



# **Energy Audit and Survey Report**

## **St Mary the Virgin Church**

### **PCC of St Mary the Virgin, Tetbury**



#### Version Control

Author	Reviewer	Date	Version
Matt Fulford	David Legge	24 <sup>th</sup> November 2019	1.0

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## 1. Executive Summary

An energy survey of St Mary the Virgin Church was undertaken by ESOS Energy Ltd to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St Mary the Virgin Church is A Grade 1 listed 18th century parish church serving the town. There is only 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.

Short Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Continue to change existing lighting for low energy lamps/fittings	63	£8	£103	12.94	List A	0.02
Fit Quattroseal draft proofing to historic doors	1,440	£181	£800	4.41	List B	0.44
Relocate over door air heater to inside the porch	None	None (improved comfort)	£200	N/A	List B	N/A

Medium Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Remove storage heaters from ambulatories, install BN Thermic under pew heaters to central block of pews.	36,000	£4,536	£11,400	2.51	List B	11.06
Consider PV array on south nave roof (based on 4kWp system)	3,431	£432	£6,000	13.88	Faculty	1.05



Long Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permlsion needed	To be actioned by who / when?
Fit 270mm of insulation into the loft	7,200	£171	£4,000	23.41	Faculty	1.32

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

Based on current contracted prices of 12.60p/kWh for electricity.

**If all measures were implemented this would save the church £5,329 per year.**



## 2. Introduction

This report is provided to the PCC of St Mary the Virgin Church to provide them with advice and guidance as to how the church can be improved to be more energy efficient. In doing so the church will also become more cost effective to run and seek to improve the levels of comfort. Where future church development and reordering plans are known, the recommendations in this report have been aligned with them.

An energy survey of the St Mary the Virgin Church, Church Street, Tetbury, GL8 8JG was completed on the 11<sup>th</sup> November 2019 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.

<b>St Mary the Virgin Church</b>	
Gross Internal Floor Area	500 m <sup>2</sup> (estimated)
Listed Status	Grade I
Typical Congregation Size	104

The church typically used for 22 hours per week for the following activities

Services	4 hours per week
Meetings and Church Groups	2 hours per week
Other (Manned and open 4 mornings per week)	16 hours per week

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



### 3. Energy Procurement Review

Energy bills for electricity have been supplied by St Mary the Virgin Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	14.73p/kWh	In line with current market rates
Weekend and Evening Rate	12.84p/kWh	In line with current market rates
Night Rate	7.78p/kWh	In line with current market rates
Standing Charge	23.4615p/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.



## 4. Energy Usage Details

St Mary the Virgin Church uses 77,835 kWh/year of electricity, costing in the region of £9,810 per year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Mary the Virgin Church has one main electricity meter, serial number S01C00886.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Church	S01C00886	3 phase 100A	Yes	GF electrical area



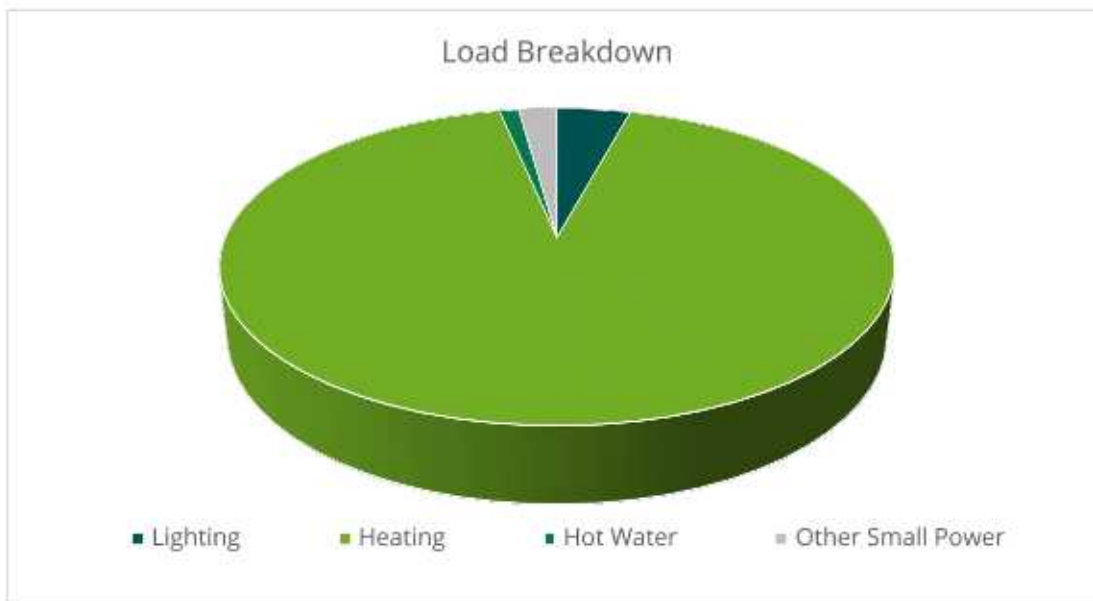
It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely and the patterns of usage reviewed against the times the building is used.

### 4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Mainly LED lighting with the remaining fittings being converted by church as they fail	4%
Heating	Night storage heaters to ambulatory, electric underfloor to front of nave and redundant under pew tube heaters	93%
Hot Water	Electric point of use water heater	1%
Other Small Power	Appliances in the office and the like, organ, sound equipment etc.	2%





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

#### 4.2 Energy Benchmarking

In comparison to national benchmarks<sup>1</sup> for Church energy use, St Mary the Virgin Church uses 8.4% less energy than would be expected for a church of this size.

	Size (m <sup>2</sup> GIA)	St Mary the Virgin Church use kWh/m <sup>2</sup>	Typical Church use kWh/m <sup>2</sup>	Efficient Church Use kWh/m <sup>2</sup>	Variance from Typical
St Mary the Virgin Church (elec)	500	155.67	20	10	678%
St Mary the Virgin Church (heating fuel)	500	0.00	150	80	-100%
<b>TOTAL</b>	<b>500</b>	<b>155.67</b>	<b>170</b>	<b>90</b>	<b>-8%</b>

The use of electrical night storage heaters results in the church having very high electrical use but this is offset by having no other heating fuel. The more efficient use of using the electricity for heating should be the key focus for any energy and carbon reduction measures.

<sup>1</sup> CofE Shrinking the Footprint – Energy





## 5. Energy Saving Recommendations (Electricity)

### 5.1 Lighting (fittings)



The lighting makes up a relatively small overall energy load within the building, and a good number of the existing fittings have already been changed for LED.

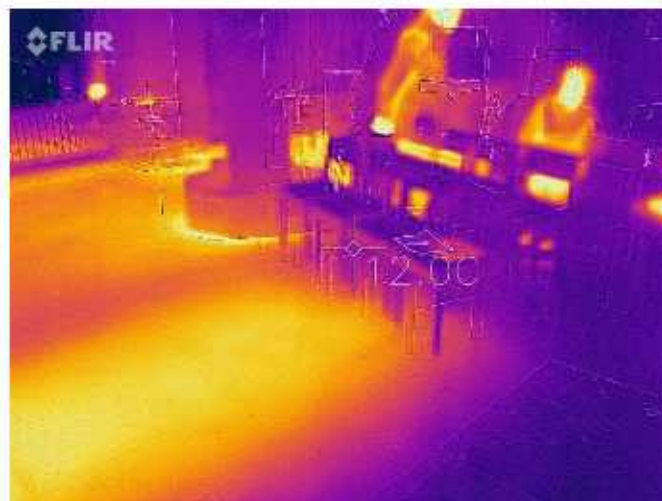
The church is well aware of the benefits of changing the remaining fittings to LED and continues to do so as bulbs fail. It is recommended that they continue with this programme and in the near future they seek to complete this for all fittings regardless of whether the existing bulb has failed or not.

One fitting that would be worth changing more promptly is the fluorescent tube in the parish office as this space is used most frequently and the current fitting is very poor.

## 6. Energy Saving Recommendation (Heating)

### 6.1 Heating System and Strategy

The church is currently heated predominantly by old electric night storage heaters. These are located in the ambulatories and to the rear of the nave in the bookshop area. In addition, there is an electric underfloor heating area at the front of the nave where the pews have been cleared but due to underground conditions when installed it should be noted that the area under the chairs to the south west section does not have underfloor heating. Some consideration of the chair layout with regarding to the heating location may be beneficial.



The performance of the heating system in terms of comfort is described by the church to be 'tolerable' but involves the church having to open the side doors into the ambulatories in order to let in heat from that areas into the nave. The ambulatories are otherwise lightly used.

There are some redundant under pew tube heaters within the high box pews which would have provided heat to the nave area. It is recommended that these tube heaters are replace for under pew heaters to the central block of pews each side of the aisle (the side pews which can only be accessed from the ambulatories are reported to be infrequently used and would be the prime location of future pew removal if ever considered).



For replacement, two most popular under pew heaters within churches are BN Thermic PH30 heaters (<http://www.bnthermic.co.uk/products/convection-heaters/ph/>) or similar from <http://www.electriceatingsolutions.co.uk/Content/PewHeating>. Existing cabling to the pew heaters can be used although some revisions may be required to balance the load on the circuits (all new cabling should be in armoured cable or FP200 Gold when above ground).

The church has previously trialled the use of some under pew heaters with less than positive feedback due to the 'burning sensation' on the back of the legs. The BN Thermic heater referenced above does not tend to give this experience due to its design and could be the ideal specification to consider. This type of heat has been installed recently within the diocese at St Andrews Church, Chedworth (contact Church Warden – Robert Young) which also has the Norel heater installed in its choir stalls for comparison.

### 6.2 Reduce / Discontinue Night Storage Heater

The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive and organs can be installed with a local background tube heater such as <https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat> within the organ casing in order to provide the heat where it is required.

It is recommended that once under pew heaters have been successfully installed the night storage heaters are removed and the heating is only turned on when the church is in occupation. With the ambulatories, at the rear of the nave and in other suitable locations where there is wall space within the church it is recommended that the PCC consider installing electrical panel heaters on a time delay switch and remove the existing night storage heater.

Suitable electric panel heaters would be far infrared panels such as <https://www.warm4less.com/product/63/1200-watt-platinum-white->. These can be purchased widely and fitted by any competent electrician. It is recommended that they are fitted with a time delay switch such as <https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tls-w-ms> so they can not be left on accidentally after use.

### 6.3 Relocate / Renew Overdoor Heater

The external west door currently has a relatively small over door air heater above it. This is not ideally located as it is within the first draught lobby and therefore provide little useful heat to the space. It is recommended that it is relocated to the other side of the draught lobby to is it over the second set of doors and as well as providing a heated air curtain, it also provides useful heat to the west porch. Some consideration may also wish to be given to installing a larger air curtain that covers the full width of the door and a wider version of the BN Thermic 800 series unit may provide a much better performance. <http://www.bnthermic.co.uk/products/fan-assisted->



[heaters/800-series/](#). This recommendation is unlikely to provide an energy saving but will assist in improving the thermal comfort of the church.

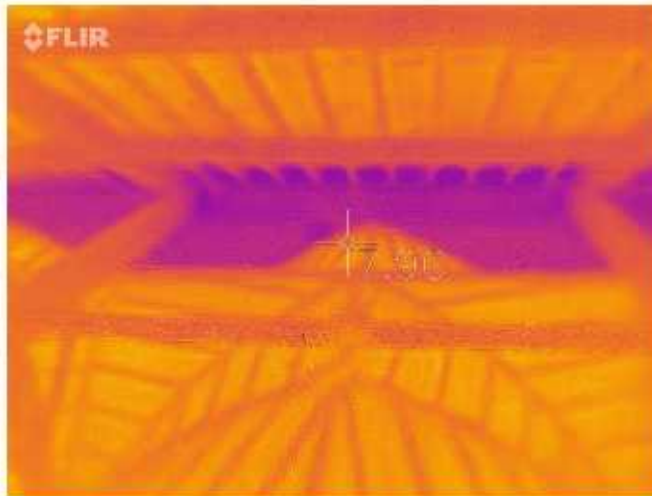


## 7. Energy Saving Measures (Building Fabric)

### 7.1 Roof Insulation

There is a timber vaulted roof above the church which is accessible. This does have a small layer of insulation between the pitched rafters but it would be feasible to insulate directly on top of the vaults. It is noted that there has been structural engineering advice received that this would be feasible but concerns raised on ventilation and the timbers being exposed for visual inspection. To address this the church may wish to consider undertaking this to a small trial area initial to review if any of these concerns are valid.





## 7.2 Draught Proofing to Doors

There are a number of external doors in the building. These have the original historic timber doors on them, but these do not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of these doors.

Where a timber door closes against a timber frame it is recommended that draught proofing is fitted. A product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing.

[http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National\\_Trust\\_Case\\_Study.pdf](http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf). Note this cannot be used where the timber door closes directly against a stone surround.

Other simple measures such as using a small fridge magnet painted black over the large keyhole or the use of 'sausage dog' type draught excluders at the base of little used doors can prove to be very effective. Doors should be reviewed in daylight and gaps where the light shines through sealed or filled in whatever the most appropriate way is for the specific door.



## 8. 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 nave roof non-visible
Battery Storage	Yes – battery and inverter could be easily located in roof void
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 electric only system in church
Air Source Heat Pump	Yes – potential for air to air source heat pump for office and ambulatories but usage may not support
Biomass	No – not enough heating load as well as air quality issues

There is potential for a small PV array on the roof of the south nave, due to the parapet and the ground contours this roof is not visible. Nonvisible PV arrays are acceptable and have been installed in the diocese at St Peters, Winchcombe, St Michaels, Withington and the Cathedral. 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 churches energy consumption during the daytime when the sun is shining is likely to be limited, therefore a small array of between 4 to 8 kWp would be worth considering.

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 therefore investment into this may be worth delaying at this stage.



## 9. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at <https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-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 as 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. Report Circulation

In addition to the PCC, this report is also sent to:

1. Your DAC secretary and your DEO, because
  - They may be able to offer you help and support with implementing your audit
  - They want to look across all the audits in your diocese to learn what the most common recommendations are.
2. Catherine Ross, the officer in the Cathedral and Church Buildings team centrally who leads on the environment, who wants to learn from all the audits across the country. She will be identifying cost-effective actions churches like yours might be able to make.

