Energy Audit and Survey Report

St Michael & All Angels Church

"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
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1. Executive Summary

An energy survey of St Michael & All Angels 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 Michael & All Angels Church is located in the suburban area of Summertown, Oxford. The church was constructed in 1909 of coursed ragstone with stone dressings with brick. The church is lit exclusively with LED lighting and is heated via gas fired boilers to perimeter radiators. There is a new narthex, including kitchen, WCs and meeting space. There is both gas and electricity 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.

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?
Optimise control settings	17,345	£746	Nil	Immediate	List A	
Install electric heaters in lady chapel for smaller services	9,829	£355	£600	1.69	List B	

Medium 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?
Install SavaWatt devices on fridges and freezers	400	£39	£120	3.05	List B	
Install Endotherm advanced heating fluid into heating system(s)	9,829	£355	£1,776	5.01	List B	
Fit timed fused spurs to hot water heaters	162	£16	£90	5.65	List B	

Long 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?
Install PIR motion sensors on selected lighting circuits (church and hall)	298	£29	£754	25.71	List B	

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

Based on current contracted prices of 9.841p/kWh (blended) and 3.61p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £1,185 per year.

2. Introduction

This report is provided to the PCC of St Michael & All Angels Church 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 Michael & All Angels Church, Lonsdale Road, Summertown, Oxford OX2 7ES was completed on the 19th August 2019 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

St Michael & All Angels Church	
Gross Internal Floor Area	810 m^2
Listed Status	Grade II
Typical Congregation Size	70

The church typically used for 22 hours per week for the following activities

Services	10 hours per week
Meetings and Church Groups	5 hours per week
Community Use	7 hours per week

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

3. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Michael & All Angels Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	10.818 p/kWh	Below current market rates
Night Rate	9.215 p/kWh	Below current market rates
Standing Charge	22.000 p/day	N/A

The current gas rates are:

Single / Blended Rate	3.610 p/kWh	Above current market rates
Standing Charge	0.0 p/day	N/A

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 gas and 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.

4. Energy Usage Details

St Michael & All Angels Church uses 14,413 kWh/year of electricity, costing in the region of £1,418 per year, and 115,632 kWh/year of gas, costing £4,174.

This data has been taken from a single supplied invoice (as opposed to a 12 month set of copy bills) and has been extrapolated, so there will be room for error. The bills have been provided by the suppliers of the site (see Appendix 2). St Michael & All Angels Church has one main electricity meter, serial number E12Z154296. There is one gas meter serving the site, serial number E016K0047815D6.

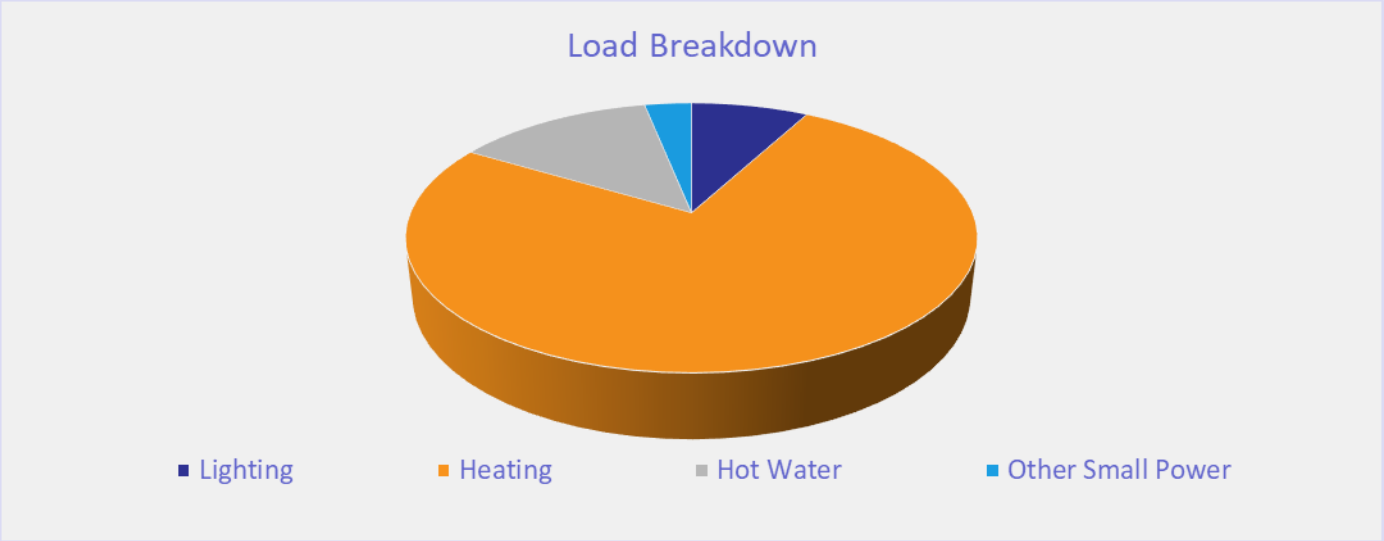
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E12Z154296	3 phase 100A	Pulse output but no AMR connectivity	South Porch
Gas – Church	E016K0047815D6		Full AMR connectivity	External gas meter cupboard, corner of churchyard

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.

4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Exclusively LED fittings in the church with T8 fluorescent fittings in the hall	8%
Heating	Provided by MHS Alpha gas fired boilers to church perimeter radiators and Worcester Bosch boiler to new Narthex extension.	76%
Hot Water	Provided via new combi boiler in Narthex	13%
Other Small Power	Alarm systems, small kitchen appliances, plug loads and the like.	3%



As can been seen from this data (which has been extrapolated from a single utility bill), the heating makes up by far the largest proportion of the energy usage on site. The other significant loads are hot water and lighting.

4.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Michael & All Angels Church uses 11% less electricity and 5% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Michael & All Angels Church use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Michael & All Angels Church (elec)	810	17.79	20	10	-11%
St Michael & All Angels Church (heating fuel)	810	142.76	150	80	-5%
TOTAL	810	160.55	170	90	-6%

5. Energy Saving Recommendations

5.1 Lighting (control for internal lights)

Several of the lighting circuits within the building already have motion / daylight sensors installed on them such as the narthex and WCs. However, it was noted during the audit that these sensors are not currently set up to work to their full potential.

It is recommended that the existing lighting sensors installed within the building are reviewed and optimised so that the time lag before they turn off the lights, and the light level at which they allow the artificial light to be turned on is adjusted so that it is suitable for the space. Depending on the type of light fitting installed it is normally recommended that areas such as storerooms and cleaners' cupboards switch off after just 1 minute, corridors and stair lobbies after 2 minutes and WCs after 5 minutes. Generally lighting levels should be around 300lux but it is highly dependent on the use of the space.

The careful optimisation of the existing lighting controls can be undertaken by Inspired Efficiency (contact matt@inspiredefficiency.co.uk, 07971 787363) without any disruption to the use of the building.

5.2 Refrigeration Controls

Within the new kitchen, there is a domestic refrigeration unit for storage of milk and food. These units run 24/7 and contribute to the baseload electrical consumption of the building.

To reduce the electrical consumption of these appliances it is recommended that they are all fitted with a SavaWatt unit. These units work by automatically detecting the load of the compressor and turning down the power when it is not in full load. This reduces the energy consumption of the refrigeration unit by around 18% while maintaining the cooling of the appliance. It does this by reducing the voltage delivered to the unit when it is idling but allowing the full energy to the unit when it is required.

The supply and installation for all units and further details can only be undertaken by SavaWatt directly http://savawatt.com/. The installation does not cause any significant disruption to operations and can be undertaken during normal operating times.

5.3 Endotherm Advanced Heating Fluid

In order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid (http://www.endotherm.co.uk/) is added to the heating system.

This fluid is in addition to and complements any existing inhibitors in the heating system and is added in a similar way. The fluid works to improve the ability of the boiler to transfer heat into the heating system and for the radiators and other heating elements to give out their heat into the rooms. It does this by reducing the surface tension of the water and increasing its capacity to transfer and hold heat. Case studies have demonstrated that the addition of this fluid into heating systems reduces heating energy consumptions by over 10% as well as helping the building heat up quicker.

Endotherm can be supplied and self-installed or supplied and installed by Inspired Efficiency (contact matt@inspiredefficiency.co.uk, 07971 787363).

5.4 Timeclocks to Hot Water Heaters

There is an electric hot water boiler (for tea making and the like) located within the new kitchen. These only need to heat the water to the required temperature when the building is in occupation but at the moment these heaters are directly wired in without any form of time control and therefore maintain their set temperature 24/7.

It is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied, and 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.

5.5 Switch off Background Heating and Optimise Controls

The use of background heating is not generally needed to preserve the fabric and running the church at 16°C background temperature is not recommended. Heating needs 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 and is an incredibly wasteful practice. If the church refuses to remove the background heating setting the background level to 12 degrees would be a good first step.

The buildings main heating, hot water and ventilation plant is controlled by a Reznor Energymizor system operated from a control panel located in the vestry.

A high level review of the settings within this control system highlighted a number of areas where the way in which it operates the building can be optimised to both reduce energy consumption and improve comfort. For example:

- The heating is always set to 16°C when the church is unoccupied
- Occupied times may be more closely controlled to match occupation

It is therefore recommended that a controls optimisation process is undertaken to re-programme the controls to match occupied times and to switch off the heating when the church is not occupied. This can be undertaken by anyone with good knowledge of the heating control panel. More than one person should be competent in the operation of the controller for minimising risk if people are on holiday/not available.

5.6 Use of Electric Panels for Heating Specific Areas only

The heating within the Lady Chapel is currently three cast iron column radiators which are run off the main heating circuit. Therefore, when this area is used for the mid-week services, the whole of the church has to be heated. To avoid having to heat up the entire church building for these smaller mid-week services, it is recommended that the PCC consider installing electrical panel heaters in this area on a time delay switch. Introducing electric panel heaters should also support the move to switch off the heating when the church is not occupied. To bring the church up to the desired 20°C will require an earlier start time, but heating bills should significantly reduce through this approach.

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.

6. 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
Battery Storage	No
Wind	No
Micro-Hydro	No
Solar Thermal	No
Ground Source Heat Pump	No

Air Source Heat Pump	No
Biomass	No

Solar PV is not really considered feasible at this church for a variety of reasons. Firstly, the church is listed and there is no viable roof space where solar panels could be installed without being very visible or alternatively not visible but in large amounts of shade due to either the steep church roof itself or the tall trees that surround the site. Secondly, the site has a low electrical demand following the installation of LED lighting throughout, so there is no real continual baseload that would require supply. Finally, as the Feed-in-Tariff has now been scrapped, any excess electrical loads not used by site would simply be fed back to the grid with no financial benefit to the church.

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 a 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, therefore investment into this (alongside any PV system) may be worth delaying at this stage.

7. 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.

8. 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.

9. Other Observations

It was noted during the audit that there was significant amounts of air within the radiators in the church. To operate the heating optimally, the heating system should be checked frequently for air and bled as necessary. If persistent air is being found within the system, it is recommended that a leak sealant is introduced to the system to try to mitigate this. This can be carried out by your incumbent heating engineer.

During the survey, the introduction of an energy display unit, such as an Owl or Wattson unit was discussed. However, this was not deemed to be necessary and the church should discuss the installation of smart meters with their utility providers, ensuring that any meter installed meets the SMETS2 standards and that a SMETS1 meter is not installed.

10. Other Observations – Church Hall

10.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building, and all areas are lit by inefficient fittings. The hall lighting is predominantly inefficient T8 fluorescent tube fittings with CFL lamps in the WCs. Savings are based on the use of the hall for 22 hours per week. Replacement LED fittings are widely available on the market and it is suggested that the complete fitting (not just the lamp) is replaced. Any new LED fitting would have a much longer life and hence reduce the need to replace the lamps in the ceiling.

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 £3,283. The annual cost saving would be £206 resulting in a payback of around 16 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.

10.2 Lighting (control for internal lights)

There are several lights which currently remain on all the time in areas such as the lobby, toilet areas, and the kitchen, as well as the hall itself. 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 consider 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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Church Hall	12	5ft Single LED	£74.84	£1,124.40	15.02
Hall WC	8	LED GLS	£18.59	£84.00	4.52
Hall Kitchen	4	5ft Single LED	£24.95	£374.80	15.02
GF Hall	12	5ft Single LED	£74.84	£1,124.40	15.02
GF Lobby	2	5ft Single LED	£12.47	£187.40	15.02