Energy Audit and Survey Report

St Peter and St Paul's 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	20th April 2019	1.0

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1. Executive Summary

An energy survey of St Peter and St Paul's 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 Peter and St Paul's Church is a Grade I listed parish church, located on the outskirts of the village of Dinton. 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?
Insulate exposed pipework and fittings in plantrooms	1,449	£46	£150	3.28	List A	
Fit timed fused spurs to hot water heaters	324	£34	£180	5.22	List B	
Install Endotherm advanced heating fluid into heating system(s)	2,844	£90	£576	6.41	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?
Tune the boiler to more efficient combustions settings	1,449	£46	£500	10.92	List A	
Fit Quattroseal draft proofing to historic doors	569	£61	£800	13.22	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 thermostatic radiator valves (TRVs)	1,706	£54	£1,540	28.56	List B	
Change existing lighting for low energy lamps/fittings	381	£41	£1,332	32.86	List A/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 10.64p/kWh (blended rate) and 3.16p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £371 per year.

2. Introduction

This report is provided to the PCC of St Peter and St Paul's 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 Peter and St Paul's Church is a Grade I listed parish church, located on the outskirts of the village of Dinton. The church was constructed in the 12th Century, with later additions throughout the next three centuries. Latest significant additions were made in 1868. There is both gas and electricity supplied to the site.

An energy survey of the St Peter and St Paul's Church, The Elms, Dinton, Aylesbury, Bucks HP17 8UG was completed on the 13th March 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 Peter and St Paul's Church	
Gross Internal Floor Area	360 m^2
Listed Status	Grade I
Typical Congregation Size	12-16

The church typically used for 5 hours per week for the following activities

Services	3 hours per week
Meetings and Church Groups	1 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.

3. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Peter and St Paul's Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	11.81 p/kWh	In line with current market rates
Evening and Weekend Rate	10.17 p/kWh	In line with current market rates
Standing Charge	27.00 p/day	N/A

The current gas rates are:

Single / Blended Rate	3.16 p/kWh	In line with current market rates
Standing Charge	27.00 p/day	N/A

It is understood that the PCC is going to obtain 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 Peter and St Paul's Church uses 1,076 kWh/year of electricity, costing in the region of £114 per year, and 28,441 kWh/year of gas, costing £899.

This data has been taken from the annual energy invoices provided by the suppliers of the site (see Appendix 2). St Peter and St Paul's Church has one main electricity meter, serial number E10TE00136. There is one gas meter serving the site, serial number 4511637S.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E10TE00136	1 phase 100A	Pulsed output but no AMR	External wall, SE corner in box
Gas – Church	4511637S	R5	Not capable of pulsed output	External boiler cupboard

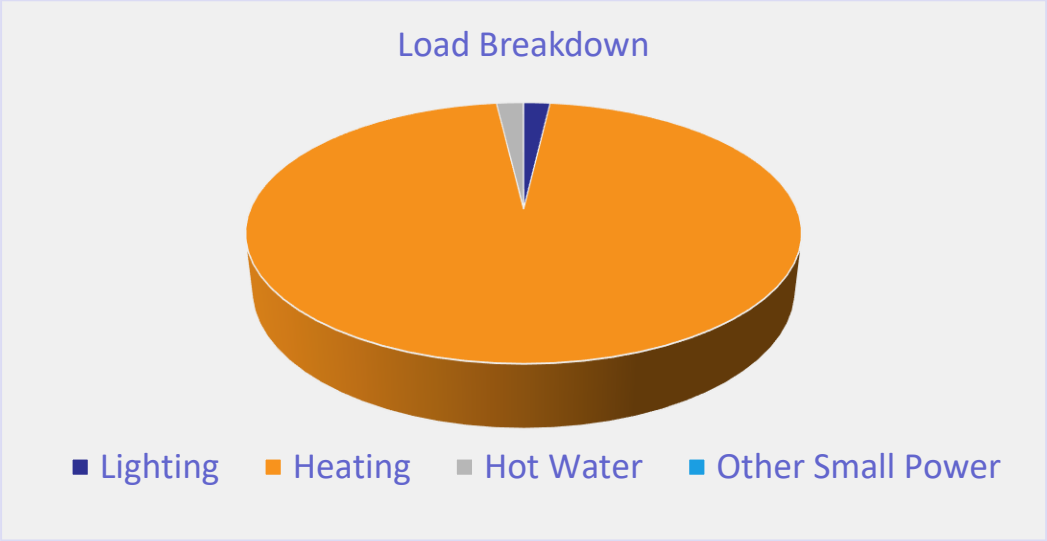
It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely and the patterns of usage reviewed against the times the building is used.

4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Main nave lighting is via pendant fittings with efficient compact fluorescent lamps. Spot lighting and choir stall lights are generally inefficient GLS or halogen spot lights,	1%
Heating	Two 26kW Glowworm ultimate 120FF atmospheric gas fired boilers provide heating to the perimeter radiators	96%

	within the church. There is electrical heating within the new meeting room and kitchen areas.	
Hot Water	New kitchen and WC area has electric point of use water heaters providing hot water.	2%
Other Small Power	Small kitchen appliances and the like	1%



As can been seen from this data, the heating makes up nearly all of the energy usage on site.

4.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Peter and St Paul's Church uses 85% less electricity and 47% less heating energy than would be expected for a church of this size. This is most likely due to the hours of operation than a particularly efficient heating system.

	Size (m^2 GIA)	St Peter and St Paul's Church use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Peter and St Paul's Church (elec)	358	3.01	20	10	-85%
St Peter and St Paul's Church (heating fuel)	358	79.44	150	80	-47%
TOTAL	358	82.45	170	100	-52%

5. Energy Saving Recommendations

5.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building, and the south aisle and nave is predominantly lit by relatively efficient compact fluorescent fittings in pendant fittings.

There still remains a number of inefficient halogen spotlights to highlight particular features of the church as well as GLS lamps in the choir stalls and for the organ foot pedals.

For the spot lights the Megaman range of LED spot (reflector) lights https://www.megamanuk.com/products/led-lamps/reflector/ provides some very suitable substitutes to the current bulbs.

If all the lights were changed the total capital cost (supplied and fitted) would be £1,332. The annual cost saving would be £41 resulting in a payback of around 33 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 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.

5.3 Insulation of Pipework and Fittings

The pipework within the plant room has some of its straight lengths insulated but there are still exposed pipes as well as the more complex shaped pipework fittings, such as valves, which have been left uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the plant room unnecessarily warm. The exposed hot surfaces also represent a health and safety risk of burns for those working in the area.

It is recommended that these areas of exposed pipework and fittings are insulated with insulating material which is widely available (https://www.wickes.co.uk/Wickes-Economy-Pipe-Insulation-22-x-1000mm--%0D%0A-Pack-of-5/p/210454) and if necessary, the valves and joints could be considered to be 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 arranged through Sustain Ltd contact Margaret Davis, 0117 403 2689, Margaret.Davis@anthesisgroup.com) or ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

5.4 Tune Boiler

The existing boilers on site are serviced at least annually during which time the flue gas is analysed and the results from this are displayed on the front of the boiler. The main purpose of this analysis is to make sure that the boiler is combusting the gas properly and not releasing too many toxic gases into the atmosphere. The flue gas analysis also provides an indication as to the efficiency of the boilers.

It was noted from the results of this flue gas analysis that while the flue gases are within the permitted limits there is more scope to adjust the burner to increase the efficiency of

combustion. It is therefore recommended that the boiler engineer is requested to maximise the burner efficiencies during their next service visit.

5.5 Water Heater Timeclocks

There is an electric hot water heaters serving the kitchen and WC hot water as well as a water boiler (for tea making and the like) located on site. 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.

5.6 Thermostatic Radiator Valves

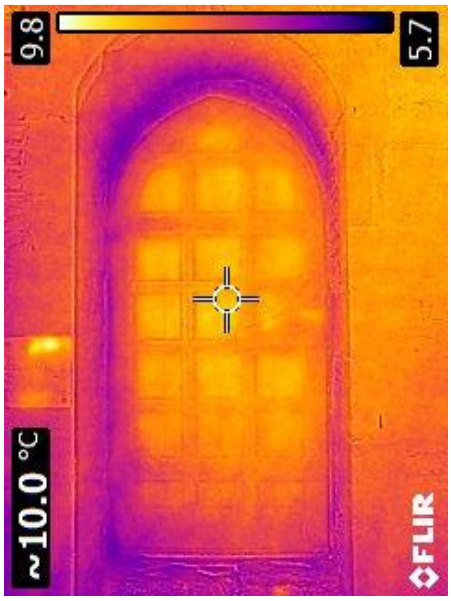
The building is heated by radiators and not all of these have thermostatic radiator valves (TRVs) installed on them.

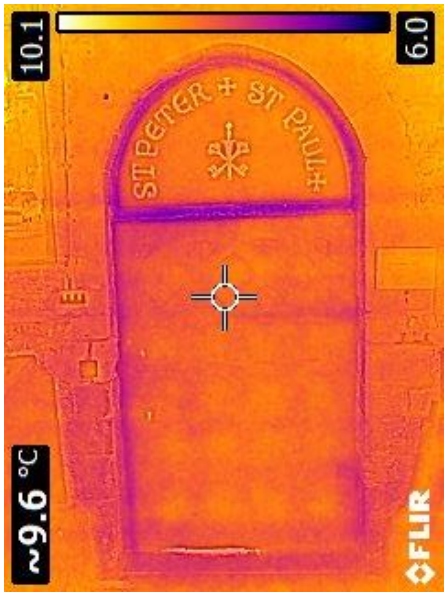
TRV's can be installed on the existing radiator and allow the users of the room to have some element of control over the temperature in the room and prevent over-heating which often leads to situations where the heating is on and the windows are open. It also allows un-used spaces to have the heating in them turned down.

It is recommended that TRVs are installed on all radiators and users advised as to the best way to operate these once they have been installed. TRV's can be supplied and installed by any good heating engineer.

5.7 Quattro Seal

There are a number of external doors in the building, notably the North and South doors. 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

5.8 Church Heating Option

The church does not currently have any reordering plans, but as the heating contributes to over 95% of the energy consumption at the church, it is something that should be considered for improving efficiency in addition to the measures outlined above.

The current heating system is reasonable in its design and does have controls, which are not being utilised; moreso it would appear that the heating is manually switched on and off by churchwardens when required. It is reported that at present, the heating is switched on the night before a service, so typically on Saturday evening and stays on all the way through to late Sunday morning. In the first instance, the existing controls should be used to reduce the number of hours the heating remains on for as it may be excessive to heat the church from early on Saturday evening.

In the longer term, a complementary heating system should be considered for regular Sunday services where the congregation size is reported to be less than 20. A more localised heating solution would remove the need to heat the whole church, improve the thermal comfort of the parishioners and reduce the running costs of the church.

Given that the pews are remaining in situ, and the typical congregation sizes are less than 20, it is recommended that electric under pew heating is considered as a replacement for the existing gas heating system. As there is only a single phase electrical supply to site, heaters could not be installed throughout, but it is recommended that the number of heaters installed are sufficient for no more than 20 people (4-6 pews total); with the congregation encouraged to sit together more so than current practice! The South aisle could be considered for typical service in this regard.

The two most popular under pew heaters within churches are BN Thermic PH30 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating. Cable runs to the pew heaters could run along the North and South walls (all cabling should be in armoured cable or FP200 Gold when above ground) to the outer rows of pews quite easily. The middle pews would need to consider the cable runs spurring either from the walls or from the dais or with some possible ground work to lay cabling under the existing floor.

The existing gas heating system should be retained for larger services and other events when the church is full and would require higher levels of heating.

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 – not sufficient demand, visible roof
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
Ground Source Heat Pump	No – archaeology in ground and 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.

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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Nave – wall lights	6	LED GLS	£3.43	£63.00	18.39
Nave – main 3 fitting pendant	7	LED GLS	£11.99	£220.50	18.39
Chancel spots	2	AR111 LED	£6.87	£89.08	12.96
Choir Stalls	10	LED GLS	£10.34	£105.00	10.15
Organ	2	R50 LED	£2.37	£23.78	10.02
Meeting room - Tower	5	2D LED 7W	£2.89	£272.75	94.27
Organ foot pedal	2	LED GLS	£2.07	£21.00	10.15