SOLAR WATER HEATING

A $1,000 grant is currently available to install selected solar water heating systems, but they need to be well designed and installed to perform efficiently.

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Assessing the solar energy potential for a building starts with the location – terrain, buildings or vegetation obscuring the sun's path will reduce solar radiation. NIWA's SolarView website (www.niwa.co.nz/our-services/online-services/solarview) is a convenient way to view the impact of terrain for any New Zealand geographical location. Sites with low levels of solar radiation or poor solar access may be better with an alternative, such as a heat pump water heating system.

AS/NZS 4234:2008 *Heated water systems – Calculation of energy consumption* covers how to calculate the energy use for water heating services. The standard divides New Zealand into two climate zones based on the amount of solar radiation: parts of Otago, Southland, Stewart Island and the West Coast of the South Island; the rest of the South Island and the North Island.

New Zealand Building Code

The installation of a solar water heating system needs to meet the performance requirements of New Zealand Building Code clauses B1 *Structure*, B2 *Durability*, E2 *External moisture*, F2 *Hazardous building materials*, G9 *Electricity*, G11 *Gas as an energy source*, G12 *Water supplies* and H1 *Energy efficiency*.

The Acceptable Solution G12/AS2 *Solar water heaters* provides a deemed-to-comply but non-mandatory pathway for the installation of solar water heating systems.

The Department of Building and Housing (DBH) has also issued *Solar water heaters – Guidance for suppliers, installers and building consent authorities*. This can be used to help explain how solar water heating systems outside the scope of G12/AS2 will meet the performance criteria of the Building Code.

System components

The components of a well performing solar water heating system are solar collectors, hot water cylinders, supplementary heating and controllers.

Solar collectors

Solar collectors have a collector surface to absorb heat and are typically one of three types:

- Flat plate collectors are made of a flat metal absorber covered with a pane of glass. Fluid is circulated to remove heat from the collector, and insulation reduces heat losses from the absorber to other materials.
- Evacuated tube collectors are made of a number of concentric glass tubes with a vacuum between them. They work in much the same way as a thermos flask, with the collector surface within the inner tube.
- Unglazed collectors are typically formed from black plastic or rubber tubes and are very efficient for lower-temperature applications such as pool heating. Unglazed collectors are less efficient at higher temperatures due to higher heat losses.

Solar collectors should be:

- of sufficient size to meet demand – different collectors will have different performance levels
- installed at the same angle as the latitude of the location to get year-round performance
- facing north or within the northeast to northwest quadrant
- not subject to shading
- protected from frost where appropriate.

Frost protection may include:

- drain-back systems where water in the collector is drained back to a reservoir when temperatures fall
- closed-loop anti-freeze systems that use an anti-freeze solution in the collector and a heat exchange coil in the cylinder
- frost valves that discharge water in the collector when the temperature falls
- pumped circulation that moves heated water from the hot water cylinder through the collector when it is cold.

Hot water cylinders

The hot water cylinder stores heat from the solar collector or other heating sources. It can be directly connected to a solar collector where the water in the cyclinder circulates through the panel or else installed separately.

Cylinders designed for use with solar collectors have additional ports or coils so that heat can be transferred to the cylinder appropriately. Some proprietary cyclinders are designed for solar, wetback, electric and heated floors. A solar collector can be added to an existing hot water cylinder (special fittings may be required), but the outcome often isn't optimal due to the position of the heating element and the limited size or insulation grade of the existing cylinder.

The size of the hot water cylinder should be sufficient for the amount of solar collectors used (for example, a minimum of 50 litres per square metre of collector area) and to provide storage for not less than 1 day's expected hot water use (for example, 40–60 litres per person).

Fluid in glazed solar collectors can reach high temperatures. The system needs to be protected with appropriate built-in control systems and materials and over-temperature safety devices.

High levels of cylinder insulation are beneficial. Cylinders installed outside will have higher heat loss unless more insulation is used.

Supplementary heating

Supplementary heating (usually electricity or gas) is needed to provide hot water on days when there is little solar radiation. The most common configuration is to provide electrical heating within the hot water cylinder connected to the solar collectors. Placement of heating elements, thermostats and outlet locations is important and should be specified by the manufacturer of the system. A poorly designed system may provide little opportunity for solar energy to heat cold water entering the hot water cylinder.

Another configuration is the preheat system, where heat from the solar collectors is stored

within a hot water cylinder that then feeds the cold input of a water heating system, such as another hot water cylinder (electric or gas) or a continuous-flow gas system.

WETBACK CONNECTION

Heat from a solid fuel burner may also be fed into a hot water cylinder via an open-vented wetback connection. Solid fuel burners are primarily used during the winter space-heating season when solar radiation levels are lower, providing a good seasonal balance of energy inputs. However, it may not always be possible to add a wetback to a solar water heating system.

How well wetback systems work with solar water heating systems is poorly documented. The additional input increases the complexity of the pipework and the likelihood of unusual circulations within the solar water heating system.

Solid fuel burners also need to meet any clean air requirements for sites less than 2 hectares.

GAS WATER HEATING

Storage gas water heating and instant gas water heating can be combined with solar water heating using preheat configurations. Gas water heater suppliers can provide details of suggested configurations.

Some gas water heaters are designated 'solar ready'. Other gas water heaters may require the installation of flow diversion valves to limit the gas burner cycling when the incoming water is within 10°C of the delivery temperature.

Controllers

Controllers should be displayed in a prominent location so users can monitor how the system is operating – optimising the system when they use hot water or minimising when supplementary heating is needed.

The supplementary heating to a storage system must have a control and a thermostat. Using timers can reduce the supplementary heating by only heating for a few hours before anticipated water demand.

Conditions within the solar water heating system also need to be controlled to reduce the risk of *Legionella*. Acceptable Solution G12/AS2 provides three *Legionella* control strategies.

Connections

The operating conditions for solar water heating systems are more challenging than for standard domestic plumbing operating at higher temperatures. Some components may need to be updated and installed by an appropriately qualified person.

It's important:

- to keep pipe lengths short and well insulated
- that piping arrangements include heat traps to prevent reverse thermosiphon currents from occurring.

Commissioning

The installer needs to educate the homeowner about how the system works and how to operate and monitor it. During the operational phase, the homeowner needs to monitor the amount of supplementary heating used and seek help when this is too high.

For general information and government subsidy programmes, see www.energywise.govt.nz/solar, or for detailed information, see www.solarindustries.org.nz.

See Build *115 (pages 31–33), for details of solar collector panel installation.*