

# Holiday home generates own clean, green electricity



Like many rural or remote properties, connecting to the electricity grid was not an option for this remote island holiday home the Bay of Islands. Instead, a stand alone power system generates the electricity needed for a relaxing getaway with all the comforts of home.

When this holiday home was built on Motukiekie island in the Bay of Islands around eight years ago, the owners decided that the generating their own electricity from renewable sources was the way they wanted to go.

Over time the system has been upgraded – thanks to caretaker Peter Hunt – and now boasts an impressive photovoltaic (PV) array, micro wind turbine, extensive battery bank and small diesel generator for back-up. No mod-cons are spared in this house, so the stand alone system has to meet high levels of electricity demand.

## The stand alone power system

Prior to the upgrade, the stand alone power system for this property comprised a small 320 W photovoltaic array and a 1 kW wind turbine, backed up by a diesel generator and with a battery bank for storage. Over time however the system began to strain at the seams, and the performance was not what Peter required. The battery bank was performing poorly, which meant that the generator had to do more work, and the inverters had also developed some faults.

## The technical stuff

The upgraded system installed on Motukiekie island has the following components:

- 4 x 80 Watt peak (Wp) and 20 x 120 Wp photovoltaic modules, giving a total array size of 2.72 kWp
- 1 x 900 W three-bladed Southwest Wind Power Whisper turbine
- 24 x 2 V 600 amp/hour batteries
- 2 x 48 V DC / 230 volt AC Outback inverterchargers
- 1 x 2 cylinder 1500 rpm Lister Petter diesel generator

The system supplies electricity to the holiday home and a self-contained caretaker apartment. The system operates the following appliances and equipment, which have an average daily load of around 8 kWh.

- Internal and external lighting (approximately 4600 W)
- Three fridge / freezer units
- A dishwasher
- Two washing machines and clothes dryer
- A microwave
- Four heated towel rails
- A heat pump
- Computer and printer
- Various other household appliances



The photovoltaic array.

Efforts have been made to reduce consumption by way of low energy lights installed throughout the house, insulation in the ceiling, walls and floor, gas used for cooking, and a high efficiency Danish fridge and freezer sourced for the apartment.

However, due to the sheer number of guests and household appliances, electricity demand is high for the 10 to 12 weeks each year the holiday house is occupied.

The holiday house's owners were determined not to compromise on comfort, and fortunately could afford an electricity generating system that can satisfy their requirements.

Generally, if electricity demand in the home is reduced as much as possible, it means a smaller (and less expensive) system can be installed.

### The solar panels

Although the house is nestled in the bush, the solar PV panels are located on top of a nearby hill, where there is plenty of direct sun. The photovoltaic array has a total capacity of 2.72 kW. This is made up of twenty 120 W modules, and the four original 80 W modules. The modules are connected in banks of four, which means that the power from the array can be transmitted down the hill at 88 V. The higher voltage means that there is less drop in voltage over the 120 m cable distance between the array and the powershed.

In most parts of New Zealand, you could expect a well designed and installed 2.7 kW photovoltaic array to generate between 7.8 kWh and 9.7 kWh per day.

*(See the box on the right on how to calculate generation per day)*

### The wind turbine

The original wind turbine had a rated capacity of 1 kW, and overall Peter was happy with its performance. When he updated the system, he had a 900 W model installed, which he says has a lower start-up speed. This is the minimum wind speed required for the wind turbine to generate electricity. The wind turbine in this system is also installed on the hill, close to the photovoltaic array.

If you put a 1 kW wind turbine into a position with an average wind speed of 6 meters per second, it should generate approximately 5 kWh of electricity per day.

*This type of system can be a viable alternative to connecting to the 'grid', even when you don't live on an island.*

## How much electricity could I generate?

Here's an easy calculation to find out how much electricity you could generate each day from a wind turbine or a solar PV array.

Take the rated capacity of the array or turbine (e.g. 2.7 kW), multiply by 24 (for the hours in the day) and then multiply by the expected resource available (estimate 12-15% for PV and 25%-40% for wind).

$1\text{ kW (capacity of generator)} \times 24\text{ hours} \times \text{between } 25\%-40\% \text{ (0.25-0.40) for a wind turbine or between } 12\%-15\% \text{ (0.12-0.15) for a PV array (resource availability)} = \text{kWh generated per day}$

## The battery bank

Peter has twenty-four 2 V battery cells wired in series, as a single battery bank. This provides 48 V DC, with a rated capacity of 600 amp/hours at a 10 hour discharge rate, or 60 amps per hour. Prior to upgrading the system, he used three separate banks of 8 x 6 V battery cells. This also provided 48 V DC, but because there were three separate banks of batteries, the charging from the photovoltaic array, wind turbine, and diesel generator was quite uneven across the cells and the performance of the batteries was compromised.



The battery bank.

## The inverters

The two inverters automatically tell the generator to start if the battery voltage gets too low, or if electricity demand in the house rises above a certain level.



The diesel generator shed.

## The diesel back-up

Peter Hunt also installed a relatively quiet Lister Petter 2 cylinder 6 kVa generator. Because the generator has lower revolutions per minute (rpm) than the previous generator, it makes less noise during operation. The generator has a guarantee for two years, or 1,000 hours of operation.

Although the photovoltaic array and the wind turbine provide a large proportion of the electricity supply in the system, Peter has programmed the generator to kick in for at least 1.5 hours each day, to ensure the batteries are topped up. In addition, if someone in the house uses the electric dryer, the generator will start. Overall, the generator runs for between 12 and 15 hours a week.

Peter has programmed the generator to kick in for at least 1.5 hours each day, to ensure the batteries are topped up.



The 900 W wind turbine.

## Results

Peter is pleased with how the new system functions. "It's a very comprehensive and reliable system."

"At the end of the upgrade we've got a system that will be good for the next 12 to 18 years, if it's looked after."

On Motukiekie island, connecting to the grid was never an option, but Peter has ensured that the electricity supply for the luxury home uses a high proportion of renewables through a sophisticated stand alone power system.

This type of system can be a viable alternative to connecting to the 'grid', even when you don't live on an island. Many remote or rural properties in New Zealand have similar stand alone power systems, especially when the upfront costs of the system can be less than the connection costs. To find out what it would cost to connect to the network, talk to your local electricity network company.

The approximate costs of this system on Motukiekie island were:

- The 900 W wind turbine: \$5,000
- Photovoltaic array: \$17,000
- Batteries: \$11,500
- Inverters: \$13,000
- Generator: \$11,500

These costs do not include labour, cabling, and installation.

## Next steps for going off grid


If you are considering a stand alone power system, there are some important steps to take.

Gather information. Get a number of different system quotes and use an experienced and qualified company. Ask your installer for references and visit the Sustainable Electricity Association of New Zealand's website – [www.seanz.org.nz](http://www.seanz.org.nz)

Get a quote for connecting your property to the electricity network. This will help you decide whether an off-grid system is viable option. [www.electricity.org.nz](http://www.electricity.org.nz) has a map of which electricity distribution company covers your area.

Get your system designed by an expert. To be effective, the system needs to meet the specific characteristics of your property – an expert can maximise productivity and minimise environmental impacts.

For more information, visit [www.energywise.govt.nz](http://www.energywise.govt.nz)

 For more information contact  
The Energy Efficiency and  
Conservation Authority:

**EECA HEAD OFFICE:**

PO Box 388, Wellington, (04) 470 2200

**EECA AUCKLAND:**

PO Box 37444, Parnell, Auckland, (09) 377 5328

**EECA CHRISTCHURCH:**

PO Box 8562, Christchurch, (03) 353 9280

or visit [www.energywise.govt.nz](http://www.energywise.govt.nz)

JUNE 2009