PV Solar Panel Installations:

A Guide for Churches in the Diocese of Chelmsford

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Updated: November 2021

The Church of England
in Essex and East London

Diocese of Chelmsford

It has become clear that the world rapidly needs to move away from the consumption of fossil fuels, in order to avert serious warming of the atmosphere. Whilst this realisation is not new, it has gained increasing traction in recent years and is something that many people in our communities care about a very great deal.

The Church of England has committed to becoming a net-zero emitter of carbon dioxide, the principal cause of global heating, by 2030. This is a significant task, and it involves changes being made to all elements of the Church's built environment – from its schools to its parsonages.

Naturally, such changes must also involve our church buildings. Many of those who care for our churches day-in, day-out, have already begun to think about what changes they might make to their buildings to make them more environmentally friendly.

In the Diocese of Chelmsford, we have the privilege of, and responsibility for, the custodianship of almost 600 church buildings. Most of these are at the heart of a community, used as they are for Anglican worship and other, related, activities. Many of our churches are ancient buildings, and some are architectural treasures. All of them will have borne witness to countless joys and sorrows, prayers and praises. On them is writ so much of the history of our area, as to be an indispensable part in the fabric of our heritage.

One of the most beautiful aspects of our church buildings is that they have evolved over the time they have existed, so as to meet the changing needs of the communities that use them. In our most ancient churches, one might easily see aspects of the building that were added or altered in perhaps eight different centuries, including the twenty-first. Plainly, no church should be 'set in aspic': a museum piece. Indeed, our churches are living embodiments of the communities that use them. It is, therefore, only right that our churches should be allowed to make reasonable changes to allow for the phasing out of fossil fuel use, where this is in sympathy with the historical nature of the building.

By law, any church wishing to make a material change to their building or curtilage, that is not covered by a specified list of exemptions, requires a Faculty to be issued, allowing them to undertake the work. The Diocesan Advisory Committee (DAC) is the body which advises the Diocesan Chancellor regarding Faculty applications made by individual churches. In order to make these recommendations, the DAC draws on the experience of a range of professionals, including architects, heating and structural engineers, conservationists, archaeologists, clergy and many others. The process of considering Faculty applications is necessarily rigorous, in order to ensure that changes made to churches will truly meet the needs of their users, yet stand the test of time, both, in terms of their utility and their sensitivity to their surroundings.

There is sometimes an unfortunate view promulgated, that sees DACs as 'standing in the way of progress' in churches, and no more so than on the issue of PV panels on church roofs. Contrary to this view, Chelmsford DAC would like to encourage appropriate, well-thought-out and sensitive development of our church buildings, to work towards carbon neutrality. Plainly, this does not mean that all churches will automatically be granted a Faculty for solar panels on their roof (if, indeed, planning permission was also granted). However, parishes should not be put off from applying for Faculties for solar generation, particularly on listed buildings, for fear that they will be dismissed out of hand. To this end, we have produced this guidance note, which is designed to help churches consider the suitability, practicability and environmental benefits of PV panels in their own situation, as well as attempting to set out what needs to be included to make the very most out of a Faculty application. We hope you find it a useful tool as you consider the option of PV panel installation.

MALCOLM WOODS
CHAIR, CHELMSFORD DAC
EASTER, 2021

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Summary

General Compliance:

All churches falling under jurisdiction of the Consistory Courts will require a Faculty to install PV solar panels. This means that if your church must apply for Faculties to do other works, you must also do so to install PV panels. This applies whether the building is listed or unlisted, and whether the proposed panels are visible, or hidden from view. If you are considering the installation of PV (solar) panels on your church, please consult the DAC at the earliest opportunity, for an informal chat. Contact details can be found in Appendix (ii), on the final page of this note.

Each application will be considered on its own merits. However, for guidance purposes, the DAC has produced a **policy on PV panels** which will guide their thinking when considering applications. A copy is included for your reference, in Appendix (i) on page 20 of this note. It is recommended that you read this as a starting point in your own considerations. The Chancellor of the Diocese of Chelmsford has final say on all Faculty applications, and will consider each case on its own merits.

The Church of England has also produced a guidance note, in conjunction with which this note should be read. This can be found at:

https://www.churchofengland.org/sites/default/files/2021-08/CCB_SolarPV_Guidance.pdf

Almost all applications for PV installations will also require permission from the local planning authority. Each planning authority will have its own guidelines and you should consult your church's architect, or the planning authority directly, for more details.

Environmental Considerations:

Contemplation of PV installation should almost never be a 'first resort' for churches, when considering how to ameliorate their carbon emissions.

All churches considering PV installation should initially commission a professional energy audit, which will provide comprehensive advice on the most environmentally-beneficial changes that can be made in the church's specific circumstances.

All churches considering PV panels should, at the very least, have already switched to a 100% green supplier for their electricity.

In most churches, heating is the biggest contributor to carbon emissions. If a church is heated by oil or gas, the installation of PV panels will not reduce a church's carbon output as significantly as other measures, designed to conserve heat. If your church is heated electrically, PV may have more of a positive impact.

Consideration needs to be made of the embedded cost of PV installation, including the method of manufacture, and the origin of the panels.

Financial Considerations:

It is not for the DAC to advise on the financial viability of PV panels. This is a matter for individual churches. However, the individual circumstances of each church may mean that there are certain installations which will be far more cost-effective than others. The DAC will not recommend that a

Faculty be granted for any scheme intended to be primarily financially, rather than environmentally, beneficial.

The 'feed-in' tariff for energy captured by panels and then fed back to the grid, is now minimal. This means that churches are unlikely to recoup the cost of panels over their natural lifespan, if they cannot use all the electricity that they generate in their building.

Generally, PV panels are more cost effective on churches that are used throughout the week, rather than merely once or twice a week. The note provides direction as to where one can access recent costed examples, relevant to a wide range of churches in different situations (see page 11 for more details).

Practical Considerations:

It is unlikely that Grade 1 or 2 listed churches would receive either planning permission or a Faculty for a PV installation, unless they can show that they are able to hide panels from view from the ground. Potential places to hide panels from view might include: behind a roof parapet; on a south-facing inner roof eave; or possibly on the top of a flat tower.

If you are contemplating a battery installation, it should be remembered that the battery life will be considerably less than the life of the panels themselves. Batteries also contain expensive metals, which may be a theft risk.

Some modern roofs are built to finer tolerances than ancient ones, so even if your church is a modern building, it is vital that you involve your parish architect, to ensure that your roof has the load-bearing capacity for the installation you propose.

Your insurers should be consulted when considering any installation, as it may affect your premium.

Any installation of PV panels will require scaffolding. In complicated installations, this can be a very significant cost. It ought to be borne in mind that ongoing maintenance of PV panels will need to take place and this may also require scaffolding.

Community Options:

It may be that, having read this note and discussed with the DAC, you conclude that a PV installation on your church is exactly the right intervention to make. If so, you should contact your architect and follow the advice on process contained on page 16.

However, if you decide that such an installation is either unlikely to get permission, or not the best use of your church's resources, you might wish to consider a partnership with other local community buildings, such as schools or community halls. These are sometimes more suitable buildings for PV installation than churches are and – particularly if your church tends to be used most at the weekend – it may be the case that an agreement for energy sharing could be reached, which would benefit both parties.

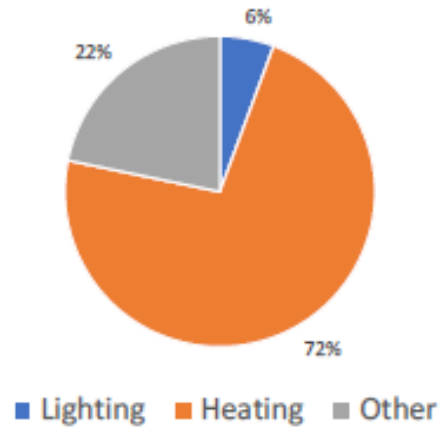
PV Panels: Environmental Considerations

If your church is considering the installation of photovoltaic ('PV' or, colloquially, 'solar') panels, it is likely that the PCC or a delegated group will have already had detailed discussions regarding the need to reduce your church's reliance on burning fossil fuels. The principal impetus for the installation of PV panels should be environmental, rather than economic, particularly given that it is now no longer possible to generate significant amounts of revenue by feeding electricity back into the grid from your panels.

Given that such a decision is principally an environmental one, it is important to ensure that such a major project as the installation of PV panels, does indeed bring real environmental benefits, rather than merely acting as a statement of environmental intent. Although in many cases, PV panels can bring about a significant net-reduction in the CO2 output of a church building, there are also situations where this is not the case.

PV panels are often the first thing that people think about, when they consider what can be done to make a building more environmentally friendly. When seen on the roofs of buildings, or in their curtilage, such panels are an obvious sign that the building's users have taken action to reduce their reliance on fossil fuels. However, the installation of PV panels on a church roof will constitute a significant upfront financial investment and normally involves a major change to the fabric of a building. Before agreeing on a course of action regarding PV panels, it therefore needs to be considered as to whether such a significant commitment might reap more environmental rewards if invested in an alternative, even if this is perhaps less of an 'obvious' environmental technology.

In 2012, the Church of England conducted some research into energy use in churches. This pie chart shows its findings. As you can see, by far the greatest proportion of energy use (and, indeed, CO2 output), concerned the heating of church buildings.



Although many rural churches are heated electrically, the majority of churches are still heated by mains gas, LPG or oil, using onsite boilers. If your church is not heated electrically, the installation of PV panels will only help to reduce your CO2 emissions in those parts of the pie chart that are coloured in grey or blue – so, at most, you will have reduced your CO2 output by 28%.

If you have gas or oil heating in your church and are serious about reducing your carbon emissions, a scheme to better-insulate your church, to re-lead some of your windows to stop draughts, or to alter or possibly renew your boiler, might actually be far better for the environment than the installation of PV panels, even if the immediate effect isn't as noticeable, as it will address a greater proportion of your CO2 output (ie. the 72% generated by heating), rather than the smaller proportion generated by electrical consumption.

If you are considering the installation of PV panels, it is therefore vital that you obtain a **Professional Energy Audit** for the building in question. These are commercially available and should not be hugely expensive, but will give you a professional opinion on what the most efficient steps are that you should take to make your church less carbon-intensive.

A prerequisite for obtaining a Faculty for PV panels is that a parish has engaged with a range of measures to conserve energy and to reduce their CO2 output. Even before you receive the results of your energy survey, your PCC can start addressing some of these issues. The following guidance may be of use in doing so:

- Booklet, entitled: *'The Fifth Mark of Mission: Your church: getting to net-zero carbon and beyond'* (Diocese of Chelmsford: 2021). Also available on the Diocesan website.
- Leaflet, entitled: *'Eight steps to an environmentally-friendly church'* (Diocese of Chelmsford: 2021). Also available on the Diocesan website.
- Booklet, entitled: *'The Practical Path to Net-Zero'* (Archbishops' Council: 2020). Accessible at: https://www.churchofengland.org/resources/churchcare/net-zero-carbon-church/practical-path-net-zero-carbon-churches

You will note that all of the advice available above suggests that one of the first things every church should do is **to ensure that the electricity they purchase from the National Grid is from a green supplier**. Whilst much has been made of the green credentials or otherwise of the larger energy providers, there are several firms which now specialise in offering 100% renewable electricity at a reasonable tariff, and a guide to these is available on the Diocesan website. Alternatively, you can utilise the 'Parish Buying' energy basket. This is a bulk-buying scheme that is run on a national basis, allowing a better price to be obtained for green energy by churches, by grouping together to buy larger quantities.

Once you have switched energy providers, and are therefore already obtaining 100% green electrical energy for your church building, it is for your PCC to decide as to whether there is sufficient extra environmental benefit in actually generating your own power through PV panels to satisfy the significant investment involved, or whether such investment could be better employed on another carbon reduction scheme.

'Embedded Carbon': how green are PV panels, overall?

It is difficult to obtain accurate, up-to-date information for the overall carbon emissions involved in the manufacture, transportation, installation and eventual decommissioning of a modern PV panel. Factors that need to be considered might include:

(1). Energy source required to create the panel. If the panel is made in China, much of the electricity used to create the panel may well be from coal-fired power stations, thus heightening the embedded carbon embodied in the panel. If the panel is made in Europe, it is likely to have a lower embodied carbon level.

(2). Type of panel. Studies have suggested that certain panel types have up to four times the embedded carbon than others.

(3). Installation difficulty. If the site is difficult, involving lots of scaffolding, multiple HGV journeys and site visits, this adds to the overall carbon consumption.

(4). Panel efficiency. This depends on the site, amount of sunlight, type of inverter used, maintenance, etc. Generally, the more efficient the panel, the less negative the environmental impact of the production of the panel.

PV Panels: Financial Considerations

Your PCC may have already conducted some research into the cost of installation of PV panels. The initial capital cost of each project varies significantly depending upon the specific situation of the church building.

In this document – produced in 2021 but designed to provide guidance for churches in the Diocese for some years to come – it would be misleading to include worked examples of actual costs, as these are forever changing. The only way to get a true figure for your church is to obtain quotes from installers, although naturally these may change once you have also liaised with your architect, and possibly a structural engineer.

However, what appears below is a list of likely cost factors to consider. Also included is a list of resources, some of which may be useful places to start for those looking for 'ballpark' installation costs for churches in a wide range of situations.

Elements likely to significantly affect installation cost:

(1). Structure of roof

It may surprise you to learn that many churches built within the last century have less capacity for load bearing on their roofs than those built hundreds of years ago! Of course, this is not always the case, and at the very least, you will need to consult your architect as to whether your roof is strong enough to bear the extra weight of PV panels. It is likely that you will need to also consult a structural engineer in this regard.

(2). Roofing material

Roofs that are tiled, slated, or felted are generally easier to install panels on than those made of sheet metal, such as lead or copper roofs. Thatched roofs are not suitable under any circumstances. Metal roofs cannot be pierced, so panels cannot be affixed directly to such roofs. Instead, a bracketing system can be used to place over the roof, onto which panels are affixed. Some newer types of panel are 'self-weighting', which suggests they do not need fixing to the roof. However, **it is imperative that you only obtain quotes from contractors with significant experience in dealing with the specific type of roof that your church has**. Otherwise, you run serious risk of the contractor underquoting, and you being left with a nasty surprise half-way through the project. A list of certified installers can be found at: *https://mcscertified.com/* See next section, on 'Practical Considerations', for detailed advice regarding different types of roofing material.

(3). Availability of roofing parapet

Parapets are discussed in more detail in the next section, on 'Practical Considerations', but – in short – if your roof has a parapet, this can be very useful from the point of view of installation of PV. Modern panels do not require a significant pitch in order to work well on a south-facing elevation, therefore the existence of a parapet potentially allows panels to be hidden between the parapet wall and the roof, out of view, and not affixed to your main roof. This may well reduce the cost of PV installation.

(4). Type of panel

There now exists forms of PV panel that mimic roof tiles and slates. These have been used on several installations on the south elevations of listed roofs to good effect. However, as of 2021, they cost between two and three times that of conventional panels. At the very least, panels will be required to blend in as much as possible, which often means paying extra for matte panels with no silver edging. It may be more economical to erect such panels on a roof, where roofing materials such as lead have to be replaced simultaneously, due to age and wear, or theft. In such circumstances, it may be that the cost of scaffolding and reduction in original roofing material replacement due to the panels, mitigate the cost of the panels somewhat.

(5). Scaffolding requirement

When investigating likely costs, it is vital that any quotes contain all scaffolding necessary. See the 'Practical Considerations' section for more details on suitable sites for PV on church roofs. However, if – for example – the south elevation of the nave can be adjudged suitable and your church is of a traditional design, it is likely that scaffold costs will be a significant part of your expenditure. If a lower roof, or a flat roof is suitable, this is likely to be cheaper but security also needs to be taken into account. Again, if a parapet roof is available, this can reduce scaffold costs as access to the entire length of the roof is often available from a certain point, or sometimes even from a door in your tower.

(6). Any need for battery storage

Battery technology has moved on significantly in the last decade, and some PV systems are now being installed with a battery, allowing churches to store the power that they create, for when they need to use it. This can be extremely useful in churches that require large amounts of power for short periods of time, particularly where electric (non-storage) heaters are used for services. However, battery installation on PV systems is a significant increased cost. Moreover, the existence in a church building of a large battery – containing significant amounts of precious metals – will be a theft risk and would need to be very secure. The lifetime of the battery also needs to be taken into account, as this will be far less than the PV panels themselves.

(7). Type of electricity connection

If your church does not have a three-phase connection to the Grid, this can be an issue. Although some small PV systems can be installed utilising a single-phase connection, normally this will not be of use to churches. Installation of three-phase electricity, where possible, would constitute a further significant cost.

Availability of grant funding for capital costs:

Sadly, much of the government funding once available for the erection of PV panels on buildings, whether residential or public, is no longer accessible (at the time of writing). A list of grant-making bodies is kept updated and is available on the Diocesan website. This includes a specific section on bodies which provide grants for specifically environmental capital projects. As you will imagine, competition for funding is fierce. Unfortunately, it is anticipated that churches would be required to self-finance the capital costs of PV installation, although naturally this is subject to any change in government policy on this matter.

Ongoing potential income generation and expenditure:

It used to be the case that any power generated, but not used, by the owner of PV panels could be fed back to the National Grid at a very reasonable feed-in tariff. Those who were signed up to the original tariff are in the fortunate position of being guaranteed a sizeable return on their investment, well into the 2040s. However, for those investing in PV now, the feed-in tariff is minimal. Whatever your church's situation, you will – as of 2021 – be very unlikely to recoup your initial capital outlay, purely by selling excess electricity to the Grid. Those churches that would be able to utilise the vast majority of the power they create, year-round, are more likely to eventually see a positive financial return on their capital outlay. See resources below for case studies on length of time taken to recoup initial investment.

Well-installed modern PV panels require little in the way of maintenance, and most are 'self-cleaning' through rainfall. However, sticky residue from trees can be a problem and regular inspections with the aid of binoculars (if practical) are recommended. In coastal areas, droppings from sea birds can be a major problem and should be cleaned off as soon as possible.

Panels generally have a minimum lifespan of 25 years, but it is anticipated that many will last considerably longer than this. Current data on the degrading of PV panels over time is given as a maximum of 0.3% p.a. and may be as low as 0.2% p.a. This would equate to between a 6 and 9% reduction in output over 30 years. If you opt for battery installation, it is likely that the battery will need refurbishment after a shorter period of time, and this can be costly. Attention to the recommended care of your battery is vital in order for it to last. If you do need to attend to your PV panels, the cost of scaffolding would once-again need to be factored-in. Ease of access tends to affect cost of maintenance more than any other aspect of PV ownership.

Churches where PV panels are most cost-effective:

An ideal scenario for PV is where a church is used a significant amount during the week, year-round, so that it will be able to utilise the electricity it creates rather than sell it back to the Grid at a very low tariff. It would also, therefore, not require battery storage.

If the church is a listed building, it would ideally have a south facing roof, tiled slated or felted, with a parapet to hide the panels behind and allow easy access for maintenance and initial installation, or an inner-aisle south-facing roof which presents similar ease of access.

If the church is an unlisted, modern building, it would ideally have a south facing roof with significant load-bearing capacity. The roof would be easy to access for maintenance purposes, but also have sufficient security that the panels are not at risk of theft when the building is unoccupied.

A church which is heated by any electrical means is likely to benefit most from PV, the installation of which could do something to counteract the increased ongoing cost of electricity compared with mains gas, and of course this is also the most environmentally sound option for any church too.

Ultimately, **if your church building is not used regularly during the week**, the installation of PV is likely to be more of an environmental decision than a financial one, because you will not be in a position to use the electricity you generate. It is unlikely that you will recoup the cost of the installation for a significant time period, if at all, as the cost of replacing the inverter will need to be accounted for, at which point it may be that the panels' economic and natural lifespan has come to an end. As always, it pays to find churches in a similar position as you, who have had an installation carried out within the last year or so (check the feed-in tariff that they are on, and ensure it is still available).

Case studies of successful PV installations on churches:

https://www.youtube.com/watch?v=1NoswkTtFA4

Church of England webinar on solar panel installations. This excellent webinar is hosted by a very experienced PV church installer. He details a wide variety of projects, including costings on Grade 1 and 2 listed churches of all descriptions. We have found this to be an extremely useful resource.

https://www.oxford.anglican.org/wp-content/uploads/2013/01/Your-Church-Solar-PV-Info-Sheet-Sept-2012.pdf

Guidance note issued by the Diocese of Oxford: *'Your church and solar PV'* although note, this was produced in 2012 and the Diocese would need to be contacted directly to provide more up-to-date figures.

https://www.london.anglican.org/kb/solar-panels

A useful list of London churches that have installed solar panels, who you may wish to contact.

PV Panels: Practical Considerations

Many of those issues dealt with above as 'financial considerations', might also be thought of as practical, and issues are only dealt with again here where they principally concern the fabric of the building.

Visibility of PV panels from the ground

For any church where the building is viewed by the wider community as a historic public asset, a major consideration is whether the addition of PV panels is likely to be viewed positively or negatively within that local community. It may well be that a community would highly value a particular church taking a lead on this issue, but if that meant an ancient church roof could be seen to have large pieces of plastic installed in prominent places, the community might be less welcoming. Likewise, heritage bodies would have serious concerns if significant alterations were proposed to very historic fabric in roofs, so the placing of PV panels will ultimately be crucial to moving forward with such a project on listed buildings.

Any church that wishes to place PV panels in a visible position on their roof, requires not only a Faculty to be issued by the Diocese, but also planning permission to be issued from their local planning authority. Non-listed churches will be far more likely to receive both a Faculty and planning permission for visible PV panels, than listed buildings will be. If a listed church building has no method of placing the PV panels out of sight from the ground, it is unlikely that either a Faculty or planning permission will be obtainable. There may be scope for the addition of solar tiles, rather than panels, in specific cases – although see the previous section on 'financial considerations' for the cost implications of this.

As has already been stated, a parapet is very useful for hiding PV panels on listed buildings. Likewise, if your listed church has part of a south-facing roof elevation that is hidden, perhaps by the pitch of an adjacent roof, this may be considered an option. Likewise, the provision of small solar installations on the flat roofs of church towers may hold potential on listed buildings. It is worth restating that all PV installations on listed church buildings require both a Faculty and planning permission, whether they are hidden from view or not. All such installations on non-listed church buildings will require a Faculty, whether hidden from view or not, but may or may not require planning permission in addition. If in doubt, consult with your architect.

Consultation with Heritage Bodies

When considering making changes to a listed church, there are a number of bodies that must be consulted when the proposed alterations would be likely to affect the building's character as a building of special architectural or historic interest. Placing an array of PV panels on a church roof is likely to fall within this category.

Such consultation should take place before a Faculty is applied for, and the views of the consultees will be taken into consideration as part of the Faculty process. Your architect may be able to advise you further as to which consultative bodies are pertinent to your church's situation.

Historic England have produced an excellent brochure, dealing specifically with PV installations. We highly recommend that you read this, if your church is a listed building.

> Energy Efficiency and Historic Buildings: Solar
>
> *https://historicengland.org.uk/images-books/publications/eehb-solar-electric/heag173-eehb-solar-electric-photovoltaics/ Electric (Photovoltaics) (historicengland.org.uk)*

The contact details for the various consultees are as follows:

Historic England

eastofengland@HistoricEngland.org.uk

The Church Buildings Council (CBC)

consultchurchbuildingscouncil@churchofengland.org

The Society for the Protection of Ancient Buildings

info@spab.org.uk

The Ancient Monuments Society

office@ancientmonumentssociety.org.uk

The Georgian Group

casework@jcnas.org.uk

The Victorian Society

churches@victoriansociety.org.uk

The Twentieth Century Society

caseworker@c20society.org.uk

Insurance

Your buildings and public liability policies may be affected by the addition of solar panels. Consult your insurers as part of your preparatory work. Likewise, your lightning conductor may need to be upgraded as a result of PV installation.

Roof mounting methods and mechanisms

The mounting of photovoltaic panels on traditional roofs is practical but needs special consideration to ensure the durability of both the panels and the original roof.

The materials likely to be encountered in considering suitable locations for the mounting of photovoltaic panels fall into two distinct groups:

1. Flat roof materials: lead, sheet metals, built-up felt.
2. Pitched roof materials: plain tiles, concrete tiles, slates, lead, sheet metal

Structural Considerations:

In respect of the photovoltaic panels, the design considerations are:

- Supporting the weight of the panels
- Preventing wind lift
- Cable restraint/management

In terms of the existing structure, the considerations are:

- Transferring the weight through the roof covering to the structure below
- Allowing for maintenance of the existing roof covering
- Protecting the roof from accelerated deterioration caused by the panel installation
- Maintaining the weatherproofing of the roof at the fixings and the cable entry points.

Practical solutions exist to most of these problems, but they need to be fully considered with the photovoltaic panel supplier prior to applying for a Faculty and entering into an agreement with a supplier for the fitting of the panels.

Fixing Considerations:

The presence of a large metal frame on the roof of a building will affect its electrical potential (for lightning strikes) and the new installation will need to be considered by the lightning conductor specialist advising the PCC and the lightning conductor system adapted to suit.

The method of fixing the panels will need careful consideration in order to obtain a Faculty.

For the photovoltaic panels, the design details will be prepared by the specialist. However, it should be borne in mind that there are number of methods of designing the installation and in some cases it may be appropriate to choose a particular method to suit the characteristics of the existing building.

Photovoltaic panels are usually mounted in large rigid panels which are in turn supported on a framework of metal (usually aluminium) which transfers the weight to particular points around the framework where a suitable fixing can be obtained on the existing roof structure. The spacing of the support points, both up and down the roof and from side to side, can be adapted to suit the particular requirements of the existing structure by varying the size of the supporting framework.

In addition to supporting the weight of the roof, the supporting framework must also provide a method of restraining the panels in strong winds. In very large installations, the loads generated by wind will be greater than the weight of the assembly. Engineering advice will be required for both the wind-loading restraint of the installation and its own weight.

The cables will be collected together and clipped to the supporting sub-frame. They will either enter the roof of the existing building or will be directed over the eaves into a wall mounted connection. In both cases, the terminal cables are of limited flexibility and will need to be weathered to prevent rainwater tracking along the cables and entering the building through the entry point. Dealing with this issue is largely a matter of practical detailing but will need to be addressed and illustrated in a Faculty application.

For a small installation on a flat roof, the panels can be restrained by weighted containers and the load supported directly on the roof covering. However, it should be borne in mind that the contact points could restrict water flow across the roof and that any weighting system must be proof against frost and quantified to ensure that the roof structure is capable of supporting the additional loads. This form of installation is very rarely appropriate other than for very small installations.

For a pitched roof, the framework needs to support the weight of the panel array, resist wind loadings and also provide for the tendency of the frame to slide down the roof. Pitched roof structures very rarely have even load-bearing capacity as they rely on individual members such as purlins, rafters and beams to support the weight of the roof covering. These features are fixed at regular centres and the carrier system for the photovoltaic panels will need to be adaptable to suit the spacing of the structural supports.

Methods of fixing to roof:

The method of fixing PV panels to roof coverings requires consideration of the characteristics of the existing roof.

Lead roofs are a common form of roof covering on both flat and pitched roofs. Lead is laid in relatively small sheet sizes to accommodate the movement that occurs in the lead when temperatures change. The lead has low tensile strength and needs to be free to move where it is not secured to the supporting boards. This means that panel fixings on lead can only be achieved in the upper third of each lead sheet. The fixing should also be kept clear of the side joints (the rolls) to prevent debris building up between the panel support and the roll which will encourage the lead to leak.

On a pitched roof it is possible to insert specially designed clips between the laps of the lead at the joints of the individual sheets to support the panels clear of the lead. These clips do not interfere with the movement of the lead sheets either above or below the joint. This form of fixing requires adequate strength in the roof structure at very specific points under the lead. If the appropriate fixings are not designed into the roof at regular intervals, it will be necessary to introduce some additional strengthening under the lead in order to support the panels.

In the other forms of metal sheet roof, the metal is stronger and more capable of dealing with tensile loads than lead and therefore is laid in longer bays. With this type of roof it may be necessary to introduce additional joints in order to insert the clips between the individual joints of the sheets. It is also necessary to have adequate support in the structure below.

For a pitched roof made up of individual tiles or slates, a clipping system inserted between the laps of the individual roof components will be appropriate. The spacing of these components would depend on the materials used. The most important consideration in this type of roof covering is the spacing of the structural supports below. There will be numerous opportunities to fix between the joints of the roof covering however care should be taken to ensure that the load is either distributed very evenly across a large area with numerous fixings; or where the primary structure consists of a relatively few large beams, that the fixings occur directly above these beams. With all forms of tiled or slated roofs, it should be borne in mind that the individual tiles and slates are vulnerable to breakages through frost or impact damage. It may be necessary to gain access to the roof in order to replace individual tiles or slate. This may involve disturbing a large area of photovoltaic panels in order to gain access to the defective area of the roof. In these circumstances, some form of release mechanism should be specified in the roof panel design.

A Guide to the Faculty Application Procedure

Applying for a Faculty can occasionally seem like a bewildering procedure! This guide is designed to help you navigate the various steps that would be necessary for any Faculty application. The notes underneath each section apply specifically to Faculties for PV installation. The note's next full section contains details the DAC would be looking for in a good application.

Stage	Simple	Slightly more detail
1	Agree what you want to do	Before seeking advice the PCC should have a clear basic idea of what it wants to do and why. It should be clear how it helps the mission of the church.
		Your PCC should have engaged with the Carbon Neutral 2030 materials produced by the Diocese, and have commissioned a professional energy audit to help you identify the most environmentally beneficial measures you can take for your church.
2	Develop your idea (for major projects)	Understand the core purpose - consultation, honing vision. If the proposal is significant consider a parish away day to refine your vision, or consult the community before you have made up your mind what you want to do.
		Your PCC will have delegated responsibility for this project to a smaller team, who will have: - engaged with the advice in this booklet, - accessed the materials on PV installation on churches, provided by the Church of England, - discussed what, in your opinion, the environmental benefits would be of installing PV in your church's particular circumstances, and - if your church is a listed building, discussed whether it will be possible to show how you might hide PV panels from view from the ground.
3	Identify professionals to work with	You will need to work with appropriate professionals for all but the most basic works. For building and reordering this will be an architects of surveyor, and for many other works there are appropriately trained professionals. Professional support with developing ideas and proposals may also be relevant.
		PV installation will require the services of a registered installer, preferably with significant experience of church installations. Your church architect will be involved, along with other professions, potentially including a structural engineer.
4	What is the appropriate permission?	
a	Secular permission	Planning permission will be needed from the local authority for works that change the external appearance of the church. It may also be needed for work to church halls and residential buildings
		Planning permission is required for all PV installations on listed buildings, and installations on non-listed churches that are visible from the ground.
b	Ecclesiastical permissions	Will the work make a change to the character of building or its furnishings or involve substantial replacement of historic material
		All PV installations on churches, whether listed or not, require a Faculty.

5	Take advice from your DAC, who may also invite others to give advice too	Taking advice will probably include at least one site meeting. This is your opportunity to ensure that your proposals are understood and for you to ask and answer questions intended to strengthen your case. It is a good idea to consult the DAC at the earliest possible opportunity. Contact details for the DAC Secretary and Diocesan Environmental Officer are to be found in Appendix (ii).
6	Consultation with others	If your proposals will involve the demolition of or change in the character of a listed building consultation with Historic England, one or more or the National Amenity Societies or the Church Buildings Council may be required. Details of historic consultative bodies can be found on page 13. Also make sure you have consulted your electricity company about becoming a registered supplier, and your insurers.
7	Listen to local views	Where substantial changes such as a reordering or extension are being considered it is important for the PCC to consult regular worshippers and the local community at a stage when proposals are at an early stage when local views can be taken into account PV panels on historic buildings can be welcomed by some, whilst to others they are contentious. It is always a good idea to seek out public opinion and to gain community support for such a project.
8	Consider and take account of advice	Your proposals may attract advice from a wide range of people, and the advice may not all agree. You should reconsider the project in the light of the advice and reconsult if you have been asked to do so. The final choice of what you ask permission to do is with the PCC.
9	Ask your DAC for its final advice	The DAC response will be a formal notification of advice. It will come with a public notice. It is not permission to start work. Occasionally it will include a requirement to consult, if this has not been done. All Faculty applications now take place online. For detailed help, see: *https://facultyonline.churchofengland.org/user-manuals - Online Faculty System (churchofengland.org)*
10	Display the public notice (which the DAC will supply)	This notice give the public 28 days to consider your proposals and to make comments. Details of the proposals have to be available for consultation during this period.
11	Apply to the Chancellor for a faculty	The papers you send to the Chancellor will nearly always be sufficient to consider your case. Now and again a proposal attracts strong opposition or is considered particularly complex by the Chancellor. In these situations the Chancellor may decide the case on written representations. In rare cases there may be a public hearing of the case for the faculty, with opportunity for the objectors to make their case. You will be given specific advice as necessary.
12		Once a faculty is granted the proposals can proceed, subject to any conditions on the faculty.

What the DAC are looking for in a PV Faculty application

(1). The petitioning church has engaged in a wide-ranging PCC discussion regarding the Carbon Neutral 2030 agenda, including **having already changed to a 100% green electricity provider**.

(2). The church has engaged an energy professional to provide a complete audit of the church's energy use and conservation, and has acted appropriately upon it.

(3). The church can show that it has considered the relative environmental benefit of PV installation, compared with other environmental interventions.

(4). The church can show proof that it has consulted widely on this issue, including with its local community, churches in similar situations, relevant heritage bodies and the local authority.

(5). The church has obtained relevant advice from its architect, potential qualified PV installer and, where necessary, a structural engineer, as to the suitability of the roof for this purpose.

(6). A relevant statement of needs is supplied, showing that the installation will provide clear environmental benefits.

(7). The church has obtained a letter of consent to the works from its insurer and can provide proof that it has liaised with its electricity provider as to the feasibility of registering itself as a provider.

(8). Detailed technical drawings of the panels, positioning, and any structural alterations required, to be submitted to accompany the application.

(9). Evidence that the all elements of the DAC PV policy have been complied with.

Community Partnerships

Having read this document, you may decide that your church is very well suited to PV panels. However, whether this is the case or not, it may be beneficial to consider some other options for the siting of PV panels which may offer even better environmental, practical and financial solutions than your church roof.

Community Links

If you have a church hall or there is another community building nearby to the church, where you share ownership or enjoy a good working relationship, it may be possible to negotiate the implementation of a shared PV scheme on the community building, which may also be able to be used by the church. Installing PV on a non-listed, relatively modern building, where the roof is at a reasonably standard height, is a lot easier than doing so on a church, and it may be of benefit to both organisations to investigate this route and possibly share costs.

Church Schools

All Voluntary Aided schools fall under the aegis of the Carbon Neutral 2030 agenda, and as such are required by General Synod to address their own carbon emissions. Funding is available through the Salix Finance loan scheme, allowing schools to borrow to fund the installation of PV panels. This is often highly cost-effective for schools, as they are able to use the majority of electricity they consume during weekdays in term time. However, it is likely that they would have spare capacity in their generation at weekends. If you have a church school (or indeed, any school with which you have good relations) that is located close to the church building, once again it may be possible to enter into partnership with them, perhaps with the agreement that the church receives electricity from the panels at the weekend.

Legal Considerations with Community Partnerships

Accessing electricity generated on the roof of another building will probably require a legal agreement to be put in place, governing access, maintenance costs and other shared responsibilities. It is recommended that you and your partners take professional advice on this matter, to avoid any complications arising in the future.

If all else fails, we return to the advice at the beginning of this guide. The vast majority of CO2 emissions produced by churches come from burning fossil fuels for heating, and – for most churches, heated as they are by oil or gas – solar panels will not help curtail these emissions. It is recommended that you investigate alternative heating methods which, in conjunction with a change to a green electricity supplier, will do a great deal to move your church to becoming carbon neutral by 2030.

Please feel free to use the contact details in Appendix (ii) to find who to contact for more information.

Appendix (i):

DAC Policy on Faculty Applications for the Installation of PV Panels on Churches

1. Siting and Quality of PV Panels:

1 (i). For all churches that are listed as being of architectural significance, the proposed installation site should not be visible from the ground. Presuming the installations will in the main be on church roofs, this means that the roof will have to be a) of low pitch behind a parapet, or b) a valley (for example between a nave and aisle roof). For non-listed churches, the proposed installation site should show appropriate sensitivity to the design of the building.

1 (ii). Except in exceptional circumstances, applications will not be recommended where structures are required outside the footprint of the existing building.

1 (iii). The roof structure should be assessed by a suitably qualified professional to ensure that it can carry the additional weight of the equipment.

1 (iv). Discreet and secure space should be identified for the inverter equipment.

1 (v). All installations to be carried out in accordance with the current IEE Regulations and the relevant certificate obtained.

1 (vi). The fixing of the panels must be reversible, and must not compromise the roof covering (for example by piercing or restricting thermal movement). Fixing methods and cable runs should be chosen so far as possible to be inconspicuous and avoid disturbance to historic features.

2. Quality of the PV Panels:

2 (i). The panels should have a minimum 25-year performance guarantee.

2 (ii). The panels should be inspected annually by a suitably qualified engineer, together with the wiring and inverter equipment.

2 (iii). Where possible, the panels should be manufactured in the UK or the EU, to reduce the carbon embedded in the manufacturing and logistical processes.

3. Environmental Significance:

3 (i). Parishes should provide the DAC with statements of need and significance, showing a clear environmental benefit to the installation.

3 (ii). Parishes should prove to the DAC that the proposed installation is part of a wider package of measures they have already taken towards better environmental stewardship, including having changed to a 100% green electricity provider.

3 (iii). There should be a current and competent energy audit of the building.

3 (iv). Contractors should provide a feasibility document identifying the expected efficiency of the installation (%), annual energy production, monetary and carbon payback periods.

3 (v). The comment of the inspecting architect is essential, and wherever possible he/she should be closely involved in the proposals Consultation,

3 (vi). Parishes should consult with (dependent on grade, etc): Historic England, The Society for the Protection of Ancient Buildings, The Ancient Monuments Society, The Georgian Group, The Victorian Society, The Twentieth Century Society, and the local planning authority.

3 (vii). A letter of consent from the insurers is essential post-installation.

4. Provision for Evaluation and Monitoring:

4 (i). After the first twelve months an evaluation report is to be produced detailing the levels of energy produced across the year, FiT earnings, and remaining energy bills.

4 (ii). Monitoring should continue throughout the lifetime of the installation, and a summary of that monitoring be provided to the inspecting architect for inclusion in QI reports.

5. Provision for End of Life:

5 (i). The DAC will not recommend any proposal that does not include a provision for removal of the panels at the end of the contract for the installation and; either renewal of the panels; or reinstatement of the building features disturbed by the installation of the panels.

NB. It should be noted that the Diocesan Chancellor has final say on all Faculty decisions, and will consider each case on its own merits.

Appendix (ii): Contact Details

For all issues relating to material changes to church buildings, including Faculty applications, contact in the first instance:

Mrs Sandra Turner, DAC Secretary
01245 294423 dac@chelmsford.anglican.org

For advice on matters pertaining to environmental improvements to churches, creation care and Carbon Neutral 2030, contact:

Rev'd James Gilder, Diocesan Environmental Officer
07729 109638 environment@chelmsford.anglican.org