

A complete guide to solar PV

How it works, the costs, the installation process and the grants available ...



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The sun provides an abundant source of clean, renewable energy. This can be converted into electricity using solar photovoltaic panels, known as 'solar PV', installed on your roof. This electricity can power your home, save you money, and help to decarbonise grid supplied electricity.

How does solar PV work?

Solar PV systems – a collection of solar panels – turn sunlight into electricity through the 'solar cells' they contain. These cells are made from thin layers of a 'semiconductor' material (traditionally silicon) between layers of glass. Electricity leaves the panel as direct current (DC) and passes through an inverter that converts it to 240V alternating current (AC) that can be used in

your home. When your solar panels are generating, the electricity will be used in any appliances that are switched on at the time, such as a washing machine, TV and so on. Any surplus electricity in a typical setup will then be exported to the electricity grid. You can be paid for all the energy that you export through 'Smart Export Guarantee' tariffs with energy suppliers and payments vary between suppliers. If you want to store this excess energy to be used later, there is additional equipment that can be used to store this as hot water in a hot water cylinder, or as electricity through using a domestic battery.

How is a solar PV system rated?

Solar PV systems are rated in kilowatts peak (kWp). This is the maximum rate of electricity the array of panels could generate at peak performance, e.g. noon on a sunny day with the panels facing south. Kilowatt-hours (kWh) is the actual electricity generated by solar panels, the same measurement as on your household electricity bill. But a

1kWp collection of panels will rarely (if ever) generate 1kW power, most of the time the output will be lower. The kWp of a solar array depends on the size, type and number of panels, with a 3-4 kWp array being typical.

The amount of electricity produced annually is determined by the system location (e.g. which way the panels face) if there's any shade, how sunny it is and the size of the system in kWp. You can expect to generate between 700 and 900 kWh per kWp installed, but output varies a great deal from season to season. The average household uses around 3,000 kWh a year, but only some of this will be replaced with generated electricity unless you're careful to make the most use of it.

Is solar PV suitable for your home?

Before you invest in a solar PV system, you should check the following:

- Is your roof roughly south-facing? Solar panels need maximum exposure to the sun.
- Will trees or buildings cast shadows over the solar panels? Even a bit of shade will reduce the amount of electricity generated.
- Is your roof structurally sound? It will need to take the extra weight of the solar panels plus the fixing frames.

How much does it cost to install solar PV?

The cost of a solar PV system depends on the size of the array, the type of solar cells used and the ease of installation. Typical costs are £1,600 per kWp, so a 3.5kWp array (about 20m²) is likely to cost about £5,600.



Solar panels come in three basic types, which differ in efficiency (measured by the amount of sunlight that can convert to energy), appearance and cost:

1. Monocrystalline: made from high-purity silicon, these are highly efficient and durable but often expensive. It's approximately 17-20% efficient. Passive Emitter and Rear Cell (PERC) technology can improve efficiency, reaching around 22%.
2. Polycrystalline: made from melting and reforming silicon crystals, these have a lower efficiency and cost than monocrystalline panels. It's approximately 15-17% efficient.
3. Thin-film: usually the cheapest option, but they degrade much quicker and take up more space. These consist of thin films of photovoltaic material on a backing material – amorphous non-crystalline silicon panels are a popular variety. It's approximately 11-13% efficient.



The inverter – the part that converts solar power to usable electricity – may need to be replaced after around 10 years, costing about £500-1000. PV systems are particularly economical if you're renovating a roof or building a new home (when scaffolding may already be up), and you can even buy roof tiles with PV cells integrated.

Most systems require little or no maintenance and the panels should last for decades, although it is worth checking that they are not too dirty every year, as this can reduce performance. If your household normally uses a lot of electricity during the day, installation costs could be repaid in as little as 9 years. If you do not currently use much electricity during daylight hours, your payback period could be closer to 16 years.

It therefore financially makes sense to shift as much of your electricity consumption as possible to during the day. This also reduces carbon emissions, as you rely less on grid electricity which is often partially generated through fossil fuels. There is more information about how to move your electricity consumption to daylight hours in the box below.

Finding an installer for solar PV panels

Follow these simple steps when looking for an installer:

- Obtain two or three quotes, requesting a technical survey, not a sales visit.
- Choose an installer registered with the Microgeneration Certification Scheme, a professional body in the sector www.mcscertified.com
- Check that your chosen installer has signed up to the Renewable Energy Consumer Code, www.recc.org.uk. This is particularly important, as demonstrating that the installer is 'suitably certified' is a requirement of the Smart Export Guarantee (more information below).

- Check with your local planning department, especially if you live in a listed building, conservation area, area of outstanding natural beauty or a world heritage site. However, it's unlikely you'll need planning permission as solar arrays are classed as permitted developments, meaning they don't need approval if they stick out 200mm or less from your building and meet other basic requirements.



How to make the most of solar generated electricity

To maximise usage of your generated electricity, consider the following:

Run high-usage appliances like washing machines and dishwashers during the day when the sun is shining, although it's best to stagger their use so they're not all running at once. Smart energy managers combined with smart plugs can be used to switch on appliances to maximise your consumption of solar electricity and save you more money.

Your solar inverter should have a display that shows how much energy is being generated currently, so you could use this to judge which appliances could be powered for free at that time. Alternatively, you could install a solar energy monitor which can display how much electricity you are generating and how much you are consuming. Depending on the type, this

information can be shown on a small stand alone device or sent directly to your smart phone.

The more energy efficient your appliances are, the more appliances you can run off your solar panels. Buying energy-efficient appliances which use less electricity reduces your overall household energy demand.

Solar PV systems can be combined with battery storage, allowing you to store surplus energy generated by the panels and use it when you need to, usually later in the evening. Although domestic battery storage is currently quite expensive, the technology is developing rapidly, and costs are falling. It still needs careful consideration as to whether they will be a worthwhile investment

for you. There is also a significant environmental cost to producing batteries and it is unclear if this will ever be recovered through savings.

You can also buy a solar diverter if you have a hot water cylinder. These devices send excess electricity to your immersion heater to provide free hot water. They cost around £250-500 to buy, or £600-800 with installation costs, and are simple to fit to an existing PV system.

If you have an electric vehicle, excess electricity could also be used to charge it.

If you have a heat pump, excess electricity could be used to provide hot water or space heating, though there will be little solar generation when you need the heating on.

Check out our "Getting the most from your solar PV" factsheet for detailed information on how to use more of your solar generated electricity.



Solar grants and funding – the Smart Export Guarantee

If your solar panels were installed before 1 April 2019, you may still receive Feed-in-Tariff (FiT) payments, but these are no longer available for new installations. The 'Smart Export Guarantee' (SEG) is a government policy that was introduced to replace the FiT. This came into force on 1st January 2020.

Under the SEG, any energy company with over 150,000 customers is obliged to offer a SEG tariff which pays customers for the renewable energy they export to the grid. Energy suppliers set the price paid for this energy, so it varies between companies.

The system is designed to be flexible, with householders being paid a market rate for the electricity they produce, in a similar manner to small-scale commercial renewable generators. Tariffs are likely to become progressively more dynamic, based on demand at different times of the day. To access SEG payments, most energy suppliers require customers to have a smart meter. Part of the reason for this is so that suppliers can offer dynamic pricing.

Even without the SEG payments, PV systems are cheaper, more durable and more efficient than ever before and will deliver long-term carbon and financial savings, especially if the price of electricity continues to rise.



Tips to cut your electricity use, and save money ...



Give your clothes a day in the sun (and give your tumble drier a break). Clothes dried in fresh air feel great, and there are sunny days in winter, too.

Dodge the draught! Fit draught-excluders to your front door, letter box and key hole, and draw your curtains at dusk to keep the heat in.



Only fill the kettle with as much water as you actually need (but make sure you cover the metal element at the base).

Buying a new appliance? Remember to check the energy rating label and consider the size.



Wait until you have a full load in your dishwasher or washing machine before doing a wash. Two half-loads use more energy than one full load.

Sleep tight. Make sure all the lights are turned off when you go to bed. You can get low-wattage night lights for children's rooms or landings.



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The Centre for Sustainable Energy is a national charity supporting people and organisations across the UK to tackle the climate emergency and end the suffering caused by cold homes.

Our Home Energy Team offers free advice on domestic energy use to householders in central southern and southwest England.