# On farm power generation

## Wind power

In Australia there are currently wind farms operating with capacities ranging from 10 kW to 2 MW. Turbines in the range 100 kW to 2 MW are likely to be the main growth market in the future.

## SUMMARY

This analysis focused on 50–500 kW capacity second hand wind turbines. Despite uncertainty about the total capital required to install a second hand wind turbine, it appears that they will be viable in many cases because they cost significantly less than new plant.

Wind is viable if the cost of electricity is more than about 10c/kWh and most of the electricity generated can be used on site. This analysis is based on:

- using second hand wind turbines with total capital expenditure of 1750 $/kW
- current subsidies (LGCs) are retained
- the turbine operates at 20% of capacity or higher
- a 10% internal rate of return is acceptable
- 100% debt financed at 6.5% pa interest over ten years

If the Renewable Energy Target (RET) is repealed, this will have a weaker impact on the financial viability of wind than it does for solar PV. The breakeven point for viability would rise to at least 12c/kWh if LGCs (Large scale Generation Certificates) are removed. Because wind is intermittent, growers need to have an electrical load pattern that ensures most of the electricity generated can be consumed on site.

## THE TECHNOLOGY

Wind turbines generate electricity by converting the kinetic energy in the wind into mechanical energy via the turbine, and then into electrical energy via an electrical generator. Wind is the next largest form of renewable electricity generation globally, after hydroelectricity.

Several Australian growers have purchased reconditioned, second hand wind turbines from Europe with capacities of up to 500 kW.

### *Key strength and benefits*

- Renewable
- Wind is usually the cheapest form of renewable power generation provided that the wind resource on a given site is of high enough quality
- Environmental, and therefore marketing benefits to use cleaner energy

There are drawbacks however:

- Intermittent
- Significant cost sensitivity to the quality and location of the wind resource, particularly for smaller wind farms. Localised features such as small hills, trees and buildings, can significantly reduce the power generated. If the best wind resource is not close to existing power infrastructure, the cost of the infrastructure can render the installation unviable.
- Uncertain financial viability if incentives are removed
- Uncertain regulatory environment
- Difficult to achieve the necessary environmental approvals

## ECONOMICS OF WIND GENERATION

The economics of wind generation can be positive in some situations. The key factors in determining economic viability are:

- The price currently paid for electricity from the grid
- The capital cost of the wind turbines (second hand, refurbished turbines are best)
- Complexity of environmental approvals
- Continuation of large scale generation certificates (LGCs) government subsidies



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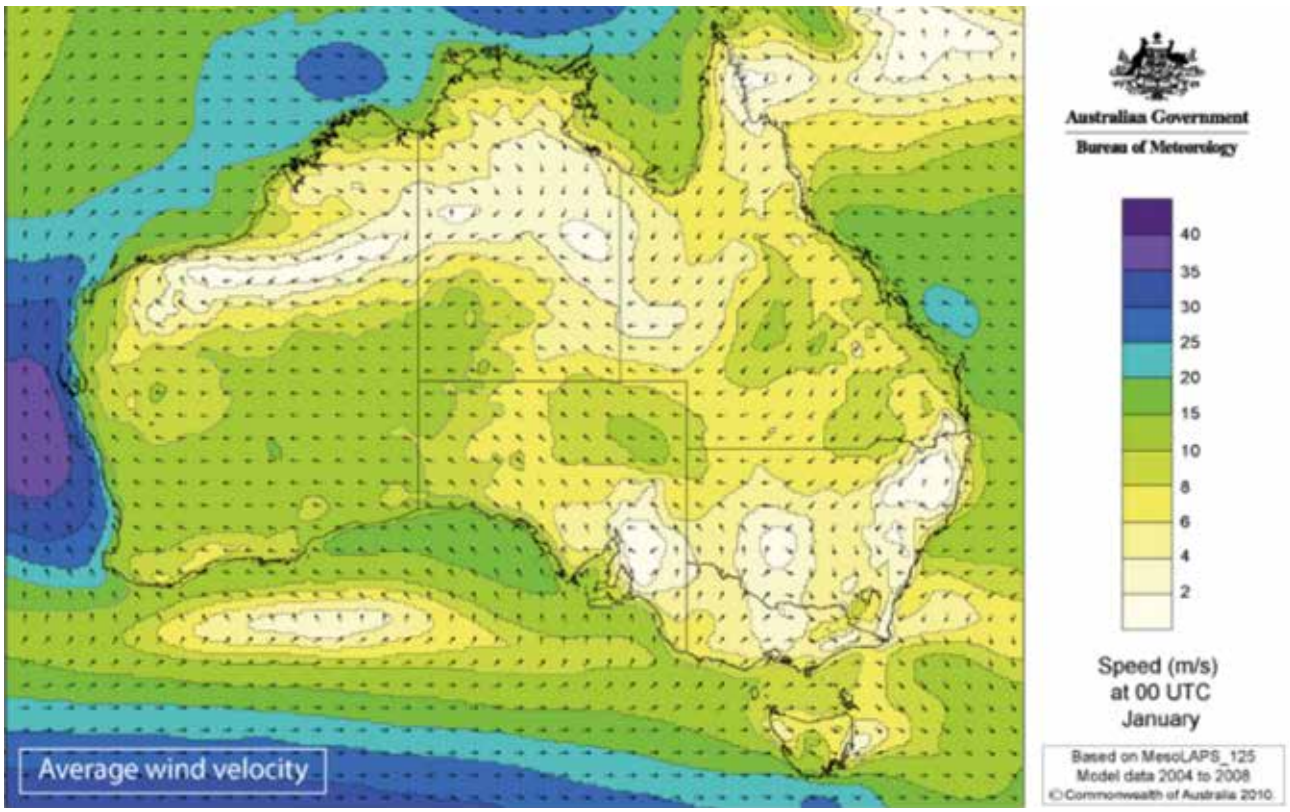


Figure 1. Average wind speeds in Australia.

- How much of the power generated can be used on site

Some key indicators:

- Wind turbines can be economically viable if electricity is costing more than 10c/kWh.
- Operating capacity: If the turbine operates at 20% of its potential capacity, the installation could be economically viable if electricity costs 12c/kWh or more. If the turbine only operates at 10% capacity, electricity would need to be 22c/kWh or more for wind to be economic.

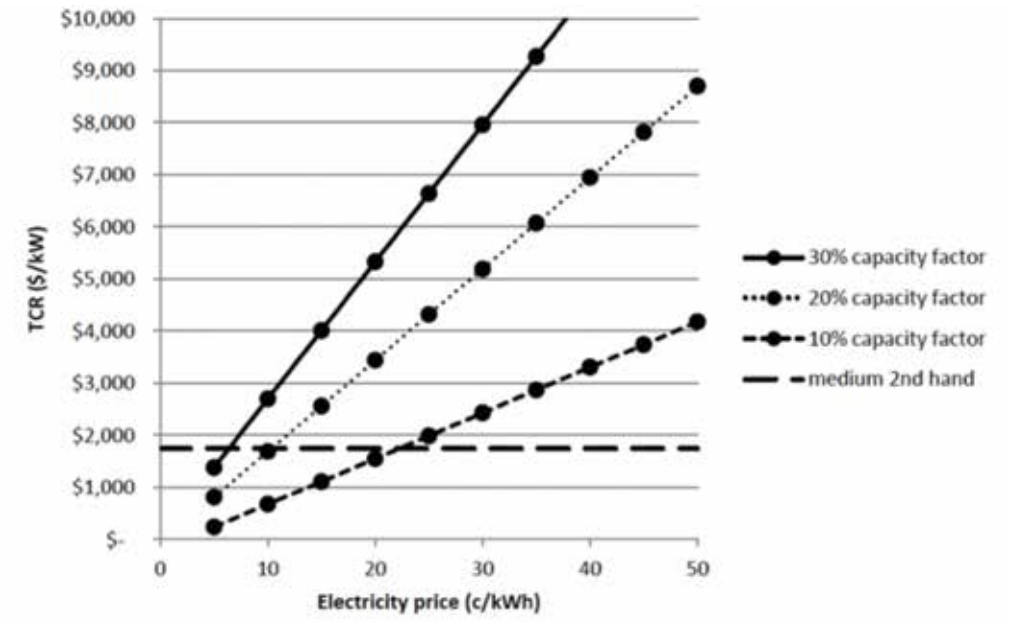


**Figure 2:** Electricity price required to make wind generation economically viable when the turbine operates at either 10%, 20% or 30% of capacity. A medium capital cost (TCR) is indicated for a second hand turbine.

- Higher electricity price allows for a lower acceptable capacity factor. Figure 2 shows the effect of low, medium and high capacity factors.
- Cost of turbines: Second hand turbines cost approximately $1750/kW (installed), which can be more attractive than solar. New turbines cost $3000-4000/kW.
- Approvals and wind studies: Large-scale installations need multi-year wind studies (expensive). At a minimum, an energy consultant is required to assess the site. Environmental objections can be an obstacle to installing turbines. Regulations and requirements change between councils. Approval can be difficult and expensive to obtain.
- Subsidies: Wind turbines over 10 kW do not attract STCs but attract Large-scale Generation Certificates (LGCs) instead. Turbines can still be economical after LGCs are removed.
- Payback periods depend on many factors, but are typically in the range 5–7 years for wind turbines.

## CASE STUDIES

The case studies revealed it is most economical for vegetable growers to install small to medium scale wind turbines for self-consumption. Wind generation is most suitable for growers with significant loads on site which can be offset by wind generation where the demand is consistent throughout the year and power requirements are around-the-clock (not the case if electricity chiefly drives pumping for irrigation).

The feasibility of wind power is dependent on there being a suitably windy site for the turbine close to the switchboard for the load. If the sites are not close enough to the meter, cost of connection between the turbine and the meter could be uneconomic.

Assessment of the wind resource at potential sites on the property is critical. Average annual wind speeds of 4.5–5m/s are the minimum at which wind power would be considered viable. An in-depth wind assessment with on-site monitoring of wind speeds over at least a 12–month period should take into account the impact of local topology to measure the actual wind resource and its variability over a year.

Medium scale second hand wind turbines can mean a lower installed cost, but should be sourced from a well-established and reputable company to try to avoid potentially costly operational problems.

Low interest government ‘green loans’ or grants, a Clean Biz grant, or a Renewable Energy Loans Scheme loan may provide low interest financing.

Two forms of approval—planning approval and approval to connect to the grid—must be sought, and can be time consuming. Development applications usually need to address visual impact, noise impact, and environmental impact. Proposals can be challenged and local community, environmental or other objections can mean costly and extensive impact studies which may render the project financially unattractive.

Wind power may be an attractive option for vegetable growers where the wind resource is good, the load is significant and consistent around-the-clock, where reliable turbines can be sourced economically and where there are unlikely to be local or environmental objections.

Financial details are available in the detailed case studies report.



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Cover photo: Matthew Kenwrick; *Windy Hill Wind Farm*; https://flic.kr/p/ap8eE3