ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St John's, Fishponds
PCC of St John's

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St John's was undertaken by ESOS Energy 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. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St John's was concentrated in 1911 and was constructed of stone with a tiled roof. The church is heated from a gas boiler to radiators and pipes in the main church. The lighting is a mix of LED lamps in the nave, and fluorescent lamps elsewhere in the church. There is both gas and electricity supplied to the site.

The church has a number of ways in which it can be more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table and the route to net zero carbon are 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)
Discontinue background heating	61,163	£2,481	£-	0.00	List A (None	11.29
Change existing lighting for low energy lamps/fittings	574	£98	£307	3.14	Faculty	0.15
Fit timed fused spurs to hot water heaters	324	£55	£180	3.26	List A (None)	0.08
Insulate exposed pipework and fittings in plantrooms	3,058	£124	£500	4.03	List A (None)	0.56
Tune the boiler to more efficient combustions settings	3,058	£124	£500	4.03	List A (None)	0.56
Add draught strips to external doors	1,223	£50	£300	6.05	List A (None)	0.23
Add secondary glazing to windows	6,116	£248	£1,800	7.26	Faculty	1.13
Replace heating system for electrical based heating solution	21,365	£464	£3,378	7.28	Faculty	3.73
Install a Solar PV array to roof of	2,676	£456	£4,317	9.47	Faculty	0.68

building (assumed 100% of energy generated used in building)						
Fit 270mm of insulation into the roof space	6,116	£248	£3,400	13.71	Faculty	1.13
Install PIR motion sensors on selected lighting circuits	13	£2	£95	42.07	List B	0.00
Consider install Electric Vehicle Charging Points	0	N/A	£2,500	0.00	Faculty	-

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

Based on current market prices of 17.035p/kWh and 4.05p/kWh for electricity and mains gas respectively.

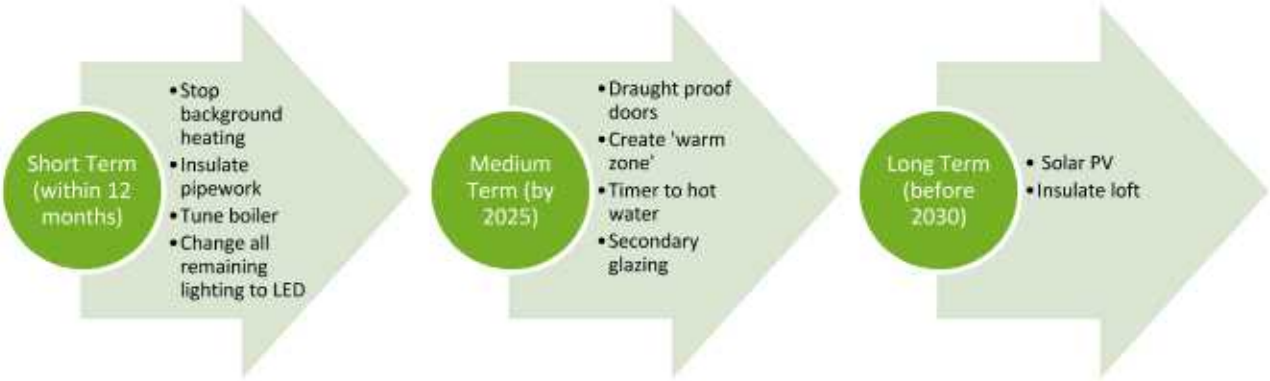
If all measures were implemented this would save the church £4,373 per year and reduce its carbon footprint by 19.57 tonnes (83%).

2. The Route to Net Zero Carbon

Our Government has committed to move towards Net Zero Carbon – the point at which we have reduced emissions as much as we can and then balanced any residual emissions through removal of carbon from the atmosphere. They have done this as part of a worldwide agreement which aims to limit global warming to well under 2 degrees Celsius, with an aim of keeping it below 1.5 degrees Celsius. This will help protect all of us from the impacts of climate change.

In February 2020, the Church of England's General Synod set its own Net Zero Carbon target. The first stage of this target covers energy used by churches, cathedrals, schools, vicarages, other church buildings, as well as emissions caused by reimbursed transport. The target date is 2030.

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 St John's to give them advice and guidance as to how the church can be improved to be more energy efficient. In doing so the church will also become more cost effective to run and seek to improve the levels of comfort. Where future church development and reordering plans are known, the recommendations in this report have been aligned with them.

An energy survey of the St John's, Lodge Causeway, Fishponds, Bristol, BS16 3QG was completed on the 30th March 2021 by Marisa Maitland. Marisa is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment and a CIBSE Low Carbon Energy Assessor

St John's	
Church Code	605089
Gross Internal Floor Area	400 m^2
Listed Status	Unlisted

The church typically used for 11.5 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	4 hours per week	
Meetings and Church Groups	1.5 hours per week	
Community Use	6 hour per week	

There is additional usage over and above these times for festivals, weddings, funerals and the like

4. Energy Usage Details

St John's uses 4,288 kWh/year of electricity, costing in the region of £720per year, and 122,327 kWh/year of gas, costing £4,961. The total carbon emissions associated with this energy use are 23.6 CO_2e tonnes/year.

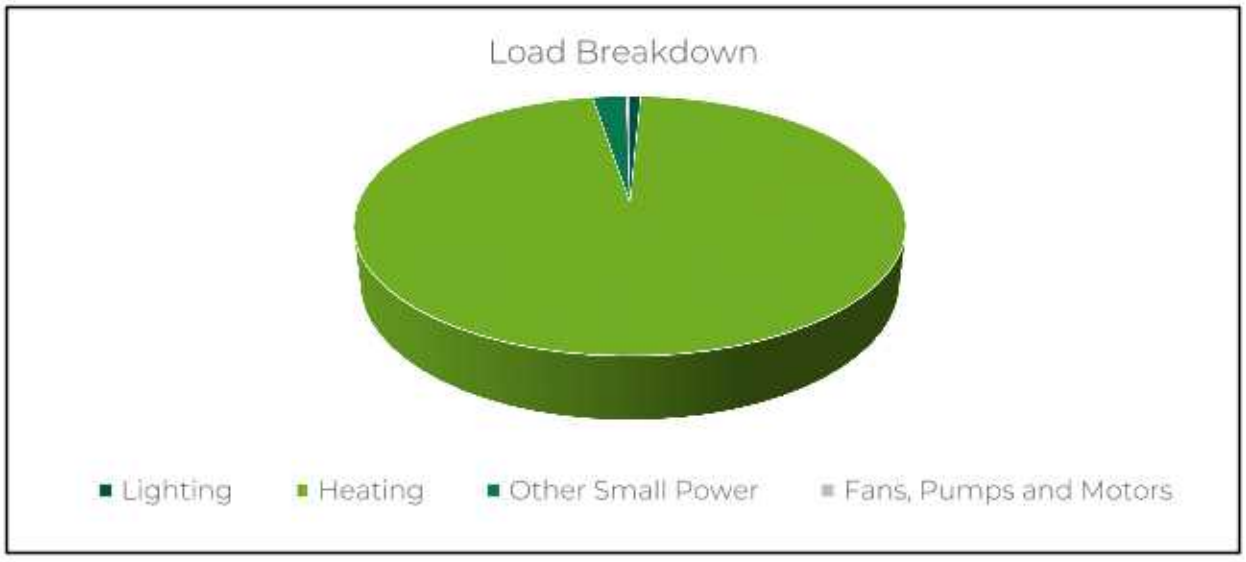
This data has been taken from the annual energy summary provided by the church.

The meters were not accessible during the audit, and it is recommended that the church check if the meters are smart meters and if not consider asking their suppliers to install smart meters so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.

4.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Mix of LED and fluorescent lamps	1%
Heating	Gas boiler to perimeter radiators	97%
Other Small Power	Hot water boiler, electric piano and other audio equipment	2%
Fans, Pumps and Motors	Heating pump	0.2%



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

4.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St John's uses 47% less electricity and 104% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St John's (elec)	400	4,228	10.57	20.00	-47%
St John's (gas)	400	122,327	305.82	150.00	104%
TOTAL	400	126,555	316.39	170.00	86%

5. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Putting in place a heating strategy that is energy efficient and low carbon is, therefore, of the highest priority

The Church of England is in the process of reviewing its heating guidelines. The process has already established some principles for heating that can help churches as they seek an acceptable combination of comfort, conservation, affordability, and environmental care. The principles can be found at https://www.churchofengland.org/sites/default/files/2020-04/CBC%20Heating%20guidance%20principles%20FINAL%20issued.pdf

As the principles make clear, every church's strategy will be unique to it, informed by many factors, including the nature of its usage, the system it's starting from, the conservation needs of the building, and the resources available. The strategies in this audit are designed specifically for your church.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches we make recommendations that will help to reduce energy wastage and, as a starting point, to optimise the system that you already have

Secondly, we recommend options for many churches that focus on heating people rather than the full volume of the church. Some of the changes that can help with this will be 'soft' changes – others will relate to the heating system itself.

Finally, we make recommendations about moving away from fossil fuels. Moves away from fossil fuels are key to cutting emissions. For most churches, this will involve moving from gas, oil or LPG to electricity. Electricity currently creates carbon emissions around the same level as mains gas, but the carbon emissions associated with it are reducing rapidly as the UK builds more renewable energy and decommissions its remaining oil and 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'. Some local areas may also be considering the option of district heating networks.

While moving away from fossil fuels may not always be possible, as the principles state, "churches should be expected to have at least carefully considered the option of moving away from fossil-fuel based heating (gas and oil boilers) towards electric-based heating." And if such options are not viable now, the churches "can try to be ready for a future retro-fit when technology and the grid has progressed."

The heating system currently in place at St John's is the use of a gas boiler to run hot water to the radiators and also electric plug-in heaters in the office. The heating is currently set to be at a minimum of 16^{0}C at all times, which means during the winter months the heating must be running all of the time. The reason for this was unclear, either just to keep the building warm, or a mis-understanding of the heating programmer. In the first instance, however this should revised, as detailed below. Whilst the main heating is suitable when the whole of the church is being used for services, there are also regular times during the week that the church is used for small group sessions, where heating is only required in one area not the whole of the church. Therefore the church should consider the creation of a 'warm zone', which would be one area of the church that can be heated independently of the rest of the church via electric heating to allow for only the space that is being used to be heated, rather than the whole building. This is further detailed below.

The current boiler was only installed in 2015, so it has 10-15 years life expectancy, and in that time the church can consider alternative heating options. One route could be an air source heat pump, using the existing heat distribution system however this is usually best suited to high use buildings. The current use of the church is low, so unless the use of the church is planned to be increased then this might not be the most suitable option. Another alternative solution would be to move to electric heating throughout. The church has the time to be able to plan for this properly and consider what would be most suitable for the building in the future.

5.1 Install Electric Panel Heaters

As detailed above, it is recommended that the PCC consider creating a warm zone in the church for use by smaller groups using the church for meetings. This would be a benefit as instead of needing to heat the whole church, which is costly and wasteful, only the area where the meeting would take place could be heated.

The most suitable way of heating the warm zone would be with the use of infrared panels. These heaters have a strong radiative effect (where heat is reflected to people from the surface) as well as a light convective effect (where air is warmed and moves around to heat the general space). For this reason, these heaters tend to provide a relatively instant sense of heat and comfort within the space and only need to be on for short periods of time. This reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It also means that the building can rapidly and economically be brought into used for short or unplanned meetings if needed.

The most suitable location in the church for a warm zone heated this way would be at the back of the church in the arch area, where this had been set up but is not currently in use due to the COVID-19 social distancing arrangements. Here the heaters could be attached on the walls within the arch to allow for the space in the middle to be heated. If the space just in front of the arch would also be desired to be heated then there could be options for installing additional panels to heat that area in places such as in the corners similar to the speakers on a shelf, or possible on the columns with straps around to keep the heaters in place. These two areas could also be zoned separately to allow for full flexibility of the space depending on size of the group.

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

6. 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:

6.1 Improve Heating Control Settings

The church's heating is controlled by a Honeywell controller located to the right of the alter.

The timings and settings on this were reviewed as part of the audit. Based on this review, there are opportunities to adjust these controls to provide more efficient energy usage of the building and a more comfortable environment for the congregation.

It is important to remember that most historic buildings survive very well without being heated and that in a number of cases the later addition of heating has actually cause fabric issues (such as the drying out of timbers, drawing damp through walls into a warmer and drier environment, or causing issues beneath metal roof covings where warmer moist air becomes trapped). In most cases the fabric of a historic building would prefer not to be heated.

The current setting for the heating at St John's is as detailed in the table below. At no time does the church drop below 16^{0}C, and on some days it at 18.5^{0}C all day. This would account for the very high gas use at the church.

Day	Time Period 1	Temp set point ^{0}C	Time Period 2	Temp set point ^{0}C	Time Period 3	Temp set point ^{0}C
Monday	07:00 - 23:50	17.0	23:30 – 23:50	16.5	23:50 – 07:00	16.5
Tuesday	07:00 – 18:00	18.5	18:00 – 23:50	16.0	23:50 – 07:00	16.0
Wednesday	07:00 – 23:50	16.5	23:50 – 07:00	16.5	-	-
Thursday	07:00 – 13:00	20.0	13:00 – 23:50	16.0	23:50 – 07:00	17.0
Friday	07:00 – 20:00	18.5	20:00 – 23:50	16.0	23:50 – 07:00	17.0
Saturday	07:00 – 13:00	16.0	13:00 – 23.50	17.0	23:50 – 07:00	18.5
Sunday	07:00 - 23:50	18.5	23:50 – 07:00	16.0	-	-

The set points and timing should be changed immediately to avoid any further excessive gas use at the church. The church only needs to be at 18^{0}C when occupied and not at any other time. The periods when unoccupied should be set to a maximum of 12^{0}C. It would be worth checking the Honeywell controller set up instructions if it has an optimised start/stop function. (This is where you can programmer the controller with the time you would like the space at the set temperature, and it will automatically bring the heating on the correct period of time before that to warm up to the temperature for that time). If this is not present the PCC will need to establish what a reasonable warm up time is for the church to heat up (this is likely to be between 4-6 hours). Also most heating systems can be turned off 30-45 minutes or so before the end of the service or meeting, and there is sufficient heat left in the radiators and pipework to maintain warmth.

The adjustment of the heating system should be above to be carried out by any member of the church who is competent in using the controls. It is recommended that the heating settings are recorded and a copy posted next to the control system, together with the name and phone number of a person to contact if there is a problem.

6.2 Tune Boiler Settings

The existing boilers within the church are serviced at least annually, at which point the flue gas is analysed and the results from this are displayed on the front of the boiler. The main purpose of this analysis is to make sure that the boiler is combusting the gas properly and not releasing too many toxic gases into the atmosphere. The flue gas analysis also provides an indication as to the efficiency of the boilers.

It was noted from the results of this flue gas analysis that while the flue gases are within the permitted limits there is more scope to adjust the burner to increase the efficiency of combustion. It is therefore recommended that the boiler engineer is requested to maximise the burner efficiencies during their next service visit.

7. Energy Saving Recommendations

In addition to having a revise heating strategy there are also a number of other measures that can be taken to reduce the amount of energy used within the church.

7.1 New LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church. There are some areas of the building which have had efficient LED lights installed but there still remains a large number of inefficient fluorescent fittings.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. 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/

If all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £307. The annual cost saving would be £98 resulting in a payback of around 3 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider. Guidance on lighting, produced by Historic England for churches, can be found at https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/

There are some fittings such as the pendant fittings 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.

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the office, vestry, toilet areas and the like. Some of these areas are only used occasionally and for a short amount of time so that, in actuality, 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, such that artificial lighting is not required for much use during the year.

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.

7.3 Insulation of Pipework and Fittings

The pipework within the boiler room has the majority of its straight lengths uninsulated. These exposed areas of pipework contribute significantly to 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 exposed pipework and fittings are insulated with bespoke flexible insulation jackets.

A free survey and quotation for the supply and installation of insulation of pipework fittings can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

7.4 Timers on Fuse Spurs to Water Heaters

There are a number of electric point of use water heaters in the church to provide hot water for hand washing. This only needs to heat the water to the required temperature when the building is in occupation but at the moment this heater is directly wired in without any form of time control and therefore maintains it set temperature 24/7.

It is recommended that the heaters 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 the building is occupied . This will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

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

7.5 Draught Proof External Doors

There are a number of external doors in the church. The timber door in the vestry corridor does not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of this door.

It is recommended that the draughtproofing around the door is improved and draught strips are added.

For timber doors that close onto a stone surround more traditional solutions such as brush draught strips rebated into the edge of the door by a skilled joiner. Other traditional methods such as using hessian or felt pads tacked to the door could be used. Keeping the door maintained in a good condition is also important.

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

7.6 Secondary Glazing

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

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.

Secondary glazing to the clerestory windows would not make any discernible difference to the heat loss and it is unlikely it would be allowed.

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

7.7 Insulation to Roof

The loft void above the ceiling was reported to have little or no insulation present. In cases where there is 100mm or less of insulation within accessible roof spaces it is recommended that insulation be added to prevent heat loss and create a more comfortable environment for the occupants of the building.

Because heat rises, the ceiling/roof of a building is the largest contributing area to heat loss from a building. The insulation of such spaces can therefore have an impact on both the efficiency of the heating system and the temperature of the space below. In churches this is limited, but if the roof is to be repaired or replaced then this would be a suitable time to do this.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

8. Other Recommendations

8.1 Electric Vehicle Charging Points

The church has a car park to the rear which serves the church. In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those visiting the church, 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 cars.

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.

Because of the parish office within the building, the church can be considered as a place of work and, as such, installation grants are available through the workplace charging scheme https://www.gov.uk/government/publications/workplace-charging-scheme-guidance-for-applicants-installers-and-manufacturers which will fund 75% of the installation cost up to £500.

9. Renewable Energy Potential

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

Renewable Energy Type	Viable
Solar PV	Yes – albeit low demand
Wind	No – no suitable land away from buildings
Battery Storage	No – no viable PV
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	Possible – when current boiler reaches end of life

Ground Source Heat Pump	No – archaeology in ground and radiator system

9.1 Photovoltaics (PV)

There is potential for a small PV array on the roof of the South Aisle to generate on-site electricity. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. The church's energy consumption is already small and the consumption during the daytime when the sun is shining is likely to be low, While technically viable, therefore, only a very small number of panels would be worth considering if at all.

Battery Storage is not strictly a renewable energy solution, but battery storage does however provide a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

Fully detailed PV design and calculations and quotation can be obtained from Batchelor Electrical, contact Stuart Patience on 01202 266212; 07793 256684; stuart@batchelor-electrical.co.uk.

10. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2019.pdf .

11. 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.

12. Offsetting

As you take action to reduce your emissions, you may also wish to offset those that you cannot yet reduce. If you would like to engage in offsetting, it is important to use a reputable scheme. The Church of England recommends Climate Stewards, which has a simple calculator that can help you to work out how much you would need to offset. https://www.climatestewards.org/

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Boiler room	2	LED GLS	£12	£24	1.93
Porch	1	LED GLS	£2	£12	5.66
Organ	1	LED GLS	£6	£12	1.93
Office	1	4ft Single LED	£12	£72	5.76
Wc	1	LED GLS	£6	£12	1.93
Corridor	1	LED GLS	£2	£12	5.66
Vestry	1	5ft Single LED	£10	£88	8.98
Kitchen	1	LED GLS	£2	£12	5.66