

Photovoltaic (PV)

What is Solar Photovoltaic (PV) technology?

Photovoltaic technology means converting solar light directly into electricity. Thus, the most abundant free energy - that from the sun - can be harnessed to power domestic electrical equipment such as kitchen appliances, computers, and lighting. This is different from solar thermal technology used for hot water.

The technology consists of PV cells connected together in PV modules (panels or arrays) which are semiconductors, typically made of crystalline silicon. When exposed to sunlight, the PV cells produce direct current (DC) electricity, which in order to use in the home is conducted to an inverter and transformed into AC electricity. The PV cells respond to both direct and diffuse solar radiation, meaning that even in overcast days a PV system can produce electricity. The output however is greater when there is more sunshine. The conversion efficiency range is between 5-15%.

Are PV systems suitable for domestic use?

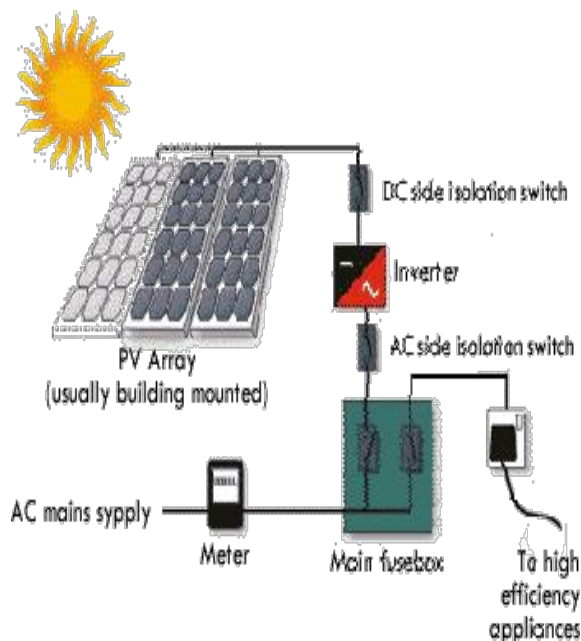
PV technology is ideally suited to use on residential buildings, providing pollution and noise-free electricity without using extra space. The use of photovoltaics in households has grown substantially in the UK over the last few years, with many impressive examples already in operation (see photo). PV systems can be incorporated into buildings in various ways. Sloping rooftops are an ideal site, where modules can simply be mounted using frames. Photovoltaic systems can also be incorporated into the actual building fabric, for example PV roof tiles are now available which can be fitted as would standard tiles.



Grid connected PV systems

In urban areas domestic PV systems are normally connected to the grid in order to maximise their utility. When the solar system is generating more electricity than is being used, the excess automatically flows into the grid and is sold to the power supply company servicing the household. When the power demand is greater than what the system is generating, electricity is automatically drawn from the grid.

How does a typical system work?



1. PV array

Daylight reaches the PV array and is converted to electricity, even on cloudy days. There are no moving parts so this happens silently.

2. Inverter

The electricity generated by the roof is DC (direct current). An inverter makes it AC (alternating current), in sync with mains electricity so that it can be used normally

3. Main fuse box

The solar electricity is fed into the mains via your fuse box, for safety

4. Meter The PV array generates electricity during the day. Spare electricity automatically flows out to the grid and is sold back to your electricity supplier. Fitting an extra electricity meter will measure how much you export

5. Peak demand and at night

Extra power is always available from the grid at times of high demand or when the PV system does not generate electricity (night time)

Where to put a PV system?

A house roof is ideal for installing a PV system – there is plenty of ‘unused’ space, the visual intrusion is minimal, and direct exposure to sun light is the greatest. Roof conditions of course vary and several key factors should be taken into consideration when assessing the solar potential of your home:

- **Orientation** - PV systems are most effective on roofs facing south, south-east and south-west (up to 95% efficiency). In the UK, a north-facing PV roof will operate at about 60% efficiency
- **Tilt** – PV products are suitable for pitched, flat and curved roofs. The optimal angle for the UK is 30°-40°. A minimum tilt of 15° is recommended to allow the rain to wash dust off the array.
- **Available area:** The more surface area available, the greater the power potential. For a grid-connected system the minimum required area is approximately 8-10 m²
- **Shadowing** – the roof must not be shaded by objects like tall trees or neighbouring buildings. Even minor shading can result in significant loss of energy

Types of PV systems

- **Roof mounted** - PV modules can be fixed on frames above the existing tiles
- **Roof integrated** - PV modules can be an integral part of the building structure replacing conventional roof tiles. This is particularly cost-effective if you are planning re-roofing



Planning permission

PV roofs do not usually require planning permission and typically fall within what is known as "permitted development rights". However, if you live in a house divided into flats or the building is listed or in a conservation area you should call your council to check on local policy

How much electricity will a system generate?

A well-positioned PV system of 1 kWp (kilowatt peak) capacity would generate approximately 750kWh/year. Respectively, a typical 2 kWp system would generate around 1500 kWh per year, which is roughly 50% of the average electricity consumption of an average household (provided heating, hot water and cooking are non electric).

Costs

Prices for PV systems vary, depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required.

For the average domestic system, costs can be around £4,000- £9,000 per kWp installed, with most domestic systems usually between 1.5 and 2 kWp. Solar tiles cost more than conventional panels, and panels that are integrated into a roof are more expensive than those that sit on top.

Grants

Currently, the Government offers straightforward grants for solar PV installations under the DTI's Low Carbon Buildings Programme. For small-scale domestic systems the grants are: Maximum £3,000 per kWp installed, up to a maximum of £15,000 subject to an overall 50% limit of the installed cost (exclusive of VAT).

For more details visit: www.lowcarbonbuildings.org.uk or call 0800 915 0990. Typically the supplier/installer will help you with the grant application. Alternatively The Oxford Solar Initiative will assist you with that – call 01865 252197.

What are the benefits of individual house PV systems?

- Provides you with your own clean power source that helps reduce global warming
- Reduces your electricity bills, since daylight is free
- Increases the value of your property
- Extremely low maintenance, with a long functional lifetime of 30 years or more
- Silent in operation and visually unobtrusive
- Increases your awareness of electricity use and encourages more energy efficient behaviour