Hot water case study : Residential heat pump and solar PV

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We heard that heat pumps were much more cost-effective than gas hot water systems, and we now know they are.

We disconnected from gas and now our home exports more energy than it uses, thanks to rooftop solar and heat pumps for hot water and space heating.

Ian Garradd, homeowner

Summary

The mulit-residance household replaced both a gas-fired water heater and a 250-litre offpeak electric hot water system with a heat pump to supply all three spaces.

The heat pump is mostly powered by the solar panels on the roof, and if cloudy, grid-sourced 100% GreenPower is used. In this way, the household can get hot water entirely from renewables and has reduced its imported energy consumption by 75%.

This case study highlights the benefits of using a renewable source of energy to heat water for a household.

In most cases, an all-electric home is cheaper to run and can source 100% renewable energy.

Fast facts

Annual water consumption	o 220,000 L (total hot and cold water)
Savings (est)	o 75% (this includes savings from solar PV) o 4,468 kWh electricity & 18.9 GJ natural gas o $1,956 per year
Costs and rebates	o Purchase and installation costs for tank and heat pump: $4,000 o Financial rebate: 33 STCs at $38/STC
Environmental benefit	o 70 tonnes over the 15-year lifetime

About the household

This case study explores a household on the NSW Central Coast with two granny flats, occupied by five to six people.

Previously, an instantaneous gas system provided the hot water for a family and one granny flat, and a 250-litre electric off-peak system provided hot water for the second granny flat.

In New South Wales, water heating is usually the largest energy-using appliance in households, followed closely by space heating and cooling.

Typically, a household will use more than half of all hot water in the bathroom, a third in the laundry and the remainder in the kitchen.

Altogether, heating water can make up close to 30% of your household's energy use.

Hot water strategy

In 2013, both the old 250-litre electric hot water system and the continuous gas hot water system were replaced by a single 4.5 kW heat pump with a single 315-litre storage tank.

The heat pump consumes 1 kW of electricity to generate 4.5 kW of heat, which is an extremely efficient way to produce hot water.

The original electric hot water system was connected to the off-peak circuit, but a decision was made to operate the hot water system during the daytime, to make use of the rooftop solar electricity. The offpeak circuit was disconnected.

The current system uses solar electricity and is connected to a time-of-use circuit, and programmed to heat water during the warmest time of the day, between 9am-4pm. This ensures that the heat pump can extract the maximum heat from the air, which increases its efficiency.

The homeowners have managed to reduce the household's annual energy consumption by 75% due to the combination of using a heat pump and solar panels and a range of energy efficiency measures.

These include:

› Installing (and using) thick curtains on all windows

- Replacing electric element and gas heaters with reverse-cycle air conditioners (also heat pumps)
- Increased insulation in the ceiling and walls
- Replacing old lights with LEDs.
- Roof-top solar PV design has been incorporated in renovations.

Heat pump system configuration

There are two types of system configurations for heat pumps.

1. An integrated system has the heat pump on top of the storage tank, which is ideal when limited space is available.
2. A split system has a separate heat pump and storage tank.

The homeowners chose a split system because of its efficiency and life-cycle costs.

Split systems can have either part replaced if one part fails. The tank has a warranty of 15 years, whereas the heat pump has a warranty of six years.

The heat pump operates quietly, with a noise level of only 37 dB, which is lower than most reverse cycle air conditioner outdoor units.

The heat pump component is located underneath the house, an area which is well ventilated.

The homeowners had space in a warm and dry storeroom for the tank, which is resulting in greater energy efficiencies than the previous location.

The pipework around the tank is fully insulated. To further increase efficiencies, all the hot water pipes to taps and showers have also been insulated.

Results

The household was able to disconnect from gas, resulting in zero gas costs and zero daily connection charges.

The electric hot water heat pump has significantly reduced energy costs.

The heat pump uses carbon dioxide as a refrigerant, which further reduces the household's greenhouse gas emissions.