

# Grid-tie: power payback

Get paid for your  
grid-tied solar power

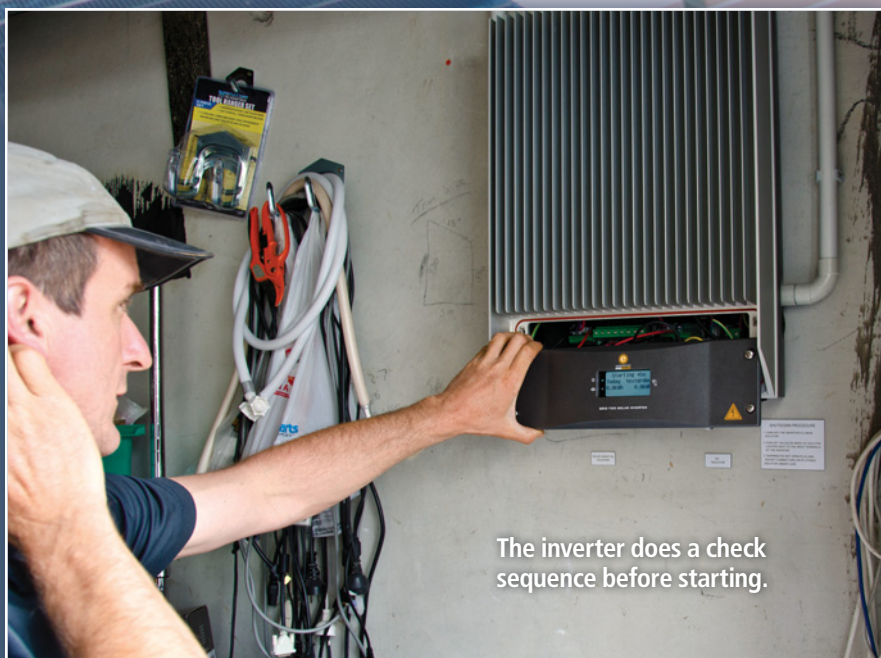
by *Roger Lacey*

Grid-tied solar panel  
power fed back to  
grid — for money.

Photographs: Roger Lacey, Jude Woodside



Testing the DC voltage  
input to the inverter.



The inverter does a check  
sequence before starting.





Brackets are screwed to purlins under the tiles...



...to hold panels.

**W**hile the summer sun beats relentlessly on the roof, shed owners must dream of ways to capture this wasted energy. Photovoltaic panels that turn solar energy into electricity have been around for a long time. On a small scale, they are now common on garden lights showing the way at night for the snails heading to the veg patch.

These garden lights have always been cheap and cheerful, but now solar panels to generate enough power for household use have become much more affordable. Early pioneers of solar power enthusiastically spent vast sums on expensive, low-power panels and battery banks with no hope of a realistic return and the real possibility of being

left in the dark on winter nights.

Two things have changed. They are:

1. a boom in solar panel production has brought down costs;
2. you can now have panels and remain connected to the grid, selling back your excess solar power.

Solar power is now becoming an economic way to not just make an environmental statement but to save money.

## Grid-tied

A grid-tied system keeps you connected to the power company which will buy your excess power from you on sunny days and sell you power when your panels cannot keep up with your demand.

The big advantage of grid-tied systems is that you can buy a small unit to offset just some of your power usage, rather than relying on it to supply all your power needs.

The grid-tied system counteracts the main drawback of solar panels—the fact they generate plenty of power during summer days but nothing on winter nights when you most need it. It also overcomes the problem that the cost of battery banks to store your power is high. To cope with peak demand you need lots of them and they will eventually need replacing.

## Meters

When you sign up for a grid-tie connection, the power company will



install two new meters for a one-off fee of around \$85. One meter reads your normal power consumption from the power company; the other meter reads any leftover power from your solar cells that has been fed back into the grid during the day. Your meter reader will read both meters.

## “Payback time of eight years”

Your bill should show any credit for the excess power you generated. Some power companies, while charging retail rate for the power you use, pay you only the wholesale rate for any power you sell them. A rare company will buy your power at the same price as they sell it to you—but up to a limit.

### Early adopter

In 1990, when Simon Cope phoned his power company and told them to disconnect the power to his Mt Roskill home, he became one of the early adopter, urban home owners to be self-sufficient with solar electricity. His early solar power system was small and he sometimes ran out of power. Gradually he expanded his generation and back-up battery bank and bought energy efficient appliances. Nine years later in 1999, married and with a young family, he concluded it

would be cheaper to pay line charges for a few extra kilowatts of power than spend \$10,000 on a new battery bank with a lifespan of ten years. He called his power company, showed them what was happening in Europe with grid-tie and became a New Zealand pioneer grid-tie customer. Today, Simon and his family have moved from Mt Roskill to a home in Meadowbank. They have just finished renovating the old weatherboard house to maximise energy efficiency and have just over four kilowatts of grid-tied, amorphous solar panels on the roof.

Simon and his wife Kristina run two businesses from home, have two teenage daughters and a tenant in the attached flat. With hot water heated by the sun in summer and a wet-back stove in winter, their power bills average around \$50 per month. A recent power bill for the five people plus home business was \$36.96 for the month. Simon offers tours of his home to school groups, community groups and anyone interested in gaining independent advice on solar power.

He can be contacted at [www.solarenergyhouse.com](http://www.solarenergyhouse.com).



Simon Cope is happy with a \$36 monthly power bill. The amorphous solar panels sit flush on the roof.





Brackets hold panels.

## Is it for me?

Check for the power supplier with the best deal in your region to work out if grid-tied solar is right for you. Buying solar systems is not like buying a TV. You have to weigh up:

- the size, angle and orientation of your roof;
- how long you intend living in your home; and
- if there are other areas you could invest your money in, such as insulation.

Large families needing lots of hot water use may find a solar hot water system a better use of their roof real estate.

For owners of homes with existing mains connection who decide to go solar, a grid-tied solar system is probably the best. In rural areas, the cost of an off-grid system may well be cheaper than getting a new power connection to the door.

## Drawbacks

Grid-tie does have disadvantages. Generating your own power and taking control of your consumption will lower your power costs. But you will still be liable for line charges. Lack of investment in our power infrastructure over many years is catching up with us and we can expect increases in line charges in the future.

If there is a grid power cut, your solar power generation to your home will be switched off, too. This is a safety mechanism that is part of the grid-tie deal.

## Solar panels

There are basically two types of solar panel available at present: crystalline and amorphous. The crystalline are the commonly seen rectangular panels. Available in mono-crystalline (more efficient but expensive), poly-crystalline (cheaper but less efficient) or a hybrid containing both types

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of crystal, these panels are rigid and sit above the roof; their power output drops off as they get hot.

Amorphous (or thin-film) panels are flexible. The film can be stuck to flat roofs or incorporated into roof tiles to form part of the roof. They are about as half as efficient as crystalline panels so need around twice the surface area for the same output. Unlike crystalline panels, amorphous panels do not have their performance affected by heat. Both types of panels have an approximate lifespan of 25 years, though performance may lessen as the panels age.

Putting solar panels is easy on a tin roof as the brackets are screwed straight through the roof into the roof purlins. Tile roofs are a bit trickier as you need to lift tiles to find the purlins, hook special



Paul Sharp of What Power Crisis: Up to 70 percent of average household power can come from solar.





## Reduced outgoings

Retired Pukekohe resident Mel LeCheminant has just installed four kilowatts of grid-tied solar panels on the roof of his home. Sixteen 250 Watt panels mounted in two banks supply a four kW inverter mounted on his garage wall. The installation is very tidy with just the panels on the roof and a neat, finned box complementing the modern look of his house. The meter box on the side of the house has two clearly labelled meters for outgoing and incoming power.

Mel's prime reason for going solar was to reduce outgoings. "If I pass on, I'd like my wife to be able to live here on

a single pension," he says. He has no regrets about the \$16,000 investment. "Bank deposit rates are low and you pay tax on the interest. I reckon should get an eight percent return from the setup, tax-free." He adds, "My first full 'bill' after we got the panels installed was a \$3.64 credit and in October, it looked about \$25 back."

Like almost all people who go solar, Mel is always thinking of ways to maximise the power from the sun. He is looking at fitting a second thermostat to his hot water tank to boost the temperature when the roof

is generating, but allowing mains power to kick in if the temperature drops below a minimum point. The New Zealand-made EnaSolar inverter has an inbuilt wireless connection to his computer where Mel can monitor the output from the solar panels, keep a total of the power generated and graph the results over time.



Pukekohe resident Mel LeCheminant: credit on his power bill.

brackets under the tiles and screw them to the purlins. This costs about an extra \$800 for a 3 kW install and \$1100 for a 4 kW install.

### Inverters

To convert the DC output of your solar panels to the 230 Volt AC household power requires an inverter. Inverters need to be able to handle the maximum output of your solar panels. If you are looking at increasing the number of panels on your roof you may need to upgrade your inverter to match.

A relatively new product is the micro-inverter. These are small 250 Watt inverters that are mounted on the back

of a 250 Watt solar panel. Up to 15 inverters can be daisy-chained together then connected to your power board via a junction box.

At around \$1000 each for a 250 Watt panel, the micro-inverter is good for those wanting to start small and

“Power bills average around \$50 per month”

expand later. They are also handy for awkward roof shapes where it is hard to fit a large array.

### Off-grid systems

If you are determined to never pay a power bill again and want to be responsible for generating all your power needs, then an off-grid system is what you need. However, to ensure you have enough power during long, cold winter nights will mean you should invest in large capacity generation, battery banks and backup systems which add considerably to the cost and complexity. Generally, off-grid is only financially viable for those in remote



## Office off-grid

What Power Crisis? is a small company gaining a big reputation for supplying affordable solar and wind-power generation across New Zealand. Based in rural Ramarama south of Auckland, they practise what they preach by installing a grid-tied generation system for their office and showroom. New developments are tested to perform to manufacturer's specifications under New Zealand conditions. Their biggest installation is 68 kW of solar panels at South Auckland Forgings and Engineering Ltd in Drury. A recent domestic, grid-tied installation near Puhoi comprised 8 kW of panels on the roof of the main home and a further 3 kW of panels on a guest house. The recent rapid drop in the price of solar panels lets them offer competitive, popular packages for 2, 3 and 4 Kw systems. They have added a micro-inverter that clips to the back of a 200 Watt panel, converting the DC power of the panel to 230 Volts AC. The inverters can be plugged together to allow customers to expand their generation capacity as they need to. EnaSolar is a Christchurch-based company that manufactures the inverters that turn the DC power output from a solar



panel to 230 Volt AC power for domestic use. They use technology from their parent company, Enatel which has a 25-year history of making backup power supplies for the telecommunications industry. The inverters come in sizes from 1.5 kW to 5 kW. They incorporate power-sensing technology to ensure the solar panels perform at their peak efficiency and have an LED screen that shows the total amount of power produced. An inbuilt transmitter can connect to any home wi-fi network and display the power production data on a computer in an easy to read graph. EnaSolar inverters were recently installed in five Tongan schools as a Ministry of Foreign Affairs and Trade initiative to improve computer accessibility on the Pacific Islands. It is hoped the project will eventually encompass 36 schools on 21 islands.



What Power Crisis?  
office in Ramarama.





## Management tool

In March this year, Drury-based South Auckland Forgings and Engineering Ltd (SAFE) installed 68 kW of solar panels to help power their factory. Two long rows of panels stretch along the northern boundary of their rural property. The cost including earthworks and cabling was around \$270,000 but

manager Richard Johnston who oversaw the project is confident that it will pay for itself in around eight years, depending on power prices. He is waiting for a full year of data to see how much they are saving but is very happy with the results so far. The grid-tied solar generation is used as a management tool and the use of

the “free” solar power is maximised whenever possible. For example, non-urgent heat-treatment jobs may wait until a sunny day before the electric furnaces are fired up. Other power-hungry processes are now done more during the middle of the day, rather than in the early morning or the evening.



areas who would have to pay a fortune for a grid connection.

### How much power?

Paul Sharp from What Power Crisis? reckons that the best-value systems generate 40 to 70 percent of a household's annual average usage, depending on how much you are home during the day. The lower figure is for people who are out a lot while the upper range suits home businesses or retired people.

“You don't want to become a power generator,” he says.

While it may seem a good idea to cover your house with solar panels and make some money, the power companies will always have the last say over how much they will pay you for your power.

### Buying

It can be very confusing trying to work out if your property is suitable for solar generation and what system to get.

You can quickly bewilder yourself with compass readings, azimuth angles, sunshine hours, roof pitch and latitude calculations.

The easiest way is to contact a reputable company who will use Google satellite images to see your house orientation and roof size. From there they can give you a good idea of what you can expect to generate and for what cost. You can buy components and fit them yourself, but a registered electrician must check electrical wiring.

It is difficult to look into a silicon crystal ball and predict whether an investment in solar power will pay dividends, but today with the lowering cost of solar panels, a payback time of eight years on an average system is achievable even without power price rises. The uncertainties are increases in line charges and whether power companies will continue to pay good rates for your excess power. ☐







The power output from a solar cell varies naturally with the amount of sunlight it receives. However for a set light level, the output current of a solar cell remains relatively consistent until it reaches a particular voltage. Above that voltage the output current rapidly drops off. If you look at the formula  $W \text{ (power)} = V \text{ (volts)} \times A \text{ (current)}$  you will see that to maximise power output from a cell you need to find maximum voltage before the drop-off. The voltage at which power drop-off occurs depends on the current so modern inverters contain a device called a Maximum Power Point Tracker or MPPT which ensures the maximum voltage and current (and so power) is being produced by the panels. Larger inverters have two MPPT inputs so panel arrays can be placed on different sides of a roof.

Solar panels work best when they are producing the optimum balance of voltage and current. As an array of panels are connected in series, if one panel is shaded and is not performing at its peak, the sensors in the MPPT can over-compensate and the output of the whole array can drastically reduce. A three percent shading can reduce output by up to 25 percent. Solar panels

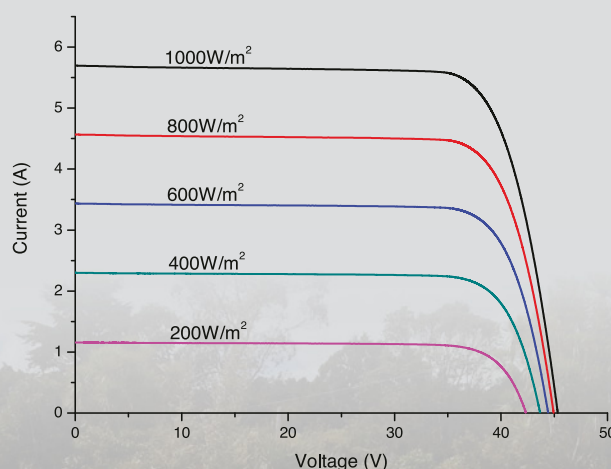
should be placed so that trees, chimneys and TV aerials do not cast a shadow on the panels. All solar panels in an array should be identical and if two or more arrays are wired in parallel, they should all have the same number of panels in each. Micro-inverter systems just look after their own panel so if one panel is shaded, only that panel's output is reduced.

Heat is another factor affecting solar panel performance. The output of a panel is given at 25 °C but as the temperature rises, the output of a typical crystalline panel drops by around 0.43 percent per degree C. If on a sunny day, the panels heat up to 45 °C then efficiency will drop by 8.6 percent. One

reason crystalline panels are mounted above the existing roof is to allow air flow underneath them.

Power output can be affected by angle that solar panels face the sun. The closer you can get the panel to face the sun, the larger the collection capacity. Unfortunately the sun does not stay still and rotating your house is a bit tricky. The good thing is that solar panels are quite forgiving and will operate effectively over a wide range of angles. Some enthusiasts might calculate their optimum angle for their panels and change it from summer to winter or even mount their panels on a motorised tracking platform but for most people it's not worth the trouble or expense.

### I-V Curves



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Irradiance	200W/m²	400W/m²	600W/m²	800W/m²	1000W/m²
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Graph shows how power output is affected by voltage.





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