Energy Audit and Survey Report

St Laurence's Church, Reading

"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	David Legge	20th August 2019	1.0

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1. Executive Summary

An energy survey of St Laurence's Church, Reading 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 Laurence's Church, Reading is a town centre church in active and regular use as an outreach for youth work. The church is Grade I listed and dates back to the 1200's. 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?
Notify energy suppliers of CCL exempt status	N/A	£2,000	Nil	N/A	None	
Change existing lighting for low energy lamps/fittings	7,969	£1,287	£1,768	1.37	List A	
Upgrade and optimise heating controls	25,382	£968	£600	0.62	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 SavaWatt devices on fridges and freezers	800	£129	£480	3.72	List A	
Install Endotherm advanced heating fluid into heating system(s)	8,630	£329	£960	2.92	List A	
Insulate exposed pipework and fittings in plantrooms	2,538	£97	£400	4.13	List A	
Change in direct / immersion to elect POU unit.	30,458	£4,162	£2,500	2.15	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	201	£32	£588	18.15	List B	

Fit draft proofing to historic doors	4,315	£697	£800	1.15	List B	
Install small PV array to tower of side chancel roof	NOTE					
Long term explore use of ASHP in lieu of gas for underfloor heating	NOTE					

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

Based on current contracted prices of 16.15p/kWh and 3.81p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £6,701 per year.

2. Introduction

This report is provided to the PCC of St Laurence's Church, Reading 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 Laurence's Church, Reading, Friar Street, Reading, RG1 1DA was completed on the 16th July 2019 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.

St Laurence's Church, Reading	
Gross Internal Floor Area	400 m^2 (assumed)
Listed Status	Grade I
Typical Congregation Size	N/A

The church typically used for 37 hours per week for the following activities

Services	3 hours per week
Meetings and Church Groups	22 hours per week
Community Use	12 hours per week

There is additional usage over and above these times other events, festival services and the like.

3. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	16.15p/kWh	Above current market rates
Standing Charge	25p/day	N/A

The current gas rates are:

Single / Blended Rate	3.814 p/kWh	Slightly above current market rates
Standing Charge	0p/day	Below current market rates

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	20%	The church is a charity and therefore should be benefiting from only be charged a 5% VAT rate. A VAT declaration should be sent to the supplier to adjust this.
CCL	100% charged	As the organisation is being charged the wrong VAT rate, 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.

The above review has highlighted that VAT and CCL are being charged when the organisation is a charity and have VAT exemption status. As such the PCC of St Laurence's Church, Reading should send the supplier at VAT declaration confirming this. VAT declaration statements have been sent via email from IE to the church for completion and send on to the suppliers.

4. Energy Usage Details

St Laurence's Church, Reading uses 17,789 kWh/year of electricity, costing in the region of £2,873 per year, and 253,819 kWh/year of gas, costing £9,680.

This data has been taken from the annual energy invoices provided by the suppliers of the site . St Laurence's Church, Reading has one main electricity meter, serial number E14Z024134. There is one gas meter serving the site, serial number E016K1680015D6.

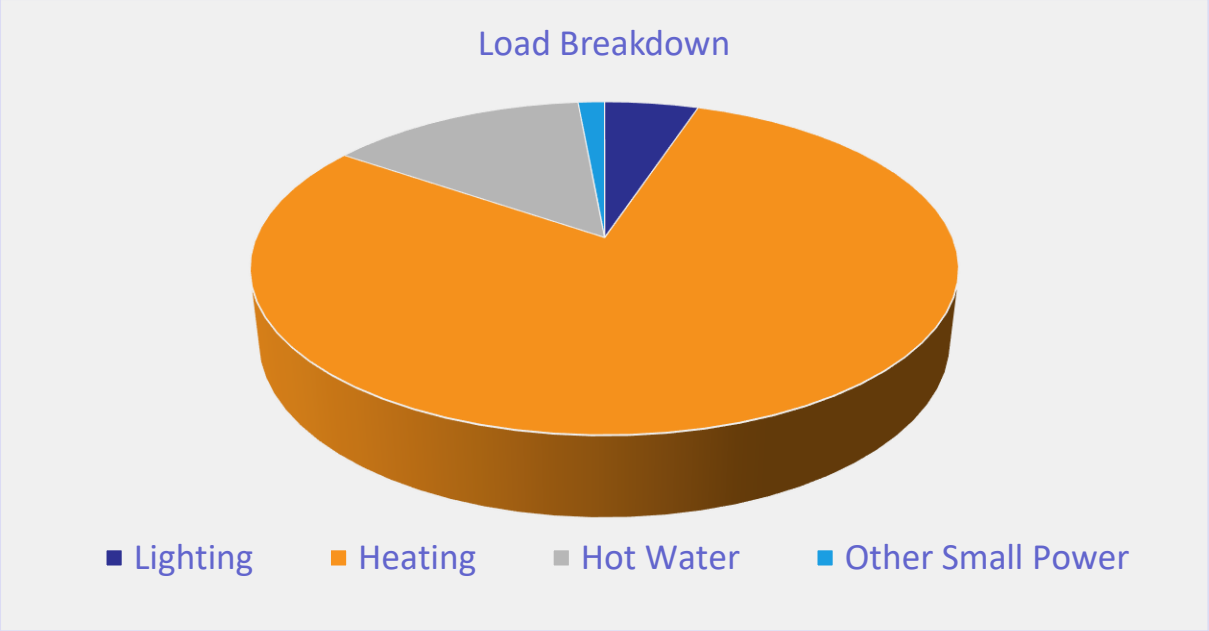
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	E14Z024134	3 phase 100A	Full AMR connected	GF elec switch room
Gas	E016K1680015D6	BK0G10E	Full AMR connected	External gas meter cupboard

All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. It is recommended that the church consider asking their suppliers for access to this half hour data 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	A mixture between good LED lighting with halogen downlighters and some SON flood within the Nave.	5.1%
Heating	Gas centralised heating to an underfloor system throughout the church	79.4%
Hot Water	Hot water heated from the boiler and stored in an indirect hot water tank in the cleaners cupboard.	14.0%
Other Small Power	Kitchen and office appliances and the like.	1.4%



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 hot water.

4.2 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Laurence's Church, Reading uses 122% more electricity and 232% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Laurence's Church, Reading use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Laurence's Church, Reading (elec)	400	44.47	20	10	122%
St Laurence's Church, Reading (heating fuel)	400	634.55	150	80	323%
TOTAL	400	679.02	170	90	299%

The fact that this church uses three times more energy than would be expected for a typical church of this size has a lot to do with the regular daytime use of this church which is far more extensive than many other churches. However, it also highlights that the gas usage is far more elevate than would be expected and this is generally down to the way in which the controls have been set up and operated. The finalising of the conversion to LED lighting will also help to reduce the electrical usage closer to expected levels.

5. Energy Saving Recommendations

5.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building, and many areas are lit by efficient LED fittings.

The spot downlights to the underside of the mezzanine, the mezzanine itself, the WC and the entrance have many GU10 halogen spotlights and the nave uses some SON floodlights. 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 lamps.

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 £1,796. The annual cost saving would be £1,287 resulting in a payback of around 1.37 years. Many of the lights, especially the spotlights, 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)

There are several lights which currently remain on all the time when the church is occupied in areas such as kitchen, toilet areas, entrance lobby and the like. 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.

5.3 Refrigeration Controls

Within the church there is a domestic fridge for storage of milk and staff food. This unit runs 24/7 and contribute 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.

Supply and installation 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 in 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 Insulation of Pipework and Fittings

The pipework within the plant room has the majority of its straight lengths insulated but the more complex shaped pipework fittings, such as valves, 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 expose pipework and 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).

5.6 Controls

The heating and hot water are controlled by a Honeywell ST6400C programmer located in the cleaner's cupboard. The Hot Water is set to run from 6.30am to 8.30am and 2pm to 4pm seven days a week. The Heating is programmed to run from 4am to 9am and 2pm to 4pm seven days a week but as the programme has been switched to 'once' rather than 'auto' it runs from 4am to 4pm every day.

It is recommended that both the heating and hot water are switched to auto as soon as possible. The heating should also be switched off on the controller for the summer months (from say May to Sept) by switching the control switch on the heating to off.

There are also thermostats around the church, and these should be checked to ensure that they are set for a temperature of 20°C.

These simple and cost-free checks and adjustments on the system will have a major impact on reducing the gas consumption and carbon emissions of the church.

5.7 Move to Electric Point of Use Hot Water

The current hot water arrangement is that there is hot water stored in a tank located in the cleaner's cupboard. This is heated up by the gas boilers in the crypt. This causes the boilers to fire twice a day every day of the year, including throughout the summer.

The hot water demand in the building is relatively low with hot water being used for handwashing in the WC's and washing up in the kitchen. A far more efficient way of providing hot water to these two areas would be to have an electric point of use unit such as a the Zip https://www.zipwater.co.uk/shop/hot-water/zip-inline-instantaneous-hot-water-heater-3kw-es3 . This would allow for the existing hot water tank to be removed and the boiler could be switched off entirely over summer. The electric point of use water heaters only use power to heat the hot water as the water runs through them so when no water is being used they do not consume any energy making this ideal for the relatively low uses of hot water in this church.

5.8 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.

htttp://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

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	Yes
Battery Storage	Yes
Wind	No
Micro-Hydro	No
Solar Thermal	No
Ground Source Heat Pump	No
Air Source Heat Pump	Yes
Biomass	No

There is potential for a small PV array on the hidden roofs of the tower or on the roof of the side of the Chancel. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. The churches energy consumption is already relatively small but due to the use of the church, the consumption during the daytime when the sun is shining is relatively frequent. While technically a large array would be viable only a small number of panels (maximum of around 10) would be worth considering.

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 the existing 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 may be worth delaying at this stage.

In the long term, to reduce the UK carbon emissions, there is going to have to be a move away from gas and toward decarbonised electricity. In the case of this church there is potential for the underfloor heating to be provided by an air source heat pump instead of the gas boiler and when the existing gas boilers start to fail (not expected to be within the next 10 to 15 years as the boilers are relatively new) it would be sensible to consider switching to an air source heating arrangement in conjunction with an increased amount of solar PV to power the electricity for the pump.

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
Cleaning cupboard	2	4ft Single LED	£29.90	£144.20	4.82
Soffit of mezzanine pod	29	GU10 LED	£459.56	£342.20	0.74
Soffit of mezzanine pod	15	NO CHANGE			
Kitchen	5	NO CHANGE			
Nave	32	NO CHANGE			
Nave	24	NO CHANGE			
Nave	8	50W LED Flood	£308.24	£730.40	2.37
Chancel	15	NO CHANGE			
Side chapel	10	NO CHANGE			
WCs	2	GU10 LED	£31.69	£23.60	0.74
WCs	5	NO CHANGE			
Entrance	7	GU10 LED	£110.93	£82.60	0.74
Entrance	2	NO CHANGE			
Mezzanine	22	GU10 LED	£348.63	£259.60	0.74