Energy Audit and Survey Report

Holy Trinity Church, Headington

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	Marisa Maitland	26th February 2019	1.0

© Inspired Efficiency Ltd

Contents

Executive Summary

An energy survey of Holy Trinity Church, Headington 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.

The Holy Trinity Church, Headington is a Victorian Church that serves the community and is also a tourist attraction. 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?
Change existing lighting for low energy lamps/fittings	406	£47	£729	15.49	List A	
Install Endotherm advanced heating fluid into heating system(s)	4,898	£173	£320	1.85	List A	
Optimise control settings - reduced hours and background set point to 8°C.	7,348	£276	£150	0.54	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?
Insulate exposed pipework and fittings in plantrooms	2,449	£86	£350	4.05	List B	
Fit Quattroseal draught proofing to historic doors	980	£114	£450	3.96	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?
Consider fitting and using small number of electric panel heaters for morning prayer services (could be part of extension)	3,919	£138	£2,500	18.09	Faculty	

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

All savings are based on current contracted prices of 11.601p/kWh and 3.527p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £834 per year.

1. Introduction

This report is provided to the PCC of Holy Trinity Church, Headington 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 the advice also seeks 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.

Holy Trinity Church, Headington is a Victorian Church consecrated in 1849 with later additions that serves the community and is also a tourist attraction related to its connection with CS Lewis. It has plans to add an extension for a kitchen and children's area.

An energy survey of the Holy Trinity Church, Headington, 46 Quarry Road, Oxford, OX3 8NU, 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.

Holy Trinity Church, Headington	
Gross Internal Floor Area	247 m^2
Listed Status	Grade II

The church typically used for 9-10 hours per week for the following activities

Services	7 hours per week (minimum)
Meetings and Church Groups	2 hours per week
Community Use	Occasional Use

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

2. Energy Procurement Review

Energy bills for gas and electricity have been supplied by Holy Trinity Church, Headington and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single Rate (plus FiT)	11.601p/kWh	Below current market rates

The current gas rates are:

Single Rate	3.527 p/kWh	Above current market rates
Standing Charge	£10.00/quarter	N/A

The current supply contracts are fixed until 31st October 2019, the procurement of the electricity contract was good and has resulted in a current rate which is lower than current market rate. The gas rate is a little higher than is currently being seen in the market. When the contracts come up for renewal in October we would 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 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% elec / 20% gas	The church is a charity and therefore should be benefiting from only being charged a 5% VAT rate on both gas and electricity. A VAT declaration should be sent to the supplier to adjust this for the gas.
CCL	100% charged on gas / not charged	As the organisation is being charged the wrong VAT rate on the gas, they are also being charged CCL which should not be applied as they are a charitable organisation. Sending the supplier a VAT declaration will remove this charge.
FiT	100% charged	A FiT charge is being applied. This is standard practice for SSE contracts.

The above review has highlighted that VAT and CCL are being charged when the organisation is understood to be a charity and have VAT exemption status. As such the Church should send the

supplier at VAT declaration confirming this and check all supplies on other sites. It is understood that the Treasurer is already aware of this issue and is awaiting a refund from the supplier.

3. Energy Usage Details

Holy Trinity Church, Headington uses 1,389 kWh/year of electricity, costing in the region of £160 per year, and 48,985kWh/year of gas, costing £1,750.

This data has been taken from the regular meter reads that are undertaken by the church and logged on the Pilio system. Holy Trinity Church, Headington has one main electricity meter, serial number K07A56231. There is one gas meters serving the site, serial number E6E06963269806

Utility	Meter Serial	Type	Pulsed output	Location
Electricity	K07A56231	Single phase 100A	No	Basement boiler room
Gas	E6E06963269806	Not seen	No	Not seen

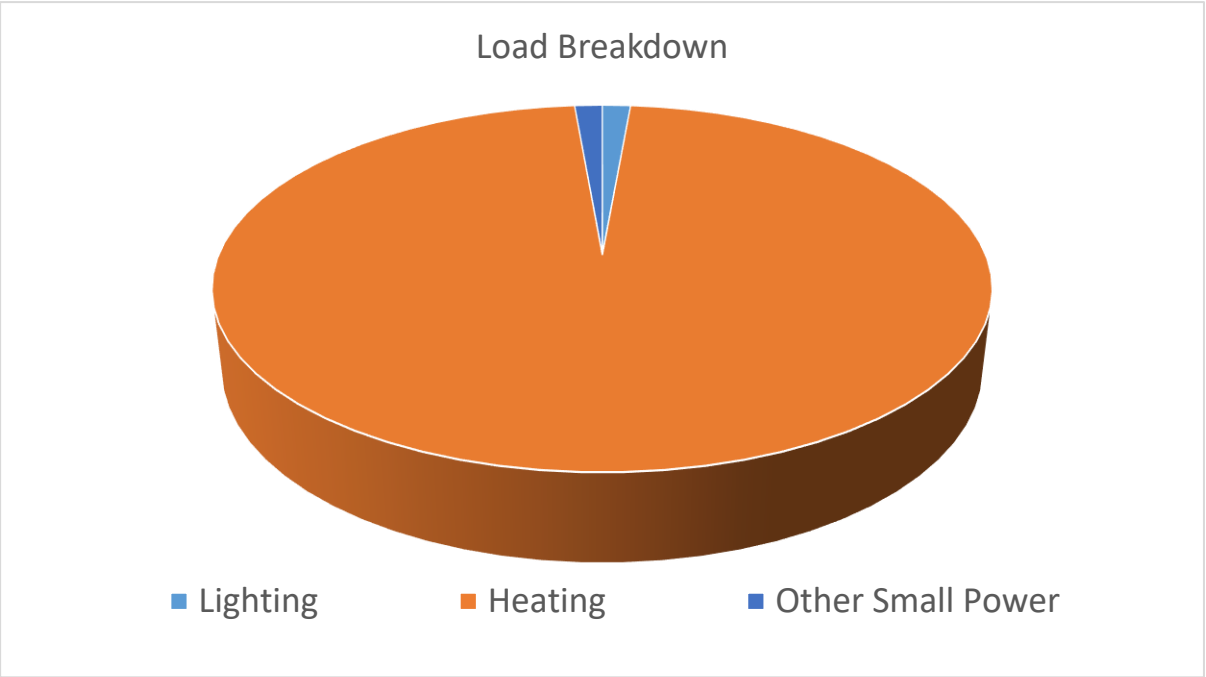
Neither of the meters have the capability of being read automatically. Given the larger gas consumption it may be prudent to consider contacting the supplier to see what the implications would be for upgrading the gas meter for a smart meter. The electricity meter will eventually be changed for a smart meter by the provider but there is little need to change it prior to then.

The church is very good at taking their own readings and using the Pilio system to record and analyse these. This is good practice and should be continued with to aid the church in reviewing its energy usage and quantifying the improvements it makes.

3.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Predominately compact fluorescent PAR38 spots in the church with some flood lights	2%
Heating	Gas fired heating system to radiators around the church	97%
Other Small Power	Kettle, organ and other small appliances	1%



As can been seen from this data, the heating makes up by far the most significant energy consuming area on site and should be the focus for making the most significant energy efficiency improvements.

3.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use Holy Trinity Church, Headington uses 72% less electricity and 1222% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Holy Trinity Church, Headington use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
Holy Trinity Church, Headington (elec)	247	5.62	20	10	-71.9%
Holy Trinity Church, Headington (heating fuel)	247	198.32	150	80	+32.2%
TOTAL	247	203.94	170	90	+20.0%

This strongly demonstrates that the church is very efficient when it comes to electrical consumption and the efforts over the previous years to improve the lighting to CFL and now to LED has delivered very well. The heating is hugely over expectations and the current approach to background heating the church at 12°C and having daily heating for the morning service is very energy intensive.

4. Energy Saving Recommendations

4.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building mainly due to the church having taken proactive action to replace its spot lighting to compact fluorescent versions. It has now embarked on replacing these for the even more efficient LED versions and it is recommended that all lights are now fitted with LED lamps. This is a List A item and requires no permission.

In addition it is recommended that the strip light in the vestry is changed to an LED linear light fitting 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.

The flood lights around the church would also benefit from being changed to LED versions. Most of the current flood lights appear to be 70W SONs and these could easily be replaced for 30W LED units. Again, 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.

4.2 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 and purchased from the link above. This would be a List A item and require no further permission.

4.3 Insulation of Pipework and Fittings

The pipework within the boiler room has been left entirely uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the boiler room unnecessarily warm. The exposed hot surfaces also represent a health and safety risk of burns for those working in the area as well as increasing the freezing risk of the pipes.

It is recommended that all areas of pipework and all the pipework 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 arranges through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com). This item could be considered as a maintence item and therefore be covered under List A, but it would be worth checking with the DAC Secretary as they may wish to deal with it as a List B item.

4.4 Clean / Flush Existing Heating System

It was noted during the audit that some of the radiators had significant amounts of air in the system, these were bled out and the system re-pressurised as part of the audit. There can be many causes for air getting into the system and it was noted that the system did occasionally need re-pressurising so it is likely that there may be a weeping joint. There were no signs of significant leaks or sludge in the system noted during the audit. There were one or two joints that show some signs of corrosions around them which may indicate a weeping joint and it is advised that the next time a heating engineer is at the church they are asked to check and seal any joints as required.

4.5 Space Temperature Set Point

The church is currently heated to 18 degrees for services which is a sensible and recommended level. It is then heated to a background level of 12 degrees at all other times. There is little in the church that necessitates background heating all the time and while the church does have daily morning prayer it does not have the level of usage that would mean that it would need to be heated constantly. It is acknowledged that the church is visited regularly but this is mainly in the summer with US tourists. It is therefore recommended that consideration is given to reducing the background temperature. Initially the first step would be to reduce this to 10 degrees and then consider if it could be reduced in steps of 1 degree until 6 or 8 degrees. This can be done relatively simply on the existing control unit. At the reduced levels of 6 to 8 degrees the duration of heating to get the church up to 18 degrees may need to be extended by an hour or two at the start to give the building more time to heat up but this will be a more efficient strategy than holding the building temperature higher.

This single measure, which can be undertaken directly by the church for no cost and will not require any permissions, could have the biggest single impact on the reduction of energy consumption and would be worthy of some attention with a gradual trial and error basis to establish the optimum background temperature level. The churches regular recording of the gas consumption will aid in this and in particular the degree day analysis from the Pillio system will be a good indicator of a more efficient strategy . This would be shown by the regression line between gas usage and degree days dropping so there is lower intercept value even through the slope may rise and the R2 value may be reduced (this will be due to the gas consumption not only being related to temperature but also more relate to occupied hours than it is at the moment).

4.6 Controls

The existing heating controls are good and sensible but need to be frequently reviewed to ensure that they are set up to the most appropriate timings for the churches need. During the audit the heating period on Monday afternoon (2pm to 6pm) and the period on Tuesday evening (6.pm to 10.30pm) were advised to no longer be required and were therefore removed, this will result in some immediate savings. The current schedule is detailed below and any changes to the church's usage should be quickly changed and reflected on the programmer.

Monday	06:30 to 08:00	
Tuesday	06:30 to 08:00	08:00 to 12:00
Wednesday	06:30 to 08:00	
Thursday	06:30 to 08:00	17:00 to 22:00
Friday	06:30 to 08:00	
Saturday	06:30 to 08:00	
Sunday	04:30 to 12:00	16:00 to 18:00

4.7 Roof Insulation

It was reported that there could be re-roofing works being undertaken in the future. These works represent a rare opportunity to add insulation into the roof structure and even the smallest thickness of insulation can be useful especially given the background heating within the church. It is therefore recommended that any re-roofing works must include insulation as a part of the project. If full thickness insulation of a rockwool or similar can be incorporated that is ideal, otherwise the use of a product such as TLX Gold (http://www.tlxinsulation.co.uk/tlx-gold/tlx-gold.aspx) can be a useful adjustment in specification.

4.8 Draught Proofing Doors

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

5. Other Recommendations

5.1 New Extension Plans

The church has plans for a new extension to the north side to accommodate a small kitchen and servery and room for children/meetings and improving the vestry. This space it likely to be used for short periods at various times during the week but will not require constant heating. It should therefore be designed to be able to accommodate being unheated for periods when it is not being used and able to be heated up quickly and effectively when being used. The inclusion of good standards of insulation and air tightness within any new fabric will therefore be important. In this regard the church should specify that wall and roof insulation should be in excess of the current Part L building regulation standards and that an tested air tightness valve of no more than 5 should be achieved. The existing gas boiler is already at its capacity for the church and is unlikely to be sufficient to take an extended system.

For the heating it is recommended that the use of electrically far infrared panel heaters (https://www.warm4less.com/product/62/900-watt-platinum-white) with a simply time lag switch (https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms) would be most appropriate. These panels are very thin and can discretely be mounted on the walls or even built into the ceiling of the extension, but they are very

effective and efficient at warming the space quickly. They should be switched on about 20mins before the space is occupied and then turned off immediately the space is empty.

Given that over 40% of the heating time is currently use for the morning prayer service, once the extension is completed it could be worth considering if this will provide a more comfortable and efficient location to hold this service so that the gas heating is not required to come on to heat all of the church for this small service and also that a room in the extension will be able to provide a much warmer and comfortable environment for those attending.

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

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 – all roofs visible
Battery Storage	No – no viable electrical generation
Wind	No – no suitable space
Micro-Hydro	No – no water course
Solar Thermal	No – all roofs visible
Ground Source Heat Pump	No – archaeology in ground
Air Source Heat Pump	Yes – but little benefit to mains gas
Biomass	Yes – but as mains gas not recommended

There are no renewables which would currently be recommended for the church that suit both the viable situation of the church and also align to the way in which the church is used. While an air source heat pump could be used in the new extension the way in which this area is likely to be used make the use of electric panels more efficient in this case.

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 for works which ca 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.