solar electricity

what is it?

Solar electricity is the generation of electricity from the power of the sun, via photovoltaic (PV) cells. It is different from solar water heating, where water passes through panels to be heated directly, and no electricity is generated.

Photovoltaic cells are made from silicon; when particles of sunlight (photons) fall on the cells, they dislodge the outer electrons of the silicon atoms, and push them along to the next atom; a chain of moving electrons is produced, and if a wire is attached to the panels, these electrons can be pushed down it to supply a useable electric current. This current is measured in amps, and to give some idea of the scale involved, one amp of current involves the movement of 6 million million million electrons per second.

The solar electricity produced this way (and also from batteries) flows in one direction only, and so is called direct current, whereas electricity from the UK national grid is alternating current, as the flow of electrons changes direction 50 times per second. Direct current can be stored in batteries to power 12 volt appliances. However, these are more expensive and less readily available than ordinary domestic 240 volt appliances, so batteries and an inverter can be used to convert the 12 volt direct current to 240 volt alternating current. Alternatively, the panels can be connected to the grid, with a meter to see how much electricity is put into the grid and how much taken from it. A grid-support system is one which charges batteries, and re-directs any surplus into the grid if the batteries are full.

Inverter with display for you to monitor the performance of your system.

what are the benefits?

As a renewable source of energy, the main environmental benefits of PV are based on the fact that it doesn't cause the problems that other types of electricity generation do.

Burning fossil fuels in conventional power stations releases nitric oxides, nitrogen dioxide and sulphur dioxide, causing acid rain which damages forests, wildlife and human health; it also releases carbon monoxide, nitrous oxides, lead, particulates and hydrocarbons, which cause damage to plants, ecosystems, and human health – especially respiratory problems. Also, burning fossil fuels releases 5 billion tonnes of CO_2 into the atmosphere each year. CO_2 is the most important of the 'greenhouse gases' responsible for global warming. Fossil fuel generation of electricity results in ten times the carbon emissions of solar PV per unit generated.

With PV solar electricity there are no emissions in use, no environmentally-damaging extraction and transport of coal and oil to feed power stations, and no radioactive waste, or the potential leaks and disasters associated with nuclear power stations. However, there are also environmental problems caused by the extraction of materials, manufacturing and waste associated with solar PV. These problems are less serious than the impact of fossil fuel extraction and burning, or the catastrophic nuclear disasters that seem to happen every 10-20 years. The application of technology will reduce the impact of PV in ways that are not possible for fossil fuels or nuclear.

PV modules generate between 9 and 34 times the amount of electricity in their lifetime as is used in their manufacture.

Large-scale use of lead-acid batteries cause environmental problems in their manufacture and disposal, so connection to the grid is better environmentally, unless in a remote location. Batteries do mean that you are autonomous though, and not subject to power cuts. The use of second-hand traction batteries can extend battery life 20 years if correctly maintained and used with a correctly-sized system.

Solar PV can democratise and decentralise our energy supply. Some technologies can only be controlled by the state or the corporate sector – like coal- or oil-fired or nuclear power stations. PV generation (although not the manufacture of the panels, yet) can be controlled by individuals and communities, along with other sources of energy such as wind, hydro or wood. Ivan Illich called these kinds of technologies 'convivial'. We don't think that control our energy supply should be with the state or a few giant corporations.

2kW installation on a flat roof in London.

what can I do?

The UK receives on average around 800kW of solar energy per square metre per year, which represents around a quarter of the annual requirement of a typical family. There's enough south-facing roof space in the UK to provide all the country's electricity needs using PV.

First find out how much electricity (in kilowatt-hours, kWh) you use in a year (check your bills – a kWh is a unit of electricity), and think about ways to reduce your usage: switch lights off when you leave the room; don't leave appliances on standby; use a laptop (c. 18 watts) instead of a desktop (c. 180 watts); use Savaplugs and low-energy lighting and appliances; don't overfill kettles; think about whether you need so much electrical gear at all.

A typical UK family will use about 3000-4000kWh per year, but if you are single with no children and / or reduce your electricity consumption, that figure might be 2000kWh per year. Taking the annual amount of sunshine into consideration, this will require a 2.4kW system. But any size system will help save money and carbon emissions.

There are no financial incentives for new installations, but with big reductions in the cost of parts over the last 10 years, it's sensible to fit your own system. As rules continue to change about whether and how much you get paid for the power you export to the grid, you might want to fit a diverter to send the power that would have been exported to a dedicated load, like your immersion heater, storage heater, or electric vehicle.

One of our course tutors (in the days before feed-in tariffs) installed panels and an inverter costing £3000, metered the electricity they produced, and compared the results to putting £3000 in the bank and paying his electricity bills from that. After 18 years the money in the bank was gone, but his PV system had paid for itself 6 years previously, and was still generating electricity. So payback times can be very project-specific, and can often be cost-effective even without government incentives.

The cost can't (easily) be reduced by self-build (like solar hot water), because the manufacturing process is too high-tech, but you could self-install if you have the know-how. Of course you could use PV in combination with a wind turbine to take advantage of all weather conditions.

Other factors to consider with solar electricity are: is your roof south-facing? Is it big enough? (if not, panels could be located on a frame in the garden or on a flat roof) Is it shaded? (If just one of your panels is partially shaded, it can affect all the panels in your system). If you're using batteries they need to be deep-cycle (able to be continuously drained and re-charged) with a charge controller to prevent overcharging.

See our further info section for everything you need to think about if you're considering a PV installation, and if you want to install a system yourself, have a look at our book, *Wind & Solar Electricity*, and/or our online course.

resources

- see lowimpact.org/solar-electricity for more info, courses, links & books, including:
- Andy Reynolds, *Wind & Solar Electricity*
- Michael Daniek, *DIY 12-Volt Solar Power*
- Brian Goss, *Choosing Solar Electricity*
- bpva.org.uk – British Photovoltaic Association
- science.nasa.gov/science-news/science-at-nasa/2002/solarcells – how PV works
- lowimpact.org/online-course-solar-electricity – online course

Solar roof tiles on a roof in Nottingham.