ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St George's Church, Ashtead
PCC of St George's Church

Author	Reviewer	Audit Date	Version
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Contents

1. Executive Summary

An energy survey of St George's Church, Ashtead 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.

St George's Church, Ashtead is an Edwardian era church dating from 1906. It is joined to a two storey building hosting a café and kitchen, hall, small meeting room and offices dates from 2001.

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						
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies. Use a Group Purchasing scheme	None	None	Nil	N/A	None	Offset 47.9 tonnes
Move fridge and freezer out of kitchen	1,750	£170	Nil	Immediate	None	0.37
Door draught proofing	1%, 1,450	£43	£50	1	List A	0.26
Optimise timer controls for water heaters	500	£48	Zero	Immediate	None	0.12
Insulate water heater output pipes	500	£48	£50	1	List A	0.12
Insert reflective radiator panels	2% 2,900	£87	£100	1.5	List A	0.52
Insulate boiler room valves and pumps	1% 1,450	£43	£100	2	List A	0.26
Clean and flush heating system	7% where not recently cleaned 10,000	£300	£300-500	1.5	List B	1.83
Install magnetic particle filter	Lower maintenance	Included above	£300		List B	
Fit presence detector controls to car park lighting	600	£58	200	4	List A	0.13
MEDIUM TERM						
Replace CFL lighting with LED	14,000	£1,350	£5,700	4.5	List B	2.95
Install solar photovoltaic panels	Up to 30,000	£2,900	£44,850 (max. size)	15.5	Faculty	6.3

LONG TERM						
Replace boiler with Ground Source Heat Pump	145,000 gas	£835	£200,000	239	Faculty	26
OR						
Replace boiler with Air Source Heat Pump	145,000 gas	£1,225	£80,000	65	Faculty	26

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

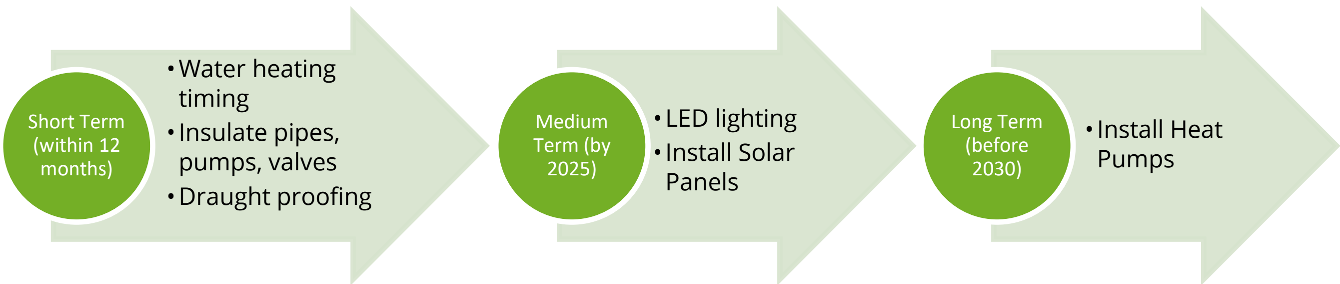
Based on current contracted prices of 9.696p/kWh and 3.00p/kWh for electricity and mains gas respectively.

If short and medium term measures were implemented this would save the church around £5,000 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 George's Church, Ashtead 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 George's Church, Ashtead, Barnett Wood Lane KT21 2DA 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 Liz Marlow and Simon Green, Facilities Manager.

St George's Church, Ashtead	CHURCH	HALL
Church Code	617171	
Gross Internal Floor Area	410m^2	575m^2
Volume	3,050m^3	2,650m^3
Heat requirement	100kW	50kW
Listed Status	Unlisted	Unlisted

The church is typically used for an average of 19 hours per week and the hall for 58 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	12 hours per week	220
Church Meetings and Groups	3 hours per week	
Community Use	40 hours per week	Daily café for 6 hours Evening hall hires
Office	40+ hours per week	
Occasional Offices	2 weddings 6 funerals	100 100

Annual Occupancy Hours: Church 1,000 Hall 3,000

4. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	9.696p/kWh
Standing Charge	unreported

Supplier: SSE

The current gas rates are:

Single / Blended Rate	3.00p/kWh
Standing Charge	136p/kWh (calculated)

Supplier: Ecotricity

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

VAT	5%	The correct VAT rate is being applied
CCL	not charged	The correct CCL rate is being applied.

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

5. Energy Usage Details

5.1 Annual Consumption

St George’s Church, Ashtead used 56,400 kWh/year of electricity in 2019, costing in the region of £6,000 per year, and 144,873 kWh/year of gas, costing approximately £5,100 at the rates listed earlier.

The total carbon emissions associated with this energy use are 47.9 CO_2e tonnes/year.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Church	K07W 528939	Elster A1140	Yes	Cafe electrical cupboard
Gas – Church	M040 K01664 09 D6	Elster Bk-G25	Yes	External cabinet, NE of site outside cafe

All the meters are AMR connected and as such an annual energy use profile for the site could be obtained from the supplier.

5.2 Energy Profiling

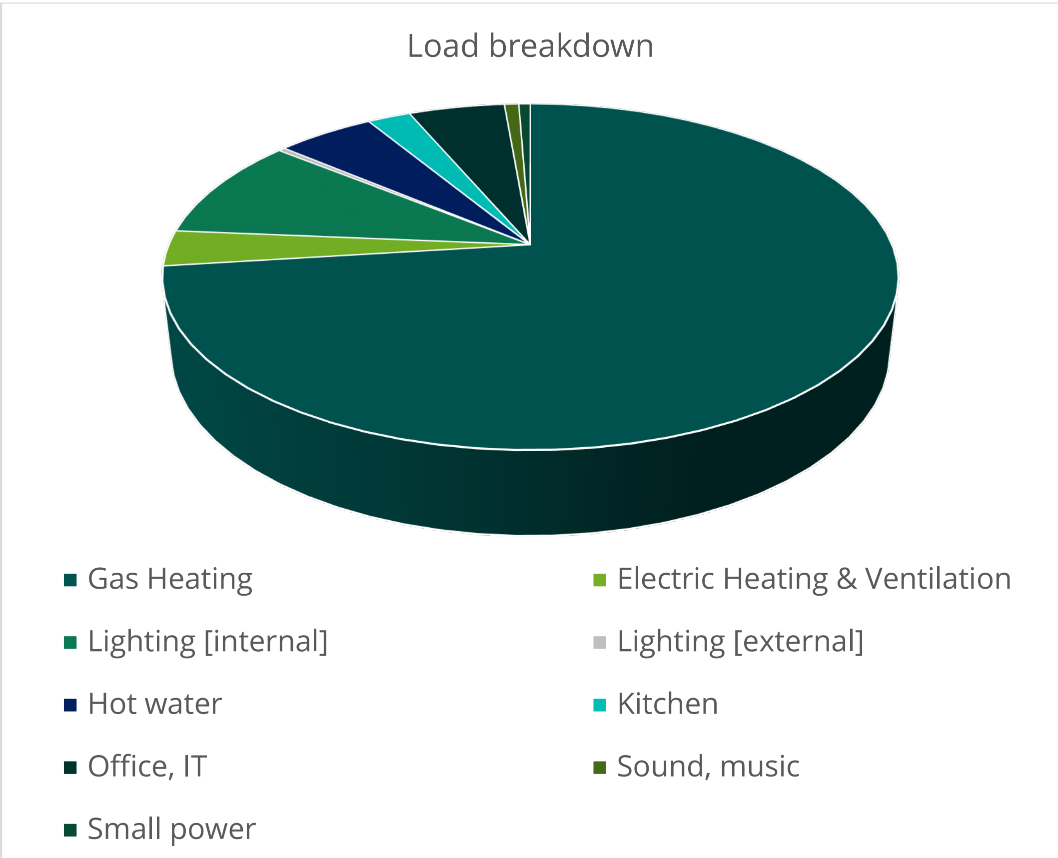
The main energy consuming plant can be estimated as follows:

	Equipment	Power kW	Annual Consumption kWh	Portion
Heating [Gas]	Whole Site MHG Pro Con H7 225 HE gas boiler, installed c. 2014 670 hours operation if at full power	216	145,000	72%
Heating & Ventilation [Electric]	Boiler circulation pumps [1 large, 4 medium] 670 hours Kitchen extraction fan, run constantly to prevent fridge and freezer overheating Server Air Conditioning	1.3 0.2 1	850 1,750 4,000 TOTAL 6,600	3.3%
Lighting [Internal]	CHURCH 1,000 hours use 28 LED lights HALL 3,000 hours use *Mixture of CFL lamps (~50), fluorescent tubes (46), halogen lamps, Various spotlights (45)*	280W *6,200W*	280 *18,600* TOTAL 18,880	9.4%
Lighting [External]	Bulkhead security lights for car park, remain on at present	0.15	700	0.3%
Hot Water	5 fixed water heater tanks, 10-15 litres each 3 instantaneous water heaters *Kettle* *Coffee machines* Drinks total calculated (14,412 cups, 460kg CO_2 output) Commercial dishwasher, used 4 hours daily	15 9 5	2,000 2,000 2,200 5,000 TOTAL 10,200	5.0%
Kitchen	Microwave Sandwich maker, toaster Electric cooker, high use Full height fridge (on constantly) Full height freezer (on constantly)	2 2, 2 3 0.25 0.25	1,000 1.000 1,000 730 730 TOTAL 4,500	2.2%
Office & IT	4 offices, Multiple staff, 15 workstations	3	6,000	

	40 hours per week Server	 0.5	 4,000 TOTAL 10,000	 4.9%
Sound, Music	Sound systems (church, hall) Organ	1 1	1,000 500	 0.7%
Small Power	Vacuum cleaner Lift	1.5 2	200 1,000	 0.6%

Sum of estimates: 53,580kWh

Annual site electricity consumption, 2020: 56,400kWh



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 ventilation, lighting, hot water and IT.

5.3 Energy Benchmarking

In comparison to national benchmarks for church energy use[1] St George's Church, Ashtead uses over double the amount of electricity and 6% less heating energy than is average for a church of this size.

High hours of the use of the hall will be the major contributing factor. Significant savings are thus possible from completing a change to LED lighting with further efficiencies from hot water provision and ventilation possible.

	Site area (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St George's Church, Ashtead (elec)	985	56,400	57.2	27	+211%
St George's Church, Ashtead (gas)	985	145,000	147	156	-6%
TOTAL	985	201,400	204	183	+12%

There is currently no benchmark data available which takes hours of use and footfall into account.

[1] CofE Shrinking the Footprint – Energy Audit 2013.

6. Efficient / Low Carbon Heating Strategy

6.1 Site Overview

St George's Church consists of a brick built Edwardian church with a heavy use on Sundays, and light use for the rest of the week. The north transept now forms an entrance foyer into the café of the adjoining 2001 building which also hosts a large bookable hall, meeting room, kitchen and offices capable of accommodating up to 15 staff for the site and St Giles' church. The site overall is in heavy daily use. The church is seated by moveable chairs and is fairly wide, precluding under pew and radiant panel heating methods. It is heated by several long double wall pressed steel radiators, so may be suitable for supply by an Air or Ground Source Heat Pump.

The modern (2001) complex is similarly suited to heat pump technology given its use pattern throughout each day. A water based (ASHP or GSHP) method is likely to have lower installation cost than an air to air system (plumbing for refrigerant pipes plus new emitters in each room).

GSHP should be considered first, due to its lower operating cost. Should capital cost or technical issues preclude this, ASHP (air to water) would involve less installation disruption than AASHP (air to air). AASHP would incur more organisational fitting challenges, but with the rewards of lower operating costs than air to water. The church is recommended to develop a long term boiler replacement plan and seek local installers. Note that the capital costs of these technologies are expected to fall over the next decade as they become more widespread. The relative costs of electricity vs gas are too unpredictable to forecast.

6.2 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.

6.3 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	3,050	0.033	100
Centre	2,650	0.02	53

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

Area	Estimated split kWh	Power output kW	Annual use hours
Church	45,000	53	1,000
Centre	100,000	100	3,000

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 Insulation of Pipework and Fittings

The pipework within the boiler room has the majority of its straight lengths insulated but the more complex shaped pipework fittings, such as valves, have been left uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the plant room unnecessarily warm. The exposed hot surfaces also represent a health and safety risk of burns for those working in the area.

It is recommended that these areas of expose pipework and fittings are insulated with bespoke made flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

7.2 Clean the Existing Heating System

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

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

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

7.3 Magnetic Particle Filter

No filter was observed in the boiler room. These devices act to catch any magnetic sludge which is circulating and protect the boiler and system. They should be cleaned annually when the boiler is inspected and serviced.

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 loose much of their heat into the masonry of the wall behind the radiator rather than give out the heat 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 such as www.heatkeeper.co.uk. 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.

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).

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 55ºC (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. 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).

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

Ground Source Heat Pumps [GSHP] supplying water at around 50ºC are more efficient than their Air Source equivalent [ASHP] (since the average ground temperature is higher than the average air temperature), but require either a borehole, or extensive trench digging.. 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 [AASHP] 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, or life expired / poorly sited units and spaces heated intermittently.

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.

8.2 Ground Source Heat Pumps

Ground Source Heat Pumps typically provide 4kW of heat for each 1kW of electricity consumed and are thus around 40% more efficient than an air to water system. They require sufficient land on which a borehole drilling rig can be accommodated.

Capital costs are higher than for air source heat pumps, estimated at £1,000 per kW output, due to the costs of boreholes. The potential for leakage from buried pipework should be considered.

The building heat loss is 200kW; costs in the region of £200,000 are expected.

The current boiler is 206kW output. A lower heat pump power output could be used, with longer operating hours (provided that the ground loops can provide sufficient heat).

8.3 Air to Water Source Heat Pumps

Air-to-Water Source Heat Pumps (AWSHPs) work by having an external unit which sucks air in and extracts the heat from it. It concentrates this heat and puts it directly into water that can then flow through the heating system. They work most efficiently when trying to produce water temperatures in the heating system between 40°C and 50°C. They tend to warm up slowly and steadily and are therefore well suited to situations where the heating is required for long periods of the day, and with heating systems that have a low temperature requirement such as underfloor heating systems. As they warm up spaces slowly, it is important that the warmth being slowly emitted is retained within the building so that the overall heat levels build up. This requires good levels of insulation and air tightness to ensure that the heat loss is lower than the heat being emitted. AWSHPs provide around 3 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of 3.

AWSHPs 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.

A potential location for the external plant would be to create a widened recessed area adjacent to the existing boiler room steps area, taking in the current vault containing the gas meter. Further visual screening could be accomplished by hedge planting.

A capital cost of £80,000 would be expected for a 200kW output system.

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

A case study of a church which has installed this solution is available at Heat pumps and fabric improvements make a rural church warm and well used : St Anne in Ings | The Church of England

8.4 Air to Air Source Heat Pumps

A further alternative can be considered if the church radiators are deemed to be insufficient to work with the warm water of an ASHP or GSHP.

instead of circulating warm water from a heat pump, refrigerant is used.

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.

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.

A capital cost of £90,000 should be expected for a 200kW output unit.

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 Kitchen ventilation

It was reported that a ventilation system is kept running constantly in the kitchen because the fridges and freezers would otherwise overheat. Refrigeration units work by transferring low grade heat from a coiled pipe at the rear which is at around 25 to 30 degrees normally. The warmer the room is, the less efficiently this can lose heat (and the harder the system has to work, because the fluid always has to be heated to hotter than the room to transfer the heat out).

It is recommended that the freezer and large (storage) fridge are removed from the kitchen to a cooler area elsewhere. This would mean the devices would not have to work as hard, saving money (refrigeration systems are working for about 1/3 of the time) and also save money from ventilation. Ideally, the ventilation system should be controlled by a presence detector. It should not be operated overnight.

A small fridge would be kept in the kitchen.

9.2 Fixed Water Heater: Timer Control

Five fixed water heaters have been installed to replace one central 300 litre tank. This substitution will reduce losses from long hot pipework runs. Further savings may be possible.

Whilst the tanks themselves are well insulated, the copper pipework is (usually) not and is a constant source of heat loss of around 100W (incandescent light bulb) and will waste around 900kWh per year, costing £140. Pipe insulation should be installed. This will also speed up the arrival of hot water at the tap.

It is recommended that where units are used regularly, they are 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 each water heater is in use. This will prevent the standing losses from the unit wasting energy during periods when that section of 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 hall 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.

9.3 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 relatively inefficient fittings.

The highest power lamps should be prioritised for replacement first; any halogen lamps such as the GU10 spotlights (recessed lighting; potentially four in the café and also in the large office). There are a large number of fluorescent tubes (16 of 58W, 30 of about 36W) which could be replaced en masse by LED strip lighting (complete fitting replacement). The type of spotlights fitted in the main hall are uncertain; if these are halogen lamps they should be replaced by LED units. The Compact Fluorescent Lamps (CFLs) can be replaced by LED lamps of about 1/3 the power – these could be bought in bulk to reduce costs and then fitted gradually as necessary.

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/

Replacement of strip lights is expected to require electrical contractors.

There are some fittings such as many of the CFL lights (e.g. in offices and corridors) where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

9.4 Install PIR motion and daylight sensors on selected lighting circuits

There are several lights in the church centre areas such as corridors, toilet areas and the like which are likely to remain on all the time when the building is in use. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors (commonly called PIRs) also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

9.5 External Lighting Controls

The external lights facing the car park are reported as being on constantly during the evening (and perhaps overnight). Passive infra-red detectors should be fitted to control these lights, so that they are only lit when people are present. These controllers are light sensitive, so the lights are not activated during daylight.

For efficient operation and to reduce light pollution and nuisance to neighbours it is generally recommended that external lighting is turned off between 11pm and 6am unless required for specific purposes.

9.6 Power Management Settings on Computers

There are several computers within the church centre's offices.

All computers can be shut down or put into a hibernate mode but this is often not done by users during the day and tends to be limited to an end of day shut down only. This tends to be due to the multi-function process that is required to do this. It is therefore recommended that all computer workstations set to go into hibernate mode after a short period of time of not being used.

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

10. Energy Saving Recommendations – Building Fabric

10.1 Draught Proof External Doors

The modern doors to the main foyer have large gaps around them. This could be addressed in various ways using polymer or rubber sealing methods appropriate to the size of the gaps.

11. Saving Recommendations (Water)

11.1 Tap Flow Regulators

The building is in heavy use throughout the week. Over provision of water for hand washing is not only a source of excessive water use, but in the case of hot water, it is also a source of wasted energy in the heating that has to go into providing the hot water.

The flow rate of the taps can be easily regulated by fitting flow regulators within the taps. It is recommended that flow regulators such as those manufactured by neoperl (http://www.neoperl.net/en/) are fitted into all the viable hand wash basin taps to save on both water and heating of the hot water. These regulators can be self-installed or by any good facilities staff.

12. Other Recommendations

12.1 Electric Vehicle Charging Points

The church has a car park on the south side of the site which serves the church and also the frequently used church hall. 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, probably on the side of the church 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.

13. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

Renewable Energy Type	Viable
Solar PV	Yes
Battery Storage	Yes
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – air quality issues
Air Source Heat Pump	Possible
Ground Source Heat Pump	Possible
Air to Air Source Heat Pump	Possible

13.1 Solar Photovoltaic Panels

The church and church centre are unlisted buildings. The south side of the church faces away from the main road and towards a car park, thus this side of the building has good potential for the installation of solar panels.

The view is taken from the South East. Areas of roof which are visible or facing left are suitable.

Assuming that the maximum amount of roof space on the south facing aspects 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 / slope	Shading factor	Annual Generation, kWh
Church nave	90	13.5	140 degrees / 60º 0.87	1	11,745
Aisle	60	9	140 degrees / 20º 0.93	0.9	7,530
Centre SE facing	20	3	140 degrees / 45º 0.93	0.9	2,510
Centre SW facing (3 sections)	60	9	230 degrees / 45º 0.93	1	8,370
Total	230	34.5			30,155

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 less than the church centre's annual recent electricity use (56,400kWh in 2019). The average load (56,400kWh / 3000 hours) is about 18kW. Without a battery, a solar PV system cannot contribute to evening and night use; this would be a useful addition. A maximum sized system would be able to contribute to running heat pumps.

- No battery installed – 18kW output system to match average consumption.
- Install battery, or sized for heat pumps – maximum sized system.

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 average 2019 installation costs (£1,300 per kWpeak); a 28.5 kWpeak system would cost £44,850.

14. 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 .

15. 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.