Energy Audit and Survey Report

St Catherine's Church, Towersey

"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 Catherine'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 Catherine's Church is a Grade II listed mediaeval church, with worship occurring on the site for over 1000 years. The windows date from 1220 but the chancel is thought to be older. The tower dates from 1850. A new servery and toilet were installed in a re-ordered area at the rear in 2018. There is electricity only supplied to the site.

The church is an exemplar of a small village church which has invested in efficient heating and lighting and reordered such that it can provide suitable warmth during winter services and also a useable venue for events.

The church has a number of ways in which it 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 Plasticine in any window cracks and gaps	5% with doors		£5		none	Warden
Further draught proofing to doors	300	£35	£30	1	List B	Warden
Replace chancel spotlights with LEDs	100	14	100	7	List A	Warden
Replace chancel floodlights with LEDs	180	25	100	4	List B	Warden

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?
Replace external floodlights with LEDs	155	18.50	200-400	~10	List B	Warden

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

Based on current contracted prices of 13.7918p/kWh for electricity.

If all measures were implemented this would save the church £92 per year operating costs.

2. Introduction

This report is provided to the PCC of St Catherine'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.

An energy survey of the St Catherine's Church, Church Lane, Towersey was completed on the 16th December 2019 by Paul Hamley.

St Catherine's Church	627024
Gross Internal Floor Area	150 m^2
Listed Status	Grade II
Typical Congregation Size	18

The church typically used for 3.5 hours per week for the following activities

Services	1.5 hours per week
Meetings and Church Groups	1 hours per week
Community Use	1 hour per week
Occasional Offices	Average of 2 weddings and 3 funerals annually

This gives an annual occupancy estimate of 270 hours including preparation and cleaning.

Heating hours, accounting for the full heating being used October to April and short periods in May and September; 225 hours.

Annual footfall is estimated at 1900; it has increased recently following the installation of toilets and kitchen. Note the village population is only 400.

3. Energy Procurement Review

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

The current electricity rates are:

Day Rate	13.7918p/kWh	In line with current market rates
Night Rate	11.9235p/kWh	In line with current market rates
Standing Charge	23.8766p/day	N/A

The church is part of the Parish Buying scheme and therefore receives economy of scale discounts.

The above review has highlighted that the current rates being paid are in line or below current market levels and the organisation can be confident it is receiving good rates and should continue with their current procurement practices.

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

4.1 Overview

St Catherine's Church uses around 7,500 kWh/year of electricity, costing in the region of £1,100 per year.

This data has been taken from the annual energy invoices provided by the suppliers of the site.
St Catherine's Church has one main electricity meter.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E14UP00363	EDMI Atlas Mk10D	2 pulses	Kitchen, cupboard on west wall

The meters is AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has been provided for the purpose of this report and this has been used to verify the data.

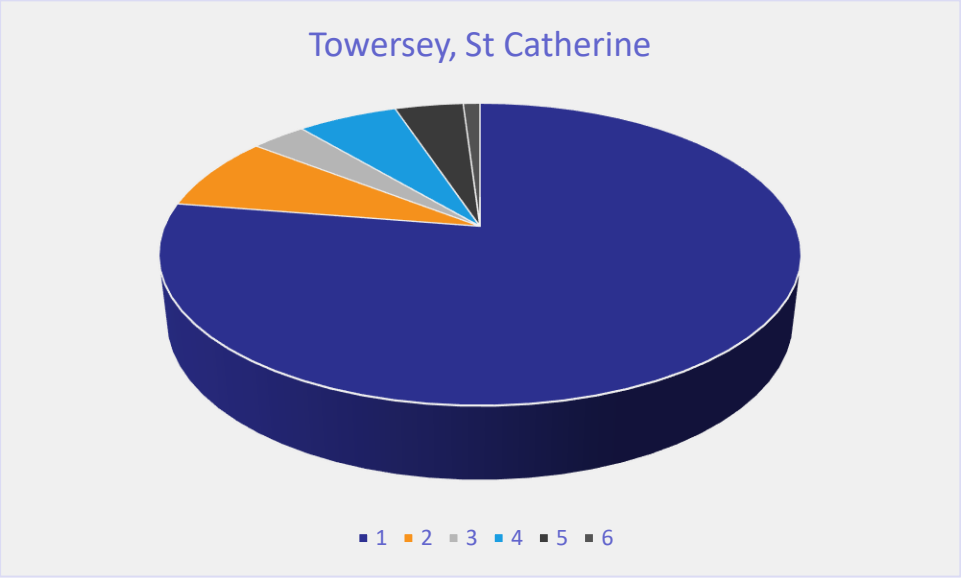
4.2 Energy Profiling

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

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage %
Lighting				
Nave	4 chandeliers x 6 LED @ 7.5W	180W	49	
	8 floodlights (uplights) LED	160W	42	
Chancel	4 halogen spotlights, 150W	600W	162	
	2 floodlights, 500W	1kW	270	
Kitchen	8 GU 10	40W	10.8	
	4 unknown mounted within diffuser boxes	80W	21.6	
Porch	Chandelier x 3 LED @ 7.5W Above estimated at 270 hours use	22W	5.9	
Toilet		20W	1	
Tower	2 bulbs traditional	200W	30	Internal 8%
Outside	4 Floodlights, 150W halide Used December - January 6 weeks x 8.5 hours	600W	215	
	3 x 30W CFL path lights; motion sensor on, timer off after 8 minutes (est half hour per day)	90W	33	External 3.3%
	TOTAL		**841**	
Heating				
Radiant Infrared heaters	Nave 8 of two elements	16kW		
	Chancel 4 smaller	4kW		
	20 mins use Sept rising to 120 mins December 2 hours preheating with all radiant on, then 1.5 hours with 8kw on = 48kWh per Sunday 48kWh x 30 heating weeks = 1440kWh, Double as Sunday hours of use are half total	**20kW**	2880	
Nave & Chancel under pew heaters	8 rows x 4 under pew @320W	10.24kW		
	2 on front pew panel @210W	420W		
	4 choir @250W	1kW		
	1 organ (beige)	210W		
	1 behind altar (beige)	500W		
	Heated mirror	210W		
	TOTAL	**12.58kW**		
	1.75 hours per Sunday = 22kWh x 30 heating weeks = 660kWh, doubled as above		1320	

Convectors	4 rear + 1 in toilet Dimplex LST150 @1.5kW 7.5kW x 2 hours per Sunday = 15kWh x 30 heating weeks = 450kWh, double + add extra for use of rear of church only	7.5kW	1020	75.5%
Kitchen	Under plinth heater Myson	3kW	360	
Ringing room	Portable radiant heater **TOTAL**	2kW	208 **5788**	
Hot Water	Church – ~ 52 boils p.a. Sunday tea – 6 boils/month = 72 boils p.a. Coffee machine ~ 30 mins per week **TOTAL**	3kW 3kW	372 78 **450**	6%
Other Small Power	Fridge AEG 2 toasters @ 1kW Microwave Vacuum cleaner Sound system **TOTAL**	100W 1kW 3kW 1kW	100 16 4 18 150 **288**	4.1%
Organ	Organ	500W	**75**	1%

Total Annual Consumption 2019: 7442kWh



KEY 1 Heating 2 Lighting (internal) 3 Lighting (external)

4 Hot water 5 Small power 6 Organ

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.

4.3 Energy Benchmarking

In comparison to national benchmarks[1] for Church energy use St Catherine's Church uses 55% electricity and only 25% heating energy than would be expected for a church of this size.

This is a combination of low occupancy and an efficient heating system.

There is not currently any benchmark data which takes hours of use and footfall into account.

	Size (m^2 GIA)	St Catherine's Church use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Catherine's Church (elec)	150	11.1	20	10	55%
St Catherine's Church (heating fuel)	150	38.4	150	80	25%
TOTAL	150	49.6	170	90	29%

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting makes up the second largest overall energy load within the building after the heating.

Most of the church is lit by LED fittings, but the chancel is not. This offers the opportunity to make further operating cost savings by changing to LED spotlights and floodlights, which have the added advantage of 15-20 year lifetimes, thus reducing capital costs of future replacements.

The chandeliers are fitted with filament effect LEDs

[Crompton LED Filament GLS, 7.5W dimmable, 2700K]

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.

If all the lights were changed the total capital cost (supplied and fitted) would be £400-600 dependent on the type of equipment sourced the annual cost saving would be £60 resulting in a payback of around 6-10 years.

Many of the lights could be self-installed. 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 Floodlights

The current floodlights currently fitted are rated at 150W each. It is possible to source suitable LED replacements of low power. The 42W Newlec floodlight illustrated below has a CFL bulb. Whatever replacements are obtained need to be IP65 rated; the measure of protection against moisture ingress.

5.3 Lighting (control for external lights)

The floodlights are currently controlled by a timer for the evening on at 16:00 and off at 22:30, and morning on at 06:00, with a light sensor to turn off the lights in the morning. They are only used during the months of December and January, about six weeks.

Changing to LED lighting will reduce consumption. The PCC might consider lighting the church during November and perhaps February during the evenings and not lighting in the morning (unless the village has lots of early risers!) and still obtain an overall reduction in consumption.

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

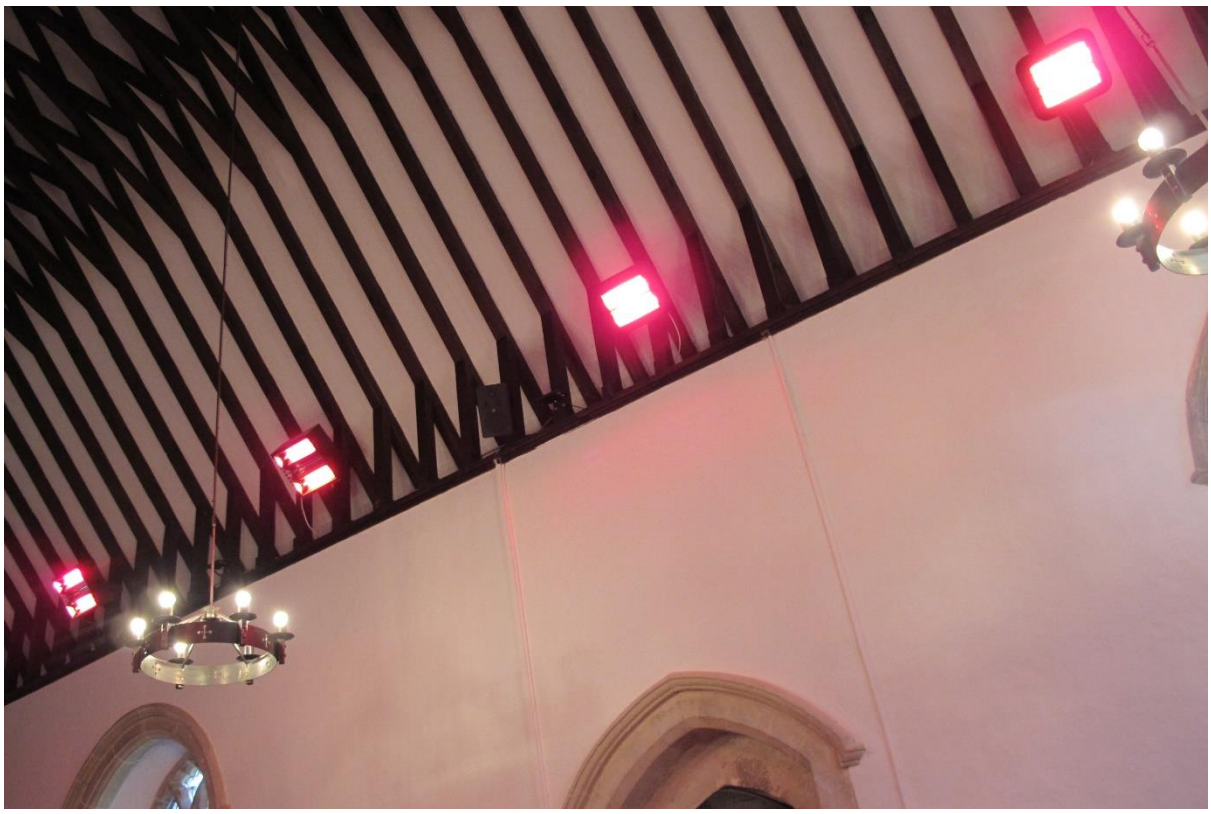
The church currently uses electricity only to heat the church by a combination of radiant and under pew heating. During the heating season (October to April), the overhead radiant heaters in the nave and chancel are energised from 07:30 (in December) for the 09:30 service. Preheating times are less in less cold weather, with around 20-30 minutes in the shoulder months of September and May. As the overhead IR heaters heat the people rather than the air turning these on for a preheat time before people arrive may not be required.

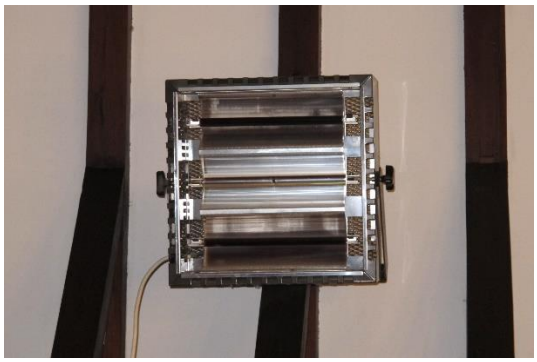
Underpew heaters are energised at 09:15; they are fabric covered cooltouch models rated at 320W. If the building is considered warm enough, most of the radiant IR heaters are turned off at the beginning of the service. As the panel heater heat the air rather than the people it may be better

to switch these on a little earlier, say 8:45 and switch the IR heaters on at 9:15 to warm the people as they arrive.

The system is reported to work well and provides adequate thermal comfort into the church. Given that the system is successful and not wasteful of energy we would recommend that this system is continued with. As the church provides an exemplar to other churches in the diocese and more widely; it is asked that it should keep accurate records of dates and hours of use of its heating.

Heating equipment – radiant heaters





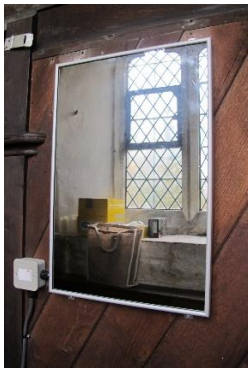
Under pew heaters – below 320W

250W in choir

210W at front of nave

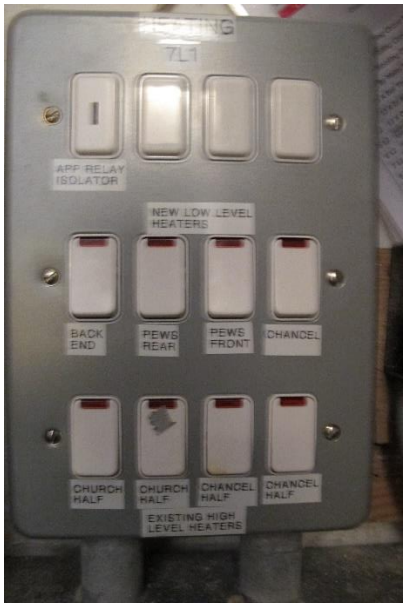
500W behind altar

210W next to organ



210W heated mirror

4 wall mounted convector heaters are installed in the open circulating and activity area at the rear of the nave, plus a similar model in the toilet.



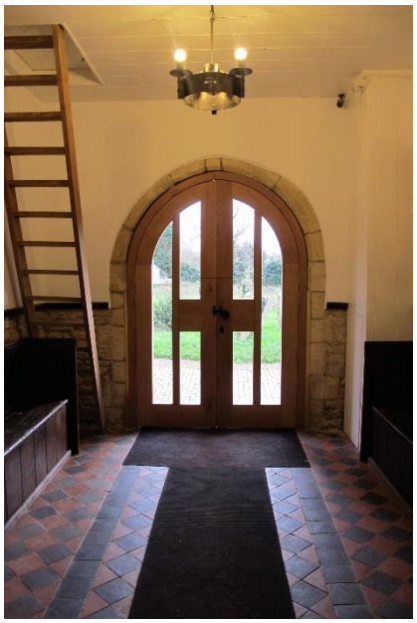
Switching is straightforward.

“Back End” is presumed to refer to the wall mounted convector heaters.

7. Energy Saving Measures (Building Fabric)

7.1 Draught Proofing to Doors

The church is entered through the tower on the south side through two doors; a modern door at the external arch and an older door, possibly mediaeval, inside.



The new door has been inserted into the arch under the Victorian tower; the space between the wooden frame and tower has not been filled and the frame is held by wedges. Given that the tower was constructed in 1850, it might be possible to obtain permission to install an airtight fixing around the frame. The gap may be too small in places to insert "P" type rubber door seals. Use of a black silicone sealant may be a solution (it can be easily peeled away from the stonework should the door be removed).

The space under the door (it closes against carpet) can be further sealed as a small gap is evident.

The inner door may also benefit from draught proofing. 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.
https://shareweb.kent.gov.uk/Documents/environment-and-planning/environment-and-climate-change/eco-schools-case-study/Simon%20Langton%20Quattroseal.pdf

Note this cannot be used where the timber door closes directly against a stone surround.

Other simple draught exclusion 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.

7.2 Windows

Plasticine is suggested as a simple method of blocking draughts from windows where there are small gaps and cracks. It is non-permanent, does not cause damage, and recommended by Historic England.

8. Renewable Energy Potential

The potential for 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
Wind	No
Micro-Hydro	No
Solar Thermal	No – low hot water use
Ground Source Heat Pump	No – burials in churchyard
Air Source Heat Pump	No – lack of location
Biomass	No – use too low

9. 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.

10. 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
Chancel Spotlights	4	LED	Est 100kWh £14	£100	7 years
Chancel Floodlights	2	LED	Est 180kWh £25	£100	4 years
External Floodlights, 150W halide	4	LED	432W, 360h, 155kWh £18.50	£200-400	10 years [just used in winter]
Tower lighting	2	LED	180W, few hours 25kWh £3	Use any spare CFL or LED bulb	immediate