Energy Audit and Survey Report

St Catherine of Siena

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

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1. Executive Summary

An energy survey of St Catherine of Siena 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 Catherine of Siena church was built in 1963 and is located in the heart of a 1960's housing estate and is opposite the Birch Copse primary school. It is of brick and concrete construction with a copper standing seam roof over the church and a pitched tile roof over the hall area. The building comprises a church and office, coupled with the later additions of a large multi-purpose hall and welfare facilities. 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?
Reduce set point of hot water to 60 deg C	1,270	£42	Nil	Immediate	List A	
Optimise control settings	8,465	£397	£150	0.38	List A	
Fit flow regulators onto existing taps	2,540	£84	£60	0.72	List A	
Install SavaWatt devices on fridges and freezers	940	£110	£290	2.64	List A	

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 Endotherm advanced heating fluid into heating system(s)	7,195	£237	£1,408	5.94	List A	
Change existing lighting for low energy lamps/fittings	4,963	£581	£3,909	6.73	List B	
Add new PIRs and adjust settings on existing PIRs	211	£25	£174	7.04	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 11.698p/kWh and 3.053p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £1,475 per year.

2. Introduction

This report is provided to the PCC of St Catherine of Siena 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.

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An energy survey of the St Catherine of Siena, Wittenham Avenue, Tilehurst, Reading RG31 5LN was completed on the 17th December 2018 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 Catherine of Siena	
Gross Internal Floor Area	200 m^2
Listed Status	Unlisted

The church typically used for 30 hours per week for the following activities

Services	4 hours per week
Meetings and Church Groups	2 hours per week
Community Use	3 hours per week
Other Use including café	11 hours per week

The hall is used more frequently, with hours of operation from 0800 until 2100 most days and Sundays used for 4 hours in the morning only. There is additional usage of both spaces 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 Catherine of Siena and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	11.698p/kWh	In line with current market rates
Standing Charge	£16.56 / quarter	N/A
FIT Charges	0.536 p/day	N/A

The current gas rates are:

Single / Blended Rate	3.297 p/kWh	In line with current market rates
Standing Charge	0 p/day	N/A
Availability Charge	0 p/kVA	N/A
Meter Charges	0 p/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 and should continue with their current procurement practices.

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	100% charged / not charged / reduced % rate charged	The correct CCL rate is being applied.
FiT	100% charged	A FiT charge is being applied. It should be checked that this is being charged in accordance with the supply contract.

The above review confirmed that the correct taxation and levy rates are being charged. It is noted that the electricity bill from British Gas dated 15 October 2018 was charged at 20% VAT but appears to have been verified and a credit note issued in November 2018.

4. Energy Usage Details

St Catherine of Siena uses 16,758 kWh/year of electricity, costing in the region of £1,960 per year, and 84,651 kWh/year of gas, costing £2,791.

This data has been taken from a summary spreadsheet provided by the church warden and validated using the annual energy invoices provided by the suppliers of the site (see Appendix 2). St Catherine of Siena has one main electricity meter, serial number K10C04233. There is one gas meter serving the site, serial number M016K0013916D6.

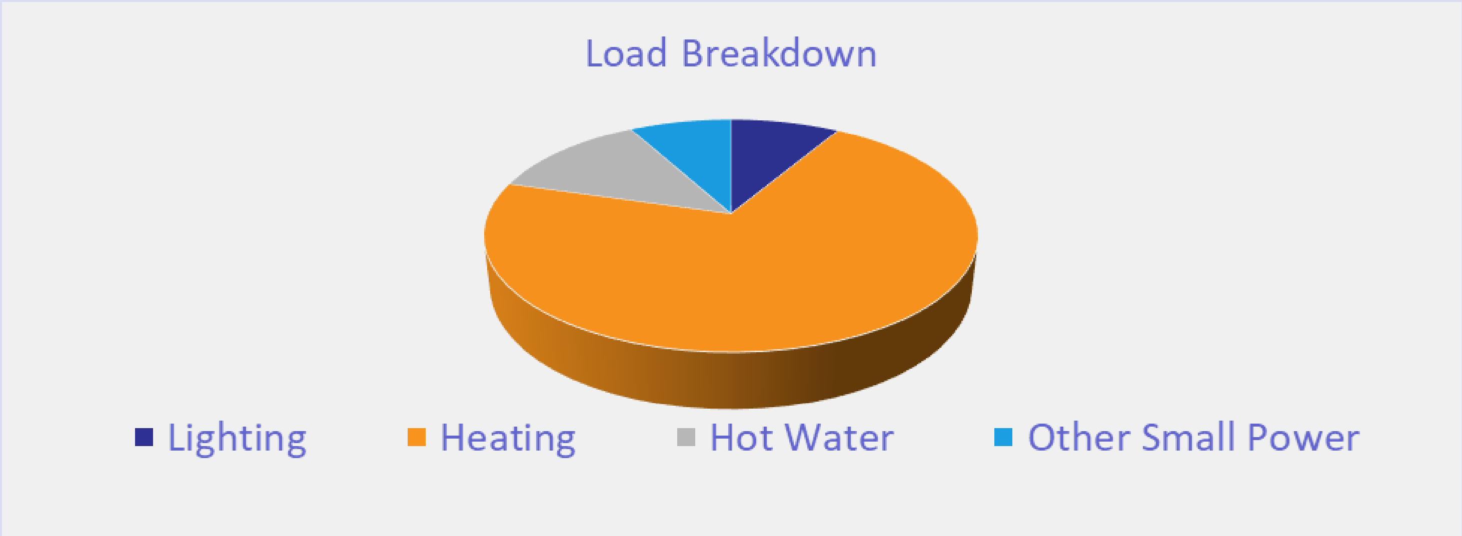
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	K10C04233	Elster A1100 - 3 phase 100A	Yes but no AMR connectivity	Wall cupboard, old lobby
Gas	M016K00139 16D6	Elster BK G10M (MDK16)	Full AMR connectivity	External gas meter cupboard

It is recommended that all the AMR metering is collected on a single web-based portal such as Stark so that regular automated energy profiles can be easily produced and shared with the site team.

4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	A broad range of fittings from inefficient T8 fluorescent tubes to more efficient CFLs and 2D fittings in the hall and the introduction of LED.	9%
Heating	Two condensing gas fired boilers providing heating and hot water to all areas.	71%
Hot Water	Indirect gas fired 60 litre hot water calorifier.	13%
Other Small Power	Kitchen appliances, fire systems and the like.	8%



As can been seen from this data, 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 Catherine of Siena uses 319% more electricity and 182% more heating energy than would be expected for a church of this size. However, the consumption figures include the hall and it is noted that both spaces are used far more frequently than a typical church, leading to an apparent over consumption.

	Size (m^2 GIA)	St Catherine of Siena use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Catherine of Siena (elec)	200	83.79	20	10	319.0%
St Catherine of Siena (heating fuel)	200	423.26	150	80	182.2%
TOTAL	200	507.05	170	100	198.3%

5. Energy Saving Recommendations

5.1 Lighting (fittings)

The lighting makes up a relatively large overall electrical load within the building, and large areas are lit by relatively efficient compact fluorescent and 2D fittings, as well as a number of LED fittings in the newer spaces.

There still remains a large number of inefficient T8 fluorescent tube fittings within WCs, hall lobby and kitchen and some SON flood lights within the church.

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

If all the lights were changed the total capital cost (supplied and fitted) would be £3,909. The annual cost saving would be £581 resulting in a payback of around 6.7 years.

5.2 Lighting (control for internal lights)

Several of the lighting circuits within the building already have motion / daylight sensors installed on them. 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 store rooms and cupboards switch off after just 1 minute, corridors 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.

There are also lights within the hall lobby and hall kitchen which currently remain on all the time and rely on being switched off manually . 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.

It is recommended that alongside the change of these fittings to LED, 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.

5.3 Refrigeration Controls

Across the site there are various domestic and commercial refrigeration units such as fridges within the hall kitchen, and a large commercial kitchen fridge and freezer within the cafe kitchen. 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 of these 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.

5.4 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.

5.5 Space Temperature Set Point

The stored hot water currently has a set point of 65°C. This is above the recommended levels for water hygiene.

HSE Guidance (HSG271 Part 2, Para 2.6) states that “Hot water should be stored at least at 60 °C and distributed so that it reaches a temperature of 50°C (55°C in healthcare premises) within one minute at the outlets.” It further states (para 2.25) that for indirect heating such as the arrangement in this building “The boiler plant (or other calorifier heat source) should be heating while the shunt pump is active to ensure a temperature of at least 60 °C is achieved throughout the vessel for at least one continuous hour a day.

It is therefore advised that the set point should be set to 60°C and the hot water system run for at least one hour each day.

This is a relatively simple adjustment which can be made by those on site or the heating engineer during their next service visit.

5.6 Controls

The buildings main heating and hot water plant is controlled by a couple of integrated controllers operated from a control panel located in the boiler room and a timeclock within the church for the perimeter heating.

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. This mainly refers to the time schedules of both the church and hall, where the heating remains on during unoccupied periods. It is recommended that the heating and hot water time schedules are more closely aligned to occupation of the spaces. Most notably, the church appears to be heated on a Monday morning for 4 hours with no-one in the space and daily for 10 minutes before midnight, for which there is no apparent reason. Additionally, the hall is heated throughout the day even though there are days with unoccupied periods of 3 hours or more.

It is recommended that during periods where the church and/or hall are unoccupied, the heating and hot water and switched off, which will reduce gas consumption and associated cost.

6. Saving Recommendations (Water)

6.1 Tap Flow Regulators

The taps to the wash hand basins within the building have been checked as part of the audit and the average flow rate within these has been measured to be 12 litres/min. The recommended flow rate for hand washing is 4.8l/min and therefore the taps are providing around double the amount of water that is necessary.

The over provision of water for hand washing is not only a source of excessive water use, but in the case of hot water, it is also a source of wasted energy in the heating that has to go into providing the hot water.

The flow rate of the taps can be easily regulated by fitting flow regulators within the taps. It is recommended that flow regulators such as those manufactured by neoperl (http://www.neoperl.net/en/) are fitted into all the viable hand wash basin taps to save on both water and heating of the hot water.

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
Battery Storage	Yes – but PV should be sized to be fully utilised
Wind	No – No suitable land
Micro-Hydro	No – No water course
Solar Thermal	No – no significant hot water demand
Ground Source Heat Pump	No – expensive ground works versus 3 year old boilers
Air Source Heat Pump	Yes – but no need with current heating system
Biomass	No – issues with air quality in a built up environment, as well as storage and deliveries

The south facing roof of the church would appear to be a good location for the installation of a solar photovoltaic array. However, standing seam roofs are typically more difficult to work with and would need to be investigated further. If the seams are pinned, the panels can be clamped without the need for drilling, however, fixing of panels may also lead to a higher capital cost if penetrations and fixings are required. The hall roof would need to be checked for structural integrity but a PV array could be mounted on a number of the roofs to generate electricity. The tree to the South of the hall may need to be removed or pruned to a lesser height and maintained if a PV array were to be installed. It is worth noting that any PV array would need to be optimally sized to make use of all generation as the Feed In Tariffs have now been discontinued.

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 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
Church	4	LED GLS	£48.21	£126.00	2.61
Altar	5	AR111 LED	£70.08	£222.70	3.18
Altar	3	50W LED Flood	£72.41	£273.90	3.78
Altar	1	50W LED Flood	£24.14	£91.30	3.78
Hall	14	5ft Single LED	£58.49	£1,481.60	25.33
Old kitchen	1	5ft Single LED	£29.06	£93.70	3.22
Old WCs (ladies)	5	2D LED 7W	£18.14	£315.20	17.37
Hall lobby	1	5ft Single LED	£29.06	£93.70	3.22