ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

St Michael & All Angels Church, Hartlip

Version Control

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St Michael & All Angels Church, Hartlip 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 Michael & All Angels Church, Hartlip is a Grade I listed mediaeval building dating from about 1290. There is electricity supplied to the site, with oil heating.

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
Tower west door draughtproofing	1000kWh	£50	£25	0.56	List A	0.21	£116.56
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
Replace tower and external flood lights for LED units	4775kWh	£941	£1,000	1.06	List B	1.47	£681.72

Replace oil heating with a mix of under pew and radiant infra-red	10,000kWh	Nil	£8,000 underpew only £15,000 overhead radiant (Avoid new boiler costs of £10,000)	N/A	Faculty	2.14	£6,061.17
Investigate ceiling insulation under nave roof	500kWh	£23	£4,000	117.78	List B	0.11	£37,299.52

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

Based on current contracted prices of 19.70p/kWh and 49p/Litre for electricity and oil respectively.

If all measures were implemented this would save the church from annual servicing and maintenance costs for the central heating system.

2. Introduction

This report is provided to the PCC of St Michael & All Angels Church, Hartlip 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 Michael & All Angels Church, Hartlip, The Street, Hartlip was completed on the 9th December 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 "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 Michael & All Angels Church, Hartlip	606290
Gross Internal Floor Area	245 m^2
Listed Status	Grade I
Typical Congregation Size	25

The church typically used for 8 hours per week for the following activities

Services	3 hours per week
Meetings and Church Groups	3 hours per week
Community Use (school)	1 hour per week
Occasional offices (12 p.a.)	1 hour per week

Annual hours of use: 416

Heating hours: 240 (30 weeks, 5h Sundays, 3h Fridays)

Footfall estimate: 7300 (2900 + 4300 school) based on attendance figures discussed.

3. Energy Procurement Review

Energy bills for oil and electricity have been supplied by St Michael & All Angels Church, Hartlip and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	19.70p/kWh	Above current market rates
Standing Charge	35p/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 its electricity supply from the CofE parish buying scheme, https://www.parishbuying.org.uk/index.php/categories/energy/energy-basket. This scheme only offers 100% renewable energy sourced electricity 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 Michael & All Angels Church, Hartlip uses 2,500 kWh/year of electricity, costing in the region of £450 per year, and 2100 Litres/year of oil, costing in the region of £1,150.

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

St Michael & All Angels Church, Hartlip has one main electricity meter.

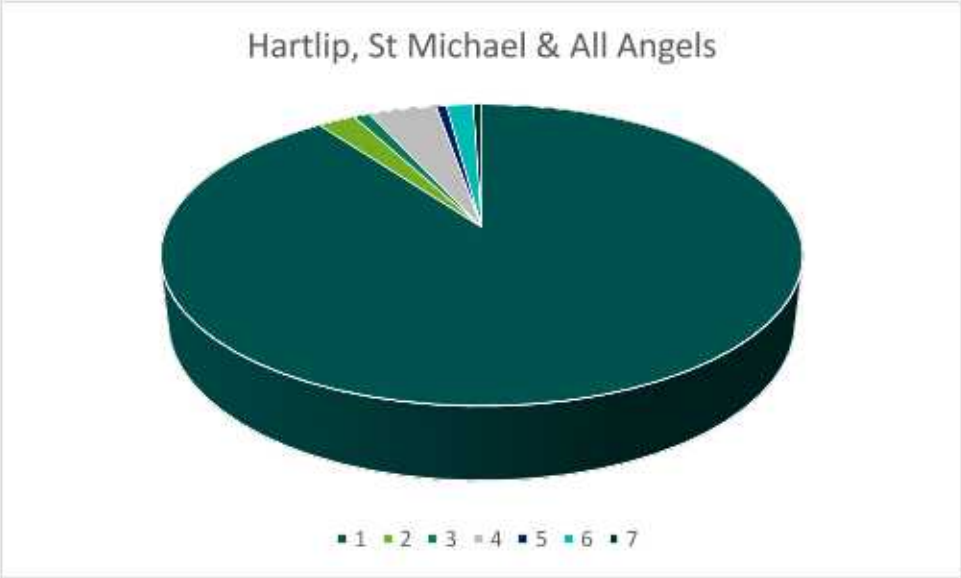
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	L8629414	Single Phase	no	Tower

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	Power	Annual Use/ kWh	Estimated Proportion of Usage
Lighting	Internal External floodlights	1250W 750W	245 1020	5.1%
Heating	Oil, est 100kW boiler (93kW used) 240 heating hours 2100L oil used per annum (approximate) 1Litre = 10.72kWh	100kW	22500	90%
Heating (electric)	Convector heaters (2) in chapel Estimate 90 hours use annually Portable radiant heater (Jan and Feb use)	6kW 1600W	540 30	2.3%
Hot Water	Kettles, 2 x 2,5kW 5 boils of 3 minutes/ week x 52 weeks used Urn 1 hr per week + 7 hrs for summer teas Water heater Santon Aquaheat	2.5kW 1650W 2kW	32 100 24	0.6%
Other Small Power	Fridge Dishwasher PA system	200W 2200W 500W	200 25 188	1.7%
Organ	Organ, pipe est 4h/ week Clavinova est 1h/week	500W 500W	100 26	0.2%



KEY 1 Oil 2 Electric heating 3 Lighting internal 4 Floodlighting 5 Hot water 6 Small power 7 Organ

As can be seen from this data, the oil heating makes up by far the largest proportion of the energy usage on site. The other significant load is floodlighting, following the installation of LED lighting inside.

4.2 Energy Benchmarking

In comparison to national benchmarks[1] for Church energy use, St Michael & All Angels Church, Hartlip uses 51% less electricity and 61% less heating energy than would be expected for a church of this size.

This is due to low occupancy hours, rather than heating efficiency.

	Size (m^2 GIA)	St Michael & All Angels Church, Hartlip use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Michael & All Angels Church, Hartlip (electricity)	245	10.2	20	10	-51%
St Michael & All Angels Church, Hartlip (heating fuel)	245	91.8	150	80	-61%
TOTAL	245	102	170	90	-60%

Recent kitchen area at the rear of the nave.

[1] CofE Shrinking the Footprint – Energy Audit, 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting is mostly recently installed LED lighting. Although it was a relatively bright morning, Lux levels during the audit were low, between 35 and 50 lux at the pews. The single bulbs might be replaceable with multiple bulbs suspended by the same cable (since LEDs are low power there is no issue from running multiple bulbs from one supply). An alternative, should the church consider overheat radiant electric heating, is to install chandeliers from the arch tops, holding both lighting and heating elements. The chandeliers would position the bulbs closer to the congregation than at present.

5.2 Lighting - external

Current 250W floodlight, above. These should be replaced by LED or Sodium (SON) floodlights as illustrated below, which would cut annual kWh from around 1155kWh to around 200kWh.

At the same time a control system should be fitted; light sensitive to switch on, and a timer to switch off.

42W CFL floodlight

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses an oil fired boiler to heat the church. Oil gives the greatest carbon footprint per kWh of heat generated [268g/kWh], and its price is subject to rapid fluctuation.

Given the churches usage profile we would suggest that a revised heating strategy for the church would provide a much more efficient use of energy and a more comfortable church. (See section 7)

6.2 Boiler Maintenance; Clean / Flush Existing Heating System

Whilst the boiler continues in use, the system should be regularly cleaned and flushed.

Corrosion inhibitor should be added to the system when your boilers are serviced annually.

6.3 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.

6.4 Insulation of Pipework and Fittings

The boiler pipework should be insulated within the external boiler room. Several degrees can be lost with uninsulated pipework even over a short distance

6.5 Security

Some churches have reported theft of oil from storage. This is a further reason towards electrification of heating.

7. Replacement Heating

7.1 Under pew heaters

The church has 17 pews (counting each box as one); those on the other (south) side of the church being longer. They appear to be an ideal size for 375W or 450W under pew heaters (reports from another church indicate 500W models are too powerful). Churches in the locality fitted with under pew heating include All Saints, Hollingbourne and St Cosmus & St Damian, Blean.

This would give 6.4kW of heating in the body of the church which would significantly reduce energy bills. Personal comfort depends equally on air temperature and radiant surface temperature. None of the pews are located next to the external walls, which helps as they accept radiant heat.

The pews are mounted on a raised wooden platform which would make installation of the necessary cabling easier. The chancel should also be heated using under pew heaters.

Two of the 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.

7.2 Radiant Infrared overhead heaters

The rear area of the church has been recently re-ordered with fixed pews replaced by around 45 chairs.

The new tiled floor has not been fitted with underfloor heating (which is only suitable for regularly used buildings since it takes a long time to warm up. There are no obvious areas of flat wall nearby on which to affix rectangular far infrared panel heaters; thus an option to heat this area is to install chandelier heaters, as at St Catherine's, Faversham. These could be suspended from the arch centres.

Using just the two rear arches would cover much of the seated area and kitchen area. It could be installed under all six arches – or alternatively the chandeliers could hold six light bulbs, interspersed with six heating elements at the rear two arches for the chaired area, and either six elements for full radiant heating at the front, or less elements, to work with under pew heaters.


Heaters at St Catherine's

7.3 Use of Electric Panels

Another option instead of using chandelier visible (glowing) radiant heaters would be to mount far infra-red (invisible heat) rectangular panels under the aisle ceilings. This would not assist in heating the nave, where most of the congregation sit.

Examples of this technology include: 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.

7.4 Electric Convector Heaters

Two electric convectors are installed in the chapel, which has been separated from the body of the church by glass screens and glass doors. They are used as required for small meetings and are reported as very effective.

8. Energy Saving Measures (Building Fabric)

8.1 Roof Insulation and ventilation issues

The nave roof appears to have a ceiling underneath it (the roof is steeply pitched). This gives an opportunity to add insulation – although it is only worth it if the church is to be used more regularly.

The black rectangles appear to be ventilators. It is suggested that your architect is consulted regarding the effect of blocking these from above – this would prevent escape of heat from the nave, and prevent moisture rising into the roof void and prevent any downdraughts from the roof in windy weather.

8.2 Draught Proofing to Doors

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 into the church around the side and base of these doors.

This door has a visible large gap underneath (and has possibly lost wood either from past rot or scraping against a surface). It is a major contender for draughtproofing.

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.

8.3 Windows

Where openable windows are fitted, such as the top rectangular panel of this lancet window, there may be a source of draughts. Small gaps where the windows are not airtight can be filled with black plasticine. This is recommended by Historic England as it is non-permanent and does not cause damage.

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 – 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, intending to switch to electric heat
Air Source Heat Pump	No – intending to switch to electric heat
Biomass	No – not enough heating load as well as air quality issues

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

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 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.

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, 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.

Appendix 1 – Schedule of Lighting

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Nave LED 12W, 1055Lumen	6				
Choir Stalls LED 9.2W, 1055Lumen	2				
Priest's stall LED 6.7W, 806Lumen	2				
Chancel floodlights Assume LED 30W?	2	LED if not fitted			
Tower floodlights Halogen 230W	2	LED			
Ringing Chamber Striplight	1				
Tower stairs 60W (rarely used)	3				
Vestry Striplight, 20W	1, T12				
Boiler room LED 8.6W					
Floodlights, 250W	3	42W LED			

Total Power – internal: 670W x 364 hours = 245kWh

External: 750W x 1360 hours = 1020kWh

Manually adjusted on-off. If from dusk, then: to 22:30 1360 hours p.a. , to 23:00 1540 hours p.a., to 23:30 1720 hours p.a.