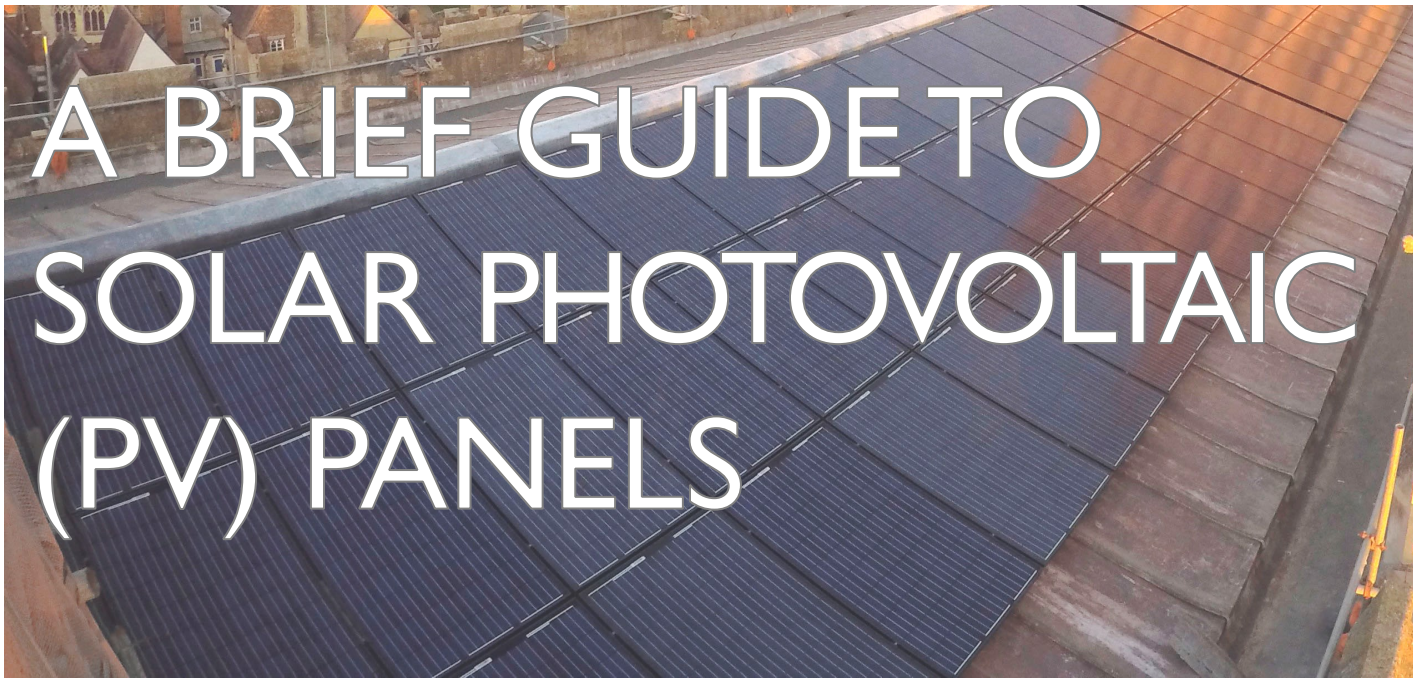


A BRIEF GUIDE TO SOLAR PHOTOVOLTAIC (PV) PANELS

Gloucester Cathedral

Introduction

This is one of a series of short guidance notes on the technologies which can help the Church move towards net zero carbon. It has been written on a pro-bono basis by Briar Associates, on behalf of the Cathedral and Churches Buildings Division, with input from the Diocesan Environment Officers Energy Group.

Solar photovoltaics (PV) is a well-established technology which generates electricity from daylight. As they are installed 'on site', solar PV panels can make a strong statement about an organisation's commitment to reducing its carbon footprint, whilst reducing day-time electricity costs.

In simple terms systems consist of panels and inverters.

The panels can be fixed on to a roof of a building, or ground-mounted on land, and they convert the daylight that falls on the panel to electricity.

The inverters take the electricity generated from the panels and convert it, so that it can integrate with standard electricity in the grid. They are usually housed in a building such as a store or electrical distribution room.

For listed buildings and conservation areas, planning constraints may mean that panels on the church roof have to be hidden from street view. Church halls and schools are less likely to be constrained in this way, and may be able to install them under permitted development rules. Notwithstanding whether planning permission is or isn't required, faculty permission will certainly always be required.

'Clean' electricity for various uses

The electricity generated by the system can be utilised in many ways. Usually the majority is consumed by the building it is connected to, reducing the amount of electricity that the building uses (or "imports") from the national grid.

It can also be used to charge batteries for use in the evenings, when the lights and heating are on. Some churches might use the panels to part-power electric vehicle charging points in the car park.

Another potential use for *some* churches, if they have a hot water tank rather than point-of-use hot water heaters, is to use spare electricity from the panels to power an electrical water heater device, which would supply the church with hot water as well as electricity.

Solar PV systems are most suitable where you have a high, consistent level of daytime electricity usage and a well-maintained, structurally-sound roof. Finding the right design and the correct fixing system is key, especially when installing on or near listed buildings.

Design

Technical design

The key to the design of the system is understanding what the electrical demand is within the building and the physical constraints of the building or site. Roofs need to be structurally assessed to show whether the roof can take the weight of a PV system. In addition, the panels must be installed where they are not going to be shaded by trees or other buildings, as this will reduce the electrical output from them.

The amount of electricity that the building uses at different times also needs to be understood, so that a suitably sized system is installed. This assessment needs to take into account any energy saving measures that may also be implemented, such as installing LED lighting.

Installing a PV system does not stop you from using electricity from the national grid. PV systems are designed so that if more electricity is needed by the building, than can be generated by the solar array, power is taken from the national grid automatically.

Systems generally need to be angled to the south to get the longest exposure to sunlight through the day, however, this should not discount east and west facing roofs as possible alternatives. Angled frames and innovative systems also allow panels to be installed on flat roofs, some without penetrating the roof coverings.

There are various styles of solar panel, the majority are large panels which can be fitted over an existing roof on a rail system. Manufacturers make a multitude of suitable fittings to attach to all types of roof. These large panels can also be installed 'in-roof' on special frames which allow the panels to be more 'flush' with the roof line.

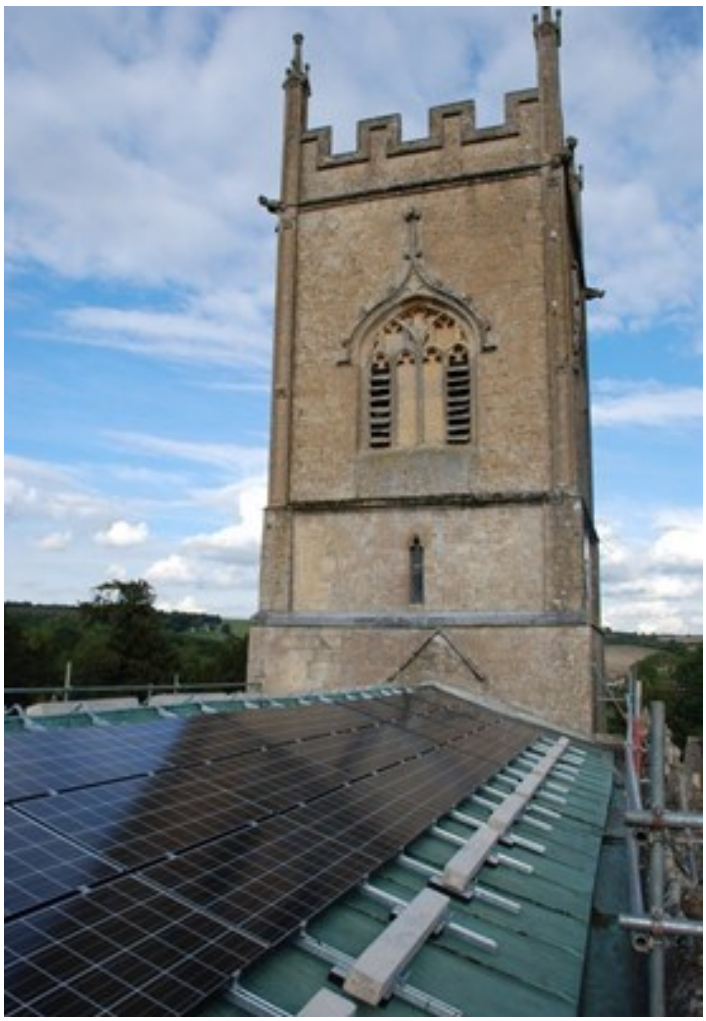
Solar slates/tiles are also available which will blend into the roof more than in-roof types. These may be requested by planners in some circumstances, but are considerably more expensive, and at time of writing none are MCS certified.

Aesthetic design and permission

The addition of a PV system to a church must be done carefully and in line with planning and faculty regulations. For listed buildings, the main criteria are whether the building is listed, whether the system will be visible and/or fronts the highway, and if so whether the benefit outweighs the impact.

In the past, PV arrays on listed buildings have generally only been considered acceptable to planning authorities where they are non-visible. However this may start to change with the growing understanding of the urgency of the climate crisis, with many councils making climate declarations.

In considering a faculty application, the DAC will want to know where the cables of the system will be routed, how the panels will be fixed to ensure the fabric of the building is not damaged, and that the system blends into the architecture of the church. Fixing panels by screwing rails down through historic roof coverings and into historic timbers is not normally acceptable and self-weighted systems for flat roofs (such as those use on St James' Piccadilly) for pitched roofs (such as those used on St Michaels, Withington and Gloucester Cathedral) are required.



Above: ***St Michael and All Angel Withington's panels being installed. Read their case study here.***

Benefits

Environmental benefits

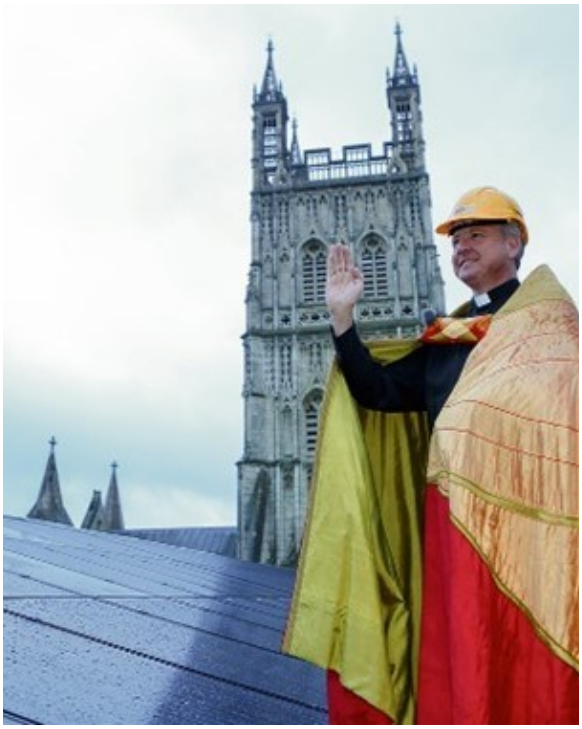
Solar PV systems generate carbon free energy from sunlight on site. However, it's worth remembering that materials go into their construction and transport to site. This 'embodied' carbon needs to be weighed up against the 'operational' carbon savings from the clean electricity. This will generally pay back in a few years. Some of the materials are relatively scarce, such as rare earth elements.

Missional benefits

The clean energy being generated helps with the Church's mission to care for creation. If the panels are visible, then they may also inspire action in the community.

Financial benefits

A PV system generates free electricity on site which can be used rather than buying power from the national grid. On the whole, the benefits are realised during the day, so a church with no day time electrical use would achieve less financial benefit from the system as you would still need to be purchasing electricity from the grid during evenings and night times.



Above: ***The blessing of the panels by the Dean of Gloucester Cathedral***

Subsidies

The well known 'Feed In Tariff' (FIT), which was a government scheme to encourage the installation of renewable energy projects has now finished, and is no longer available for any new installations.

Depending on the size of system, guaranteed minimum export rates are paid for electricity being exported to the grid by electricity suppliers, this is called Smart Export Guarantee (SEG). The OfGem website has up-to-date information.

It is worth noting that to qualify for the SEG the PV system should be installed by an installer registered with the Microgeneration Certification Scheme (MCS). In addition, the use of an installer who has MCS certification will be an expected quality standard that the DAC is likely to seek within any faculty application.

Affordability

Although Solar PV systems may have been investigated in the past and discounted due to them not appearing to be affordable, it may now be the time to revisit this technology. Costs of systems have continued to fall dramatically, and the efficiency of panels has increased, so even though the old subsidies are no longer offered this could still prove an attractive energy saving and cost saving technology.

Installed systems now cost only about 10–20% of the cost they were 10 years ago (excluding scaffolding). In addition, panels now output more energy than they used to. Average panels used to typically generate around 250W per panel this has now increased to around 400 Watts.

Systems range in price, however an average cost per kW installed would be around £700 - £1,300. In some circumstances, especially on churches with high complicated church roof structures or where complicated fixing systems are required, specialist access equipment and expensive fixing systems will raise this cost. The cost of scaffolding should always be considered alongside the cost of the panels.

VAT is chargeable at 20%, and should be reclaimable for listed buildings through the Listed Places of Worship Scheme.

Suitability

The financial benefit that a PV system can bring is directly linked to the size of the system that can be installed and the amount of power consumed by the associated building, or buildings, during daylight hours. A church that is utilised lightly during weekdays may only benefit from a small PV system (which could possibly be located on the hidden roof of the tower), however, a church hall that is used every day by the community may benefit from a larger system.

A larger system will always be cutting more carbon emissions than a smaller system, and therefore having a greater missional benefit, even if the spare electricity generated is "exported" to the grid.

The best way to determine the best fit for a PV system is to review the amount of energy that the building uses during daylight hours and engage with a solar PV specialist, who will be able to provide opinion and guidance on the best system for your needs. They will also be able to assist with legal applications, such as planning permission and grid connection. Advice should then be sought from your DAC on its suitability and they will be able to review any proposals you have received in an unbiased way.

As part of the installation the PV installer must carry out a structural survey to ensure the roof structure can support the new PV installation. Installations on historic timbers may require specialist structural consultation from a structural engineer with experience in historic buildings.

Before investing in PV, it is always worth checking for cost effective ways to reduce energy use within the building (s), for example through improved heating and lighting controls or LED lighting.

Procurement

There are many ways that a church could procure a solar PV system:

Capital expenditure – A system can be paid for out right and the full benefit of the free electricity it produces can be used by the building it is connected to instead of buying electricity from the grid.

Loan – various loans or forms of asset finance are available that would allow the system to be funded over a given time to spread the cost. This can be financially attractive, sometimes even cash positive, compared to purchasing the same quantity of electricity from the grid.

Power Purchase Agreement (PPA) – this is where the system is owned by a third party and installed for free with no capital expenditure made by the church. The church buys the electricity produced by the system at a given p/kWh rate from the company that owns it. Power Purchase Agreements/ 3rd party ownership may have faculty implications; check with your DAC.

Community Energy Scheme – similar to a PPA, except it is a community organisation which carries out a share issue to raise the funding from local people, and pays to install the panels. The church gets cheaper electricity and the local investors get a small return on their investment. Read more on the Community Energy England website.

Suggested first steps

A local PV supplier will be able to give you some general advice and guidance on whether your building could be suitable for PV. Many will give you a free desktop survey. MCS provides a list of approved installers.

In tandem with this, speak to your architect to get their views on suitability of solar PV for your church.

Our Net Zero Carbon webinar programme includes a session on church solar.

An independent energy audit can be a good place to start, to put a project like this in the context of all the changes you could make. Parish Buying offers energy audits, as do some dioceses.