ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Mary's, Fordingbridge

PCC of St Mary's

Author	Reviewer	Date	Version
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1. Executive Summary

An energy survey of St Mary's was undertaken by ESOS Energy 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 Mary's church was originally built in 1086 with subsequent extensive additions and rebuilds in 1150 and 1230. There was a full renovation in 1840 and the largely Norman church has Grade I listed status. The church is heated via an ineffective 1961 Grundy stove which allows heat to naturally convect through a wall grille to attempt to heat the church. There is both gas and electricity supplied to the site.

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.

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)
Refurbish window ironmongery / draught seals	10,026	£208	£150	0.72	List A (None)	1.85
Optimise and upgrade controls for electric heating	30,358	£630	£3,000	4.76	List A (None)	5.60
Replace heating system for electrical based heating solution	184,386	£2,038	£18,540	9.10	Faculty	32.92
Install Draughtproofing to External Doors	6,015	£125	£2,400	19.22	List B	1.11
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	3,223	£424	£8,633	20.34	Faculty	0.82
Install PIR motion sensors on selected lighting circuits	30	£4	£156	40.14	List B	0.01
Change existing lighting for low energy lamps/fittings	3,178	£418	£32,798	78.38	Faculty	0.80

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

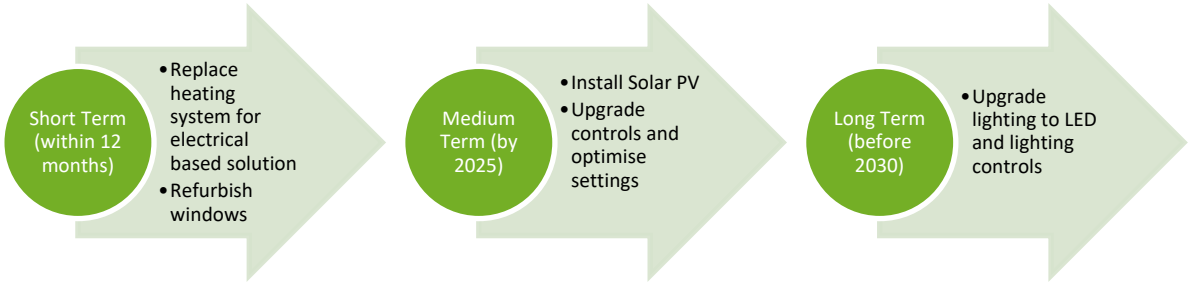
Based on current contracted prices of 13.16p/kWh and 2.07p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £3,848 per year.

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.

This church has a clear route to become net zero by 2030 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Mary'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 Mary's, Church Street, Fordingbridge, SP6 1BB was completed on the 2nd October 2020 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

St Mary's	
Church Code	641202
Gross Internal Floor Area	648 m^2
Listed Status	Grade I

The church typically used for 12 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	6 hours per week	312
Meetings and Church Groups	2 hours per week	104
Other	4 hour per week	208

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 Mary's and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single Rate	13.1679p/kWh	Below current market rates
Standing Charge	48.6418p/day	N/A

The current gas rates are:

Single / Blended Rate	2.0758p/kWh	Below current market rates
Standing Charge	471.3p/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.

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.

5. Energy Usage Details

St Mary's uses 12,819 kWh/year of electricity, costing in the region of £1,687 per year, and 200,515 kWh/year of gas, costing £4,162.

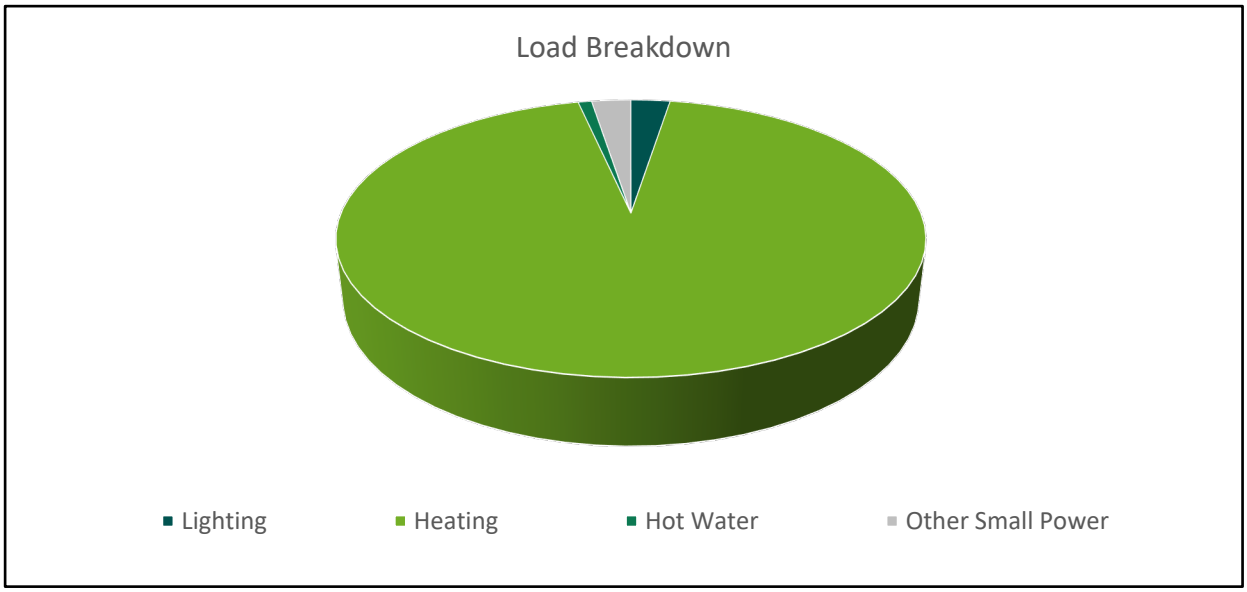
This data has been taken from the annual energy invoices provided by the suppliers of the site. St Mary's has two main electricity meter, serial numbers E12Z062293 and E12Z062209. There is one gas meter serving the site, serial number K0176815D6.

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.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Metal halide flood lights to nave and side aisles, halogen flood lights to chancel and altar. T5 in choir vestry and T12 in vestry	3%
Heating	1961 Grundy stove (oil rotary heater) converted to gas in 1984, new burner installed c. 2018, draught heating to church, background heating used. Unidare night storage heaters used in choir vestry and vestry on fused spurs and switched on as required. IR heater for 'boost' in vestry.	94%
Hot Water	Heatrae sadia point of use water heater to WC and vestry.	1%
Other Small Power	Organ power, sound system and other small plug-in loads	3%



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 Mary's uses 1% less electricity and 106% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Mary's (elec)	648	12,819	19.78	20.00	-1%
St Mary's (gas)	648	200,515	309.44	150.00	106%
TOTAL	648	213,334	329.22	170.00	94%

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 remain coal fired power stations. 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'. 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.

Given the age of the current boiler in the church and the warm up time required for when the church is used, this church would strongly benefit from an up-grade of heating system to an electrical based solution.

Having reviewed the use of the church building and the needs of the different areas, a combination of under pew heaters and infrared panels would be the best solution, as detailed below.

Area	Type/ Size	Watts	Number (or m) Required
Side aisles	Electric Far IR Wall Panel 1200W	1200	8
Central aisle	Electric Far IR Wall Panel 900W	900	16
Vestry	Near IR Overhead Heater 3kW	3000	2
Choir stalls	Electric Under Pew 650W	650	8
Altar / reredos	Electric Far IR Wall Panel 350W	350	2

6.1 Install Electric Under Pew Heaters to choir stalls

The choir stalls are to be retained and adding under pew heaters to these can provide a very efficient way of heating the users here.

Two of the most popular under pew heaters within churches are BN Thermic PH65 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating.

We would therefore suggest that the 650W under pew heaters are installed.

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 rows of pews. Each pew heater to be switched with a neon indicated fused spur located underneath the 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

In the other areas of the church, the use of infrared panel heaters will provide suitable heating to the users of the church. 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

It is recommended that the PCC consider installing electrical far IR panel heaters in the central aisle (mounted on columns, possibly at 2.5m height) and side aisles (thin profile, wall mounted panels), as well as wall mounted panels within the altar and vestry on a time delay switch and remove the existing radiators.

Suitable electric panel heaters would be far infrared panels such as https://www.warm4less.com/p/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 cannot be left on accidently after use.

6.3 Optimise and upgrade controls for electric heating

With the introduction of a new heating system, a new control system should be introduced to control the heating. A move to an all electric heating system will also require a change in scheduling the heating as the current arrangement requires the heating to be switched on many hours before occupation; electric heating is more instantaneous and therefore only requires the heating to be switched on less than an hour before occupation. The use of a simple timeclock and thermostat within the church will significantly reduce the heating demand within the church. Any new control system should be introduced in parallel with a new electrical heating system.

To be able to have sufficient electrical power to supply enough energy into an electrical heating system the church will need to increase the electrical supply it current has coming in from the existing single phase 100A supply to a 3 phase 100A supply.

The upgrade to the supply has to be carried out by the District Network Operator in the area. The DNO in your area is thought to be SSE Power Distribution - www.ssepd.co.uk; 0800 0483516 (North Scotland and Southern England)

The cost of bringing in a new 3 phase supply can range from £300 to £30,000 but the DNO will provide a quotation for free so it is well worth obtain a quotation in the short term so that decisions can be made on a well informed basis.

7. Energy Saving Recommendations

In addition to having a revise 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 and SON fittings within the main body of the church.

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. An example of such a range of fittings is available from http://www.qvisled.com/

The lighting that has been recommended as a replacement, is not on a "like for like" basis within the nave and chancel, a suggestion of a more flexible lighting system with spot lights on a track system has been made. For the full replacement with the recommended changes, the total capital cost (supplied and fitted) would be £32,798. The annual cost saving would be £418 resulting in a payback of around 78 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.

There are some fittings such as the porches and choir stalls where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to w 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)

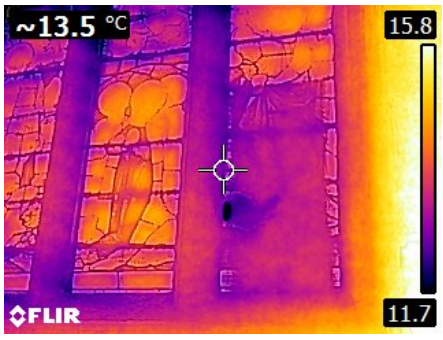
There are several lights which currently remain on all the time in areas such as porches, vestry, toilet areas and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit 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 Refurbish window ironmongery / draught seals

The windows are in generally good repair, however there are two smashed windows, one in North aisle and one in large West window allowing cold air into church. These gaps allow large quantities of cold air into the church whilst also allowing heat to escape. As a temporary measure for small gaps elsewhere gaps can be filled temporarily with black plasticine (which will cause no damage and can be easily removed).



Gaps can temporarily be filled with black plasticine which will cause no damage and can be easily removed (as recommended by English Heritage). It is recommended that the masonry, mortar and frames are repaired to reduce these gaps.

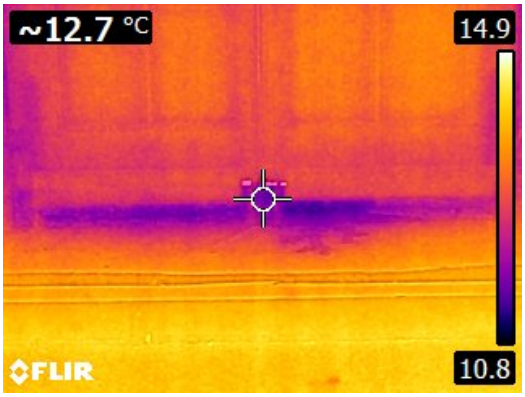
7.4 Draught Proof External Doors

There are a number of external doors in the church. 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 in to the church around the side and base of these doors.

It is recommend that the draughtproofing around the door is improved and draught strips are added. This could be achieved in a number of ways.

For timber doors that close onto a timber frame 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 timber doors that close onto a stone surround more traditional solutions such brush draught strips rebatted 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.



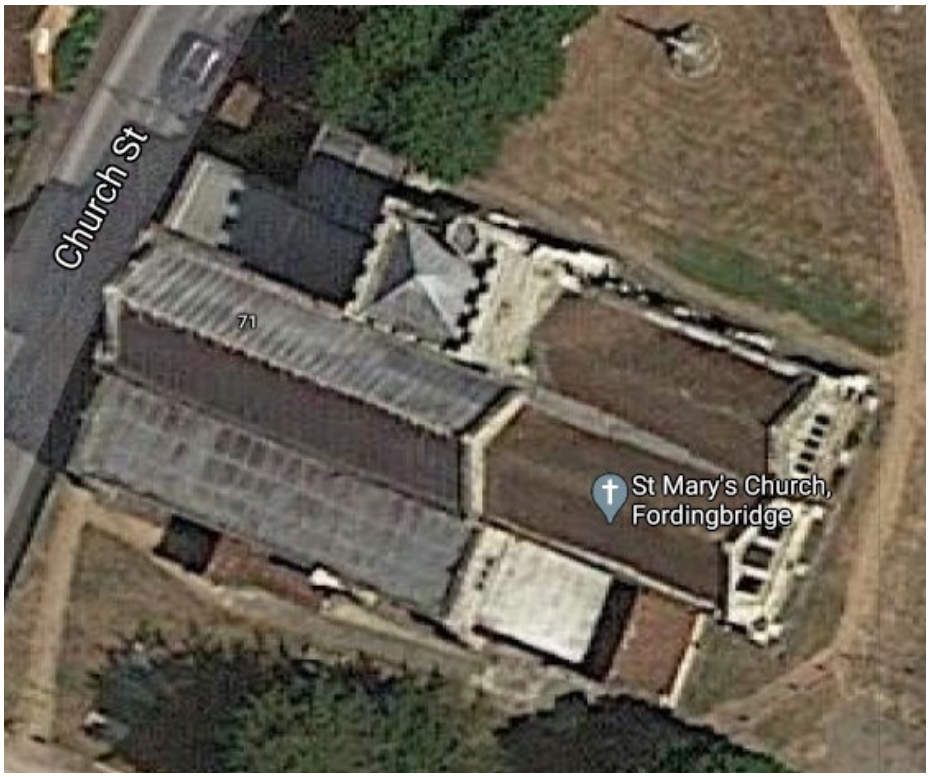
Simple measures such as having a 'sausage dog' style draught excluder laid along the base of a door, using plasticine of the right colour to fill gaps where daylight can be seen and putting painted fridge magnetic over large keyholes can all be simple DIY measures which are effective.

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 – south flat roof with parapet
Wind	No – no suitable land away from buildings
Battery Storage	No – no viable 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	No – archaeology in ground and radiator system

There is potential for a small PV array on the roof of the South Aisle behind the parapet, so it will not be vis. 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 very 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 4) would be worth considering.



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
Chancel	12	3 Spot Track lights	£185	£12,000	64.74
Nave and aisles	15	3 Spot Track lights	£89	£15,000	169.03
North and South Porch	4	LED GLS	£12	£48	3.87
Choir stalls - candle lamp	12	LED GLS	£46	£286	6.17
Nave and aisles	5	PAR38 LED	£51	£85	1.67
Choir vestry	3	5ft Single LED	£23	£321	14.18
Vestry	2	5ft Single LED	£9	£176	19.75
WC	2	2D LED 11W	£3	£118	34.21