

# SOLAR ENERGY

The energy from the sun is used all the time in everyday situation. The radiations from the sun naturally warms objects, people and space; this is called passive solar heating. Solar energy can also be collected via specific panels and is therefore called active solar heating. The most popular type of panel is the solar water heating collector. These panels absorb the energy from the sun and distribute it to the water used for showers, baths, etc. The other type of panel is called a photovoltaic panel (PV) which has special components that will transform the sun's radiation directly into electricity.

## Passive Solar

Passive solar energy is nothing new. About 14% of space heating in an ordinary British home comes from solar energy through walls and windows. Passive solar design tries to optimise the amount of energy that can be derived directly from the sun.

By incorporating passive solar design into new buildings, annual fuel bills can be cut by up to a third, with corresponding carbon dioxide savings. This helps to reduce global warming. In addition, the increased daylight means that the need for additional electric lighting is lowered.

## Did you know... ?

Over 25% of UK primary energy goes towards heating buildings, more than for any other purpose!

## Solar Water Heating

Solar water heating systems are the most popular form of solar energy used in the UK. The panels are installed on a roof which is south facing but anywhere between south east and south west is fine. For maximum output the panel should be angled towards the sun.

The fluid that circulates in the panel is in a closed circuit because it is a mixture of water and anti-freeze. Without anti-freeze the water would expand during the winter as it freezes and damage the panel. When the sun shines the temperature of the fluid in the panel rises. It is then circulated to the tank, where it transfers its heat to the water via a heat exchanger (see diagram below).

Solar water heating systems can provide over half of a household's hot water requirements over the year. In the summer, a solar water heating sys-

tem can produce most of the hot water needs but the contribution in winter is less. There are now over 50,000 solar water heating systems installed in the UK.

There are two main types of solar water heating collectors: flat plates collectors and evacuated tubes.

## Flat Plate Collectors

Solar water heating panels in their simplest form are made of copper tubes attached to a sheet of metal, which increase the surface area. The metal sheets are coated with a special low emissivity black paint that absorbs and retains the heat from the sun.

The metal sheets and tubes are embedded in an insulated box, which prevents the heat from escaping and covered with glass or clear plastic on the front to maximise solar gains.

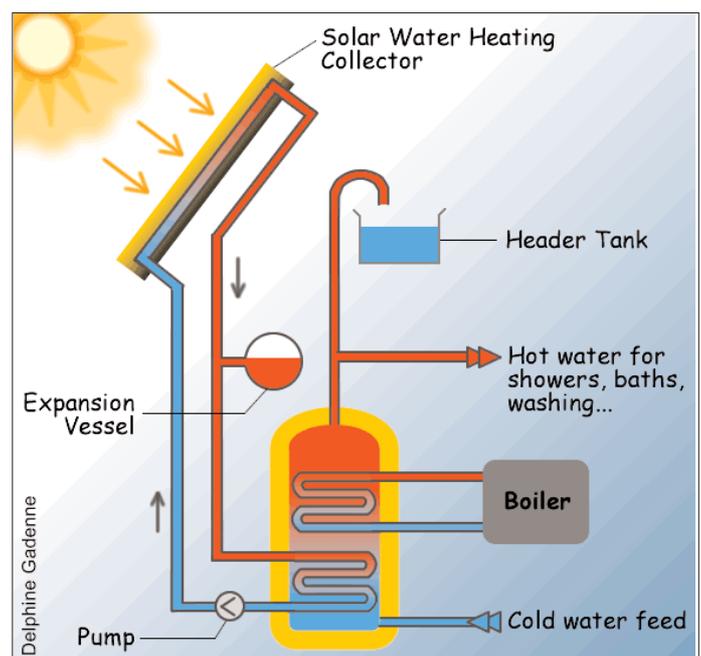


Fig. 1: A Solar Water Heating System

## Evacuated Tubes

Collectors can be made of a series of vacuumed glass tubes. The heat transfer liquid is in a finned pipe in the centre of the tube and is heated up by the sun as in flat plate collectors. The vacuum in the tube is very effective at preventing heat losses ensuring good capture of the solar energy.

## Photovoltaic (solar electric)

The word *photovoltaic* (PV for short) comes from the Greek "photos" which means light and "volt" which is the name of the force that causes the electrons to move.

### How does it work?

Photovoltaic panels consist of a series of solar cells, which produce around half a volt each. Solar cells are made of special materials that can transform the energy from the sun into electricity. Silicon, which has been treated to make it photo-sensitive is the most common material used.

A Panel of 30 cells produce a voltage sufficient to charge a 12 volt battery. Larger modules or arrays of modules are used to generate power for the grid (see fig.2). However, small devices such as calculators can also use PV panels to supply energy.

### Did you know... ?

A typical system for a house will measure between 10-40 m<sup>2</sup> and will generate between 1,000 and 3,000 kWh per year, which will save up to 4 tonnes of carbon dioxide emissions!

### PV in the house

PV arrays are typically mounted on a roof facing south and angled at 30° with the horizontal for optimum performance in the UK. They feed the power via an inverter which converts 12 Volt direct current (DC) into 240 Volt alternating current (AC) needed for all main appliances in the house. The panels are also connected to a 2 way meter. This allows the householder to sell the electricity to the grid when the panel is producing more energy than needed and to import energy

from the grid when the panel is not producing enough electricity (at night time for example).

Photovoltaic panels are also used in remote areas where a grid connection would be too expensive to install. In this case the panels need to be connected to a series of batteries which will store the electricity from the panel.

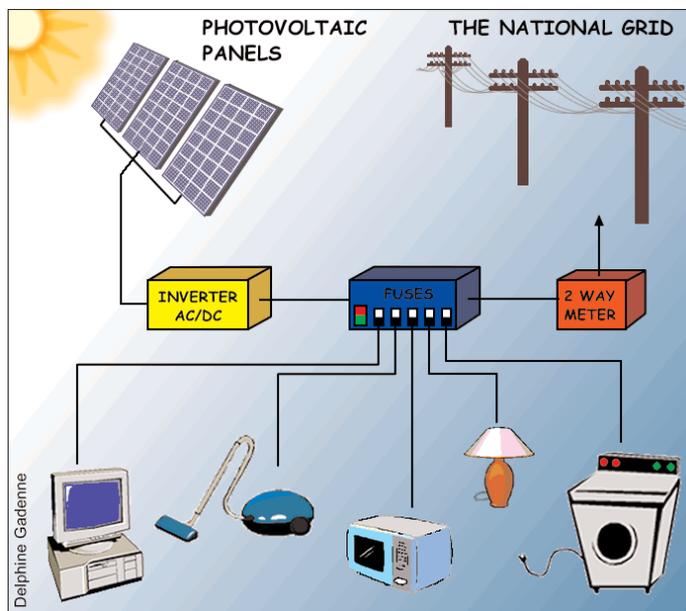


Fig. 2: A Photovoltaic System Connected to the Grid

At a smaller scale, PV panels can be used in caravans and also in boats to power nautical equipment and other devices.

### Did you know... ?

The International Space Station has the largest solar power system ever taken into space. It measures 73 metres tip-to-tip and provide enough electricity to run 15 average-sized homes.

### Small Solar Devices

Although the use of photovoltaic panels is still at an early stage for householders mainly because of the cost, it is widely use for small devices. One common example is the solar calculator. There are many other use of photovoltaic panels such as burglar alarms, parking meters, torches, fountains, etc. Obviously most of these items contains small batteries charged by the solar panel to make sure they continue to work at night time.

**Sponsors:** The National Energy Foundation, The Department of the Environment Transport and the Regions, Student Force, PowerGen

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