Energy Efficiency and Zero Carbon Advice

St Helen's , Abingdon

PCC of St Helens

Author	Reviewer	Date	Version
Tamsin Hockett	Matt Fulford	10th December 2020	1.2

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1. Executive Summary

An energy survey of St Helen's 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 Helen's is a large church, dating back to 1180 and the last of 5 aisles built in 1539. The most recent reordering began in 2003. The heating is provided by a gas fired underfloor heating system, with reflector lamps and some LED lighting . There is both gas and electricity supplied to the site.

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 (£)	Permission needed	CO2 saving (tonnes of CO2e/year)
Install electrical based heating solution into choir and clergy vestry and under pew in lady chapel	7,183	N/A	£4,322	Faculty	0.79
Insulate exposed pipework and fittings in plantrooms	7,500	£201	£50	List A (None)	1.38
Change existing lighting for low energy lamps/fittings	9,367	£1,116	£3,215	Faculty	2.37
Install PIR motion sensors on selected lighting circuits	147	£17	£293	List B	0.04
Install a Water Source Heat Pump into the building from the Thames to replace existing heating system	105,000	£42	£76,000	Faculty	17.32
Install small PV system on one of the hidden south facing valleys	2,688	£320	£5,040	Faculty	0.68

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

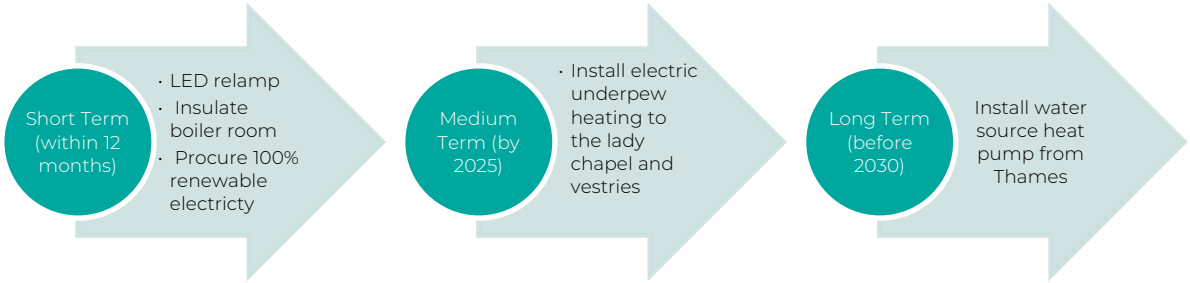
Based on current contracted prices of 11.9p/kWh and 2.68p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £1,168 per year.

2. The Route to Net Zero Carbon

The Diocese of Oxford's Diocesan Synod has set a target of reaching Net Zero Carbon by 2035, or as soon thereafter as is possible. General Synod, meanwhile, has set a target for the Church of England to reach a limited-scope Net Zero Carbon target by 2030. Our diocese will need to respond to the national target. which, as it is presently framed, means that every church, cathedral, church school and vicarage in the C of E will need to reach net zero - or compensate for residual emissions - within the next ten years.

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Helen's to give them 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 Helen's, West St Helen's Street, Abingdon-on-Thames was completed on the 23rd October 2020 by Matt Fulford. Matt is a highly experienced energy auditor with over 15 years' experience in sustainability and energy matters in the built environment. He is a chartered surveyor with RICS and a CIBSE Low Carbon Energy Assessor. He is a Member of the DAC in the Diocese of Gloucester and advises hundreds of churches on energy matters.

St Helen's	
Church Code	627295
Gross Internal Floor Area	1,009 m^2
Listed Status	Grade I

The church typically used for 36 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	20 hours per week	130
Meetings and Church Groups	2 hours per week	20
Community Use	2 hour per week	200
Other (visitors)	12 hours per week	-

There is additional usage over and above these times for festivals, weddings, funerals and the like.

4. Energy Procurement Review

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

The current electricity rates are:

Single	11.914p/kWh	Below current market rates

The current gas rates are:

Single	2.550p/kWh	Below current market rates

The electricity is supplied by Southern electric 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 offer economies of scale in the procurement of energy. Its 'Green Energy Basket' tariff delivers 100% renewable electricity and 20% green gas. We would recommend that the church obtain a quotation for its gas and electricity supplies from the scheme: http://www.parishbuying.org.uk/energy-basket. Alternatively, Bulb, Ecotricity and Good Energy are suppliers which 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%	The correct VAT rate is being applied.
CCL	Not charged	The correct CCL rate is being applied.
FiT	100% charged	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.

5. Energy Usage Details

St Helen's uses 13,000kWh/year of electricity, costing in the region of £1,548 per year, and 150,000 kWh/year of gas, costing £4,018.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Helen's has one main electricity meter, serial number 217334179. There is one gas meter serving the site, serial number E016K0297519D6.

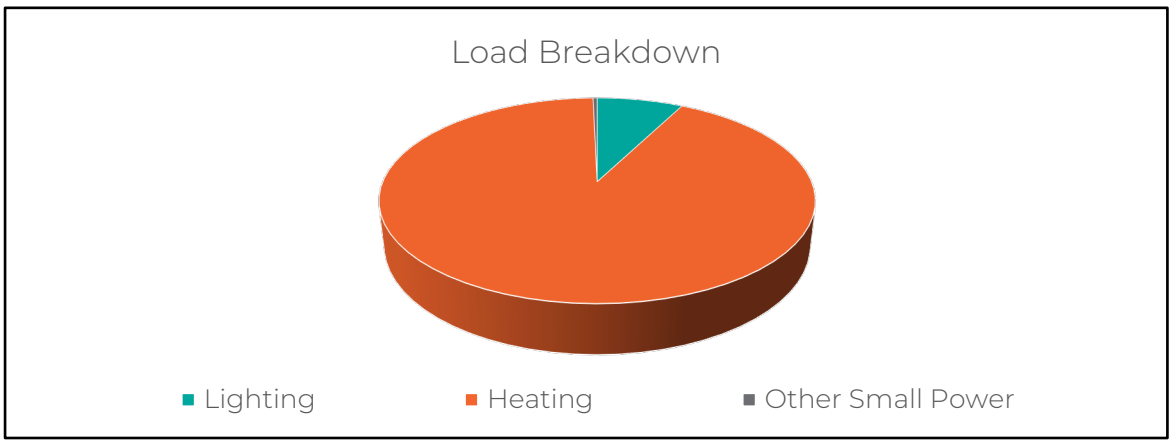
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	217334179	Atlas Mk 10D	Full AMR connected	Boiler room
Gas	E016K0297519D6	MDK16	Full AMR connected	Boiler room

All the meters are 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.

5.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Reflector lamps throughout the church with some LED.	8%
Heating	Gas fired underfloor heating system, run constantly but set point very closely managed.	92%
Other Small Power	Organ, kitchen appliances and other small power appliances.	0.4%



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

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Helen's uses 36% less electricity and 1% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Helen's use kWh	St Helen's use kWh/m^2	Typical Church use kWh/m^2	Variance from Typical
St Helen's (elec)	1,009	13,000	12.88	20.00	-36%
St Helen's (heating fuel)	1,009	150,000	148.66	150.00	-1%
TOTAL	1,009	163,000	161.55	170.00	-5%

6. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Heating also often uses gas or oil as its primary fuel, these are fossil fuels with high carbon emissions and little opportunity to decarbonise in the future. 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 it remaining oil and coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of biogas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. It is therefore a critical element to review and set out a plan to make more efficient and less carbon intensive and one way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches..

The church currently has an underfloor heating system which heats the majority of the church. This has its set point turned down when there are not services and turned up for services. The set point is very closely managed by a member of the church looking at detailed analysis of weather conditions. The heat is currently provided from gas condensing boilers located in a remote boiler house on the Thames side of the church.

Some of the smaller services are usually held in the Lady chapel which is the only area of the church to retain its fixed pews. In order that this can be heated independently, without the need to raise the setpoint of the underfloor system to the whole church, it is recommended that this is fitted with electric under pew heaters. Direct electric heating could be considered to the choir vestry.

Quite unusually this church would be recommended to consider a water source heat pump using the very near by Thames as a source of heat. This would involve a significant amount of design and feasibility work involve an Environment Agency licence and the heat main could easily be routed down the church path, across the small lane directly into the Thames and would integrate well with the underfloor system.

6.1 Install Electric Under Pew Heaters

In the Lady Chapel the heating here can be provided by under pew heaters. We would therefore suggest that four 650W Under Pew Heaters suspended from brackets from the underside of the pew seats.

Cable runs to the pew heaters should run along the along the existing routes (all cabling should be in armoured cable or FP200 Gold when above ground) to the pews. Each pew heater to be switched with a neon indicated fused spur located underneath the pew seat.

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.

6.2 Install Electric Panel Heaters

It is recommended that the PCC consider installing electrical panel heaters in the Clergy Vestry and the Choir Vestry on a time delay switch and remove the existing radiators.

These heaters have a strong radiative effect (where heat is reflected to people from the surface) as well as a light convective effect (where air is warmed and moves around to heat the general space). As such these heaters tend to provide a relative instant sense of heat and comfort within the space and only need to be on for short periods of time.

In the Clergy Vestry we would therefore suggest that two Electric Far IR Wall Panels 700W be installed.

In the choir vestry, there is no wall space for a heater, so we would suggest a ceiling hung heater, such as a Pulsar 2400w heater.

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 New LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church, and large areas are lit by relatively inefficient fluorescent, halogen and SON fittings.

There are some areas of the building which have had efficient LED lights installed but there still remains a large number of inefficient including fluorescent, SON and halogens within the church and vestries.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. There are a vast number of specifications of LED lights on the market but it is recommended that any LED light should come with branded chips and drivers and offer a 5 year warranty.

If all the lights were changed on a simple “like for like” the total capital cost (supplied and fitted) would be £3,215. The annual cost saving would be £1,116 resulting in a payback of around 4 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider.

Almost all the fittings (such as in the Lady Chapel, Chancel, Corona and Clergy Vestry) are where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

7.2 Lighting Controls (Internal)

There are several lights which could currently remain on for extended times in areas such as clergy vestry, south porch kitchen and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific 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.

7.3 Insulation of Pipework and Fittings

The pipework within the boiler room has the majority of its straight lengths insulated but the more complex shaped pipework fittings, such as valves, have been left uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the plant room unnecessarily warm. The exposed hot surfaces also represent a health and safety risk of burns for those working in the area.

It is recommended that these areas of expose pipework and fittings are insulated with bespoke made flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

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 – small array could be located in hidden valleys, sized to suit churches need only.
Wind	No – no suitable land away from buildings
Battery Storage	Yes – in conjunction with PV
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	No – insufficient electricity supply
Ground Source Heat Pump	Yes- water source heat pump from the Thames

Having reviewed the site it is not considered that there is good viability for many renewables apart from a Water Source Heat Pump from the Thames and potentially a small PV array which could be increased in size to part power the heat pump if that were to be installed..

Heat Pumps are a low carbon method of creating heat, there use and suitability for this church and, coupled with the purchase of 100% electricity, would result in this church being net zero carbon.

There is a clear, short route from the exiting boiler room (with the open door on the photo), down the path to the Thames which is indicated with the red arrow on the photo.

The existing boiler house could be a good location for the various pumps required and the route down the path limits any archaeological risks. There is a small lane to cross to the river but this is not overly problematic. The system would work well with the existing underfloor heating and therefore, technically, a water source heat pump is relatively straight forward.

The challenge will be to design the system and gain the required permissions to use the Thames. Initial contact has been made with the Canal and River Trust. (Maurice Bottomley, Business Development Manager – Heating & Cooling, 07551 133369, Maurice.Bottomley@canalrivertrust.org.uk)

The response was “The River Thames is not one of our waterways but we may still be able to help your client, depending upon what scope you wish to take on. In order to progress with a feasibility study and proceed to the actual use of Thames water to supply heat to St Helen's church, an abstraction licence and environmental permit must be gained from the Environment Agency. Plus, it must be determined who has ownership/access rights to the river.”

It is therefore suggested that the PCC form a working group to further explore this possibility and make contact with Maurice Bottomley to progress the feasibility of using the Thames.

There is potential for a small PV array on the roof of the one of the hidden valleys. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. The church’s energy consumption is already relatively small and the consumption during the daytime when the sun is shining is likely to be very low indeed, therefore while technically viable only a very small number of panels (maximum of around 12) would be worth considering at this stage. This could be increased if a heat pump were to be installed.

Battery Storage is not strictly a renewable energy solution, but battery storage does however provide a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

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 .

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
North	13	PAR38 LED	£61	£221	3.63
North nave	10	PAR38 LED	£47	£170	3.63
Lady chapel	7	PAR38 LED	£193	£119	0.62
Chancel	7	PAR38 LED	£193	£119	0.62
Choir vestry	2	PAR38 LED	£9	£34	3.63
Nave	5	AR111 LED	£80	£213	2.65
South nave	10	PAR38 LED	£47	£170	3.63
Corona	24	GU10 LED	£273	£576	2.11
South nave	5	50W LED Flood	£138	£600	4.34
South aisle	10	PAR38 LED	£47	£170	3.63
Clergy vestry	4	R63 LED	£28	£86	3.12

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