ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

All Saint's Hall & Office, Laleham
PCC of All Saint's Church

Author	Reviewer	Audit Date	Version
Paul Hamley	Tamsin Hockett	10th November 2022	1.0

Contents

1. Executive Summary

An energy survey of All Saint's Hall & Office, Laleham was undertaken by ESOS Energy 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.

All Saint's Hall & Office, Laleham dates from c. 1960 .

There is both gas and electricity supplied to the site.

The building 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 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						
Office – purchase heated chair or cushion(s)	300	£64	£150	<3	None	0.06
HALL						
Main hall fire door replacement	2% 700	£150	Unknown	Unknown	Faculty	0.12
MEDIUM TERM						
Replace windows	15%	£270	£9,000	33	Faculty	0.95
LONG TERM						
Replace hall boiler with Heat Pump	35,000 gas 7,777 electricity required	£138 at current rates	£9,450	68 Less due to lower servicing costs	Faculty	4.6
Install solar photovoltaic panels on roof	15,000	£3,200	£19,500	6	Faculty	3.1

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

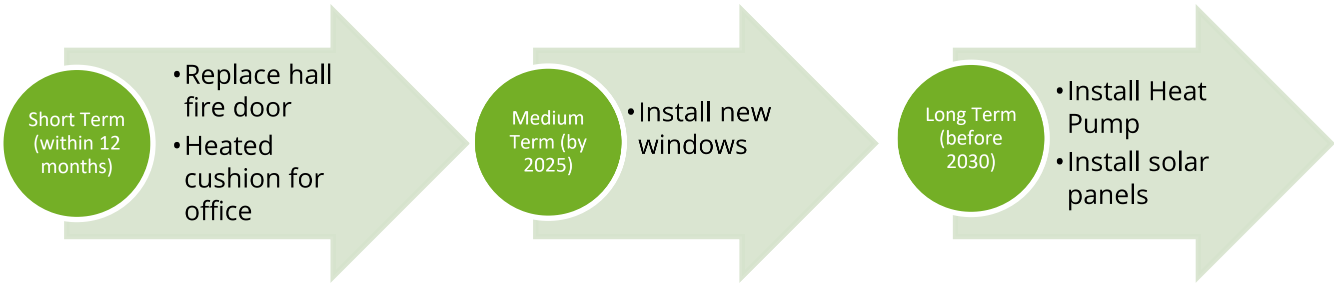
Based on current contracted prices of 21.4p/kWh (hall), 20.9p/kWh (office) and 5.15p/kWh (hall) for electricity and mains gas respectively.

If short and medium term measures were implemented this would save around £500 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 2030 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of All Saint's Hall & Office, Laleham to give them advice and guidance as to how the buildings can be improved to be more energy efficient. In doing so the buildings will also become more cost effective to run with improvements in the levels of comfort.

An energy survey of the All Saint's Hall & Office, Laleham, TW18 1RZ was completed on the 10th November 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 Eco Congregation.

The church was represented by Deborah Bull, Church Administrator.

All Saint's Hall & Office, Laleham	***HALL***	***OFFICE***
Gross Internal Floor Area	265m^2	45m^2
Volume	700m^3	110m^3
Heat requirement	21kW	3kW
Listed Status	Unlisted	Unlisted

The church hall is typically used for 27 hours per week, and the office for 30 hours per week for the following activities:

Type of Use	**Hours Per Week (Typical)**	**Average Number of Attendees**
Church Meetings and Groups	2 hours per week	Teenage group
Community Use	25 hours per week	Nursery

4. Energy Procurement Review

Summed energy and gas use data has been supplied by the church covering the last four years.

The current electricity rates are:

Hall Rate	20.9p/kWh
Office Rate	21.4p/kWh
Standing Charge	28.63p/day (office) Zero for hall

The current gas rates are:

Hall Rate	5.15p/kWh
Standing Charge	Zero

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, Charity Buying Group 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.

VAT information has not been supplied.

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.

5. Energy Usage Details

5.1 Annual Consumption

All Saint's Hall & Office, Laleham used the following amounts of energy;

Electricity	2019	2021
Hall	5,942	5,242
Office	5,702	4,473
Gas - Hall	31,687	38,006

Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Hall	K12B 000733	Elster A1100 3 phase	Yes	Store room
Gas - Hall	G4 A0352284	Sclumberger metric	No	External gas meter cabinet

Having an AMR connected gas meter fitted would allow an annual energy use profile for the site gas use to be obtained from the supplier. This should be available for electricity use.

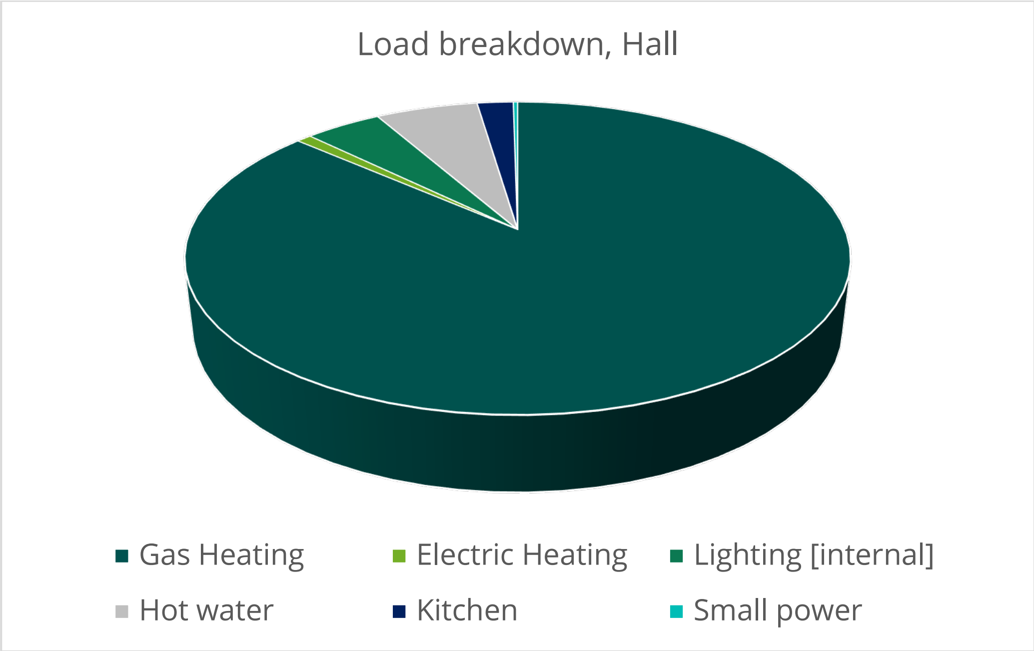
5.2 Energy Profiling

The main energy consuming plant can be summarised as follows:

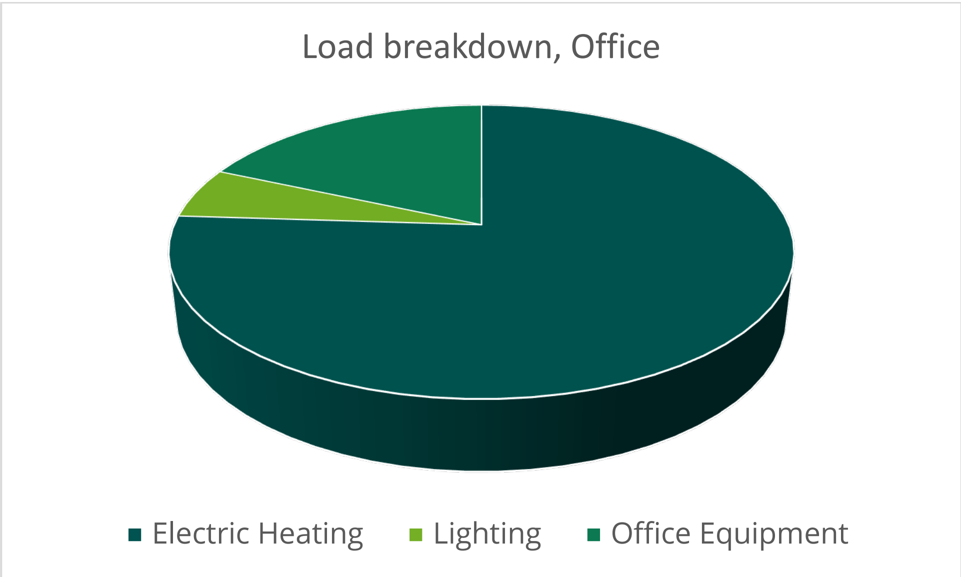
	Equipment	Power kW	Annual Consumption kWh
Heating [Gas]	HALL Worcester Greenstar GR8300iW boiler	30	35,000
Heating [Electric]	HALL Boiler circulation pump Dimplex 2kW blower over entrance door OFFICE *6 electric convector heaters, wall mounted. Main office 8kW 20 weeks x 25 hours.* *Foyer, toilet, Heritage room 5kW*	 0.2 2 *13*	 230 120 *3,000* *800*
Lighting [Internal]	HALL 1,400 hours use LED lighting, some panels integrated into suspended ceilings OFFICE *All LED units mounted in suspended ceiling*	 1,300W *250W*	 1,800 *280*
Hot Water	Kettle Dishwasher, daily use	3 3	800 1,600 TOTAL 2,400
Kitchen	Cooker (occasional use) Microwave Fridge (on constantly) Printer	3 1 0.1 0.5	100 200 300 50 TOTAL 850
Office	*2 Workstations* *Photocopier* *Fridge* *Microwave oven* *Coffee machine*	*2 x 0.2* *0.5* *0.1* *1* *2*	*250* *50* *300* *20* *300* *TOTAL 920*
Small Power	Vacuum cleaner	1.5	100

Annual Hall electricity consumption: 5,500kWh

Annual Office electricity consumption: 5,000kWh



As can been seen from the data above, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is lighting / hot water.



6. Efficient / Low Carbon Heating Strategy

6.1 Reducing Environmental Impact

The energy used for heating a building typically makes up the majority 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 biogas 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.

The hall and office 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

Building	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Hall **Ceiling insulation, single glazed**	700	0.03	21
Office **Insulated, double glazed**	110	0.022	2.4

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

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 Radiator Reflective Panels

The hall 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 Introduction

When the hall boiler requires replacement, it is recommended that a heat pump is installed.

There are two options, an Air to Water pump utilising the existing radiator network (which must therefore be in a good enough state of repair to function for a further 20 years), or an Air-to-Air system. The latter requires removal of the radiators and substitution of internal fan heater units. The layout of the building means that the external units would be located immediately outside and also that units for the different rooms such as the church room at the front would be independent. This gives the advantage of only having to heat the part of the building which is used if small groups are hosted during evenings and weekends.

An air-to-air system is recommended because of:

- Lower operating costs due to higher efficiency
- Greater flexibility allowing individual rooms to be heated separately
- Lower maintenance liability than with an ageing radiator system

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.

8.2 Air to Air Source Heat Pumps

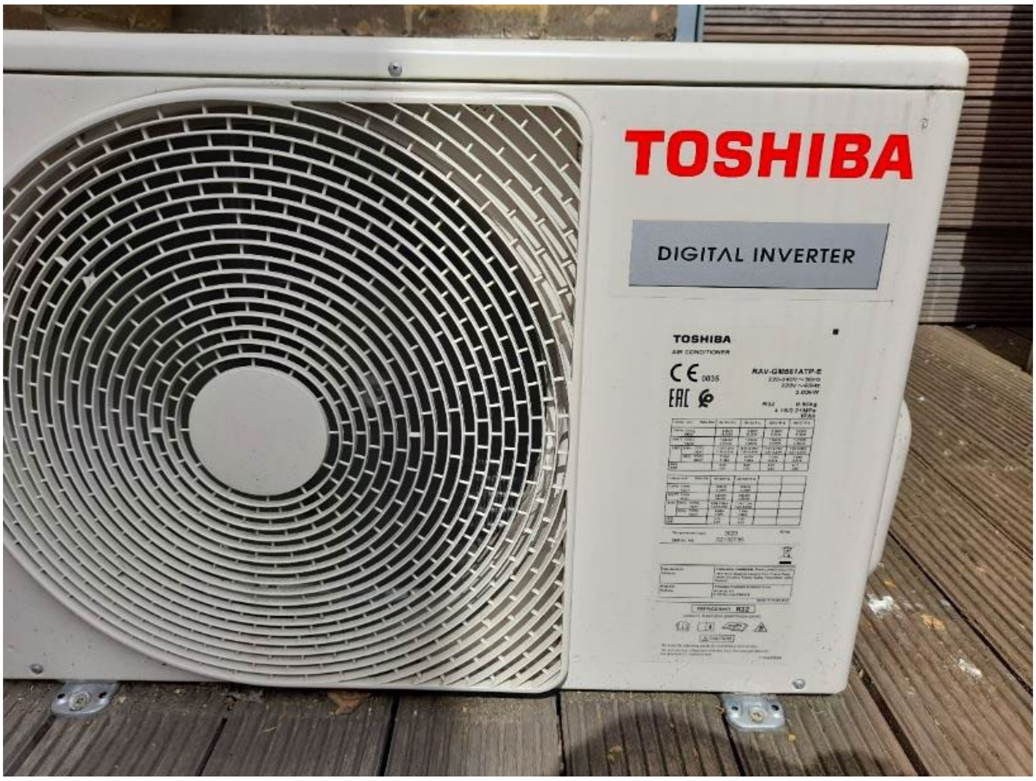
Air-to-Air Source Heat Pumps (AASHP) work by having an external unit which sucks air in and extracts the heat from it. The pumps concentrate this heat and put it into a refrigeration gas (in the same way as a fridge or freezer works). This refrigeration gas is then piped inside the building in a small pipe where is it then allowed to expand in an internal unit with a fan. This heat is then blown out into the space. This system is identical to an air conditioning system, but it works in reverse to heat the space. As warm air is blown into the space this type of system can heat spaces from cold relatively quickly. Air-to-Air Source Heat Pumps provide around 4.5 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of 4.5.

The Centre for Sustainable Energy model has been used to estimate heat load for the building.

In total, across the different rooms, a heat pump system of 21 kW would be required.

AASHPs require the installation of external units which look like air conditioning modules in well ventilated external locations. These external units will need an electricity supply and pipework running from them to the heating system. They will also need a drain nearby as the back of the units can build up moisture, which condenses and sometimes freezes on the coils. The larger units do create some low-level noise and therefore the location and baffling of the units may need to be considered carefully. For this hall, two or three of the small external units (left, below) would be required.

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



Internal units come in a variety of styles. Cassette units within the suspended ceiling or wall mounted units in the positions of existing radiators are possible for the hall.

FUA-A - Under ceiling cassette air conditioning unit

Unique under ceiling cassettes for high rooms with solid ceilings or false ceilings with a shallow void. Suitable for all types of commercial applications.

The FUA-A range provides comfortable heating and cooling even for rooms with high ceilings and has individual louvre control flexibility to suit every room layout.

FTXM-R - Wall mount air conditioning unit

Attractive, wall mounted design with perfect indoor air quality. 2 area motion detection sensor: air flow is sent to a zone other than where the person is located at that moment; if no people are detected, the unit will automatically switch over to the energy-efficient setting.

FVXM - Floor Mount Air Conditioning Unit

Designed to fit rooms of any size and shape, it blends well with the interior due to the new design which incorporates more flowing lines and softer edges. These units are ideal when it is not possible to fit a high level wall mount unit for aesthetic or practical reasons.

They are suitable for a wide range of applications including domestic, small to medium offices and commercial uses.

All these units do have a fan element within them and therefore a small amount of fan noise is emitted. This tends to be less than a fan convector heater on a boiler-based system and similar to the noise from a fridge or freezer. Air conditioning units are commonplace in hotel rooms, indicating that the noise is low enough even to be suitable for sleeping environments.

A case study of a church which has installed such a solution is available at 5. Air-source heat pumps at Hethel Church - All Saints Church, Hethel - A Church Near You

Similar systems have been installed in church halls.

8.3 Air to Air Source Heat Pumps Costs

Pumps to supply 21kW of heat (with capital cost estimated at £450 per kW output: £9,450) would deliver the same amount of heat annually, 35,000kWh, as the current system.

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

Operating at a Coefficient of Performance of 4.5, a 21kW heat output requires 4.7kW of electricity supply.

Annual electricity consumption = 35,000kWh/4.5 = 7,777kWh

At current costs of 21.4p/kWh, annual operating cost = £1,664

Present gas costs are 5.15p/kWh x 35,000kWh = £1,802 + VAT

Annual servicing costs for gas will also be avoided, thus lowering the payback period.

Note that gas costs may continue to rise against electricity costs; this will also favour heat pumps.

9. Energy Saving Recommendations – Office

The office is fitted with double glazing and insulation above the suspended ceiling. Fitted with electric heating, there is little which can be done to reduce its carbon footprint except for ensuring that a 100% renewable electricity supply is used.

For the beginning and end of the heating season, and for "top up" heating in midwinter, a heated cushion, or heated office chair is suggested.

10. Energy Saving Recommendations – Building Fabric

10.1 Draught Proof External Doors

The fire exit double doors to the main hall are deteriorating and will require replacement.

There is a hole (drilled) though one door which is a source of draught. The exterior planking is completely rotten at the bottom (i.e. it was found to be soft and wet) which suggests complete replacement rather than repair is required.

Replacement would be an opportunity to ensure this door is properly draught proofed

Most of the planks have split at the bottom; the third from right has thoroughly decayed.

10.2 Windows

Apart from one window, the hall has metal framed single glazed windows. Costs at £550/m2 for double glazing indicate an outlay around £9,000. This will cut heat requirement by 15%, but there is still a comparatively long payback period.

Reducing heat load will lower the size of heat pump plant required and hence the capital cost will reduce, as will operating costs. Therefore the church should budget for replacement of the hall windows in the medium term. In the short term, putty or filler is required to prevent frames beginning to fall out where putty has been lost.

The area at the end of the hall has been colonised by self seeded trees with roots very close to the bulding. This may cause problems with the foundations if the trees continue to proliferate.

11. Other Recommendations

11.1 Electric Vehicle Charging Points

The hall has a small car park. In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those using the hall, the church may wish to consider installing an electric vehicle charging point, probably on the side of the hall 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 Water Source Heat Pump	Possible
Ground Source Heat Pump	Yes, but expense greater, borehole required
Air to Air Source Heat Pump	Yes

12.1 Solar Photovoltaic Panels

The roof of the unlisted building offers a site for solar panels. The regular use profile of the building, with potential to install an electric heat pump, make installation worthwhile.

It is unclear if the barrel vault roof is strong enough to support panels; otherwise the flat areas would suffice.

The flat roof sections offer areas of around 100m^2. This could generate 0.15kWpeak/m^2 giving a 15kWpeak system.

A 1kWpeak system can generate up to 1000kWh annually.

Annual consumption is currently 5,500kWh. Heat pumps would add another 8,000kWh summing to 13,500kWh. Solar panels would provide free summer cooling. Grid electricity would still be required to supplementary heating in winter. Addition of a battery would be useful if the hall was used regularly in evenings, but not otherwise.

Annual Generation (kWh) = Area x 0.15kWp/m^2 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
Hall, flat	100	15	180 degrees / 35^0 1.0	1	15,000

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.

If no heat pumps are installed, the system should be sized appropriate for current electricity consumption -around $30m^2$ would suffice and this would supply much of the electricity needs.

The system should be specified for future addition of a battery, when battery costs reduce as this would extend system usefulness into the evening. However, due to the expense, this would only be worth installing if the hall has regular evening use.

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 average 2019 installation costs for simple systems (£1,300 per kWpeak); a 15 kWpeak system would cost £19,500.

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

All other works, including the like for like replacement of gas and oil boilers will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.