ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Barnabus Church, Worcester
PCC of St Barnabus

Author	Reviewer	Date	Version
Matt Fulford		5th August 2021	1.0

Contents

1. Executive Summary

An energy survey of St Barnabus Church, Worcester 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 Barnabus Church, Worcester is Victorian church built in 1885 which serves a suburban area of Worcester. There is both gas and electricity supplied to the site. The church has modern gas boiler installed in 2018 and LED lighting throughout.

The church has a number of ways in which it can be more energy efficient and reduce its carbon emissions. 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)
Procure energy from 100% renewable supplier	-	-	-	-	-	3.34 tonnes offset
Insulate exposed pipework and fittings in plantrooms	5,682	£104	£800	7.66	List A (None)	1.05
Replace heating system for electrical based heating solution in 15- 20 years time	92,412	-£1,527	£28,760	N/A	Faculty	15.60

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

Based on current market/contracted prices of 17.04p/kWh and 1.83p/kWh for electricity and mains gas respectively.

If all measures were implemented this would reduce the churches carbon footprint by 16.65 tonnes (68%).

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 Barnabus Church, Worcester 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 Barnabus Church, Worcester, Church Road, Worcester, WR3 8NX was completed on the 17th July 2021 by Matt Fulford. Matt is a highly experienced energy auditor with over 15 years' experience in sustainability and energy matters in the built environment. He is a chartered surveyor with RICS and a CIBSE Low Carbon Energy Assessor. He is a Member of the DAC in the Diocese of Gloucester and advises hundreds of churches on energy matters.

St Barnabus Church, Worcester	
Church Code	642134
Gross Internal Floor Area	400 m^2
Listed Status	Unlisted

The church typically used for 12.5 hours per week for the following activities

Type of Use	Hours Per Week (Typical)
Services	10.5 hours per week
Meetings and Church Groups	0.5 hours per week (averaged out over the year
Occasional Services (wedding, funerals, festivals etc.)	1 hours per week (averaged out over the year
Community Use by school etc.	0.5 hours per week (averaged out over the year

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

4. Energy Procurement Review

Energy bills for gas have been supplied by St Barnabus Church, Worcester and have been reviewed against the current market rates for energy. No electricity bills have been supplied

The current gas rates are:

Single / Blended Rate	1.84p/kWh	Below current market rates
Standing Charge	0.37p/day	Below current market rates

The above review has highlighted that the current rates being paid are in line or below current market levels and the organisation can be confident it is receiving good rates and should continue with their current procurement practices. It is recommend that the church procures all of its electricity from 100% renewable suppliers from the Diocese Supported parish buying scheme, http://www.parishbuying.org.uk/energy-basket. This scheme only offers 100% renewable energy and therefore it is an important part of the process of making churches more sustainable.

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 Barnabus Church, Worcester uses 13,180 kWh/year of electricity, costing in the region of £2,245 per year, and 113,640kWh/year of gas, costing £2,100. The total carbon emissions associated with this energy use are 24.31 CO_2e tonnes/year.

This data has been taken from a spreadsheet of monthly energy use provided by the church. It has been assessed, by cross reference to the one gas bill provided, that the data for the gas has been taken from meter readings and is in m3, not in kWh as stated on the spreadsheet and has therefore been adjusted accordingly. St Barnabus Church, Worcester has one main electricity meter, serial number E12Z095270. There is one gas meter serving the site, serial number K0314115D6.

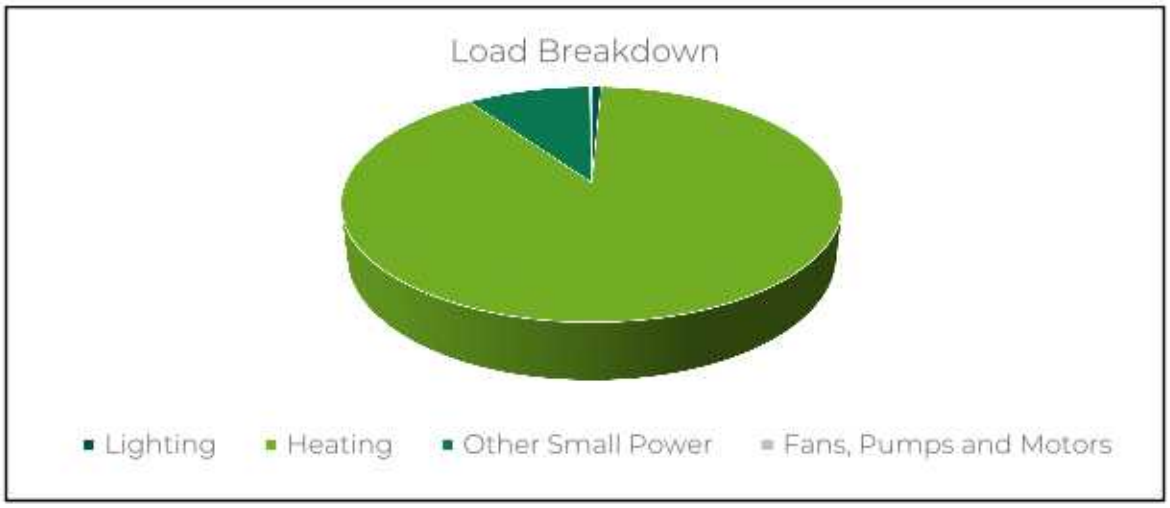
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	E12Z095270	1 phase 100A	Yes	WC Cupboard
Gas	K0314115D6	BK-G25M	Yes	Green enclosure by front wall

All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has not been provided for the purpose of this report. It is recommended that the church consider asking their suppliers for access to this half hour AMR data 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	All LED lighting through out	0.7%
Heating	Modern gas boilers heating to oversize perimeter pipework and the like	89.6%
Small Power	Sound system, kitchen and cleaning appliances and the like. Potentially this will now be much reduced as total power figures could include lighting consumption prior to the LED install.	9.5%
Pumps	Electricity for heating circulation pumps	0.2%



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

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Barnabus Church, Worcester uses 65% more electricity and 89% 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 Barnabus Church, Worcester (elec)	13,180	32.95	20.00	65%	13,180
St Barnabus Church, Worcester (gas)	113,640	284.10	150.00	89%	113,640
TOTAL	126,820	317.05	170.00	87%	126,820

The benchmark comparison is surprising and suggests that the electricity data may come from a period prior to the LED installation and there are questions over the accuracy of the gas data provided or that the heating system is/was run with background heating during the winter which should be avoided if this is currently still the case.

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. 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 biogas 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 church has two gas boilers which were newly installed in 2018. These are good efficient condensing boilers. Given that these have been recently installed there is little sense in considering the removal of 3 year old boilers which are relatively efficient. It is therefore suggested that their use should be continued with until they reach the end of their serviceable life in 15 to 20 years time. At that point the use of electric under pew heating should be consider as the usage of

the church is relatively light and would suit this form of heating as a way of providing good levels of thermal comfort in a decarbonised way. There is some potential for a very modest initial installation of these underpew electric heaters to be installed in the shorter term on the existing single phase electricity supply (possibly to the chancel) so that they could be used for smaller services and avoid the use of the gas boiler. That way there would also be a secondary heating solution in the event of the gas boiler failing or a leak occurring in the heating system.

To move to complete electric under pew heating the existing electricity supply would require increasing in capacity to a 3 phase 100A supply. Given the location this is likely to be available in the street but would need to be dug in through an underground supply so would involved disruption and costs in doing so.

There is some debate about the potential of future pew removal. Given the nature of the church, from a heating point of view, the central nave is the most challenging area to heat successfully without pews. It is therefore suggested that consideration be given to retaining the central block of pews within the nave and this would retain the central aisle format which tends to be much preferred for the majority of services. The pews to the side aisle and some of the rear rows from the central block could be removed if desired and the heating then provided from wall panel heaters.

6.1 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 to 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 such as https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat 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. The gas data suggest that background heat may have been used in the church in the past and if this is still occurring it should be avoided.

6.2 Install Electric Under Pew Heaters

The two most popular under pew heaters within churches are BN Thermic PH65 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating.

We would therefore suggest that the following works could be considered:

Install BN Thermic Under Pew Heaters suspended from brackets from the underside of the pew seat as follows:

Area	Type/ Size	Number Required	Notes	Estimated Cost
Chancel	Electric Under Pew 300W	12	10 to choir stalls, 2 to priests stool	£3,756.00
Nave central	Electric Under Pew 450W	76	to all central nave pews except rear 2. Could remove rear 2 rows of pews and side aisles	£25,004.00

Cable runs to the pew heaters should run along the along the existing routes (all cabling should be in armoured cable or FP200 Gold when above ground) to both rows of pews. Each pew heater to be switched with a neon indicated fused spur located underneath the pew seat.

The under pew (see photo below) and panel heaters have been recently installed at St Andrews Church, Chedworth, Gloucestershire, GL54 4AJ. The church is open in daylight hours so can be viewed at any time.

6.3 Install Electric Panel Heaters

IN addition to the pew heaters, if the pews to the aside aisles are removed it is recommended that the PCC consider installing electrical panel heaters in these area on a time delay switch and remove the existing radiators.

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.

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.

7. Improve the Existing Heating System

As the existing heating system is being retained, 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 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.

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).

8. 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	No – not sufficient demand, visible roof
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	No – insufficient electricity supply
Ground Source Heat Pump	No – potential archaeology in ground and radiator system

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.

9. 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 .

10. 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.

11. 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 amount of CO_2 out of the atmosphere. These either involve locking up ('sequestrating') CO_2 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.