# Photovoltaic (PV) - Solar Electricity

FACTSHEET 4

## Introduction

Energy from the sun has been harnessed for thousands of years. We utilise this energy in three main ways:

- Passive heat: This is the heat that we receive from the sun naturally. This can be taken into account in the design of buildings so that less additional heating is required.
- Solar thermal: Where we use the sun's heat to provide hot water for homes or swimming pools. We cover this topic in another fact sheet.
- Photovoltaics (PV): Uses energy from the sun to create electricity to run appliances and lighting. PV requires only daylight - not direct sunlight - to generate electricity. When talking about solar energy it is important to distinguish between these three types.

### How PV technology works

Photovoltaic systems use cells to convert solar radiation into electricity. The PV cell consists of one or two layers of a semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity.

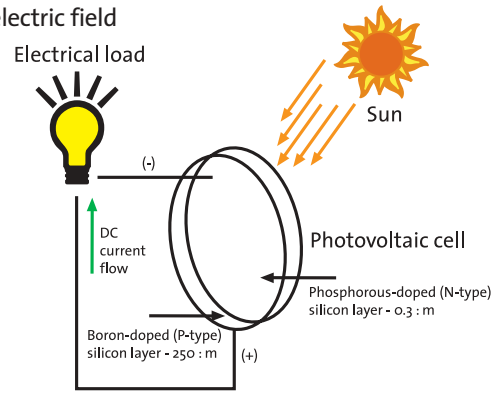


*Fig 1: Principles of PV Cells*

PV systems generate no greenhouse gases, saving approximately 450kg of carbon dioxide per year for each kW peak installed (Kilowatt (kW) peak - PV cells are referred to in terms of the amount of energy they generate in full sun light). The three main types of solar cells are:

- Monocrystalline: made from thin slices cut from a single crystal of silicon. This has a typical efficiency of 15%.
- Polycrystalline: made from thin slices cut from a block of silicon crystals. This has a typical efficiency of around 12%.
- Thin Film: made from a very thin layer of semiconductor atoms deposited on a glass or metal base. This has a typical efficiency of 7%.

Individual PV cells are connected together to form a module. Modules are then linked and sized to meet a particular load (need). The result is a PV array. A PV array supplies power to the building it is fitted on. If the building has mains electricity, any excess electricity can be exported to the grid. Alternatively, when demand is high, extra electricity can be purchased from the grid through the utility companies. Where there is no mains supply, PV arrays can be used to charge batteries.

PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles, to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity.

*Fig 2: A large array of solar panels for a household*

### Applications

There are many applications for PV, ranging from calculators, solar torches and battery chargers to integrated systems for homes, offices, factories and public buildings. Stand alone applications include solar powered street lighting, parking meters and bus shelters. You can use PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it. If the roof surface is in shadow for parts of the day, the output of the system decreases. Another consideration is that the roof

must also be strong enough to hold the significant weight of the panels, especially if the panel is going to be placed on top of existing tiles.

## Domestic Installations

The size of a PV array required to provide electricity for a typical home varies, depending on a number of issues; load requirements (what you want it to power), the type of cell used, roof space available and budget. Typical systems are generally around 1.5kWp, enough to provide around a third of the average family's annual supply (assuming gas is used for heating requirements and there are no energy efficiency savings). This array would typically cover 10-15$m^2$ of roof area.

*Fig 3: Typical domestic installation*

Solar PV installations should always be carried out by a trained and experienced installer. The Energy Saving Trust manages an accreditation scheme for PV installers - see below for further information.

## Cost and maintenance

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 to be supplied.

For the average domestic system, costs can be around £5,000-£7,000 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. If you intend to have major roof repairs carried out it may be worth exploring PV tiles as they can offset the cost of roof tiles.

Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem. The wiring and components of the system should however be checked regularly by a qualified technician. For stand-alone systems, i.e. those not connected to the grid, further maintenance is required on other system components, such as batteries.

## Planning considerations

Some local authorities require planning permission to allow you to fit a PV system, especially in conservation areas or on listed buildings. Always check with your local authority about planning issues before you have a system installed. Obtaining retrospective planning permission can be difficult and costly!

## Are there any grants available?

Yes, funding is available from the DTI's Major PV Demonstration Programme which is managed by the Energy Saving Trust. To find out more contact the Hotline on 0800 298 3978 or access www.est.org.uk/solar

## Where can I get more information?

The Scottish Community and Householder Renewables Initiative (SCHRI) is funded by the Scottish Executive as a one-stop shop providing funding, advice and project support to further the development of small-scale renewables in Scotland. A network of 12 SCHRI Development Officers are in place to provide an advisory and project management service for community groups within their local regions; to find your nearest Development Officer contact the Hotline on 0800 138 8858.

Information and advice for householders is provided by SCHRI via the Energy Efficiency Advice Centre (EEAC) network which is managed by EST to provide free and impartial advice on energy efficiency in the home. EEAC advisors have also been trained to provide advice about renewable energy technologies. To talk to a trained advisor contact your nearest EEAC on 0800 512 012.

## Useful links

- PV Grants website: www.est.org.uk/solar
- Scottish Community and Householder Renewables Initiative: www.est.org.uk/schri
- General overview of renewable energy, case studies, FAQs and other funding sources: www.saveenergy.co.uk/renewables
- PV-UK (the trade association of the UK PV industry; a wide range of information on PV applications, case studies etc): www.pv-uk.org.uk
- DTI renewables site: http://www2.dti.gov.uk/energy/renewables/

*Title picture courtesy of Proven Engineering*
*Figures 2 and 3 courtesy of solarcentury*