Energy Efficiency and Zero Carbon Advice

St Mary's, Hardwick
Diocese of Oxford

Author	Reviewer	Date	Version
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1. Executive Summary

An energy survey of St Mary's was undertaken by Inspired Efficiency Ltd 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.

St Mary's is a 13th century parish church with later additions, used predominantly for Sunday worship only. There is both oil and electricity 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 is 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)
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A
Switch electricity suppliers to ones which provide 100% renewable supplies	None	None	Nil	N/A	None	N/A
Insulate exposed pipework and fittings in plantrooms	1,070	£48	£200	4.12	List A (None)	0.29
Change existing lighting for low energy lamps/fittings	1,826	£282	£1,176	4.17	Faculty	0.46
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	4,230	£653	£6,475	9.92	Faculty	1.07
Add or Replace draught strips to external doors	428	£19	£450	23.20	List A (None)	0.11
Replace heating system for electrical based heating solution	16,612	£231	£21,189	91.71	Faculty	4.52
Install PIR motion sensors on selected lighting circuits	7	£1	£293	282.11	List B	0.00

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

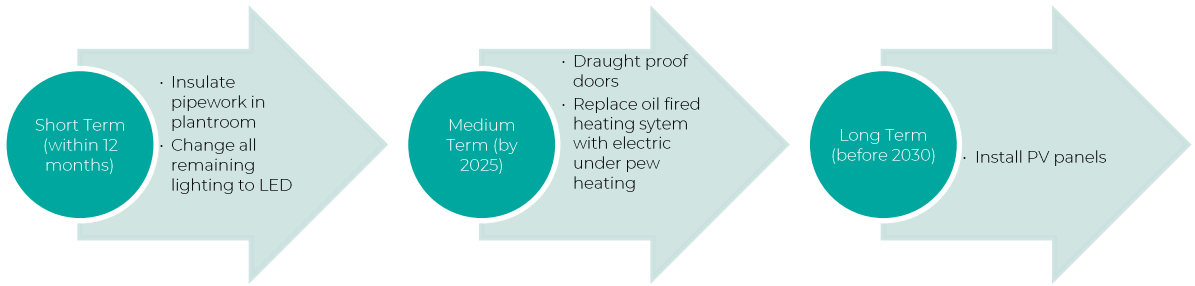
Based on current contracted prices of 15.43p/kWh and 4.53p/kWh for electricity and oil respectively.

If all measures were implemented this would save the church £1,234 per year.

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years. Furthermore, the Diocese of Oxford has also declared a climate emergency and has an ambition to be carbon neutral by 2035 and is discouraging the replacement of oil heating systems.

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Mary's to provide them with 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, Lower Road, Hardwick, Bucks, HP22 4DT was completed on the 17th July 2020 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 Mary's	
Church Code	627687
Gross Internal Floor Area	409 m^2
Listed Status	Grade II*

The church typically used for 3 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	2 hours per week	25
Meetings and Church Groups	0 hours per week	-
Community Use	1 hour per week	25

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

4. Energy Procurement Review

Energy bills for oil and electricity have been supplied by St Mary's and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	0.1757p/kWh	Slightly above current market rates
Night Rate	0.1502p/kWh	Slightly above current market rates

The current oil rates are:

Single / Blended Rate	0.0453p/kWh	In line with current market rates

The above review has highlighted that there are opportunities to gain cost savings from improved procurement of the energy supplies at this site. We would therefore recommend that the church obtains a quotation for its electricity supplies from the Diocese Supported parish buying scheme, http://www.parishbuying.org.uk/energy-basket. This scheme only offers 100% renewable energy sourced 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 Mary's uses 7,445kWh/year of electricity, costing in the region of £1,149 per year, and 21,400 kWh/year of oil, costing £970.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Mary's has one main electricity meter, serial number K10EM00323.

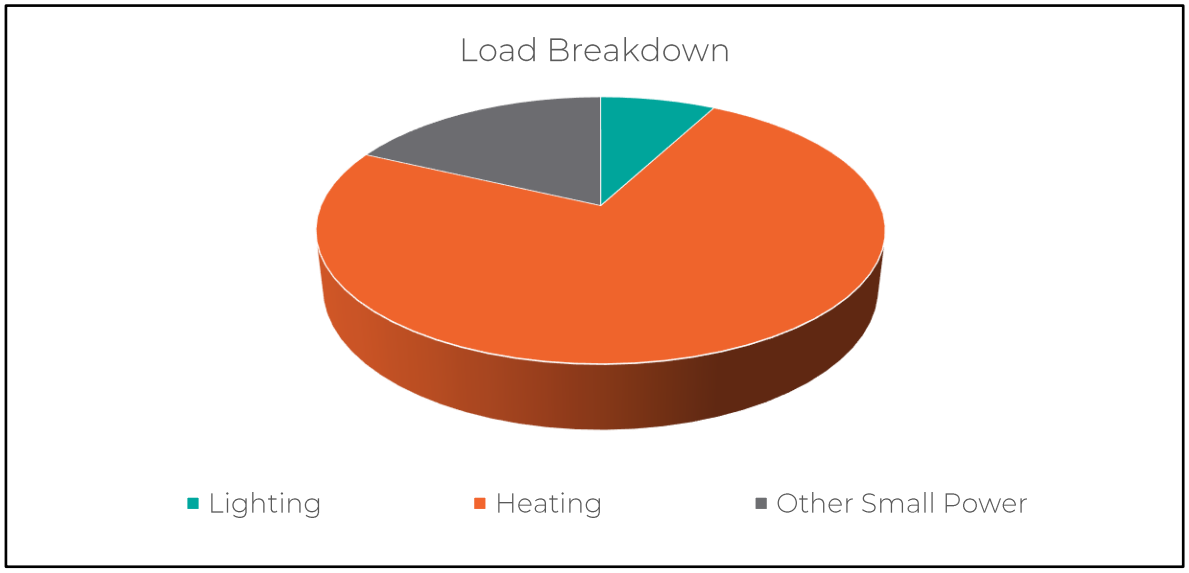
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	K10EM00323	Elster A1120	No Pulse or AMR	Corner of nave

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.

5.1 Energy Profiling

The main energy use within the church can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	GLS Pendants through out	8%
Heating	Oil fired boiler and radiator	74%
Other Small Power	Overhead electric radiant heaters, organ and other appliances	18%



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 Mary's uses 9% less electricity and 65% less heating energy than would be expected for a church of this size.

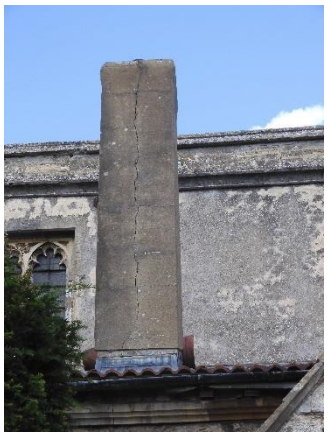
	Size (m^2 GIA)	St Mary's use kWh/m^2	Typical Church use kWh/m^2	Variance from Typical
St Mary's (elec)	409	18.20	20.00	-9%
St Mary's (heating fuel)	409	52.32	150.00	-65%
TOTAL	409	70.53	170.00	-59%

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. Heating also often uses gas or oil as its primary fuel (St Marys uses oil), these are fossil fuels with high carbon emissions and little opportunity to decarbonise in the future. Electricity currently has carbon emissions around the same level as mains gas and lower than oil but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions it remain coal fired power stations. It is therefore a critical element to review and set out a plan to make more efficient and less carbon intensive and one way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches.

St Marys currently has a hybrid heating system, using an oil boiler to provide heating to radiators for some background space heating for services and there are then wall mounted overhead infrared units which heat the people.

The oil heating system should be considered as being at end of life. The oil boiler is 25 years old, the oil is stored in a single skin metal oil tank above which is starting to show signs of corrosion at the base and no longer meets environmental or safety regulations (being at risk of developing an oil leak and being too close the timber roof eaves of the church). The chimney/flue is also in a poor state of repair and shows large cracks. The church report that this is stable (but a full structural safety check would be advisable if not already carried out).



The oil heating system should not be replaced. A number of dioceses are now prohibiting the replacement of oil boilers due to their environmental impact and it would be unwise to replace the one at this church. It is therefore advised that the oil system should be removed (including taking down the chimney and removing the oil tank). The existing overhead heaters can continue to be used and the background space heating element of the heating system could be provided through a mixture of electric under pew heaters (similar to those at St Johns) and electric panel heaters.

6.1 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.

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.

6.2 Install Electric Panel Heaters

It is recommended that the PCC consider installing electrical panel heaters in non pewed areas 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). As such these heaters tend to provide a relative instant sense of heat and comfort within the space and only need to be on for short periods of time

The church has an existing 3 phase electricity supply so could power these heating elements and they may find that the overhead units are able to provide sufficient heat/comfort on their own with little additional heating 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 LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church, but large areas are lit by relatively inefficient fluorescent.

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 £1,176. The annual cost saving would be £282 resulting in a payback of around 4.2 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.

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the Nave, Chancel, Porches and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of

natural daylight coming in through the windows where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors (commonly called PIRs) also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

7.3 Insulation of Pipework and Fittings

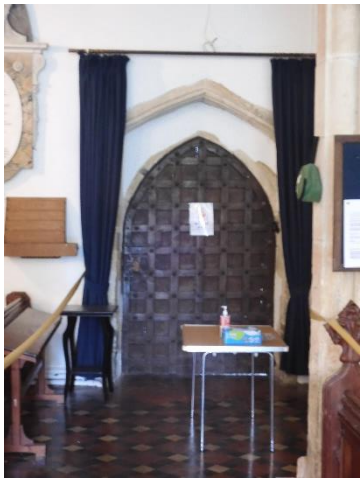
The pipework within the plant room has the majority of its straight lengths insulated but the more complex shaped pipework fittings, such as flanges and valves, have been left uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the plant 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 made flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

This would only be relevant if the oil boiler is being retained for more than 5 years and as this is unlikely this measure may not be that relevant.

7.4 Draught Proof External Doors

There are a number of external doors in the building. These have the original historic timber doors on them, but these do not close tightly against the stone surround and hence a large amount of cold air is coming into the building around the side and base of these doors.



It is recommended that draught proofing is fitted to all external doors where there is timber doors closing

For timber doors that close onto a stone surround more traditional solutions such brush draught strips rebatted 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 and keeping the door maintained in a good condition is important.

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

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 – on the south facing roof
Wind	No – no suitable land away from buildings
Battery Storage	Yes – to be used in conjunction with the 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

There is potential for a small 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 churches 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 (maximum of around 12) would be worth considering if at all.

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. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

9. Funding Sources

This audit programme offers each participating church the chance to apply for a grant of up to £150 towards implementing some of the audit's recommendations. An application form is included with this report. This could be usefully used to fund the LED replacement light bulbs for the nave lighting.

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 .

Trust for Oxfordshire's Environment (TOE) does have some funds available (over and above the small implementation grants of £150 available through this scheme) to support energy efficiency improvements in community facilities. If your church is used by the wider community, visit www.trustforoxfordshire.org.uk or contact admin@trustforoxfordshire.org.uk to find out if your project is eligible for a grant of up to about £5,000.

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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Nave (BC)	11	LED GLS	£44	£131	3.00
Base of tower	2	GU10 LED	£0	£125	375.85
Chancel	2	LED GLS	£5	£24	4.62
Porches	3	LED GLS	£8	£36	4.62
External	2	100W LED Flood	£225	£400	1.78

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