

# Considerations in Wind Farm Design

**As with any major development project, there are many important factors to consider in planning and development.**



Renewable energy projects do not exist in isolation. They have environmental, social, and economic impacts on communities and ecosystems. While renewable projects have many positive impacts, there is also the potential for negative impacts if planners do not ensure they have assessed the social and environmental impacts of their project.

Ethical issues in development can be considered at three different levels:

- micro (everyday relationships/interactions)
- meso (strategies for community development engagement and action)
- macro (distribution of resources and electricity).

Community development should strive to promote participation, sustainable development, rights, economic opportunity, equality and social justice through the organisation, education and empowerment of people within their communities.

## **Planning and designing wind farms**

When planning and constructing wind farms, the aspects above must be considered. On a more specific level, these include the wind energy available, environmental considerations, community impacts, the efficiency of the wind farm, ease of construction and maintenance, and connection to transmission lines so that the electricity generated can be used.

The factors below and on the next page are important considerations:

### **Noise sensitivity**

- State Governments and local councils often have strict noise standards, and while wind turbines have made great strides in noise reduction, the impact this noise might have on nearby communities is something to be mindful of.

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## **Adequate site accessibility**

This is important during planning, construction, operation and ongoing maintenance of a renewable energy project. The incredibly large towers and turbine blades, cranes, construction materials and workers all need to be able to be safely and efficiently transported to and around the site. It's important that the workforce has good access during the construction and operation phases of the project.

## **Minimal risk to agriculture**

Wind turbines have minimal risks when it comes to agriculture. Most wind farms are sited on existing agricultural farms, and farming practices typically continue around the turbines.

## **Land use arrangements**

Wind farms might be spread out over large areas, but the turbines themselves only occupy about 2% of the overall land that a wind farm is on. This land might be owned by farmers but renewable projects can only go ahead with their consent. The agreements signed between a wind farm developer and a landowner include a range of conditions to ensure the landowner is happy to host the project on their land. For example, the agreement will specify how much the landowner will be paid for hosting the wind turbines and might include conditions to make sure agricultural activities aren't impacted negatively. Building the wind turbines might temporarily disrupt farming activities due to the construction of access roads and other infrastructure, but plans will be made by the wind farm developer in consultation with the landowner to minimise these disruptions

## **Environmental considerations**

Special environmental landscape elements need to be considered as environments need to be protected so future generations can enjoy them, and local flora and fauna can continue to live and thrive. The environmental impacts of renewables projects vary significantly based on their geographic location and the renewable energy technology type.

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## Environmental considerations cont.

Bird and bat strikes, and land clearing are the main impacts of wind turbines on wildlife. Wind farm developers design their projects to try to avoid this, by choosing areas with fewer threatened bird/bat species. Most land clearing for wind farms is to create access roads to the specific locations where turbines will be built. Australia has strict planning laws which aim to minimise the environmental impacts of renewables projects. This is a process called 'Environmental Impact Assessment', which analyses the likely environmental impacts of a project. Wind farm developers will get experts to conduct a range of detailed environmental studies about the proposed project's potential impacts, and these studies are submitted to government agencies that make decisions about whether to approve the wind farm based on the extent of its impacts.

## Proximity to transmission lines

The electricity generated by wind power has to get to the people who are using it. This means it is desirable to build wind farms near to existing transmission infrastructure. This reduces the cost of building new infrastructure to connect the wind farm to the grid and also means the process of connecting to the grid is faster, meaning the farm can supply electricity to homes and businesses more quickly. There are losses of electricity the further the generated energy travels due to undesirable energy transfers and so keeping the travel distance at a minimum is also more efficient. Building new transmission lines is a slow process requiring careful planning. It can require land clearance which has negative environmental impacts.

## Wind resource

The main objective of a wind turbine is to harness energy from the wind in order to transform it into electrical energy. This means that areas with higher wind speeds are more desirable for wind farms. The wind speed isn't the only thing to take into account, the wind density, which is how often those wind speeds occur can give a more reliable indication of the suitability of a location. Wind turbines are growing taller and the towers are usually in the range of 150m high. This is because wind speed is higher at higher altitudes.



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## Turbine spacing

- Wind turbines need to be placed far enough apart so they don't interfere with each other. When one turbine is too close to another, it disturbs the wind, making the next turbine less efficient.
- A good rule is to place turbines at least five rotor diameters apart in the direction the wind usually blows and three rotor diameters apart in the other direction.
- “Distances between 6 and 10 times the diameter of the rotor are optimal, with most wind farm developers settling on 7 times the distance.”



Source: Energy Follower (2022) Wind turbine spacing: How far apart should they be?

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## Turbine spacing: The wake effect

The wake effect happens when the wind hits a wind turbine and slows down as it passes through the blades. This creates a "wake" of slower, turbulent air behind the turbine. If another turbine is too close, it ends up in this wake, where the wind is weaker and more chaotic. This makes the second turbine less efficient because it can't capture as much energy from the wind.



A light fog reveals the wake effect behind turbines at Vattenfall's Horns Rev wind farm off Denmark.  
Source: [Recharge News](#)

The wake effect is like what happens when a cyclist rides right behind a car. When the car moves, it pushes the air out of the way, and the cyclist can ride in the calmer air behind the car with less effort.

For wind turbines, when the wind hits a turbine, the blades slow down the wind and make the wind more turbulent behind the turbine. If another turbine is too close, it ends up in this messy wind and can't work as well.

To avoid this, turbines need to be spaced out properly so each one gets a strong, steady flow of wind.