YourHome

Hot water service

Water heating is the largest source of greenhouse gas emissions from an average Australian home and the second largest segment of household energy use in Australia, after space heating and cooling. It accounts for about 21% of the energy and generates about 23% of the greenhouse gas emissions (DCCEE 2010). In Australia, about 48% of the energy used for water heating comes from natural gas, 45% from electricity, 3% from liquefied petroleum gas (LPG) and 4% from solar (DCCEE 2012). Electric water heaters in particular contribute to these emissions: only half of Australian homes use electric water heaters, but they contribute 80% of hot water greenhouse emissions. Reducing your hot water use and using renewable energy sources to heat water are great ways to reduce your environmental impact.

By installing the most appropriate and efficient water heater for your household size, water use patterns and climate you can save money and reduce greenhouse gas emissions without compromising your lifestyle. An efficient hot water service (HWS) can also add value to your home and help meet state, territory or local government regulations.

21% of energy used in the home heats water.

Energy use in the Australian residential sector 1986–2020. Data are projected energy use for 2012

Household energy use	%
Heating and cooling	40
Water heating	**21**
Appliances and equipment including refrigeration and cooking	33
Lighting	6

Source: DEWHA. 2008

More than half of hot water use is in the bathroom, a third in the laundry and the remainder in the kitchen. One of the best ways to reduce energy bills is to reduce hot water use by installing water efficient showerheads and taps — and save on energy and water. Behaviour change also saves energy and water: take shorter showers, use cold water for clothes washing, use water-efficient appliances, rinse dishes in cold water, and use mixer taps

Water efficient showerheads save water and energy.

in the cold water position when hot water is not required. (see *Reducing water demand*)

Water heaters

Both of the two basic types of water heater — storage systems and continuous flow (or instantaneous) systems — can use a variety of energy sources to heat water including solar, gas (LPG and natural gas) and electricity.

Storage water heaters

Water is heated and stored in an insulated tank for use when it is required. These systems can operate on mains pressure or from a gravity feed (constant pressure) tank.

Mains pressure — Hot water is delivered at a similar pressure and flow rate to cold water so more than one outlet can usually be turned on without greatly affecting pressure. The storage tank is usually located at ground level inside or outside the house.

Mains pressure systems have been the most popular systems in recent decades but heat losses from storage tanks and their associated fittings and pipes can be substantial. Large electric storage tanks and their fittings can waste up to 1,000kWh each year; a typical 5 star gas storage HWS wastes 3,500MJ. This is equivalent to the energy required to heat 50–60L of hot water each day.

Constant pressure or gravity feed — Hot water is delivered at lower than mains pressure from a tank located in the roof of the house. Pressure depends on the height difference between the tank and the point of use. Gravity feed systems are most common for older properties and properties not connected to mains water.

For either type of system, storage tanks may be made of copper, glass (enamel) lined steel or stainless steel. Copper and glass-lined tanks typically have a sacrificial anode to reduce tank corrosion, which needs to be replaced every few years. Warranties offered for tanks typically range from five to ten years.

Continuous flow water heaters

Continuous flow or instantaneous systems heat only the water required and do not use a storage tank, so do not suffer the heat/energy losses of storage systems. They can operate on natural gas, LPG or electricity. Gas models are available with either electronic ignition or a pilot flame. They can be mounted externally or internally if suitable ventilation is available.

Because continuous flow systems heat the water as it is used, they cannot run out of hot water. Continuous flow water heaters can be fitted with sophisticated temperature controls, including controls that allow the user to set the desired water temperature at the point of use (e.g. in the shower). Water is not overheated and hot water does not need to be diluted with cold water to achieve a suitable temperature, thus saving energy and reducing the risk of burns or scalding.

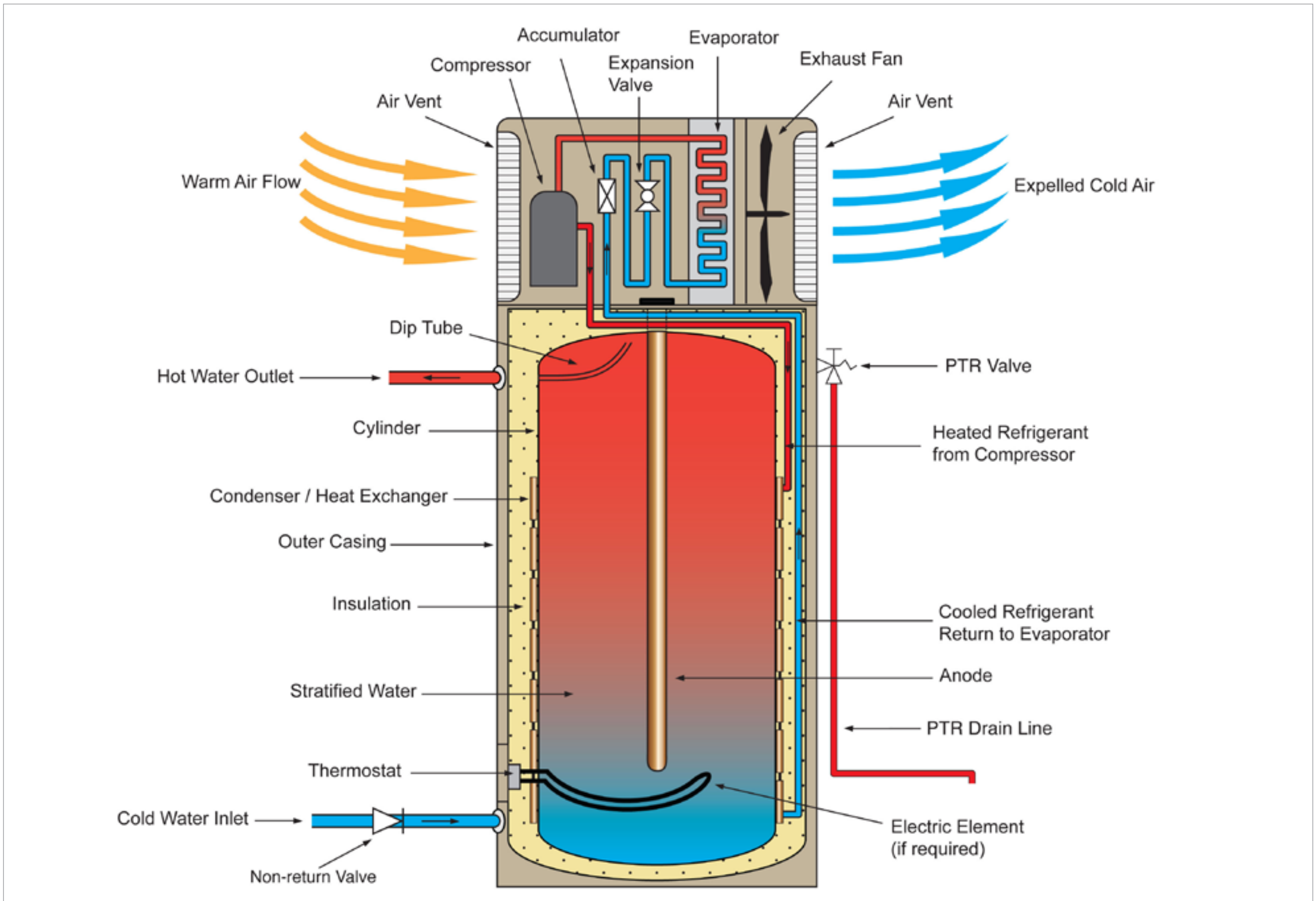
Types of hot water service

The main types of water heaters on the Australian market are:

- heat pump
- gas (natural or LPG) — storage or instantaneous
- solar — electric or gas (natural or LPG) boosted
- electric — storage or instantaneous.

Heat pumps

Air-sourced heat pumps are an efficient type of water heater that extracts heat from the environment (air, water or ground) to heat water. Electricity is not used directly to heat water (unless the heat pump is fitted with an electric boost element); it runs the compressor and thus its use is much less than for traditional resistive electric systems and of similar efficiency to an electrically boosted solar system.



Source: DRET

Integrated heat pump water heater with a wrap-around condenser/heat exchanger.

The pumps operate like a refrigerator but in reverse. Ambient air is used to heat a refrigerant, which converts to a gas. The gas is then compressed, expelling heat, which is transferred to the water. The refrigerant is expanded back to a liquid and the cycle repeats.

Like solar water heaters, heat pump water heaters cost more to purchase than conventional HWS but save energy and can reduce energy bills. Small-scale Technology Certificates are available to assist with their purchase cost. Check with your state or territory government for additional state based rebates or energy saver incentives (see www.livinggreener.gov.au/rebates-assistance).

Seek expert advice on choosing the most cost-effective heat pump and electricity tariff for your local climate and needs.

Air-sourced heat pumps work best in warm, humid climates. In cold climates, the efficiency of a heat pump decreases to a point where the refrigerant is less able to absorb heat. However, some heat pumps are designed to operate efficiently in cold climates and in frequent freezing or very cold and dry conditions.

Note that some heat pumps have an electric booster element installed to help boost the water temperature in regions where it is cold or during periods of high hot water use.

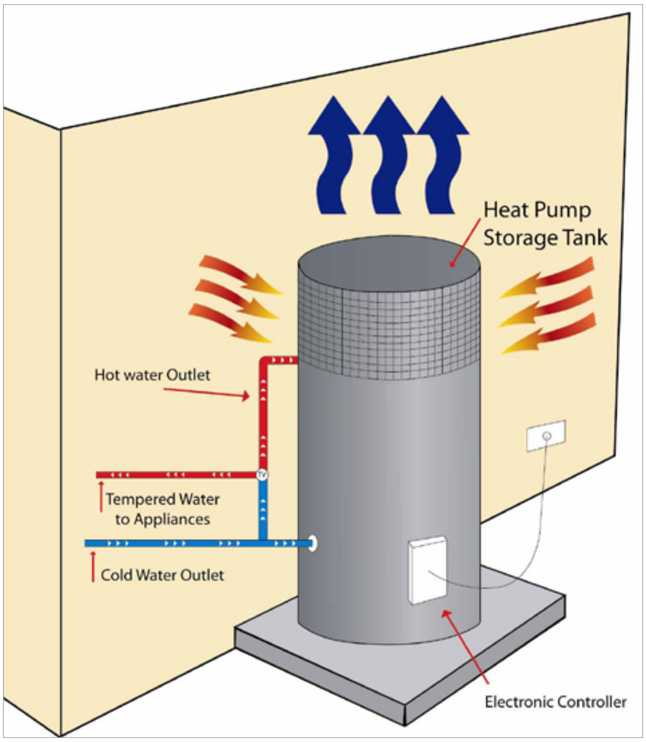
The cost of running a heat pump may increase if it is required to operate its compressor on high cost electricity tariffs, or operate an electric booster. Electricity tariffs differ across the states and territories, and some heat pump water heater models are more suited to operation under restricted hours tariffs. For further information talk to your plumber or electrician, ask your supplier about the heating specifications of the product you are considering and contact your energy retailer to find out which tariffs may apply.

CO_2 heat pumps, which use carbon dioxide (CO_2) as the refrigerant, are relatively new to the Australian market but have been operating successfully for a number of years in Japan. They operate in the same manner as air-sourced heat pumps.

Heat pump configurations

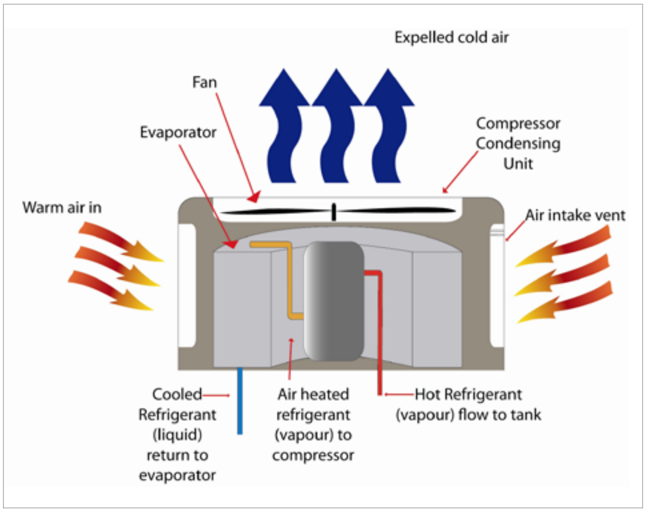
In an integrated system, the heat pump is fixed to the hot water storage tank, which has similar characteristics to a standard electric HWS and is connected in the same way. Installation of an integrated system can be very straightforward, especially when replacing an existing electric HWS.

In a split system, the heat pump (evaporator) unit is placed away from the hot water tank. This can be useful in circumstances where the tank location does not offer the ventilation required to operate the heat pump system. The tank, for example, can be placed inside a cupboard and the smaller evaporator in a well-ventilated space or outdoors. Split systems require a small amount of additional electricity for pumping.



Source: DRET

In an integrated system the tank and heat pump make a single unit.



Source: DRET

Heat pump unit.

Some heat pumps can be fairly noisy, so check noise level and consider potential noise impacts on neighbours.

Heat pumps avoid the need for the roof-mounted collectors of solar HWS units. They also avoid any risk of overheating or dumping of water in hot weather, as the compressor switches off when the stored water reaches the required temperature.

Geothermal heat pumps

Ground source (or geothermal) heat pumps use a waterbody, shallow trench or deep bore instead of the air as a heat source. They usually provide both space heating and water heating. Electricity is used to pump water or refrigerant around a loop buried in the ground or immersed in a waterbody. The enclosed water absorbs heat from the surroundings. Geothermal heat pumps can produce more than four units of heat energy for every unit of electrical energy used. They are best suited to multi-residential applications, where plenty of space is available and the high capital costs can be spread over a number of users.

Heat pumps can be located and designed to use waste heat from air conditioners and refrigerators.

Natural gas

Natural gas water heaters generate far fewer greenhouse gas emissions than electric resistance storage systems using mainland grid electricity. Natural gas burns more efficiently than the coal burnt to generate most electricity in mainland Australia.

Gas storage systems have quicker heat recovery times and generally use a smaller tank than a comparable electric storage system.

Instantaneous systems must heat the water as it is used. They thus require high gas flow rates when delivering large amounts of hot water, which may necessitate installation of larger gas pipes and even larger gas meters. Standard units can deliver adequate hot water to only one or two points at the same time but high performance gas units can supply several points at once.

Some continuous flow gas units operate erratically at low flow rates, especially when the inlet water is relatively warm (e.g. in warm climates or when pre-warmed by solar). Their burners cannot turn down low enough to avoid overheating the water, so they shut down for safety reasons. Thus some units may not work well with water-efficient showerheads or solar preheating. Check with your plumber or local people using the same models.

These heaters usually use natural gas as it is cheaper for this application than LPG.

Liquefied petroleum gas

Liquefied petroleum gas (LPG) systems are typically two to three times more expensive to run than natural gas. If you don't use much hot water this may not be an important consideration. For example, if you have a clothes washer and dishwasher that heat the water themselves (or if you wash in cold water), most of your hot water will be used for showering. With only a couple of people in a household and water efficient showerheads, hot water use is probably low.

Instantaneous models, particularly high power electronic control models, use a much larger gas burner than storage systems, and generally need a larger gas supply pipe. So, where possible, decide what you are going to buy before having the gas supply pipe installed. If you already have gas connected to supply a stove or room heater, the supply pipe may have to be replaced with a larger one. LPG units will generally require two 45 kilogram capacity gas cylinders to avoid frequent replacement of gas bottles.

Solar hot water systems

Solar hot water systems use roof mounted solar collectors to absorb energy from the sun to heat water which flows to a storage tank.

There are various system options available, allowing choice of:

- boosting options
  - gas (natural or LPG)
  - electric
- collector types
  - flat plate panels
  - evacuated tube collectors
- system configuration
  - thermosiphon
    - integrated systems
    - split systems
  - split systems.

Solar HWSs are storage systems and, depending on your climate, can provide up to 90% of your hot water for free, and without greenhouse gas emissions using the sun's energy (DCCEE 2010). They cost more to buy and install than conventional HWSs but can save energy and reduce bills. Rebates and incentives are offered around Australia to reduce the up-front cost of solar units (see www.livinggreener.gov.au/rebates-assistance). The time required to break even (the payback period) depends on the climate, type of system installed, hot water use and energy tariff applied. Solar water heaters have additional benefits: they last longer than conventional water heaters and add to the value of your home.

Seek expert advice to help you choose the most cost effective solar water heater for your needs. Consider the energy source for boosting (gas or electricity), energy efficiency, energy tariffs, ease of installation and product cost.

The two usual types of solar collector are flat plate units and evacuated tubes. Flat plate units are most common and have been well proven in Australia for over 50 years. Evacuated tubes, which work more efficiently in cold climates, are more common in Europe and China.

Flat plate collectors have been well proven over 50 years of use in Australia.

Roof mounted flat plate solar collectors and hot water tank.

To provide hot water on cloudy days or when demand exceeds supply, most solar water heaters come with a gas or electric booster. A gas booster usually produces fewer greenhouse gas emissions unless renewable electricity is used or the booster is a heat pump.

Automatic booster systems located inside the storage tank can be inefficient — cutting in and pre-empting the sun. Override switches and timers can correct this problem if well managed. A popular approach is to use an inline gas booster that works like a continuous flow water heater but the system must be specially designed to work as a booster for solar hot water (*see 'Continuous flow water heaters' above*).

The solar collector is generally located on the roof of your home, facing north. Make sure it is not overshadowed for long periods. The storage tank can be located on or inside the roof or at ground level.

Installation of a solar HWS is often more complicated than for a traditional HWS, and may incur time delays. In urgent situations, it is possible to install the solar tank and/or booster unit quickly, which can deliver reasonable hot water supply from just the booster. The solar panels can then be added a few days later. Some suppliers also offer to install a temporary HWS, which is removed when the solar HWS is installed.

How do they work?

Most solar HWSs use solar collectors or panels to absorb energy from the sun. Water is heated by the sun as it passes through the collectors. It then flows into an insulated storage tank for later use.

In passive systems, water flows due to a thermosiphon effect between the collectors and the tank. As the water heats in the collectors, it becomes less dense and rises to the tank above the collectors, and cold water replaces it. In active systems, water is pumped between the collectors and the tank.

The storage tank is usually fitted with an electric, gas or solid fuel booster that heats the water when sunlight is insufficient. Some solar water heaters also have frost protection to prevent damage in frost prone areas.

Solar HWSs are required to comply with Section 8 of AS/NZS 3500.4:2003, Plumbing and drainage — heated water services. For further information see the Building Code of Australia (BCA) Volume 2, Part 3.12.5.

Solar collectors

Solar collectors trap and use heat from the sun to raise the temperature of water. The two main types are flat plate and evacuated tube collectors.

Flat plate solar collectors — are the most common type and comprise:

- an airtight box with a transparent cover
- a dark coloured, metallic absorbing plate containing water pipes
- insulation to reduce heat loss from the back and sides of the absorber plate.

One slight disadvantage of flat plate collectors is that they only operate at maximum efficiency when the sun's rays strike perpendicular to the flat plate. They also suffer some heat loss in cold weather.

Evacuated tube solar collectors are more efficient than flat plate systems.

Evacuated tube solar collectors consist of a series of transparent outer glass tubes that allow light rays to pass through with minimal reflection. Each tube contains an inner water pipe coated with a layer that absorbs the sun's rays. Water runs through the pipe and is thus heated. A vacuum (hence 'evacuated') between the outer tube and the water pipe acts as insulation, reducing heat loss.

Evacuated tube systems are more efficient than flat plate systems, particularly in the cooler months and on cloudy days. This efficiency comes from the vacuum insulation, which minimises heat loss, and the curved surface of the tubes that allows the sun's rays to strike perpendicular to the water pipes for a greater part of the day. Evacuated tube systems weigh much less than flat plate systems but cost significantly more. Individual tubes can be replaced in the event of damage, making long term maintenance potentially less costly. In warmer climates, such as Darwin, the additional cost of evacuated tubes is usually not warranted over flat plate solar collectors.

Properly maintained solar thermal collectors should outlast the life of the storage tank. When the tank needs replacing, the existing collectors can be connected to the new tank.

Frost protection

Frost protection for solar collectors is essential in frost prone areas. During a frost, water can freeze in the solar collector and damage it unless preventative measures are taken. Common types of frost protection include:

- knock valves (mechanical drain down valves), which can be problematic as they often jam open and drain the tank, or fail to operate, causing severe damage
- electric heating elements, which are vulnerable in the event of power failure
- closed circuit systems, which separate the heating fluid from the water and are usually the best option as water does not flow through the solar collectors and therefore cannot freeze there.

Open circuit versus closed circuit

In an open circuit system, water flows directly through the solar collectors, into the storage tank and then through pipes into your home.

In a closed circuit system, a fluid other than water flows through the collectors, picks up heat from the sun and transfers this heat to water in the storage tank through a heat exchanger.

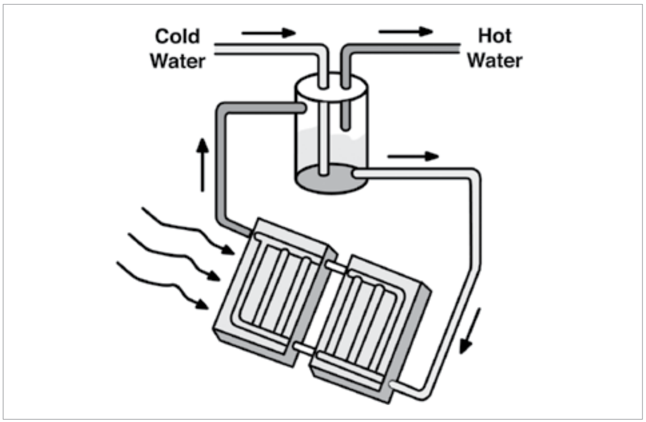
Closed circuit systems are most commonly used for frost protection. A fluid with a lower freezing point than water is used to prevent ice forming in the solar collectors and damaging them as it expands. Choose the fluid carefully as some become 'gluggy' and reduce efficiency. Most fluids need to be checked or replaced every five years.

Some closed circuit systems pump hot water through the collectors when temperatures approach freezing. Avoid systems with this feature if frosts are likely because this action lowers efficiency significantly in cold weather.

Passive versus active systems

Passive (or thermosiphon) systems

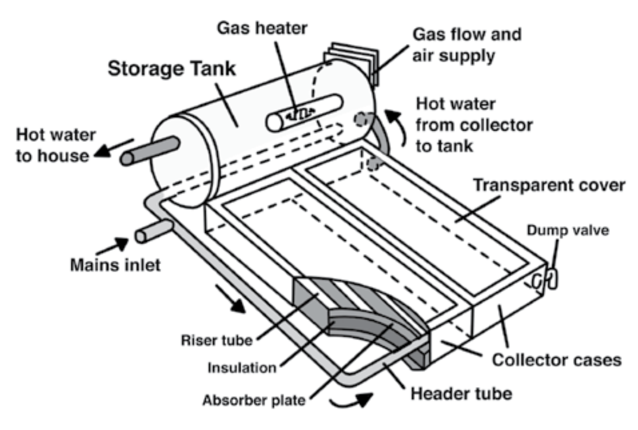
In passive (or thermosiphon) systems the tank is placed above the solar collectors so that cold water sinks into the collectors, where it is warmed by the sun, and rises into the tank. A continuous flow of water through the collectors is created without the need for pumps.



Passive solar systems create a continuous flow of water through the collectors.

Passive systems come in two types: close coupled and gravity feed.

In a close coupled system the horizontal storage tank is mounted directly above the collector on the roof and supplies heated water at mains pressure. The roof must be strong enough to hold the weight of the tank of water.

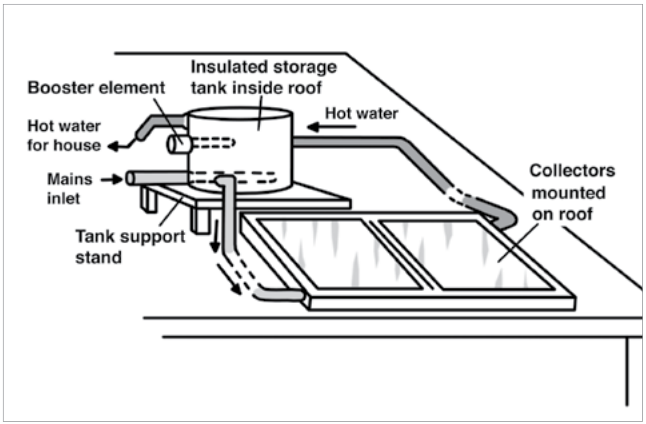


A flat plate solar, close coupled system supplies heated water at mains pressure.

This arrangement is the most cost effective to install but efficiency is reduced in cool and cold climates by heat loss from the tank. Additional insulation of tanks is desirable in these climates. Alternatively, tanks can be detached and moved inside the roof space, although this increases the cost.

Passive solar systems have a continuous flow of water through the collectors without the need for pumps.

In a gravity feed system, the storage tank is installed in the roof cavity. These systems are cheapest to purchase but household plumbing must be suitable for gravity feeding, including larger diameter pipes between the water heater and taps. A common alternative is to use a closed circuit gravity feed system to heat mains pressure water using a heat exchanger.



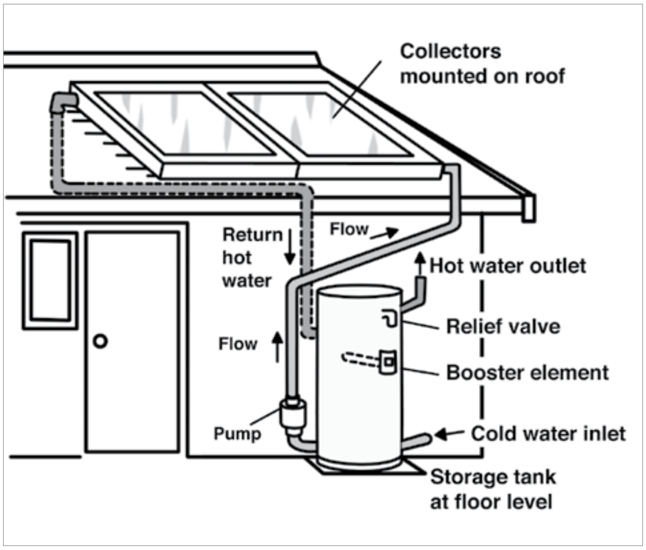
In a gravity feed system, the storage tank is installed in the roof cavity, still above the collectors.

Active (or pumped) systems

In active systems (also known as pump or split systems), solar panels are installed on the roof and the storage tank is located on the ground or another convenient location that does not have to be above the solar collectors. Water (or another fluid) is pumped through the solar collectors using a small electric pump.

Because active systems do not require a roof-mounted tank they have less visual impact, particularly when the solar collectors are mounted flush with the roof. However, active systems are usually more expensive to purchase and require more maintenance than passive systems.

Active systems generally use more energy than passive systems because extra energy is required for pumping. There are also additional heat losses in the pipes between the tank and solar collectors. However, if renewable energy is used to power the pump and a



An active system can place the tank conveniently at ground level.

high level of insulation is used for the pipes and tank, active systems can reduce greenhouse gas emissions as much as a passive system. (see *Renewable energy*)

Careful checking of an active system is required to ensure that it is working as designed. If the pump or sensors fail, it may not be obvious as the booster (gas or electric) continues to heat the water. Turn off the boost in summer to check if the pump is still working as designed. If the water temperature is cold, call the service agent to check the system. Higher energy bills may also indicate a faulty system. Select a product with a warning light that shows the pump is working, if possible.

Active systems are often used for solar conversions, when solar collectors are added to an existing HWS, or when the roof can't support the weight of a passive system.

Storage tanks

Tanks are manufactured from stainless steel, copper or mild steel coated with vitreous enamel. Copper tanks are suitable only for low-pressure systems. The other tanks are suitable for mains pressure.

Vitreous enamel tanks are fitted with a 'sacrificial anode' that needs to be replaced every few years to protect against corrosion (more frequently where water quality is poor). Other tanks do not require this protection unless noted by the manufacturer.

Outdoor storage tanks can suffer frost damage and significant heat losses in cool climates. In such climates they should be located indoors whenever possible, as part of a drying cupboard.

Booster systems

Solar water heaters can be gas, electric or solid fuel boosted.

Electric boosters use an electric element inside the storage tank to heat water.

Gas boosters use a natural gas burner to heat water either in the storage tank or more commonly as a separate unit downstream from the storage tank. Inline gas boosters are becoming more common: when designed properly they provide hot water at the desired temperature, while maximising the solar contribution. However, the inline booster must be designed to work with a solar water heater for boosting when the inlet water temperature is not sufficient. Check to make sure it is (*see 'Continuous flow water heaters' above*).

Solar collectors and tanks can fit into building design.

Solid fuel boosters heat water through a heat exchanger, commonly known as a 'wetback' system.

Gas and solid fuel boosted systems produce fewer greenhouse gas emissions.

Boosters can be manually operated or automatically controlled by a thermostat that cuts in when tank temperatures fall below desired levels. If boosters are not appropriately designed and operated they can defeat the purpose of having a solar water heater by reducing the solar contribution.

For example, thermostat controlled boosters inside the tank on off-peak electricity often cut in at night, which means that when the sun rises, there is little useful heating to be done. If residents mostly shower at night, or the storage tank has high heat losses, the problem is worse.

Timers can also be used to manage boosters and ensure maximum solar contribution. Talk to your supplier about the correct operation of timers.

Positioning your solar water heater

For optimum performance throughout Australia, a solar HWS should face solar north. Orientation can deviate up to 45° from north without significant loss of efficiency. Frames can help orient a solar HWS if necessary. Use a compass to check orientation or check the map in a street directory — true north is at the top of the map. (see *Orientation*)

For maximum efficiency, ensure that the solar collectors are not shaded by trees or nearby buildings, particularly in winter when the sun is low in the sky.

Optimise your solar collector's performance by facing it due north, keeping it in full sunlight and tilting it to the recommended angle for your latitude.

For best performance, install solar collectors at an angle to the horizontal to maximise the annual amount of sunlight falling on the panels. The recommended angle to the horizontal for installing solar collectors is the same as the angle of latitude at that location. In Australia, the angle varies from 17.5° in Darwin to 53° in Hobart. In some cases, it may be desirable to increase the angle somewhat to improve winter performance and reduce overheating in summer.

In practice, many solar water heaters are installed at the roof pitch angle as it is cheaper and usually more aesthetically pleasing to install solar collectors flush with the roof, rather than use supports such as tilt frames to achieve a greater angle. Roof pitch angles in Australia are commonly between 20° and 30°, so this often reduces performance in winter and increases the risk of summer overheating. In existing homes, the benefits usually outweigh the costs. In new homes, roof areas could be designed to accommodate a suitable solar collector angle.

Other installation tips

A complete thermosiphon system full of water can weigh several hundred kilograms. Most roofs can support a storage tank without reinforcement but check with your builder, designer or engineer before installation.

Be sure to insulate all components, including pipes and valves, to get the best performance from your system. This is particularly important for thermosiphon systems where there is a long distance between the tank and hot water taps. It is critical in cold climates.

Make sure the booster control is in an accessible location and has an indicator light you can see from inside to remind you to turn it off when not required.

Operating and maintaining your system

Follow the manufacturer's maintenance recommendations.

Set the temperature of your booster thermostat to 60°C. A lower setting may allow growth of harmful *Legionella* bacteria.

In favourable climates during summer, water temperatures in a solar water heater can approach boiling point. Heat dissipation devices may be required to prevent water from boiling. It may also be necessary to fit a mixing valve to reduce water temperatures at the tap to safe levels during summer. When some solar systems overheat (usually when high temperatures, strong sun and low usage combine, such as when residents are away), they may dump significant amounts of hot water to protect themselves. This can be a safety issue and can impact on water consumption.

Some people with low hot water usage hear strange noises from pressure build-up in summer, due to overheating. Some shade a part of their solar collector in summer to reduce overheating problems.

Carry out activities that need hot water early in the day so that the water left in the tank will be reheated by the sun, ready for use at night.

Regularly clean solar panels to remove dust. Flush out solar collectors to remove sludge. Heat pump systems do not require flushing.

Make sure you turn the booster off when going on holidays. Ensure the water is boosted sufficiently when you return from holidays to kill harmful bacteria and run the hot water to flush the pipes. Boost the water to at least 60°C for 35 minutes before using the hot water to kill any bacteria that may have grown. It could take several hours for the water to heat.

Legionella

Legionella bacteria can be present in water and become a health concern when present in high concentrations. Heating water in storage tanks to particular temperatures can kill the bacteria. Water should be heated to at least 60°C temperature for at least 35 minutes to ensure *Legionella* bacteria are killed. For additional information speak to your plumber.

Electric hot water systems

In December 2010, all states and territories except Tasmania agreed to phase out greenhouse intensive (electric) HWSs. This phase-out will reduce energy consumption and greenhouse gases and may also help householders save money on their electricity bills.

Greenhouse gas intensive hot water systems can no longer be installed in *new* buildings under the BCA. The Northern Territory, Queensland and Tasmania have not adopted the provisions of BCA; Victoria has introduced a requirement for either a solar water heater or a plumbed rainwater tank to be installed.

It is proposed that existing houses will be regulated through changes to state and territory plumbing regulations.

Starting dates for extension of the phase-out to existing homes depend on decisions by individual jurisdictions. Existing houses in South Australia are no longer able to install greenhouse intensive HWSs in metro locations that have access to reticulated (piped) natural gas.

Electricity can be used for heat pump systems, for boosting solar systems or for standard storage water heaters where permitted. A three-phase electricity supply is usually needed for instantaneous systems but new systems under development might be suitable for single phase supply. They could be used in areas where long pipe runs mean heat losses are significant and the water heater located at the source of hot water use can produce a lower overall energy use.

Electric storage water heaters

Standard electric storage water heaters use a heating element inside the tank to heat the water, just like an electric kettle. When powered using mainland grid power in Australia, they are responsible for the most greenhouse gases of any water heater and are being phased out for household use (*see 'Electricity' above*). Their emissions can be greatly reduced by using GreenPower or other renewable energy to run the water heater.

Greenhouse intensive (electric) hot water services are being phased out across mainland Australia.

Electric storage water heaters of less than about 150L usually use peak electricity and are often the most expensive water heaters to run, though they may be cost effective for households with low hot water use.

Larger electric storage water heaters generally use cheaper off-peak electricity tariffs, where available, heating water at restricted times (usually overnight).

To reduce the chance of running out of hot water, tanks are often oversized and overheated, increasing energy consumption and greenhouse gas emissions. An electric storage water heater can indirectly produce as much carbon dioxide each year as the average family car.

An electric storage water heater may be cheap to buy but is probably expensive to run. Take this into account when deciding which water heater to buy.

Electric instantaneous water heaters

Electric instantaneous water heaters have to be connected to the day-rate tariff, so the running costs will probably be higher than with an off-peak storage system. However, because there's no tank to lose heat, they're cheaper to run than day-rate storage heaters (Barnes 2011). Modern models have better temperature control than older ones and are now being used more in apartments.

Hot water tips

Reducing hot water use is a great way to save on energy bills, regardless of the type of water heater. (see *Reducing water demand*)

Showering uses the most hot water in an average household. Installing a water efficient (at least 3 star) showerhead can reduce this use by about half. If you have a continuous flow water heater, make sure that the water efficient showerhead is compatible and does not reduce flow excessively. Check with the heater manufacturer. Of course, it's preferable to buy a continuous flow HWS that is compatible with a water-efficient showerhead!

Use a shower timer to remind everyone in the household to save water (and energy).

Buy washing machines and dishwashers that have a cold or warm water or economy cycle option and use these cycles as much as possible.

Immediately repair dripping hot water taps and leaking appliances, including the relief valve from your water heater. (A relief valve protects storage water heaters by relieving excess pressure in the system; if a bucket placed under the valve fills in a day, it needs replacement.)

Set the thermostat on storage HWSs to at least 60°C. A higher temperature means that energy is used unnecessarily and a lower temperature may allow harmful bacteria to thrive. Continuous flow HWSs should be set to no more than 50°C.

Mixer taps can increase hot water use as they mix hot and cold water together in the centre position. In bathrooms or other locations with long pipe runs to the tap, one or more litres of hot water is wasted in the pipe and only cold water comes out. If you do not need hot water or need it only for short uses, move the mixer tap to the cold position.

Maintain the system and have it serviced according to manufacturer's instructions.

Choosing a hot water service

From the many different types of water heaters on the market, select a hot water system that suits your needs, where you live and your budget. Choosing a hot water system is a decision you may only make a few times in your life. Spending time researching your options will ensure you purchase a system that provides enough hot water, saves you money and reduces your household's greenhouse gas emissions.

When selecting a system, it's crucial you consider the following matters.

Household size — The number of people living in your home and your hot water consumption patterns (i.e. whether you all shower at the same time of day; run the dishwasher, washing machine and bath at the same time) determine optimal system size and help identify the best system and energy source for your needs. The use of efficient showerheads reduces the volume of hot water and should be taken into account when sizing an HWS.

Cost — Both the purchase cost and operating costs of your HWS need to be considered. The energy used by your water heater impacts on your energy bill for years to come so consider carefully before buying. Specific operating costs depend on the type of system and energy costs. The amount of solar energy input and energy costs vary depending on your location (see www.livinggreener.gov.au for running costs and tariffs). A low running-cost HWS may also increase resale value of a home.

When choosing a hot water service consider: household size, cost, available space, solar access, existing HWS and available energy sources.

Space available — It may not be possible to install some systems in existing homes with lack of space or a difficult layout.

Solar access and adequate north facing roof space — They must be available if a solar HWS is to be installed (*see 'Installation'*).

Existing water heater — Some existing HWSs can be easily converted to more sustainable types. For example, some standard electric storage systems can be attached to a split system — heat pump or solar HWS unit.

Available energy sources — Your choice may also be limited by available energy sources. Natural gas is not available in some areas. Solar or heat pump HWS units may be more attractive where gas is not available. Considerations such roof space and shade may impact of being able to install solar. LPG can be quite expensive if you use a lot of hot water — tariffs are similar to a day rate tariff for electricity.

The energy source of an HWS has a large impact on greenhouse gas emissions. A natural gas HWS typically generates fewer greenhouse gas emissions than an electric storage HWS, and a solar or heat pump HWS can generate even fewer greenhouse gas emissions.

Photo: Solar Solutions Design and Drafting

Solar hot water services work best on a northern aspect with little shade.

Local climate — Sunny locations with good solar radiation allow solar HWSs to operate most effectively. In warm climates, less energy is also needed to raise the temperature of water storage tanks, as the difference between the cold water temperature and the required hot water temperature is smaller, and less heat is lost in higher air temperatures.

Greenhouse gas emissions — The amount of emissions generated by your HWS depends on the:

- greenhouse intensity of the energy source
- efficiency of the hot water appliance
- amount of solar radiation available for a solar HWS
- amount of heat available in the ambient air for a heat pump HWS
- amount of heat lost by hot water storage tanks, fittings and pipes to the outside air
- volume and times of day that hot water is consumed.

Use the following recommendations to help minimise greenhouse gas emissions:

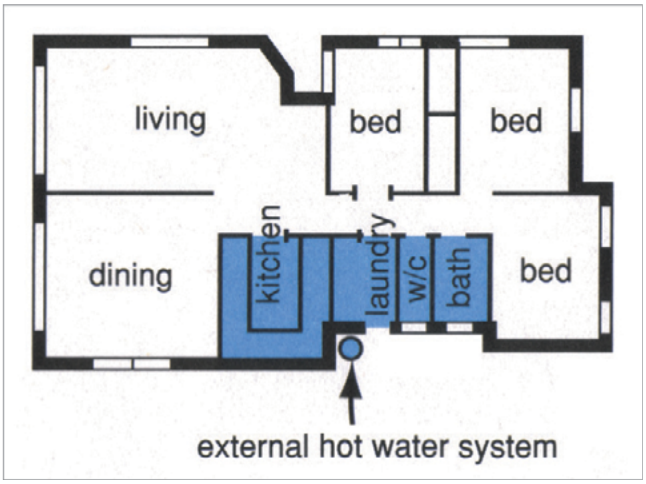
- Where gas is available and solar access is good, a gas boosted solar water heater or high performance solar-electric HWS generates the lowest greenhouse gas emissions.
- Where gas is available but solar access is poor, a continuous flow gas system or air-sourced heat pump is usually the lowest emission option for small to medium households.
- Where gas is not available, an electric-boosted solar system or an air-sourced heat pump minimises emissions.
- For multi-residential developments, a large, cost effective central (or several shared) solar water heater can be effectively combined with instantaneous gas boosters, or with highly insulated small electric storage tanks or instant electric boosters in each unit. A geothermal heat pump could also be cost effective for blocks of five or more units. However, heat losses and pumping energy losses can be high with central systems and need to be considered when deciding if a central solar system is more efficient.

System design and installation

About 30% of the energy used to heat water in a storage system is wasted in heat loss from the tank and associated pipework and a higher proportion can be lost by householders with low hot water consumption. This loss can be reduced through careful design and installation.

Reduce heat loss from storage systems with careful design and installation.

Keep hot water pipes as short as possible to minimise heat loss. In new or renovated homes, locate wet areas close together with the water heater close to all points of hot water use. If this is not possible, locate it close to the kitchen where small, frequent amounts of hot water are used. Avoid installing mixer taps, which waste hot water unless they are very carefully used.



Source: SEAV

Locate wet areas close together with the water heater close to all points of hot water use.

Estimate your hot water needs accurately to ensure your system is not oversized or undersized for your household. If storage system tanks are too small for the number of people in the house, hot water can run out. If the tank is too large, operating costs are excessive unless it (as well as fittings and supply pipes) is very well insulated. Carefully consider your hot water needs and match the system to your requirements. A smaller system may provide adequate hot water and reduce storage heat losses, especially with water efficient showerheads and taps. Consider installing a high efficiency continuous flow water heater if your hot water needs are small, or intermittent.

Storage systems lose heat through the tank walls. Reduce heat loss from electric hot water heaters or gas storage HWSs with electronic ignition by wrapping the tank with an insulation blanket. Such blankets are unsuitable for gas storage systems with pilot lights because the stored water may be overheated (especially in hot weather).

Insulate hot water pipes, particularly externally exposed pipes leading from the water heater to the house and the pipe leading to the relief valve (on storage systems). The BCA now specifies minimum pipe insulation.

NOTE: Standard green lagged hot water pipes are inadequate for external protection in cold and cool temperate climates. R0.6 or better significantly reduces temperature losses. (R0.6 = 25mm of closed cell polymer or equivalent; R1.0 = 38mm of fibreglass or equivalent.)

The pipes taking hot water from the water heater or storage tank to the tempering valve (required to limit hot water to 50°C to prevent scalding) should be as well insulated as possible to minimise pipe heat losses. Be sure to comply with your state or territory government requirements for locating a tempering valve.

> *Leave mixer taps in the cold position and use hot water only when necessary.*

Design new homes with a roof pitch and orientation suitable for a solar water heater. You may not want to install one now but it leaves the option open for the future. A north-facing roof with a pitch of between 22° and 40° is usually adequate. Frames can be used for other roof pitches.

A hot water supply system must be designed and installed in accordance with Section 8 of AS/NZS 3500.4:2003, Plumbing and drainage — heated water services (including amendment 1) or clause 3.38 of AS/NZS 3500.5:2000, National plumbing and drainage — domestic installations (including amendments 1, 2 and 3). A solar hot water supply system located in climate zones 1, 2 or 3 (see *Design for climate*) is exempted from complying with these requirements. For further information see the BCA Volume 2, Part 3.12.5.

References and additional reading

Contact your state, territory or local government for further information on hot water services and the rebates available. www.gov.au

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