

## Energy Efficiency and Zero Carbon Advice

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### St Lawrence's Church PCC of St Lawrence



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## 1. Executive Summary

An energy survey of St Lawrence’s 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 Lawrence’s Church is a Grade I listed building located in the village of Crosby Ravensworth in Yorkshire Dales National Park. The church has its current origins in the C12 but with additions in the C13 and C15 including the West tower, which had a top stage added in the early C19. There were major restoration works undertaken between 1850 and 1880. There is only electricity supplied to the site.

The church is already energy efficient as it utilises LED lighting and under pew electric heating and is occupied for less than 2 hours per week. Our key recommendation has been listed in the table below and is 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)
Replace heating system for electrical based heating solution	0	0	£38,180	N/A	Discuss with DAC	N/A

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

Based on current contracted prices of 17.04p/kWh for electricity.

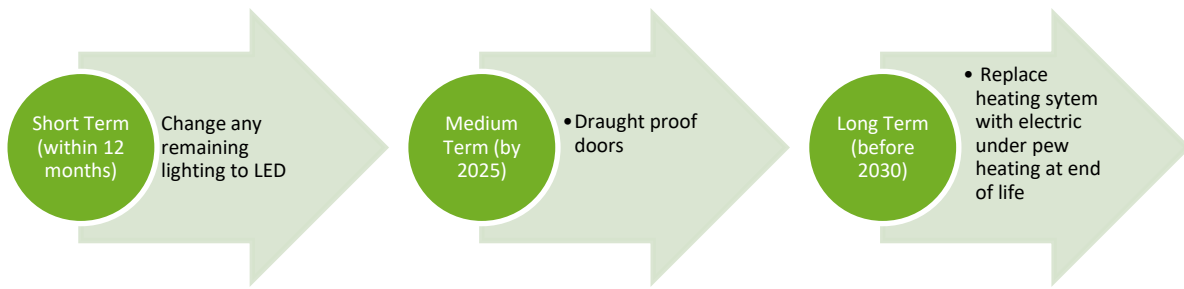
## 2. The Route to Net Zero Carbon

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 Lawrence's 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 Lawrence's Church, Crosby Ravensworth, CA10 3HY was completed on the 21<sup>st</sup> July 2022 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

<b>St Lawrence's Church</b>	
Church Code	607013
Gross Internal Floor Area	685 m <sup>2</sup>
Listed Status	Grade I

The church typically used for 2 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	2 hours per week	Unknown
Meetings and Church Groups	Ad hoc use only	Varies
Community Use	Ad hoc use only	Varies

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



## 4. Energy Usage Details

St Lawrence's Church uses 6,378 kWh/year of electricity, costing in the region of £1,086 per year. The total carbon emissions associated with this energy use are 1.61 CO<sub>2</sub>e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Lawrence's Church has one main electricity meter, serial number Z05FM01880.



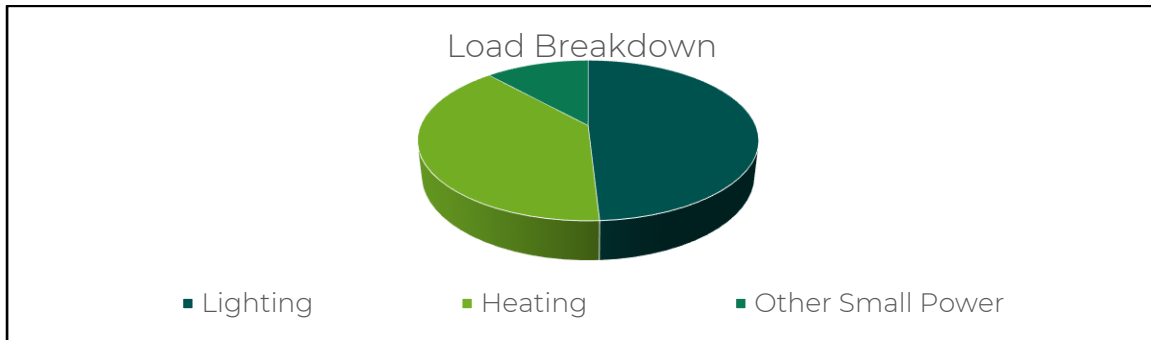
Utility	Meter Serial	Type	Pulsed output
Electricity	Z05FM01880	3 phase 100A	Yes but not fully AMR connected

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.

### 4.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	LED lighting throughout	49%
Heating	Electric under pew tube heaters	39%
Other Small Power	Organ power, plug in loads	12%



As can be seen from this data, the lighting makes up by far the largest proportion of the energy usage on site as the church is open to the public daily and lights can be turned on. The other significant load is heating which is timeclock controlled and only used for services.

#### 4.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Lawrence's Church uses 95% less energy than would be expected for a church of this size.

	Size (m <sup>2</sup> GIA)	Annual Energy Usage (kWh)	Actual kWh/m <sup>2</sup>	Benchmark kWh/m <sup>2</sup>	Variance from Benchmark
<b>St Lawrence's Church (elec)</b>	685	6,378	9.31	20.00	-53%
<b>St Lawrence's Church (gas)</b>	685	0	0.00	150.00	-100%
<b>TOTAL</b>	685	6,378	9.31	170.00	-95%



## 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 church audit was carried out unaccompanied and the surveyor did not meet anyone at the site. It is difficult to ascertain the accurate usage of the church without these on site discussions and therefore make recommendations in respect of the heating system. However, the church is only supplied with electricity and therefore operates as a net zero carbon church. The question then lies in how efficiently the church can be heated for weekly services as the church remains unheated when open for the public on a daily basis.

The heating of the church at the moment is via electric under pew tube heaters which appear to be in reasonable condition. The church should continue to utilise these until they reach the end





of their life or become less efficient and the heat output is not sufficient to maintain thermal comfort. At this stage, new under pew heaters should be installed throughout as per below.



In smaller areas or areas where pew heaters are not a possibility, far infrared panel heaters may be used to heat spaces in an efficient manner.

### 5.1 Install Electric Under Pew Heaters

For replacement, 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.electriceatingsolutions.co.uk/Content/PewHeating>.

Area	Type/ Size	Length (mm)	Watts	Number (or m) Required
<b>Nave</b>	Electric Under Pew 650W	948	650	44
<b>Nave</b>	Electric Under Pew 650W	948	650	44
<b>Choir stalls</b>	Electric Under Pew 300W	525	300	8

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 the 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.



## 5.2 Install Electric Panel Heaters

It is recommended that the PCC consider installing electrical panel heaters in the altar, chapel and vestry 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 accidentally after use.



Area	Type/ Size	Length (mm)	Watts	Number (or m) Required
<b>Transept</b>	Electric Far IR Wall Panel 1200W	1200	1200	3
<b>Chapel</b>	Electric Far IR Wall Panel 1200W	1200	1200	4
<b>Vestry</b>	Electric Far IR Wall Panel 1200W	1200	1200	1
<b>South Porch</b>	Overdoor air heater 6kW	1105	6000	1

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.

## 6. 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.

### 6.1 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 may still remain other inefficient fittings.





It is recommended that any non-LED fittings are 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/>

## 7. 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 – archaeology in ground and radiator system

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.

## 8. 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> .





## 9. 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 as 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.

## 10. 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<sub>2</sub> out of the atmosphere. These either involve locking up ('sequestering') CO<sub>2</sub> 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.