Energy Efficiency and Zero Carbon Advice

St Mary's Church, Wargrave

PCC of St Mary's

Author	Reviewer	Date	Version
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1. Executive Summary

An energy survey of St Mary's Church, Wargrave 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 Mary's Church, Wargrave is a Parish Church dating back to Norman times but rebuilt in 1916 after a disastrous fire. The church has an adjacent Church Centre which was recently built in 2019. 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 (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Insulate exposed pipework and fittings in plantrooms	3,631	£123	£500	4.06	List A (None)	0.67
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A
Install new dusk to dawn timer on external lighting	757	£171	£300	1.75	List A (None)	0.19
Change existing lighting for low energy lamps/fittings	5,977	£1,351	£3,892	2.88	Faculty	1.51
Block up grilles in floor where redundant heating pipes run	3,631	£123	£800	6.49	None	0.67
Install a Solar PV array to tower of church (assumed	1,796	£406	£3,453	8.50	Faculty	0.45

100% of energy generated used in building)						
Install PIR motion sensors on selected lighting circuits	71	£16	£314	19.53	List B	0.02
Install Draughtproofing to External Doors	2,179	£74	£1,600	21.65	List B	0.40
Replace existing boilers for high efficiency, low NOx condensing boiler	10,893	£370	£8,400	22.73	List A (None)	2.01
Install Variable Speed Drives (VSD) to pumps	61	£14	£800	58.09	List A (None)	0.02

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

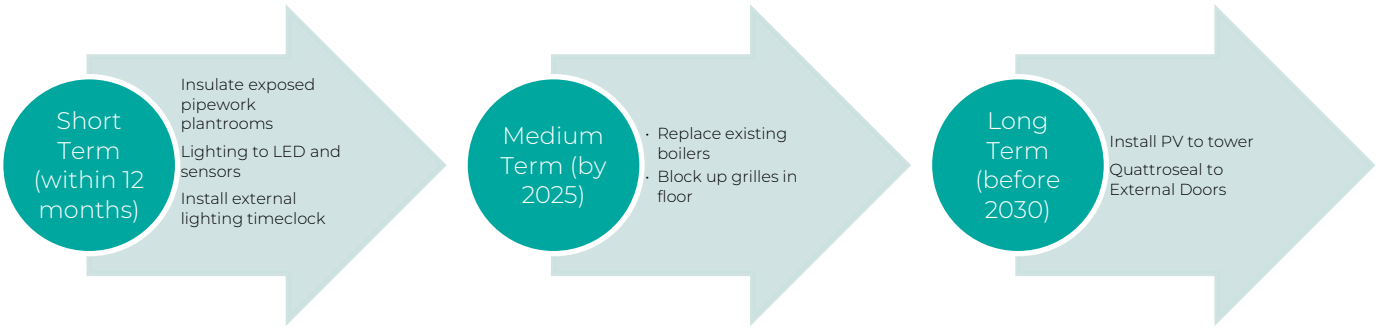
Based on current market prices of 22.61p/kWh and 3.39p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £2,994 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 closer to net zero by 2035 by undertaking the following steps:


Short Term (within 12 months)
Insulate exposed pipework plantrooms
Lighting to LED and sensors
Install external lighting timeclock
Medium Term (by 2025)
Replace existing boilers
Block up grilles in floor
Long Term (before 2030)
Install PV to tower
Quattroseal to External Doors

3. Introduction

This report is provided to the PCC of St Mary's Church, Wargrave 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, Wargrave, Station Road, Wargrave, Reading, RG10 8EU, was completed on the 9th September 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 Mary's Church, Wargrave	
Church Code	627491
Gross Internal Floor Area	486 m^2
Listed Status	Grade II*

The church typically used for 7 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	3 hours per week	120
Meetings and Church Groups (weekly evening prayer, choir practice and the like)	2 hours per week	-
Community Use (school use, holiday club, village festival etc.)	2 hour 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 Marys Church, Wargrave and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	25.046p/kWh	Above current market rates
Night Rate	21.012p/kWh	Above current market rates
Standing Charge	35.107p/day	N/A

The current gas rates are:

Single / Blended Rate	3.375p/kWh	In line with current market rates

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 gas and electricity supplies.

The electricity is supplied by OPUS Energy and is purchased on a renewable tariff.

Remaining with a renewable tariff is an important part of the process of taking churches towards net zero. It may, however, be possible to get a renewable tariff at a lower price. 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. We would recommend that the church obtain a quotation for its electricity supplies from the scheme: http://www.parishbuying.org.uk/energy-basket. The church should continue with sources of 100% renewable or off-set gas which are available from an increasing range of suppliers.

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 Church, Wargrave uses 12,195 kWh/year of electricity, costing in the region of £2,757 per year, and 72,619 kWh/year of gas, costing £2,463.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Mary's Church, Wargrave has one main electricity meter, serial number E12Z017663. There is one gas meter serving the site, serial number M025A0384408A6.

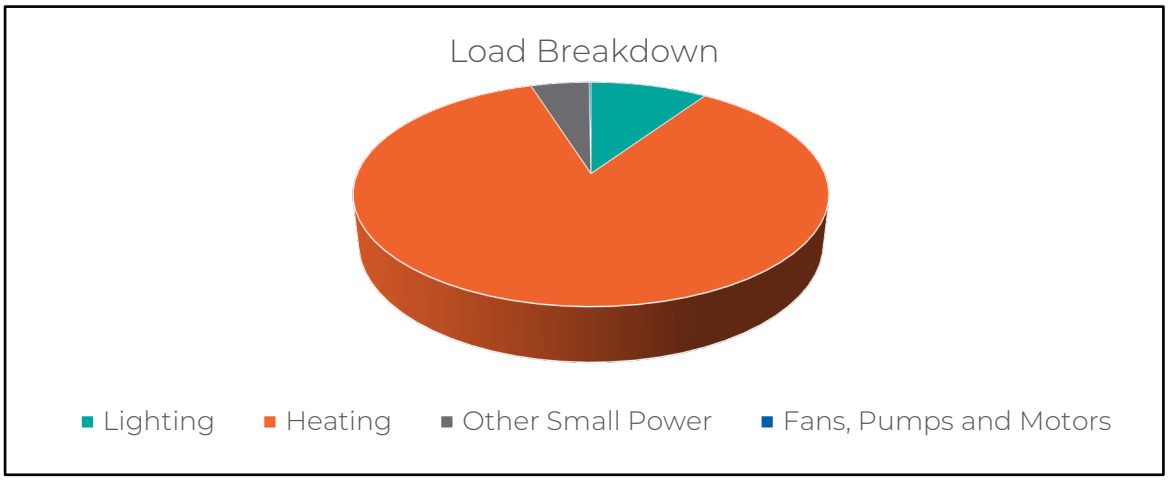
Utility	Meter Serial	Type	Location
Electricity – Church	E12Z017663	Unknown	Not Seen
Gas – Church	M025A0384408A6	Unknown	Not Seen

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 use within the church can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Mix of fluorescent, PAR 38 and LED lamps.	9%
Heating	Gas boiler to radiators	86%
Other Small Power	Organ, sound and projection systems, cleaning and other small appliances	4.7%
Fans, Pumps and Motors	Pumps associated with the heating system	0.1%



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.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Mary's Church, Wargrave uses 25% more electricity and the same amount of heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Mary's Church, Wargrave use kWh	St Mary's Church, Wargrave kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Marys Church, Wargrave (elec)	486	12,195	25.09	20.00	25%
St Marys Church, Wargrave (heating fuel)	486	72,619	149.42	150.00	0%
TOTAL	486	84,814	174.51	170.00	3%

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..

This is a church with a large floor area and moderate usage. The current heating system comprises of relatively modern radiators and pipewort within the church which is reported to heat up the church satisfactorily. There is a new pressurisation system on the heating system and the only item which remains that is at the end of its life is a larger 140kW gas boiler. The church only turns the heating on when it is used and does not use background heating which would be unnecessary. While the church does currently have pews the extensive nature of its size would result in any electric under pew heating system being very large. The size and nature of this church does not support the use of heat pump technology very well and would require adaptation of its otherwise reasonable radiator system. On balance the continuation of the efficient use of gas, procured from a renewable source would be the least worst option in terms of environmental impact of the heating system. Any other solution is likely to result in far greater carbon emissions from the extensive works which would be required and also result in perfect good and serviceable components being wasted.

The efficient use of gas with a new boiler and appropriate insulation measures is therefore suggested. This position should be review again in 25 years time when any new boiler would then have reached the end of its life and other technological solutions may have become available.

6.1 Replace the Existing Boiler for a High Efficiency Condensing Boiler

The existing gas boiler within the church is now around 30 years old and as such is reaching the end of its serviceable life. Boiler efficiencies have also improved since this boiler was originally installed and therefore replacing the boiler for a new, high efficiency, Low NOx gas condensing boiler will deliver gas savings through more efficient combustion and heat transfer in any new boiler.

Installing a new gas boiler now will lock the church into a gas / fossil fuel based solution for the lifetime of the new boiler (around 20 years) but this route is considered to be the one that has the least environmental impact at this time. The installation of a hydrogen ready boiler and the continued procurement of green gas supplies alongside the frugal use of the boiler must continue. At this time the replacement of the existing boiler with a new hydrogen ready gas condensing boiler should be considered and would be expected to deliver 15% to 20% improvements in gas consumption.

A replacement gas boiler can be undertaken by a competent mechanical engineering company and it would make sense to install the new VSD pumps and undertake the pipework insulation as part of these works. The heating system could also be flushed clean and refilled with inhibitor and advanced heating fluids (such as endotherm) on completion to maximise the efficiencies.

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 PAR38 lamps.

There are some areas of the building which have had efficient LED lights installed but there still remains a large number of inefficient fluorescent lamps within the church.

There is also a large external lighting installation which uses high energy SON lighting. As these lights are used most evenings the replacement of these to LED units is highly recommended.

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 £3,892. The annual cost saving would be £1,351 resulting in a payback of around 3 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 replacement of the PAR38 spotlight fittings 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. These fittings can be procured widely on line such as www.energybulbs.co.uk/products/megaman-15-5w-led-es-e27-warm-white-35deg-141384

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the store room and areas in the nave. 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 External Lighting Controls

The external flood lights are currently on from 5pm until 11pm. For efficient operation and to reduce light pollution and nuisance to neighbours it is generally recommended that external lighting is turned on at dusk and off after 10pm.

It is therefore recommended that the existing timer (pictured and located in the boiler room) is adjusted to switch off the external lights at 10pm. A timeclock with a time and day capacity is recommended over those that only have time of day capacity.

7.4 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.

7.5 Variable Speed Pumps

The existing pumps within the church are fixed speed units meaning that they are either running at full power or they are off. In varying conditions the pumps will only need to operate at part power and can consume less energy in doing so.

It is recommended that the pumps are changed to variable speed drive units which can automatically vary the power they use depending on the conditions at that particular moment in time, for example, how much heat is required into the heating system.

The installation of variable speed units will require the removal of the existing pump and the installation of a new unit with integration back into the controls system. As such this should be carried out by a competent mechanical engineer.

7.6 Draught Proof External Doors

There are a number of external doors in the church. These have the timber doors but these do not close tightly against the timber frame and hence a large amount of cold air is coming into 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 these 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

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.

7.7 Block up grilles in floor where redundant heating pipes run

The church has a large length of metal floor grilles which used to be where the underground pipework for the heating system ran. Since the replumbing of the heating system these ducts are now redundant but they can create cold draughts which blow into the church.

It is therefore recommended that these are sealed. Many churches have simply lifted the grilles, packed the duct with mineral wool insulation, fixed a piece of marine ply over the top and painted the upper surface black and then replaced the metal grille on top so that the appearance is the same but the duct is insulated and sealed and the ply also prevent heels or debris falling into the duct.

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 the tower roof
Wind	No – no suitable land away from buildings
Battery Storage	Yes – In conjunction with the PV
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – Issues with boiler size and fuel storage, little advantage given mains gas use.
Air Source Heat Pump	No – insufficient electricity supply
Ground Source Heat Pump	Yes - Potential in future but not currently suitable to integrate well with existing heating system.

There is potential for a small PV array on the roof of the tower. 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 8) would be worth considering if at all.

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.

Heat Pumps are a low carbon method of creating heat, there use and suitability for this church have been review in the section earlier on in this report on Efficient and Low Carbon Heating Strategies. While the use of these, especially ground source, could be a consideration in the future, the current arrangements at this church would suggest that the efficient use of gas boilers with the current system and a focus on improving the boiler efficiency, insulation and draught proofing measures would be most appropriate at this time.

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. This grant could be usefully used to purchase the LED PAR 38 replacement light bulbs for the church to self-install.

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.

11. Other Observations

A walk through of the adjoining Church Centre was undertaken during the visit. This was found to be a modern and highly efficient build and no further energy saving recommendations need to be made for this building. The Hannen Rooms were also reviewed and recommendations for improvements around lighting have been included as part of this report.

The boiler controls and the use of the external lighting were discussed as part of this audit and the church may wish to consider the installation of a high quality broadband supply into the church which would then enable WiFi devices to be used to aid with highly efficient heating controls and security devices such as cameras and external PIR lighting which do not need the external lights to be on all the time.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Store room	2	4ft Single LED	£5	£143	26.43
Store room	2	5ft Single LED	£10	£176	16.85
Parish office	1	5ft Single Proteus LED	£9	£127	13.92
Tower	2	PAR38 LED	£23	£34	1.46
Nave	10	NO CHANGE			
Chancel	4	PAR38 LED	£47	£68	1.46
Altar	2	5ft Single LED	£13	£176	13.15
Side Chapel	1	NO CHANGE			
Side Chapel	3	NO CHANGE			
Nave ceiling uplights	8	50W LED Flood	£399	£960	2.41
Front of nave	6	PAR38 LED	£70	£102	1.46
Hannen Room	8	PAR38 LED	£93	£136	1.46
Hannen Kitchen	5	NO CHANGE			
External	5	100W LED Flood	£494	£1,000	2.02
External	2	50W LED Flood	£89	£240	2.70
External	1	100W LED Flood	£99	£200	2.02

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