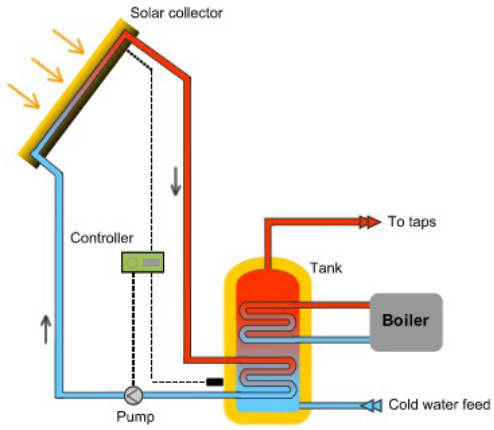
SOLAR

A Generic Overview

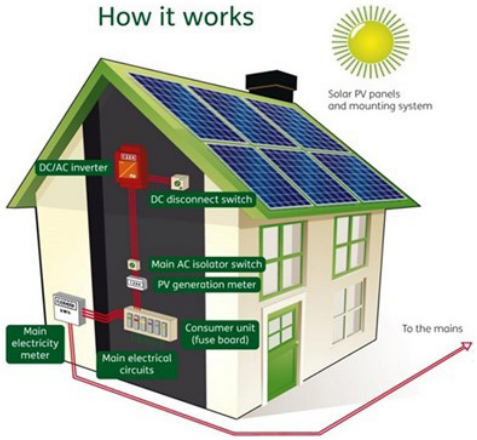
Definitions:

Solar Energy is gained by harnessing energy from the sun to generate thermal or electrical energy.



Solar Thermal (Solar Hot Water)

- Solar Thermal is the collection of the suns radiation as heat through a series of pipes filled with water which is stored in a hot water tank.
- Consists of absorber panels on the roof which are typically flat panels or a row of tubes and a cylinder inside the house
- This water can be used for heating a domestic hot water cylinder or adding heat to a swimming pool or heating system.



Solar Power (Photovoltaics or Solar PV)

- The conversion of the suns radiation into electricity (Direct current DC)
- Consists of photovoltaic panels on the roof and an AC inverter (Alternating Current)
- Power is consumed by the house directly, stored in batteries for later use or exported to the national electricity grid
- Best used to offset household base load, sized for summertime

While there is a lot of energy in the sun, there are limits to what is possible for reasonable capital costs with all solar installations

Solar Thermal

Central Heating New Zealand recommends that Solar thermal is ideal for heating domestic hot water cylinders. When designed correctly solar thermal can provide up to 70% of domestic hot water demand. The best time for heating is the summer months when the sun is available for up to 16 hours out of 24. The solar panels must be sized correctly for summertime heating and the amount of water in the cylinder. During winter the solar input to the cylinder is reduced as the sun is only available for around 8 hours in 24. Back up energy from an electric element or boiler is used to boost the hot water if the solar input is not sufficient

If the solar panel was sized to suit the cylinder for winter time heating, it would produce too much heat for summer time use. This excess heat could be used if there was a swimming pool, if the heat cannot be used elsewhere then the system is oversized and this can result in overheating issues. The best value in terms of capital cost and payback is to size the solar panels for summertime heating of the cylinder.

Solar thermal can technically be used in a heating system, however these systems do not provide the energy input to the heating system in a cost-effective way. Additional heat sources such as a boiler or heat pump would be required, not just in back-up, but to do the bulk of the work. This is due to the lack sun in winter and a much greater energy requirement, at that time for the central heating system.

Direct Solar Gain

As people who live in sunny houses know, direct use of the sun's heat via windows, conservatories and patios is the most economical way to use the suns energy. However on a grey day or in winter when it is dark for 2/3 of the day, the windows that provided so much sun, then become the biggest heat escape route. Also, due to the penchant of many New Zealand designers to have extensive windows without eaves or louvres many houses these days overheat rapidly, creating the requirement for cooling systems. As usual, the best answer is a balance between letting the sun in, using thermal drapes to keep the energy inside in the winter and have the ability to block solar gain in the summer.

Solar Power (Photovoltaics or Solar PV)

Solar PV can also be used to heat the domestic hot water cylinder via the electric element in a cylinder. To achieve the equivalent heating capacity the solar PV panel area needs to be 3-4 times the size of the solar thermal panel.

While there are incentives for selling power back to the grid, the best value solution is to consume the power in the house when it is being produced by the PV panel. Again, water storage tanks could be used to store excess power produced for later consumption in a central heating system but the capital payback value is much diminished due to the large thermal storage required and limited actual input. Space for this equipment would need to be allowed for. As with the solar thermal, there would need to be a heat source that did the bulk of the work for the central heating system.

Central Heating New Zealand recommends using Solar PV with a smart controller prioritising an electric element in the domestic hot water cylinder as the load requires.

Off Grid Applications

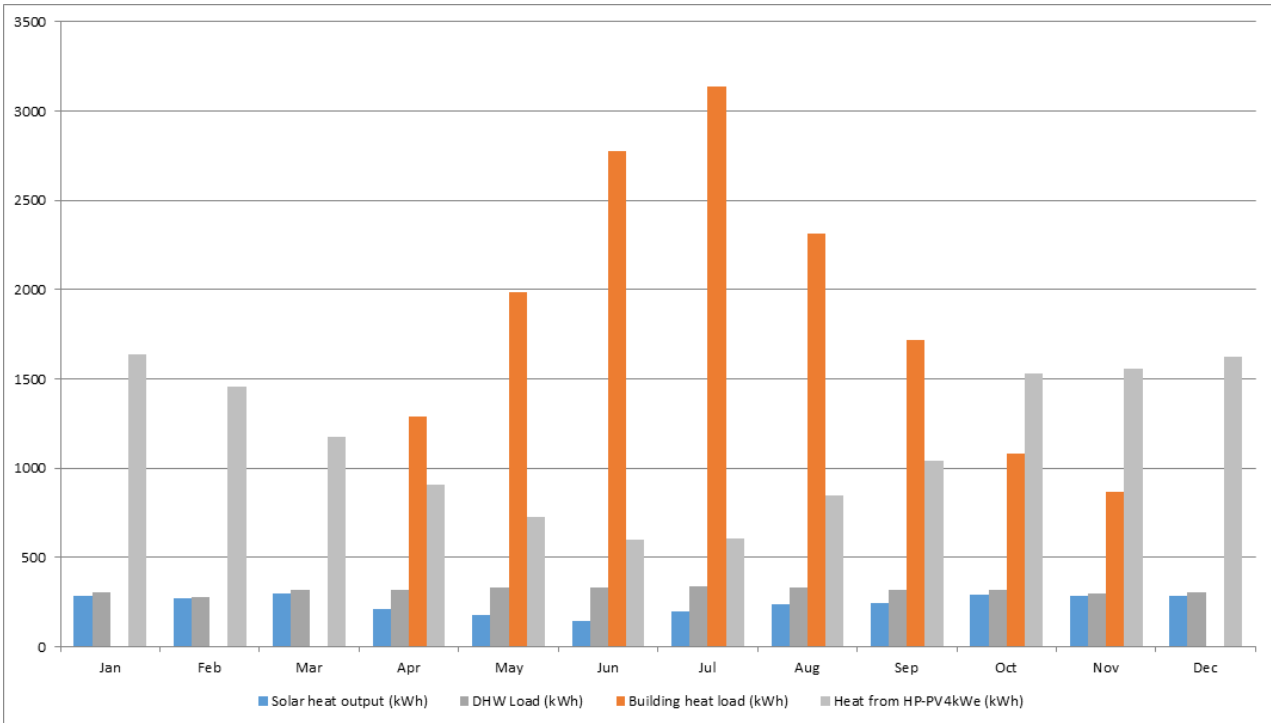
If central heating is required for off grid applications Central Heating New Zealand recommends using a boiler that is diesel or gas fired as the electrical input is small for the amount of energy produced in these systems and a solar PV with battery storage can easily cope with this along with other very low use appliance and lighting

Solar Thermal Domestic Hot Water and Heating:

The graph below shows monthly solar gain from a 30 tube solar Panel. Domestic hot water demand and building heat load (energy required to heat the house) are also indicated on a monthly basis. This clearly shows the solar thermal is effective for hot water for the house, the solar available can provide most of the hot water during the summer months.

The energy required to heat the house from April to November is significantly greater than available heat from the solar, confirming the requirement for an alternative heat source.

NB: This graph applies to a standard New Zealand House. In some parts of Europe where solar thermal input to the heating system is popular, the houses are much smaller and are built with up to 5 time's greater insulation values. Hence the solar input becomes much more viable.



The vertical axis indicates kWh consumption/month.

The monthly solar gain for a Photovoltaic panel is similar to the solar thermal chart indicated above. It is essential to note that the output rating of a panel is a peak rating and may reach the output once a day.

Frequently Asked Questions

1. Can I run my Heat Pump off a PV system?

Not directly. This is down to the simple fact that when the sun is shining you do not require the heat pump to be running. You can store the energy in batteries during the day so that when the heat pump is required to run in the morning and evenings it can use the stored energy.

2. Will a 3kW PV system meet my heating demand?

No. A 3kW PV system means it has can potentially generate a peak output close to 3kW at one point in time during the day. The electrical requirement for a properly heated home of average size in winter could be around 50-60kWh per day or more, whereas a 3kW PV system will produce around 10-12kWh per day on average – so in reality only about 20% of the house requirements but this must be stored energy to have any effect on heating.

3. Can I use batteries to store the energy?

If you wish to store the energy then yes you can. Please ensure you receive accurate information on the cost and life span of batteries as this can have a high capital investment.

4. Why can I not run my heat pump and store the energy when I do not need it from PV?

It is possible to store the energy from the PV into a thermal storage tank. However this will add significant capital and maintenance costs to the system.

5. Why would I not oversize the PV system?

You can oversize the PV system however the capital investment is intensive and payback period is poor as a result. We recommend the solar PV is designed for Domestic Hot Water Cylinder output. The best value in terms of capital cost and payback is to size the solar panels for summertime heating of the cylinder.

6. I wish to install a DHW tank with solar thermal and a Heat Pump heating the water?

It can be complex to integrate solar thermal with a heat pump. If you wish to install solar thermal we advise the heat pump is kept separate from the Domestic Hot Water Cylinder. In this case the solar could be backed up by an electric element.