SOLAR WATER HEATING SYSTEMS

Despite people's reluctance to install solar water heaters, a well installed system can now achieve reliable performance levels with savings of around 75% on water heating.

By Andrew Pollard, BRANZ Energy Efficiency Scientist

Many people are reluctant to spend their hard-earned money installing a solar water heating system. This stems from not knowing how much it will save or how well it will perform.

A solar water heating system is more sophisticated than a regular hot water system. Because fewer are sold than conventional systems, economics of scale haven't brought the cost down. However, the Energy Efficiency and Conservation Authority (EECA) currently provides financial assistance to purchase approved systems.

Performance predictions now more reliable

The ability to reliably predict the performance of a solar water heating system has improved considerably. A sophisticated computer program called 'TRNSYS' can determine how much energy such a system will save, if all the components are known and specified.

A new standard (AS/NZS 4234:2008) provides guidelines of how to use this program to predict savings. Results for a number of complete systems are on the EECA website (www.energywise.govt.nz/solar-systems).

These results only apply to the specific system listed. The best-performing system can't be swapped for a cheaper, potentially lower-performing solar collector and the same performance expected.

System needs to be professionally installed

Getting a system that can reliably save a large proportion of water heating costs requires the solar professional to specify a system that considers 'the five Cs' and beyond.

COLLECTORS

The solar collector is the first stage of getting solar energy into the water in the solar water heating system. Solar collectors should be:

- of sufficient size to meet demand
- installed at the same angle as the latitude of the location to get the best year-round performance – tilt angle is the angle of the solar panels in relation to the ground and latitude varies down New Zealand: Auckland is around 36°, Wellington 41° and Dunedin 45°
- facing north – the sun shines from the north, so any surface facing north (preferably in a range of 20°W to 30°E of true north) will capture sun
- not subject to any shading.

See pages 31–33 for more details on installing solar collectors.

Correct positioning is essential to get good performance from a solar collector.

CYLINDERS

The hot water cylinder provides two functions: storing solar heated water and providing supplementary heating for water when there hasn't been enough sun. Well insulated, larger cylinders are preferred as they provide greater storage.

Solar cylinders also benefit from additional ports or coils so that solar heat can be transferred to the cylinder appropriately. Insulation levels on cylinders need to be appropriate for New Zealand conditions.

CIRCULATION PUMPS

Many systems have the solar collector and cylinder separate and make use of a specially controlled pump to transfer heat from the solar collector to the cylinder.

CONTROLLERS

Additional control should also be used on the supplementary heating (in addition to the thermostat). Timers that only heat for a few hours before anticipated water demand are a practical and effective solution.

Look for a system with clear operating instructions. If everyone in the household knows how the system works, it can be used more efficiently.

CONNECTIONS

Putting all the components together requires an installer familiar with the requirements for solar water heating. Make sure that pipe run lengths are kept short and well insulated.

Specify then verify

Getting all the 'Cs' right will achieve a good system, but it's important to verify that

everything works correctly and that the overall performance is as expected. Frequently the only feedback of how well a system is performing is a power bill for the entire house every 2 months.

Consumer displays verify performance

An upcoming BRANZ study report examines practical means of assessing solar water heating system performance. Determining performance requires additional information on how much water is being used and how much supplementary heating is required.

This process can be sophisticated – measuring the electricity, water flow and temperature, then processing that data and displaying the results – or the process can be simplified to measure the supplementary heating with a low-cost (less than $40) electricity meter added to the fuse board. A bit more work is then required to calculate the system's performance, as you also need to estimate the hot water use.

Heat pump water heater systems monitoring

Currently, EECA is undertaking performance monitoring for a number of new heat pump water heater systems in a similar way to how solar water heating systems are monitored. Electricity and water meters are installed at the same time as the rest of the system. Owners are asked to read the meters monthly for the first 3 months.

The results of this work are not available at this stage.

Expected performance levels can be met

A recently completed report for Beacon Pathway showed that it is possible to reliably achieve the expected performance levels in the real world.

Solar water heating systems were added to three 1970s houses taking part in Beacon Pathway's Papakowhai Renovation project. These systems were expected to save around 75% of water heating needs. All three matched the expected performance and saved over 70% of water heating needs.

With electrical water heating costing New Zealand households around one billion dollars annually, homeowners could potentially save hundreds of millions of dollars with improved water heating systems.

CASE STUDIES

Beacon Pathway has used solar water heaters in five research homes. Only those that followed the guidelines for solar collector size and alignment met the specified targets.

Beacon Pathway has used solar water heaters in two new NOW Home®s in Waitakere and Rotorua and three home renovations in the Papakowhai Renovation project. As each of these homes was part of a research project, monitoring has shown how well the solar water heating systems worked.

Waitakere NOW Home®

Solar panels were installed at an angle of 20° in line with the roof. Ideally, they should have sat at 37° to match the Auckland latitude.

A display unit showed the homeowners exactly what temperature their solar system was providing. An on/off button allowed them to turn off supplementary heating, which they seldom did, but there was no automatic timer control.

This system provided 45% of water heating.

Rotorua NOW Home®

The solar panel was limited to an angle of 30° by the framing that it came with. It should have been at Rotorua's latitude of 38°. The outdoor cylinder also had the most heat loss.

There was no display or timer control, which would have allowed the occupants to maximise solar heating during the day.

This system provided only 36% of water heating.

Papakowhai renovation project

Solar panels sat at 41° to match the latitude of the site. Two 12-tube panels were connected, forming a large collection area, and 300 litre hot water cylinders with lagged pipes were installed.

A SolaStat Plus controller limited the amount of supplementary heating provided while the circulation pump is operating (and therefore when solar energy is available), but again, there was no timer preventing unnecessary supplementary heating.

These systems provided between 70–75% of hot water.

For the full report on Beacon's solar water heating systems, visit www.beaconpathway.co.nz/further-research/article/reports_and_presentations_energy.