

## Introduction |

Solar collectors provide a simple and effective way to supplement water heating and reduce fossil fuel use. There are over 40,000 solar water heating systems operating in the UK. Most of these are only used to heat water for washing and bathing, but there are systems available that pre-heat the central heating water.

In the UK, the energy captured by a solar water heating system is much greater in summer and is therefore out of phase with the demand for heating in winter. This problem can be solved in part by using a very large storage tank.

## Technology |

There are two common designs of solar collectors for water heating: flat plate and evacuated tubes. Both contain a fluid which is heated in the collector to transfer heat to a storage cylinder which is usually larger than a domestic hot water cylinder. The collector will still heat water on overcast days, however most systems are designed to work with an existing boiler or an electric immersion as a supplementary heat source.

**Evacuated tube** collectors consist of an array of tubes, an insulated manifold header where heat is transferred from the tubes to the fluid and a supporting frame. Each tube measures approximately 50 mm in diameter x 1500 mm long and panel sizes range from 10 to 30 tubes.

**A flat plate collector** consists of a thin absorber sheet (usually copper, to which a black or selective coating is applied) backed by a grid or coil of tubing and placed in an insulated casing with a glass cover. The absorber collects solar heat which is transferred to a fluid circulating through the tubing. A heat exchanger then delivers the heat to the hot water system. Some systems circulate water through the collector so that it is heated directly before being circulated to the hot water cylinder.

Because of their curved shape, evacuated tubes maintain a more constant area of collector perpendicular to the sun and therefore a more even heat output over the day. Their higher efficiency means the area of collector will be smaller, however they tend to have a higher profile and tend to be more expensive. In practice, the efficiency of the collector is not the only important aspect in overall performance and a quote for both types of system should be obtained.



A variety of solar hot water panels

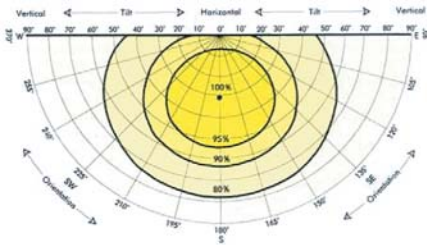
**Top & middle photos:**

Examples of flat plate collectors.

**Bottom:**

Evacuated tube collectors and PV panels.

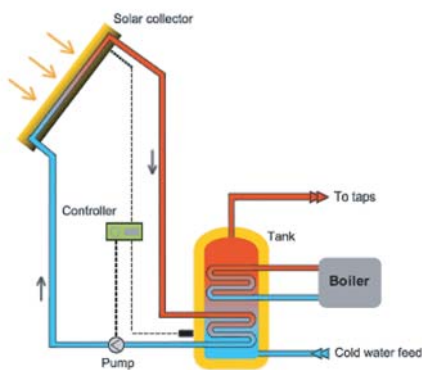
## Site Suitability |



**Fig 1:** Illustration showing the effect of panel orientation and angle on performance, the dark yellow indicates best performance.”

Solar water heating can easily be integrated into pre-existing buildings, or added to new designs. Solar collectors perform best when mounted facing due south at an angle between 25-65°. This angle corresponds to the roof pitch of most domestic properties in the UK. Panels can be mounted facing anywhere between southeast and southwest see **fig 1**.

Solar panels can be expected to produce around 40 to 60% of domestic hot water needs. The area of collector needed will depend on the amount of hot water needed per person per day, the number of people in the building and the orientation of the roof to be used. **Table 1** can be used to roughly size a system in the South West region (where insolation is slightly higher than the UK average) and is based on allowing 40 litres per person per day, typical of domestic use.



Orientation of collector	W	SW	S	SE	E
Number of people in house					
3	3	3	3	3	3
4	5	4	4	4	5
5	6	5	5	5	6
6	7	6	6	6	7

The table assumes that the system will be used for water heating only, not for space heating and that a flat plate system is used (an evacuated tube system would require around two thirds of the area).

Conventional systems use a mains powered circulation pump whenever the hot water tank is positioned below the solar panels. Most systems in northern Europe are of this type. The storage tank is placed inside the building, and thus requires a controller that measures when the water is hotter in the panels than in the tank. The system also requires a pump for transferring the fluid between the parts. Newer zero-carbon solar water heating systems use solar electric (photovoltaic or PV) pumps. These typically use a 5-20 W PV panel which faces in the same direction as the main solar heating panel and a small, low flow diaphragm pump to pump the water.

A conventional system uses a twin-coil, indirect hot-water tank. This tank is normally 200 litres or more, making it 1500 mm high. The lower part of the tank is heated from the solar coil, and the upper part is heated by the boiler. Alternatively, a single-coil tank can be used, with the upper part heated by an electric immersion heater.

Although solar water heating systems are usually designed to work with a hot water cylinder, it is possible to install a solar water heating system if you have a "combi" boiler that has no hot water tank. If you have a combi boiler, the solar panel would "pre-heat" water that passes through the boiler, reducing

the amount of fuel needed to bring the water up to temperature. Solar heated water would be stored in new a hot water tank that would feed the boiler. Solar-heating systems can be sealed, in which the system is full of water all the time, or 'drain-back' systems, in which the water in the collector drains back into the storage tank when the pump is not running. The benefit of the 'drain back' system is that it is not necessary to fill the system with anti-freeze to prevent winter freezing, nor is it necessary to install heat-escape mechanisms to prevent boiling on hot days when the water is not being used - such as when the house is unoccupied.

## Issues |

Solar panels should ideally be mounted on south-facing, unshaded roof areas, as shading will reduce the energy output of the panels. Panels are, therefore, usually mounted in a visible position.

### **Planning Permission**

Planning permission will not normally be needed for a domestic system, unless it is a listed building or in a conservation area. It is best to talk to the local planning department before starting the project, providing them with details of the technology, its scale and location will ease the planning application process.

### **Maintenance**

Solar water heating systems should last for around 25 years. They generally come with a ten-year warranty and require very little maintenance. A yearly check by the householder preferably with a cleaning of the collector surface, and a more detailed check by a professional installer every three to five years should be sufficient maintenance. Some systems which do not drain back out of the collector use anti-freeze that many have to be replaced approximately every 10 years.

## Finance |

**Output and Payback.** A domestic solar water heating system might generate around 1500kWh/year. For a typical house, at current fuel prices this equates to around £45 per annum saving if you have a gas boiler and £160 if you currently use electricity to heat your water [LR]. Domestic scale systems have payback periods of more than 10 years.

## Sizing Tools |

A very simple but approximate sizing tool for schools is available to download from The Centre for Energy and the Environment ([www.ex.ac.uk/cee/re](http://www.ex.ac.uk/cee/re)). For homes and other buildings, a more accurate but complicated free sizing tool can be downloaded from RETSCREEN ([www.retscreen.net/ang/t\\_software.php](http://www.retscreen.net/ang/t_software.php)).

## Costs and Grants |

The price for a complete DIY domestic solar water heating system ranges from £1100 to £2500 depending on size, type and manufacturer. Installed price ranges from £2500 to £5000, including VAT at the reduced rate of 5%. Prices for non-domestic systems vary widely depending on system size.

The Low Carbon Buildings Programme from the DTI can offer a maximum £400 regardless of size, subject to an overall 30% limit (exclusive of VAT) for home owners; for larger buildings a maximum of 40-50% of total costs (excluding VAT) can be received. For further information see [www.lowcarbonbuildings.org.uk](http://www.lowcarbonbuildings.org.uk)

**For more details see Grants section**

## More Information |

- A list of installers can be found on the Regen SW website at [www.regensw.co.uk/directory](http://www.regensw.co.uk/directory)
- See Chapter 5 for case studies.
- New and renewable energy technologies for existing housing (CE102) Energy Saving Trust ([www.est.co.uk/myhome/publications/](http://www.est.co.uk/myhome/publications/))
- Solar hot water systems in new housing - a monitoring report (GIR88) Energy Saving Trust ([www.est.co.uk/myhome/publications/](http://www.est.co.uk/myhome/publications/))

## References |

LR Based on data in the London Renewable Guide