Energy Efficiency and Zero Carbon Advice

St Thomas' Church, Clapton Park
PCC of St Thomas' Church

Author	Reviewer	Audit Date	Version
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Contents

1. Executive Summary

An energy survey of St Thomas' Church, Clapton Park was undertaken by ESOS 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 Thomas' Church, Clapton Park was constructed in 1773, with a tower added in 1828. Severe war damage resulted in a rebuilt nave constructed around 1960 in a similar style, but with modern concrete beam floor.

There is both gas and electricity supplied to the site.

The church has a number of ways in which it can become 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)
SHORT TERM						
Move to a supplier of renewable energy offering group purchasing savings	N/A	5-15%	None	Immediate	None	5.5
Draughtproofing works	2% 1,000	£87	£100	<2	List A	
Investigate use of a dehumidifier for the crypt alongside ventilation options	N/A	N/A Controls damp	£200	N/A	None	N/A
Install reflective radiator panels (church and crypt)	2% 1,000	£87	£50	<1	List A	
Install Air to Air Source Heat Pump for crypt	20,000	£300	£13,000	43 Without solar power	Faculty	
Install Air to Air Source Heat Pump for vestry / office	N/A	N/A	£1,800 (4kW)	N/A	Faculty	N/A
Install secondary glazing to office window	10% per room		£600	Reduces heat pump operating cost	Faculty	
MEDIUM TERM						
Install Air to Air Heat Pump for hall	5,000	£75	£2,250	30 Without solar power	Faculty	
LED relighting scheme	5,000	£1,450	Unknown £10k likely	7 to 10	Faculty	
Install solar panels	20,000	£5,800	£26,000	5	Faculty	

	Bigger than need					
LONG TERM						
Plan for church boiler replacement using a heat pump	30,000 gas Replaced by 7,500 elec	£456	£40,500 current. Unknown, > 5 years in future	89 without solar	Faculty	

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

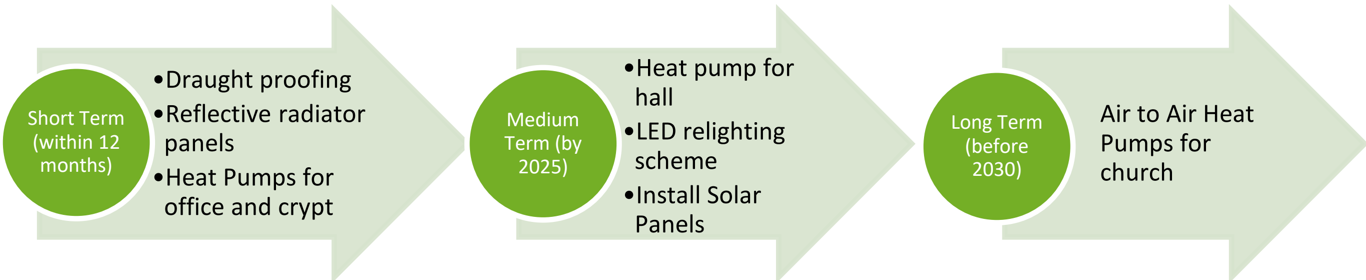
Based on current contracted prices of 28.96p/kWh and 8.76p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church around £8,000 per year in operating costs. Solar panels will reduce heat pump operating costs by around half.

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.

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 Thomas' Church, Clapton Park 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 with improvements in 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 Thomas' Church, Clapton Park, E5 9BW was completed on the 28th September 2022 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Church Energy Advisors Network developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE affiliate 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.

The church was represented by Father William Taylor, Vicar and Adele, former church warden.

St Thomas' Church, Clapton Park	CHURCH Including crypt and vestry,	HALL
Church Code	623096	
Gross Internal Floor Area	760m^2	50m^2
Volume	4,000m^3	150m^3
Heat requirement	119kW Church 90kW, crypt 29kW	5kW
Listed Status	Grade II Historic England ref. 1265859	Unlisted

The church is typically used for 14 hours per week and the crypt for 25 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	7 hours per week	35
Church Meetings and Groups	5 hours per week	
Community Use (mainly crypt)	25 hours per week	Daily use by various groups
Occasional Offices	1 weddings 4 funerals	100 100

Annual Occupancy Hours: Church 650 Crypt 1,300

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Thomas' Church, Clapton Park and have been reviewed against the current market rates for energy.

The current electricity rates are:

Church Rate	28.96p/kWh
Standing Charge	27.397p/day

Supplier: Bulb

Hall Rate	50p/kWh
Standing Charge	200p/day

Supplier: EDF

The current gas rates are:

Rate	8.76p/kWh
Standing Charge	27.397p/day

Supplier: Bulb

The above review has highlighted that when the current contracts expire, there will be opportunities to gain cost savings from improved procurement of the energy supplies at this site using a group purchasing scheme.

We would therefore recommend that the church looks into 100% renewable tariffs and obtains quotations for its gas and electricity supplies from group purchasing schemes such as the Big Church Switch scheme and the Parish Buying scheme, http://www.parishbuying.org.uk/energy-basket.

This scheme offers 100% renewable electricity and a proportion of renewable gas and therefore are an important part of the process of making churches more sustainable.

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

VAT	20%	The organisation is understood to be a charity and therefore should be benefiting from only be charged a 5% VAT rate. A VAT

		declaration should be sent to the supplier to adjust this.
CCL	100% charged	As the organisation is being charged the wrong VAT rate they are also being charged CCL which should not be applied as they are a charitable organisation.

Whenever monthly electricity consumption exceeds 1,000kWh, or gas consumption exceeds 4,397kWh (52,000kWh per annum), 20% VAT is charged unless the customer has submitted a VAT declaration form.   This should always be done when changing supplier.

The church is a charity and therefore can claim VAT exemption status.

Excess VAT paid can be reclaimed for the past three years.

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.

A detailed explanation is available here: https:// perfect-clarity.com/vat-on-church-utility-bills/#:~:text=There%20is%20no%20VAT%20chargeable%20on%20Church%20water%20bills

5. Energy Usage Details

5.1 Annual Consumption

St Thomas' Church, Clapton Park used 8,500kWh/year of electricity from 2 July 2021 to 2 July 2022, costing £2,650 for the year. The hall used 1,000kWh on average over a two year period from 6 February 2020 to 8 February 2022 costing £537 annually. This figure may be lower due to the pandemic, but the data indicates less consumption in the second year.

Gas use for the church is estimated as 50,000kWh. This has been scaled up from six months readings from January to July 2022 following a long period of unreliable estimated readings.

This data has been taken from monthly electricity and gas bills provided by the church.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Church	F91A 19337	London Electricity Board	No	Porch electrical cupboard
Electricity Hall (presumed)	S75A 13710	Unknown	No	Not observed
Gas – Church	M016 A03694 06 A6	Actaris metric	No	Basement, boiler room

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. This will prevent large billing errors occurring again.

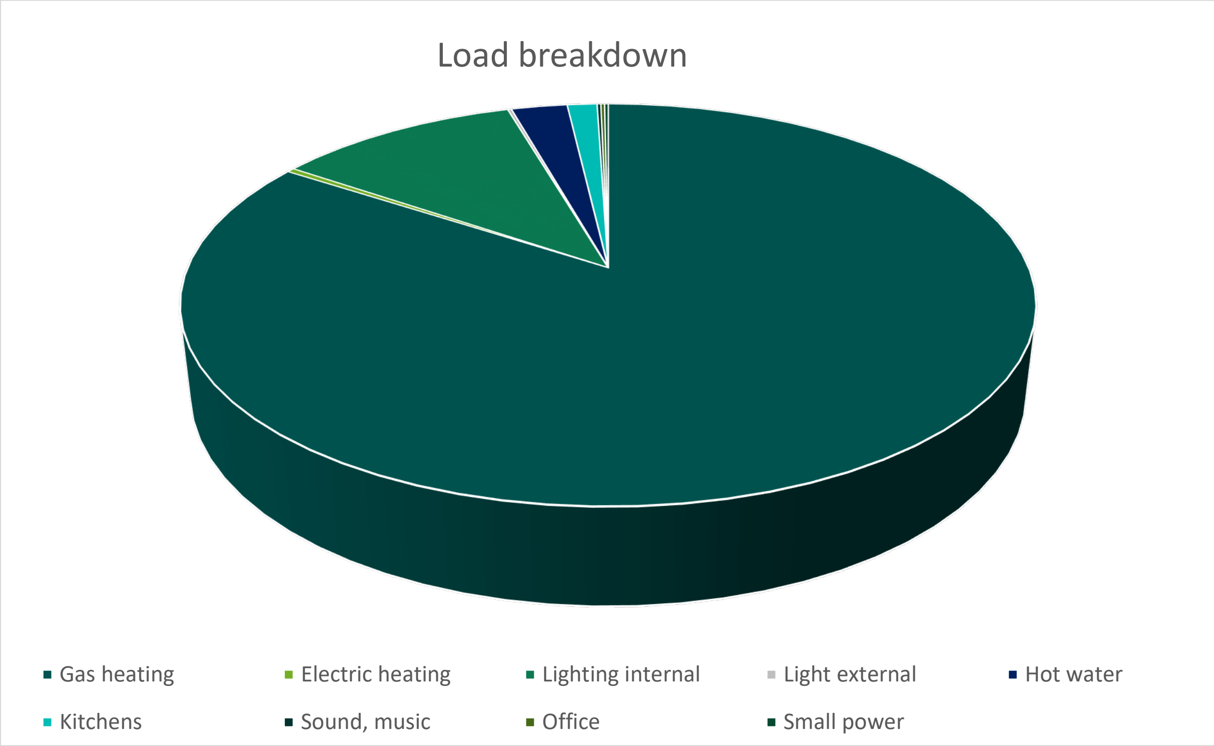
5.2 Energy Profiling

The main energy consuming plant can be summarised as follows:

	Equipment	Power kW	Annual Consumption kWh	Portion
Heating [Gas]	CHURCH, crypt and vestry Vaillant Eco Tec Plus, installed 2019 HALL Worcester domestic boiler	 100 c. 25	 Combined 50,000	 84%
Heating [Electric]	Boiler circulation pumps Est. 800 hours	0.2	200	0.3%
Lighting [Internal]	CHURCH 650 hours use 27 spotlights, 75 and 100W 29 pendant bulbs, mix of CFL and 75W halogen CRYPT 30 x F58W fluorescent tubes OFFICE 1 x fluorescent F58W HALL Unknown hours use 6 x fluorescent F58W	 2500W 1700W 1740W 58W 348W	 2,730 2,300 70 1,400 TOTAL 6,500	10.9%
Lighting [External]	Two entrance lights	200W	100	0.17%
Hot Water	Fixed water heater, Heatrae Sadia 15 (15 litres) in boiler room Kettle Urn	3 3 3	1000 250 250 TOTAL 1,500	2.5%
Kitchens	Electric cooker Fridges (on constantly)	3 0.1	200 600 TOTAL 800	1.3%
Office	Photocopier	0.5	100	0.17%
Sound, Music	Organ	0.5	100	0.17%
Small Power	Vacuum cleaner	1.5	100	0.17%

Sum of estimates: 9,400kWh

Annual site electricity consumption, 9,500kWh



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 lighting and hot water.

6. Efficient / Low Carbon Heating Strategy

6.1 Reducing Environmental Impact

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 its 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 plan to increase building efficiency and become less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches.

6.2 Forward Planning

Whilst there are plans to add hydrogen to the network, and "green" gas from anaerobic digestion; some suppliers offering up to 20% "green gas" tariffs, the majority of the gas supply will continue to be fossil fuel for the next decade. The economics of hydrogen production and the need to replace some pipework make full decarbonisation of gas unlikely. Some hydrogen is due to be added to the gas grid over the next five year period. If plans to decarbonise the gas grid are implemented; the hydrogen mix will eventually exceed 20% and a hydrogen compatible boiler (and piping) will be required. The transition will be overseen by the regulatory bodies in a similar way to that between town gas and north sea gas.
Domestic boilers such as that in the hall kitchen, have a lifetime of around ten years (the age when maintenance contracts expire). Light commercial boilers such as that installed in the basement can last for longer. The church should develop a boiler replacement plan, by obtaining detailed quotations for the options presented in this report. Where electric heating can be obtained at similar or lower operating cost, this is recommended.

6.3 Site Heat Demand

The Centre for Sustainable Energy model[2] 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 m³	Insulation Factor kW/m³	Heat Required (Space heating) kW
Church plus vestry [Served by Vaillant 100kW boiler in basement]	3,000	0.033	90
Crypt (same boiler)	960	0.03	29
Hall [double glazed]	150	0.03	5

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

The site uses around 50,000kWh of gas yearly. The church and crypt share a heating system with 1,300 hours estimated use for the crypt at around 25 hours use weekly. Assuming that the heating season is 30 weeks, this is 750 heating hours.

6.4 Heating Recommendations

6.4.1 Church

The church is heated by a recently installed boiler (dating from c. 2019) connected via a heat exchanger to a network of traditional cast iron radiators. This is expected to provide heat for the next decade or more, but the church should keep informed of gas prices and replacement options. The surface area of these radiators is considered to be insufficient for successful heat transfer using an air or ground to water heat pump (supplying warm water at around 50ºC).

A transition to electrical heating would therefore *not* use the existing radiators. The option offering lowest operating costs would be to install Air to Air Heat Pumps (with internal floor standing fan units in locations similar to the radiators). These are suited to a medium to high use building and are the best option to allow hours of use to increase without significant increase in costs. This option would be consistent with the desire to turn the building into a venue aimed at greater community engagement.

In addition, in certain areas extra heating could be installed. This might involve use of wall mounted infra red radiant panels (non glowing), although as these have a reach of 3 to 4 metres only it restricts them to the aisles. This method is not suited to heating the majority of the space. It would be suited to creating a local “warm zone” either for elderly parishioners, or to allow a small area of the church to be heated for short duration meetings when it is not worthwhile heating the whole space.

Another option is the provision of heated cushions, portable and with a low power requirement.

These have recently been trialled by the Diocese of Sodor and Man.

6.4.2 Crypt

The crypt is a large area (300m^2, around 1,000m^3) with a medium height concrete ceiling (3.2m). It’s subterranean location and position under the thermally “heavy” church means it will be slow to warm up or to cool down. Temperature will be strongly influenced by the average temperature of the ground (around 10^{o}C).

The current approximate 25 hours of weekly use and the above characteristics suggest that it is suitable for a heat pump to be installed. The existing radiators are twin wall pressed steel; 2 of

1.2m/ 1.2kW and two of 1.5m / 1.5kW.   These may be insufficient to work with the lower water temperature provided by an air to water heat pump and may require augmentation.

The church is considering the need to add ventilation to this space – obtaining further advice is suggested.   Use of a temperature and humidity datalogger will inform what humidity levels are reached which will be relevant information informing the required rate of Air Changes per Hour.

The ACH rate required is higher where sports are performed.

6.4.3 Church Office / Vestry

This area is currently heated by the church central heating system. With the proposal to refurbish the vestry as an office for use throughout the working week; it should be provided with an independent heating system which does not rely on having to heat the whole church.

Installation of a heat pump (e.g. Air to Air) will provide 4 to 5 times the amount of heat which it consumes in electricity.   This is recommended over any "direct" form of electric heating whether convective or radiant which supply 1kW of hear per 1kW of electricity.

The south facing wall of the room (with window) offers a location for the plant, with an external unit located on the wall (in a garden area not visible to the public) and an internal unit either floor mounted under the window where the existing radiator is, or wall mounted to the left of the window.

Capital costs are around £450 per kW output and a 5kW unit may be required for the space.

6.4.4 Hall

The hall consists of two rooms, that facing the garden which is visible above, and one behind which is hired by a florist as a studio, plus a small kitchen to the right behind the entrance.

Heating is currently by domestic combination boiler located in the kitchen.

When this boiler requires replacement, it is suggested than an Air to Water heat pump is substituted to provide *heating only.* Boilers are often sized to provide sufficient hot water. The building volume suggests that a heat pump of lower power than the current boiler would be sufficient.

The existing radiators in the "garden side" room are three fan assisted radiators (pictured below) which could be suitable for use with a heat pump. The radiators in the Florist's room could not be viewed.

Suitability of the current radiators for re-use would have to be confirmed by a heat pump installer.

The external unit could be located on the flat roof (subject to assessment of structural suitability), or in the garden area between hall kitchen and church vestry / office.

The hours of use of this hall are unknown; it is suggested that over 20 hours of weekly use are required for a heat pump to be suitable. If hours of use are very low; then "direct" electric heating using (non-glowing) radiant infra-red panels are recommended. These provide instantaneous heat and are suited to short meetings at short notice. They do not give any efficiency advantage as heat pumps do, so are more expensive to run than gas heating for medium to high hours of use.

Hot water provision in future should be by an instantaneous point of use heater (which only provides water on demand and has no tank. This avoids standing losses associated with keeping a volume of water hot). An example of this technology is the "Zip" heater.

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 Data and Dataloggers

It is recommended that a temperature and humidity monitor is purchased to better understand the thermal behaviour of the building and therefore to optimise the heating timing.

Experiments in the Diocese of Lichfield show that central heating systems should be turned off optimally 45 minutes before the end of the service / meeting.

Obtaining a temperature and humidity datalogger will also inform decisions relating to ventilation of the basement. It can reveal levels of humidity and how closely these approach the dew point, at which condensation will occur. This must be avoided to prevent mould growth which can occur above 80% relative humidity.

One suitable device is the Easylog USB-2, or similar. These devices collect data over a period (a week is useful) and can be positioned in different places sequentially to build up a clear understanding of thermal behaviour.

7.2 Radiator Reflective 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. Future Heating Options

8.1 Heat Pump Overview

Heat Pumps are a low carbon method of creating heat.

As the hours of use of a building increase, so do heating costs.

Electrically operated heat pumps can provide between 2.5 times and 5 times the amount of heat in kW which they consume in electricity (this is termed the Coefficient of Performance, CoP).

The efficiency advantages of heat pumps mean that in some circumstances they can work out at equivalent or cheaper operating cost than gas despite the higher cost of electricity per kWh. This effect is increased if electricity is generated on site by solar power.

When replacing gas boilers directly, sometimes larger radiators are required, or fan assisted radiators, or running the system for longer periods to achieve the same temperature (but at less power input).

With electricity prices now only three times more per kWh than gas (it was about four times), heat pumps are becoming steadily more cost effective. Refrigeration technology is mature and reliable; the units appear to offer lower maintenance costs compared to gas boilers.

Heat pumps generally deliver water at around 50ºC (although there are higher temperature ones on the market which require more energy to run); thus are compatible with a building which is regularly used and can be supplied with constant, medium heat, rather than a full power heat up on Sunday mornings.

Air source systems deliver between 2.5 and 3 times the amount of heat in kWh to water that they consume.

Ground source systems are more efficient (since the average ground temperature is higher than the average air temperature), but require either an expensive borehole, or extensive trench digging. Ground Source Heat Pumps supplying water at around 50ºC are more efficient than their Air Source equivalent. Where a site has a daily requirement for heat (and thus high daily expenditure), the lower operating costs of a ground source pump outweigh the higher capital costs.

Air to Air systems deliver warm air through indoor fan units and have a CoP rating of up to 5 and they can also provide cooling. The latter would be suitable where there are no radiators, insufficient radiators, or life expired / poorly sited units and spaces heated intermittently. These are recommended where there is no existing radiator system or an unsuitable / undersized or life expired system.

Some of the extra electricity required to run heat pumps can be obtained from solar PV panels. Some types of heat pump can provide cooling – solar powered cooling in summer is very efficient.

The flat roofs of St Thomas' church offer a good potential for installing solar panels and this will increase the economic case for heat pumps.

Note that some installers consider churches unsuitable for heat pumps as their calculations indicate very long heat up times. The existing very long heat up times of gas boiler – radiator systems should be borne in mind. There are case studies being added to the Church Building Council Webpages. www.churchofengland.org/resources/churchcare/advice-and-guidance-church-buildings/renewable-energy

8.2 Air to Air Source Heat Pump Details

Air to Air Source heat pumps require internal fan units, blowing warm air, connected to external units – they do not require radiators. Systems provide summer cooling as well as winter heating and can deliver up to 4 to 5 times the amount of heat which they consume in electricity.

Two large units below supply an office of area 500m^2 with 75kW of heat and with the four small units below supplying one floor of area 165m^2 with a further 21kW of heat.

There are a wide variety of internal units for ceiling, high wall and low wall mounting.

At St Thomas's, pipework for future AASHP internal units in the church could be installed from the crypt.

External units would need to be found locations which were non viewable or hidden in some way, but need to be well ventilated for this method to be viable.

8.3 Air to Air Source Heat Pumps Costs – Office

A pump to supply 4kW of heat with capital cost estimated at £450 per kW output would cost £1,800.

Costs may be less as only direct connections through the wall between external and internal units are likely, minimising piping costs.

Operating at a Coefficient of Performance of 4, an 4kW heat output requires 1kW of electricity supply.

8.4 Air to Air Source Heat Pumps Costs – Church

Pumps to supply 90kW of heat (with capital cost estimated at £450 per kW output: £40,500 at current costs) would deliver the same amount of heat annually, 30,000kWh, as the current system (assumes a 30,000 / 20,000kWh split between church and crypt).

Operating at a Coefficient of Performance of 4, a 90kW heat output requires 22kW of electricity supply – this is at the limit of a single phase of power, with lighting etc and further heat pumps an additional load, so a three phase supply is required.

Annual consumption = 30,000kWh/4 =7,500kWh.

Air to Air source heat pumps do not require water radiators. The external units could be located on the flat sections of the aisle roof which are not proposed to be used for solar panels, due to shading (sited on the side away from the road if they would otherwise be visible).

This is a convection based space heating system, which like the existing system, supplies warm air to fill the building.

8.5 Air to Air Source Heat Pumps Costs – Crypt

Pumps to supply 29kW of heat (with capital cost estimated at £450 per kW output: £13,050 at current costs) would deliver the same amount of heat annually, 20,000kWh, as the current system.

Operating at a Coefficient of Performance of 4, a 29kW heat output requires 7.5kW of electricity supply.

Annual consumption = 20,000kWh/4 =5,000kWh.

8.6 Air to Water Heat Pump – Hall

This would be a direct replacement for the gas boiler, assuming that the current fan assisted radiators have sufficient area and output for the lower temperature water which is supplied.

8.7 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 electrical supply it currently has coming in from the existing single phase 100A supply to a 3 phase 100A supply.

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

The DNO in your area is UK Power Networks - www.ukpowernetworks.co.uk; 0800 029 4282 (London, South East and Eastern England)

The cost of bringing in a new 3 phase supply can range from £300 to £30,000 but the DNO will provide a quotation for free so it is well worth obtain a quotation in the short term so that decisions can be made on a well informed basis.

9. Energy Saving Recommendations - Equipment

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.

9.1 Fixed Water Heater: Timer Control

A Heatrae Sadia 15 litre water heater is located in the boiler room. Whilst the tank itself is well insulated, the copper pipework is not and is a constant source of heat loss of around 100W (incandescent light bulb) and will waste around 900kWh per year, costing £140.

It was unclear where this unit was switched from and thus it could be left on constantly, whereas the requirement for hot water in the kitchen is only at certain times during the week.

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

Note that a 15 litre tank will only deliver half this volume of hot water. As the water is drawn, it is replaced by cold, so the second half of the tank will be lukewarm.

If the kitchen use pattern is so unpredictable that the timer needs to be altered daily, the church is recommended to replace the whole unit with a point of use water heater immediately, in advance of the kitchen tap. This will then heat only the water actually required.

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

9.2 New LED Lighting

The lighting makes up a relatively large overall energy proportion of the electricity used within the church, and large areas are lit by inefficient halogen fittings within the church, and large numbers of relatively inefficient fluorescent tubes in the crypt.

The church lighting is made up of a mixture of 60, 75 and 100W bulbs as pictured above.

It is recommended that all lighting is changed for LED; either like for like bulb replacement or LED strip lighting for the crypt, with the entire units being replaced.

The church is considering a relighting scheme, which should be LED based.

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

10. Energy Saving Recommendations – Building Fabric

10.1 Draught Proof External Doors

There are a number of external doors in the church. It is recommended that the draughtproofing around the door is improved and draught strips are added where they are not present. This could be achieved in a number of ways.

For timber doors that close onto a timber frame a product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing. http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

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

10.2 Windows

Some of the 1960 windows in the church are damaged with broken panes (below), and one on the west side marked "Do not open, the window will fall out". These should be repaired as holes are a constant source of draught and heat loss.

Windows in the crypt, above, could have secondary double glazing installed.   The opening panels could be retained but would need restrictors added (or modified) so they do not hinge so far.

10.3 Secondary Glazing

The windows of the building are singled glazed with metal frames. It is not possible or desirable to change the window(s) as the building carries listed status. Given the windows to the crypt are relatively small, and have a more simple surround, they would be suitable to have secondary glazing installed as they are also not primary or important windows within the church.

The introduction of secondary glazing would considerably reduce the heat loss through the existing windows and improve both thermal comfort and noise levels as well as providing added security.   It would also benefit installation of a heat pump for the crypt by reducing heat loss and improving the economics of heating.

Any possible installation would need to be carefully specified, and companies such as https://www.selectaglaze.co.uk/heritage-listed-buildings or https://www.stormwindows.co.uk/ can provide very discrete and appropriate systems for all types of spaces.

The vestry / office window would also benefit from internal secondary glazing for the same reasons.

11. 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 – flat roofs
Battery Storage	Future potential
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	Yes for hall Compare with Air to Air for crypt No for church – radiators insufficient
Ground Source Heat Pump	No – capital cost
Air to Air Source Heat Pump	Yes for office and church in future

12.1 Solar Photovoltaic Panels

The roof is flat with lower aisle and entrance sections and a higher nave section.

The south aisle roof is shaded by trees.

The nave roof, together with the entrance area offer areas of around 160m² and 70m², and the hall roof a further 30m² In total. this could generate 0.15kWpeak/m² giving a 39kWpeak system. A 1kWpeak system can generate up to 1000kWh annually.

The aisle roofs are not included as they are both heavily shaded. In addition, these locations could host heat pump units.

The following formula calculates annual generation.

Annual Generation (kWh) = Area x 0.15kWp/m² x 1000kWh/kWp x Orientation Factor x Overshading Factor.

Roof Section	Useable area / m²	System Size / kW peak	Orientation factor	Shading factor	Annual Generation, kWh
Church nave	160	24	Optimum with panels on supports	1	24,000
Church entrance	70	10.5	Optimum with panels on supports	1	10.500
Hall	30	4.5	Optimum with panels on supports	1	4,500
Total	260	39			39,000

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 maximum potential generation is considerably greater than the sites annual recent electricity use (9,500kWh). If no heat pumps are installed, the system should be sized appropriately for current electricity consumption.

If heat pumps were installed, this would require extra power. With a current gas use of 50,000kWh, if heat pumps achieved an average of CoP 4 this would require 12,500kWh of electricity. With a cut in lighting load by around 5,000kWh from a full LED installation, predicted annual load with the heat pumps rises to around 17,000kWh.

This suggests the Solar PV array should be around half maximum possible size, generating 20,000kWh from a 20kWpeak system.

Energy, for cooling and during spring and autumn, could be mostly from solar PV, grid electricity being required during evenings and dark winter days. A heat pump powered by solar PV offers very low cost heating, so heat can be added to the building during daylight hours.

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 provides a means of storing energy generated from solar PV on site and 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. This is a new but fast-growing technology.

Using average 2019 installation costs for simple roofs (£1,300 per kWpeak); a 20 kWpeak system would cost £26,000.

12. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at www.parishresources.org.uk/resources-for-treasurers/funding/

This includes a 77 page guide to funders and their criteria:

https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2020.pdf .

13. 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.