# Solar PV for Cedar Chase

## Why do solar?

At least 9 houses are interested in installing solar panels on the roof. Everyone has different priorities, but the main reasons people want to do this are:

- Money saving: the price of energy is rising.
- Reduced $CO_2$ and reduced pollution from fossil fuels. Each house could save about 1 tonne of $CO_2$ per year which is about 10% of a UK person’s carbon footprint.
- Reduced dependence on imported (possibly unreliable) energy
- Improving the house value (solar PV improves the official energy rating)
- Can be configured to provide backup power in power-cuts

## Reference Design

Our aim is to have a reference design that will work for all houses, with a few options to account for different requirements. There will also be at least one nominated contractor that is able to install the system as specified.

There is no obligation to install solar panels or to use the nominated contractor.

The idea is for the AGM to approve the reference design and to delegate approval of per-house details to the committee.

## Planning Permission

Most solar installations are considered to be ‘Permitted Development’ and do not need planning permission. Being in a Conservation Area imposes a few restrictions but our reference design accounts for that. If you are concerned you might want to apply for a Certificate of Lawfulness.

## Components

The main parts of a solar PV installation are:

- Solar panels – one or more arrays of photo-voltaic panels on the roof
- An inverter to convert the electricity to mains voltage
- An optional battery pack to store energy for use when the sun is not shining

# Appearance

We will specify all-black panels mounted on black fixing bars with black anti-bird mesh around the edges. There will be one group of panels on each face of the roof and both will be 2.8m high and 3.1m wide. All houses should follow the same design and layout for the panels.

We looked at the possibility of fitting the panels in-roof rather than over-roof. This would have a slightly lower profile but it disturbs more of the roof structure and replacing the panels with another type later would be much harder. The over-roof version also helps to shade the roof in summer.

We looked at PV slates but the manufacturer says our roofs don't slope enough to fit them. They would not exactly match our composition slates in any case, so the ragged-edge pattern would be visible as the slates age and weather. Rectangular arrays of panels would be neater.

The inverters and optional batteries would either be fitted inside the houses (probably in the bin-store/utility room) or at ground-level outside. The best location varies from house to house but this equipment should not be visible from public space.

The cable-route from the panels to the inverters will vary from one house to another. It may need to be on the outside so it will need careful planning and approval on a case-by-case basis. The reference design has some examples showing how this might be done.

Here are some pictures to help visualise what the panels would look like.

Warren Jacobs

*Figure 1: Visualisation showing some houses with solar panels*

*Figure 2: Detail showing one house with panels*

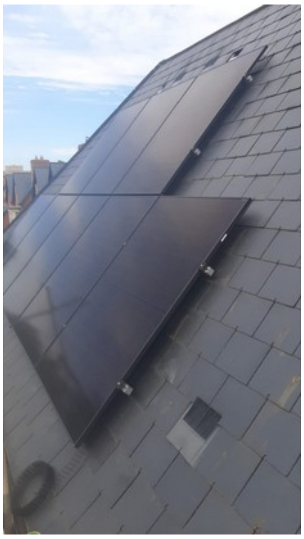


*Figure 3: Black panels on a house in Mill Lane*

*Figure 4: Two Mill Lane houses with black panels: note the one on the left which has dark slates*

## Can all houses install Solar PV?

Yes, but it might not be economic for those with very shaded roofs. The panels will work even without direct sunshine, so it is worth asking a solar installer to calculate how effective they would be. All houses can install batteries.

## Longevity and sustainability

Panel life is usually quoted as 25 years though they should last much longer. Our reference design uses REC Twinpeak panels which are guaranteed for 25 years. The efficiency drops slightly as the panels age. The REC panels are guaranteed to produce at least 86% of their original output after 25 years, though anecdotal evidence suggests that they will do better than that. These panels also have good eco credentials, with much care devoted to reducing the impact of production and to making them easy to recycle.

## Recycling

Solar panels and batteries can all be recycled very effectively. First-generation panels are starting to reach the end of their economic life now, and the recycling industry is expanding to cope with this new stream of work.

Panels typically contain these recoverable materials:

76% glass
10% plastic
8% aluminium
5% silicon
1% other metals such as silver

[Source: www.greenmatch.co.uk] Almost all of this can be re-used to make new panels.

Batteries contain even more valuable materials, and there is an established industry to recycle them.

As with all waste it is important to make sure that it is removed by a registered contractor so that it goes to recycling and is not just dumped.

## Effect on the roof structure

Most houses now have new roofs and we don’t want to damage them! Solar panel installers should use experienced roofers to install the fixing brackets and mount the panels.

Each group of panels will add about 150kg to the weight of the roof. Cedar Chase houses have much larger roof beams than most other houses so this should be well within their carrying capacity.

If your house has not already had the roof re-done and properly insulated then it makes sense to do that first (ideally using one set of scaffolding for both projects and getting the roofers to co-ordinate with the solar installers).

## Safety

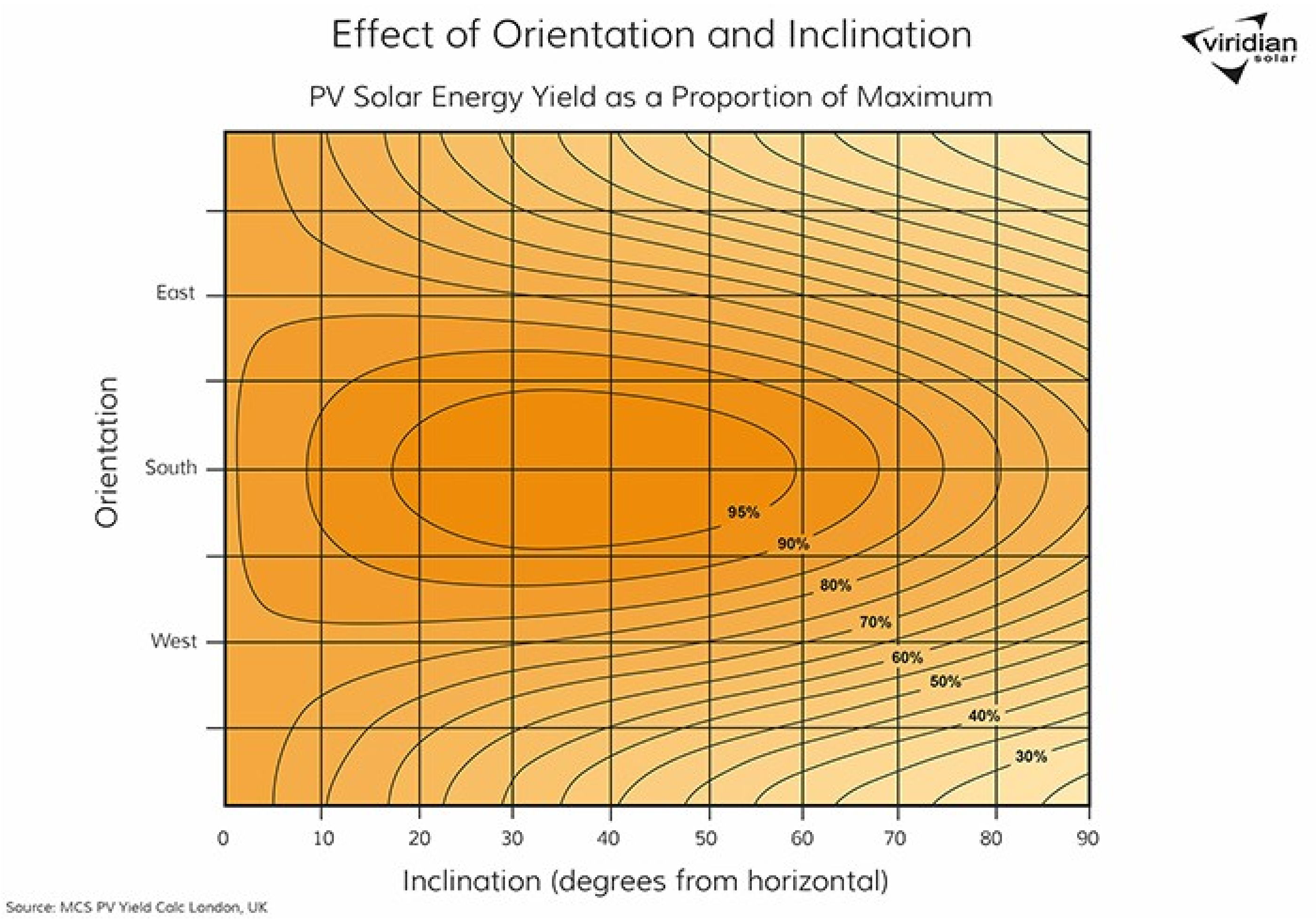
There have been a few press reports about fires caused by solar PV systems so people may be concerned about safety. The Buildings Research Establishment looked into this and the summary of their report says *“There is no reason to believe at present that the fire risks associated with PVs are any greater than those with other electrical equipment”*. The BRE report *Fire and Solar PV Systems – Recommendations for the Photovoltaic Industry* (July 2017) found that there had been 46 incidents that were either known or likely to have been caused by the PV system over the previous few years, from an installed base of 898,000 installations.

The majority of problems were caused by poor installation practices, with a few caused by faulty products. BRE recommend that only qualified installers should fit PV systems and that the installation should be inspected every few years.

The optional battery in our reference design is a LiFePO unit, which is the safest type on the market.

## Is the roof at the right angle?

There is no ‘right angle’ for solar PV. Even the *optimum* angle varies depending on when you want the most output, but in practice it does not matter very much. Our roofs are about 20 degrees above horizontal so we would expect at least 95% of optimum output over the year. Every house has one south-facing roof and one west-facing, so by putting panels on both faces we can get good generation at most times of day.



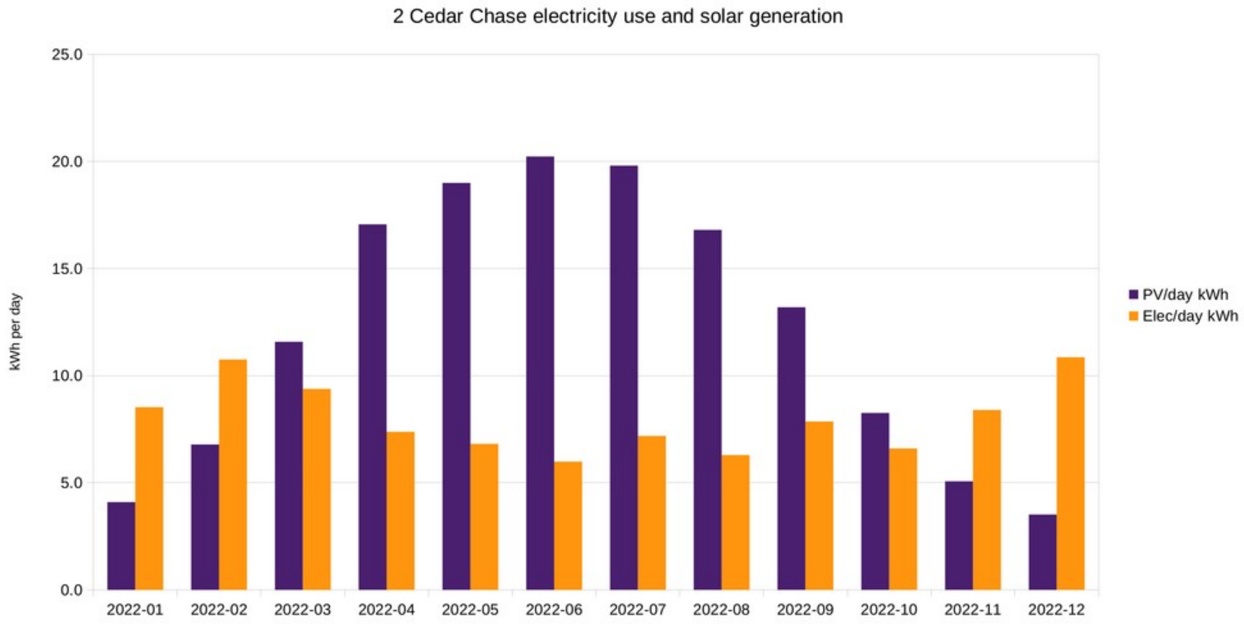
# How much energy will we get?

The reference design has two groups of six panels. Each group has a peak output of 2.4kW but one faces south and the other faces west so they capture sunlight at different times of day. There are standard ways to calculate solar generation and the results are approximately:

South-facing panels: 2400 kWh/year
West-facing panels: 2000 kWh/year

The total of 4400 kWh/year is much more than the electricity consumption of a house that uses gas to produce hot water so a lot of the output will be exported to the grid. If you heat water with an immersion heater then you will be able to use more of it yourself. It would cost you about £1400 to buy 4400 kWh from the grid.

Generation varies throughout the year: in January we would get about 4kWh per day and in June it would be nearer 20kWh per day. This chart shows predicted daily PV generation compared with actual electricity consumption at #2 in 2022 (note that water heating at #2 uses gas):




# Should we wait for better panels?

PV technology is improving gradually. Current panels are mostly around 20% efficient with the best commercial panels approaching 23%. Single-layer silicon PV cells have a theoretical limit around 29%. There are lots of technologies at the lab stage that promise more, but it will take years to develop them into products economic for domestic use.

If we assume that PV cells will improve by 1 percentage point per year, in 5 years time we could be buying panels with 25% efficiency. If a new technology like dual-layer Silicon/Perovskite becomes available in that timescale we might even get to 30%. Such a panel would generate 1.5 times as much each year as a 2023 panel, but by that time we would have lost 5 whole years of generation so it would not catch up until almost 2040! Much better to install what we can get now and consider upgrading it in 20 years time.

# Batteries

Solar PV produces most power around mid-day. That might not be when you use most electricity, so you might want to install a battery to store the energy for use at other times.

Batteries are not essential as you can sell surplus energy to the national grid. However, the grid pays much less per kWh than you would pay to buy a kWh when the sun is not shining. The battery helps to minimise the cost by using more of the solar energy yourself. Batteries cost money and they will eventually wear out so you should consider the economics. The payback time depends very much on what sort of energy tariff you are on and when you use most electricity. Most of the traditional energy companies pay very little for energy that you generate, but some of the new ones (particularly Octopus and E.ON) pay quite well.

Batteries can also be used to supply electricity during power cuts, but your house wiring would have to be modified for this to work.

You can install batteries without solar panels if you like. This can be useful if you pay more for electricity at certain times of day.

Batteries are usually guaranteed for 10 years. They should still have at least 80% of their original capacity at the end of that time.

# Cost and Payback

A simple system without a battery will cost around £8000

A system with a 5kWh battery will cost around £12000

See the last section of this document for links to more detailed estimates.

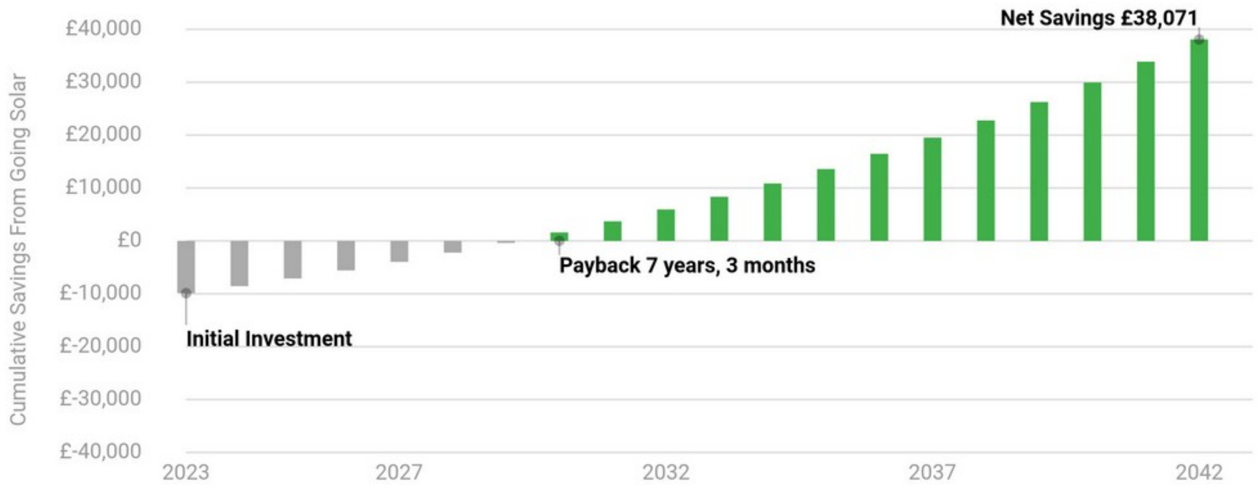
You might need to replace the inverter after 10 years or so: about £1200

Financial return depends strongly on energy tariffs and usage patterns. Here is an example based on a simple flat-rate tariff in October 2023, assuming a system with a battery:

> Electricity costs about 29p/kWh at the moment, so if you were to use half of the energy generated by the panels you would save about £640 per year. If you sold the rest through Octopus at 15p/kWh that would raise another £330, giving a payback time of 8-12 years and a total return of more than £24,000 over 25 years (minus the installation cost). This assumes that inflation is zero, so it is ‘in 2023 money’. In practice energy costs are likely to rise over the long term so the actual return in pounds sterling will be greater.

There are things you can do to improve the return on investment: do the washing while the sun shines for example. Some need a little more technology, like heating water when you have surplus power.

Here is the payback graph from a recent estimate for a system matching our reference design and including a battery. It makes different assumptions from the example above (in particular it assumes that you will *use* 5000 kWh per year). Payback is faster without the battery (around 5-6 years), but that is very dependent on the feed-in tariff (which is quite generous at the moment):




*Payback graph from an estimate received in October 2023*

The Energy Saving Trust website has a calculator that can help you to estimate payback times based on your actual energy usage.

Energy payback also needs considering: how long does it take to recover the energy used to make the panels? For current panels this is in the range 1-4 years depending on the technology and location. See https://en.wikipedia.org/wiki/Solar-cell_efficiency

## Availability of supplier and fitter

Jim Ingram of Heppelthwaite Green Building Solutions has been involved with this project for some time, and is able to quote for installation on a reasonable timescale: JamesSJC@outlook.com

Some estimates from October 2023 are available online: https://app.opensolar.com/#/myenergy/2052445?token=AAzGVGhLoUCiYIx-Ylg

These are not final quotes: Jim would have to measure up and discuss details with you before issuing a firm quote.

SolarPV-for-Cedar-Chase.odt

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