ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Margaret's Church, Putney
PCC of St Margaret's Church

Author	Reviewer	Audit Date	Version
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Contents

1. Executive Summary

An energy survey of St Margaret's Church, Putney 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 Margaret's Church, Putney is an Edwardian era church dating from 1905. It was constructed as a Baptist church, so ecclesiastical east is to the north. There is a modern era hall to the side.

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
Purchase a temperature and humidity datalogger	Potential 5%	£200	£60	<1	None	0.6
Purchase a dehumidifier for the crypt	N/A	N/A Controls damp	£200	N/A	None	N/A
Complete new boiler installation with a Magnetic Particle Filter	N/A	Reduction in long term maintenance	Thought to be covered by boiler package	N/A	None	N/A
Install reflective radiator panels	2% 1,400	£65	£50	1	List A	0.25
Install Air to Air Source Heat Pump for crypt	N/A	N/A	£1,800	N/A	Faculty	N/A
Draughtproofing works	2% 1,400	£65	£150	3	List A	0.25
Install secondary glazing to selected windows	10% per room 700	£33	£2,000		Faculty	0.13
MEDIUM TERM						
Install Air to Air Heat Pump for hall	6,000	£1,000	£5,000	5	Faculty	1.2
LED relighting scheme	Limited		Unknown		Faculty	
Install solar panels	25,000	£4,380	£39,000	9	Faculty	5.3
LONG TERM						
Plan for boiler replacement using a heat pump	70,000 gas Replaced by 17,000 elec		Unknown, > 5 years in future		Faculty	

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

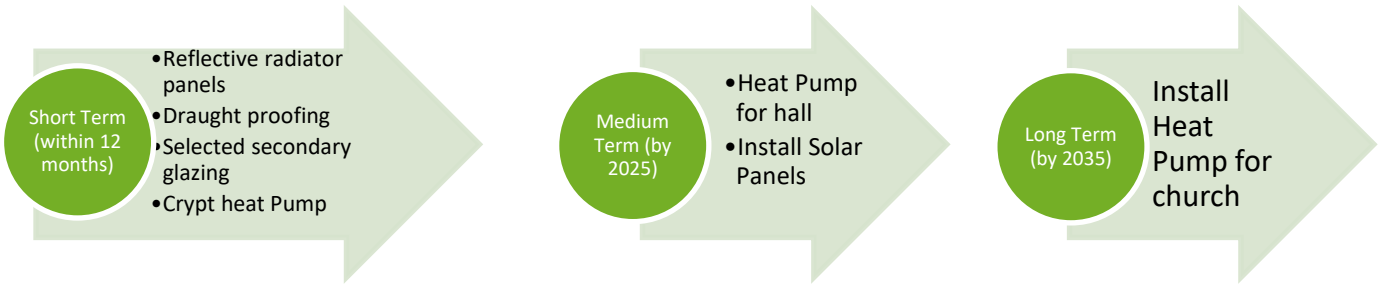
Based on current contracted prices of 17.52p/kWh and 4.69p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church around £5,700 per year in operating costs.

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 Margaret's Church, Putney 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 Margaret's Church, Putney, Putney Park Lane, SW15 5HQ was completed on the 14th September 2022 by Dr. Paul Hamley. Utility consumption data for the hall was provided – this building was not inspected internally as it was in use by a nursery but recommendations have been included. 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 Rev Brutus Green, vicar.

St Margaret's Church, Putney	CHURCH
Church Code	637348
Gross Internal Floor Area	450m^2
Volume	3,200m^3
Heat requirement	104kW
Listed Status	Unlisted

The church is typically used for 21 hours per week, the office for 40 hours per week, crypt for 8 hours and the hall for 70 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	9 hours per week	85
Church Meetings and Groups		
Community Use	7 hours per week	

Annual Occupancy Hours: Church 1,100 Hall 3,700

4. Energy Procurement Review

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

The current electricity rates are:

Single Rate	17.52p/kWh	Below current market rates
Standing Charge	26.554p/day	N/A

Supplier: British Gas

The current gas rates are:

Single Rate	4.69p/kWh	Below current market rates
Standing Charge	Zero	N/A

Supplier: British Gas

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. The current rates are lower than the market rate and should be retained at present.

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 Diocese supported Parish Buying scheme, http://www.parishbuying.org.uk/energy-basket.

These 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	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.

A mix of 5% and 20% VAT is levied on hall meter 1. The hall is occupied by a commercial nursery.

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 Margaret's Church, Putney [Church] used 8,050kWh/year of electricity from 29 November 2020 to 1st December 2021, costing £1,300 for the year. The hall used 18,000 during 2021 (total for the two meters).

Gas use for the church was 70,000kWh during 2021, costing £4,358.

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

5.2 Energy Profiling

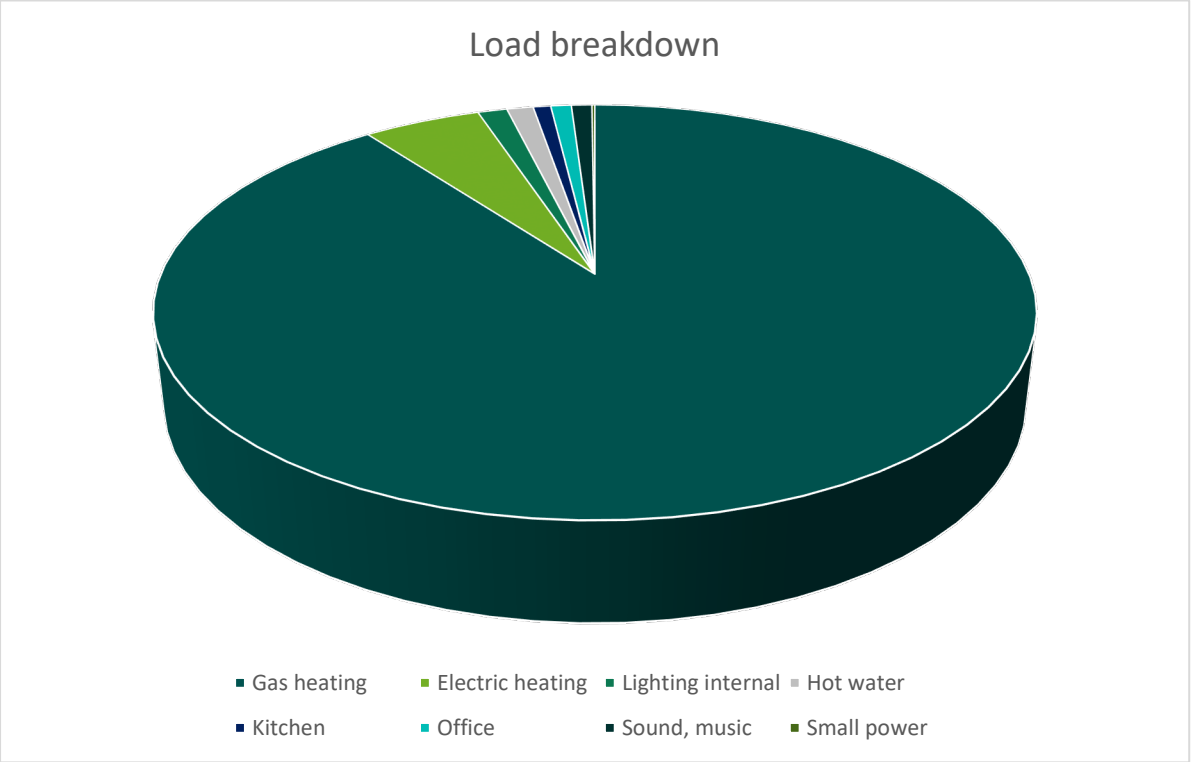
The main energy consuming plant can be summarised as follows:

	Equipment	Power kW	Annual Consumption kWh	Portion
Heating [Gas]	CHURCH Vaillant Eco Tec Plus condensing boiler (installed 2022)	80	70,000 (by previous unit)	89.7%
Heating [Electric]	Daikin heat pump, office and vestry If 4 hours/day for 20 weeks = 400hours	10	4,000	5.1%
Lighting [Internal]	CHURCH 1100 hours use 60 pendant LEDs Various other lighting, foyer etc Office 2200 hours use Bulkhead lighting	 300W 200W 200W	 550 450 TOTAL 1,000	 1.3%

Hot Water	Fixed water heater, Ariston, under kitchen sink (normally turned OFF) 2 Kettles 2 Coffee machines, Domestic Dishwasher, weekly use	3 3 3 3	200 200 300 200 TOTAL 900	1.1%
Kitchen	Microwave Fridge (on constantly) Mini oven	1 0.1 2	100 300 200 TOTAL 600	0.8%
Office	2 workstations Photocopier	300W 500W	600 100	0.9%
Sound, Music	Sound system Organ	0.5 1	500 200	0.9%
Small Power	Vacuum cleaner	1.5	100	0.1%

Sum of electricity consumption estimates: 8,000kWh

Annual site electricity consumption, 2021: 8,050kWh



As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site.

5.3 Energy Benchmarking

In comparison to national benchmarks for church energy use St Margaret's Church, Putney uses 6% less electricity and 5% more heating energy than is average 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 Margaret's Church, Putney (elec)	450	8,050	17.9	19	-6%
St Margaret's Church, Putney (gas)	450	70,000	155	148	+5%
TOTAL	550	78,050	173	167	+4%

There is currently no benchmark data available which takes hours of use and footfall into account. CofE Shrinking the Footprint – Energy Audit 2013.

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.

Over the next decade, the church should follow technical developments and their costs to develop a boiler replacement plan. 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

Insulation Factors

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
Church, including office and vestry	3,200	0.033	104
Crypt	130	0.030	4
Hall	estimated	0.0020	15.5

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

The crypt has not been provided with heating. It is partly below ground. Currently it is being refurbished.

The church uses around 70,000kWh of gas yearly. At 100kW load, this is 700 hours, around 23 hours per week for a 30 week heating season. The newly installed boiler is thought to be of 80kW output.

Cost per hour = Boiler power kW x gas price 4.69p/kWh = 375p/hour.

At the government's business energy price cap of 7.5p/kWh, cost per hour = 600p/hour.

[Useful for comparison between different heating methods when the total number of hours is either uncertain, or may change with modified building use].

6.4 Heating Recommendations

6.4.1 Church

The church is heated by a newly installed boiler connected via a heat exchanger to the existing network of a small number 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 a heat pump (supplying warm water at around 50°C).

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 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.

In addition, in certain areas radiant electric heating could be installed. 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. This might be in one of the aisles or the transepts towards the entrance area. This method is not suited to heating the majority of the space.

6.4.2 Crypt

The crypt is a fairly small area (62m^2, 130m^3) with a low suspended ceiling (2.1m). The lower half of the space is below ground and it is covered by the concrete floor of the church, which results in it being a thermally "heavy" space, heating and cooling very slowly. Temperature will be strongly influenced by the average temperature of the ground (around 10°C).

There are two options to heat this space.

If use is sporadic, and for short periods of time, radiant infra red panels are suggested. These will probably be best located on the ceiling, since various furniture will obstruct portions of the walls and this offers the best coverage. The heat loss model indicates only 4kW is required to heat the space, so a distribution of smaller output panels will give a better coverage than four x 1kW units. Infra red heating offers very rapid heat up times, it is compatible with short duration use, which can be at short notice. However, the low ceiling will inevitably result in "hot spots" close to the panels. Panel suppliers include BN Thermic, Herschel and Surya.

The above heating method gives 1kW of heat per 1kW of electricity purchased. As hours of use increase, then use of a heat pump will give more kW of heat per kW of electricity, cutting operating costs. With no radiators, Air to Air heat pumps (AASHP) are recommended, probably one unit each side of the space. They provide a space heating method which should be fairly rapid given the small volume. An AASHP will provide about 4.5kW of heat per kW of electricity.

6.4.3 Church Office and Vestry

These areas are heated by the church central heating system, plus a Daikin Air to Air heat pump system for use when the church is not in use and unheated.

The Internal unit, is a Daikin 30W FTXS42K3V1B. The external unit is unknown (not visible on flat roof). The unit in the office is used rarely, that in the vestry hardly used.

[It is possible that the vestry unit could be re-utilised in the crypt if an identical system was installed].

6.4.4 Hall (not audited).

The hall is in use by a commercial nursery during the day and various groups during evenings including dance classes and uniformed organisations for approximately 70 hours per week.

The building offers the greatest potential for saving of energy and the following interventions should be considered:

- Insulation
- Draught proofing
- Moving to electric heating – using a heat pump to offer high efficiency and summer cooling.
- There is potential for solar panels on the roof.

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.

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 Crypt Dehumidifier

Damp can be most effectively removed using a dehumidifier; which avoids the cooling resulting from open windows and is significantly more efficient than heating to remove moisture. Heating will dissolve moisture which is then transported to the coldest surface and condenses there. An ordinary domestic unit retailing at under £200 is suitable.

7.3 Magnetic Particle Filter

This is proposed to be fitted to the radiator circuit in the boiler room by your heating engineer to complete the installation of the new boiler. It will prevent fouling of the new heat exchanger, which would reduce efficiency. Installing the filter is strongly recommended.

7.4 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 Pumps: delivering more kWh of heat than electricity used

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.

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). They are compatible with underfloor heating, which typically runs at fairly low water temperatures, but not with high temperature heating systems. 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.

Both Air and Ground source systems delivering water at around 55°C require a network of large radiators which is not available at St Margaret's. If the radiators must be changed anyway, it is logical to install an AASHP system of higher efficiency and lower operating cost.

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.

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 small available area of the roofs means that the majority of electricity will still be required from the grid.

8.2 Air to Air Source Heat Pumps Overview

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 three floors, area 500m^2, together with four of the small units which supply one floor of an office of area 160m^2. This gives a heating capacity of 75kW (large units) and 21kW (small units). The CoP is between 3.2 and 3.9 depending on the type of internal unit chosen.

There are a wide variety of internal units for ceiling, high wall and low wall mounting. Low wall/floor mounted units are recommended for churches

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. Hedge planting has been used to hide oil tanks at some churches. The recessed location of the current boiler room, with grilles above basement windows offers a potential location (which may require enlargement of the sunken spaces).

8.3 Air to Air Source Heat Pumps Costs

Pumps to supply 80kW of heat current capital costs are estimated at £450 per kW output: £36,000, (but this may change considerably over the next decade).

Operating at a Coefficient of Performance of 4, an 80kW heat output requires 20kW of electricity supply.

Currently, 70,000kWh annually / 80kW boiler = 875 hours.

20kW x 875 hours = 17,500kWh electricity used annually.

At current costs of 17.52p/kWh, annual cost = £3,066, which is lower than the current gas cost.

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

An Ariston 15 litre fixed water heater is installed under the kitchen unit near the sink. This is normally left turned off and therefore does not waste electricity keeping water hot between occasional uses. It is recommended that a reminder notice is positioned next to the switch. Should the unit require replacement, a point of use, instantaneous water heater should be fitted. [An example is the "Zip" heater].

9.2 New LED Lighting

The lighting in the church consists of small chandeliers each supporting five LED (mostly) bulbs.

A relighting scheme is being considered for the future.

Other areas are lit by either bulkhead lights, CFL bulbs or strip lighting. Fluorescent strip lighting can be replaced when life expired by LED strip lighting – the whole unit should be changed (it is difficult to source LED strips of exactly the right length to fit the existing luminaires]

10. Energy Saving Recommendations – Building Fabric

10.1 Draught Proof External Doors

The Main external and internal pairs of doors are wood closing on wood. For an unlisted building it may be possible to use E or P section black rubber draught excluder strips where these can be installed unobtrusively. Your DAC should be consulted for advice.

The vestry / office door has a large crack between panels in the centre which needs repair to prevent draughts and further water damage, plus a hole for a missing 9mm (?) “spy” viewer.

This should be repaired.

10.2 Windows

Plasticene can be used to fill gaps and stop draughts where there are opening sections. This is easily removable later. Any rust to window frames should be treated as it leads to deformation and further leakage of rainwater.

10.3 Secondary Glazing

The windows of the building are singled glazed with metal frames.

The windows of the office are reported to allow a fierce draught to enter. As this is immediately behind the administrators seat it should be addressed. The windows in the crypt could also be given secondary glazing; this would help to insulate the space. Given the windows to this area is relatively small 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.

Three levels of expenditure are possible:

i) Glazing film applied with double sided adhesive tape. This does not allow the windows to be opened without removing the film.

ii) Thin polycarbonate sheet, cut to size with a craft knife and inserted in the window reveal (with a thin softwood frame if necessary). This is removable.

iii) Professionally installed secondary glass glazing units.

Options (i) or (ii) are probably sufficient for the crypt with (iii) for the office.

11. Other Recommendations

11.1 Electric Vehicle Charging Points

The church has a small car park on the north west side of the site which serves the church and its office (seen in the image below). In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those both visiting the church and using the hall, the church may wish to consider installing an electric vehicle charging point, to allow visitors to charge their electric car.

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

12. 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	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 to Air Source Heat Pump	Yes
Air Source Heat Pump	No – radiator network unsuitable
Ground Source Heat Pump	No – radiator network unsuitable

12.1 Solar Photovoltaic Panels

The pitched roof is visible from the ground. The building is unlisted, but planning permission for solar panels on a building of traditional construction may be difficult to obtain.

The flat area of roof offered by the transept on the west side is ideal, above the office is possible (although shaded by the higher transept) and the separate hall building are ideal locations for panels. Modern panels generate electricity without the need for direct sunlight, hence the east side transept is also a possible location.

The flat roofs on each side of the building offer a maximum area of 50m^2 each, although parapet walls, a skylight and access will reduce this.

This could generate 0.15kWpeak/m^2. A 1kWpeak system can generate up to 1000kWh annually, giving a total annual generation of around 10,500kWh.

With separate supply and metering for church and hall, two separate systems should be installed.

Assuming that the maximum amount of roof space could be, and was used 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
Church, per side	50	7.5	80 and 260 degrees / 35° optimised panels 0.85	0.8	5,100
Hall	100	15	180 degrees / 35° (optimised panels) 1.0	1	15,000
Total	**200**	**30**			**25,200**

This is the maximum likely figure, which may be reduced by factors such as the weight of panels (due to roof strength), 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 similar to the annual recent electricity use (8,050kWh for the church, 18,000kWh for the hall in 2021). Church consumption is around 500kWh per month in the summer (double in midwinter) which suggests an annual generation of around 5,000-6,000kWh is appropriate.

If heat pumps were installed, this would require extra power to be drawn from the grid in winter. In summer, the combined current consumption of the two hall meters if around 1,000kWh; this could be generated by the hall solar installation which could also contribute to cooling by the heat pump.

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 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 2019 installation costs (for "simple" roofs £1,300 per kWpeak); a 30kWpeak system would cost £39,000.

13. 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 .

14. 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.