

Energy Efficiency and Zero Carbon Advice



St Mary's Church, Pirton
PCC of St Mary's Church

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1. Executive Summary

An energy survey of St Mary's Church, Pirton 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 Mary's Church, Pirton is a Grade I listed 12th century church. There is both gas and electricity supplied to the site, the gas being disconnected.

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)
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None	Offset 0.5 tonnes and will be Net Zero Carbon
Draught proofing works	1% 56	£19	£200	10	Consult DAC	0.01
Consider registering for Eco Church	The <u>Eco Church</u> 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+++.)					

Alternative Options	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Install subsidiary under pew heating to selected pews	N/A	N/A	£5,600 (for 8 pews, 16 heaters)		Faculty	
Install heated cushions to pews	N/A	N/A	£300 per pew		Faculty	
Purchase portable heated cushions	N/A	N/A	Up to £180 per chair		None	



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

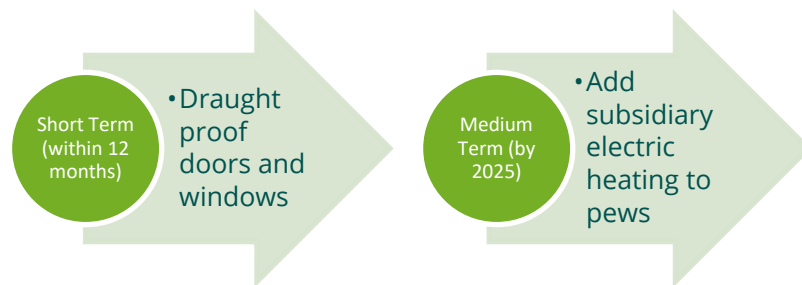
Figures in the table are based on current contracted/market prices of 37.8724p/kWh (day) and 31.6906p/kWh (evening and weekend) for electricity. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.211 for electricity, 0.18 for gas and 0.27 for oil. Do note that as energy prices 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 Mary's Church, Pirton 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 Mary's Church, Pirton, Crabtree Lane, SG5 3QE was completed on the 24th January by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church.

St Mary's Church, Pirton	
Church Code	632180
Gross Internal Floor Area	280 m ²
Volume	2,000 m ³
Heat requirement	66kW
Listed Status	Grade I
Average Congregation Size	28

The church is typically used for 2.5 hours per week for the following activities

Type of Use	Hours Per Week (Typical)
Services	2 hours per week
Meetings and Church Groups	0 hours per week
Community Use	0 hours per week
Occasional Offices	2 Weddings 4 Funerals



4. Energy Procurement Review

Energy bills for electricity have been supplied by the church.

The current electricity rates are:

Day Rate	37.8724p/kWh
Night Rate	31.6906p/kWh
Standing Charge	1052.64p/day

The electricity is supplied by Total Energies, and is purchased on a renewable tariff (although the supplier's overall fuel mix disclosure is only 50%).

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% rate charged	The correct CCL rate is being applied.

The above review confirmed that the correct taxation and levy rates are being charged.

The church is a charity and therefore can claim VAT exemption status. This should always be done when changing supplier. VAT declarations are available from the suppliers website and can usually be found by typing the suppliers name followed by "VAT Declaration Certificate" into most website search engines.



5. Energy Usage Details

St Mary's Church, Pirton uses 6,500 kWh/year of electricity, costing in the region of £6,350 per year at present rates. The total carbon emissions associated with this energy use are 1.37 CO₂e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

Utility	Meter Serial	Type	Pulsed output
Electricity – Church	E14UP10464	EDMI Atlas Mk10D Three Phase	Yes



The meter is AMR connected and as such obtaining an energy profile for the energy usage from the supplier should be possible.



5.1 Energy Profiling

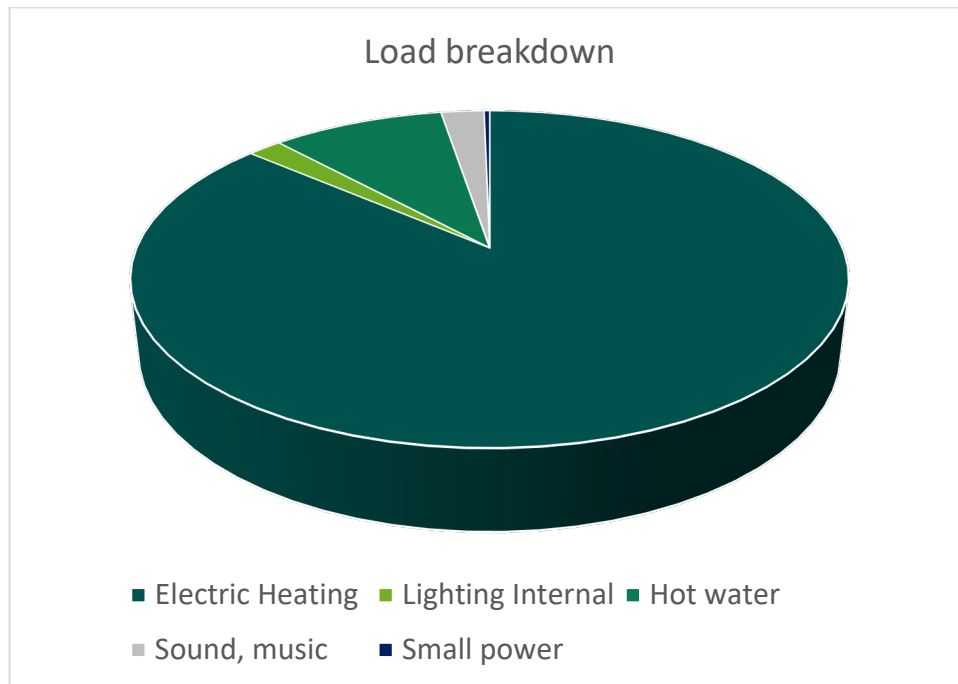
The main energy consuming plant can be summarised as follows:

Equipment	Power kW	Annual Consumption kWh	Proportion
Heating [Electric] Wall mounted Infra Red heaters, 6 x 3.2kW (in nave) Wall mounted radiant quartz heaters 4 x 4.5kW (chancel and tower) Wall mounted radiant quartz heaters 2 x 1.5kW (upper room) 140 hours use [4 hours 40 minutes per week x 30 weeks]	19.2 18 3 TOTAL 40.2	5,600	86%
Lighting [Internal] Church 140 hours use over year Compact fluorescent 54 x 11W LED 6 x 11W LED 18 x 8W Kitchen recessed LED 9 x 5W TOTAL	594W 66W 144W 40W 844W	120	1.8%
Hot Water (electric) Wall mounted water heater, Heatrae Sadia Supreme 155 - normally turned off Fixed water heater under sink (10 litres, Zip Aquapoint 2) - normally turned off	3 3	300 300	9.3%
Sound, Music Organ Sound system	1 0.3	100 30	2.0%
Small Power Vacuum cleaner	1.5	20	0.3%

Sum of electricity use estimates: 5,600 heating + 870kWh = 6,470kWh

Annual church electricity consumption pre IR heating, 2019: 4,974kWh [This is much higher than the estimate above and suggests halogen lighting may have still been in use during 2019, and/or greater hours of use, plus the older radiant heating in the chancel and tower]

Annual church electricity consumption, 2022: 6,500kWh



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 hot water.



Above, looking east. The nave is heated by wall mounted radiant heaters.



Below, looking west, showing overhead radiant quartz heaters in the chancel.



6. Efficient / Low Carbon Heating Strategy

6.1 Overview

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.

6.2 Present Heating System

The church is heated by radiant electric heaters. Those in the nave were installed in 2020 and are each rated at 3.2kW giving a total of 19.2 kW heat to this area.



The crossing tower and chancel both have two quartz radiant heaters mounted at about 4m height, and there are a further two smaller units to heat the upper room. Total heat provision is 48kW; the church have evaluated the running cost (at present cost rates) as £18.27/hour day rate, £15.29/hour evening/weekend rate.

The system is reported as not supplying quite enough heat to the congregation. Options for extra heat provision for midwinter are presented below.





6.3 Additional Heating Options

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

The church is recommended to obtain quotations and to discuss how many units are necessary to provide heat for the normal size of congregation. Is extra heat required for all, or just some people? Can the use of polyester throws / blankets remove the need for more heating?

Decarbonisation Heating Solution	Viable
Under Pew Electric Heating Panels	Yes
Heated Chair Cushions	Yes
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	Yes if needed but does not address the heating for seating issue

6.4 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.



Pews are 3.02m long (inside dimension). Two heaters could be installed per pew (seating 4)

Fitting 8 pews; 16 heaters

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

Install under pew heaters suspended from brackets from the underside of the pew seat as follows:

8 pews with two 650W heaters in each row between uprights

Capital cost estimate £5,600

Operating cost $10.4\text{kW} \times 31.6906\text{p/kWh} = \text{£}3.30$ per hour.

NB: The number of units which need to be switched on will depend on congregation size.

Cable runs to the pew heaters should run 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.

A similar installation could be fitted to the choir stalls if so desired.

A case study of a church which has adopted this solution is available at <https://www.churchofengland.org/about/environment-and-climate-change/st-andrews-chedworth-electric-heating>



Photos of installations are shown below. In addition, several churches have recently installed such systems. If you would like to find out about churches whom you could ask about their experiences, please contact the diocese.



Brown BN Thermic 650W under pew heaters fixed to underside of pew seats for pews which have no solid backs.



Black 650W Norel under pew heaters fitted to solid pew backs.

6.5 Heated Pew / Seat Cushions

Most are now familiar with the concept of heated seats within cars; the same solution is also used in some outdoor venues such as alfresco dining and sports stadiums. These provide a heated cushion to sit on: the direct warmth from the contact areas provides a degree of comfort even when the surrounding space is cold. This can be a useful solution for churches which only have chairs (having removed pews) and/or for small congregations where there are few other alternatives.

There are a variety of heated seat cushions on the market. Some are directly plugged into a power socket (similar to an electric blanket). Others have battery packs, which can be charged



and then connected to a seat pad. This makes them more flexible and avoids trailing leads. The more advanced products have a pressure sensor which means heat is only provided when someone is sitting on the cushion. Heated pads for 'benches' can also be used to heat a pew or could even be adapted to form a heated kneeler for the communion rail.

Pew length heated cushions are available (one manufacturer being Kovo Schidt – a quotation obtained by another church suggests a cost of £300 for a 3m cushion). These are less flexible than portable individual cushions and may be more expensive if they have to be produced to a specific length.

Therefore, as an alternative to fixed under pew heaters, it is recommended that the church consider using a set of portable heated cushions. These could be used:

- In the pews as “top up” heating for those who feel the cold
- In the pews during midwinter
- For the choir
- In the upper room for meetings

This may provide a more flexible approach than installing more fixed heaters.

As previously mentioned, use of polyester throws or blankets can be an effective form of insulation. Beware of wool, which attracts moths.

A case study of a church using heated cushions is available at <https://www.churchofengland.org/about/environment-and-climate-change/towards-net-zero-carbon-case-studies/marown-church-tries-new>

7. Energy Saving Recommendations

There are also a number of 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 two electric water heaters in the kitchen, a wall mounted Heatrae Sadia Supreme 155 and a Zip Aquapoint 2 ten litre tank under the sink (below).

These only need 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.

It is recommended that a laminated notice is posted reminding of the need to switch these units off after the church service – left running each will lose heat; models such as below through the copper pipework and models with metal cases through the case itself. Losses are similar to a 100W incandescent light bulb: 900kWh each per year, or about £300 for each unit t current rates.

If the church becomes used more frequently during the week, installing timer controls, or replacement with a boiling tap (at about £300) is recommended.



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 Draught Proof External Doors

There are a number of external doors in the church. Where doors do not close tightly against the frame or surround a large amount of cold air can enter the church around the side and base of the doors.



It is recommended that the draughtproofing around doors improved where possible 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 is often used in heritage environments to provide appropriate draught proofing.

For timber doors that close onto a stone surround, traditional solutions can be used 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 also be used. Keeping the door maintained in a good condition is also important.



It is necessary to check with the DAC before undertaking any form of draughtproofing that involves work on the fabric of the door.

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.

Such measures should be considered carefully around bat conservation needs to ensure that access points bats use are not disturbed. Check your draught excluding plans with the Bat Conservation Trust’s free helpline: 0345 1300 228 <https://www.bats.org.uk/>

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

+

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

The hours of use of the building are very low, and the call for electricity is generally not when the majority of generation would occur.

9. 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.pariahresources.org.uk/resources-for-treasurers/funding/>

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 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.

11. Other Items

11.1 Bats in Churches

The Bat Conservation Trust has a project with the Church Buildings Council Natural England, the Church of England, Historic England and the Churches Conservation Trust to address bat issues: www.churchofengland.org/resources/churchcare/advice-and-guidance-church-buildings/bats-churches