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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') that are 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 turn sunlight into electricity using 'solar cells'. These are made from thin layers of a semiconductor material (traditionally silicon) laid 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, like the washing machine or TV.

- Any surplus electricity will then be exported to the electricity grid. You can be paid for this through 'Smart Export Guarantee' tariffs, though payments vary between suppliers.

- Alternatively, the electricity that you don't use can be stored in a domestic battery. Or it can be used to heat water which is stored in a hot water cylinder.

How is a solar PV system rated?

Solar PV systems are usually rated in **kilowatts peak** (kWp). This is the maximum rate of electricity the solar panels could generate under optimum conditions – a clear sunny day on a south-facing roof.



The kWp of a solar array is determined by the size, type and number of panels; a 3-4 kWp array is typical in the UK.

Kilowatt-hours (kWh) is the actual electricity generated by solar panels, the same measurement as on your household electricity bill. The yield of the panels is the kWh per kWp - the annual electricity generation per kilowatt of panel capacity, this is affected by the orientation (which way the panels face) and pitch of the roof, and the amount of shading. Annually, 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 (see below).

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. If your roof has an east-west aspect you could install panels on both sides.
- **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 single-crystal silicon and are black in appearance. These have a higher efficiency of between 17-22% but are more expensive to install.
2. **Polycrystalline:** made from melting and reforming silicon crystals and are blue in appearance. These have a lower efficiency of between 13-17% and are cheaper to install.
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 7-13% efficient.

Note: The inverter – the part that converts solar power to usable electricity (picture, right) – may need to be replaced after around 10 years, costing about £500 to £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
- Check that your chosen installer has signed up to the Renewable Energy Consumer Code. This is particularly important, as demonstrating that the installer is ‘suitably certified’ is a requirement of the Smart Export Guarantee (more information below).

Further things to consider:

- Check with your local planning department if you live in a listed building, conservation area, area of outstanding natural beauty or a world heritage site as there will be restrictions on if or where you can install the panels. For most properties 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.
- You will also need to notify your district network operator (DNO) that you are planning to install a solar pv system but check with your installer as they may do this on your behalf.

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.





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.



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