Fact sheet

Photovoltaic systems

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Why consider photovoltaics?

Photovoltaic systems (PV or solar modules) generate electricity for your home using the most abundant energy source on the planet, solar radiation. Reasons to consider PV systems are:

- They are silent
- They consume no fuel
- They generate no pollution.
- They also contribute to the reduction of greenhouse gas emissions; a 2kW PV system on a house will prevent the emission of about 40 tonnes of CO_2 during its projected 30 year lifetime.
- PV will reduce your electricity bills and exposure to fluctuating / rising electricity prices.
- They can be connected into the electricity grid, so when you aren't using all the power, you can sell it back to the grid.

Key points to note

- Most places in New Zealand have a minimum of 2000 sun hours. Average sun hours exceed 2350 in places such as Blenheim, Nelson and Whakatane. Southland still receives on average 1700 hours yearly. This is high compared to e.g. 1500 in London.
- PV systems generate less electricity on cloudy days but do continue to work. Amorphous modules perform better under these conditions than crystalline modules.
- A PV system can provide sufficient or a large part of the energy requirements **if and only if** energy-efficient lights and appliances are used; gas/wood/solar energy/other sources are used for heat; and gas/induction is used for cooking.
- Grid-connected systems will not provide return on investment within a reasonable time period. Off-grid systems do provide a return on investment within a reasonable time period compared to full diesel generation.
- Feed-in or Buy-Back tariffs for green energy are currently priced lower than retail prices. Buy-back tariffs will have negligible impact on the return on investment as most grid-connected systems are often too small to result in energy being exported to the grid; moreover, tariffs are currently unfavourable too.

What is a photovoltaic system?

A photovoltaic system consists of

- solar panels
- an array frame to hold the panels
- an inverter.

The inverter is necessary because most household appliances use alternating current (AC) electricity, which is what comes out of the power point of a mains-grid connected house. However, the batteries used in a stand alone system supply (DC) electricity. To make conventional appliances run in a stand alone system, this DC electricity must be converted to AC. This conversion is done by an inverter. The inverter is connected to the battery bank, and provides mains-type AC electricity to the system. The inverter needs to be sized to suit the system's electrical requirements.

There are three types of system:

1. Grid-connected systems
2. DC coupled off-grid system
3. AC coupled off-grid system

Choosing the right system

For urban homes

System	Grid-connected system where power generated by the PV system is added to the electricity supplied via the public grid.
Components	The system consists of PV modules, string inverter, connection materials and array frame. Additional options are a monitoring system and back-up system.
Motivation	Currently this will appeal to people trying living more sustainably as no financial return on investment is possible within a realistic time frame.
Size of system	The solar system is likely to be smaller than the actual electricity needs of the household. The size of the system depends on the size of the investment people are willing to make. The average size is 1.5kWp of PV, generating roughly 4.5kWh electricity a day requiring approximately 15m2 (crystalline).

For baches/holiday homes (off-grid)

System	Off-grid system where solar energy source is the main source of energy.
Components	The system consists of PV modules, inverter/charger, controller, connection materials, over-current devices, array frame and battery bank. Additional options are a monitoring system, connection and auto-start option for diesel generation.
Motivation	People with both ecological and economical motives will consider investing in an off-grid system. Return on investment within first 7-10 years compared to full diesel generation.
Size of system	People will have minimal power requirement/energy consumption. The average size is smaller than 1kWp of PV generating roughly 3kWh electricity a day requiring approximately 10m2 (crystalline).

For a lifestyle block off-grid

System	Off-grid system where solar energy source is the main source of energy or integrated with other renewable energy sources such as wind and water.
Components	The system consists of PV modules, battery inverter, string inverter, connection materials, array frame and battery bank. Additional options are a monitoring system, generator and wind/hydro inverter.
Motivation	People with ecological and economical motives will consider investing in an off grid system. Return on investment within first 7-10 years compared to full diesel generation.
Size of system	The size of the system depends on the number of dwellings (community) and the usage of other energy sources. The average size for a lifestyle block is 3kWp of PV generating roughly 9kWh electricity a day requiring approximately 30m2 (crystalline).

Choosing solar panels (modules)

Crystalline modules are recommended when the customer has limited roof space available and would like to optimise the watt peak rating per square meter. The advantage of crystalline modules is the higher yield per square meter.

Amorphous modules are provided in laminates and as framed modules. The yield per square meter is lower therefore the customer needs to have sufficient roof space to accommodate the PV array (up to 40% more space). Furthermore the laminates require special roofing (Eurotray), which creates the possibility to choose for a roof integrated solar array. Amorphous modules perform better under cloudy/diffuse light conditions, better resistance against higher temperatures and have shading tolerance. Furthermore the embodied energy of the laminates is significantly lower compared to crystalline modules as no aluminium and glass is used.

Optimal pitch and orientation

The optimum pitch for **off-grid locations** is the latitude plus 10 degrees. The optimum pitch is higher for off-grid locations in order to get maximum benefit from the low winter sun. The priority of households is to maximise the output during wintertime

The optimum pitch for **grid-connected locations** is latitude minus 10 degrees.. The optimum pitch for grid-connected locations is lower in order to maximise the yearly average output. If the pitch is not optimum then an additional module could be added to the PV array.

The PV array is best orientated to the north, northwest or northeast. If the orientation is not optimum then an additional module could be added to the PV array.

Maintenance

Your photovoltaic system will require some monthly and annual maintenance. The solar panels will need to cleaned for greatest efficiency. Check your instruction manuals.

An example

The New Zealand Housing Foundation's HomeSmart Home included a grid linked photovoltaic system capable of producing in excess of 2100 kWh per annum.

In total, the house used 5890 kWh of electricity – sourced from both the grid and the photovoltaic system. The photovoltaic system produced 2000 kWh over the year, approximately a third of electricity use. Of this 1000 kWh was able to be used by the household, with the remaining 1000 kWh exported to the grid. Once the family installed a smart meter, they were able to receive a credit on their electricity bills for the 1000 kWh exported to the grid – on a tariff of 26.6 cents/kW, this is estimated at $265 worth of electricity. Overall, the photovoltaic system saved the family $532 per annum on their electricity bills.

For more information:

- See Fact sheets on
  - Solar hot water systems
- Read more on the Smarter Homes website: www.smarterhomes.org.nz/energy/generating-your-own-electricity/photovoltaic-cells/
- Read more on the Level website: www.level.org.nz/energy/renewable-electricity-generation/photovoltaic-systems/