

MORAIRA PLUMBING HEATING

solar hot-water systems

Next time you get a really big [electricity](#) or gas bill, your

thoughts may turn to solar panels. Wouldn't it be good if you could catch all the power you need from the Sun? Millions of people already do get their energy this way, though mostly in the form of heat rather than electricity. Solar electric panels (also called [solar cells](#) or photovoltaic cells) that convert sunlight to electricity are still not widely used; **solar thermal panels**, which use sunlight to produce hot water, are much more common. Even in relatively cold, northern climates, solar hot-water systems can chop significant amounts off your fuel bills. Typical systems generate anything from 10–90 percent of your hot water and pay for themselves within a few years (even sooner if you're using them for something like a swimming pool). Let's take a closer look at how they work!

How to build a solar heating system



Imagine you're an inventor charged with the problem of developing a system that can heat all the hot water you need in your home. You've probably noticed that [water](#) takes a long time to heat up? That's because it holds [heat energy](#) very well. We say it has a high **specific**

heat capacity and that's why we use it to transport heat energy in central heating systems. So can we devise a simple solar heating system using water alone?

Stand a [plastic](#) bottle filled with cold water in a window, in the Sun, and it'll warm up quite noticeably in a few hours. The trouble is, a bottle of water isn't going to go very far if you've a house full of people. How can you make more hot water? The simplest solution would be to fill lots of bottles with water and stand them in a row on your window-ledge.

Or maybe you could be more cunning. What if you cut the top and bottom off a plastic bottle and fitted pipes at each end, feeding the pipes into your home's hot water tank to make a complete water circuit. Now fit a pump somewhere in that loop so the water endlessly circulates. What will happen is that the sunlight will systematically heat all the hot water in your tank (although it'll never get particularly warm because plastic bottles standing on window-ledges aren't that brilliant at collecting heat). But, in theory, you've got a working solar heating system here that's not a million miles away from the ones people have installed on their homes. It's very crude, but it works in exactly the same way.

The parts of a solar-thermal hot-water system

In practice, solar heating systems are a little bit more sophisticated than this. These are the main parts:

Collector

This is the technical name for the big black panel that sits on your roof. Smaller homes (or ones in hotter climates) can get away with much smaller panels than larger homes (or ones in colder climates); typically collectors vary in size from about 2–15 square meters (~20–160 square feet). Not surprisingly, collectors work most efficiently on south-facing roofs that have a direct, unblocked view of the Sun (with few trees or buildings in the way). Broadly speaking, there are two types of collectors known as flat-plate and evacuated tube.

Flat-plate collectors

Flat plates are the simplest collectors: at their most basic, they're little more than water pipes running through shallow metal boxes coated with thick black [glass](#). The glass collects and traps the heat (like a greenhouse), which the water running through the pipes picks up and transfers to your hot water tank.

Evacuated tubes

These are a bit more sophisticated. They look like thicker versions of fluorescent strip lights, but work more like [vacuum flasks](#). Completely empty (hence the name "evacuated"), they collect and trap the heat from sunlight. This flows to a collecting device (sometimes called a manifold) at the top (or at one end) through which water or another fluid flows, carrying the heat to the hot water tank. Unlike flat-plate collectors, they don't let as much heat escape back out again, so they're more efficient. However, since they're a bit more hi-tech and sophisticated, they are sometimes more expensive.

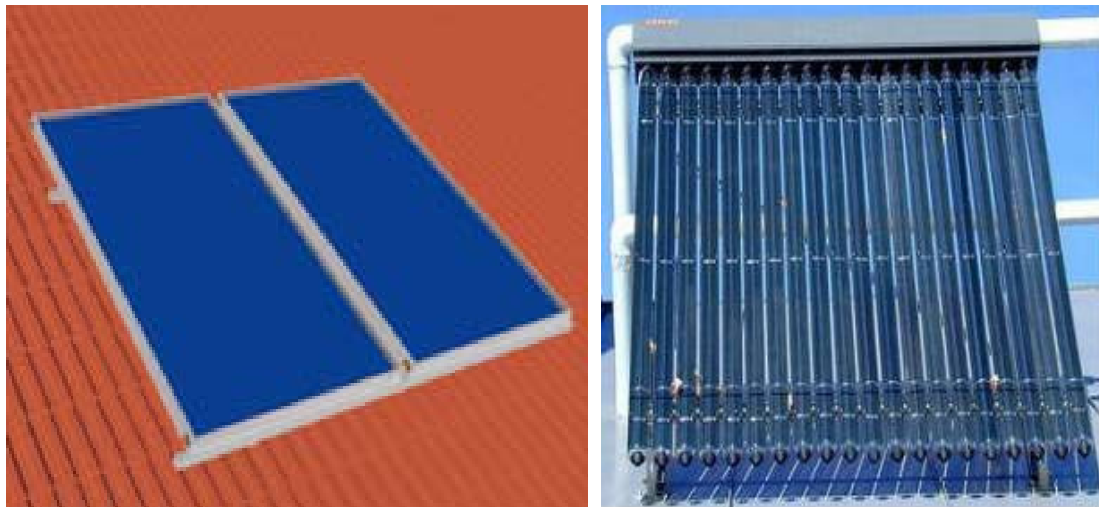


Photo: Two types of solar-thermal collector: Left: A flat-plate collector.

Right: An evacuated-tube collector. Note the grey manifold at the top and the white water pipe flowing through it.

Hot water tank

There's no point in collecting heat from your roof if you have nowhere to store it. With luck, your home already has a hot-water tank (unless you have a so-called gas "combi"[boiler](#) that makes instant hot water) that can be used to store heat from your collector; it's a kind of "hot water" [battery](#) that you heat up at conveniently economic times (usually at night) ready for use during the day. If you don't have a hot-water

tank, you'll need to have one fitted. The more people in your household, the bigger the tank you'll need. A typical tank for a family home might be about 100–200 liters (30–60 gallons). Approximately 50 litres per person per day.

Heat exchanger

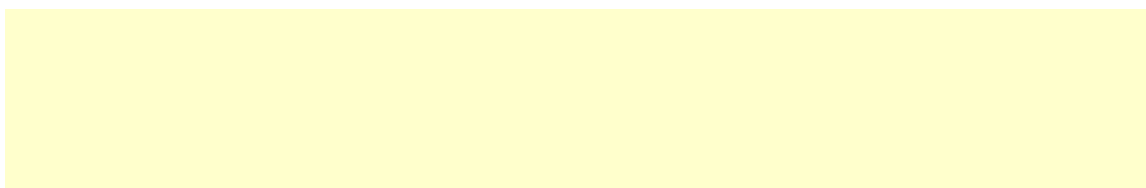
Typically, solar panels work by transferring heat from the collector to the tank through a separate circuit and a [heat exchanger](#). Heat collected by the panel heats up water (or oil or another fluid) that flows through a circuit of pipes into a [copper](#) coil inside your hot-water tank. The heat is then passed into the hot water tank, and the cooled water (or fluid) returns to the collector to pick up more heat. The water in the collector never actually drains into your tank: at no point does water that's been on your roof exit through a tap

Pump

Water doesn't flow between the collector and the tank all by itself: you need a small electric [pump](#) to make it circulate. If you're using ordinary electricity to make the water flow, the energy consumed by the pump will offset some of the advantage of using solar-thermal power, reduce the gains you're making, and lengthen the payback time. Cleverly, some solar-thermal systems use [solar-electric](#) (photovoltaic) pumps instead, which means they are entirely running on [renewable energy](#). A good thing about a design like this is that the solar pump is most active on really sunny days (when most hot water is being produced) and less active on cold, dull days (when, perhaps, you don't want your solar panel to be working at all).

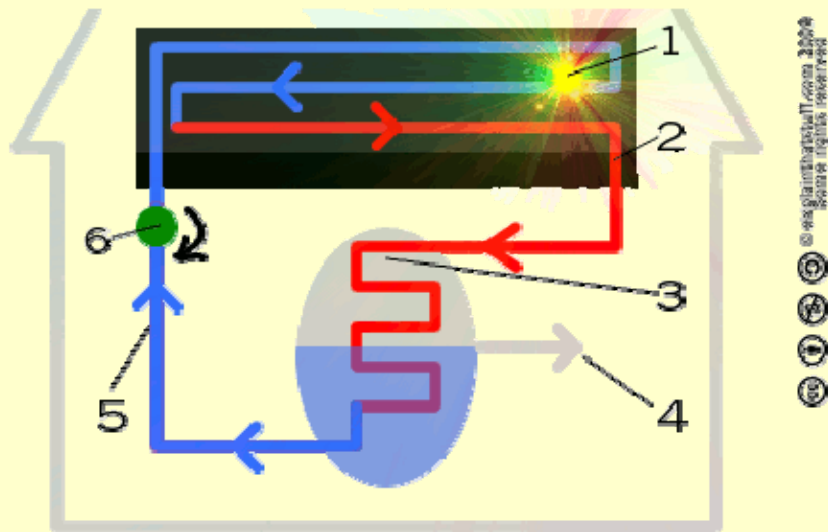
Control system

If it's the middle of winter and your roof is freezing cold, the last you thing you want is to transfer freezing cold water into your hot water tank! So there is also generally a control system attached to a solar-thermal panel with a [valve](#) that can switch off the water circuit in cold weather. A typical control system may incorporate some or all of the following: a pump, flowmeter, pressure gauge, [thermometer](#) (so you can see how hot the water is), and [thermostat](#) (to switch off the pump if the water gets too hot).



How solar-thermal panels work

Here's a simple summary of how rooftop solar hot-water panels work:



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1. In the simplest panels, Sun heats water flowing in a circuit through the collector (the panel on your roof).
2. The water leaving the collector is hotter than the water entering it and carries its heat toward your hot water tank.
3. The water doesn't actually enter your tank and fill it up. Instead, it flows into a pipe on one side of the tank and out of another pipe on the other side, passing through a coil of copper pipes (the [heat exchanger](#)) inside the tank and giving up its heat on the way through.
4. You can run off hot water from the tank at any time without affecting the panel's operation. Since the panel won't make heat all the time, your tank will need another source of heating as well—usually either a gas boiler or an electric immersion heater.
5. The cold water from the heat exchanger returns to the panel to pick up more heat.
6. An electric pump (powered by your ordinary electricity supply or by a solar-electric (photovoltaic) cell on the roof keeps the water moving through the circuit between the collector and the water tank.