ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Michael's Church, Aldbourne
PCC of St Michael's

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1. Executive Summary

An energy survey of St Michael's Church, Aldbourne 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 Michael's Church, Aldbourne is medieval parish church in a rural village setting. There is both gas and electricity supplied to the site. A virtual tour of the church can be viewed at https://view.ricohtours.com/fa07e674-359f-4e23-859e-b35f4a8dd992

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)
Change existing external lighting for LED flood lights	903	£152	£556	3.65	0.23	List B
Adjust existing timer on external lighting to 10pm off time	437	£74	£-	0.00	0.11	List A (None)
Replace gas blowers and electric tube heating system for electric under pew panel heating solution	22,688	£267	£14,088	52.79	4.06	List B (from July 2022)
Fit 270mm of insulation into the roof space	2,458	£59	£2,100	35.84	0.45	Faculty / List B
Add or Replace draught strips to external doors	492	£12	£600	51.20	0.09	List B
Install a Solar PV array to roof of building with 5kWh battery	4,647	£784	£14,173	18.07	1.18	Faculty

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

Based on current contracted prices of 16.88p/kWh and 2.38p/kWh for electricity and mains gas respectively.

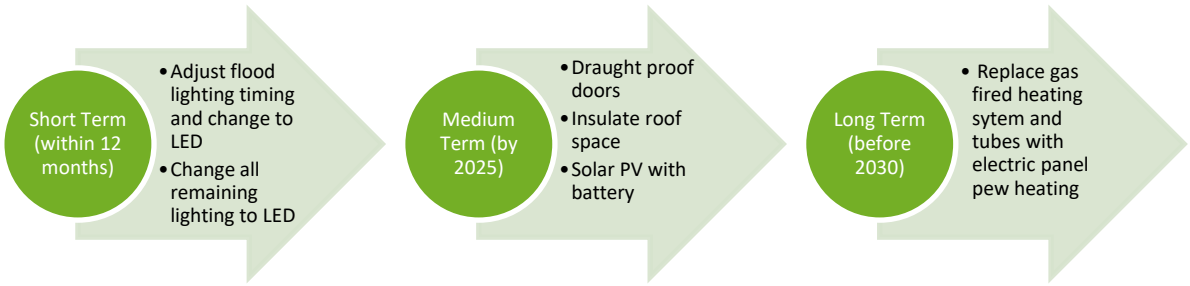
If all measures were implemented this would save the church £1,348 per year and reduce its carbon footprint by 6 tonnes.

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 Michael's Church, Aldbourne 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 Michael's Church, Aldbourne, Crooked Corner, Aldbourne, SN8 2EL was completed on the 4th July 2022 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 Michael's Church, Aldbourne	
Church Code	634554
Gross Internal Floor Area	587 m^2
Listed Status	Grade I

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

Type of Use	Hours Per Week (Typical)
Regular Services	2 hours per week
Toddler Group	1.5 hours per week
Occasional Service (average)	1 hour per week

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

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Michael's Church, Aldbourne and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	16.88p/kWh	Below current market rates
Night Rate	13.227p/kWh	Below current market rates
Standing Charge	57.9113p/day	N/A

The current gas rates are:

Single / Blended Rate	2.384p/kWh	Below current market rates
Standing Charge	197.1178p/day	N/A

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. The PCC should expect a very significant increase in these rates when the current contract comes to an end.

The church report that they are currently procuring their supplies on a renewable tariff and the supplier is SSE which tends to have a much larger than average renewable proportion of its supply mix.

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 Michael's Church, Aldbourne uses 5,420 kWh/year of electricity, costing in the region of £915 per year, and 24,578 kWh/year of gas, costing £586. The total carbon emissions associated with this energy use are 5.91 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by St Michael's Church, Aldbourne has one main electricity meter, serial number D14C42193. There is one gas meter serving the site, serial number E025K0008019D6.

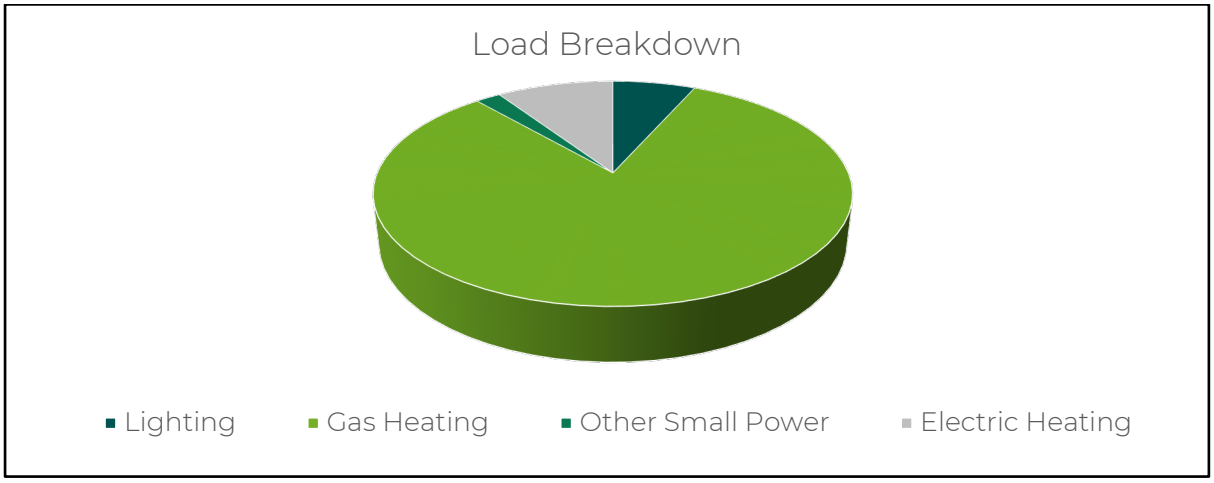
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	D14C42193	3 phase 100A	Yes	Boiler Room
Gas – Church	E025K0008019D6	MDK25	Yes	External Meter Housing to NE side of churchyard

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 it is recommended that the church request access into this data through the supplier portal.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	LED internal lighting and external flood lighting. Not the external flood lighting accounts for 63% of the total amount of lighting.	6.7%
Gas Heating	Gas fired direct air heater blown into the church from duct at rear of nave.	81.9%
Electric Heating	Electric under pew tube heaters, overhead radiant heaters.	9.4%
Other Small Power	Organ, kitchen appliances, cleaning equipment and the like.	2.0%



As can been seen from this data, the gas heating makes up by far the largest proportion of the energy usage on site. The other significant load is electric heating and external lighting.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Michael's Church, Aldbourne uses 54% less electricity and 72% less 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 Michael's Church, Aldbourne (elec)	587	5,420	9.23	20.00	-54%
St Michael's Church, Aldbourne (gas)	587	24,578	41.87	150.00	-72%
TOTAL	587	29,998	51.10	170.00	-70%

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 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 has a mixed heating system as it has found that the electric tube heaters were insufficient to provide thermal comfort. Given the low and intermittent usage of the church it would suit a direct electric heating solution and the upgrading of the guarded tube heaters which are 240W each to low surface temperature electric panel heaters which are 650W each will provide an electric heating solution which is able to provide a good level of thermal comfort without the use of gas. Some of the wiring and infrastructure for the existing tube heaters could potentially be reused. The gas heater was only installed in 2011 and can therefore be expected to have a further 10 years life left in it. The transition over to electric pew heaters can therefore be made gradually and it could start with a core area of pews which the regular congregation tend to use and this could be the sole method of heating in autumn and spring with the gas

limited to providing heating only in the depth of winter for large congregations such as remembrance and Christmas.

The use of over head units to the Goddard Chaple can remain.

6.1 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.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, to replace the tube heaters as follows:

Nave, 39 PH65 heaters in pews between uprights

Choir, three PH65 heaters in pews uprights

Any new 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 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.

6.2 Upgrade to 3 Phase Electricity Supply

The church already has a 100A 3 phase supply and therefore no upgrade to the electrical capacity would be required.

7. Energy Saving Recommendations

In addition to having a revise 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 New External LED Flood Lighting

The external flood lighting makes up a relatively large overall energy proportion of the electricity used within the church.

The current flood lighting comprises of four 150W SON style flood lights. These can easily be replaced for LED equivalents which are likely to be 50W each. External LED flood lights are widely available and could be fitted by a competent electrician. As they are a direct replacement for the existing this would normally be a List A matter and not require any further permission.

7.2 External Lighting Controls

The external flood lights are currently on until midnight each night . For efficient operation and to reduce light pollution and nuisance to neighbours it is generally recommended that external lighting is turned off between 10pm and 6am unless required for specific purposes.

It is therefore recommended that the existing timer is adjusted to switch on the lights only between dusk and 10pm.

7.3 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. 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.

7.4 Insulation to Roof

There is a loft void above the which currently has no insulation present. In all 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.

Further discussions should be undertaken with the church architect to review how insulation could be added to this void and preserve the ventilation required.

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	Yes – to non-visible south aisle
Wind	No – no suitable land away from buildings
Battery Storage	Yes – with PV and would be used for daily floodlighting
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	Possible but direct electric heating is more viable given duration church is used
Ground Source Heat Pump	No – archaeology in ground and lack of access for large drilling rig

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 modest PV array on the roof of the South Aisle. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. The church's energy consumption is already very small and the consumption during the daytime when the sun is shining is likely to be very low indeed, therefore while technically viable only a very small number of panels would be worth considering. Battery Storage is not strictly a renewable energy solution, but battery storage does however 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 PV is no longer generating. It therefore extends the usefulness of the existing PV system particularly in this sort of church and would be very sensible to install to charge during the day and used to power the flood lighting each night. The floodlighting (once changed to LED) would be expected to use around 1kWh of energy per night therefore a small (maximum 5kWh) battery would be more than sufficient.

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.