components of a wind turbine



Wind farm lifecycle



NOTE

As wind energy technology continues to improve, turbines are becoming larger and more efficient, allowing them to capture more energy per square metre of land.

Beyond the turbine

There's more to a wind farm than turbines. A range of supporting infrastructure is also required. This includes:

- Access roads for vehicles to reach the turbines and flat work areas for cranes, trucks, and turbine components.
- Underground or overhead cables connecting turbines to substations.
- Substations to collect generated energy and increase the voltage for transmission.
- Operations and maintenance buildings to house worker facilities, wind farm controls, equipment, and spare parts.
- Meteorological masts to monitor wind speeds and turbine performance.
- Water tanks and firefighting equipment for safety.

Design and development

Developing a new wind farm requires considerable planning, research and specialist expertise. The development process is iterative, with the design evolving as new information comes to light – whether it's related to the site conditions, compliance or feedback from the community or other stakeholders.

A wide range of technical, community, and environmental factors are considered. The process typically takes a minimum of six years, and includes several important steps, outlined on the next page.

Step 1: Identify a site

Finding a promising wind farm location means considering many factors, including the site's topography and ground conditions, current and future productivity and proximity to the electricity transmission network. This phase involves:

- Engaging with landowners
- Site visit/s
- Landowner agreements
- Feasibility studies

Step 2: Energy studies

This phase involves evaluating the site's energy production potential by undertaking:

- Wind monitoring
- Energy modelling
- Site investigations
- Layout developments

Step 3: Specialist studies

Independent experts conduct environmental studies and assessments to identify potential project impacts. These studies are used to support decisions on design, planning, and construction management. Common studies include:

- Biodiversity
- Landscape and visual impact
- Heritage
- Noise
- Traffic and transport
- Aviation
- Telecommunications and Electromagnetic interference (EMI)
- Shadow flicker
- Risk

Step 4: Planning and environment

Ultimately, a wind farm's size, location, and value will determine whether approvals are needed from local, state, and/or federal governments – but typically, a Development Approval will be required from the State Government. Steps required may include:

- Applying for development or planning permission
- Environmental referrals and assessments
- Engaging with stakeholders including traditional landowners and the community
- Formal public exhibition and response to submissions process

Step 5: Commercials & procurement

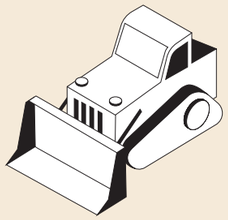
This final phase involves testing the wind farm's commercial viability and planning delivery by:

- Creating detailed designs for the wind farm and associated infrastructure
- Developing comprehensive plans for construction logistics and operations, including transport route planning
- Securing funding and making informed investment choices
- Selecting construction partners and turbine suppliers through a competitive process

NOTE

It's critical that the local community is involved in planning for, and decisions about, a new wind farm. At Avenis, we build long-term partnerships with the communities where we develop and operate projects, engaging with local councils, landowners, neighbours, and surrounding communities as early as possible.

Construction

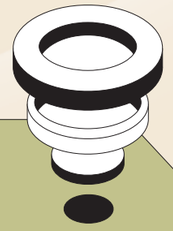


Once plans for a wind farm have been approved, it's onto construction. Depending on the size of the project and the weather conditions, this may take 2-3 years. Throughout this process, it's important to work closely with landholders, neighbours, local councils, communities, and stakeholders to ensure everyone's kept informed, and impacts are kept to a minimum.

Avenis has a firm commitment to responsible construction. For every project, we create detailed Management Plans that are created to ensure potential impacts are effectively managed and project requirements are fully understood and addressed. Here's an overview of the types of issues we address, and how.

Potential impact	Management strategies
Safety risks associated with major construction works, including safety of our workers and the community.	• We collaborate closely with contractors to develop Health and Safety Management Plans that promote safe construction practices, identify potential risks, and implement effective mitigation strategies. All workers and contractors are required to complete mandatory training in safety and emergency procedures before commencing work on-site. • We also utilise well-maintained equipment and facilities, and take care to comply with approval conditions, legislation, industry standards, and best practice guidelines.
Noise and disruption, particularly outside standard working hours.	• Each state's Environment Protection Agency (EPA) provides guidelines for standard construction hours, typically 7:00 AM to 6:00 PM on weekdays and 8:00 AM to 1:00 PM on Saturdays. If work outside these hours is necessary, we strive to provide advance notice and implement measures to minimise disruption. • Construction noise limits are outlined in project approvals and governed by state or territory legislation. If any construction activities are anticipated to exceed these noise limits, we will implement mitigation measures to minimise the impact on local residents as much as possible.
Increased traffic, including daily site visits by workers and deliveries of materials, machinery, and turbines.	• A Traffic Management Plan (TMP) is created in consultation with road authorities to ensure the safe and efficient management of construction traffic. • Local roads may be upgraded prior to construction to ensure they can support large and oversized vehicles. Transport routes for oversized, and heavy vehicles will primarily use major highways and main roads, with local roads used when necessary to access the construction site.
Dust created by traffic and construction.	• The most common method for controlling dust during construction is by spraying water. Water trucks are used to dampen work areas and unsealed roads. We carefully assess the sustainability of water supply when sourcing water for dust control and ensure an adequate supply to effectively manage dust impacts on-site.
Water usage required during construction, primarily for dust suppression and concrete production.	• Rainwater tanks are typically installed on-site to meet the water needs of the operational and maintenance facility, such as toilets and kitchens. • Throughout the project development process, various water sourcing options are assessed to ensure a reliable supply is available without negatively impacting the local water supply or environment. A comprehensive water sourcing strategy is developed as part of the pre-construction planning process.
Increased volume of people and vehicles in the area, and high demand for temporary accommodation, such as motels and pubs.	• We collaborate with local communities, councils, and our contractors to minimise any disruptions and ensure that local towns benefit economically from increased spending on accommodation, food, and local goods and services.

Typical project timeline



Site Feasibility

1.

Feasibility Studies

- Landowner signs a short-term agreement to work with Avenis Energy exclusively while we assess their land.
- We complete a detailed screening process to make sure a project on the land will be successful, at no cost or risk to the landowner.
- We negotiate an Option to Lease/Purchase agreement for the project.

PAYMENTS TO LANDOWNER

Exclusivity Fee

Planning & Approval

2. Grid Connection Process

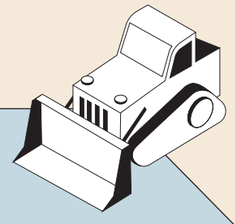
3. Development Approval Process

4. Pre-construction Design & Engineering

- Landowner signs an Option to Lease/ Purchase agreement and receives option payments.
- We work with the landowner and local community to secure development approval and connection agreements for the project, at no cost or risk to the landowner.

PAYMENTS TO LANDOWNER

Annual Option Fee



Construction & Operation

5. Construction

6. Operation

7. Decommissioning

- We enter into the lease or purchase agreement just prior to the start of construction.
- Landowner receives CPI-linked rental income from the start of the lease, or payment to buy the land.

PAYMENTS TO LANDOWNER

Lease fees or purchase price

STAGES OF CONSTRUCTION

1. Site preparation

Internal and external access tracks are built, and offsite local roads may be upgraded. Any temporary facilities needed are set up, and environmental protection measures implemented.

2. Turbine foundations

A secure footing (approx. 20 metres diameter) is built for the turbine, plus hardstand areas for cranes and assembly.

3. Turbine assembly

Parts are delivered separately then put into place by crane over a period of around 3-4 days.

4. Supporting infrastructure

Substations, monitoring masts, operations buildings and transmission lines are put in place.

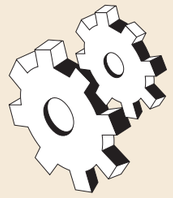
5. Electrical connections

Underground fibre optic cables and overhead transmission lines are installed, connecting wind farm substation to the grid.

6. Commissioning

Turbines are commissioned individually to start generating power; temporary buildings and access tracks are removed and the ground rehabilitated.

Operation



Wind farms typically have an operational lifespan of around 30 years. A dedicated team, either based on-site or within the region, is responsible for ongoing operations.

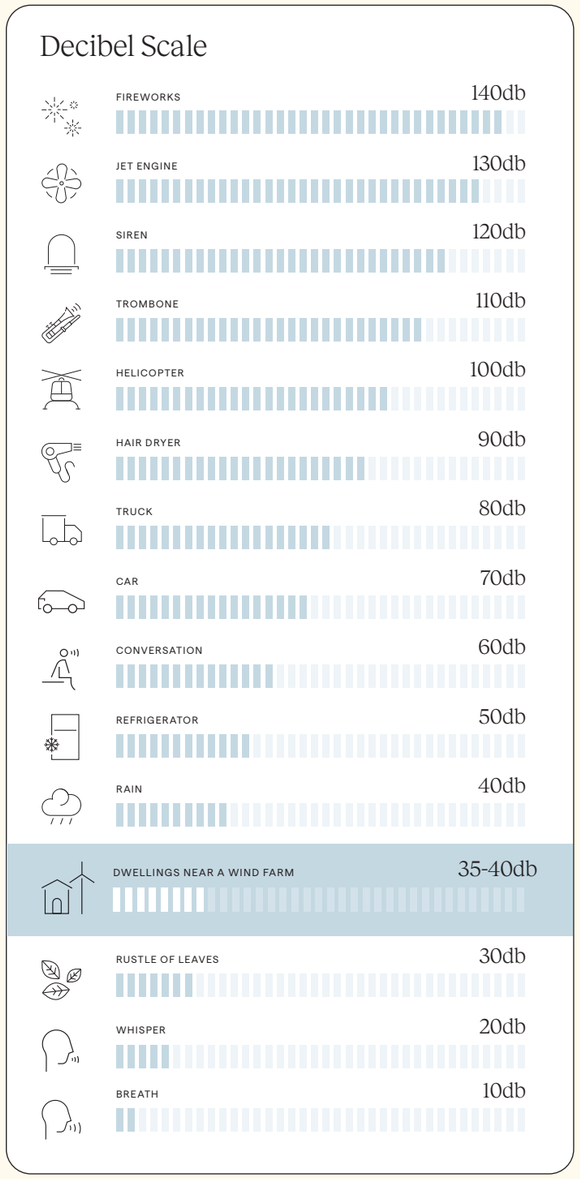
The operation of wind farms often raises questions, particularly about potential impacts, which we've addressed below.

How much noise will there be?

Like any moving object, wind turbines produce sound. This sound is often described as a cyclic whooshing or swishing noise. Noise levels can vary based on factors such as the terrain, the listener's location, and the wind's speed and direction. Wind turbines typically produce more noise as wind speed increases; however, this is often masked by other sounds that also become more pronounced at higher wind speeds, such as the rustling of wind in trees.

During the development of a wind farm, noise specialist consultants conduct detailed studies, helping ensure the final layout will meet the required noise limits (these are set by relevant legislation and guidelines throughout the project's operational life).

In most cases, it's possible to have a conversation at the base of a wind turbine without needing to raise your voice.



What about infrasound?

Infrasound is sound waves with a frequency below the threshold of human hearing. Numerous studies have investigated the infrasound produced by wind turbines, and the findings confirm that the level of infrasound from wind turbines is no higher than that of other natural and man-made noises encountered daily.

Do wind farms cause health problems?

The Australian National Health and Medical Research Council (NHMRC) Statement on Wind Farms and Human Health offers guidance to the community and government regarding potential health concerns. The NHMRC's conclusion is that, at present, there is no consistent evidence to suggest that wind farms have harmful effects on human health.

Will electromagnetic interference affect local TV reception?

All television broadcasts in Australia are now digital. These signals are generally less prone to interference from wind farms compared to analogue signals; however, some disruption may occur in areas with weak signal strength.

Studies are conducted to assess the existing television and radio reception strength in the area to determine if the wind farm is causing any interference. If any TV reception issues arise after construction, the developer will provide solutions to resolve the problem.

Do wind turbines impact birds?

Wind farms undergo a thorough assessment and approval process to ensure their potential impact on the environment, including local fauna and flora, is carefully evaluated before construction begins. This process includes avian assessments to identify the bird and bat species present on the site and to assess any potential impacts.

Bird and bat mortality due to collisions with wind turbines accounts for only a small fraction of the losses caused by other human-related factors, such as vehicles, buildings, habitat loss, and climate change.

In the first few years of operation, bird and bat mortality is closely monitored and assessed. This includes using trained personnel to locate birds and bats that may have collided with turbines, conducting surveys to understand bird and bat activity in the surrounding area, and analysing how quickly scavengers, such as foxes, remove any carcasses.

This process helps estimate the potential impact of the wind farm, ensuring that the level of impact aligns with pre-construction assessments and confirming that the wind farm is not causing significant harm to any species.

What happens when there is no wind?

Wind farms connect to the electrical infrastructure system, commonly referred to as the electricity network or grid. In Australia, there are several electricity networks. The largest is the National Electricity Market (NEM), which is an interconnected system spanning Queensland, New South Wales, the Australian Capital Territory, Victoria, Tasmania, and South Australia.

The electricity network is supplied by a wide range of geographically and technologically diverse generators. The Australian Energy Market Operator (AEMO) manages the NEM and ensures a diverse mix of generators and storage technologies is available to meet demand. If the wind is not blowing at one wind farm, generators in other regions or those using different technologies can step in to meet the demand.

What if a wind turbine catches fire?

The risk of fire at wind farms is very low due to several safety measures, including:

- Lightning protection devices installed on each turbine
- Monitoring systems that automatically slow or shut down turbines if temperature or wind speed exceed set thresholds
- Active fire protection systems within turbines, including detection, alert, and suppression systems
- Turbines being located on cleared construction pads.

Could a wind farm make fighting a bushfire harder?

Wind farms are not considered to increase bushfire risk, and wind farm owners have a strong incentive to minimise fire risks to protect their assets. In many cases, wind farms provide advantages, such as an extensive network of access tracks that double as fire breaks, additional personnel on-site during construction and operations, extra water access points and tanks, and fire mitigation measures mandated by the relevant authorities. Wind farms are designed and constructed in close consultation with fire services.

Wind farms do not pose additional hazards for aerial firefighting. Turbine locations and wind meteorological masts are registered with airspace authorities, and pilots treat turbines similarly to other tall structures or hazards, such as power lines, transmission towers, radio masts, and mountains. Wind farms are just another obstacle that is managed on a case-by-case risk basis during firefighting operations.

What is the carbon payback for a wind farm?

The carbon payback period refers to the time it takes for a wind turbine to generate enough clean electricity to offset the carbon emissions produced during its manufacture. Numerous studies indicate that the payback period typically ranges from six to twelve months of turbine operation.

Can aerial farming operations such as spraying and helicopter mustering continue when the wind turbine is operating?

While a wind farm introduces additional aerial obstacles for pilots, the methods used to assess existing hazards remain the same. The large scale of wind turbines makes them highly visible during aerial operations, and in many cases, they pose less risk than other obstacles, such as transmission lines.

Aerial spraying or spreading is a common agricultural activity on wind farm properties. Typically, spraying or spreading is carried out in low wind conditions to minimise drift and keep the activity contained within target areas. This aligns well with wind farm operations, as turbines tend to operate at slower speeds, reducing the likelihood of turbulence affecting the aerial activities.

In some areas, helicopter mustering is used to reach locations that are difficult for ground-based mustering. A benefit of wind farms is that the access tracks needed for construction and operation improve access to these areas, potentially reducing the need for helicopter mustering. However, when necessary, aerial mustering can still be conducted, like spraying and spreading activities, following a proper assessment of site hazards. Aerial farm operations are just one aspect of managing both a farm and a wind farm on the same property. Effective communication and a strong relationship between all parties are essential for the ongoing success of both operations. Management plans, regular meetings, and, most importantly, open communication ensure that when challenges arise, solutions can be found that benefit both parties.

What happens to the wind farm at the end of its life?

When a wind farm reaches the end of its operational life, the site can be decommissioned, restoring the area to its original condition. Decommissioning a wind farm involves:

- Removing wind turbines
- Dismantling and removing related infrastructure, including buildings and overhead power lines
- Restoring the site by covering and revegetating access roads and foundations.

Landowners may request the retention of specific elements, such as buildings or access tracks, if they remain useful. The wind farm operator may also collaborate with landowners and government agencies to explore options for repowering or upgrading the equipment to extend operations – although this will typically require a new planning and environmental approvals and establishing new or updated agreements with landowners.

Who is responsible for decommissioning?

The responsibility for decommissioning a wind farm lies with the wind farm owner, and the associated costs are factored into the wind farm's planning to ensure adequate funding is available. Contracts with landowners and planning approvals will always specify the requirements for decommissioning, including land reinstatement. Decommissioning costs will never be the liability of host landowners or communities.

The Australian wind farm industry prioritises decommissioning. No wind farm in Australia has ever been abandoned, and the industry remains committed to ensuring this never occurs.

What happens to the actual wind turbines when no longer needed?

Wind turbines and ancillary infrastructure removed during decommissioning are disposed of responsibly, with a focus on recycling as much material as possible.

A recent report from the Clean Energy Council highlights that 85–94% of wind turbine materials (by mass) are recyclable and can be processed within Australia.[1]

Turbine manufacturer, Vestas, has calculated the average recyclability across the components of a V126-3.3 MW wind turbine to be approximately 87.5%.[2]

1. Winding up: decommissioning, recycling and waste management of Australian wind turbines, Clean Energy Council, April 2023.

2. Vestas, (2014). Life Cycle Assessment of Electricity Production from an onshore V126-3.3 MW Wind Plant – 6 June 2014, Version 1.0. Vestas Wind Systems A/S, Hedeager 42, Aarhus N, 8200, Denmark.

Economic, environmental and social benefits

At Avenis, we're committed to developing high quality renewable energy projects that are good for landowners, good for communities and good for the country. Here's an overview of some of the benefits that wind farms can deliver.

Good for the environment

REDUCED GREENHOUSE GAS EMISSIONS

Wind energy doesn't release greenhouse gases like carbon dioxide during operation, unlike fossil fuel power plants.

IMPROVED AIR QUALITY

By replacing electricity generation from fossil fuels, wind farms help reduce emissions of harmful air pollutants and particulate matter.

RENEWABLE AND SUSTAINABLE

Wind is an abundant and inexhaustible resource, making wind energy a sustainable and long-term solution for electricity generation. Shifting to wind energy also reduces reliance on finite and polluting fossil fuels, contributing to a more sustainable energy system.

LIMITED ENVIRONMENTAL IMPACTS FROM CONSTRUCTION

Compared to traditional energy generation (mining), wind farms offset their construction-related emissions in a much shorter period (as little as six to twelve months). They also require a smaller footprint and can co-exist with other land uses such as agriculture.

Good for the community

Responsible wind farm developers such as Avenis commit to a long-term vision for each project, and work collaboratively with local residents, businesses, and organisations to promote and realise that vision.

Avenis is dedicated to creating tailored programs that share benefits with each community. These programs are designed to respond to essential social, economic, and environmental needs in the local area and region, and may include community and education funds, neighbour benefit initiatives, training and skills development, scholarship programs, and conservation projects.

Good for the local economy

EMPLOYMENT OPPORTUNITIES

Renewable energy construction generates hundreds of jobs at the site level. The construction phase creates demand for tradespeople, transport providers, skilled machine operators, earthmoving contractors, quarries and concrete suppliers and general labourers. Once operational, a small team based on-site or within the region manages daily operations and performs routine maintenance.

DEMAND FOR GOODS AND SERVICES

Wind farms boost local economies by increasing demand for accommodation, restaurants, food and fuel suppliers.

PARTNERSHIP POTENTIAL

Site operators often establish relationships with local suppliers to source general services and supplies, such as equipment hire, engineering support, materials, cleaning services, and miscellaneous items.

Avenis is dedicated to hiring local people and sourcing locally whenever possible, and creates Goods and Services Registers for each project, encouraging local businesses and individuals to register their interest.

Do wind farms impact the value of land?

Several studies have investigated the impact of wind farms on property prices in surrounding areas – and while the data is inconclusive, findings suggest that wind farms are unlikely to negatively affect land values in agricultural settings, with primary producers experiencing no direct loss of productivity due to wind farms.

A review of property resale analysis showed that all examined properties experienced capital growth consistent with trends in the broader property market at the time.[1] Dual revenues are a benefit, as normal farming practices can continue alongside the operation of a wind project.

1 Review of the Impact of Wind Farms on Property Values, Urbis, 21 July 2016.

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Get in touch

Like to know more? Please contact our team — we're here to help.

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