A guide to buying solar water heating

EECA energywise™
THE POWER TO CHOOSE

Contents

Thinking of going solar?

A properly specified and installed solar water heating system can slash your hot water bill.

A solar water heating system can provide at least 50%* of your annual hot water needs. It can be effective nearly anywhere in New Zealand, even in less sunny areas. Over time, it can pay for itself through lower power bills. By using solar water heating, you'll also be helping to reduce New Zealand's greenhouse gas emissions.

The Energy Efficiency and Conservation Authority (EECA) has produced this **free guide**, we explain what to look for, and how to use the system to get the best return in 'free' hot water.

* Savings depend on local conditions and proper specification and installation of the solar water heating system.

Costs and benefits

Reduced energy bills

In summer, it may be possible to heat all the water you need with solar energy. In winter, or on cold cloudy days, solar water heating will meet part of your hot water needs – you'll also need some supplementary heating from your booster system.

The exact amount you save from solar water heating will depend on a wide range of factors including how much hot water you use, the solar water heating system you install, and the quality of the installation.

It's been estimated that, for an average household, an effective system will:

- provide at least 50 percent* of annual hot water needs
- cut about 2200kWh from annual electricity use
- provide savings of $350–$450 a year (depending on the cost of your electricity or gas supply).

Installation costs

Because each installation is different, the installation cost of a solar water heating system can vary widely. For systems connected to an existing hot water tank, the average cost is about $5,500. For systems that also include a new tank, the average cost is around $7,300. Prices could be higher or lower depending on a range of factors, such as the size of the system.

In general, it's more expensive to install solar water heating in an existing house than in a new house. This is because, in an existing house, you sometimes need to:

- add pipes in parts of the house that are hard to access
- add structural framing in the roof so it can carry the extra weight of the solar water heating collectors and tank – if you choose to have the tank on your roof.

You may be eligible for a $1,000 grant. To check whether you qualify, and how to apply, see **www.energywise.govt.nz**

EECA publishes the indicative performance data for all solar water heating systems qualifying for the $1,000 grant. This is a useful way to compare the performance of systems eligible for a grant. **www.energywise.govt.nz/solar-systems**

Environmental benefits

If you install solar water heating, you're helping to reduce New Zealand's dependence on non-renewable energy sources and you're helping to cut greenhouse gas emissions.

Every residential solar water heating system installed is estimated to save, on average, about 1.4 tonnes of carbon dioxide emissions a year.

* Savings depend on local conditions and proper specification and installation of the solar water heating system.

Is it right for you?

Hot water use

Solar water heating is generally more economically viable in larger households that use a lot of hot water. The savings won't be as noticeable if you don't use much hot water.

House design

The design and location of your house are also important – they will determine how easy it is to have solar water heating installed, and how well the solar water heating system performs.

The solar collector should face true north or as close to true north as possible, so you'll need a section of roof that:

- faces true north or close to true north (in New Zealand true north is about 20° west of magnetic north, which is what you see on a compass). There is a 20% loss in annual performance for SWH systems whose collectors face directly East or West.
- has good year round exposure to the sun (ideally with no shading – and remember shading is likely to be greater in winter)
- is large enough to accommodate the collectors (roughly 1m^2 per person in the house)
- is preferably located near the hot water tank, and the tank is located near where you use the hot water (e.g. bathroom).



How does it work?

A solar water heating system works by absorbing energy from the sun in collector panels located on your roof. This energy is then transferred to water stored in a hot water tank.

At times when there isn't enough solar energy to heat the water, 'booster' heating is used to keep the water in the tank at the right temperature. The booster heating can be provided by electricity, gas or a wetback.

The main components of a solar water heating system include solar collectors, the hot water tank, and equipment such as a pump and controller.

Choosing a system

Packaged solar water heating systems

There are a number of different kinds of solar water heating systems to choose from, and within those systems there are further options for each component.

To make things easy for you, suppliers typically offer packaged solar water heating systems, so that some decisions about the system are already made for you.

A packaged solar water heating system has been tested as a whole to ensure all components are well matched and work well together.

EECA publishes the indicative energy performance for all solar water heating systems qualifying for a $1,000 grant. This is a useful way to compare the performance of systems eligible for a grant. www.energywise.govt.nz/solar-systems

System size

Solar water heating systems are sized according to demand for hot water. The more hot water you use, the larger the storage tank and collector panel area should be. The number of people living in your house is a good guide for how large the system should be.

These numbers below are a rough guide only. The actual tank size and collector area you need will depend on your individual household situation, the system you choose, and the way it is configured.

Number of occupants	Cylinder size (litres)	Collector panel area (m^2)	Evacuated tubes
3 or fewer people	Up to 200	1.5 to 3.5	10 to 20
4-5 people	200-350	2.5 to 6	15 to 40
6 or more people	300 or more	4 upward	40 upward

In general there should be no more than $1m^2$ of collector per 50 litres of water and no less than $1m^2$ of collector per 100 litres of water.

We recommend you discuss this with your supplier and installer to ensure you get a system that will meet your requirements.

‘Open loop’ and ‘closed loop’ systems

In some solar water heating systems, water is circulated through the collector panels and heated directly before being returned to the hot water tank. These are known as ‘open loop’ systems.

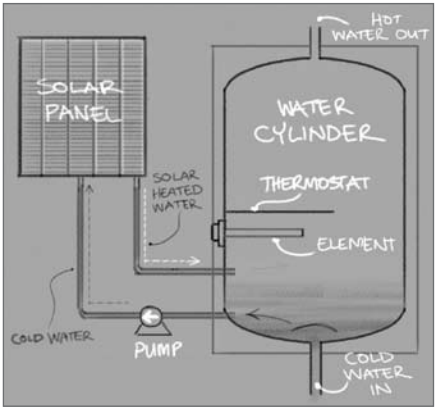

Diagram of an open loop system

Advantages of open loop systems:

- Less cost than closed loop systems
- Generally better performance as water is heated directly by collector

Disadvantages of open loop systems:

- Not suitable for low water quality areas
- Performance may reduce over time if impurities build up on pipes
- Needs frost protection measures

In other systems, a heat transfer fluid (usually a mixture of water and glycol) circulates through the collector panels. This fluid then passes through a heat exchanger in your hot water tank, heating up the water in your tank.

There’s no mixing between the heat transfer fluid and the water stored in your tank. This type of system is known as a ‘closed loop’ system.

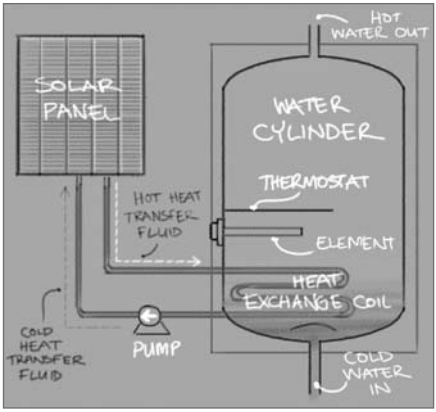

Diagram of a closed loop system

Advantages of closed loop systems:

- Suitable for all locations
- No additional frost protection required if glycol is used
- If well maintained will perform well, long into the future

Disadvantages of closed loop systems:

- Glycol needs replacing periodically
- Slightly more expensive than open loop systems

Discuss with your supplier and installer whether either option is more suited to your requirements.

Collector panels

There are two main types of collector panels for solar water heating systems: flat plate panels, and evacuated tube panels:

- A flat plate panel looks similar to a skylight. It absorbs sunlight and transfers the heat into the water (or heat transfer fluid) flowing through the collector panel. A typical house would have roughly 1m^2 of collector per person in the house.
- An evacuated tube panel is made up of a series of glass tubes (between 1.5m and 2m long) sloping lengthwise up and down the roof. A typical house may have 15 to 40 tubes installed on it with 2.5m^2 – 7m^2 of total absorber area.

There are many types of flate plate and evacuated tube collectors with different absorber coatings, methods of manufacture and internal design, some with reflectors and some without.

The main thing to consider is the total solar water heating system performance and how well the system components are sized in relation to each other and to your water use. This is far more important than whether it is a flate plate collector or an evacuated tube.

For independent performance information on solar water heating systems that are eligible for funding under the EECA solar water heating programme visit www.energywise.govt.nz

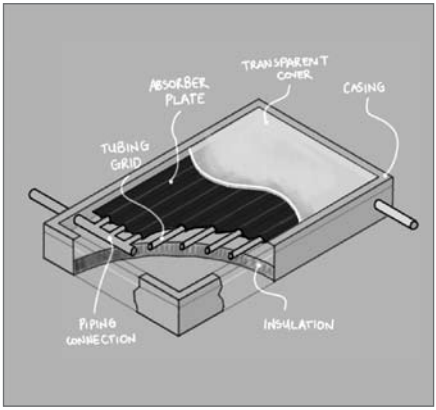

Diagram of a flat panel collector

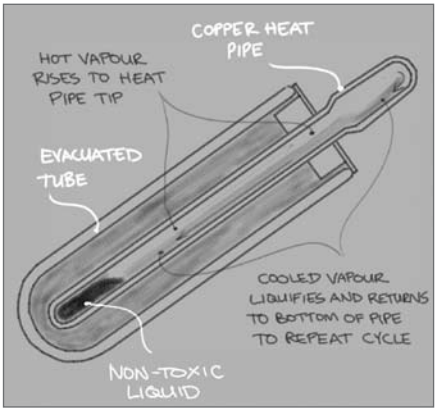

Diagram of an evacuated tube

Typically solar collectors are positioned on your roof. However an in-roof installation option is also available. In-roof solar collectors are put into the roof in a similar way to a skylight. (It is also possible to mount solar collectors at ground level.)

In New Zealand's temperate climate, both types of panel are about as efficient as each other.

Circulation system

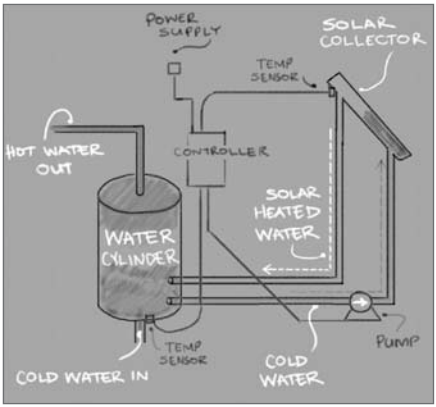

Diagram of using a pump system

Water or heat transfer fluid can be circulated around the solar water heating system using a pump (an 'active' system), or it can be circulated naturally (a 'thermosiphon' or 'passive' system).

In a thermosiphon system the hot water tank has to be located above the collector panels, usually on the roof but sometimes inside the roof space. Cold water or heat transfer fluid moves down from the tank into the collector panels. Once it is heated by the sun, it rises naturally back up into the tank.

Natural circulation by thermosiphon has the advantage that it is not dependent on electricity, whereas a pump system is.

However, the disadvantage of a thermosiphon system can be that, when the hot water storage tank is on the roof, there can be greater heat losses because of exposure to the outside temperature.

With a pump system, the hot water tank can be located at a level below the collectors. This can be helpful if you want to use an existing hot water tank, or if you would rather not see the tank on the roof. Controllers must be used to turn the pump on when there is enough solar energy available and off when there is not.

The advantage of the pump system is that the tank can be stored in more convenient locations, where heat losses can be reduced, and you can retrofit the solar water heating system to your existing tank.

Hot water tanks

The hot water tank can be part of the system on the roof, or it can be set up separately.

You can use a conventional hot water tank or a specialist solar water heating tank. The key difference is that specialist tanks are larger, store more water, have thermostat connections and are specially designed to maximise the use of solar energy. If you choose a specialist tank the system is likely to perform better. However, it is possible to achieve reasonable performance with a conventional tank, through effective system design.

If you are considering retrofitting a solar water heating system to your existing conventional tank, here are some things you should consider;

- It is not recommended that solar water heating systems are retrofited to a tank that is less than A grade as the heat losses from the tank reduce the performance of the system. If you do retrofit to any tank, install a cylinder wrap to reduce heat losses.
- Ensure that the solar water heating system you choose includes timer control of the booster heating so the solar panels are given a chance to heat the water before the booster does.

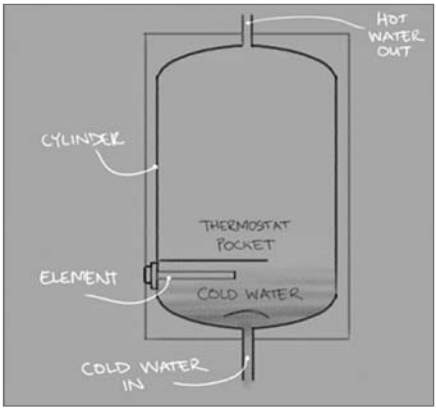

Diagram of a conventional hot water tank

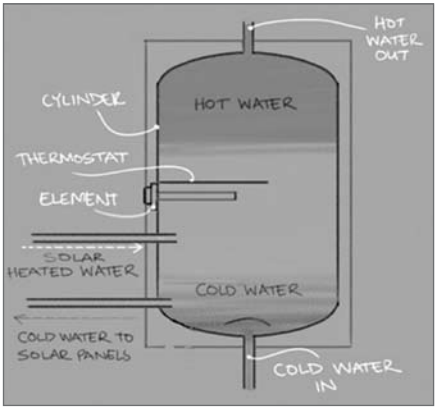

Diagram of a specialist solar water heating tank

- If you are planning to retrofit to an existing mains pressure, enamel tank then you should consult with the tank manufacturer, as solar water heating systems can produce very hot water in the tank in summer and this may affect the life of the tank.

Conventional hot water tanks in houses are usually 180 litres or less. This storage capacity is generally too small for a solar water heater to achieve optimal performance for a household of three or more people.

If you are planning to get a system that includes a tank, check the quotes carefully – a cheap price may mean the tank and other components aren't included or that sub-standard, or under-sized tanks are being offered. Ensure the tank has been tested and meets the government Minimum Energy Performance requirements. If in doubt, ask the supplier to confirm.

If an enamel lined tank is specified as part of the solar water heating system ensure that the tank manufacturer warrants the tank for use with solar water heating systems.

Controllers

A controller is required on pumped systems to turn the pump on when sufficient heat is available at the collector to heat the water, and off when there is not.

An additional function of the controller is to control the use of supplementary or 'booster' gas or electric heating systems.

In electric supplementary heating sytems, there are two basic elements in tank setups that need to be controlled in different ways, these are:

1. Element located halfway up the tank

The element is usually controlled so that if the temperature in the top half of the tank drops below 60˚C then the element turns on until 60˚C is met.

This type of system has the advantages of:

- Simple control
- Hot water always available
- Cold water always available for solar to heat
- Generally better performance.

Sometimes an additional element is located in the bottom of the tank that is manually controlled. This can be turned on when more hot water is needed, such as if guests come to stay and the sun hasn't been shining. It is important that this manual switch automatically resets itself.

2. Element at the bottom of the tank

Bottom element tanks used in solar water heating systems occur mainly when solar water heating systems are retrofitted to existing hot water tanks. This is where it is important to control the element so that the solar water heating system has the maximum opportunity to heat the cold water before the element turns on. This is balanced with the need for hot water to be available. Hence a timer control on the booster element is the ideal control in this situation.

If you use hot water in the morning the element could be turned on between 4am and 7am to ensure plenty of hot water for showers before work. The solar water heating system should heat the water during the day, unless there is not enough sun and the element could be turned on at 4pm till 6pm in the evening if the tank was not up to temperature for evening showers.

Without this type of control on bottom element tanks the energy saving provided by the solar water heating system is very poor.

It's also worth reviewing your electricity tariff when you install a solar water heating system to ensure you are paying the best rate for water heating.

A well set up controller will ensure that you get the maximum performance from your solar water heating system. Make sure you talk to the installer or supplier about the type of controller you need.

The NZ Building Code sets out the minimum requirements for controlling the temperature of the water in your hot water tank to protect you from Legionella bacteria. Ensure the system you install meets these requirements. For additional information on these requirements visit the Department of Building and Housing website and download the acceptable solution for solar water heating systems G12/AS2.

Frost protection

In frost-prone areas, ensure that the solar water heating system you buy has frost protection. Otherwise, the water or heat transfer fluid could freeze in the collector panels.

The water/glycol mixture used in most closed loop systems has anti-freeze properties, so freezing won't be a problem.

In open loop systems with a pump, temperature sensors can turn the pump on to run water through the system before the collector panels freeze. This method of frost protection effectively takes hot water from the tank to heat the collector panel, so it doesn't freeze. In severe frost locations this type of frost protection will reduce the energy savings provided by the system, and costly damage can occur to the collector should there be a power outage during a heavy frost.

Drain back systems, where the fluid is completely drained from collector into a drain back tank are an excellent option to protect the collector from freeze damage and are used extensively in Europe where freezing is common. Not all collectors are suitable to be used in a drain back system as the fluid may not be able to completely drain.

Some open loop thermosiphon systems have frost valves that stop the water from flowing through the collector panels when the temperature is close to freezing.

Frost tubes could also be considered on some systems. These enable the water in the collector panels to freeze without causing damage. The tubes absorb any pressure build-up created by the water expanding or freezing.

Again, talk to your installer or supplier about what method is appropriate for the system you choose.

Choosing an installer

Look for an installer who has completed a course in solar water heating installation. Note that, to qualify for an ENERGYWISE™ grant for solar water heating, your installer must be registered on EECA's website.

As part of their quote, installers should include an assessment of your house, roof orientation, and any structural support requirements for the tank. Ask them about their specific experience in installing systems in circumstances similar to yours, for example if you have a two-storey house, or if you live close to the sea or in a very exposed place.

If you choose to have a system with a tank on the roof, the installer will need to do an assessment of any structural requirements to ensure the weight of the tank is supported. If you have a system with just collector panels on the roof, this is not likely to be a concern.

Obtain quotes and information from several suppliers or installers to ensure you get the best system at a competitive price.

Installation and building consents

It is critical that the installer and the installation quality meet the requirements of the NZ Building Code.

Regardless of which type of system you choose, the installation will need to comply with the NZ Building Code. You will need a building consent from your local Building Consent Authority (normally, your local council).

It is the homeowner's legal responsibility to make sure the required building consent is obtained, however the installer should assist you with this.

Some councils offer reduced consent fees or other incentives to encourage solar water heating and other renewable technologies. Check with your local council.

Use and maintenance

Maintenance requirements

A solar water heating system requires little maintenance, but there are some things you can do to keep it running at its best:

1. Manufacturers' instructions should be followed for any maintenance issues or requirements over the life of the system.
2. Collectors should be washed if they get dirty.
3. Check collector panels for shading and debris – nearby trees may have grown unnoticed.
4. Collectors that are out of sight should occasionally be visually inspected. Check for leaks, which may occur in the case, glass or pipes. Condensation on the glass or wet insulation indicates the system may be leaking.
5. Talk to your supplier or installer if you see any discolouration or corrosion.
6. Although uncommon, broken glass or damaged glazing should be replaced immediately as water coming in will rapidly deteriorate the absorber's surface and insulation.
7. Solar hot water tanks should be maintained in a similar manner to normal electric hot water tanks. Flush the hot and cold relief valves on the hot water tank every six months. Glass-lined water tanks should have their anode changed every five years (or more frequently in hard water areas).
8. Frost protection methods that use frost plugs (which are increasingly rare) sometimes need resetting in freezing conditions. If the system uses glycol or a water-glycol mixture, this will need replacing periodically. See your manufacturer's instructions for details.

Make sure your supplier or installer gives clear, detailed operating instructions when your system is installed.

Any problems?

As long as the solar water heating system has been specified and installed properly, it should perform well. If not, go back to your installer and ask for the system to be fixed. After the supplier's warranty has expired, you are still covered by the **Consumer Guarantees Act** for both manufacturing defects and lack of skill by the installer.

So how do you know your system is working properly?

Check your energy bill, but this is only a rough indicator as to how well the system is performing as energy bills may vary for a number of reasons such as the seasons, occupancy, new appliances, etc.

Some controllers are capable of detecting faults and reporting them on the controller display screen. If your controller is tucked away in a cupboard you may also want an audible alarm to alert you to any problem detected.

Some controllers available can also measure and display the energy supplied by the solar water heating system so you can check the amount of energy the solar water heating system is saving. Insist on this type of controller as they should not cost anymore than a standard controller but let you know just how well your system is performing.

Top tips to use less hot water

Making savings on hot water can have a real impact on your household costs. Try out some of these tips so you can reduce how much you spend on hot water:

- Check your hot water temperature at the tap. It should be at 55°C. An extra 10 degrees could cost you between $25 and $50 extra a year
- Rinse dishes with cold water rather than rinsing them under the hot tap
- Stop the drips. Fix any dripping hot taps by replacing the washer or fitting
- Wrap the heat in. If your electric hot water cylinder and pipes feel warm to the touch, they are losing heat. Insulate them by wrapping – you can get cylinder wraps from hardware stores. You can't wrap gas hot water cylinders
- Ease the pressure. Around 80% of your hot water gets used in showers. Install an energy efficient shower head and get a good shower without wasting water. This could save you up to $500 a year if you use a lot of hot water
- Shower rather than bath. Take a shorter shower. If a family of four each spent a minute less in the shower they'd save around $100 a year
- Check your tariff option with your energy retailer. Make sure your tariff is best suited to your needs.

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New Zealand Government

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Te Tari Tiaki Pūngao