Energy Efficiency and Zero Carbon Advice

St Michael's Church Hall, Bray, Maidenhead

PCC of St Michael's Church

Author	Reviewer	Date	Version
Paul Hamley	Matt Fulford	7th August 2020	2.0

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1. Executive Summary

An energy survey of St Michael's Church Hall, Bray, Maidenhead 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 Michael's Church Hall, Bray, Maidenhead was constructed in 1705. The walls are of flint with a rubble interior; the south wall is seen to thicken towards the foundations so that the interior wall is sloping. Movement has been detected and there are visible cracks. The west end of the building is a single hall extending to the full height of the roof. There is a central kitchen with serving hatch and an office at the east end. Above the kitchen and office are two small meeting rooms.

It is proposed to repair and modify the building, inserting tie bars at the base of the roof structure to control movement which will allow construction of a mezzanine floor above the hall. The large west end window would be replaced and an exit to the adjacent toilet block provided. This would provide new opportunities for community use and it is proposed that the building be rentable for events.

The building 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 implementing these recommendations over the coming years.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Contact suppliers to arrange for the electricity meter to be changed to smart meter	None	None	Nil	N/A	None	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	5-15% possible when switching to Parish Buying	Nil	N/A	None	0.25
Add Endotherm fluid to heating circuit	10% 960	£20	£50	3	None	0.17
Seal hopper windows	10% 960	£20	£2	<1	None	0.17
Draughtproofing entrance doors	5% 480	£10	£10	1	List A	0.088
Install LED lighting where not fitted	60 maximum	£9	90	10	None	0.015
PIR sensors in toilets					None	
Thermostatic Radiator Valves in hall	Allows office and meeting rooms to be used separately				None	
Electric Heating as part of refurbishment	Not quantifiable if	Cost is 2x greater	£5,400 present		Faculty	

	building is brought into greater use Approx. 7000 at present use hours	with grid electricity, lower with solar power	building, more with mezzanine floor added			

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

Based on current contracted prices of 15.17p/kWh and 2.0769p/kWh for electricity and mains gas respectively.

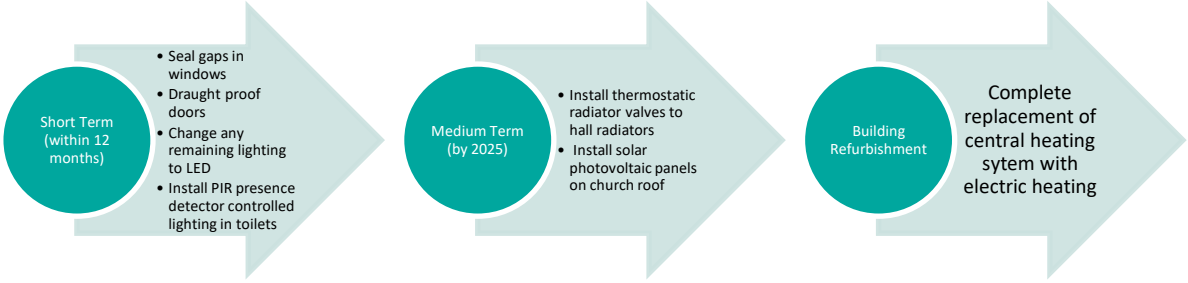
If short term measures were implemented this would save around £30 per year in operating costs. Further savings require capital expenditure which could be part of a larger project to repair and refurbish the building and increase its usefulness.

There is potential to reduce utility bills to zero by installing solar photovoltaic panels on the church roof, with battery storage, together with converting to fully electric heating and become zero carbon.

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years.

The church hall has a clear route to become net zero by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Michael's Church Hall, Bray, Maidenhead to provide them with advice and guidance as to how the church hall can be improved to be more energy efficient and the levels of comfort improved where possible.

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's Church Hall, Bray, Maidenhead, High Street, Bray, Berkshire SL6 2AE was completed on the 13th July 2020 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, and has been an assessor for EcoChurch.

St Michael's Church Hall, Bray, Maidenhead	
Church Code	627369
Gross Internal Floor Area	140 m^2
Listed Status	Grade II*

The church typically used for around 9 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**	**Heating hours**
During and after Church Services	2 hours per week	1h x 40
Meetings and Church Groups	4 PCC meetings annually (x 4h) Deanery meeting twice annually (x 4h) Twice midweek (x 2h)	4h x3 4h x 1 4h x 30
Community Use	Brownies Saturday mornings (3 hours)	3h x 20

Estimated opening hours 460

Estimated heating hours 240 (9,600kWh)

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Michael's Church Hall, Bray, Maidenhead and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single Rate	15.17p/kWh	In line with current market rates
Standing Charge	26.85p/day	N/A

The current gas rates are:

Single / Blended Rate	2.0769p/kWh	In line with current market rates
Standing Charge	367p/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.

However, the electricity is supplied by SSE and is not purchased on a renewable tariff. Going onto a renewable tariff is an important part of the process of taking churches towards net zero. The church is therefore encouraged to consider the Parish Buying scheme, which uses the power of group purchasing to achieve a lower price through economies of scale. It delivers 100% renewable electricity and 20% green gas. We would therefore recommend that the church obtains a quotation for its gas and electricity supplies from the 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 taking churches towards zero carbon output.

Alternatively, Bulb, Ecotricity and Good Energy offer 100% renewable electricity.

A review has also been carried out of the taxation and other levies which are being applied to the bills. These are:

VAT	5% [20% during part of 2018]	The correct VAT rate is being applied. A rate of 20% was applied to the gas charge from January-April and October-December 2018
CCL	not charged currently	The correct CCL rate is being applied.
FiT		A FiT charge is being applied for each of the electricity meters. It should be checked that this is being charged in accordance with the supply contract.

The above review has highlighted that VAT and CCL was charged for gas during two periods in 2018. The church is a charity and therefore can claim VAT exemption status. As such the PCC of St

Michael's Church Hall, Bray, Maidenhead should send the supplier at VAT declaration confirming this and check all supplies on other sites. VAT declarations are available from the supplier's website and can usually be found by typing the suppliers name followed by "VAT Declaration Certificate" into most search engines.

5. Energy Usage Details

St Michael's Church Hall, Bray, Maidenhead uses around 1,000kWh/year of electricity, costing in the region of £240 per year, and approximately 9,600 kWh/year of gas, costing £200.

Utility	Annual use/ kWh	from	to	Cost
Electricity	969	February 19	January 2020	£233
Gas - Hall	9.600 estimated	31/01/19	31/01/20	£200

The church hall 40kW boiler is set to run for two 30 minute periods on a Sunday. This will use between 1200-1600kWh annually, (depending on the number of weeks it is run from, probably between 30 and 40). Midweek use for church meetings, PCC and Deanery meetings plus Brownies on term time Saturdays adds to an estimated 240 hours.

This data has been taken from the annual energy invoices provided by the suppliers of the site and information provided by the warden. St Michael's Church Hall, Bray, Maidenhead is supplied with one phase of power with an electricity meter located under the stairs. There is one gas meter serving the site which is located in a cabinet adjacent to the toilet block.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity	L66C 00646	Landis and Gyd CL7 Single phase	No	Under stair cupboard
Gas – Church and Hall	M025 K02636 10 D6			External gas meter cupboard next to toilet block

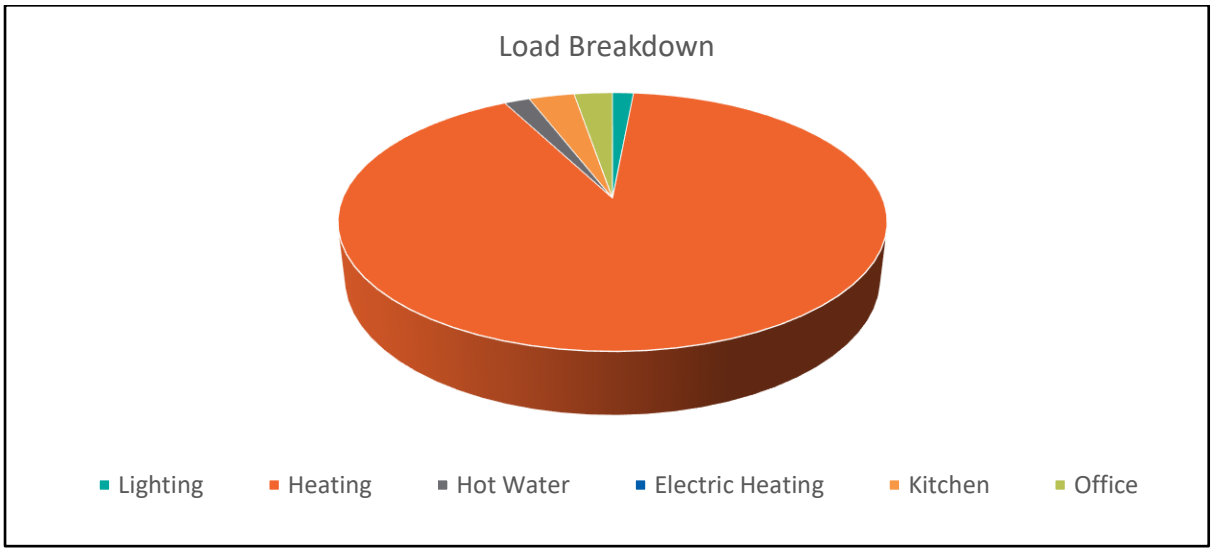
5.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	8 hall uplights + 3 kitchen + 2 office + 4 upstairs Estimated 100 lighting hours IF non LED (halogen / CFL = 1000W = 100kWh If all LED = 360W = 36kWh Toilets,7 lights, CFL 350W = 20kWh	1.5%
Heating	40kW boiler, 30-40 hours annually, 9600kWh	91%
Hot Water	Kettle, 3kW, 20 uses weekly (1 hour) = 156kWh 2 Urns (used rarely for outside events) = 24kWh	1.7%
Kitchen	Fridge, 288kWh Electric cooker = 50kWh	3.2%
Office	Computer Printer Photocopier	2.5%
Toilet block	Immersion water heater, 2kW (rarely used) = 10kWh	0.09%

Total Annual Electricity Consumption (measured, 2019) = 969kWh

Total Annual Gs consumption (estimated) = 9,600kWh



As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site.

6. Efficient / Low Carbon Heating Strategy

The energy used for heating the hall currently makes up about 90% of its overall energy consumption. Gas heating leads to high carbon emissions and little opportunity to decarbonise in the future. Mains gas does have some potential to reduce its carbon content through the use of bio gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. Electricity currently has carbon emissions around the same level as mains gas but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions its remaining coal fired power stations. Churches which procure 100% renewable electricity can substantially reduce their carbon footprint and can achieve net zero more easily if electric heating is employed. It is therefore critical to review energy use and plan to make it more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution.

In the future, there are two options to assist in decarbonisation:

Either: install an Air to Water Heat Pump (probably located on the toilet block) to serve the existing radiator network, plus any extra radiators required for a new mezzanine room [Section 8].

Or: install electric heating (far infrared heaters plus some convector heaters).

The latter option would allow for more rapid heat up times, which would allow the building to be used for short periods and at short notice. This could be more compatible with the desire to rent out the building to community groups in the future.

7. Energy Saving Recommendations

In addition to having a revised heating strategy there are also a number of other measures that can be taken to reduce the amount of energy used within the church.

7.1 Heating operation times

Radiators filled with hot water retain their heat for a considerable period. Measurements at over 70 churches in the Diocese of Lichfield show that the heating system can be turned off 45 minutes before the end of the service (i.e. approximately 16:15 on Sunday) and heat will still be emitted.

Heating the building for short periods each Sunday might be achieved by offsetting both the heating start and stop times earlier (so the heating is warming the building before use then switched off soon after use begins).

7.2 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. This additive should be installed into the radiator circuit side of the heat exchanger, NOT the boiler circuit. Endotherm can be self-installed.

7.3 Thermostatic Radiator Valves

The current system could be made slightly more flexible by adding thermostatic radiator valves to the main hall radiators.

TRVs are fitted to the two upstairs radiators, but not to those in the main hall. If radiators are to be retained, they should be fitted to give better control.

7.4 Lighting (fittings)

Any light bulbs which have not been replaced by LED should be changed. This can be done by members of the church as all fittings are at relatively low level in the hall. As there is not a need to dim the lights, economy LED bulbs can be used.

7.5 Draught Proof External Doors

The hall has two pairs of double doors. Historic timber doors often do not close tightly against the surround and hence a large amount of cold air can enter the church around their sides and base. It is recommended that the draughtproofing around the door is kept well maintained and improved where practical. This could be achieved in a number of ways:

For timber doors that close onto a timber frame, 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.
http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

For other doors and those of which close onto a stone frame, brush draught strips could be rebated into the edge of the door by a skilled joiner. Other traditional methods such as using hessian or felt

pads tacked to the door could be used and keeping the door maintained in a good condition is important. For little used doors, or those which will be closed for long periods during the week simple measures such as placing a 'sausage dog' draught excluder at the base of the door (suitably weighted using pea gravel or similar to ensure it stays tightly in place) can be employed.

Keyholes can be sealed temporarily by using a fridge magnet painted black over the keyhole.

Draughts can blow fairly continuously and even small draughts can waste 5% of heat.

7.6 Draught Proofing of Windows

The hopper windows do not close properly, allowing draughts, with a large gap between the left hand window and its frame. This should be addressed immediately before the weather cools.

It is proposed to replace this whole window if the building is refurbished; installing a mezzanine floor and doors on the ground level leading to the toilet block.

The hinged windows in the hall and upper room should be kept maintained. Small draughts can be blocked by use of black plasticine (recommended by Historic England) – it can fill small to medium gaps and is easily removed.

7.7 Electric Heat

Replacing a 40kW boiler by either far infrared wall or ceiling panels, or a mix of these plus convector heaters does not require as great an electrical power input. Reasons include not having to heat the mass of water of high heat capacity, and not having to rely on warm air convected firstly up to the ceiling making its way down.

Wall or ceiling mounted infrared panel heaters could be placed in the office and each meeting room (one each; low temperature units, 55^{o}C surface temperature unless these areas are to be used by young children or vulnerable elderly in which case 42^{o}C surface temperature units should be used.)

For the main hall, a mix of infrared panels plus a fan convector heater is suggested. A new mezzanine room could have ceiling mounted infrared panels.

A 1200W far infrared wall panel plus installation will cost around £600. Room sizes are 58m^2 (hall), 17m^2 (office and one meeting room), 23m^2 (second meeting room). It is suggested that each office/meeting room be fitted with one unit, and six in the hall (and a further six in a mezzanine floor if of equal area). The installed cost would be in the region of £9,000.

Even if it is decided to retain central heating, any mezzanine room should be electrically heated. This will avoid piping installation costs and avoid overtaxing the boiler, and allow this room to be independently heated, so it can be used economically when required.

8. 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, on church roof – see church report
Battery Storage	Yes, as above
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 poor radiator system. Borehole has been investigated and was considered too expensive
Air Source Heat Pump	Potential alternative to electric heat
Biomass	No – air quality issues

- Wind turbines require highly exposed sites and should be located 250m way from buildings as such this site is not suitable for a wind turbine to be installed.
- Hydro electricity is a highly efficient source of renewable energy but requires a body of flowing water with a differential height which is not present on this site.
- Solar thermal installations are best suited to heat water for use in washing up, hand washing and bathing. There is minimal hot water demand at this church so such an installation would not be viable.
- Heat Pumps are a low carbon method of creating heat, their use and suitability for this church have been considered previously by the church.
    - Ground Source Heat Pump coils are not permissible due to the large number of burials adjacent to the church
    - A borehole has been ruled out due to cost
    - A Water Source Heat Pump has been considered, but the trenching costs to the Thames are considered too great.
- Air to Water Source Heat Pumps would use the existing radiator network. They are cost effective for regularly used buildings where fairly constant, low grade heat is supplied, but not where there is a sporadic use pattern calling for occasional and often unplanned rapid heating. The response time is much slower than for an electric heating method, asking an ASHP system to deliver heat rapidly will significantly lower its efficiency.

  There is no obvious location for the pumps on the hall (the external wall which would probably not be allowed for heritage reasons), but they may be allowed to be installed on the toilet block.

- Biomass is an alternative boiler and fuel to oil or gas. It requires wood chips or pellets to be delivered on site, stored, and then fed into a large boiler for burning. While the fuel is not a fossil fuel there are emissions from the burning of wood and these can be detrimental to local air quality particularly in more built up areas for all these reasons it is not considered a viable recommendation for this site. This technology is only viable for a regularly used building, where there is someone to oversee and load the feed hopper.

9. Other issues

Evidence of past attack from wood boring beetles is seen in the end first floor room. No evidence of recent activity (i.e. sawdust) was noted. A watch should be kept for beetle activity, especially in rarely viewed spaces such as inside cupboards and the underside of furniture. Small infestations can be dealt with using a handheld sprayer, whereas large problems such as under floors or in the roof structure require professional treatment.

10. 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 .

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.

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