ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St John the Baptist Church
PCC of Wincester

Arle Valley Benefice

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St John the Baptist Church 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 the Baptist Church is a mid-19th century church serving the community of Alresford on the outskirts of Winchester. The original church is constructed of flint stone walls with some sandstone detailing, as well as pitched tiles roofs. The base of the tower is of Norman age, with the whole church reconsecrated in 1898. There was a significant extension constructed in 1967 with the addition of the church hall and offices. This was constructed of cavity brick walls and a flat, asphalt covered roof. 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 1.6 tonnes
Timers on fuse spurs to water heaters	41	£12	£350	28.1	List A	0.01
Install an overdoor heater	N/A	N/A	£690	N/A	List B	N/A
Replace gas fired kitchen appliances with electric replacements	549	-£113	£2,500	N/A	List B	0.07
Upgrade cavity wall insulation in extension	1,321	£159	£4,764	30.1	Faculty	0.24
Upgrade roof insulation to 270mm in extension	2,082	£250	£6,875	27.5	Faculty	0.38
Replace heating system for electrical based heating solution (Church) (AASHPs)	7,902	£408	£108,557	265.9	Faculty	1.41
Replace heating system for electrical based heating solution (Offices) (AASHPs)	9,356	£483	£13,200	27.3	Faculty	1.67

Replace heating system for electrical based heating solution (Church Hall) (AASHPs)	10,135	£524	£16,800	32.1	Faculty	1.81
Install solar photovoltaic panels	6,104	£1,831	£15,775	8.6	Faculty	1.18
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.

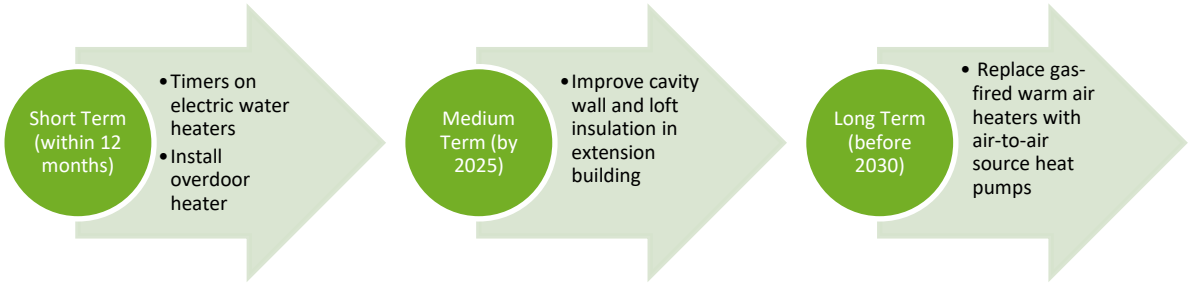
Figures in the table are based on current contracted/market prices of 30p/kWh and 10p/kWh for electricity and mains gas respectively. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.21107 for electricity, 0.18 for gas and 0.27 for oil. Do note that as energy prices increase, 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 John the Baptist Church 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 the Baptist Church, East Street, Alresford, SO24 9AG was completed on the 25th January 2023 by Nathan Tonkin. Nathan is an experienced energy auditor with over 4 years' experience in sustainability and energy matters in the built environment.

St John the Baptist Church	
Church Code	641003
Gross Internal Floor Area	**Church**: 520 m^2 **Hall**: 275 m^2
Listed Status	Grade II
Average Congregation Size	75

The church typically used for 10 hours per week for the following activities:

Type of Use	**Hours Per Week (Typical)**
Services	3 hours per week
Meetings and Church Groups	5 hours per week
Community Use	2 hour per week

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

The halls and offices see a much higher usage, with the hall providing most of the community events and usage, and the offices being used for 20/25 hours per week by staff.

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St John the Baptist Church.

The current electricity rates are:

Single / Blended Rate	34.5099p/kWh
Standing Charge	83.8936p/day

The current gas rates are:

Single / Blended Rate	2.0097p/kWh
Standing Charge	311p/day

The electricity is supplied by TotalEnergies, 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.

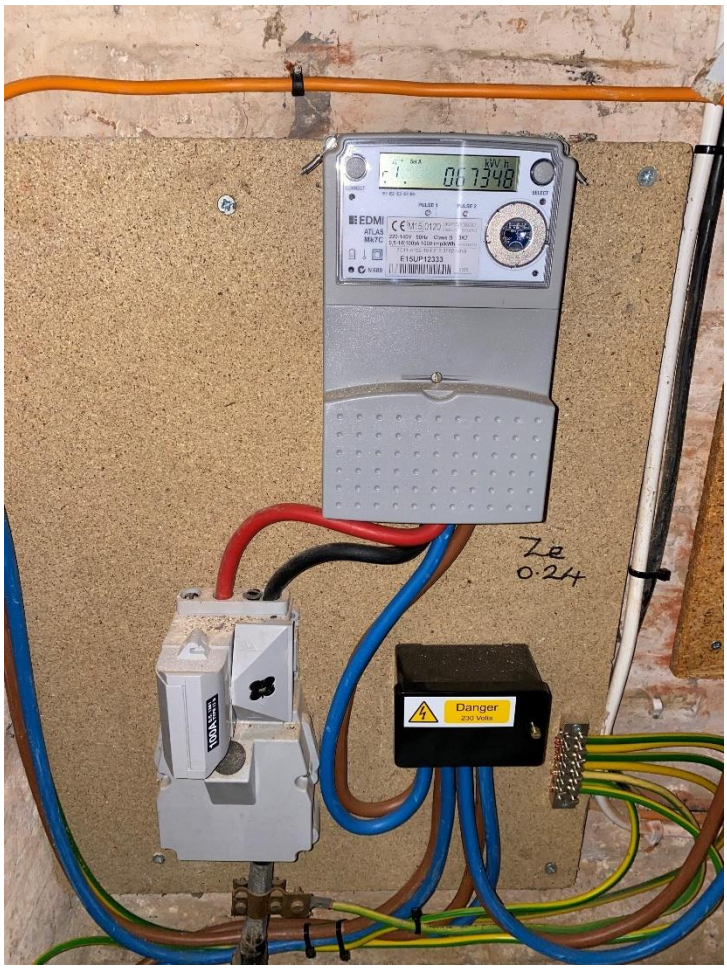
5. Energy Usage Details

St John the Baptist Church uses 8,295 kWh/year of electricity, costing in the region of £2,488 per year, and 37,793 kWh/year of gas, costing £4,535. The total carbon emissions associated with this energy use are 8.50 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St John the Baptist Church has one main electricity meter, serial number E15UP12333. There is one gas meter serving the site, serial number K0000412D6.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E15UP12333	EDMI ATLAS Mk7C Single phase 100A	N but capable	GF elec switch room
Gas – Church	K0000412D6			

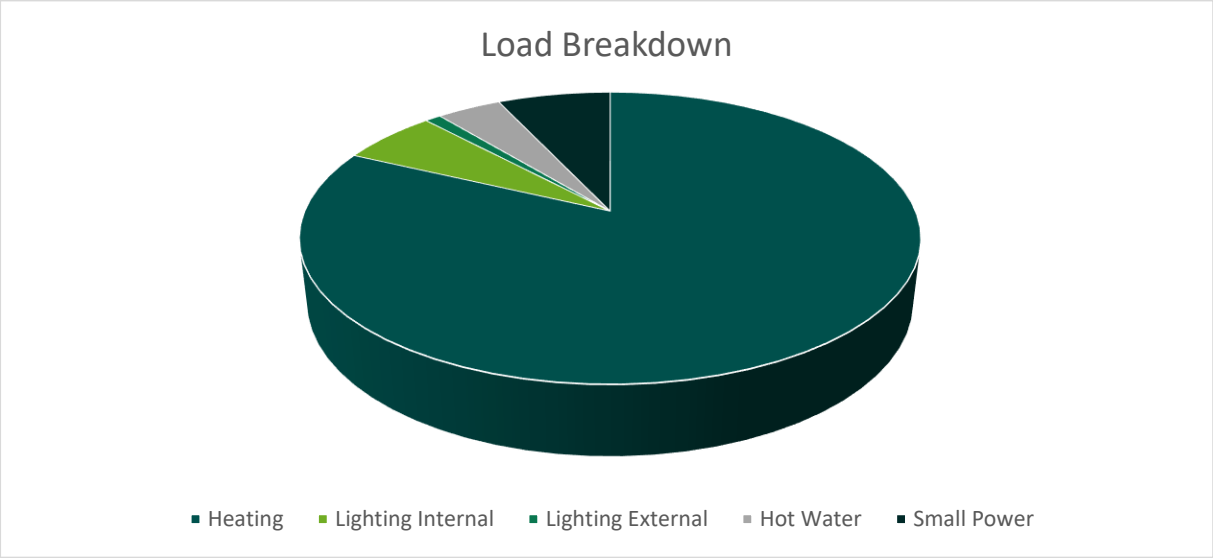
It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.



5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	**Main Church** 8x chandeliers with LED bulbs >20 LED downlighters Other lighting so subsidiary areas of church, all LED **Church Offices** >15 LED panels in suspended ceilings **Church Hall** >10 LED panels in suspended ceiling **External** <4 LED downlighters	7%
Heating	**Main Church** 1x Reznor 45-year-old gas-fired blown air heater **Church Offices and Hall** Brink B-34D gas-fired open flued warm air heater, approx. 15 years old	82%
Hot Water	1x Stiebel Eltron 15L hot water heater for handwashing and other sink usage in kitchen 1x Lincat hot water heater for tea and coffee 1x Ariston 10L hot water heater for handwashing in toilets	4%
Other Small Power	IT equipment in office and hall, kitchen applciances, other small power	7%



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 and other IT devices.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St John the Baptist Church uses 48% less electricity and 68% 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.

Despite the high usage of both the hall and offices, the church uses significantly less energy than would be expected, and should be commended for this. The introduction of 100% LED lighting as well as relatively efficient existing heating systems, combined with consistent monitoring of the heating schedule contribute heavily to this.

	Size (m^2 GIA)	St John the Baptist Church use kWh	St John the Baptist Church use kWh/m^2	Typical Church Use kWh/m^2	Variance from Typical
Electricity	795	8,295	10.43	20	-47.83%
Heating Fuel	795	37,793	47.54	150	-68.31%
TOTAL	795	46,088	57.97	170	-65.90%

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 bio gas 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 warm air heater which was installed approximately 45 years ago and appears to be many years beyond the end of its serviceable life should be replaced as soon as possible. The boiler provides heating which is blown through cast iron grates in the floor of the church, including to the altar and chancel.

The church makes use of flexible seating across all areas, including the nave and chancel.

The church is used once per week on a Sunday for service and the typical congregation size is 75, with further usage throughout the week. The heating is set to come on several hours earlier in the winter to ensure the church is warm for this service.

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 – existing gas-fired systems work on warm air so this is suitable
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 – in smaller, subsidiary areas like the vestry and eating area to the west of the Hall
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	Yes – over west-facing entrance to church
Overhead Infra-Red Heaters	No – visual intrusion to the church would do harm, 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 across the church, offices and main hall. 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 m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Main Church	1560	0.033	51.5
Offices	330	0.033	10.9
Church Hall	429	0.033	14.2

Therefore, a heat pump of 51 kW would be required in the church.

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

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

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.

Area identified where external units could be placed with minimal intrusion.

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. In the offices and hall, ceiling cassettes will be the most applicable due to the suspended ceiling.

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 this area (on a time delay switch) allowing removal of the existing radiators.

Existing radiator in vestry which is one area considered for replacement.

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 Install an Overdoor Heater

In order to achieve the sense of a 'warm welcome' into the church an over door air heater could be provided. This would also help to provide warmth to the rear of the church. Such an over door unit must be sized to cover the whole width of the door.

A variety of overdoor air heaters are available on the market and can be installed by an electrician. The heaters that will cover the entire width of the door tend to be larger output units, which will require a dedicated electrical cable of the correct size run to them. The church should resist the temptation to reduce the size and output of the heater to avoid running a new cable, as the output from smaller heaters and of those with insufficient width tends to be disappointing.

West facing door which should be considered for installation of overdoor heater.

6.4 Upgrade to 3 Phase Electricity Supply

To be able to have sufficient electrical power to supply enough energy into an electrical heating system, the church will need to increase the existing electrical supply from single phase 100A supply to a 3 phase 100A supply.

From a visual inspection of the nearby electricity network, it appears as if there is 3 phase power available on a nearby pole located in the southwest corner of the churchyard. There is an overhead route from this to the church into where the electricity meters are currently located.

The upgrade to the supply has to be carried out by the District Network Operator in the areas.

The DNO in your area is thought to be

> SSE Power Distribution - www.ssepd.co.uk 0800 0483516 (North Scotland and Southern England)

The cost of bringing in a new 3 phase supply can range from £300 to £30,000. The DNO will provide a quotation for free, so it is well worth obtaining a quotation even if plans are not yet certain, so that decisions can be made on a well-informed basis.

7. 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.

7.1 Timers on Fuse Spurs to Water Heaters

There are various electric hot water heaters and water boilers (for tea-making and the like) as well as others which provide hot water for hand washing 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.

7.2 Cavity Wall Insulation

The church extension is constructed with a cavity wall method, and the inspection of the wall showed no signs that insulation has been added. Prior to the early 1990's, building regulations did not require walls to be fully insulated and therefore it is likely that there is no insulation present. It could, however, be added through injection into the cavity walls.

It is recommended that cavity wall insulation is considered and added to the walls where appropriate. A survey to check the width of the cavity, exposure of the wall and condition of the cavity should be carried out by a CIGA-approved installer who will then be able to provide you with a quotation to undertake the works. Installing cavity wall insulation will help to reduce heat loss and improve the comfort of the space, but needs to be considered alongside other control measures such as TRV's or room sensors to ensure that the space does not overheat because of the additional insulation.

7.3 Insulation to Roof

The loft void above the suspended ceiling was not inspected as part of this audit but assumed 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 a dramatic impact on both the efficiency of the heating system and the temperature of the space below.

8. Other Recommendations

8.1 Replace gas fired kitchen appliances with electric replacements

In order for the church to become fully decarbonised, it must replace all appliances within the building that run on gas, including the 6-ring range with cooker. It is recommended that this unit be replaced with an electrically powered unit when it reaches the end of its life (approximately 5-10 years).

Modern induction ranges improve the efficiency from 60% with gas to 90%, can be easier and cheaper to install, and require less maintenance.

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)	Yes – sufficient demand, roof only visible from side blocked by trees
Battery Storage	Yes – 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.

There is potential for a small solar PV array on the pitched roof of the south-facing central roof structure. The church's energy consumption is already very small and the consumption during the daytime when the sun is shining is likely to be low but significant enough with the high amount of IT usage, therefore only a very small number of panels (maximum of around 8-10) would be worth considering if at all.

Battery storage is not strictly a renewable energy solution, but it does 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 solar PV is no longer generating. It therefore extends the usefulness of the existing solar PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantially over the next 2 to 3 years.

Area for solar PV consideration.

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.

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/

Climate Stewards encourages people to 'reduce what you can and offset the rest' as part of your journey to Net Zero carbon emissions. They provide training and resources to help you understand climate change and its impacts, and to calculate the carbon footprint from your activities including travel, energy, expenditure, and food. Their online carbon calculators for individuals and smaller organisations are free to use, and they provide bespoke carbon footprint audits for larger organisations.

Having reduced as much of your organisation's carbon footprint as you can, there will always be unavoidable emissions from your work and travel. Carbon offsetting allows you to compensate for the negative impact of your carbon emissions by funding projects which take an equivalent mount of CO2 out of the atmosphere. These either involve locking up ('sequestrating') CO2 as trees grow or reducing emissions by using low-carbon technology such as fuel-efficient cookstoves or water filters.

Climate Stewards has a close relationship with all their project partners in Ghana, Uganda, Kenya, Tanzania, Nepal, and Peru. They work closely with them to design, develop, implement and monitor projects which will not only mitigate carbon, but also bring tangible benefits to the local community - including improved health, savings in time and money previously spent on buying or collecting fuel, and improvements in local biodiversity. Each project is assessed using their Seal of Approval protocol which enables us to assess and monitor carbon mitigation and ensure robust, sustainable, and transparent partnerships.