

Wind Energy Case Study

Improving electricity supply

Most people will simply flick a switch and expect a light to shine or a kettle to boil. While it is easy to use electricity, ensuring electricity is available whenever and wherever it is wanted is anything but. New Zealand's wind farms are helping to improve electricity supply by improving the robustness of networks and supplying local generation.

Stabilising electricity networks

For the electricity system to function, electricity supply from power stations must be continually matched to consumer demand. Achieving this can be challenging as demand continually fluctuates and there is always the possibility that generation and transmission equipment may fail.

Faults on the network or at a power station, or a sudden change in demand, can cause supply and demand to become unbalanced. When this happens, the system operator will normally draw on reserve generation to restore the balance. But in some cases such imbalances can cause power stations to trip off line. In extreme cases this can lead to a blackout.

Modern wind turbines are able to continue to supply electricity under most fault conditions. By continuing to generate they help to prevent a disruption becoming worse. This ability is a positive by-product of recent improvements in wind turbine technology, which enable wind farms to generate a smooth supply of electricity from a variable and turbulent fuel supply – the wind.

Modern wind turbines are able to alter their generation very quickly, responding to turbulence and changes in wind speed by turning their blades into or out of the wind. They also contain converters – essentially a buffer between the generator and the network – that ensure the frequency of the electricity being generated matches the frequency of the network the wind turbine is connected to. The combination of these two features enables wind farms to be as responsive to turbulence on the grid as they are to turbulence in the wind.

While the electricity system does not rely on a certain amount of wind generation always being present, New Zealand's wind farms have a track record of helping to keep the lights on during extreme faults on the electricity system.

In the future, wind farms could offer greater support to the electricity system. The technology inside modern wind turbines enables new wind farms to provide the services that are required to balance supply and demand, such as reserve generation, frequency keeping and voltage support.

New Zealand's wind farms do not currently supply these services, but the technology has already been installed at some wind farms. To implement it Transpower and wind farm operators would need to agree how to use it.

For electricity consumers, all of this means that the electricity system will remain robust and secure as the amount of wind generation in the system increases.



Tararua wind farm, Manawatu

Contributing to North Island supply

In February 2010, the HVDC system (also called the Cook Strait Cable) was shut down for over three hours while a fire under an overhead cable was put out. This prevented the transfer of electricity from South Island power stations to North Island consumers.

The outage coincided with a period when a number of North Island power stations, including the large 400 MW gas station at Otahuhu, were offline for maintenance.

Fortunately there were strong winds at the North Island wind farms during this time, and so the wind farms made an important contribution to meeting demand. West Wind near Wellington ran at approximately 75% of rated capacity while the HVDC was offline, and the wind farms in the Manawatu ran at around 50%.



West Wind wind farm, Wellington

Keeping the lights on in Wellington

The Wellington region gets its electricity from West Wind wind farm and connections to the national grid at the Haywards and Wilton substations.

In September 2009 an equipment failure led to a fire at Haywards substation and caused one of the transformers there to stop working. Without West Wind, the situation would have caused a major blackout affecting both residential consumers and essential services.

The transformer outage initially caused a voltage dip on the network. West Wind successfully rode through the fault and continued to supply Wellington with electricity.

The remaining two transformers at Haywards were taken offline while the fire was put out. With all three transformers at Haywards offline, Wellington's electricity supply for the next five hours came through one transformer at Wilton, half of the old circuit of the Cook Strait Cable Link (Pole 1 of the HVDC system) and from West Wind.

During this time, the load on the network ranged between 250 and 390 MW. The maximum load that could be transferred into the region through Pole 1 and the Wilton transformer was about 330 MW. Fortunately this extreme situation coincided with a period of good wind, with West Wind generating between 60 MW and 120 MW. West Wind's generation helped to keep the lights on throughout the region for several hours.



White Hill wind farm, Southland

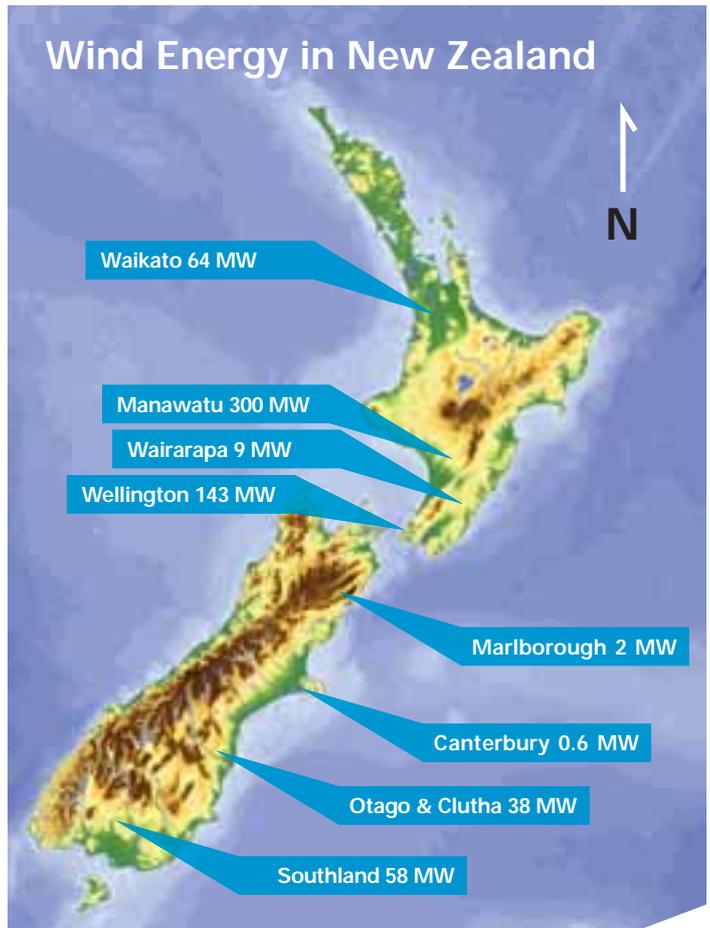
Improving power quality in rural areas

White Hill wind farm, near Mossburn in Southland, provides local generation to communities at the very end of a rural lines network.

Prior to White Hill's commissioning in 2007, the local network experienced fluctuations in voltage as load varied throughout the day (which is normal for a rural network). For residents in Te Anau, Winton, Lumsden and Mossburn these fluctuations could be perceived to cause dimmed lights and ovens that would not heat up to temperature.

Electricity from White Hill now helps to stabilise voltage on the lines network, resulting in better power quality for consumers.

Wind Energy in New Zealand



NZ Wind Energy Association
 PO Box 553, Wellington 6140,
 New Zealand
info@windenergy.org.nz
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The New Zealand Wind Energy Association (NZWEA) is an industry association that works towards the development of wind as a reliable, sustainable, clean and commercially viable energy source. We aim to fairly represent wind energy to the public, government and the energy sector. Our members include 80 companies involved in New Zealand's wind energy sector, including electricity generators, wind farm developers, lines companies, turbine manufacturers, consulting firms, researchers and law firms. Find out more about wind energy and wind farms in New Zealand at www.windenergy.org.nz