Energy Audit and Survey Report

St Mary's Church, Buscot

"There is a plan to reduce global carbon emissions to net zero by 2050. The plan will work. It involves all of us. We need to begin now, in our homes and workplaces and churches"

Revd Dr Stephen Croft, Bishop of Oxford

Version Control

Author	Reviewer	Date	Version
Marisa Maitland	Matt Fulford	15th March 2020	1.0

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1. Executive Summary

An energy survey of St Mary's Church, Buscot 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 Church, Buscot is Grade 1 listed C13 small rural parish church with fine Norman chancel arch. There is both gas and oil supplied to the site.

The church has a number of ways in which is 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	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
Discontinue the practice of background heating	11,845	£551	Nil	Immediate	None	2.54
Change existing lighting for low energy lamps/fittings	9	£2	£111	72.77	List A / List B	0.00
Insulate exposed pipework and fittings in plantrooms	1,974	£92	£400	4.36	List A	0.42
Fit Quattroseal draft proofing to historic doors	671	£31	£800	25.63	List B	0.14
Replace pipe stat to boiler as limiting flow temps	3,356	£156	£450	2.88	List A	0.72
Investigate 3 phase power supply with	5,034	£3,200	£182	17.55	Faculty	1.08

SSE and move to electric under pew in chancel						
Move to electric under pew in nave and remove oil boiler	27,855	£1095	£15,000	13.70	Faculty	5.97

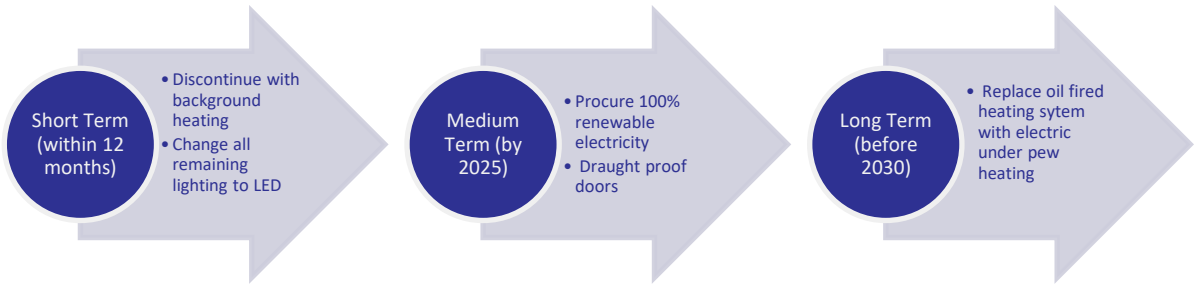
The Church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works.

Based on current contracted prices of 17.14p/kWh and 4.65p/kWh for electricity and oil respectively.

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.

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, Buscot 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 Church, Buscot, Farringdon SN7 8BY was completed on the 15th March 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, Buscot	
Gross Internal Floor Area	153 m^2
Listed Status	Grade I
Typical Congregation Size	30

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

Services	2 hours per week
Meetings and Church Groups	0 hours per week
Community Use	0 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 oil and electricity have been supplied by St Mary's Church, Buscot and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	17.14p/kWh	Above current market rates
Standing Charge	42.42p/day	N/A

The current oil rates are:

Single / Blended Rate	4.65p/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 Church, Buscot uses 1,747 kWh/year of electricity, costing in the region of £299 per year, and 39,483 kWh/year of oil, costing £2,368.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Mary's Church, Buscot has one main electricity meter, serial number S79C92332.

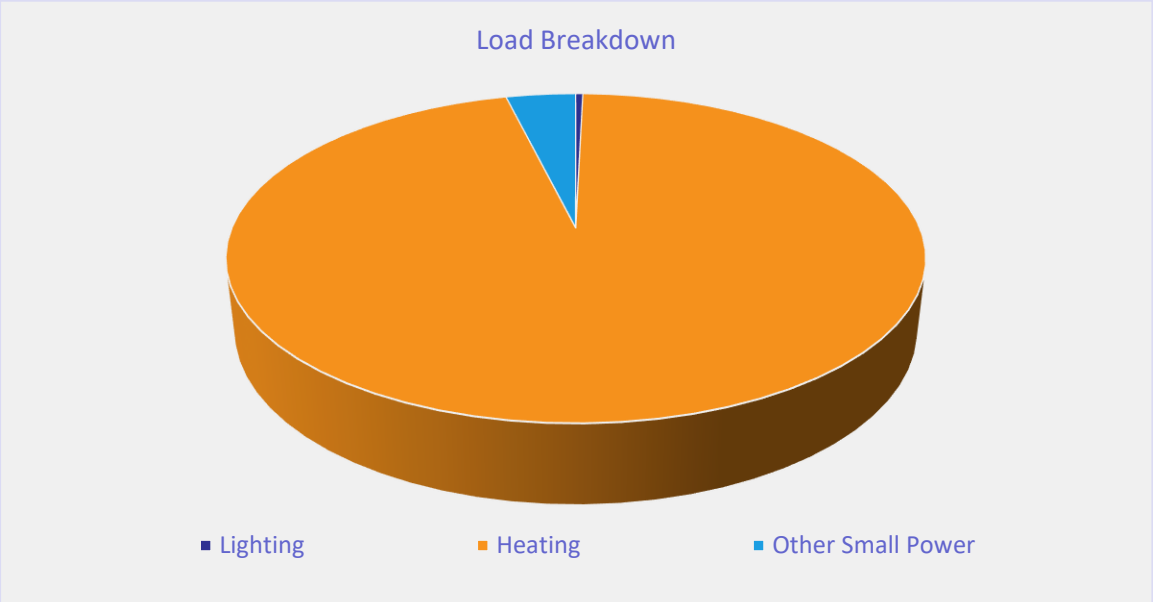
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	S79C92332	Single phase dial	No pulse or AMR	Vestry

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	Mix of LED and fluorescent lamps	0.4%
Heating	Condensing oil boiler to underfloor trench pipes	95.8%
Other Small Power	Plug in electric heaters, kettles and the like	3.8%



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 Church, Buscot uses 43% less electricity and 72% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Mary's Church, Buscot use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Mary's Church, Buscot (elec)	153	1,747	11.38	20.00	-43%
St Mary's Church, Buscot (heating fuel)	153	39,483	257.34	150.00	72%
TOTAL	153	41,230	268.72	170.00	58%

The additional usage on the heating is due to the practice of background heating the church to 10°C all the time even though the building is in use for very minimal amounts of time during the week or month.

6. Energy Saving Recommendations

6.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building, and two small areas are lit by inefficient fittings. The lighting in the vestry is a fluorescent 2D lamp, and the tower light is a SON. All the main lights in the nave and chancel have been replaced for LED already and the church should be commended for their actions on this.

It is recommended that all of the fittings, scheduled in Appendix 1, are changed for LED.

If all the lights were changed the total capital cost (supplied and fitted) would be £111. The annual cost saving would be £2 resulting in a payback of around 72 years. Many of the lights could be self-installed and therefore cost much less than the supply and fit cost above. In this case the £150 grant available through this process could be very usefully employed to fund the purchase of replacement LED lamps which the church installs themselves.

6.2 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 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.

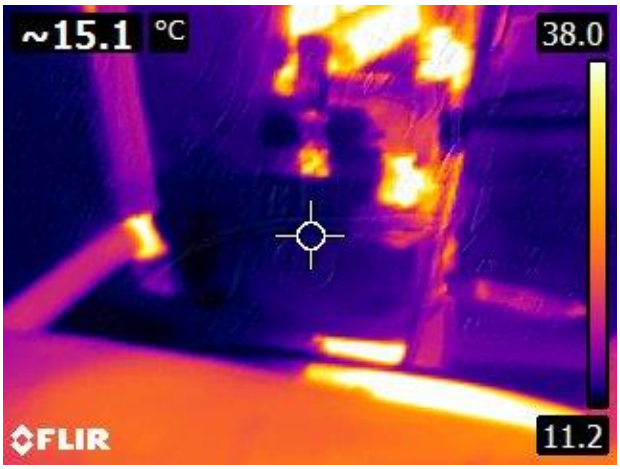


Photo 1 - Heating pipework - light colours highlight high heat loss

It is recommended that these areas of expose 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.

A free survey and quotation for the supply and installation of insulation of pipework fittings can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

6.3 Heating Pipe Stat

It was discovered on site that the flow temperatures within the pipework when the boiler was running were rather low. It is for this reason that the heating has to run on for so long before a service and will have impacted on the churches current decision to maintain a level of background heating within the church. Investigations on site suggest that the flow temperature of the boiler is currently being held back by the pipe sensor on the flow pipework. Even although this has been turned up the flow temperature is being limited to around 45°C to 55°C.

Photo 2 - Faulty pipework sensor next to boiler

It has therefore been concluded that this pipe stat may well be faulty and should be replaced. Replacement pipe stats can be purchased for around £30 and fitted by any competent heating engineer. This should then result in much higher flow temperatures within the system that will result in shorter and more effective warm up times and avoid the need for background heating.

6.4 Discontinue Background Heating

Most traditional churches were constructed without any form of heating. The modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The only times when background heating may be required is if there are historic wall paintings or to for the preservation of large artefacts such as tapestries. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive and organs can be installed with a local background tube heater such as https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat within the organ casing in order to provide the heat where it is required. The fabric is often subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates)

Providing constant background heating to the church building as a whole is excessive and wasteful of energy. At the very least we would recommend that this background level is reduced to a maximum of 6°C and ideally avoided all together.

6.5 Investigate 3 Phase Power Supply with SSE

Given the need for all churches to decarbonise, the best step for this would be to move to electric heating within the church. This would require an upgrade of the currently 100A single phase electricity supply to the church to allow for the additional load of electric heating, which is discussed further below. The church would need to speak with the current electricity supplier, SSE to investigate this process but it would appear as if the upgrade may be relatively straight forward as there is a 3 phase power supply on the pole immediate behind the church from which the overhead supply into the church is supplied.

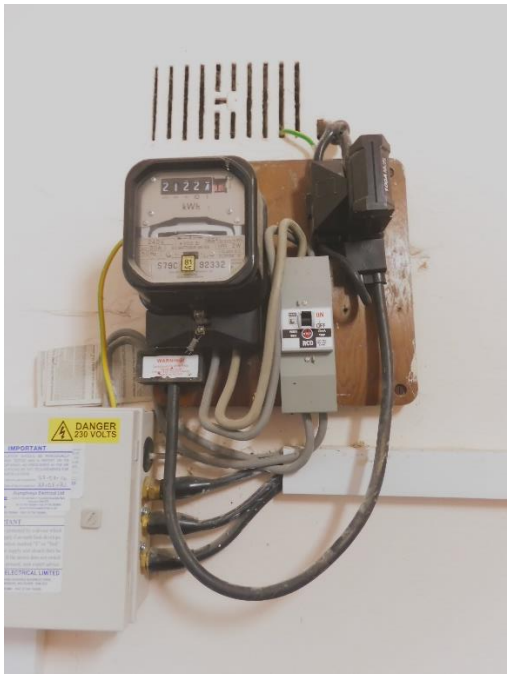


Photo 4 - Existing incoming 100A single phase supply

Photo 3 - Overhead 3 phase line behind church

6.6 Under Pew Heaters

Given the churches usage profile we would suggest that a revised heating strategy for the church would provide a much more efficient use of energy and a more comfortable church. The current oil boiler provides background heating and heat on a Sunday morning service once a week.

As mentioned above, with most medieval churches, this church would have survived most of its life without any form of heating the modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary.

We would suggest that the church considers the installation of electric under pew heaters to all of its pews in both the chancel and the nave and then the oil boiler could be removed. The electric under pew heaters provide heat direct where it is required and most comfortable placed (directly under the occupants when they are seated) and provides good quality heat within 20mins of being switched on. At all other times and heaters could be left off.

For replacement, two most popular under pew heaters within churches are BN Thermic PH30 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 could run along the North and South walls (all cabling should be in armoured cable or FP200 Gold when above ground) to the both rows of pews quite easily. Armoured cable could be used below ground as sub main cables taking power to each block of pews and utilise the routes of the existing pipework in places.

We would recommend that the church considers the use of electric underpew heating in two stages.

Stage 1 – Install under pew heaters (15 heaters in total) to the choir stalls in the chancel. This could be installed using the existing single phase 100A supply so could be undertaken in the short term. The use of electric heaters in this area would provide an independent heating source for the chancel which could be used for smaller services instead of the oil heating. It would also provide a back-up plan in the event of the oil boiler failing where this area of the church could be used to continue worship as and when the boiler breaks down.

Stage 2 – Install under pew heaters to all the pews in the nave. This is likely to require 57 small heaters (three under each of the 19 pews) to be installed to obtain complete coverage. In addition, two far IR panel heaters should be installed in the non-pewed areas by the font and by the organ to provide thermal comfort to those areas. 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 can not be left on accidently after use.

Photo 5 – Choir Stalls

Photo 6 – Pews to Nave

6.7 Quattro Seal

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 church around the side and base of these doors.

It is recommended that draught proofing is fitted to all external doors. 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

Photo 7 - West door - dark area at base of door indicate cold air blowing in

7. Other Recommendations

There is one tree within the church yard which provides significant shading on the south side of the church due to its proximity to the church and its evergreen nature. This shading is not helpful in that it does not allow for the church to benefit from solar heat gain and results in this section of the church being more damp. The tree itself appears to be in poor condition with a large section having previous split off and the remaining tree therefore appearing to be unbalanced.

Investigations should be made as to whether retaining this tree is a pragmatic solution in the long term or whether it should be removed and replace for multiple trees along the boundary of the church yard where they will have less adverse impact on the fabric of the building.

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	No – not sufficient demand, visible roof
Battery Storage	No – no viable PV
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Ground Source Heat Pump	No – archaeology in ground and radiator system
Air Source Heat Pump	No – insufficient electricity supply
Biomass	No – not enough heating load as well as air quality issues

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.

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 (£)
Vestry	1	2D LED 11W	£0.37	£54.55
Tower	1	Virgo 15W (190mm dia)	£1.16	£46.31