# Energy Audit and Survey Report

# St Mary and St Nicholas 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 |
|---|---|---|---|
| David Legge | Matt Fulford | 29th April 2019 | 1.0 |

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# 1. Executive Summary

An energy survey of St Mary and St Nicholas 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 and St Nicholas Church is a Grade II* listed parish church, located in the village of Littlemore. 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? |
|---|---|---|---|---|---|---|
| Install SavaWatt devices on fridges and freezers | 140 | £32 | £50 | 1.55 | List A | |
| Change existing lighting for low energy lamps/fittings | 2,959 | £680 | £3,047 | 4.48 | 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 | 13 | £3 | £59 | 20.20 | List B | |
| Fit Quattroseal draft proofing to historic doors | 562 | £129 | £800 | 23.73 | 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 22.98p/kWh and 6.00p/kWh for electricity and mains gas respectively.

**If all measures were implemented this would save the church £844 per year**.

***The use of portable LPG heaters within churches is hugely detrimental and should be put to a stop in this church as a matter of some urgency. These heaters provide huge amounts of acidic moisture into the air which can extremely harmful to the building fabric. There is no flue for the combustion products and therefore harmful combustion gases include Carbon Monoxide are breathed in by the congregation and the use of them within churches can also invalidate the church insurance.***

## 2. Introduction

This report is provided to the PCC of St Mary and St Nicholas 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.

St Mary and St Nicholas Church is a Grade II* listed parish church, located in the village of Littlemore. The church was built in 1836 for John Newman as a Chapel of Ease, until 1847 when it became its own parish church. There is both gas and electricity supplied to the site.

An energy survey of the St Mary and St Nicholas Church, Sandford Road, Littlemore, OX4 4PP was completed on the 4th April 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 Mary and St Nicholas Church** | |
|---|---|
| Gross Internal Floor Area | 270 $m^2$ |
| Listed Status | Grade II* |
| Typical Congregation Size | 45 |

The church typically used for 10 hours per week for the following activities

| | |
|---|---|
| Services | 5 hours per week |
| Meetings and Church Groups | 2 hours per week |
| Community Use | 3 hour 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 Mary and St Nicholas Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

| | | |
|---|---|---|
| **Single / Blended Rate** | 22.9830 p/kWh | Well above current market rates |
| **Standing Charge** | 36.091 p/day | N/A |

The current gas rates are:

| | | |
|---|---|---|
| **Single / Blended Rate** | 6.004 p/kWh | Well above current market rates |
| **Standing Charge** | 24.60 p/day | N/A |

The above review has highlighted that there are significant opportunities to gain cost savings from improved procurement of the energy supplies at this site. We would therefore strongly recommend that the church promptly 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 Mary and St Nicholas Church uses 4,751 kWh/year of electricity, costing in the region of £1,092 per year, and 28,081 kWh/year of gas, costing £1,686. In addition, 4no. portable LPG gas heaters are used in the church, but this data has not been provided and as such costs are not recorded.


This data has been taken from the annual energy invoices provided by the suppliers of the site (see Appendix 2). St Mary and St Nicholas Church has one main electricity meter, serial number L03C06578. There is one gas meter serving the site, serial number M016A05224 15A6.

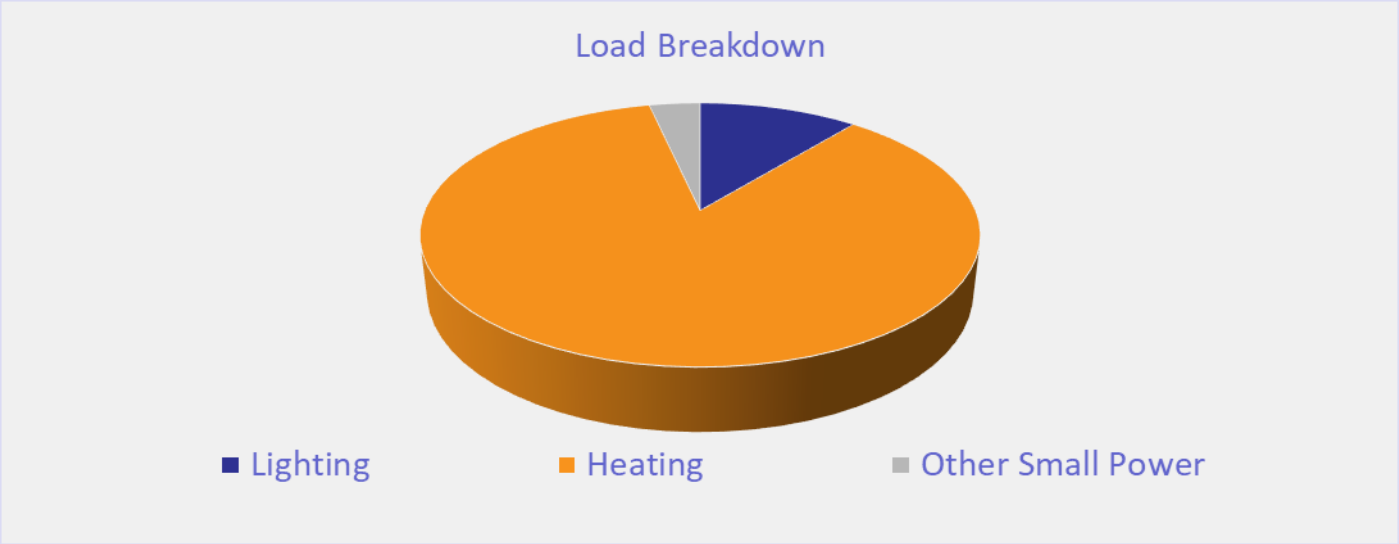
| Utility | Meter Serial | Type | Pulsed output | Location |
|---|---|---|---|---|
| **Electricity – Church** | L03C06578 | 1 phase 100A | Yes but no AMR connectivity | Vestry |
| **Gas – Church** | M016A0522415A6 | | Full AMR connectivity | Cupboard adjacent to font |

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** | Predominantly inefficient PAR38 spot lights, some SON flood lights in chancel and a move to LED in the nave | 11% |
| **Heating** | A broad mix of systems including 6no. high level direct gas burners (half reportedly defective), 4no. portable gas burners, 3no. electric panel radiators, underpew heaters in choir stalls and 3no. radiant heaters. | 85% |
| **Other Small Power** | Fridge and small kitchen appliances | 4% |




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 load is lighting.

## 4.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Mary and St Nicholas Church uses 12% less electricity and 31% less heating energy than would be expected for a church of this size. This is likely to reflect the hours of use more than the efficiency of the heating and lighting.

| | Size ($m^2$ GIA) | St Mary and St Nicholas Church use kWh/$m^2$ | Typical Church use kWh/$m^2$ | Efficient Church Use kWh/$m^2$ | Variance from Typical |
|---|---|---|---|---|---|
| **St Mary and St Nicholas Church (elec)** | 270 | 17.61 | 20 | 10 | -12% |
| **St Mary and St Nicholas Church (heating fuel)** | 270 | 104.11 | 150 | 80 | -31% |
| **TOTAL** | 270 | 121.73 | 170 | 100 | -28% |

# 5. Energy Saving Recommendations

## 5.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building, and all areas are lit by inefficient fittings. The nave and chancel are predominantly lit by inefficient PAR38 spot lights, located at the top of the wall plate. These are supplemented by LED flood lights half way along the wall plate, plug in lamps and fairy lights. The chancel is further lit by SON flood lights. The vestry is lit by relatively efficient 2D fittings.

The church has a decorative but dark wooden ceiling which is currently poorly lit. To provide good general area lighting to the nave and chancel, the use of up and downlighters should be considered (and is understood to have been considered with a lighting design developed by Sylvania) to promote a welcoming environment but which could also serve to provide different lighting options.

Care should be taken of the exact fitting which is specified, and consideration should be given to using a slightly whiter light than might otherwise be used in churches. Something around the 3500K colour range should provide a good balance of a white light without being too yellow.

It is therefore suggested that track spot lighting fittings are located at the top of the wall plate in the nave and chancel. The track mounted spot fittings will be able to be directed to give a better range of light and can be easily added to as required. These fittings can provide the opportunity

for both up and down lights if the fittings can be wired to allow dimming the up lighting and down lighting fittings to different levels.

There are hundreds of fittings on the market and merely one example of what could be considered is the JCC Starspot 3000 range https://www.jcc.co.uk/en_GB/products/jc14204blk

Installing track lighting would allow for various lighting options and all other light fittings could then be removed.

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 £3,047. The annual cost saving would be £680 resulting in a payback of around 4.5 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.

## 5.2 Lighting (control for internal lights)

The vestry and meeting room 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 suggested that a motion sensor can be 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

In the vestry there is a domestic refrigeration unit for storage of milk and food. This unit runs 24/7 and contributes to the baseload electrical consumption of the building.

To reduce the electrical consumption of this appliance it is recommended that it is 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.

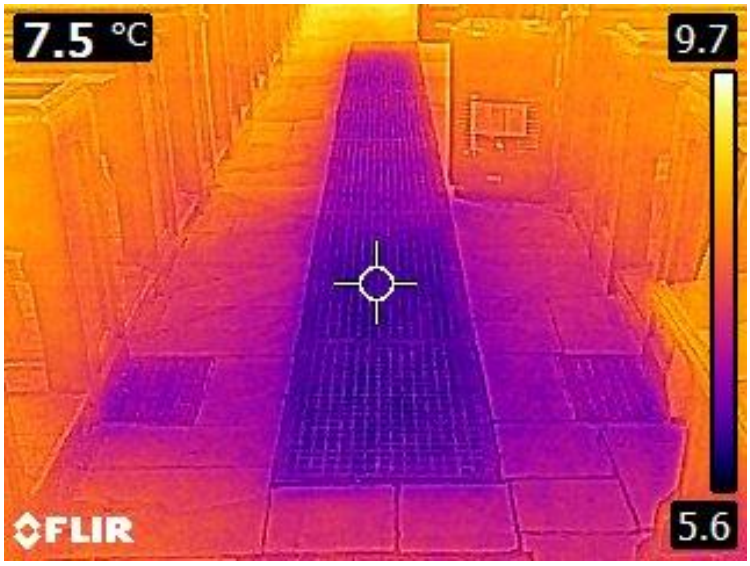
## 5.4 Quattro Seal

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 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

In addition, to reduce the cold air ingress from the underfloor void, the open ends of these floor grilles should be blocked up or the grille lifted, and insulation backed board (painted black) fixed in beneath the grille and then the grille replaced. This will reduce cold air into the church space and will be noticeable as this is next to the current seating, so parishioners will notice the cold air.




## 6. Reordering Plans

There are reordering plans for the church, whereby the pews are to be removed and replaced with moveable stacking chairs. In addition, the organ is to be relocated to a new gallery, with a new kitchenette and WC underneath the gallery. The hope is that the use of flexible seating and improvements to the space will attract more community use and the church will be used far more frequently than it currently is.

The current heating solution consists of a wide variety of heating systems which includes: 3no. plug in radiant heaters, 6no. direct gas burners, and 4no. portable LPG heaters all to heat the nave, under pew heaters to the choir stalls, and 2no. electric panel radiators within the vestry. Suffice to say that this appears to have grown organically and requires an overhaul to heat the space in the most efficient manner.

The PCC have obtained a quotation from Chris Dunphy heating to install a gas fired heating system, which distributes the heat via perimeter radiators throughout. Chris Dunphy heating engineers have recommended that a background level of heating (at say 10°C) is maintained year round to drive out moisture and retain heat within the building. There is reported mould growth in the chancel and reports that the reredos may suffer without a level of background heating. It is most likely that the root cause of the current moisture and mould growth is the high levels of moisture given off from the direct burning of gas through the portable propane heaters and high-level gas heaters. Removing these heaters is likely to solve a large element of this issue. If conservators are of the opinion that the reredos requires conservation heating, this

will be best delivered to it locally with the use of a tube or similar heater. Adopting a solution which has year around background heating can therefore be avoided and provide an end result which improves the fabric situation without having to consuming vast amounts of energy as it is equally important to conserve the fabric as it is to conserve the world God created!

The vestry areas and the upstairs meeting room are only used for short periods of time. Given the nature of both their uses, a simple Far infrared electric panel heater (https://www.warm4less.com/store/7/premium-white-panels) with a time delay switch (https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms) will be a suitable and simple solution where the occupant can switch on the heat which will provide instant heat and it will then automatically switch off after the chosen amount of time so that it is not able to be left on accidentally.

The nave and chancel could then be heated by perimeter radiators from a gas fired boiler as per the suggestion from Chris Dunphy albeit that the control of them should be for services and other events only and not to provide constant year round background heating.

As per the recommendation for vestry heating, it is recommended that the use of electrical far infrared panel heaters with a simple time lag switch would be most appropriate for times when only this area is being used. Equally, the use of under plinth electric heaters such as https://www.myson.co.uk/products/kickspace_electric.htm can be used in the kitchenette.

The hot water to the kitchenette and WC should be provided by an electric point of use heater which has little or no stored water within it; simple over sink units can be very effective in this situation.

Lighting should be LED and within the WC should be controlled with a simple PIR sensor to automatically switch off the light when the space is unoccupied. This sensor should be set to as short a period as possible, with a suggested time of 5 minutes without movement before switching off the light.

# 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** | No – insufficient demand to make financial sense, visible roofs |
| **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 even with new kitchenette and WC |
| **Ground Source Heat Pump** | No – archaeology in ground no radiator system |
| **Air Source Heat Pump** | No – insufficient electricity supply |
| **Biomass** | No – not enough heating load as well as air quality issues |

Now that the Feed in Tariff scheme has come to an end the installation of solar PV panels in situations where there is not almost full usage of the electricity generated on site is not really viable.

Having reviewed the site it is not considered that there is good viability for any renewables and instead a good clear focus on reducing the energy demand of the building should continue with a targeted approach on reducing the heating energy.

## 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 |
|---|---|---|---|---|---|
| **Narthex** | 1 | 2D LED 11W | £2.50 | £97.00 | 38.80 |
| **Nave** | 28 | PAR38 LED | £415.61 | £1,247.12 | 3.00 |
| **Chancel** | 4 | 50W LED Flood | £59.28 | £365.20 | 6.16 |
| **Chancel** | 13 | PAR38 LED | £192.96 | £579.02 | 3.00 |
| **Vestry** | 3 | 5ft Single LED | £4.47 | £323.55 | 72.31 |
| **Vestry** | 2 | 2D LED 7W | £5.13 | £151.55 | 29.52 |