Energy Efficiency and Zero Carbon Advice

St Paul's Church, Ealing

PCC of St Paul's Church

Author	Reviewer	Date	Version
Paul Hamley	Marisa Maitland	5th January 2020	1.0

Contents

1. Executive Summary

An energy survey of St Paul's Church was undertaken by Inspired Efficiency Ltd 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.

St Paul's Church is an Edwardian era church built in 1906. It is not listed. 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. 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 is used as the action plan for the church 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)	Permission needed	CO2 saving (tonnes of CO2e/year)
Procure Electricity and Gas supplies from a bulk buying scheme such as Parish Buying	N/A	5 to 15 %; 350 to 1000	Zero	Immediate	None	None
Install Solar Photovoltaic panels on roof, system configured to accept battery in future.	25,500	3,300	£36,000	11	Faculty	6.4
Maintenance of external door seals	5% of nave use ~ 3,000	70	200	3	List A	0.55
Heating EAST END ZONES 1,2 Clean, flush system	7% 1,800	42	250	6	List B	0.33
Heating EAST END ZONES 1,2 Install Endotherm heat transfer fluid	10% 2,560	59	80	1.5	List B	0.47
Heating EAST END ZONES 1,2 Replace 27kW Boiler 1 With Ground Source Heat Pump, 28kW	Gas 25,600	595 gas saved, 1085 grid electric cost	28,000	N/A	Faculty	2.8
Heating WEST END ZONES 4,5 Foyer and Balcony Room, install Radiant far infra red panel heating, 24kW of heating	Gas 15,360 Replaced by ~10,000 electric	357 gas saved 1,440 grid electric cost	15,000	N/A	Faculty	0.5

Note that with installation of a large Solar Photovoltaic system, reliance on grid electricity diminishes. Heat pumps can be run partially on night rate grid electricity, infra-red heating panels require less preheating than gas space heating.

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

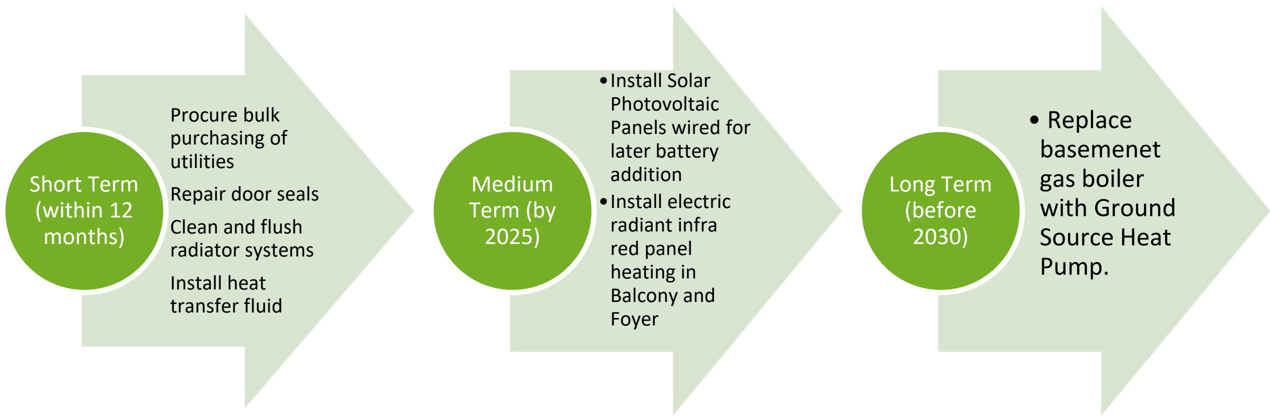
Based on current contracted prices of 14.421p/kWh (day), 9.918p/kWh (night) and 2.324p/kWh for electricity and mains gas respectively.

If all efficiency measures were implemented this would save the church £1,900 per year in operating costs.   With electricity generated on site plus efficiency measures, up to £2,900 savings are possible (see Section 10).

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years. Furthermore, the PCC of St Paul's Church has also declared a climate emergency and has an ambition to be carbon neutral by 2035 and has recently implemented a policy that will not allow the replacement of oil heating systems.

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Paul's 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 St Paul's Church, Ridley Avenue W13 9WXwas completed on the 21st December 2020 by 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 and has been an assessor for EcoCongregation.

St Paul's Church	
Church Code	623447
Gross Internal Floor Area	GIA 960 m^2, Footprint 750 m^2
Listed Status	Unlisted

The church typically used for 56 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**	**Average Number of Attendees**
Services	6 hours per week	412
Meetings and Church Groups	50 hours per week	6
Community Use	Included above	200
Occasional Offices	2 weddings annually 6 funerals annually	100 100

Occupancy hours 2,900

Footfall 33,000

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Paul's Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	14.421p/kWh	Above current market rates
Night Rate	9.918p/kWh	Below current market rates
Weighted Average	13.78p/kWh	Above current market rates
Standing Charge	89p/day	N/A

Supplier: Haven Power. Renewable tariff

The current gas rates are:

Single / Blended Rate	2.324p/kWh	In line with current market rates
Standing Charge	2.739p/day	N/A

Supplier: SSE Contract end date 31 March 2021.

The above review has highlighted that there are opportunities to gain cost savings from improved procurement of the energy supplies at this site. We would therefore recommend that the church obtains a quotation for its gas and electricity supplies from a bulk purchasing scheme such as the Diocese Supported parish buying scheme, http://www.parishbuying.org.uk/energy-basket. This scheme only offers 100% renewable energy and therefore it is an important part of the process of making churches more sustainable. A combined package is likely to be cheaper than separate procurement of each utility.

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.

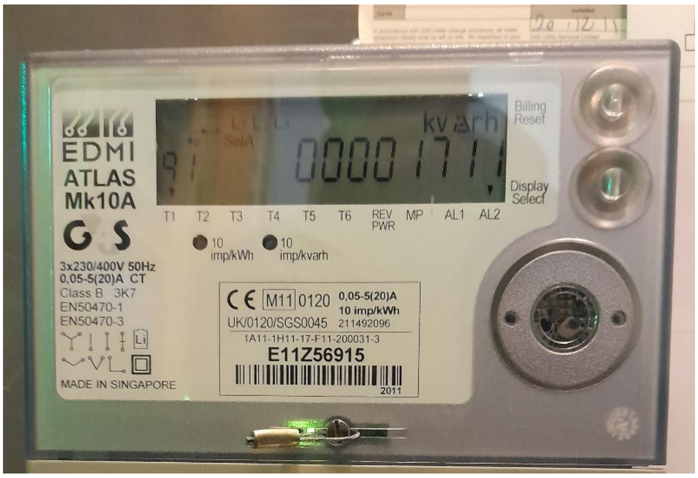
The above review confirmed that the correct taxation and levy rates are being charged.

5. Energy Usage Details

St Paul's Church uses 25,500 kWh/year of electricity, costing in the region of £3,300 per year, and around 105,000 kWh/year of gas, costing in the region of £3,600.

This data has been taken from the annual energy invoices provided by the suppliers of the site and data enetered on the Church of England Energy Footprint Tool.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E11Z56915	EDMI Atlas Mk 10	Yes	Electrical room in office corridor
Gas – Church	M025 A03245 09 D6		Yes	Bottom of boiler room steps, mounted externally



All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has been provided for the purpose of this report and this has been used to verify the data.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

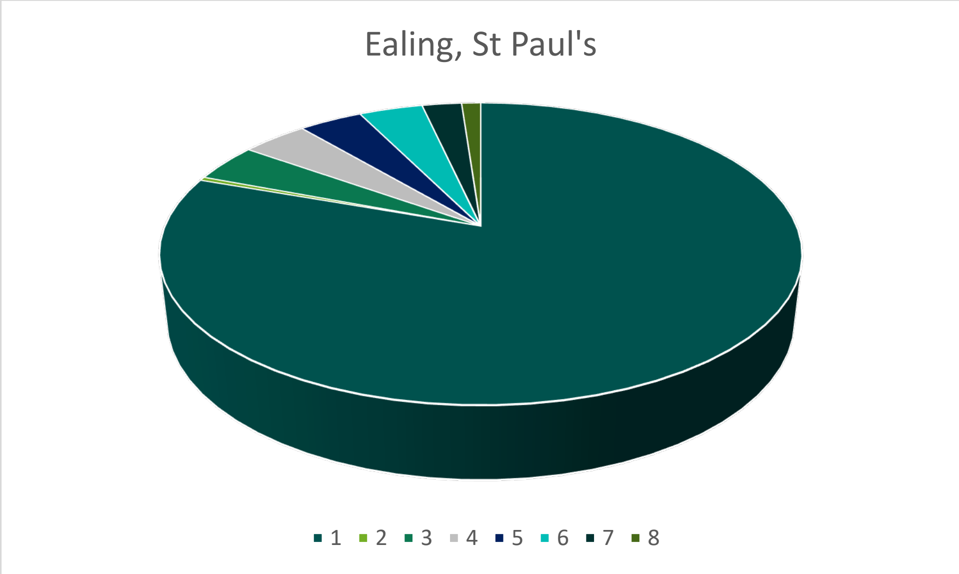
Service	Description	kW	kWh	Estimated Proportion of Usage
Heating [Gas] **Five zones heated from three systems** **32 week heating season** **A single meter means that relative proportions of use between each system are estimates**	B1 Chancel room, Chapel & Office Boiler [Zones 1&2– mostly office hours 5 days per week; 40+hours] Worcester Greenstar 27 CDi B2 Foyer and Balcony Boiler [Zones 4&5 – Sundays 11 hours plus occasional evening meetings Estimate 20 hours] Vaillant Eco Tec Plus 624 Church. Zone 3, 11 hours Sundays, occasional midweek use: 5x ~15KW Gas fired balanced flue heaters (not blown air) 2x 14kW Gas powered flue fan assisted heaters (blown air); Temcana Kestrel 400 8	27 Regular heating at part power 24 Occasional heating at full power Nave Total 100kW	1,320hrs @20kw 25,600 640hrs 15,360 640hrs 64,000 TOTAL 105,000	80.5%
Heating [Electric]	Several (~5) portable 2kW heaters, used in severe weather	Total about 10	500	0.38%
Hot Water [Gas]	B3 Foyer kitchen boiler, HW only B4 Ladies toilet ground floor boiler, HW only		Minimal	-
Hot Water [Electric]	Dishwasher, 5 day/week use Urns 4 Kettles 4+ Coffee Machines 2 Lincat Water boiler (intelligent – learns use pattern and switches on/off) Fans, nave heaters Pumps, boilers	5 4 x 3 4 x 2 2 x 2 2 2 0.5	1000 200 200 800 800 1280 1000 TOTAL 5,280	3.9%
Lighting [internal]	Majority LED, ~100 bulbs	1 0.3	1,500 200	3.9%

	Some CFL bulbs in lightly used areas Fluorescent tubes light the edges of the nave (44 x F58W) Plus the Foyer (36 x F18W)	FL total 3.8	3,500 TOTAL 5,200	
Lighting [external]	Spire floodlights, timed dusk to 22:00 (average 3.5 hours; 1280 hours total) Illuminated banners	1	**5,000**	3.8%
Small Power	(TV) display units {~5} PA Equipment Lift IT and security systems *		**5,000**	3.8%
Office	9 desktop computers, each ~150W, shared by 20 staff Printer	2 0.5	3,000 100 TOTAL 3,100	2.3%
Kitchens	Oven (gas – minor use) Extraction fan Toaster Microwaves 3 Fridges	0.5 2 3 x 1 0.3	100 100 300 1000 TOTAL 1,400	1%

Total annual electricity consumption: 25,500kWh

Total annual electricity and gas consumption 130,480kWh

Summer night rate electricity use during 2020 was 261kWh for two months. This represents the baseload when only systems such as the spire floodlights, external illuminated signs, security and fire alarms, and elements of IT systems which are left running are turned on. The 7 hour night electricity rate period allows calculation of the load to be 1.2kW. Thus it can be seen that the annual consumption of these systems (highlighted in bold above) is 1.2kW x 8760hours = 10,000kWh.



KEY 1 Gas Heating 2 Electric heating 3 Hot water [Electric] 4 Lighting [internal]

5 Lighting [external, including display screens] 6 Small Power 7 Office 8 Kitchens

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 loads are hot water and lighting.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use[1] St Paul's Church uses 2% less electricity and 30% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Paul's Church (elec)	960	25,500	26.5	27	98%
St Paul's Church (gas)	960	105,000	109	156	70%
TOTAL	960	130,500	136	183	74%

1 The Church of England; Shrinking the Footprint Energy Audit Report 2012/13.

The body of the church has been divided into three by screens, that at the west end creating a foyer room with kitchen and toilets below, and the balcony room with kitchenette and toilets above. Each of these three areas form separate heating zones; there are a further two zones at the east end.

The main entrance to the church is rear, right with a stairwell and lift leading to the balcony room and a prayer room which is (normally) kept open.

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 future. 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 it remaining 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'. It is therefore important to review and set out a plan to make energy use more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this represents a more efficient and comfortable solution for churches.

6.1 Heating Strategy

A heating strategy should be agreed before either of the boilers becomes necessary for replacement.

The church is divided into five heating zones.

1 East End ground floor, chancel room and chapel; Boiler 1

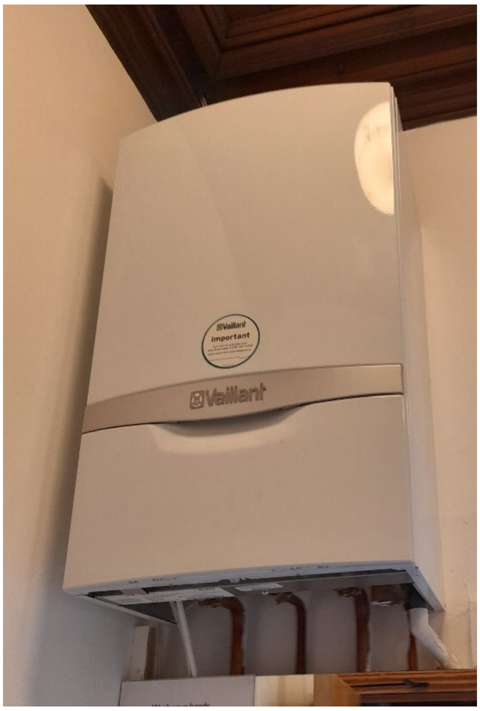
2 East End upper floor, offices; Boiler 1

3 Nave; fan assisted gas heating

4 West end ground floor, foyer, kitchen, toilets; Boiler 2

5 West end first floor, balcony room, kitchenette, toilets, prayer room; Boiler 2

Boiler 1, Worcester Greenstar 27CDi, 27kW.

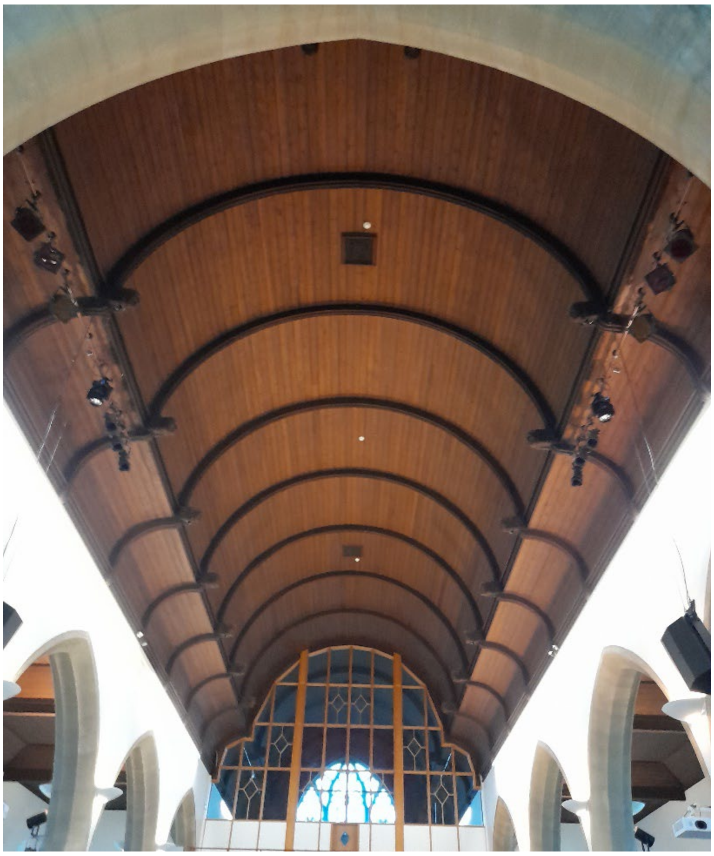


Boiler 2, Vaillant EcoTec Plus 624H, 24kW.

Zone 2 is intensively used with up to twenty people using the office during the week. The need for constant heat during office hours (plus potential use of the chancel room on some evenings) means that the boiler could be economically replaced with a heat pump, see Section 9.2.

Zone 3, the nave, is fitted with five fan assisted gas fired heaters (external exhaust) and two blown air fan assisted direct heaters, all located along the external north and south walls.

The church is seated by individual chairs and has a wooden panelled barrel vault roof. It is used mostly on Sundays, with 11 hours heating during the season and for larger evening meetings occasionally. This use pattern is incompatible with a heat pump which requires regular use. Should the church wish to being the nave into regular use in the future, a heat pump system would require new heating output equipment (unless an air-to-air system was chosen). Alternative heating would be best if an underfloor heating system – but this should only be chosen if the space is to be regularly used during the week; at over 40 hours use ideally. Wall mounted electric far infra-red panel heaters are considered problematic to heat the centre of the nave, due to distance (to provide enough power, people in the aisles would be overheated. The curved roof shape does not look compatible with panel installation.



Zone 4, the Balcony Room is used sporadically with occasional meetings in the evenings and sometimes during the week. In order to provide the ability to heat this space rapidly, for short meetings, installation of electric far infra-red wall mounted panel heaters is recommended.

Zone 5, the Foyer, is used at the same time as the nave, heavily on Sundays plus some evening use.

This area could either remain heated by the present boiler; or could be heated by overhead ceiling mounted electric far infra-red panels. The relatively low ceiling height will assist with this.

Finally, the Prayer Room on the first floor at the north west corner, above the entrance, should become a separately heated zone (Zone 6). This room is recommended to be fitted with electric far infra-red wall mounted panel heater(s), connected to a PIR presence director so that the heating is activated when someone enters. The system should also be fitted with thermostat control so that it is only activated when necessary, when the room temperature is below (say) 17^{o}C.

6.2 Install Electric Infra-Red Radiant Panel Heaters

It is recommended that the PCC consider installing electrical infra-red radiant panel heaters in Zones 4 (Balcony Room, wall mounted), Zone 5 (Foyer room, ceiling mounted) and Zone 6 (Prayer room, wall mounted) on a time delay switch and remove the existing radiators. These are non glowing rectangular panels, available in white or other colours, or with printed artworks from some suppliers.

There is sufficient space in the foyer ceiling at approximately 3.5m height to install infra red panels.

Suitable electric panel heaters would be far infrared panels such as https://www.warm4less.com/product/63/1200-watt-platinum-white- . These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch such as https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms so they cannot be left on accidently after use.

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). As such these heaters tend to provide a relative instant sense of heat and comfort within the space and only need to be on for short periods of time

7. Improve the Existing Heating System

As the existing heating system is being retained at the east end of the building it is recommended that measures are taken to improve the efficiency of the existing heating system, this should include:

7.1 Optimisation of Zones 1 & 2 (Office, Chancel) Boiler Settings

The Worcester Greenstar boiler is a condensing combination boiler. To obtain maximum efficiency the temperature of the return water should be less than 55ºC, which then allows the exhaust steam to condense, recovering some waste heat and using less gas as a result.

Use of a thermometer or temperature data logger on the return water pipe will obtain this temperature. The central heating was set to maximum temperature, achieving 76ºC. This may need to be reduced to allow for efficient operation. Running with a lower flow temperature will mean more hours of operation to deliver the same amount of heat; but a portion of this is now obtained "free" i.e. recovered from the exhaust gases. Gaining experience of operating at a lower water temperature for more hours will also help with transition towards using a heat pump. Most heat pumps supply water at around 50-55ºC although there are newer versions which can supply up to 70ºC, although this will reduce efficiency.

7.2 Clean the Existing Heating System

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

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 where 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 to 15%. This can dramatically improve comfort for the congregation.

7.3 Endotherm Advanced Heating Fluid

In order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid (http://www.endotherm.co.uk/) is added to the heating systems.

This fluid in in addition to, and complements any existing inhibitors in the heating system and is added in a similar way. The fluid works to improve the ability of the boiler to transfer heat into the heating system and for the radiators and other heating elements to give out their heat into the rooms. It does this by reducing the surface tension of the water and increasing its capacity to transfer and hold heat. Case studies have demonstrated that the addition of this fluid into heating systems reduces heating energy consumptions by over 10% as well as helping the building heat up quicker.

Endotherm can be self-installed by someone competent to repressurise the system.

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 Lighting Controls (Internal)

Lights in the prayer room and the entrance area and stairwell leading to it should be controlled by presence detectors.

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 consider 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.

8.2 Power Management Settings on Computers

All computers can be shut down or put into a hibernate mode. This is rarely done by users during the day and tends to be limited to an end of day shut down only (It was noted that computers are routinely shut down at the end of the day at St Paul's office).

This tends to be due to the multi-function process that is required to do this. It is therefore recommended that all computer workstations set to go into hibernate mode after a short period of time of not being used.

This can be set on the computers by going into the Power Options settings on the computers control panel and adjusting the times on the 'change when computer sleeps' option. It is recommended that computers should turn off their display after 2 minutes and put the computer to sleep after 5minutes. Putting the computer to sleep will not lose any unsaved work but will require the user to power up the computer again when returning to their desk. Having shorter hibernate modes not along helps to save energy but also improves security by reducing the time that computers are left on but unsupervised.

8.3 Draught Proof External Doors

The external glass doors forming the public entrance on the north side of the church are missing part of their central seal. This allows cold air into the building on a constant basis. Fitting a new seal should be organised with the suppliers or installers of the doors.

The close up image shows the remaining upper portion of the polymeric door sealing strip.

8.4 Secondary Glazing

The windows of the nave are singled glazed with metal frames. Many of the windows in areas at the east end of the building are double glazed where rooms are in regular use throughout the week. In areas such as the office, it is cost effective to install double or secondary glazing. Any single glazed rooms which are used regularly would benefit.

8.5 Insulation to Roof

The ceiling/roof of a building 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.

The roof above the prayer room is insulated. The area above the offices would benefit from insulation.

In all cases where there is 100mm or less of insulation within accessible roof spaces it is recommended that insulation be added to prevent heat loss and create a more comfortable environment for the occupants of the building.

It is not cost effective to install insulation where the space is only used once (or twice) weekly, such as above the nave.

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
Battery Storage	Yes – install system ready for future battery addition
Wind	No
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – urban air quality issues
Air Source Heat Pump	Not preferred due to equipment location issue
Ground Source Heat Pump	Yes for office heating

9.1 Solar Photovoltaic Panels

The church has received a quotation for the installation of solar panels on the south facing nave roof.

An array of 100 to 115 panels has been considered, giving a 30kWpeak system.

The upper roof area of approximately 220m^2, angled at approximately 40 degrees is able to support a system of this size, and could generate around 29,000kWh of electricity per annum. This is slightly in excess of the current annual consumption of 25,500kWh. However, a transition to electric heating of the foyer and balcony room, together with installation of a Heat Pump for the office and chancel room would ensure use of most if not all of the solar power generated.

A system of this size would weigh in the region of 2,200 to 3,000kg, so your architect would need to conform that the roof structure is of sufficient strength to support the additional weight and wind loading.

The average price for large systems in 2018 (Microgeneration Certification Scheme data) was £1,200 per kWpeak, installed. This would result in a capital cost of £36,000 for a 30kWp system.

The Feed in Tariff has been replaced by the Smart Export Guarantee. This pays in the order of 5p/kWh; and needs to be individually negotiated with the purchasing utility company. As grid electricity charges are in the region 12-15p/kWh, generating a large surplus is no longer a way of repaying the capital cost of installation. A battery system offers more flexibility and will reduce the amount drawn from the grid during evenings; although there will be less generated to be stored during the winter.

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.

9.2 Heat Pumps

Heat Pumps use electricity to move heat from a low grade reservoir source (the air, soil or water) and "upgrade" it to provide (usually) water in the range 40-70ºC, or sometimes warm air.

A large amount of reservoir air or water is cooled by a degree or two, extracting a large amount of heat. The pump uses refrigeration fluid to capture this heat by evaporation in a heat exchanger, causing cooling of the reservoir air or water. When the fluid is compressed again it heats, transferring the heat across a second heat exchanger into the water (or air) which is then circulated around the building. The Coefficient of Performance is the ratio of how much useful heat is obtained compared to the energy expended by the pump to "lift" the heat from the external reservoir.

For Air Source Heat Pumps, this is usually in the range 2-3, for Ground Source Heat Pumps 3-4. This means an efficiency of up to 400% with a COP of 4; you receive 4 times more heat energy in kWh than you pay for in electricity. However, no laws of physics have been broken: the "missing" heat has come from the reservoir (air, ground or water); these sources provide free heat, ultimately from the sun.

Heat pumps deliver warm water to heat a building gently – they cannot provide short bursts of high temperature heat, so are incompatible with an irregularly used building which is only heated once or twice per week.

The office and chancel room zones of the church are suitable for heating by a heat pump since they are in use for working hours (office), and a system sized for this room can be configured to heat the other rooms when the office is not in use, such that the pump is running almost continuously. This will obtain the optimum output for the minimum capital cost.

The current 28kW (maximum output) boiler could be envisaged to be replaced by a 28kW output GSHP, requiring 7kW of electricity at a COP of 4. As for the current system, a heat output of 20kW or less is likely. 20kW of heat supplied with a COP of 3.5 requires 5.7kW of electricity.

At the same annual hours of use as estimated for the present system, 1,320 hours, this would require around 7,500kWh of electricity, costing £1,085 annually at current day rates.

A Ground Source system is recommended from an efficiency viewpoint. However, GSHPs have higher installation costs than ASHPs due to the trenching required for the pipework. The amount of land surrounding the church appears insufficient for trenched pipework (it has not been used for burials), a borehole system is probably more feasible for the site. There are examples of this system applied to a church such as at St Mary the Virgin in central Ashford.

ASHPs look like air conditioning units and need to be installed in a well ventilated space on the exterior; there is no clear location for these (although the building is unlisted, obtaining faculty permission is expected to be difficult).   It might be possible to use the existing underground boiler room; it would need large air ducts added requiring a grid to be inserted in place of adjacent grass.

9.3 Biomass Boiler

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.

In addition, a relatively large storage area for the fuel would be required, plus regular maintenance.

10. Cost Comparison

Operating costs

ITEM	Annual kWh	Cost (inc. VAT)	Cost totals
Gas – Present	105,000	£3,600	
Gas – Projected (nave only)	64,000	£2,200	
Electricity – Present	25,500	£3,300	
Electricity – Current use GSHP Direct IR heating Zones 4 & 5 replacing boiler B2, (same kWh) TOTAL	 25500 + 7,525 + 15,360 = 48,385		

Electricity projection with savings from less preheating of zones 4&5	25,500 + 7,525 + 10,000 = 43,025		
Annual solar generation	29,000	Zero	
Projected Grid requirement	14,025	£1,820*	
Present total			£6,900
Projected total			£4,020

- Projected grid costs are assumed to be a mix of day and night rates, since a GSHP can be run to preheat rooms overnight; this has been calculated at 13p/kWh
- Annual savings of £2,900 operating costs are possible.

11. 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 .

12. 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.