

Getting the best from your solar PV panels

If your home has solar panels you may need to rethink the way you consume electricity in order to maximise the benefit.

Solar photovoltaic (PV) panels convert the energy from sunlight into electricity, which can be used by any of your home appliances whilst the panels are generating. Any generated electricity that is not used in the home will typically be exported to the grid.

You can get paid for exported electricity through Smart Export Guarantee (SEG) tariffs that some suppliers offer. However, the amount you get paid per kWh is typically much lower than the cost of purchasing grid electricity, so it makes financial sense to shift as much of your electricity consumption to sunlight hours or store your solar generated energy for use later on.

How much electricity am I generating?

A typical household array of solar panels is rated at around 3kW (3 kilowatts or 3,000W). This means that the theoretical maximum power output of the array is 3000W of electricity in strong, direct sunlight, with no shading.

However, arrays will rarely produce their maximum power output and their actual output will depend on numerous factors including cloud cover and the location of the sun in the sky. For example, a 3kW array may be generating around 2,000W at midday in July, but may only be generating 200W on a cloudy afternoon in December.

Summer vs winter

Solar panels generate less electricity in winter for three main reasons:

1. There are fewer sunny days.
2. There are fewer daylight hours.
3. The sun is lower in the sky, which means it is less powerful.

Although generation in winter months is lower than in summer, there still may be days where solar generation exceeds demand. Clear and sunny days in winter can result in high levels of generation and even overcast days can provide small amounts of excess solar electricity. A PV diverter works well in these situations, using all the excess electricity it can for your hot water **(see section on solar PV diverters below)**.

How much electricity do my appliances use?

In order to know how to make best use of this energy, you need to have an idea of how much electricity different appliances use. Let's look at some typical power ratings:

- LED light bulb: **5W**
- Fridge: **100W**
- Laptop: **50W**
- Microwave: **750W**
- Washing machine: **2500W (2.5kW)**

For example, let's assume your solar panels are generating a steady 1000W (1kW). Of this, 100W will be used by the fridge (though not continuously since it switches itself on and off during the day) which leaves 900W for other appliances. So based on the ratings above you could use your 750W microwave for free and still have 150W available to run lower power appliances, such as lights.

You can't run a 2500W washing machine with only 900W, so to run this at that time you would import the extra 1600W that you need from the grid, and you will be charged for this.

It follows that you should stagger the use of high-wattage appliances to make the most of the free electricity available. This might mean waiting for your washing machine to finish before running the dishwasher.

What technology does solar PV include?

The technology used for domestic PV systems varies between households. A basic system will have a number of solar panels forming an array, an inverter and a generation meter, and will

then be connected to the grid via your consumer unit. The inverter may tell you how much the array is generating at the time but not how much you are using in the home and how much you're exporting. Inverters are also often installed in places which are inconvenient to access, such as the loft, making them difficult to use for solar generation monitoring.

Solar energy monitors

Advanced monitoring of your PV system and electricity usage to help you balance your electricity generation with your consumption is becoming more common. Monitors track your generation, consumption and export and display this information via a smart phone app or separate small display unit in the home. They cost approximately between £100-400 depending on the type. Some can be installed using the accompanying instructions, but others need a qualified electrician.

Smart appliances and energy managers

Common appliances that you could use during daylight hours, rather than at peak times, are washing machines, tumble driers, dishwashers, electric water heaters, and electric vehicles. Most washing appliances and water heating systems have timers and

can be scheduled to start their cycles or heating water during hours when your solar panels are most likely to be generating.

However, timers do not sense when your panels are actually generating electricity and can only be set to come on during hours when it is likely that you will be generating electricity. If your washing machine is set to run at midday but it is particularly overcast at that time, you may not be generating sufficient electricity to run the machine and may be drawing a portion of the energy used from the grid.

‘Smart appliances’ are those with Wi-Fi connectivity and are part of what is known as the ‘internet of things’ (IoT). This connectivity allows you to turn on appliances remotely when you see adequate solar generation. ‘Smart plugs’ allow you to turn a socket on remotely in the same way, but this may be of limited use if you still need to turn the appliance itself on.

An optimal approach would be to automate this process through a smart energy manager, which you would set up to automatically turn on particular appliances when solar generation

is adequate. Some of these systems may require a particular inverter while others can be universally retrofitted. These systems can also integrate EV chargers, heat pumps and PV diverters.

An important caveat is that an appliance with a long cycle, such as a washing machine, may start because there is enough PV generation, but it must then complete its cycle even if the PV generation is reduced.

Solar PV diverters

Typically, PV diverters, also called solar or immersion diverters, take any surplus PV generation which your household isn't using and diverts it to heat your hot water via the immersion heater in your cylinder (so they are not compatible with combination boilers). They work because your immersion heater can take varying 'quantities' of electricity, depending on how much your array is generating.

For example, a PV diverter that is connected to a 3kW (3000W) rated immersion water heater is able to use any quantity of excess power that is supplied to it. If the amount of excess solar

power is only 150W, the PV diverter will only supply 150W of power to the heater. As this power is being supplied by the diverter, rather than its usual method of operation, it **will not** draw the additional 2850W from the grid to match its full rated power. The heater will instead draw that 150W of excess power from the solar panels and store the energy as heated water in the hot water cylinder. The amount of water heated will be relative to the amount of power that the device is supplied. If your hot water tank is full of hot water then any surplus PV will now be exported to the grid, for which you can be paid via the SEG.

For comparison, if you simply set your water heater to turn on at midday with a timer, and you were only generating an excess of 150W, your immersion heater **will** draw the additional 2850W from the grid and would consequently cost more to run.

PV diverters are a great way to maximise your own solar PV consumption, storing excess solar generated electricity like a thermal battery. With a typical PV array, you should generate all the hot water you need during the summer months. As well as saving on fuel costs, this will also reduce usage of your boiler, prolonging its life.

PV diverters are easy to retrofit to an existing PV system, taking less than hour to fit, and should pay for themselves within two years.

Batteries

Batteries offer the opportunity to store excess electricity generated by your PV system which can be used when the panels aren't generating, either in the evening or into the following day. Domestic battery systems can store as much electricity as a household typically uses in a day, enabling a PV system to produce up to 70% of a household's annual electricity demand.

Batteries may not currently make financial sense for everyone; those with higher levels of evening/morning electricity consumption will see larger savings. However, as capital costs come down and electricity costs rise, their payback periods will reduce.

Additionally, as time-of-use tariffs expand there will be the potential to buy grid electricity when it is cheaper, and even

export it back to the grid for a higher price. See our “Getting smarter with energy” factsheet. This will further improve the economics of battery storage and make them an option for households without solar PV.

The environmental case for batteries is not clear cut. The argument in favour rests on batteries being better for the environment because they lower the amount of electricity imported from the grid, which can be high carbon. And widespread battery uptake could form part of a ‘smarter’ grid with battery storage helping to balance supply and demand with intermittent energy sources such as wind and PV. This may ultimately reduce emissions if batteries replace fossil fuel generators which are currently used to meet peak demand.

However, as the grid is increasingly decarbonised, the ecological impact of producing a domestic battery may never be recovered by its carbon savings.

In summary, the financial and environmental case for domestic batteries may be questionable at the moment, but both are likely

to improve over time. If your primary motivation is to reduce your emissions, the cost of a battery system would be better spent on reducing your heating demand and installing a heat pump.

A note on feed-in-tariff payments

If your solar panels were installed before 1 April 2019, you may receive feed-in tariff (FiT) payments, which are no longer available for new installations. This means you will be paid for every kWh of electricity that you generate.

And you'll receive these payments whether you use your solar electricity in your home or not, so you can power your appliances during the day without paying for grid electricity, and still get paid for that electricity by your energy supplier!



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