Energy Audit and Survey Report

St James' Church, Bix

"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
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1. Executive Summary

An energy survey of St James' Church, Bix 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 James' Church, Bix is a Grade II listed Victorian church built in 1874. Electricity only is supplied.

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?
Draughtproofing measures	5% 300	30	<30	1	List A or B	Warden
Change all non LED light bulbs to LED	150	15	200	>10	None	Warden
Install a motion sensor to control some lights for visitors	N/A	Prevents leaving them on!	100	N/A	List A	PCC
Replace some under pew bar heaters with convector heaters	0	0	1000	N/A Comfort increase	List A or B	PCC

Medium Term: Re Ordering recommendations	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	To be actioned by who / when?
Re Ordering – consider far infra-red panel heaters for rear of nave	N/A	N/A	5000	N/A	Faculty	PCC
Re Ordering – replace two bar heaters at west wall with skirting convector heaters.	N/A	N/A	500	N/A	Faculty	PCC
Re Ordering – install overdoor fan heater	N/A	N/A	1000	N/A	Faculty	PCC

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

Based on the current contracted price of 10.757p/kWh (off peak rate) and 14.87p/kWh (standard rate) for electricity.

2. Introduction

This report is provided to the PCC of St James' Church, Bix 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 James' Church, Bix, Oxfordshire was completed on the 16th December 2019 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church and has been an EcoCongregation assessor.

St James' Church, Bix	627163
Gross Internal Floor Area	165 m^2
Listed Status	Grade II
Typical Congregation Size	20

The church typically used for 3 hours per week for the following activities

Services	2.5 hours per week
Meetings and Church Groups	0 hours per week
Community Use	0 hours per week
Occasional Offices	2 weddings, 5 funerals

Church annual use = 175 hours

Heating hours: Church = 260 hours [6.5 hours x 40 weeks]

Estimated footfall = 1700 people

3. Energy Procurement Review

Energy bills for electricity have been supplied by St James' Church, Bix and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	14.87p/kWh	Above current market rates
Night Rate	10.757p/kWh	Above current market rates
Standing Charge	21.24p/day	N/A

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 electricity supply 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
FiT	0.604p rate	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.

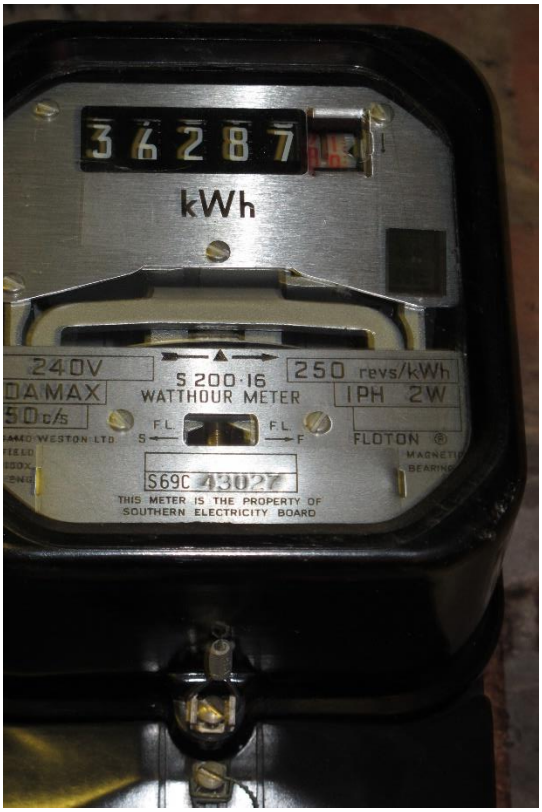
4. Energy Usage Details

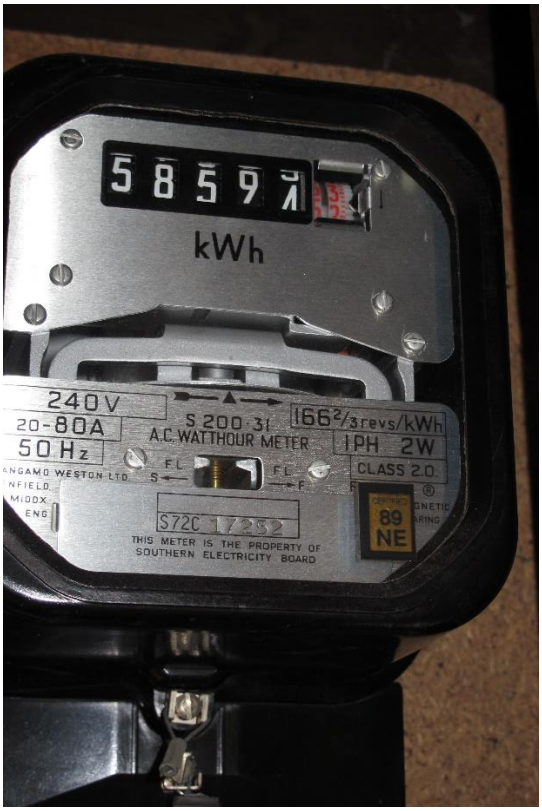
4.1 Annual Consumption

St James' Church, Bix uses 6,846 kWh/year of electricity, costing in the region of £466 per year.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – meter 1	S69C43027	S200	No	Vestry
Electricity – meter 2	S72C17252	S200	No	Vestry





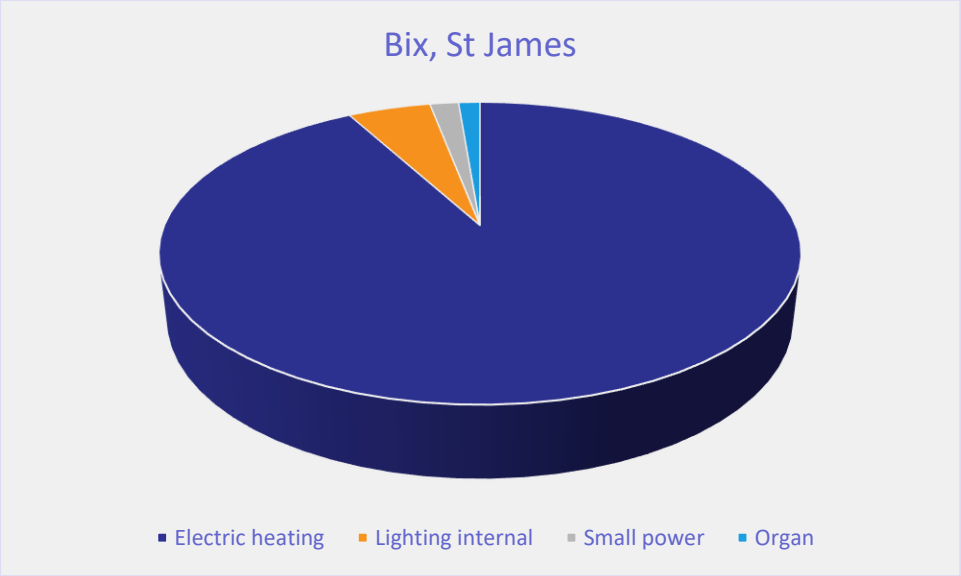
It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely and the patterns of usage reviewed against the times the building is used.

4.2 Energy Profiling

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

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage %
Lighting **Nave** **Aisles** **Chancel** **Vestry**	4 chandeliers x 6 bulbs 3 chandeliers x 3 bulbs 3 spotlights x 100W Fluorescent strip TOTAL	1200W 450W 300W 50W 2000W	 340	
Heating [Electric]	Electric underpew heating elements Total, 31 elements, if 3kW each (long elements) and 2kW each (short elements). Estimated use with preheating 140 hours Estimate to balance electricity use	83kW	[11,620] 6300	%
Hot Water	Zero		0	
Other Small Power	Sound system Vacuum cleaner	500W 1.5kW	88 30	 %
Organ	Organ	500W	88	%

Total Annual Consumption 2019: 6,846kWh



4.3 Energy Benchmarking

In comparison to national benchmarks for Church energy use St James' Church, Bix uses just 16% electricity for lighting and small power, and 25% of electricity for heating compared to an average church of this size. This is due to the low hours of use.

	Size (m^2 GIA)	St James' Church, Bix use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St James' Church, Bix (electricity not for heating – 546kWh)	165	3.3	20	10	16%
St James' Church, Bix (heating fuel – 6300kWh	165	38	150	80	25%
TOTAL	165	41.5	170	90	24%

There currently no benchmark data which takes hours of use and footfall into account.

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building.

Lux levels were measured at 85 to 155 Lux in the pews, which is adequate, and 50 at the font.

On the date of the visit they were reported to be 50% LED. It is recommended that the remainder of the light bulbs are changed to LED.

Note that there are different colour temperatures; “warm” which give a yellow light (i.e. traditional filament bulbs; below 3000K colour temperature) and “cool” which gives a white light (above 4500K).

It is sensible to make a bulk purchase to ensure that all the bulbs are the same colour temperature.

Bayonet fittings are provided, but of two different sizes (the font and rear section are wider diameter). It is suggested that the fittings are standardised.

If there are areas identified which the church feels are insufficiently lit; higher lumen LED bulbs can be installed. This might, for instance result in using a 1100 lumen bulb (11 watts) in place of an 800 lumen (8 watts). As the LED power requirement is low; they allow a certain amount of “upgrading” for a small increase in power; which is very much less than traditional lighting.

Note that if you intend to dim the bulbs, the type you buy must be compatible with your dimmer apparatus, and a lighting contractor should be consulted.

5.2 Lighting (control for internal lights)

The existing lighting control panel is well labelled. When church re-ordering occurs, it would be expected that the newly refurbished area will have its own local lighting controls. These should be specified to be of a type which requires turning on manually (i.e. only if there is a need) but are fitted with a movement sensor which turn off automatically when the room is vacated.

If the church is to be open for visitors during the day, then it is recommended that a motion sensor is installed on certain 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.

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses under pew electric heating elements to heat the church.

The church has a reputation of being the coldest in the district. The heating elements appear to be reasonably old. The electricity use of the church is small, with an estimated 6300kWh of power being used by the heating. With heating times reported as 0430 – 1030 (0915 service) x (say) 40 weeks, with an extra hour once per month, gives 250 hours, indicating a 25kW load.

There are 31 heaters (29 under pews, 2 on the west wall), indicating an average of 810W each.

The heaters emit radiant heat, some of which will be heating the undersides of the pews.

It is recommended that some heaters are changed for electric convector heaters, and a comparison made.

For replacement, 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 both rows of pews quite easily.

Heaters with an output of 400W seem to be more suitable than 500W models according to reports from different churches.

The under pew (see photo below) and panel heaters have been recently installed at St Andrews Church, Chedworth, Gloucestershire, GL54 4AJ. The church is open in daylight hours so can be viewed at any time.

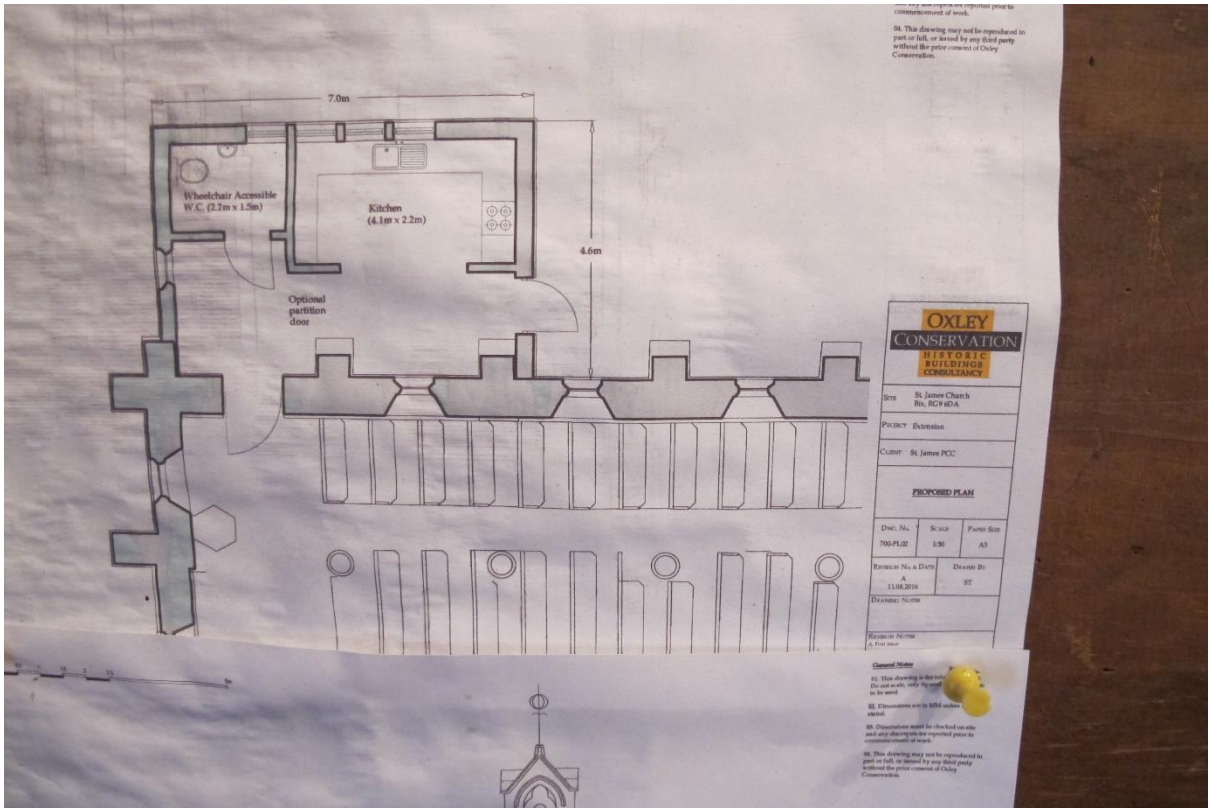
Another option is provided by “Cooltouch” fabric covered radiant under pew heaters. These are installed in St Catherine’s, Towersey, a church which has additional wall mounted infra-red heaters.

https://www.cooltouchheaters.co.uk/

7. Alternative Heating Systems

7.1 Re Ordering

Re-ordering of the church is planned, to include the construction of a 7.0 x 4.6m kitchen and toilet facility. The rear area of the nave, adjacent to the south porch, may have some pews removed to create a larger circulating area, which could be used for small meetings or to host a café or toddler group.



A church with low hours of use per week will always fall back to "base" temperature between heating events (it may take around 12-24 hours for the temperature to fall). A system which can heat rapidly, without sending most of the heat to the ceiling first, and in addition can be configured to heat small areas independently for small services or midweek meetings will be more efficient than one which seeks to heat up the whole volume.

7.2 Use of Electric Heating for the Rear Section of the Nave

To avoid having to heat up the entire church building by pew heater (the heat will be in the wrong place for use of the rear of the nave) for these mid-week uses it is recommended that the PCC consider installing electrical panel heaters in this area on a time delay switch. Use of infra-red heating, potentially ceiling mounted (given several memorials on the walls), plus replacing the rear two tube heaters on the west wall (behind the font) with inconspicuous skirting convector heaters and fitting of an over door fan heater would provide rapid heating capability for the new area.

Given the (current) low hours of use, the small size of the village, the likely on/off pattern of use of the new facility, it is not recommended that underfloor heating is considered. It is expensive and requires a very long heat up time so is only suited to very regularly used facilities.

Suitable electric panel heaters would be far infrared panels such as the following or similar: https://www.warm4less.com/product/63/1200-watt-platinum-white- . These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch such as https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms so they cannot be left on accidently after use.

Suitable low profile convector heaters would be Adax Neo skirting convector heaters (up to 1200W each) or similar. https://www.adax-solaire.com/towel-rails-c3/electric-heaters-c1/electric-panel-heaters-c2/neo-low-profile-skirting-electric-radiator-wall-mounted-panel-heater-p64

7.3 Overdoor Air Heaters

In order to achieve the sense of a 'warm welcome' into the church an over door air heater could be provided. This would also help to provide warmth to the rear of the church up to and including the font. Such an over door unit should be sized to cover the whole width of the door and it is suggested the BN Thermic 860 model would be quite suitable. This has a 6kW output.

The installation would consist of installing a BN Thermic 860 Overdoor Fan heater above the main entrance door wired in with a BN Thermic CS-7 control switch. The unit requires single phase power. All new cabling to be run in FP200 Gold ducting.

8. Energy Saving Measures (Building Fabric)

8.1 Draught Proofing to Doors

The external timber doors should be kept maintained so that they close tightly against the surround to prevent a large amount of cold air from coming into the church around the side and base of the doors.

Where a timber door closes against a timber frame it is recommended that draught proofing is fitted. 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. Note this cannot be used where the timber door closes directly against a stone surround.

Other simple measures such as using a small fridge magnet painted black over the large keyhole or the use of 'sausage dog' type draught excluders at the base of little used doors can prove to be very effective. Doors should be reviewed in daylight and gaps where the light shines through sealed or filled in whatever the most appropriate way is for the specific door.

8.2 Closed Door Policy

The main entry doors in the north porch should be kept closed in cold or windy weather and quickly closed behind the congregation by your friendly welcome team!

8.3 Windows

If there are draughts caused by broken or cracked windows, especially where hopper windows do not shut correctly, a temporary solution is to use black plasticine to fill gaps. Broken or damaged widows should be repaired before more problems are caused.

9. 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 – 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 no radiator system
Air Source Heat Pump	No – no radiator system
Biomass	No – not enough heating load as well as air quality issues

Having reviewed the site it is not considered that there is 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.

It is recommended that the church join the EcoChurch scheme administered by A Rocha, which gives much help and advice.

10. Funding Sources

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-Nov-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.

11. 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 current faculty rules (due to change slightly in April);

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.

12. Report Circulation

In addition to the PCC, this report is also sent to:

1. Your DAC secretary and your DEO, because
   - They maybe be able to offer you help and support with implementing your audit
   - They want to look across all the audits in your diocese to learn what the most common recommendations are.
2. Catherine Ross and team, the officer in the Cathedral and Church Buildings team centrally who leads on the environment, who wants to learn from all the audits across the country. She will be identifying cost-effective actions churches like yours might be able to make.