ESOS-ENERGY
Energy efficient solutions

# Energy Efficiency and Zero Carbon Advice


## St Andrews Church Hall
## PCC of Bebington

THE CHURCH OF ENGLAND
Diocese of Chester

| Author | Reviewer | Date | Version |
|---|---|---|---|
| David Legge | Matt Fulford | 29th October 2022 | 1.0 |

# Contents

# 1. Executive Summary

An energy survey of St Andrews Church Hall was undertaken by ESOS Energy to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St Andrews Church Hall was built in 1959 and is located in a suburban area in Bebington, Birkenhead. The hall comprises the main hall and viewing gallery/corridor, kitchen, WCs and a number of side rooms on both floors. The hall is a double height space of brick construction with cavity walls and a pitched tiled roof which does not have any insulation. The hall has double glazed windows throughout with the exception of the glazing above the front door. There is both gas and electricity supplied to the site.

The church hall has a number of ways in which it can be more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table and the route to net zero carbon are used as the action plan for the church hall in implementing these recommendations over the coming years.

| Energy saving recommendation | Estimated Annual Energy Saving (kWh) | Estimated Annual Cost Saving (£) | Estimated capital cost (£) | Payback (years) | CO2 saving (tonnes of CO2e/year) |
|---|---|---|---|---|---|
| **Change existing lighting for low energy lamps/fittings** | 3,240 | £972 | £4,733 | 4.87 | 0.82 |
| **Install PIR motion sensors on selected lighting circuits** | 107 | £32 | £567 | 17.62 | 0.03 |
| **Install SavaWatt devices on fridges and freezers** | 400 | £120 | £120 | 1.00 | 0.10 |
| **Replace heating system for electrical based heating solution** | 4,859 | -£667 | £2,748 | -4.12 | 0.50 |
| **Install suspended ceilings into first floor side rooms** | 1,275 | £128 | £7,200 | 56.47 | 0.24 |
| **Inject cavity wall insulation into walls** | 1,700 | £170 | £15,000 | 88.24 | 0.31 |
| **Fit flow regulators onto existing taps** | 750 | £75 | £53 | 0.70 | 0.14 |
| **Fit timed fused spurs to hot water heaters** | 162 | £49 | £90 | 1.85 | 0.04 |
| **Replace windows** | 6,375 | £638 | £850 | 1.33 | 1.18 |
| **Consider install Electric Vehicle Charging Points** | 0 | N/A | | | |
| **Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)** | 3,108 | £932 | £8,633 | 9.26 | 0.79 |
| **Install an Air Source Heat Pump into the building to replace existing heating system** | 22,313 | £319 | £16,800 | 52.71 | 3.46 |

The PCC for the church hall should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works.

Based on current market prices of 30p/kWh and 10p/kWh for electricity and mains gas respectively.

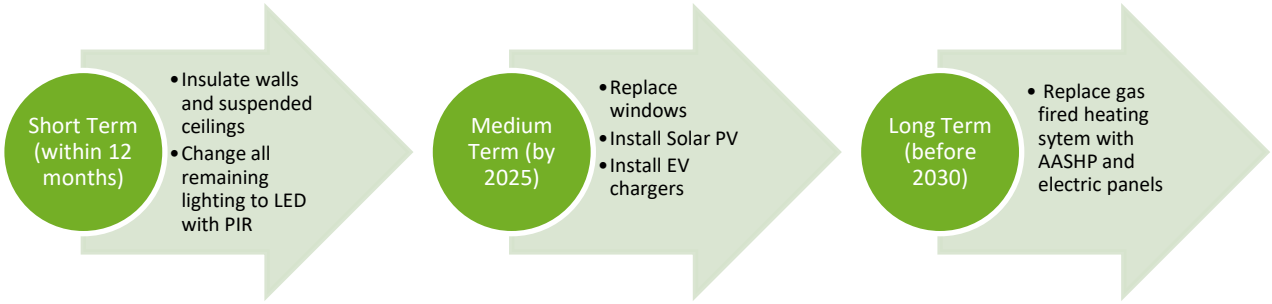
**If all measures were implemented is estimated to save the church £2,767 per year and reduce its carbon footprint by 7.6 tonnes (65%)**.

## 2. The Route to Net Zero Carbon

Our Government has committed to move towards Net Zero Carbon – the point at which we have reduced emissions as much as we can and then balanced any residual emissions through removal of carbon from the atmosphere. They have done this as part of a worldwide agreement which aims to limit global warming to well under 2 degrees Celsius, with an aim of keeping it below 1.5 degrees Celsius. This will help protect all of us from the impacts of climate change.

In February 2020, the Church of England's General Synod set its own Net Zero Carbon target. The first stage of this target covers energy used by churches, cathedrals, schools, vicarages, other church buildings, as well as emissions caused by reimbursed transport. The target date is 2030.

This church hall has a clear route to become net zero by 2030 by undertaking the following steps:



# 3. Introduction

This report is provided to the PCC of St Andrews Church Hall to give them advice and guidance as to how the church hall can be improved to be more energy efficient. In doing so the church hall will also become more cost effective to run and seek to improve the levels of comfort. Where future church development and reordering plans are known, the recommendations in this report have been aligned with them.

An energy survey of the St Andrews Church Hall, Church Road, Bebington CH63 3EX was completed on the 5th July 2022 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

| **St Andrews Church Hall** | |
|---|---|
| Church Code | n/a |
| Gross Internal Floor Area | C300 $m^2$ |
| Listed Status | Unlisted |

The church typically used for 35 hours per week for the following activities

| **Type of Use** | **Hours Per Week (Typical)** | **Average Number of Attendees** |
|---|---|---|
| Services | 0 hours per week | n/a |
| Meetings and Church Groups | 20 hours per week | Varies |
| Community Use | 15 hours per week | Varies |

# 4. Energy Usage Details

St Andrews Church Hall is estimated to use 10,000 kWh/year of electricity, costing in the region of £3,000 per year, and 50,000 kWh/year of gas, costing £5,000. The total carbon emissions associated with this energy use are 11.8 $CO_2e$ tonnes/year.

This data has been estimated as no utility bills or consumption data has been provided for the church hall (only data was provided for the church)

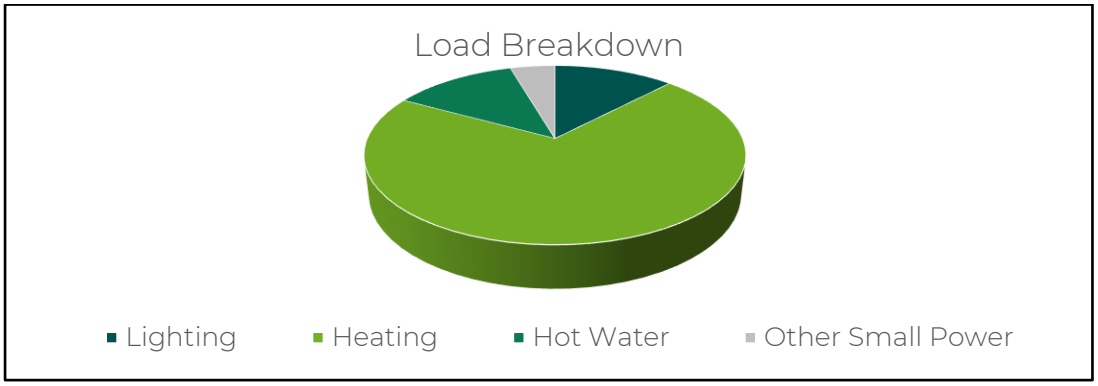
| **Utility** | **Meter Serial** | **Type** | **Pulsed output** | **Location** |
|---|---|---|---|---|
| **Electricity** | E12Z007406 | 3 phase 100A | Yes, but not fully AMR connected | Foyer cupboard |

It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.

## 4.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

| Service | Description | Estimated Proportion of Usage |
|---|---|---|
| **Lighting** | Main hall has T5 5ft fluorescent tubes and other areas are lit by PLL bulkhead fittings, CFL lamps and some LED to the side rooms | 12% |
| **Heating** | Provided by a gas fired Worcester boiler to LST and standard radiators throughout | 71% |
| **Hot Water** | Provided by the gas fired combination boiler | 13% |
| **Other Small Power** | Plug loads, kitchen appliances and alarms and security | 5% |




As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is lighting.

# 5. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Putting in place a heating strategy that is energy efficient and low carbon is, therefore, of the highest priority

The Church of England is in the process of reviewing its heating guidelines. The process has already established some principles for heating that can help churches as they seek an acceptable combination of comfort, conservation, affordability, and environmental care. The principles can be found at https://www.churchofengland.org/sites/default/files/2020-04/CBC%20Heating%20guidance%20principles%20FINAL%20issued.pdf

As the principles make clear, every church's strategy will be unique to it, informed by many factors, including the nature of its usage, the system it's starting from, the conservation needs of the building, and the resources available. The strategies in this audit are designed specifically for your church.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches we make recommendations that will help to reduce energy wastage and, as a starting point, to optimise the system that you already have

Secondly, we recommend options for many churches that focus on heating people rather than the full volume of the church. Some of the changes that can help with this will be 'soft' changes – others will relate to the heating system itself.

Finally, we make recommendations about moving away from fossil fuels. Moves away from fossil fuels are key to cutting emissions. For most churches, this will involve moving from gas, oil or LPG to electricity. Electricity currently creates carbon emissions around the same level as mains gas, but the carbon emissions associated with it are reducing rapidly as the UK builds more renewable energy and decommissions its remaining oil and coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of bio gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. Some local areas may also be considering the option of district heating networks.

While moving away from fossil fuels may not always be possible, as the principles state, "churches should be expected to have at least carefully considered the option of moving away from fossil-fuel based heating (gas and oil boilers) towards electric-based heating." And if such options are not viable now, the churches "can try to be ready for a future retro-fit when technology and the grid has progressed."

The church hall is currently heated by a gas fired boiler which was installed in 2018 and appears to have a further 15 years serviceable life before requiring replacement. The boilers provide heating to low surface temperature radiators around the perimeter of the hall, including to the side rooms.

The church hall is used frequently throughout the week, with side rooms used at different times and requiring individual heating, which the current system does not offer.

## 5.1 Air to Air Source Heat Pumps

Air-to-Air Source Heat Pumps (AASHP) work by having an external unit which sucks air in and extracts the heat from it. The pumps concentrate this heat and put it into a refrigeration gas (in the same way as a fridge or freezer works). This refrigeration gas is then piped inside the building in a small pipe where is it then allowed to expand in an internal unit with a fan. This heat is then blown out into the space. This system is identical to an air conditioning system, but it works in reverse to heat the space. As warm air is blown into the space this type of system can heat spaces from cold relatively quickly. Air-to-Air Source Heat Pumps provide around 4.5 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of 4.5.

AASHPs require the installation of external units which look like air conditioning modules in well ventilated external locations. These external units will need an electricity supply and pipework running from them to the heating system. They will also need a drain nearby as the back of the units can build up moisture, which condenses and sometimes freezes on the coils. The larger units do create some low-level noise and therefore the location and baffling of the units may need to be considered carefully.


*Examples of external units for ASHP comprising of three smaller 3kW units and two larger 10kW units.*

Internal units come in a variety of styles. The most appropriate internal units for most churches are floor mounted units which look very similar to a fan convector heater.

**FUA-A - Under ceiling cassette air conditioning unit**

**Unique under ceiling cassettes for high rooms with solid ceilings or false ceilings with a shallow void. Suitable for all types of commercial applications.**

The FUA-A range provides comfortable heating and cooling even for rooms with high ceilings and has individual louvre control flexibility to suit every room layout.

**FTXM-R - Wall mount air conditioning unit**

**Attractive, wall mounted design with perfect indoor air quality.** 2 area motion detection sensor: air flow is sent to a zone other than where the person is located at that moment; if no people are detected, the unit will automatically switch over to the energy-efficient setting.

**FVXM - Floor Mount Air Conditioning Unit**

Designed to fit rooms of any size and shape, it blends well with the interior due to the new design which incorporates more flowing lines and softer edges. These units are ideal when it is not possible to fit a high level wall mount unit for aesthetic or practical reasons.

They are suitable for a wide range of applications including domestic, small to medium offices and commercial uses.

All these units do have a fan element within them and therefore a small amount of fan noise is emitted. This tends to be less than a fan convector heater on a boiler-based system and similar to the noise from a fridge or freezer. Air conditioning units are commonplace in hotel rooms, indicating that the noise is low enough even to be suitable for sleeping environments.

A case study of a church which has installed such a solution is available at 5. Air-source heat pumps at Hethel Church - All Saints Church, Hethel - A Church Near You

## 5.2 Install Electric Panel Heaters

Electric panel heaters can provide additional heating to the smaller areas of the hall. Suitable electric panel heaters would be far-infrared panels. These heaters have a strong radiative effect (where heat is reflected to people from the surface) as well as a light convective effect (where air is warmed and moves around to heat the general space). For this reason, these heaters tend to provide a relatively instant sense of heat and comfort within a specific space and only need to be on for short periods of time. The heating effect spreads out from the panel by up to 3 meters, although this is reduced by people and furniture. This means that these heaters provide a useful source of supplementary heating or primary heating for some well-defined areas but are not very well suited to providing a complete heating solution for the hall without other forms of heating (such as an ASHP). As these heaters warm up almost instantly, this reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It also means that areas using this form of heating can rapidly and economically be brought into used for short or unplanned meetings if needed.

It is recommended that the PCC consider installing supplementary electrical panel heaters in the following areas on a time delay switch and remove the existing radiators.

| Area | Type/ Size | Length (mm) | Watts | Number (or m) Required |
|---|---|---|---|---|
| **Toilets/lobby** | Electric Far IR Wall Panel 350W | 600 | 350 | 4 |
| **Kitchen** | Near IR Overhead Heater 1.5kW | 480 | 1500 | 2 |

These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch so they cannot be left on accidently after use.

If you would like to discuss panel heaters with a church or hall in the diocese that already makes use of them, please contact the diocese.

# 6. Energy Saving Recommendations

In addition to having a revise heating strategy there are also a number of other measures that can be taken to reduce the amount of energy used within the church.

## 6.1 New LED Lighting

The lighting makes up a relatively large overall energy proportion of the electricity used within the church. There are some areas of the building which have had efficient LED lights installed but there still remains a large number of inefficient fluorescent fittings within the main hall, office and foyer.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. There are a vast number of specifications of LED lights on the market, but it is recommended that any LED light should come with branded chips and drivers and offer a 5 year warranty. An example of such a range of fittings is available from http://www.qvisled.com/

If all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £4,733. The annual cost saving would be £972 resulting in a payback of around 4.9 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider. Guidance on lighting, produced by Historic England for churches, can be found at https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/

There are some fittings such as the CFL lamps in the WCs where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to w new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

## 6.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the foyer, office, stairs and the like. Some of these areas are only used occasionally and for a short amount of time so that, in actuality, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows, such that artificial lighting is not required for much use during the year.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors, commonly called PIRs, also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

## 6.3 Refrigeration Controls

Within the hall there are various domestic refrigeration units such as fridges within the kitchen area. These units run 24/7 and contribute to the baseload electrical consumption of the building.

To reduce the electrical consumption of these appliances, it is recommended that they are all fitted with a SavaWatt unit. These units work by automatically detecting the load of the compressor and turning down the power when it is not in full load. This reduces the energy consumption of the refrigeration unit by around 18% while maintaining the cooling of the appliance. It does this by reducing the voltage delivered to the unit when it is idling but allowing the full energy to the unit when it is required.

Supply and installation and further details can be undertaken by SavaWatt directly http://savawatt.com/. (Note the self installed SavaPlug has been discontinued, but the professionally installed Savacontrol option is available) The installation does not cause any significant disruption to operations and can be undertaken during normal operating times.

## 6.4 Timers on Fuse Spurs to Water Heaters

There is an electric hot water boiler (for tea making and the like) located in the hall. These only need to heat the water to the required temperature when the building is in occupation but at the

moment these heaters are directly wired in without any form of time control and therefore maintain their set temperature 24/7 .


It is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied . This will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

Such units can be purchased at any electrical wholesaler and fitted by your existing electrician or any NICEIC registered electrical contractor.

## 6.5 Cavity Wall Insulation

The church hall is constructed with a cavity wall method, and the inspection of the wall showed no signs that insulation has been added. Prior to the early 1990's, building regulations did not require walls to be fully insulated and therefore it is likely that there is no insulation present. It could, however, be added through injection into the cavity walls.

It is recommended that cavity wall insulation is considered and added to the walls where appropriate. A survey to check the width of the cavity, exposure of the wall and condition of the cavity should be carried out by a CIGA-approved installer who will then be able to provide you with a quotation to undertake the works. Installing cavity wall insulation will help to reduce heat loss and improve the comfort of the space, but needs to be considered alongside other control measures such as TRV's or room sensors to ensure that the space does not overheat because of the additional insulation.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

## 6.6 Install Suspended Ceiling to side rooms

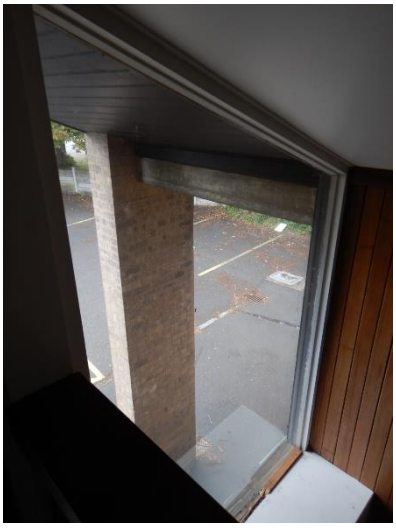
The side rooms have exposed ceilings at present which match the roof profile and the supporting structure is shown.

It is recommended that the air volume of these spaces is reduced through the installation of insulated suspended ceilings to the side rooms on the first floor. It is recommended that insulated panels are used or

that insulation be added to prevent heat loss, to reduce the heated volume of the building and create a more comfortable environment for the occupants.

The ceiling of a room is the largest contributing area to heat loss from a building as heat rises. The insulation of such spaces can therefore have a dramatic impact on both the efficiency of the heating system and the temperature of the space below. Insulation measures such as this also need to be combined with control measures such as TRV's or room sensors to ensure that the space does not overheat because of the additional insulation. The insulation is usually fitted in the form of bags or pads sized to the same dimensions of the ceiling tile and therefore it maintains access into the ceiling through the easy removal of ceiling tiles as required.

### 6.7 Replace Windows



The windows on the front of the building above the front door as well as the first floor external door are single glazed with wooden surrounds and as such are very poor in terms of thermal quality. In addition, many of the openings do not close well against the frames and excessive cold air is being let into the space.

The introduction of new double glazed units would considerably reduce the heat loss from the building and improve thermal comfort. This measure would be costly and disruptive to install but could be considered as part of a refurbishment programme. The use of high quality windows will also reduce external noise transfer and provide added security. To enhance heat ingress in particularly cold areas, double glazing with low emissivity (Low-E) glass could be selected as this allows more solar gain than standard double glazing.

It is therefore recommended to replace these windows with new double glazed windows with wooden/aluminium/uPVC casements set into the existing surrounds. It is suggested that any window installation is undertaken by a FENSA Approved Installer www.fensa.org.uk

## 7. Saving Recommendations (Water)

### 7.1 Tap Flow Regulators

The taps to the wash hand basins within the building have been checked as part of the audit and the average flow rate within these has been measured to be over 8l/min. The recommended flow rate for hand washing is 4.8l/min and therefore the taps are providing around double the amount of water that is necessary.

The overprovision of water for hand washing is not only a source of excessive water use, but in the case of hot water, it is also a source of wasted energy in the heating that has to go into providing the hot water.

The flow rate of the taps can be easily regulated by fitting flow regulators within the taps. It is recommended that flow regulators are fitted into all the viable hand wash basin taps to save on both water and heating of the hot water.

These regulators can be self-installed or by any good facilities staff or it can be installed by anyone with competent DIY skills.

# 8. Other Recommendations

## 8.1 Electric Vehicle Charging Points

The church hall has a car park to the front of it which serves the church and church hall. In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those visiting the church and/or using the hall, the church may wish to consider installing an electric vehicle charging point, probably on the side of the church hall to allow visitors to charge their electric cars.

Installing a unit such as a Rolec Securi-Charge http://www.rolecserv.com/ev-charging/news/view/Robust-EV-Charging-With-Rolecs-SecuriCharge-EV-Wall-Unit-Coin-Token-PAYG would allow the organisation control over who is allowed to use the unit with a key operated system. Or given the type of use of the building and control over the usage of the car park as a whole a simple 32 amp type 2 wall pod type charger may be most suitable and these are widely available through many suppliers such as http://www.rolecserv.com/ev-charging/product/EV-Charging-Points-For-The-Home.

Because of the parish office within the building, the church can be considered as a place of work and, as such, installation grants are available through the workplace charging scheme https://www.gov.uk/government/publications/workplace-charging-scheme-guidance-for-applicants-installers-and-manufacturers which will fund 75% of the installation cost up to £500.

# 9. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

| Renewable Energy Type | Viable |
|---|---|
| **Solar PV** | Yes – small array to SE facing roof |
| **Wind** | No – no suitable land away from buildings |
| **Battery Storage** | No – no viable PV |
| **Micro-Hydro** | No – no water course |
| **Solar Thermal** | No – insufficient hot water need |
| **Biomass** | No – not enough heating load as well as air quality issues |
| **Air Source Heat Pump** | Yes – described earlier in report |
| **Ground Source Heat Pump** | No – not preferred heating solution, no ground works planned |

Now that the Feed in Tariff scheme has come to an end the installation of solar PV panels in situations where there is not almost full usage of the electricity generated on site is not really viable.

There is potential for a small PV array on the roof of the hall. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce.


Battery Storage is not strictly a renewable energy solution, but battery storage does however provide a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

Wind turbines require highly exposed sites and should be located 250m way from buildings as such this site is not suitable for a wind turbine to be installed.

Hydro electricity is a highly efficient source of renewable energy but requires a body of flowing water with a differential height which is not present on this site.

Solar thermal installations are best suited to heat water for use in washing up, hand washing and bathing. There is minimal hot water demand at this church so such an installation would not be viable.

Heat Pumps are a low carbon method of creating heat, there use and suitability for this church have been review in the section earlier on in this report on Efficient and Low Carbon Heating Strategies.

Biomass is an alternative boiler and fuel to oil or gas. It requires wood chips or pellets to be delivered on site, stored and then fed into a large boiler for burning. While the fuel is not a fossil fuel there are emissions from the burning of wood and these can be detrimental to local air quality particularly in more built up areas for all these reasons it is not considered a viable recommendation for this site.

## 10. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2019.pdf .

## 11. Faculty Requirements

It must be noted that all works intended to be undertaken should be discussed with the DAC at the Diocese.

Throughout this report we have indicated our view on what category of permission may be needed to undertake the work. This is for guidance only and must be checked prior to proceeding as views of different DACs can differ.

Under the new faculty rules;

List A is for more minor work which can be undertaken without the need for consultation and would include changing of light bulbs within existing fittings, repair and maintenance works to heating and electrical systems and repairs to the building which do not affect the historic fabric.

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also the replacement of existing boilers so long at the same pipe work, fuel source and flues are used. It can also be used to replace heating controls.

All other works will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.

## 12. Offsetting

As you take action to reduce your emissions, you may also wish to offset those that you cannot yet reduce. If you would like to engage in offsetting, it is important to use a reputable scheme. The Church of England recommends Climate Stewards, which has a simple calculator that can help you to work out how much you would need to offset. https://www.climatestewards.org/

Climate Stewards encourages people to 'reduce what you can and offset the rest' as part of your journey to Net Zero carbon emissions. They provide training and resources to help you understand climate change and its impacts, and to calculate the carbon footprint from your activities including travel, energy, expenditure, and food. Their online carbon calculators for individuals and smaller organisations are free to use, and they provide bespoke carbon footprint audits for larger organisations.

Having reduced as much of your organisation's carbon footprint as you can, there will always be unavoidable emissions from your work and travel. Carbon offsetting allows you to compensate for the negative impact of your carbon emissions by funding projects which take an equivalent amount of $CO_2$ out of the atmosphere. These either involve locking up ('sequestrating') $CO_2$ as trees grow, or reducing emissions by using low-carbon technology such as fuel-efficient cookstoves or water filters.

Climate Stewards has a close relationship with all their project partners in Ghana, Uganda, Kenya, Tanzania, Nepal and Peru. They work closely with them to design, develop, implement and monitor projects which will not only mitigate carbon, but also bring tangible benefits to the local community - including improved health, savings in time and money previously spent on buying or collecting fuel, and improvements in local biodiversity. Each project is assessed using their Seal of Approval protocol which enables us to assess and monitor carbon mitigation and ensure robust, sustainable and transparent partnerships.

## Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

| Room/Location | Number of Fittings | Recommended Upgrade | Annual Saving (£) | Total Cost (£) | Payback |
|---|---|---|---|---|---|
| **Toilets** | 3 | 2D LED 11W | £79 | £176 | 2.23 |
| **Main hall** | 12 | 5ft Single Proteus LED | £294 | £1,528 | 5.20 |
| **Foyer/Stairs** | 10 | 2D LED 11W | £282 | £588 | 2.08 |
| **Kitchen** | 2 | 2D LED 11W | £56 | £118 | 2.08 |
| **Under gallery** | 5 | 2D LED 7W | £62 | £273 | 4.41 |
| **Office** | 4 | 5ft Single Proteus LED | £99 | £255 | 2.58 |