ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Paul's Church, Woking
PCC of St Paul's Church

Author	Reviewer	Audit Date	Version
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Contents

1. Executive Summary

An energy survey of St Paul's Church, Woking 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 Paul's Church, Woking is a Victorian church constructed of brick in 1895. In the position of a south transept is a "house" which provides the church office on the ground floor and a self-contained flat on the first floor. To the south is a hall built in 1955 to which a foyer and kitchen have been added in recent years. There is both gas and 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)
Purchase a temperature and relative humidity monitor			£80		None	
CHURCH						
Door Draughtproofing	2% 350	£35	£100	3	Consult DAC	0.06
Change floodlight lamps from halogen to LED	400	£128	£300	3	List A	0.08
Install reflective radiator panels	2% 350	£35	£50	2	List A	0.06
HALL						
Remove Storage heaters in flat and office Install air to air heat pump for flat (and office)	Unknown	Unknown	£2,500		Faculty	
Install Air to Air Heat Pumps in Hall	30,000	£9,600	£13,500	2	Faculty	6.3
Investigate installing cavity wall insulation	8% Electric 4,000	£1,280	£3,750	3	Faculty	0.8
Brick up east facing window in youth room, remove corrugated skylight.	1% 400	£128	£500	4	Faculty	0.08
Install instantaneous water heaters	Depends on use pattern		£200 each		List B	

Install Solar Photovoltaic panels	23,000	£7,360	£31,200	4.5	Faculty	4.8
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 market prices of 32p/kWh and 10p/kWh for electricity and mains gas respectively. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.211 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 St Paul's Church, Woking 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 St Paul's Church, Woking, Oriental Road, GU22 7BD was completed on the 18th January 2023 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church.

St Paul's Church, Woking	CHURCH	HALL
Church Code	617216	
Gross Internal Floor Area	240 m^2	540m^2
Volume	2,060 m^3	1,300 m^3
Heat requirement	68kW	30kW
Listed Status	Unlisted	Unlisted
Average Congregation Size	70	

The church is typically used for 3 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)
Services	2 hours per week
Meetings and Church Groups	0 hours per week
Community Use	0 hours per week

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

The hall is used for an average of 28 hours per week for a variety of community activities.

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by the church.

The current electricity rates are:

Single / Blended Rate	15.5935p/kWh
Standing Charge	45,5830p/day

Supplier: Total Energy

The current gas rates are:

Single / Blended Rate	2.0697p/kWh
Standing Charge	116p/day

Supplier: Total Energy

The electricity is supplied by Total Energies, and is purchased on a renewable tariff (although the supplier's overall fuel mix disclosure is only 50%).

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.

The church is a charity and therefore can claim VAT exemption status. This should always be done when changing supplier. VAT declarations are available from the suppliers website and can usually be found by typing the suppliers name followed by "VAT Declaration Certificate" into most website search engines.

5. Energy Usage Details

5.1 Annual Consumption

St Paul's Church, Woking used 4,651 kWh/year of electricity from the meter reported, in the year from October 2021 to September 2022, costing £936, and 17,757 kWh/year of gas, costing £830. The total carbon emissions associated with this energy use are 4.2 CO_2e tonnes/year.

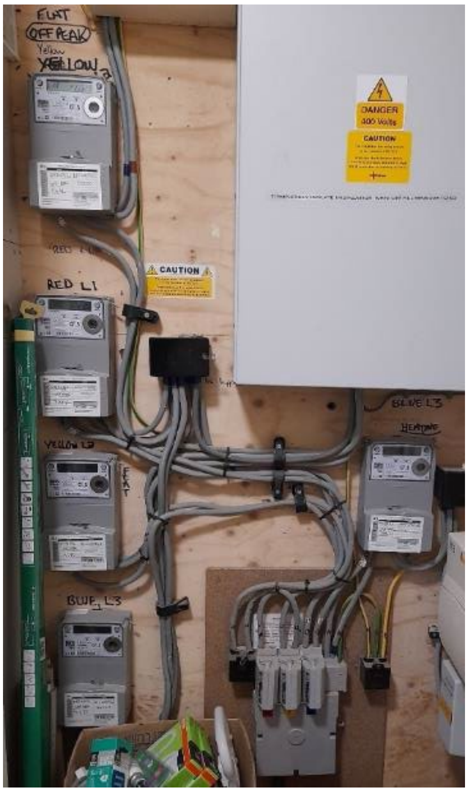
The hall, which is heated electrically, used 46,546kWh in 2021 and 51,194kWh in 2022. This includes the office and flat.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

Utility	Meter Serials and labels	Type	Pulsed output	Location
Electricity - Church	E12Z034412	EMDI Mk7c Single phase to church	Yes	North Porch
Electricity – Hall	E12Z033358 - heating E12Z033359 – yellow phase E12Z050950 – red phase E12Z034426 – yellow, flat E12Z050945 – blue phase	EMDI Mk7c 3 phase supply	Yes	Electrical cupboard, hall
Electricity – flat Submeter	Not readable	Rotating disc	No	Office, high on wall
Gas – whole site	M040 K01411 16 D6	Elster Bk-G25M	Yes	External brick cabinet, east end of church

All the meters are AMR connected and as such energy profile for the entire energy usage could be obtained from the supplier.

In order to reduce standing chargers consideration could be given to combining all the of the hall/office/flat meters into just one (or two) meters.



Church electricity meter

Hall, office and flat meters

5.2 Energy Profiling

The main energy consuming plant can be summarised as follows:

	Equipment	Power kW	Annual Consumption kWh	Proportion
Heating – Church [Gas]	Glow Worm Ultracom 38hxi boiler, 38kW input [590 hours operation]	38	17,757	26%
Heating [Electric]	Boiler circulation pump [590 hours] Church over door heater Storage heaters (i) – Flat – in use (ii) office – disused Wall mounted convector heaters Foyer (3), corridor (2), rooms (9) Portable heaters: office	170W 3 3 3 42 3	100 200 5,000 38,000 1,200 TOTAL 43,500	63%
Lighting [Internal]	Church: 150 hours use 14 Floodlights, halogen R7s lamps If 500W each 2 LED Hall: 1,450 hours use Rooms – units in suspended ceiling Corridor – LEDs Office – 4 x T5 fluorescent 35W Kitchen, fluorescent F58W Toilets 6 bulkhead, being changed to LED.	 7000W 15W 116W 50W 140W 116W 220W	 1,000 500 1,000 TOTAL 2,500	3.6%
Lighting [External]	3x pedestal 3 LED uplights Bulkheads	120W 15W 60W	300	0.4%
Hot Water (electric)	Kitchen: Heatrae Sadia Multipoint 15 Coffee machine Commercial dishwasher Toilets (units left on) 2 x Ariston 10 litre 1 x 5 litre	 3 2 5 3 3	 300 700 500 2,000 1,000 TOTAL 4,500	6.5%
Kitchen	Oven Extraction fan Microwave oven	3 0.2 1	150 15 35	

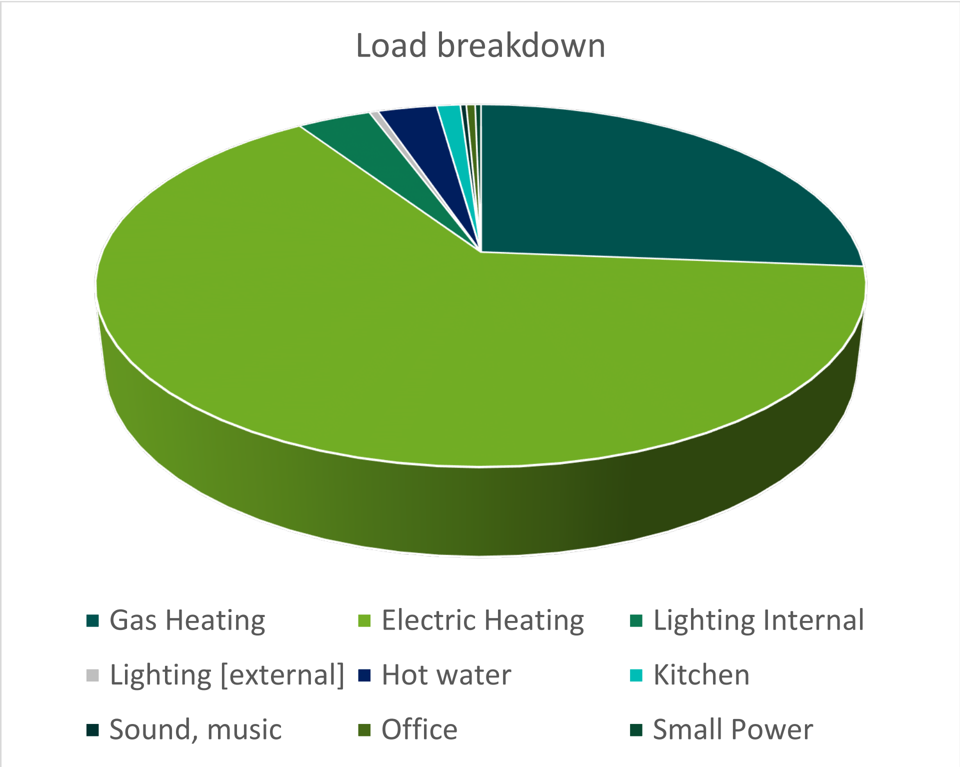
	Fridge/freezer	0.2	600 TOTAL 800	1.1%
Sound, Music (church)	Organ Sound system, TV screens	1 1	100 100	0.3%
Office	10 hours per week 2 workstations Photocopier	 0.4 0.5	 200 100	0.4%
Small Power	Vacuum cleaner	1.5	200	0.3%

Annual consumption: Church 4,600 kWh

Sum of estimates from reported hours of use: 1,800kWh – the lighting accounts for the majority of church electricity use; there may have been greater hours of use than reported.

Annual consumption: Hall 50,000kWh

There is a high electrical heating load. The lighting is a mix of LED, LED tunes and fluorescent, this and hot water use make minor proportions of the overall consumption.



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

The recently constructed Welcome Area bridges the gap between church and hall.

Church, left, hall to the right and flat above office to the rear (east of the site).

East end of site showing the end of the hall (elevation containing meeting room and toilets), link block to ground floor office, external stairway to first floor flat, end of church to right.

The church is lit with high level floodlights, the hall rooms with suspended ceiling mounted units. The church is used once per week on a Sunday for service and the typical congregation size is 70.

The hall has three large meeting rooms, a smaller room, youth room, kitchen & welcome foyer.

6. Efficient / Low Carbon Heating Strategy

6.1 Overview

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.

6.2 Current Heating System

The church is currently heated by a domestic sized Glow Worm Ultracom condensing gas fired boiler which was installed between 2012-15 and appears to have a further ten years serviceable life before requiring replacement. The boiler provides heating to six pressed steel double wall radiators around the perimeter of the church, with a further two in the chancel.

The hall is heated by wall mounted electric convector heaters [3 in the Welcome area, 3 in each of the three meeting rooms, 2 in the corridor.

The flat is heated by a storage heater (below). A further storage heater in the office is out of use.

6.3 Future Heating Options

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	Church: No – does not suit hours of use at present Hall – no – no radiator network
Air to Air Source Heat Pump	Church: No – does not suit hours of use Hall - yes
Water Source Heat Pump	No – no water source locally
Ground Source Heat Pump	No – low hours of use
Under Pew Electric Heating Panels	No – no fixed pews
Electric Panel Heaters (to provide supplemental heating only)	No – nave too wide
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	Already fitted to church
Overhead Infra-Red Heaters	For church in future, ideally far IR (non-visible)
Heated Chair Cushions	Possible for church

The recommendation is therefore that the church should consider a long term installation of radiant overhead electric heating (if the present very low hours of church use continue).

For the hall which is in use for around 30 hours per week, an Air to Air Heat Pump system is recommended which would offer a significant cost saving over direct electric heating.

6.4 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. AASHPs 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 up to 4.5.

The Centre for Sustainable Energy model[1] can be used to estimate heat load for the building.

Heat Load (kW) = Volume V (m^3) x Insulation Factor

<u>Insulation Factors</u>

Condition	Factor kW/m^3
Poorly insulated with open or broken windows, draughty doors (add 5%)	0.034
Poorly insulated (assume no interventions)	0.033
Some insulating features	Estimate value
Well insulated	0.022
Insulated to 2010 regulations	0.013

Area	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Hall	1,300	0.025	32
Flat, office (combined)	135	0.025	4

Therefore, a heat pump system delivering 36 kW would be required.

Capital costs would be in the region of £16,000.

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.

It is suggested that a series of small wall mounted external units, each supplying one or two internal units on a room by room basis would provide operational flexibility and minimise

[1] www.cse.org.uk/local-energy/download/estimating-the-heat-demand-of-a-hypothetical-community-building-79

pipework length (and installation costs). Cassette units may be incorporated in the suspended ceiling, or wall mounted units used, with wall or floor standing units in the flat and office.

Examples of external units for AASHP comprising of three smaller 3kW units (10kW output each) and two larger 10kW units (37.5kW output each).

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 :

https://www.achurchnearyou.com/church/10125/page/43744/view/

Air-source heat pumps at Hethel Church - All Saints Church, Hethel - A Church Near You

6.5 Overhead Infrared Heaters

In areas where there are no fixed pews on to which heaters could be fitted, an option for heating the people, rather than all the air in the space, is to use overhead infrared heaters. These come in a variety of forms from the traditional that have a visible red-light glow emitted from them, to ceramic units and the more modern 'black heat' units which have no visible light. In most cases the distance from the heater to the people being heated needs to be no more than around 2.5 to 3m, although this varies slightly between heater types (therefore a mounting height of between 3m to 4m is typical). Units mounted outside of their heating range are likely to give poor performance. This form of heating provides heat from above and can leave lower limbs and feet feeling cold; therefore some people find this form of heating less comfortable, especially for longer periods of time. Comfort perceptions tend to improve in spaces where people are standing and more able to move around but reduce in areas where they are sitting in a fixed position for more than around 15 minutes. Some of these units can also have extremely high surface temperatures, and care should be taken not to mount them directly next to historic timbers or fabric that may be impacted by high heat levels.

There are some units on the market that incorporate a large chandelier type unit with both lighting and heating. These tend to be a very large visual intrusion in most churches and for that reason are not seen as appropriate where buildings of historic significance are concerned.

In this church it is recommended that if hours of use remain very low, installing overhead radiant heaters to deliver around 32kW of heat (8 units of 4kW) could provide a useful heating solution. The current boiler (which has relatively low hours of use, and is condensing) should be retained; legislation is likely to preclude any replacement after 2035. If hours of use of the church itself rise above 15 hours, a replacement of the boiler by an Air to Water heat pump (probably located in the current location but with windows and door removed to allow high airflow), and using the existing radiator network (perhaps with extra radiators) becomes feasible. This technology area is developing rapidly and the church should keep the options under review.

6.6 Heated Pew / Seat Cushions

Most are now familiar with the concept of heated seats within cars; the same solution is also used in some outdoor venues such as alfresco dining and sports stadiums. These provide a heated cushion to sit on: the direct warmth from the contact areas provides a degree of comfort even when the surrounding space is cold. This can be a useful solution for churches which only have chairs (having removed pews) and/or for small congregations where there are few other alternatives.

There are a variety of heated seat cushions on the market. Some are directly plugged into a power socket (similar to an electric blanket). Others have battery packs, which can be charged and then connected to a seat pad. This makes them more flexible and avoids trailing leads. The more advanced products have a pressure sensor which means heat is only provided when someone is sitting on the cushion. Heated pads for 'benches' can also be used to heat a pew or could even be adapted to form a heated kneeler for the communion rail.

It is recommended that the church consider purchasing a set of heated cushions or chair covers to provide heating to the for smaller services, or for those who feel the cold.

A case study of a church using heated cushions is available at https://www.churchofengland.org/about/environment-and-climate-change/towards-net-zero-carbon-case-studies/marown-church-tries-new

6.7 Heated Office Chair

A heated chair is an option for the office and may be more effective than greater use of a convector heater. These cost around double the price of a positionable office chair, around £300-400.

6.8 Remove Storage Heaters

Electric storage heaters are fitted in the flat (in use), and office. These are stated to be 50 years old.

Unless the off peak electricity rate is significantly less than the day rate, these units are extremely expensive to run as well as technically inefficient. It is understood that the church is supplied with electricity at one rate.

Overnight, electricity is used to heat the internal storage bricks (there will be some leakage by conduction). During the day, heat continues to leak out slowly. When there is a demand for heat, a fan draws air over the storage bricks to export the heat. The later in the day this happens (e.g. the evening after charging), the less heat is left. Turning on the heater in the evening means it is both charging the storage bricks with heat plus heating the room.

The office unit is not used (there is a portable heater instead). The flat unit should be replaced ASAP, either with a wall mounted convector heater, or a heat pump emitter if heat pumps are fitted to the hall building as part of this installation.

7. Improve the Existing Heating System

In the years before the replacement of the existing heating system it is recommended that measures are taken to improve the efficiency of the existing heating system. This should include:

7.1 Clean the Existing Heating System

Magnetic sludge builds up and can circulate within heating systems. This will preventing the proper and efficient operation of the system by reducing both the ability of the boiler to heat up the water and the output of the radiators. It is similar to how scale build up can adversely affect kettles and showers.

The church should have a record in the Log Book if the system has been flushed recently.

It is strongly recommended that the heating system is cleaned to remove this sludge from the system. This is done by using a chemical clean and/or power flush procedure in which cleaning chemicals are put into the system, which is then turned on and run through a filter consisting of high-power magnetics to remove the sludge.

The cleaning of a heating system can be carried out by any competent heating engineer and typically increases the efficiency of a system by between 10 and 15%. This can dramatically improve comfort for the congregation.

7.2 Install Reflective Radiator Panels

The church is heated by radiators served from the boiler. These radiators are located on the external, uninsulated walls and have no reflective or insulated surfaces directly behind them at present. They therefore lose much of their heat into the masonry of the wall behind the radiator rather than giving it out into the body of the church.

In order to improve the insulation directly behind the radiators, a reflective panel can be installed. This helps to make sure more of the heat from the radiator goes into the space and requires less overall heating from the boiler to achieve the set point. There are a wide variety of reflective panels for installing behind radiators on the market. It is recommended that these panels are installed behind all radiators within the building.

The installation of radiator panels can be carried out by anybody competent in basic DIY and does not require the radiators to be removed.

8. 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.

8.1 New LED Lighting

The lighting makes up a relatively large overall energy proportion of the electricity used within the church. There are still a large number of inefficient halogen fittings.

The nave is lit by 14 floodlights containing halogen lamps, these are often of 150-250W power, but the church consumption data suggests 500W lamps may be fitted.

A spare or removed lamp should be checked for length – if 118mm length these are R7s lamps and can be replaced by 20 or 30W 118mm linear LED lamps with off centre end connectors. [These LED lamps are of c 25mm diameter, those with centre connectors will not fit in the luminaire housing. There are several products available online, care is needed to select the type which will fit the housing]

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/

8.2 Lighting Controls (Internal)

It is recommended that motion sensors are installed on lighting circuits for corridors, toilets and store rooms (where not fitted) 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.

Generally, lighting levels should be around 300 lux but the levels are highly dependent on the use of 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.

8.3 Timers on Fuse Spurs to Water Heaters

There are various electric hot water heaters located around the church for hand washing [Two Ariston 10 litre and one 5 litre serving toilets, and one Heatrae Sadia, plus a wall mounted unit in the kitchen]. 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.

Although the tanks themselves are insulated, the copper pipework is not and along its length loses heat (approximately the amount of an incandescent light bulb), the pipes were found to be warm, so losing heat.   This is around 900kWh per year per heater. 2,700kWh costs £405 at the 2022 rate and £864 at the current market rate.

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.

When these units require replacement, instantaneous water heaters with no tank should be fitted.   It may be found to be more cost effective to install instantaneous heaters rather than fit timers to the existing units.

8.4 Draught Proof External Doors

The North West porch has an outer and an inner pair of doors.   The outer pair, with wooden frames (seen below) have large gaps, ~8mm around the edges, 2mm between the leaves and up to 25mm underneath, allowing a large and persistent draught which will be a major source of heat loss.

The inner pair of doors have interlocking wooden strips in the centre and could be fully draught proofed using self-adhesive rubber strips.


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

For timber doors that close onto a timber frame a product called QuattroSeal is often used in heritage environments to provide appropriate draught proofing.

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.

For an unlisted building, there will be more options available to draught proof these doors.

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

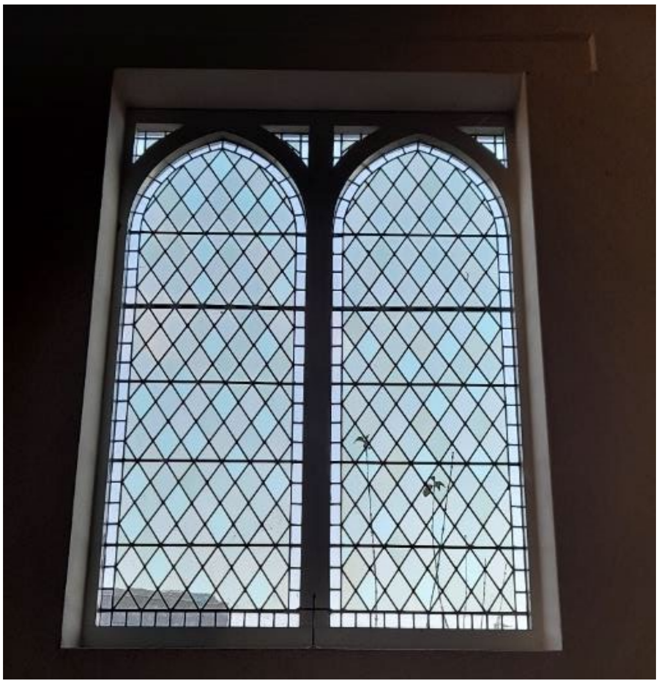
Simple measures such as having a 'sausage dog' style draught excluder laid along the base of a door (it needs to be sufficiently heavy to stay in place), using plasticine of the right colour to fill gaps where daylight can be seen, and putting painted fridge magnets over large keyholes can all be simple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

8.5 Windows

Two of the windows in the church have opening panels which can be a source of draughts. Gaps can be filled reversibly with black plasticene.

Permission has previously been refused for secondary glazing.



This meeting room, above, is situated at the south east corner of the hall. It was described as difficult to heat. Outside of the curtained window opposite is a narrow passageway with a fence or outbuilding beyond, meaning that very little light enters from this east facing aspect. Thus it is recommended that this window is removed and bricked up (with suitable insulation material filling the cavity). The inner skin could utilise "Thermalite" aerated concrete blocks or a similar product for good insulation performance although as a non-load bearing wall under an existing lintel it may be possible just to use insulation panels on the inside – consult your inspecting architect for advice. The window to the right is double glazed.

8.6 Cavity Wall Insulation

The 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. The perimeter of the hall is approximately 75m, and an approximate price for 150m^2 of CWI is £3,750.

8.7 Insulation to Roof

The loft void above the ceiling of the house / office building was inspected as part of this audit and found to have sufficient insulation present (below).

The hall would not have been constructed with any roof insulation and there are opportunities to improve this. There are two first floor rooms, one used for storage (below). This room has a skylight which appears to consist of a single thinkness of sheeting – suitable for a shed or barn. It is recommended that any such areas of roof are replaced with insulated roof coverings; the room is used for storage and does not benefit from a skylight. Loss of light should not be an issue in a room entered only occasionally.

If re-roofing becomes necessary, this would give the opportunity to install light pipes to bring light down into the meeting rooms and toilets; reflective tubes which bring daylight down into the building. This opportunity can be discussed with your architect. Monodraught are one company who supply these products.

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 Photo Voltaic (PV)	Yes
Battery Storage	In future if significant evening use of hall

There is potential for a solar PV array on the roof of the hall. The south facing aspect of the hall is the most suitable location for panels. The following formula calculates annual generation:

Annual Generation (kWh) = Area x 0.15kWp/m^2 x 1000kWh/kWp x Orientation Factor x Overshading Factor.

Roof Section	Useable area / m^2	System Size / kW peak	Orientation factor	Shading factor	Annual Generation, kWh
Hall (south facing)	160	24	180 degrees / 30^0 0.97	1	23,280

This is the maximum likely figure, which may be reduced by factors such as the weight of panels (due to roof strength) and access space between panels. The ability of the roof structures to support the extra loads should be discussed with the church's inspecting architect.

The hall annual consumption is around 50,000kWh, much of which is heating and in use throughout the day. A large solar PV installation would be able to provide a significant portion of this in autumn and spring and contribute during winter.

Changing to a heat pump system (with a coefficient of performance of 4) would reduce hall heating electrical requirement from an estimated 38,000kWh to one quarter, 9,500kWh which when added to lighting and hot water would reduce the annual load significantly (by 28,000KWh to around 22,000kWh). Therefore it is recommended that a decision on installing solar panels is left until after a decision on heat pumps is made, so the system can be sized appropriately, once provided with detailed heat pump consumption data.

The system should be specified for future addition of a battery, when battery costs reduce as this would extend system usefulness into the evening.

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.

Using average 2019 installation costs (£1,300 per kWpeak); a 24 kWpeak system would cost £31,200.

10. 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/

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 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.