ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

St Barnabas' Church

Boughton under Blean

Version Control

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St Barnabas' Church was undertaken by ESOS Energy 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. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St Barnabas' Church was constructed in 1895. It is a brick structure, laid to English bond, although the east wall is laid to stretcher bond on the inside, so is probably a 15 inch thick solid wall structure. There are two side rooms to the rear of the building accommodating an office and toilets. To the left side is a modern entrance area and disabled toilet. There is both gas and electricity 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.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)	£/tonne of CO2
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None	N/A	N/A
Complete installation of LED lighting	3300	£430	£315	1.00	None	1.01	£424.16
Optimise condensing boiler temperature	1000	£22	Nil	Immediate	None	0.21	£-
Add Endotherm to existing heating system	850	£25	£200	10.73	List A	0.18	£1,097.04

Investigate ceiling insulation	680	£15	£1200	80.51	List B	0.15	£8,227.83
Add draught proofing to existing doors	510	£11	£800	71.56	List B	0.11	£7,313.63
Replace boiler with radiant electric panels	4000	Similar operating costs	£5000	57.03	Faculty	0.86	£5,828.05

Based on current contracted prices of 13.1853p/kWh and 2.1920p/kWh for electricity and mains gas respectively. The Church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works.

If all measures were implemented this would save the church £450 per year.

2. Introduction

This report is provided to the PCC of St Barnabas' 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 Barnabas' Church Boughton under Blean was completed on the 6th November 2019 by 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 2018 "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.

St Barnabas' Church	606120
Gross Internal Floor Area	170 m^2
Listed Status	Unlisted
Typical Congregation Size	50

The church typically used for 14 hours per week for the following activities

Services	4 hours per week
Meetings and Church Groups	2 hours per week regular 1 hour from Messy church
Community Use	2 hours per week (choir) 2 hours (keep fit)
Occasional Offices	

This gives an estimated annual use of 760 hours.

The church is not normally open to visitors.

Footfall is estimated at 6350 given information provided.

3. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	13.1853p/kWh	In line with current market rates
Standing Charge	30.0019p/day	N/A

The current gas rates are:

Single / Blended Rate	2.1920p/kWh	Below current market rates
Standing Charge	66p/day	N/A

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.

Procuring electricity from Parish Buying is planned to always supply 100% renewable electricity. The scheme currently supplies 20% green gas.

Information about the VAT rate has not been supplied (this will be on every bill).

If the church is being charged 20% VAT and Climate Change Levy, as a charity it should be benefiting from only being charged a 5% VAT rate.

A VAT declaration should be sent to the supplier to adjust this.

4. Energy Usage Details

4.1 Meters

St Barnabas' Church uses 5000 kWh/year of electricity, costing in the region of £775 per year, and 17,000 kWh/year of gas, costing in the region of £620.

This data has been taken from information supplied by the church. St Barnabas' Church has one main electricity meter, and one gas meter serving the site, both of which are located in the kitchen area formed within the north porch, where the boiler is also located.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E15Z013699	EDMI Atlas Mk7c	2 pulses	
Gas – Church	G4 A0112630 14 01			

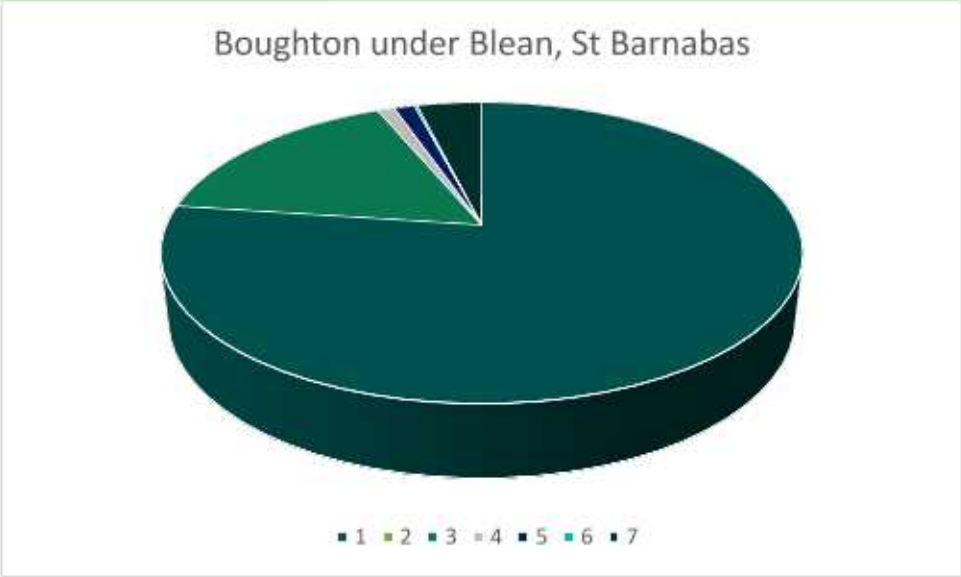
The electricity meters is AMR connected and as such, obtaining an energy profile for the entire energy usage should be possible.

It is recommended that the church consider asking their suppliers to install a smart meter for gas 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	Hall			
	12 x 100W (assumed) downlights	1200W		
	6 x 500W (assumed) floodlights	3000W		
	Chancel; 1 flood, 2 spots	400W		
	Kitchen 3x GU10 halogen spotlights 150 hours annually, assume lights are on for double service times (for set up and cleaning)	150W		
	Office	20W		
	Toilets	40W		
	Path 6 exterior lights	300W		
		TOTAL 5.1kW	3880	17.6%
Heating	Gas, 46 kW boiler 370 heating hours	46kW	17017	77.2%
Hot Water	Kettle 20 boils of 3 minutes/ week x 52 weeks used	3kW	150	
	Water heater in kitchen area	3kW	60	
	Ariston water heater in toilets (little use)	3kW	60	1.2%
Kitchen	AEG Competence Cookers x 2 Lunch every 2 weeks – 26 events	7kW	728	
	Warming drawer NEFF	1kW	104	
	Microwave Panasonic	1kW	26	3.9%
Other Small Power	Photocopier	500W	26	
	Printer (used regularly)	250W	13	0.06%
	Total Annual Electricity use		5032	



Key 1 Gas Heating 2 Electric heating (0) 3 Internal Lighting (green) 4 External lights
5 Hot water 6 Small power 7 Kitchen

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 Barnabas' Church uses 48% more electricity and only 67% of the amount of heating energy that would be expected for a church of this size. The low value for heating derives from the low hours of use.

	Size (m^2 GIA)	St Barnabas' Church use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Barnabas' Church (elec)	170	29.6	20	10	148%
St Barnabas' Church (heating fuel)	170	100	150	80	67%
TOTAL	170	76	170	90	45%

The benchmarking figures above are for churches in average use.

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting makes up the majority of the electrical energy load within the building.

The downlights are thought to be probably halogen.

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.

These fittings are widely available on the market and it is suggested that the complete fitting (including the luminaire, not just the lamp, in order to ensure compatibility) is replaced. Any new LED fitting would have a much longer life and hence reduce the need to replace the lamps in the ceiling as often:15 to 20 years is the likely lifetime.

If all the lights were changed the total capital cost (supplied and fitted) would be £315. It is suggested that the church could fit the bulbs itself given the comparatively low height. The annual cost saving would be £430 resulting in a payback of less than 1 year.

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)

Lights are controlled from a single location labelled to highlight switch function.

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses gas central heating to heat the church. This is reported to work well and provides adequate thermal comfort into the church.

Advice is given regarding optimising the current boiler, followed by replacement options.

6.2 Boiler Optimisation - Temperature

The boiler is a Vaillant EcoTec VU GB 466/4-5,

A condensing boiler of 46kW output.

A condensing boiler achieves maximum efficiency by allowing the exhaust steam to condense on a heat exchanger and transfer the heat of vaporisation back into the central heating water. This can only work if the return water is at or below 55°C. If the boiler is run on a high output temperature, (systems were traditionally set to 80°C) you will burn more gas. At an "Eco" setting (usually 56°C), less gas is used as the waste steam provides extra heat. The lower operating temperature means that you will have to run the system for longer but the extra efficiency will compensate.

6.3 Boiler Controls Optimisation - Timings

Honeywell timer

It is recommended that the boiler is set to operate at 56°C (or Eco setting if this is an option) and the effects monitored. You may need to bring the heating start time forward.

The timing should be set so that it turns off 45 minutes before the service ends. Sufficient heat will be present in the water to allow radiators to emit heat for some time. This advice is based on experiments conducted at many churches in the Diocese of Lichfield.

6.4 Clean / Flush Existing Heating System

This should form part of the annual service. A magnetic particle filter should be fitted to the circuit just before the boiler, to protect it against sludge and rust. Corrosion inhibitor should be topped up or replaced following cleaning of the system

6.5 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. Endotherm can be self-installed.

6.6 Electric Heating

An alternative option is to install far infrared radiant panel heaters; rectangular panels which do not glow. Standard white panels could be installed either on the angled surface of the ceiling (it's relatively low height is helpful) or in the more traditional location on the walls. This method would require very little preheating.

Suitable electric panel heaters would be far infrared panels such as 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 can not be left on accidently after use.

7. Energy Saving Measures (Building Fabric)

7.1 Draught Proofing to Doors

There are a number of external doorways in the building. All doors should be kept well maintained to ensure that they close properly.

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, for more modern doors, "E" or "P" cross section rubber adhesive gap closure strip can be used.
http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

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.

7.2 Ceiling Insulation

There appears to be a void between the ceiling and roof. This would benefit from having insulation added if the church is to be brought into more regular use (it is not cost effective for buildings heated only once per week).

8. Renewable Energy Potential

The potential for the generation of renewable energy has been reviewed and the viability noted.

Renewable Energy Type	Viable
Solar PV	No – insufficient 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 – insufficient land area for coils, no access for borehole drilling rig
Air Source Heat Pump	Potential
Biomass	No – not enough heating load as well as lack of space and fuel delivery issues

The rear of the building offers potential locations for air source heat pumps to be located as noted in section 6.8.

9. 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

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
Church	12 Halogen 100W?	LED bulbs in appropriate luminaires where not already fitted.	1100W 836kWh £110 saving	£100	1 year
	6 Floodlights 500W?	LED replacement	2600W 2000kWh £260 saving	£150	< 1 year
Chancel	1 floodlight 250W 2 spotlights 150W	LED	500W 380kWh £50 saving	£50	1 year
Kitchen area	3	LED	130W 99kWh £13 saving	£8-15	< 1years
Office		T8 fluorescent			
Toilets		Replace CFL with LED when due			
External	6 path lights				

Total saving of around 3300kWh; £430 annually.

Lux levels were measured during strong daylight, which contributed to light levels of over 200 Lux.

If any fluorescent strip lighting needs replacement, T8 sized high frequency replacements are recommended. [A source of information is https://www.lyco.co.uk/advice/high-frequency-lighting-what-is-it/]