

TURNING SOLAR FOR WATER HEATING

As electricity shortages and increasing energy costs hit home, interest is growing in renewable energy sources, like the sun. A recent 3-year study identified some issues around solar water heating and found the key is getting the installation right.

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Solar energy can be used in different ways, and most familiar energy sources owe their origins to the sun. For example, oil is formed from the entrapment of animal and plant remains over millions of years. The sun's energy powered the photosynthesis process these plants used to grow, and animals also depended on these processes as they fed on plants (or other animals that fed on plants), so fossil fuels are essentially stored reserves of solar energy.

But reserves of fossil fuels are limited. In contrast, solar energy is always available, and today's technologies can make immediate use of it. One example is residential solar water heating, which makes direct use of solar radiation within a solar collector to provide heat input into a household's hot water system.

Solar water heating has huge potential

Historically, the uptake of solar water heating in New Zealand has been low. Only about 2% of houses currently have it, but with water heating accounting for approximately 31% of residential electricity use, there is huge potential to save power by making greater use of this technology.

The government is looking to further encourage homeowners to install solar water heating. It has recently been announced that grants will increase from \$500 to \$1,000 per system for those that meet the eligibility criteria.

Study across country

BRANZ has just completed a 3-year research programme commissioned by Building Research and EECA, aiming to better understand the issues involved in solar



New houses in Nelson with solar water heating installed, making the most of the high local sunshine hours.

water heating for New Zealand houses. This research had three components:

- How the systems have been installed.
- What householders think of them.
- How well they perform.

A sample of 35 solar water heating systems in Auckland, Wellington, Christchurch and Dunedin was used for all three parts of the study. Performance information was also collected over the summer for four air-to-water heat pump hot water systems. The systems in this sample were installed between June 2004 and October 2006. Systems installed today will be different.

Saving money beats environmental concerns

The Centre for Research Evaluation and Social Assessment undertook surveys on the householders' attitudes and experiences with solar water heating. Although respondents expressed general concern for the environment, they regarded themselves as middle of the road on environmental issues. Their reasons for installing a solar water heating system were more driven by the desire to save money. A number of householders

felt that more information could have been provided. Some had other issues with the installation of the systems, but, overall, 86% of those interviewed would recommend solar water heating systems to family and friends.

System set up most important

The sample was constructed to examine the impact of region (Auckland, Wellington, Christchurch and Dunedin) and technology (thermosiphon flat plate, pumped flat plate, pumped evacuated tube and air-to-water heat pump) on system performance, but these factors were less important than the variation from how well each individual system was set up.

The performance of each of the systems was monitored over a year. Each system was inspected for its condition and the way it was installed when the monitoring equipment was setup in late 2006 to early 2007. These inspections indicated that, at the time the systems were put in, the quality of the installations varied considerably. Better temperature control and greater attention to detail were required around the solar collector on the roof.

Many of the solar collectors on roofs had inclination angles of around 20–30°. Although the solar water heating systems performed well during summer when the sun is high in the sky, the glancing incident angles result in a markedly reduced performance during winter when the sun is low. Year round performance may be improved by ensuring that the solar collectors are installed at a steep angle, ideally at an angle greater than the latitude of the site (for example, 37° for Auckland and 46° for Dunedin).

Only seven of the 35 systems used timers on the electric boost heating element to effectively control the time when the supplementary heating could operate, yet controlling when the boost can operate is a key component in system efficiency.

Other factors that influenced the system performance included the amount of cylinder insulation, the arrangement of the piping at the cylinder and whether the element was located in the top part of the cylinder.

Air-to-water heat pump

The performance of the air-to-water heat pump is dependant on external temperature, so winter time performance will be less than summer time performance.

Acceptable Solution to improve quality

In December 2007, an Acceptable Solution for solar water heating was published for the New Zealand Building Code Clause G12 *Water supplies*. This Acceptable Solution provides an easier and more verifiable pathway for solar water heating systems to comply with the Building Code and is intended to reduce compliance costs and improve quality for the majority of installations.

There is still no clear picture as to how much energy could be saved nationally with a greater uptake of solar water and heat pump water heating systems. Further work is required to give more confidence that a specified level of savings can be achieved with these technologies.

Details of the inspections, and performance and survey information can be found in BRANZ study reports 184 and 188 respectively. Both are available as free downloads from www.branz.co.nz.

Maximising solar water heating efficiency

For solar water heating systems to be most efficient, they need:

- solar collectors installed at an angle at least equal to the latitude of the site
- timer controls on the supplementary water heating
- well insulated cylinders
- a piping arrangement in open systems to reduce back circulation at night
- elements preferably located at the top of cylinders
- system displays in a prominent location within the house so they can be monitored
- a check after installation to ensure the system is working to specifications
- users who understand how to operate the timers.