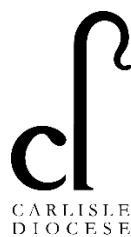


## Energy Efficiency and Zero Carbon Advice

---



### St Nicholas' Church PCC of St Nicholas



Author	Reviewer	Date	Version
David Legge	Matt Fulford	13 <sup>th</sup> December 2022	1.0



# Contents

1. Executive Summary .....	3
2. The Route to Net Zero Carbon .....	4
3. Introduction.....	5
4. Energy Usage Details .....	6
4.1 Energy Profiling .....	6
4.2 Energy Benchmarking .....	7
5. Efficient / Low Carbon Heating Strategy .....	8
5.1 Install Electric Under Pew Heaters.....	9
5.2 Install Electric Panel Heaters.....	10
6. Energy Saving Recommendations.....	11
6.1 New LED Lighting .....	11
6.2 Timers on Fuse Spurs to Water Heaters.....	11
6.3 Draught Proof External Doors .....	12
7. Renewable Energy Potential.....	12
8. Funding Sources .....	13
9. Faculty Requirements.....	13
10. Offsetting.....	14
Appendix 1 – Schedule of Lighting to be Replaced or Upgraded.....	14



## 1. Executive Summary

An energy survey of St Nicholas' 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 Nicholas' Church is a Grade II listed church set in the village of Lazonby in a rural location. The church was built in 1863 to a design by Antony Salvin on a mediaeval site but lacks any historical perspective. The present church is on the site of an earlier church that was completely demolished. The church comprises nave and chancel, north aisle, vestry, porch and bell tower. The church is built of red sandstone in the Gothic Revival style with random and diminishing slate roofs and is Victorian in character. There is electricity only supplied to the site.

The church has a number of ways in which it can be more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table and the route to net zero carbon are used as the action plan for the church in implementing these recommendations over the coming years.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Fit timed fused spurs to hot water heaters	162	£49	£90	1.85	List A (None)	0.04
Install under pew heaters for typical weekly service	2,729	£819	£4,672	5.71	Faculty	0.69
Change existing lighting for low energy lamps/fittings	92	£28	£716	25.98	Faculty	0.02
Install Draughtproofing to External Doors	126	£38	£1,600	42.21	List B	0.03

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

Based on current market prices of 30p/kWh for electricity.

**If all measures were implemented this would save the church £933 per year and reduce its carbon footprint by 0.79 tonnes (60%).**

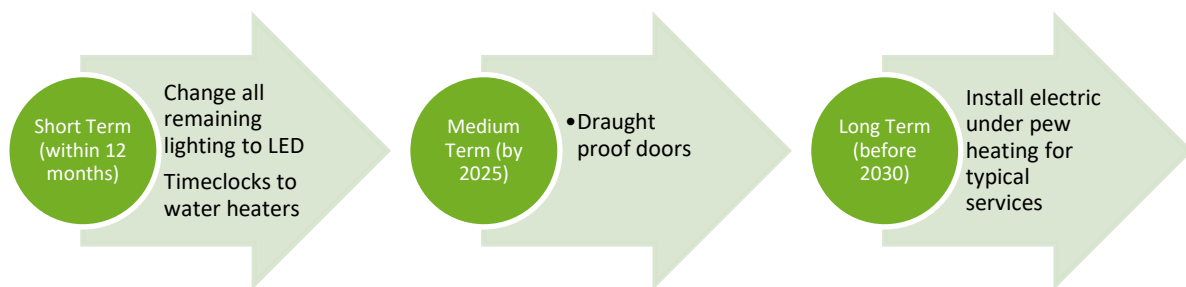


## 2. The Route to Net Zero Carbon

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 Nicholas' 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 Nicholas' Church, Lazonby, Penrith, Cumbria CA10 1BL 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 Nicholas' Church</b>	
Church Code	607140
Gross Internal Floor Area	240 m <sup>2</sup>
Listed Status	Grade II

The church typically used for 4.5 hours per week for the following activities

<b>Type of Use</b>	<b>Hours Per Week (Typical)</b>	<b>Average Number of Attendees</b>
Services	2 hours per week	20
Meetings and Church Groups	1.5 hours per week	<20 (fortnightly choir)
Community Use	1 hour per week	5 (bell ringers)

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



## 4. Energy Usage Details

St Nicholas' Church uses 5,193 kWh/year of electricity, costing in the region of £1,558 per year. The total carbon emissions associated with this energy use are 1.31 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 Nicholas' Church has one main electricity meter, serial number 21E1006373.



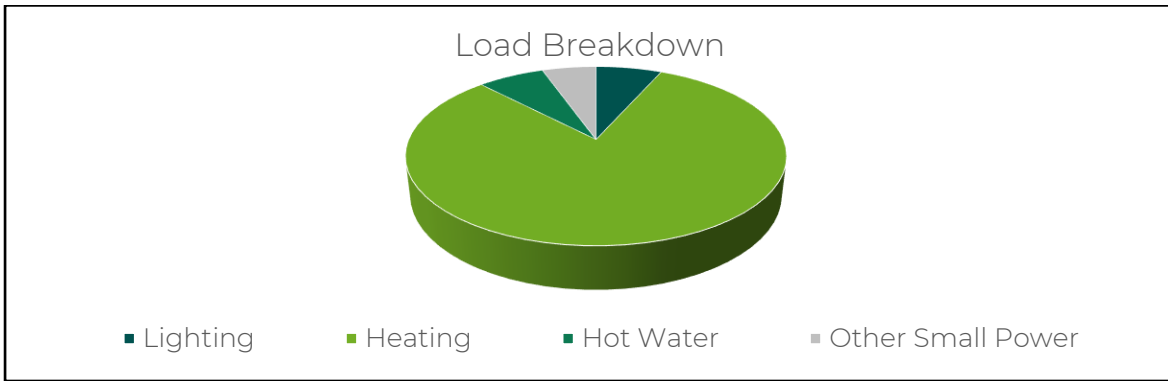
Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Church	21E1006373	3 phase 100A	Yes, fully AMR connected	Tower / play room

All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has been provided for the purpose of this report and this has been used to verify the data.

### 4.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Predominantly Led but some CFL to kitchenette, GU10 to WCs and GLS in vestry	7%
Heating	Electric near infrared heaters throughout	81%
Hot Water	Hot water heater within kitchenette	7%
Other Small Power	Organ power and other plug in loads	5%



As can be 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.

#### 4.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Nicholas' Church uses 87% 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 Nicholas' Church (elec)</b>	240	5,193	21.64	20.00	8%
<b>St Nicholas' Church (gas)</b>	240	0	0.00	150.00	-100%
<b>TOTAL</b>	240	5,193	21.64	170.00	-87%



## 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 current heating system for the church comprises near infrared heaters which are wall mounted at a height of c. 4 metres above ground level. These heaters are relatively new and have a further 15 years serviceable lifetime before requiring replacement. These heaters tend to provide quite localised heat and also emit a red glow which is not preferred in the church setting by most.

The typical weekly usage of the church is for Sunday service and congregation numbers are typically around 20 people. During winter months, the infrared heaters are used in an







attempt to heat the air volume of the church for 20 people. The church has fixed wooden pews for the most part throughout the nave.

It is therefore recommended that with a small congregation, it would be more efficient to install under pew heaters as described below. A limited number of under pew heaters could be installed to serve the typical weekly needs of the church whilst significantly reducing the heating consumption and associated costs for a Sunday service. Where larger services take place, the overhead infrared heaters can be used to heat a larger number of people.

### 5.1 Install Electric Under Pew Heaters

Electric under pew heaters provide a high level of thermal comfort to people sat in the pews. They are not installed to try and heat the entire air volume of the church, instead thermal comfort is achieved through a flow of warm air rising past the person in the pew. This means that the heaters should be installed under the entire length of all the pews that are likely to be used.



These heaters warm up almost instantly and a flow of warm air over the pew area is created within around 15 minutes of their being turned on. This significantly reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It is important that this reduced 'on time' is properly reflected in any comparisons with other types of heating.

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

Area	Type/ Size	Length (mm)	Watts	Number (or m) Required
Main nave	Electric Under Pew 650W	948	650	12

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.



## 5.2 Install Electric Panel Heaters

It is recommended that the PCC consider installing electrical panel heaters in the 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
Vestry	Overhead Far IR Bar Heater 1kW	1080	1000	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 still remains a large number of inefficient fluorescent and halogen fittings within the WC, vestry and kitchenette.



It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. There are a vast number of specifications of LED lights on the market, but it is recommended that any LED light should come with branded chips and drivers and offer a 5 year warranty. An example of such a range of fittings is available from <http://www.qvisled.com/>

If all the lights were changed on a simple “like for like” the total capital cost (supplied and fitted) would be £716. The annual cost saving would be £28 resulting in a payback of around 26 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider. Guidance on lighting, produced by Historic England for churches, can be found at <https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/>

There are some fittings such as GLS and GU10 where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

### 6.2 Timers on Fuse Spurs to Water Heaters

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

It is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied. This will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

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



### 6.3 Draught Proof External Doors

There are a number of external doors in the church. The historic timber doors do not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of these doors.

It is recommended that the draughtproofing around the door is improved and draught strips are added. This could be achieved in a number of ways:

For timber doors that close onto a timber frame a product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing.



[http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National\\_Trust\\_Case\\_Study.pdf](http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf)

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

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

## 7. Renewable Energy Potential

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

Renewable Energy Type	Viable
<b>Solar PV</b>	No – not sufficient demand, visible roof
<b>Wind</b>	No – no suitable land away from buildings
<b>Battery Storage</b>	No – no viable PV
<b>Micro-Hydro</b>	No – no water course
<b>Solar Thermal</b>	No – insufficient hot water need
<b>Biomass</b>	No – not enough heating load as well as air quality issues
<b>Air Source Heat Pump</b>	No – insufficient electricity supply
<b>Ground Source Heat Pump</b>	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.

### Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
<b>Kitchenette</b>	8	Virgo 8W (110m dia)	£6	£345	60.05
<b>WC</b>	4	GU10 LED	£14	£250	17.49
<b>Vestry</b>	1	LED GLS	£8	£12	1.58