ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

All Saints Church
PCC of Bournemouth

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of All Saints Church 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.

All Saints Church is a mid-nineteenth church constructed of squared rubble stone walls and a pitched, tiled roof. It is located in the rural town of Awbridge, on the outskirts of Southampton, and has been serving the community for 140 years. There was a significant extension built in 1990 which includes the church rooms, kitchen and toilet area. There is only electricity supplied to the site.

The church has a number of ways in which it can be more energy efficient and a clear path towards net zero carbon. 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 diagram below are used as the action plan for the church in implementing these recommendations over the coming years.

Energy and decarbonisation recommendations	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None	Offset 1.05 tonnes
Change existing lighting for low energy lamps/fittings	331	£99	£1,595	16.1	List B	0.06
Timers on fuse spurs to water heaters	65	£19	£350	18.0	List A	0.01
Install an overdoor heater	N/A	N/A	£1,200	N/A	List B	N/A
Draught proof external doors	84	£10	£650	64.2	List B	0.02
Replace heating system for electrical based heating solution (Underpew heaters)	158	£47	£21,330	450.4	Faculty	0.03
Consider registering for Eco Church	The Eco Church programme, which is recommended by the Church of England, helps congregations care for the environment in all aspects of church life. The programme is free; you can, however, make a donation to A Rocha UK towards its costs.					

Create a procurement policy for appliances (and other goods)	Commit to buying only appliances with the new energy efficiency ratings of A, B or C at the lowest when those you currently have reach the end of their useful life. (NB ovens, air conditioners and space or water heaters are still on the older rating scale, so for these, try for A+++.)

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

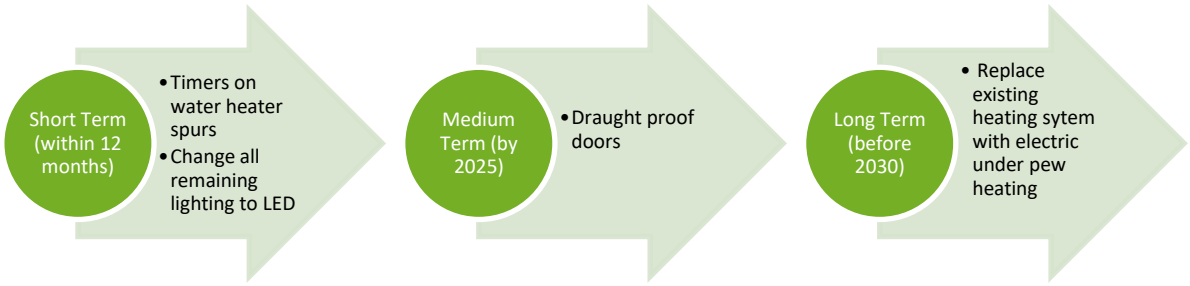
Figures in the table are based on current contracted/market prices of 30p/kWh and 10p/kWh for electricity and mains gas respectively. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.21107 for electricity, 0.18 for gas and 0.27 for oil. Do note that as energy prices increase, payback periods decrease.

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 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 All Saints Church to give them advice and guidance as to how the church can be improved to be more energy efficient. In doing so the church 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 All Saints Church, Church Lane, Romsey SO51 0HN was completed on the 24th of January 2023 by Nathan Tonkin. Nathan is an experienced energy auditor with over 4 years' experience in sustainability and energy matters in the built environment.

All Saints Church	
Church Code	641280
Gross Internal Floor Area	257 m^2
Listed Status	Grade II
Average Congregation Size	20-30

The church typically used for 7.25 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**
Services	3 hours per week
Meetings and Church Groups	3 hours per week
Community Use	2.5 hours bi-weekly

There is additional usage over and above these times for festivals, weddings, funerals and the like

4. Energy Procurement Review

Energy bills for electricity have been supplied by All Saints Church.

The current electricity rates are:

Day Rate	15.231p/kWh
Night Rate	10.542p/kWh
Standing Charge	£24.28/quarter
Availability Charge	0.615p/kVA

The electricity is supplied by sse, and is not purchased on a renewable tariff. Going onto a renewable tariff is an important part of the process of taking churches towards net zero. The church is therefore encouraged to consider procuring its electricity from suppliers that offer 100% renewable electricity, and in some cases 'green' or 'carbon neutral' gas.

A review has also been carried out of the taxation and other levies which are being applied to the bills. These are:

VAT	5%	The correct VAT rate is being applied.
CCL	not charged	The correct CCL rate is being applied.

The above review confirmed that the correct taxation and levy rates are being charged.

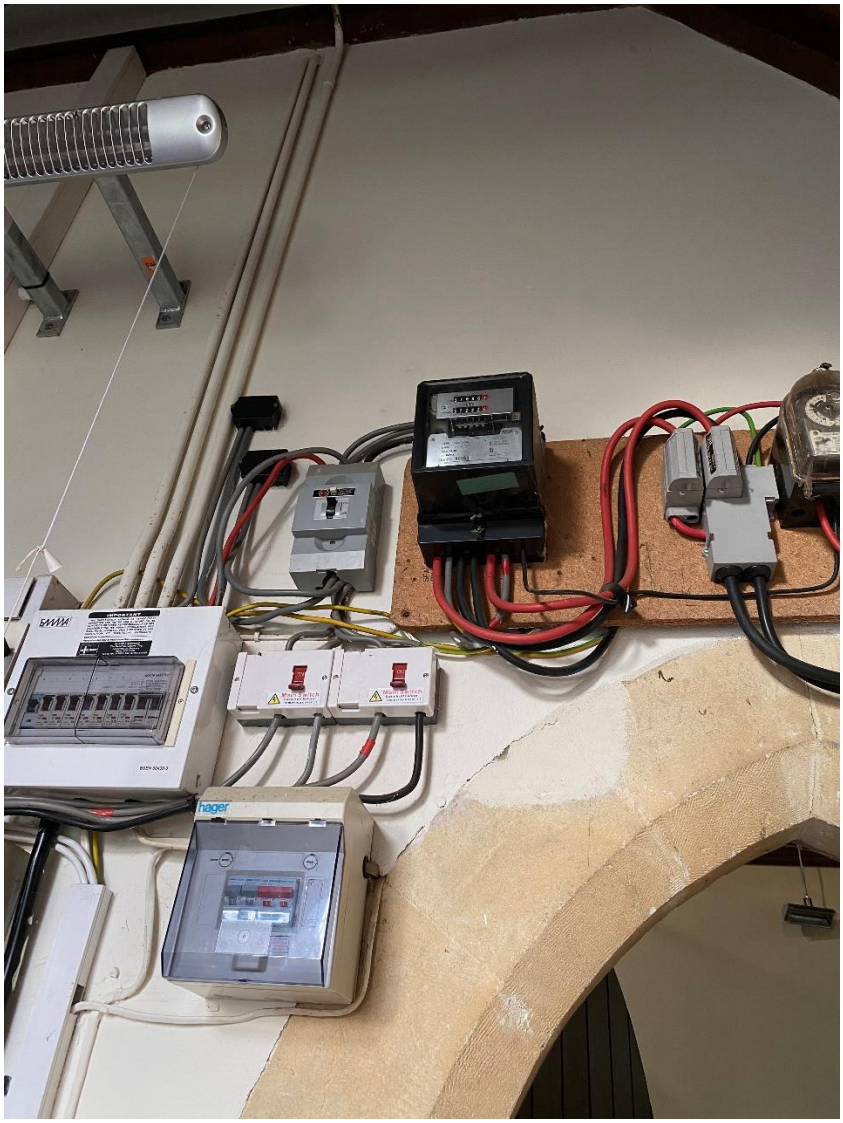
5. Energy Usage Details

All Saints Church uses 5,412 kWh/year of electricity, costing in the region of £1,624 per year. The total carbon emissions associated with this energy use are 1.05 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. All Saints Church has one main electricity meter, serial number K87C48061.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	K87C48061	2 phase 100A	N	Vestry wall

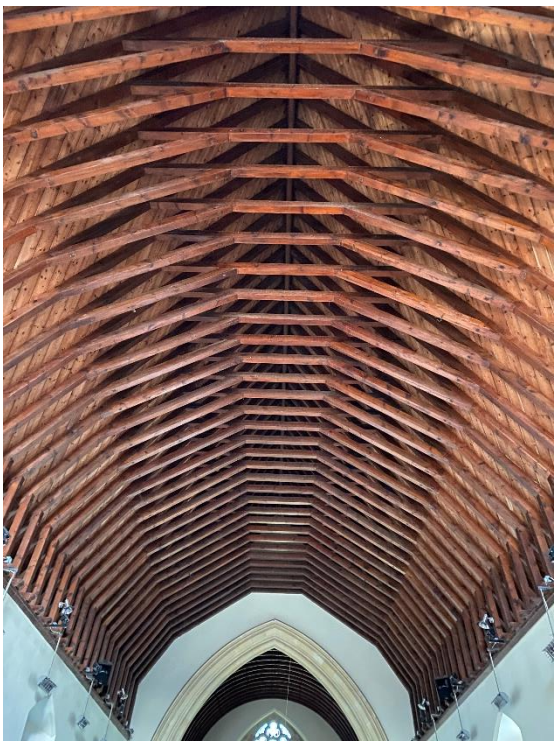
It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.

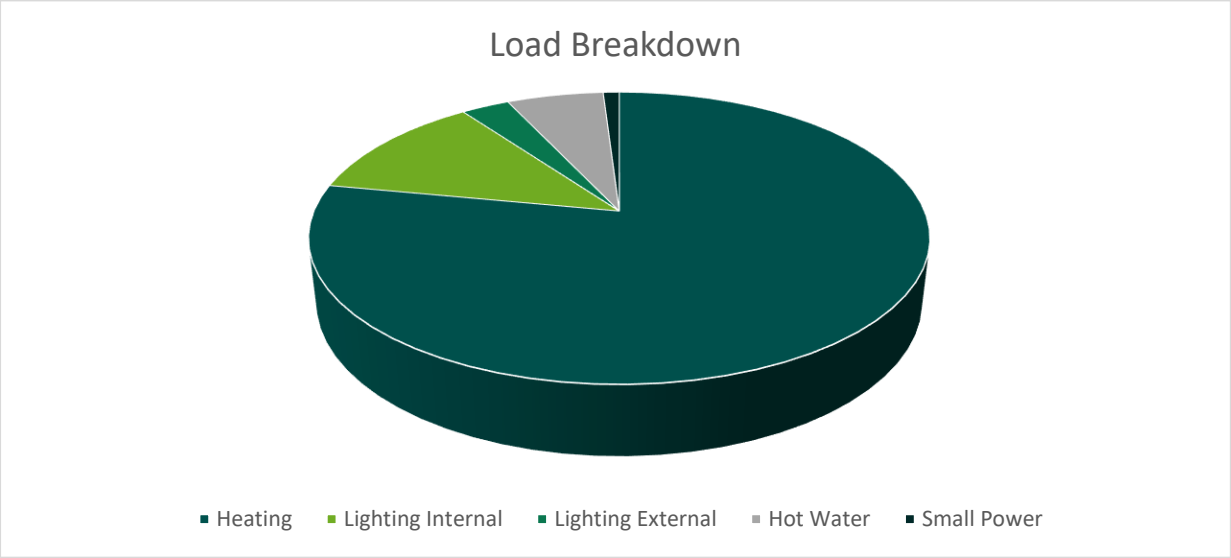


5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	**Nave** >6 halogen spot downlighters >12 halogen uplighters **Chancel** >2 halogen uplighters **Church rooms** >6 halogen tube lighting **Toilets, entrance, vestry, other assorted areas** >3 tungsten bulbs >6 compact fluorescent tubes	15%
Heating	Overhead Infrared heaters around the perimeter of the church. 22 in nave 1 in vestry	78%
Hot Water	1x Stiebel Eltron point of use hot water heater for handwashing. 1x ZIP Contract 15L hot water heater for kitchen sink and handwashing.	6%
Other Small Power	Other IT equipment, kitchen appliances	1%





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.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use All Saints Church uses 5% more electricity than would be expected for a church of this size. However, taking into account that this is combining both normal electric usage, as well as heating the church, the church uses 88% less energy than a typical church.

It should be noted that the national benchmarks do not make any specific adjustment for the amount of time the church is used and the usage of this church will therefore affect how it performs against this benchmark.

	Size (m^2 GIA)	All Saints Church use kWh	All Saints Church use kWh/m^2	Typical Church Use kWh/m^2	Variance from Typical
Electricity	257	5,412	21.06	20	5.29%
Heating Fuel	257	N/A	N/A	150	N/A
TOTAL	257	5,412	21.06	170	-87.61%

6. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Heating also often uses gas or oil as its primary fuel. These are fossil fuels with high carbon emissions and little opportunity to decarbonise in the near future. 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' in the foreseeable future.

It is therefore important to review and set out a plan to make heating more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents an efficient and comfortable solution for churches. Electricity currently has carbon emissions of around the same level as mains gas, but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions its remaining oil and coal-fired power stations.

The church is currently heated by overhead infrared heaters which were installed around 10-15 years ago and appears to have a further 10 years serviceable life before requiring replacement. The heaters are located around the perimeter of the main church with an additional unit in the vestry. Further areas in the extension are heated by electric wall mounted radiators.

The church makes use of fixed wooden pews in the nave, with further fixed choir stalls in the chancel.

The church is used once per week on a Sunday for service and the typical congregation size is 20-30, with further usage on a Tuesday. The heating is set to come on several hours earlier in the winter to ensure the church is warm for this service.

The various options for a decarbonised heating solution have been reviewed in the table below.

Decarbonisation Heating Solution	Viable
Air to Water Source Heat Pump	No – no existing hot water system
Air to Air Source Heat Pump	No – does not suit use of building
Water Source Heat Pump	No – no water source locally
Ground Source Heat Pump	No – significant archaeology
Under Pew Electric Heating Panels	Yes – fixed pews in nave which are suitable
Electric Panel Heaters (to provide supplemental heating only)	Yes – in supplemental areas such as the church rooms
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	Yes – would provide additional heating and 'warm welcome'
Overhead Infra-Red Heaters	Yes – this is the existing system and should the church wish to continue using this strategy the emitters would need updating
Heated Chair Cushions	No – other solutions preferred

The recommendation is therefore that the church consider under pew heaters and electric panel radiators. As described below.

6.1 Install Electric Under Pew Heaters

Electric under pew heaters provide a high level of thermal comfort to people sat in the pews. They are not installed to try and heat the entire air volume of the church, instead thermal comfort is achieved through a flow of warm air rising past the person in the pew. This means that the heaters should be installed under the entire length of all the pews that are likely to be used.

These heaters warm up almost instantly and a flow of warm air over the pew area is created within around 15 minutes of their being turned on. This significantly reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It is important that this reduced 'on time' is properly reflected in any comparisons with other types of heating.

We would therefore suggest that the following works could be considered:

Install under pew heaters suspended from brackets from the underside of the pew seat as follows:

North side, 12 rows with three 450W heaters in each row between uprights

South side, 11 rows with three 450W heaters in each row between uprights

Cable runs to the pew heaters should run along the along the existing routes (all cabling should be in armoured cable or FP200 Gold when above ground) to both rows of pews. Each pew heater to be switched with a neon indicated fused spur located underneath the pew seat.

A similar installation could be fitted to the choir stalls if so, desired which would consists of:

4 rows with three 450W heaters in each row between uprights

A case study of a church which has adopted this solution is available at https://www.churchofengland.org/about/environment-and-climate-change/st-andrews-chedworth-electric-heating

Photos of installations are shown below. In addition, several churches have recently installed such systems. If you would like to find out about churches whom you could ask about their experiences, please contact the diocese.

Brown BN Thermic 650W under pew heaters fixed to underside of pew seats for pews which have no solid backs.

Black 650W Norel under pew heaters fitted to solid pew backs.

6.2 Install Electric Panel Heaters

Electric panel heaters can provide additional heating to areas where there are no pews. 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 a church without other forms of heating (such as under pew). 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 all areas of the church rooms (on a time delay switch) allowing removal of the existing radiators.

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 in the diocese that already makes use of them, please contact the diocese.

Electric panel heater installed behind an altar

6.3 Install an Overdoor Heater

In order to achieve the sense of a 'warm welcome' into the church an over door air heater could be provided. This would also help to provide warmth to the north of the church. Such an over door unit must be sized to cover the whole width of the door.

A variety of overdoor air heaters are available on the market and can be installed by an electrician. The heaters that will cover the entire width of the door tend to be larger output units, which will require a dedicated electrical cable of the correct size run to them. The church should resist the temptation to reduce the size and output of the heater to avoid running a new cable, as the output from smaller heaters and of those with insufficient width tends to be disappointing.

6.4 Upgrade to 3 Phase Electricity Supply

To be able to have sufficient electrical power to supply enough energy into an electrical heating system, the church will need to increase the existing electrical supply from double phase 100A supply to a 3 phase 100A supply.

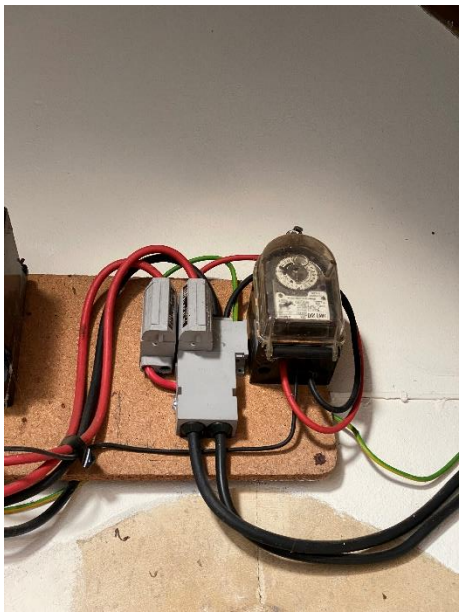
From a visual inspection of the nearby electricity network, it appears as if there is 3 phase power available on a nearby pole located to the northeast of the churchyard. There is an overhead route from this to the church into where the electricity meters are currently located.

The upgrade to the supply has to be carried out by the District Network Operator in the areas.

The DNO in your area is thought to be

> SSE Power Distribution - www.ssepd.co.uk 0800 0483516 (North Scotland and Southern England)

The cost of bringing in a new 3 phase supply can range from £300 to £30,000. The DNO will provide a quotation for free, so it is well worth obtaining a quotation even if plans are not yet certain, so that decisions can be made on a well-informed basis.



7. Energy Saving Recommendations

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

7.1 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 are still a large number of inefficient fluorescent, halogen and tungsten fittings within the church.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED fittings. There are a vast number of specifications of LED light fittings on the market, but it is

recommended that any purchased should come with branded chips and drivers and offer a 5 year warranty. An example of such a range of fittings is available through Parish Buying.

If all the light fittings were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £1,595. The annual cost saving would be £99 resulting in a payback of around 16 years. This estimate includes the supply of the lights, the labour to install them and the access required. It does not include 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 toilet where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and, unlike a change of fittings, would be a List A item, so no permissions would be required.

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the vestry, toilet, and the like. Some of these areas are only used occasionally and for a short amount of time. The light, therefore, 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.

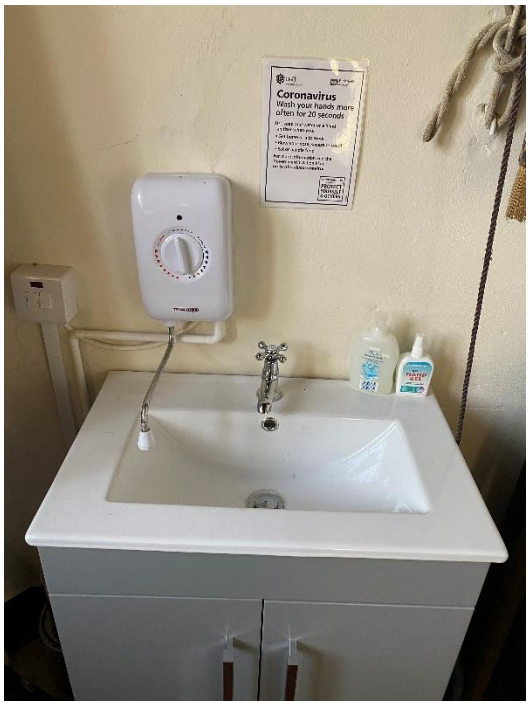
Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

7.3 Timers on Fuse Spurs to Water Heaters

There are a number of electric point of use water heaters in the kitchen and toilets to provide hot water for hand washing. This only needs to heat the water to the required temperature when the building is in occupation but at the moment this heater is directly wired in without any form of time control and therefore maintains it 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. 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.



7.4 Draught Proof External Doors

There are a number of external doors in the church. The historic timber doors do not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of these doors.

It is recommended that the draughtproofing around the door is improved and draught strips are added. This could be achieved in a number of ways:

For timber doors that close onto a stone surround, traditional solutions can be used such as brush draught strips rebated into the edge of the door by a skilled joiner. Other traditional methods such as using hessian or felt pads tacked to the door could also be used. Keeping the door maintained in a good condition is also important.

It is necessary to check with the DAC before undertaking any form of draughtproofing that involves work on the fabric of the door.

Simple measures such as having a 'sausage dog' style draught excluder laid along the base of a door (it needs to be sufficiently heavy to stay in place), using plasticine of the right colour to fill gaps where daylight can be seen, and putting painted fridge magnets over large keyholes can all be simple DIY measures which are effective.

Such measures should be considered carefully around bat conservation needs to ensure that access points bats use are not disturbed. Check your draught excluding plans with the Bat Conservation Trust's free helpline: 0345 1300 228 https://www.bats.org.uk/

8. 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 Photo Voltaic (PV)	No – not sufficient demand, visible roof
Battery Storage	No – no viable solar PV

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.

Having reviewed the site it is not considered that there is good viability for any renewables and instead a good clear focus on reducing the energy demand of the building should continue with a targeted approach on reducing the heating energy.

Battery storage is not strictly a renewable energy solution, but it does 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 solar PV is no longer generating. It therefore extends the usefulness of the existing solar PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantially over the next 2 to 3 years.

9. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available on this Parish Resources page: https://www.parishresources.org.uk/resources-for-treasurers/funding/

10. 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 includes the installation of under pew heaters to pews which are made in or after 1850 and are not of historic interest.

All other works, including the like for like replacement of gas and oil boilers 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. This includes items such as solar PV installations.

11. 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 mount of CO2 out of the atmosphere. These either involve locking up ('sequestrating') CO2 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
North Entrance	1	600 x 600 LED Panel	£2	£90	46.8
Nave	6	LED Spot lamps	£27	£90	3.3
Nave	12	25W LED lamp	£30	£240	8.0
Chancel	2	25W LED lamp	£5	£40	8.0
Vestry	1	600 x 600 LED Panel	£2	£90	46.8
Kitchen	1	600 x 600 LED Panel	£2	£90	46.8
Toilet corridor	1	6W LED lamp	£6	£15	2.5
Toilet	1	6W LED lamp	£6	£15	2.5
Toilet	1	6W LED lamp	£6	15	2.5
Church room (downstairs)	3	600 x 600 LED Panel	£6	270	46.8
Church room (stairs)	1	11W LED 2D	£1	110	147.4
Church room (upstairs)	4	11W LED 2D	£3	440	147.4
Church room (upstairs)	1	600 x 600 LED Panel	£4	90	23.8