Energy Audit and Survey Report

St Mary the Virgin Church

Diocese of Oxford

"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
Matt Fulford	David Legge	18 January 2019	1.0

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1. Executive Summary

An energy survey of St Mary the Virgin Church 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 the Virgin Church is a Victorian Church built in the 1850's with some later additions. There is a large nave with north and south aisles through a wide colonnade. There is only electricity supplied to the site. This is a 3 phase 100amp supply which provides all the energy for heating via overhead infrared units, lighting and small power needs.

The church is already relatively efficient in energy terms but there are 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.

Short Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	To be actioned by who / when?
Change fluorescent lighting in tower to LED	82	£11	£207	18.16	List B	
Fit Quattro seal draught stripping to all external doors	230	£32	£800	24.96	List B	

Based on current contracted prices of 13.94p/kWh for electricity.

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

Of greater note is the church's plans for a major reordering project in the coming years. The ambitions of this project are for the church to have very regular and frequent use during weekdays, evenings and weekends. This will result in the church's internal environment needing to achieve much greater thermal comfort levels than current levels and the church could have an entirely different usage style as it is moving away from infrequent short usage to longer more constant usage where alternative heating solutions will be more efficient. It must be noted that using the church more extensively will naturally result in greater energy use, but it will create a more sustainable building as it will be of greater value and serve the community better for the future. Some of this report has therefore been dedicated to advising on the most efficient future heating solutions to consider in the reordering scheme.

2. Introduction

This report is provided to the PCC of St Mary the Virgin Church, Wheatley 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 these in mind.

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An energy survey of the St Mary the Virgin Church, Church Road, Wheatley, Oxford, OX33 1LZ was completed on the 14th December 2018 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 the Virgin Church	
Gross Internal Floor Area	302 m^2
Listed Status	Grade II*
Typical Congregation Size	30

The church typically used for 6 hours per week for the following activities

Services	3 hours per week
Meetings and Church Groups	2 hours per week
Community Use	1 hour per week

There is additional usage over and above these times for festivals, weddings funerals and the like which have not been included in the savings calculations.

3. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Mary the Virgin Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	15.97p/kWh	In line with current market rates
Night Rate	13.94p/kWh	In line with current market rates

The above review has highlighted that the current rates being paid are in line with current market levels. It is also currently procuring energy from Ecotricity which is an excellent energy company in providing 100% renewable energy and features very highly with Ethical Consumer in being a sustainable and ethical supplier.

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.
FiT	not charged	A FiT charge correctly not being applied

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

4. Energy Usage Details

St Mary the Virgin Church uses 12,490 kWh/year of electricity, costing in the region of £1,800 per year (not including standing charges, VAT and the like).

This data has been taken from the annual energy invoices provided by the suppliers of the site for the period from 28th June 2017 to the 27th June 2018. St Mary the Virgin Church has one main electricity meter, serial number P06C12467.

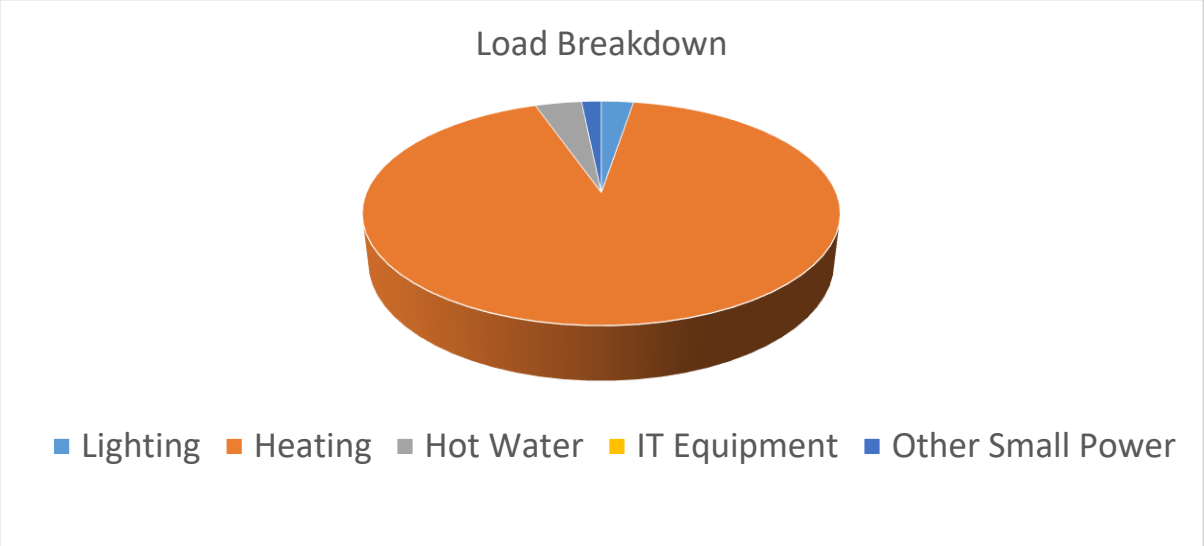
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	P06C12467	3 phase 100A	No but capable	On Tower Mezzanine

The meter is capable of providing a pulse output which in turn can be sent automatically to the energy company. This level of metering allows for an energy profile to be obtained so that the Church can see when it is using the most energy and take action accordingly. Given that there is currently only electricity provided to this site such an automated reading would give a full energy profile with one step.

4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Fluorescent and LED lights	3%
Heating	Overhead infra-red heaters	91%
Hot Water	Electric water heater to kitchenette/WC	4%
Other Small Power	Appliances and the like	2%



As can been seen from this data, the heating makes up by far the largest proportion of the energy usage.

4.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Mary the Virgin Church uses 75.7% less energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Mary the Virgin Church use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Mary the Virgin Church (elec)	302	41.36	20	10	+106.8%
St Mary the Virgin Church (heating fuel)	302	Inc above	150	80	-100.0%
TOTAL	302	41.36	170	90	-75.7%

This benchmarking, together with the observations from site shows that St Mary the Virgin Church currently operates in an energy efficient manner however, it must be noted that while having low overall energy consumption, it does not provide a comfortable and therefore well used, building.

5. Energy Saving Recommendations

5.1 Lighting (fittings)

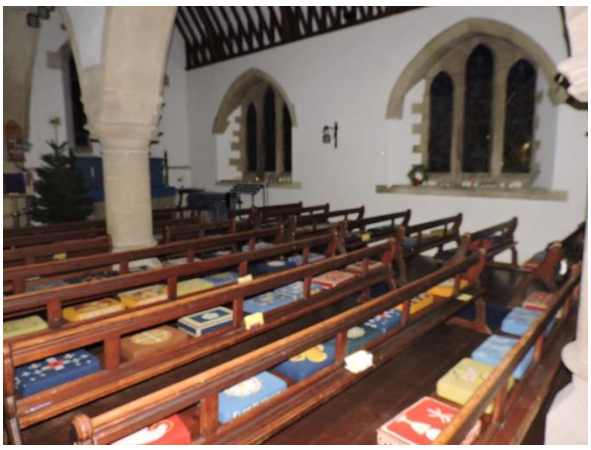
The main lighting within the nave are relatively low energy pendant fittings. These may be reviewed as part of the wider reordering plans but at present there it no recommendation for these to be changed. Within the kitchen area under the tower there are some inefficient fluorescent light fittings. It is recommended that these are replaced with LED linear lights such as http://www.qvisled.com/store/p73/QLINE-18-1200NW.html . This can be simply undertaken by a local electrician an could be considered as a List B or even a List A item so not requiring a faculty.

5.2 Door Draught Proofing

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 in to 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

6. New Heating Solutions for Reordering



The existing heating is provided from overhead radiant heaters located throughout the church (6 in the nave, 3 in each of the side aisles, 2 in the chancel and 2 in the vestry area. These are reported to be very ineffective in heating the church.

There are plans to remove all the pews within the church and provide a large clear open space for a variety of functions including a drop-in café, secular community group use, gallery space as well as worship space. There are plans for an office / meeting room space to be created in the north east corner.

It is intended that the church will have regular daily use and therefore the heating requirements of the building will radically change from requiring intermittent heating to regular, almost constant heating. The movement towards more regular heating increases the importance of draught proofing and insulation; therefore, the aforementioned recommendation on draught sealing on the doors should be carried out. In addition, any opportunity to insulate the roofs with any roof replacement works in the future must be seized. In the very specific area of the north east corner it is proposed to create a segregated office/meeting room space. This area currently has lower ceilings and it is in the coldest (north east) corner of the church. The proposed use lends itself to sedentary activity and people could be in this space for many hours and will require higher comfort levels; therefore, it is advised that the possibility of insulating internally between the rafters of the roof and then boarding over between the major roof trusses (but leaving the trusses exposed) should be discussed with the church architect and DAC.

Having considered the proposed use of the building and its attributes, it is suggested that the most efficient method of heating the building will be with a mixed system (outlined below) which is capable of providing a low level of background heat in the most efficient manner and then having the facility to boost the heat in the space when occupied. There is mains gas available in the road running directly in front of the church.

A suitable heating solution would therefore be:

- Installing a gas fired underfloor heating system underneath the current timber board pew areas for background heating.
- Installing far infrared panels to the walls of the north and south aisles and behind the altar. These would also be a suitable heating source in the proposed office. These heaters are to be used during occupied hours only.
- Installing an overhead door heater above the main entrance door to be used only when occupied.
- Installing under pew heaters to the choir stalls to be used for services only.

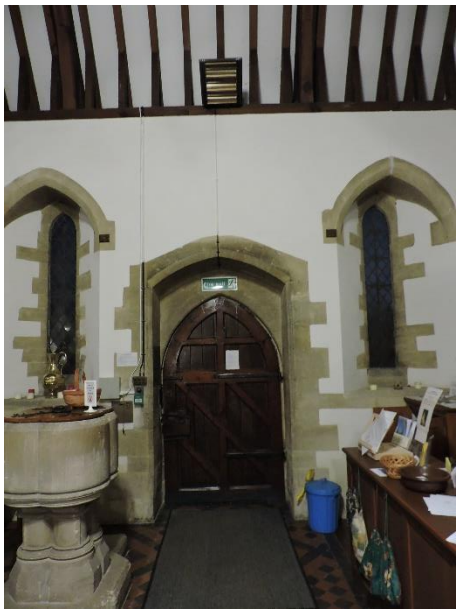
The under-pew heaters to the choir, the over head door heater and panel heaters to the north and south aisle could be installed now, prior to the reordering, to assist in improving the efficiency and comfort of the church but be coordinated with the long-term heating solution.

The phased installation could therefore be:

- Remove the 2 overhead radiant heaters to the north and south aisle and replace with far infrared panel heaters such as https://www.warm4less.com/product/62/900-watt-platinum-white . Three of proposed four of these could be fitted down each wall. A further panel could be installed behind the altar.

- Remove the 2 overhead radiant heaters in the chancel and install under pew heaters to the choir stalls. The two most popular under pew heaters within churches are BN Thermic PH30 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/), whereby three of the PH30 units are required and will fit under the choir stalls on each side or the same from http://www.electricheatingsolutions.co.uk/Content/PewHeating .

- Remove infrared heater located at high level above the main south door and install an overdoor heater full width on the white wall above the door surround. The 890 unit from http://www.bnthermic.co.uk/products/fan-assisted-heaters/800-series/ would be a suitable overdoor heater that is wide enough to fully cover the door.



All of the above could be carried out before the reordering and would help to improve the heating within the church and also the appearance as it removes the unattractive and red glowing infrared units. A discussion should take place with the DAC with regard to whether the above measures could be dealt with as a list B application as they could be considered as “works of adaptation to heating systems”.

Within the reordering project, the feasibility can then be considered for the removal of the remaining overhead heaters in the nave and bringing in a new gas supply to the church from the road, routing this up the church path to a suitable location for a new boiler somewhere at the west end. This could then serve an underfloor heating system located under the existing timber pew platforms which should be removed, insulated and then the underfloor heating installed and new covering put on top. This underfloor system will not be capable of heating the whole church as there is simply not enough floor area to provide sufficient output, but it will be capable of providing background heating at a constant level at around 14 degrees, and from this both the underfloor and

the supplementary heaters can be used to increase/boost the temperature when the building is occupied. By restricting the underfloor heating to the existing boarded pew areas, the need to extensively lift the original floors and any consequential archaeology is avoided. Such a move would provide marginal gains in terms of heating but very significantly add to the project costs.

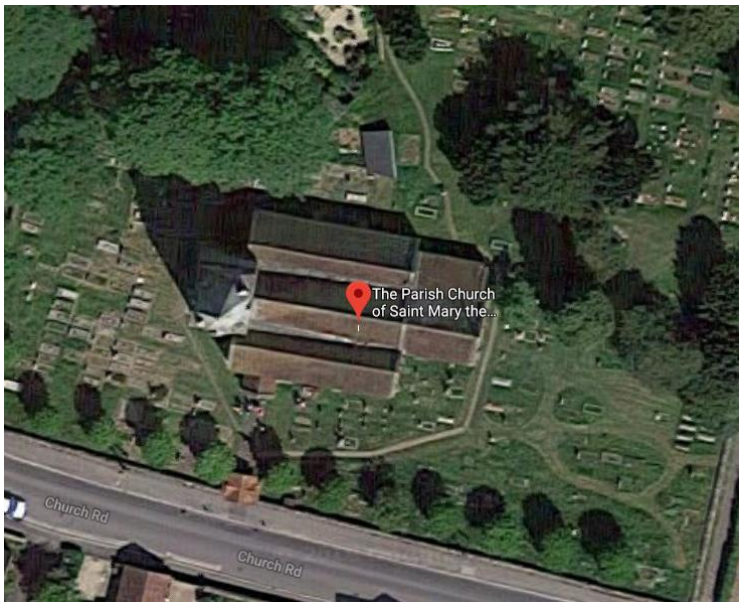
A gas based underfloor system is preferred to an air source-based system as the use of the underfloor will be to maintain the church at a low base level temperature in colder weather conditions (in the shoulder periods of autumn and spring the underfloor heating could be turned off as the ambient weather conditions are warm enough for the panel heaters to provide all the heating). In such operating conditions the coefficient of performance of air source heat pumps is reduced and also it has been found in other churches that the system does not have sufficient levels of heat within poorly insulated and draughty churches for the air source heat pump to be able to successfully defrost itself, thus leading to a freezing cycle rather than a heating cycle. As such the running costs and emissions from a gas based underfloor heating system will be less than an air source-based system and therefore this recommendation will result in a more environmentally and financially sustainable solution.

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
Solar PV	Yes – see note below
Battery Storage	No
Wind	No
Micro-Hydro	No
Solar Thermal	No – insufficient hot water demand
Ground Source Heat Pump	No – archaeological issues for ground works
Air Source Heat Pump	Yes – but see above note
Biomass	Yes – but major issues with delivery and storage of fuel and not advised when mains gas is available

There is a small possibility for a PV array to be installed at St Mary the Virgin.



The south facing slope of the main nave roof has a hidden valley behind the pitched roof of the south aisle and there is a largely non-visible section lower in this valley that could be used. There is some visibility into this valley from the east side, but it is discrete and therefore could be argued to be acceptable. The array will not be large and could have some shading issues from the ridge of the south aisle in winter. Such an array might be capable of providing a small proportion of the electrical needs of the church for lighting and small power, but all energy efficiency items should be implemented prior to this being considered.

8. 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.

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 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 application.

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.