ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St. James' by the Park
PCC of Winchester

St James' by the Park

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St. James' by the Park 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. James' by the Park is a very early Victorian era church, first consecrated on 20 August 1836. It was constructed with a square type tower on the west side of the main church building. Solid brick walls make up the exterior of the church and pitched roofs. Internally there is the main nave and chancel, with both north and south aisles adjoining. There is a balcony that runs over the aisles. Just inside the entrance to the church is the narthex, with a kitchen, toilet, and creche to either side. The interior of the building was renovated in 1994; the pews were removed, and the floor levelled and carpeted. 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 and a clear path towards net zero carbon. 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 diagram below are used as the action plan for the church in implementing these recommendations over the coming years.

Energy and decarbonisation recommendations	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None	Offset 1.38
Improve pipework lagging and insulation on existing boiler	665	£200	£569	2.9	List A	0.12
Change existing lighting for low energy lamps/fittings	1,239	£372	£2,235	6.0	List B	0.24
Timers on Fuse Spurs to Water Heaters	28	£9	£350	41.0	List A	0.01
Replace heating system for electrical based heating solution (AASHPs)	38,124	£840	£341,558	406.4	Faculty	6.96
Consider registering for Eco Church	The Eco Church programme, which is recommended by the Church of England, helps congregations care for the environment in all aspects of church life. The programme is free; you can, however, make a donation to A Rocha UK towards its costs.					

Create a procurement policy for appliances (and other goods)	Commit to buying only appliances with the new energy efficiency ratings of A, B or C at the lowest when those you currently have reach the end of their useful life. (NB ovens, air conditioners and space or water heaters are still on the older rating scale, so for these, try for A+++.)

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

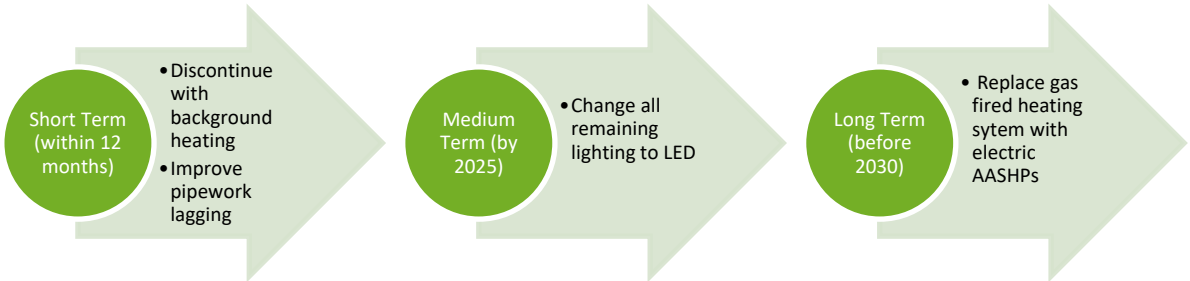
Figures in the table are based on current contracted/market prices of 30p/kWh and 10p/kWh for electricity and mains gas respectively. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.21107 for electricity, 0.18 for gas and 0.27 for oil. Do note that as energy prices increase, payback periods decrease.

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. James' by the Park to give them advice and guidance as to how the church can be improved to be more energy efficient. In doing so the church will also become more cost effective to run 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. James' by the Park, 133 Church Street, Southampton SO15 5LW, was completed on the 25th January 2023 by Nathan. Nathan is an experienced energy auditor with over 4 years' experience in sustainability and energy matters in the built environment.

St. James' by the Park	
Church Code	641315
Gross Internal Floor Area	613 m^2
Listed Status	Grade II
Average Congregation Size	150

The church typically used for 20 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**
Services	4 hours per week
Meetings and Church Groups	11 hours per week
Community Use	5 hour per week

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

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St. James' by the Park.

The current electricity rates are:

Single / Blended Rate	15.2870p/kWh
Standing Charge	65.2265p/day

The current gas rates are:

Single / Blended Rate	2.0030p/kWh
Standing Charge	239p/day

The electricity is supplied by Total Gas and Power and is not purchased on a renewable tariff. Going onto a renewable tariff is an important part of the process of taking churches towards net zero. The church is therefore encouraged to consider procuring its electricity from suppliers that offer 100% renewable electricity, and in some cases 'green' or 'carbon neutral' gas.

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

St. James' by the Park uses 7,149 kWh/year of electricity, costing in the region of £2,145 per year, and 58,871 kWh/year of gas, costing £7,064. The total carbon emissions associated with this energy use are 12.13 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St. James' by the Park has one main electricity meter, serial number E17UP22065. There is one gas meter serving the site, serial number K0168515D6.

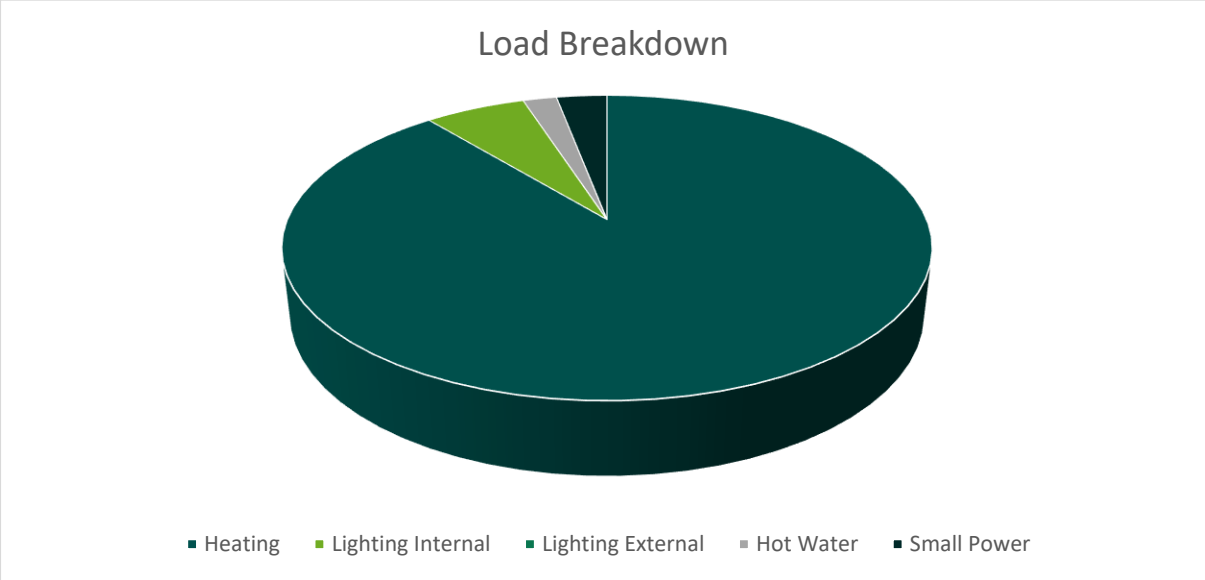
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E17UP22065	EDMI Altas Mk10D 3 phase 100A	N but capable	GF elec switch room
Gas – Church	K0168515D6		N	GF meter cupboard

It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	**Main Church** >30 mixed LED and halogen spotlights in suspended ceiling above nave <10 halogen uplighters in aisles Other areas mostly halogen	6%
Heating	**Main Church** 1x Ferroli GN2 N 06 gas fired boiler 116kW input	89%
Hot Water	**Main Church** 1x Ariston 15L under-sink hot water heater supplying kitchen sink 1x Heatrae Sadia 170 7.5L hot water heating for tea and coffee making 1x Kingspan Ultra flow 20L hot water heater serving handwashing sink in the toilet	2%
Other Small Power	AV equipment, approx. 4 mounted TV screens, other IT equipment	3%



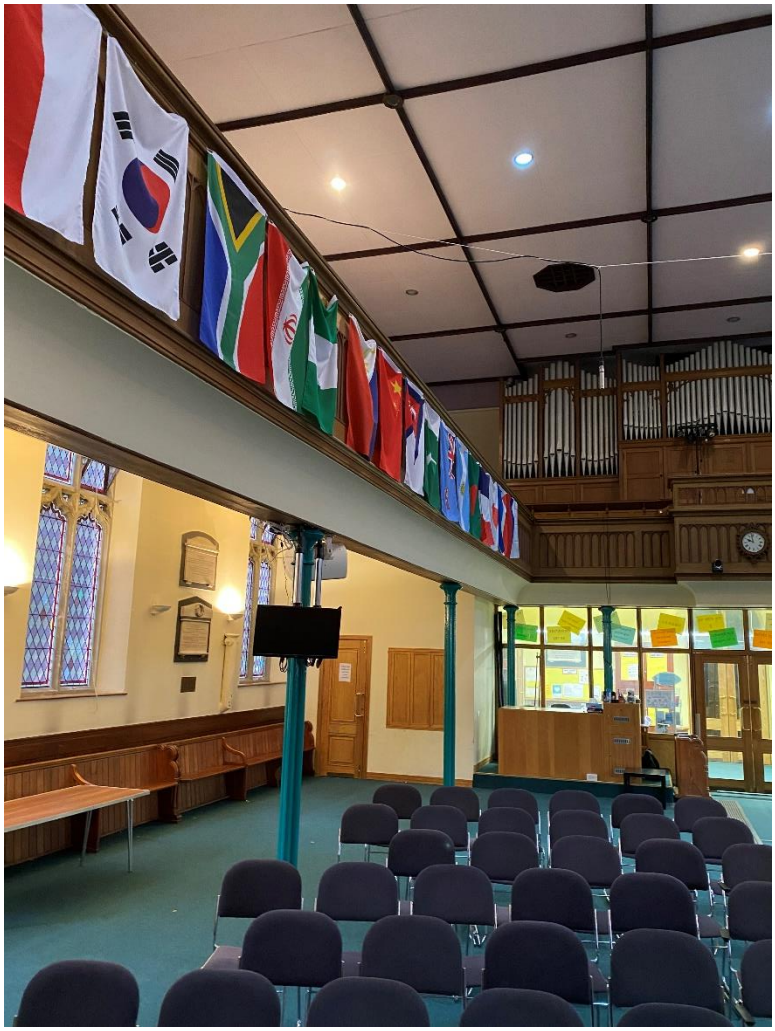
As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is lighting.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St. James' by the Park uses 42% less electricity and 36% less heating energy than would be expected for a church of this size. It should be noted that the national benchmarks do not make any specific adjustment for the amount of time the church is used, and the usage of this church will therefore affect how it performs against this benchmark.

St. James' by the Park is utilised less than would be expected for a church of its size, coupled with using the church hall next door as much as possible, has led to performing well against the benchmark.

	Size (m^2 GIA)	St. James' by the Park use kWh	St. James' by the Park use kWh/m^2	Typical Church Use kWh/m^2	Variance from Typical
Electricity	613	7,149	11.66	20	-41.69%
Heating Fuel	613	58,871	96.04	150	-35.98%
TOTAL	613	66,020	107.70	170	-36.65%



6. Efficient / Low Carbon Heating Strategy

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 near future. 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' in the foreseeable future.

It is therefore important to review and set out a plan to make heating more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents an efficient and comfortable solution for churches. 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 oil and coal-fired power stations.

The church is currently heated by a gas fired boiler which was installed in 2016 and appears to have a further 10 years serviceable life before requiring replacement. The boilers provide heating to cast iron, oversized and exposed pipework which contributes to the heating of the church. There are electric radiators in the narthex which look to be at the end of their serviceable life and should be considered for replacement.

The church makes use of flexible seating in the nave and there are fixed pews around the perimeter of the church.

The church is used twice per week on a Sunday for service and the typical congregation size is 150. The heating is set to come on several hours earlier in the winter to ensure the church is warm for this service.

The current Ferroli gas fired boiler provides LTHW to the whole church building using the pipework described above. There are grates and vents across the whole of the pipework network around the church which help the hot air, heated by the pipework, to circulate. Currently the church has set the heating to a background level of 12°C.

The various options for a decarbonised heating solution have been reviewed in the table below.

Decarbonisation Heating Solution	Viable
Air to Water Source Heat Pump	No – unsuited to current heating pipework and heat emitters
Air to Air Source Heat Pump	Yes – significant hurdles to install and potentially not financially viable. However, provides best payback and efficiency
Water Source Heat Pump	No – no water source locally
Ground Source Heat Pump	No – significant archaeology
Under Pew Electric Heating Panels	No – no fixed pews
Electric Panel Heaters (to provide supplemental heating only)	Yes – to supplement smaller areas such as the creche and vestry which would not need AASHPs
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	No – internal draught door already constructed
Overhead Infra-Red Heaters	Yes – however least preferred heating source due to comfort
Heated Chair Cushions	No – other solutions preferred

The recommendation is therefore that the church consider air-to-air source heat pumps. However due to the construction of the building these may not be able to be installed as easily as other, overhead IR heaters. The church should carefully consider the benefits and drawbacks of each solution, as described below.

6.1 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. AASHPs 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 up to 4.5.

The Centre for Sustainable Energy model[1] 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	Insulation Factor	Heat Required (Space heating)

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

	m^3	kW/m^3	kW
Church	3188	0.033	105.2

Therefore, a heat pump of 105 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.

Examples of external units for AASHP comprising of three smaller 3kW units and two larger 10kW units.

Internal units come in a variety of styles. The most appropriate internal units for most churches are floor mounted units which look very similar to a fan convector heater.

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

6.2 Install Electric Panel Heaters

Electric panel heaters can provide additional heating to areas where there are no pews. Suitable electric panel heaters would be far-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 a specific space and only need to be on for short periods of time. The heating effect spreads out from the panel by up to 3 meters, although this is reduced by people and furniture. This means that these heaters provide a useful source of supplementary heating or primary heating for some well-defined areas but are not very well suited to providing a complete heating solution for a church without other forms of heating (such as under pew). As these heaters warm up almost instantly, 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 areas using this form of heating can rapidly and economically be brought into used for short or unplanned meetings if needed.

It is recommended that the PCC consider installing supplementary electrical panel heaters in the creche, narthex (replacing existing units) and toilet (on a time delay switch) allowing removal of the existing radiators.

These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch so they cannot be left on accidently after use.

If you would like to discuss panel heaters with a church in the diocese that already makes use of them, please contact the diocese.

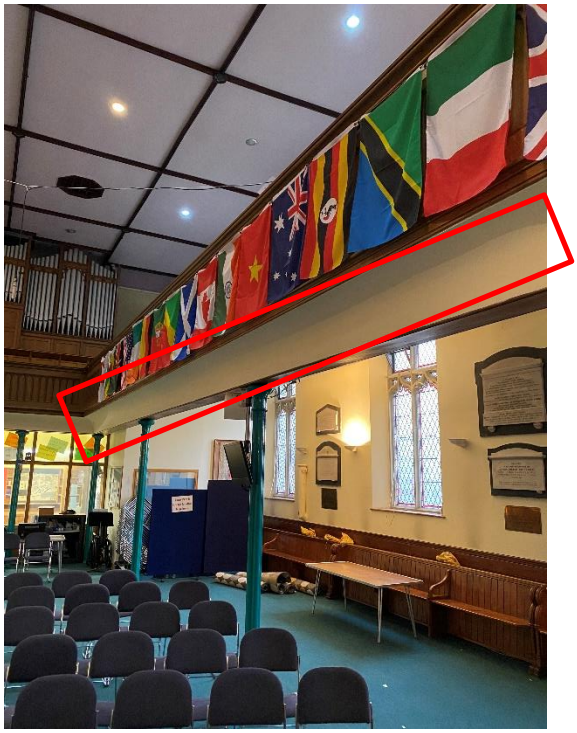
Electric panel heater installed behind an altar

6.3 Overhead Infrared Heaters

In areas where there are no fixed pews on to which heaters could be fitted, an option for heating the people, rather than all the air in the space, is to use overhead infrared heaters. These come in a variety of forms from the traditional that have a visible red-light glow emitted from them, to ceramic units and the more modern 'black heat' units which have no visible light. In most cases the distance from the heater to the people being heated needs to be no more than around 2.5 to 3m, although this varies slightly between heater types (therefore a mounting height of between 3m to 4m is typical). Units mounted outside of their heating range are likely to give poor performance. This form of heating provides heat from above and can leave lower limbs and feet feeling cold; therefore some people find this form of heating less comfortable, especially for longer periods of time. Comfort perceptions tend to improve in spaces where people are standing and more able to move around but reduce in areas where they are sitting in a fixed position for more than around 15 minutes. Some of these units can also have extremely high surface temperatures, and care should be taken not to mount them directly next to historic timbers or fabric that may be impacted by high heat levels.

There are some units on the market that incorporate a large chandelier type unit with both lighting and heating. These tend to be a very large visual intrusion in most churches and for that reason are not seen as appropriate where buildings of historic significance are concerned.

In this church it is recommended that an overhead radiant heater could provide a useful heating solution to the nave area.



One area for consideration of installing overhead IR heaters

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. These should include:

7.1 Discontinue with Background Heating Strategy

Most traditional churches were constructed without any form of heating. The modern addition of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The only times when background heating may be required is if there are historic wall paintings or for the preservation of large artefacts such as tapestries. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive. Organs can be installed with a local background tube heater within the organ casing in order to provide the heat where it is required. The fabric is often subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates).

Providing constant background heating to the church building as a whole is excessive and wasteful of energy. At the very least we would recommend that this background level is reduced to a maximum of 12°C and ideally avoided all together.

8. Energy Saving Recommendations

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.

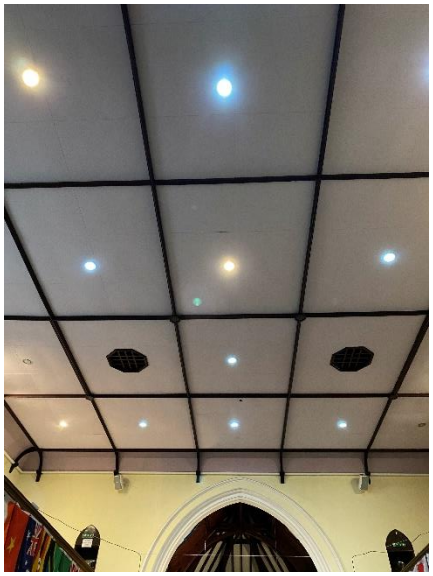
8.1 New LED Lighting

The lighting makes up a relatively large 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 are still a large number of inefficient fluorescent and halogen fittings within the church.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED fittings. There are a vast number of specifications of LED light fittings on the market, but it is recommended that any purchased should come with branded chips and drivers and offer a 5 year warranty. An example of such a range of fittings is available through Parish Buying.

If all the light fittings were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £2,235. The annual cost saving would be £372 resulting in a payback of around 6 years. This estimate includes the supply of the lights, the labour to install them and the access required. It does not include 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

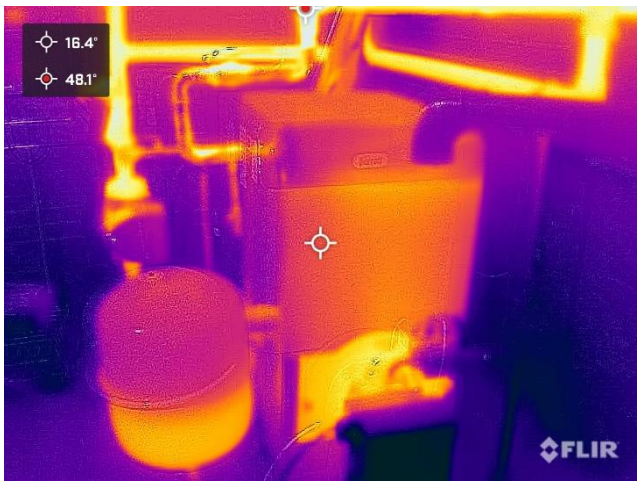
found at: https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/



8.2 Insulation of Pipework and Fittings

The pipework within the boiler room has almost no insulation, so therefore the pipework along with the more complex-shaped pipework fittings, such as valves, should be insulated. 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. These wrap around the various elements but can be removed and then replaced for any servicing activities.



8.3 Timers on Fuse Spurs to Water Heaters

There are various electric hot water heaters (for tea-making and the like) and electric point of use water heaters (for handwashing) located around the church. These only need to heat the water to the required temperature when the building is in occupation but at the moment these heaters are directly wired in without any form of time control and therefore maintain their 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. 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.

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 Photo Voltaic (PV)	No – not sufficient demand
Battery Storage	No – no viable solar PV

Now that the Feed in Tariff scheme has come to an end, the installation of solar PV panels in situations where there is not almost full usage of the electricity generated on site is not really viable.

Having reviewed the site it is not considered that there is good viability for any renewables and instead a good clear focus on reducing the energy demand of the building should continue with a targeted approach on reducing the heating energy.

10. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available on this Parish Resources page:
https://www.parishresources.org.uk/resources-for-treasurers/funding/

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 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. This includes items such as solar PV installations.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Boiler room	1	600 x 600 LED Panel	£5	£90	17.0
Nave	12	LED Downlighter	£41	£1,200	29.1
Nave	13	LED Spotlamps	£162	£195	1.2
Nave	12	12W LED lamp	£41	£180	4.4
Creche	1	1800mm LED Twin	£34	£160	4.7
Kitchen	1	1800mm LED Twin	£34	£160	4.7
Chancel	6	12W LED lamp	£21	£90	4.4
Vestry	1	1800mm LED Twin	£34	£160	4.7