Energy Audit of St Margaret of England, Little Faringdon (II*)

December 2013

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1.0 Introduction

This report has been prepared to detail the energy saving measures and renewable energy generation potential that exist at St Margaret of England, Little Faringdon.

The report was prepared following a site audit conducted by Annie Westaway, Sustain on 4th December 2013. She was accompanied by Colonel Jeremy Taylor.

A summary of recommendations is made in Section 8 of this report.

The findings of this report in no way negate the PCC of St Margaret of England, Little Faringdon to petition for a faculty in order to conduct any works at the church. For further advice on the requirement for a faculty the church should seek advice from the DAC Secretary.

Further advice in planning and implementation of the recommendations may be sought from the Diocesan Advisory Committee (DAC).

"...churches aren't just places of wonder, encounter and community; they're also real buildings which make an impact on the natural world, and it's our responsibility to make sure that their carbon footprint is as small as possible. We have over 800 church buildings in our diocese, and with all the people who pass through them in a year, we can influence literally hundreds of thousands more buildings."

Bishop of Oxford

This energy audit has been carried out as part of a scheme to encourage and support church buildings in Oxfordshire to become more energy efficient. The scheme is being run by the Trust for Oxfordshire's Environment (TOE2) in partnership with the Diocese of Oxford, with Sustain as the delivery partner.

TOE2 is an environmental funder for Oxfordshire, supporting and developing projects which improve and benefit Oxfordshire's environment and local communities. TOE2 supports projects in 3 main areas: biodiversity, access to green spaces and energy efficiency and the sustainable use of resources.

This church energy audit scheme for Oxfordshire is being supported by TOE2 with funds from the Patsy Wood Trust, the Beatrice Laing Trust and Charlie Laing, with additional funding provided by the Bishop of Dorchester and the Diocese of Oxford.

For further information about TOE2 please contact us at:
fionadanks@trustforoxfordshire.org.uk or www.trustforoxfordshire.org.uk

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2.0 Church Details

St Margaret of England in Little Faringdon is the local parish church serving the community. It is located in Oxfordshire and dates back to 1208.

2.1 Listed Status

St Margaret of England is of a Grade II* listed status. This listing has been taken into account when determining the recommendations for energy saving measures and renewable energy within this building.

2.2 Size

During the site visit the approximate internal area of the church was measured as 85m^2.

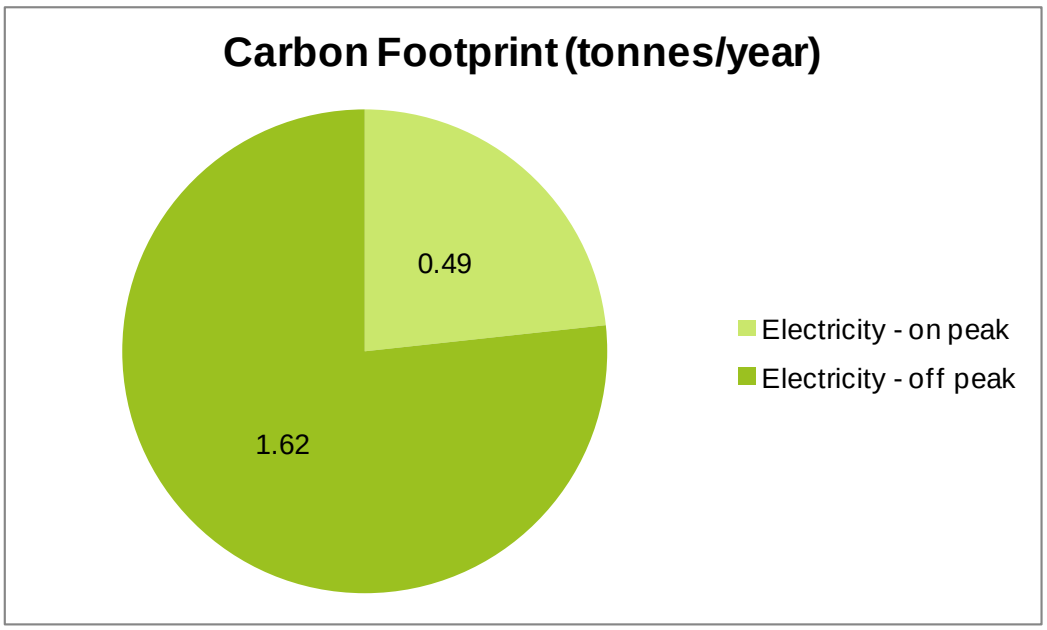
From the application form and discussions at the church it has been established that the typical usage of the church is for 3 hours per month.

	Description	Average Monthly Use
Church Use	2 services per fortnight	3 hours/month
Community Use	Occasional lectures	
Administration	n/a	
Catering and Events	Occasional concerts	
TOTAL		**3 hours/month**

The average congregation size is 10 to 15.

2.3 Current Energy Usage

Annual energy bills for the church have been provided and examined. These show that the current carbon footprint of the church is 2.12 tCO_2e per year.



The annual energy consumption has been taken from the energy bills provided from 26 September 2012 to 25 September 2013. These may include the use of estimated readings where actual readings have not been taken.

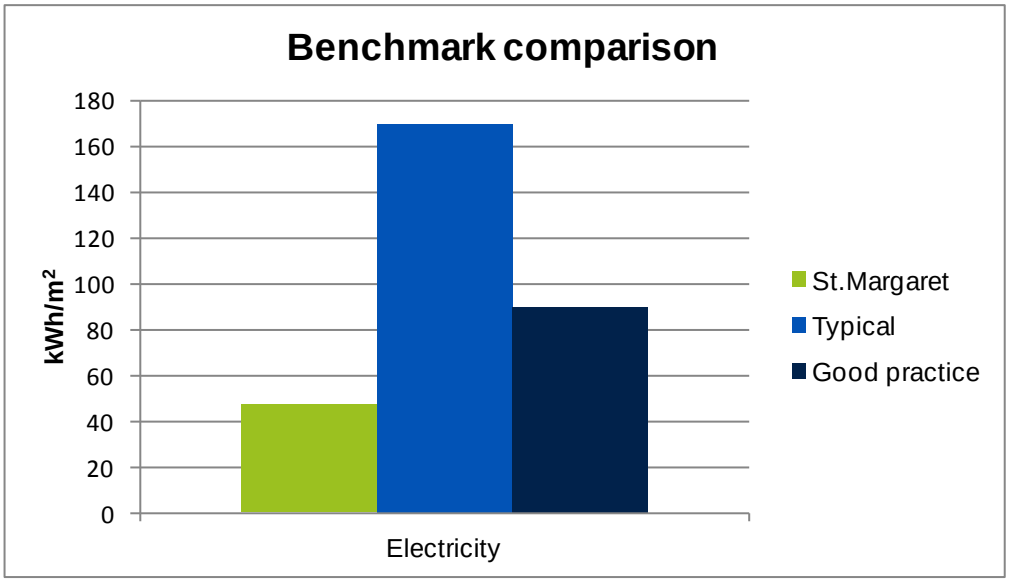
	kWh/year	Cost/kWh	Total cost	Total CO_2e (tonnes)
Electricity - on peak	939	£0.12	£115	0.49
Electricity - off peak	3,094	£0.11	£332	1.62
Electricity TOTAL	4,032		£446	2.12

Note: The above costs are for the energy only and do not include standing charges, VAT etc

Typical and good practice energy benchmarks[1] exist for non heating electricity use and gas use for churches with gas heating. It is difficult to compare a church with electric heating to these as we do not know the proportion of electricity that is used for heating. We have therefore presented just the overall picture below. This shows St Margaret of England is consuming less electricity than would be expected for a church of the same size. This is positive but there will certainly be room for improvement. One of the limitations to benchmarking is that it does not take into account occupancy hours.

Energy consumption in kWh/m^2

	St.Margaret	Typical	Good practice
Electricity	47	170	90



All energy bills should apply the VAT rate of 5% due to the charitable status of PCC's and this is being correctly applied at this church.

[1] CIBSE (2012) *Guide F Energy Efficiency in Buildings*

2.4 Energy purchasing

The church may benefit from obtaining reduced energy rates by switching energy suppliers. The church could also use the opportunity of switching suppliers to explore ‘green electricity’ options.

The Church of England has created the National Parish Buying scheme to provide churches access to negotiated schemes with energy providers and pool their energy to buy in bulk with an ‘energy basket’ – in the first instance this is a ‘brown energy’ basket, but a ‘green’ version will be available if enough churches express an interest, so please specifically register an interest in a ‘green option’ when contacting Parish Buying. By bulk buying energy it is anticipated that the costs will be 10% lower compared to buying alone.

Alternatively the Diocese of Oxford has negotiated green electricity schemes with both Good Energy and Ecotricity, who supply electricity from renewable energy sources at competitive prices.

For more details on all the above options visit: http://www.oxford.anglican.org/mission-ministry/environment/resources/switch-your-church-to-green-electricity/"

It is further recommended that any cost savings obtained from improved rates through the purchasing scheme or from the reduction in VAT are re-invested in the energy saving measures outlined within this report.

3.0 Electrical Saving Recommendations

3.1 Internal Lighting

The energy used for the internal lighting within churches typically makes up the largest use of electricity (except where all electric heating is installed) and therefore savings made to this area can result in significant overall reductions to energy usage.

The internal lighting within the church has been surveyed and it is recommended that the following improvements are made.

3.1.1 Replace bulbs/lamps within existing fittings

The following lights can have a new low energy bulb fitted to them to generate an energy saving however as the church is only used for 50 hours per year the payback on replacing these is long. Low energy bulbs are divided into LED and fluorescent. LEDs have much longer lamp life and are lower wattage but are more expensive.

Location	Existing Lamp Type	Recommended Lamp Type	Example Source
Main chandelier in nave (10 lamps)	Dimmable 40W incandescent lamps (rated lifetime 2,000 hours)	LED option Dimmable 3.7W LED lamps (rated lifetime 25,000 hours)	http://www.simplyled.co.uk/led-bulbs/b22-led-bayonet-cap/duracell-b22-bayonet-bc-led-mini-candle-shape-bulb-dimmable.html These are however only equivalent to a 25W incandescent lamp.
Main chandelier in nave (10 lamps)	Dimmable 40W incandescent lamps	Fluorescent option 9W fluorescent lamps (rated lifetime 8,000 hours)	http://www.efficientlight.co.uk/Light-Bulbs/9W-Candle.aspx These are equivalent to a 40W incandescent lamp but are not dimmable.
Downlighters in nave and chancel	Not known estimated to be 60W (5 in chancel, 7 in nave)	Depends on existing lamp type, require existing specification to determine low energy lamp alternative.	

When sourcing alternative bulbs it is important to consider the aspects listed below. Suppliers can provide advice and will often allow customers to trial lamps as long as they are returned in re-saleable condition. It is usually not recommended to mix lamp types within a fitting so it may be necessary to change all the lamps at once rather than as each fails.

- The lumen output of the light - a measure of how bright the light is, higher is better.
- Lamp efficacy measured in lumens/Watt - a measure of the lamp's energy efficiency. A good quality LED will now have over 70 lumens per watt output.
- Lamp life expectancy in hours - if a lamp has a short life expectancy, this will have an impact on your maintenance costs. One of the main secondary benefits of LEDs is that the maintenance time is vastly reduced due to the 20,000 - 50,000 hour lifespans.
- The time it takes to get to full brightness, LEDs are often instantly at full brightness, whereas even the best compact fluorescents often only start at 80%, and take a while to fully "warm up".
- Colour rendering quality and index (i.e. 100 - Excellent to 0 - Poor) - a measure of the accuracy with which colours can be seen.
- The beam angle/spread - think of a torch, the wider the beam the less the average illuminance (brightness) is, you get the same light out with a wide beam but it is spread more "thinly" over a wider area, compared to a narrow, bright spot for a "tight" beam.
- Colour temperature - a measure of the colour appearance of a light source ranging from "warm" light (for example, the light a candle produces) through to "cool" light (for example, a bright white fluorescent light). This is measured in Kelvin (K). Lamps below 3,300K are classed as "warm" whilst those above 5,300K are "cold" or "daylight".
- If the light is suitable for use with dimmers.

If the main chandelier lamps are changed to fluorescent alternatives (which we feel is more financially realistic than LEDs) we estimate this to **cost £29** but **save £2** per year therefore providing a payback in 15 years at current energy prices and lasting much longer than this. The payback period is so long due to the low occupancy hours. This also means the church will not benefit from the much longer lamp lifetime of LEDs.

We have assumed that the church can safely purchase and install the new lamps themselves without use of an external contractor. The changing of lamps within existing fittings will not require a faculty.

3.1.2 Controls

The lights are currently controlled by switches. In order that those using the building only turn on the lights they need at that time we always advise that each switch is labelled to describe which light it switches on and off and this has been done at St.Margaret. A simple

use of red and green dots can be helpful to indicate which lights are required for general visiting. Lights should only be used when required.

3.2 External Lighting

This church has three external floodlights which are only used 3-4 times a year.

Location	Existing Fitting	Recommended New Fitting	Example Source
External floodlights	Estimated to be 150W ceramic metal halide (2 external)	LED would be lower energy alternative but it would not be cost effective to replace the existing fittings at this church as they are only used 3-4 times a year. Any new floodlights should be LED and this is the case for the new (third) external floodlight which the church recently had installed.	

3.3 Small Power

During the site visit no small electrical appliances were found plugged in and left on when the church is unoccupied.

4.0 Heating System Saving Recommendations

4.1 Heat emitters

The heating within the church is supplied by electric panel heaters on the walls. This are not proving satisfactory as the hot air rises to the top of the church. The church warden currently has to turn the heating on 24 hours beforehand to prepare the church for a Sunday service. The church has requested funding to replace these heaters with 29 under pew heaters and one beside the door and one in the chancel. It is important to make sure the existing heaters are disconnected and not used in addition to the new heaters.

For pew heaters some churches have chosen in preference skirting heaters (e.g. Dimplex SCH5) fitted on the back of the pew in front as these more directly heat the person sitting in the pew and means coats can be stored under the pew, they are however of course more visible.

4.2 Controls

The electric panel heaters on the walls were controlled by a central programmer but this has been disconnected and they are now each controlled separately and manually. The new replacement heaters will be individually switched so only those required will be switched on. As these are much closer to where people sit they can be switched on before the service rather than the day before.

The option of fitting a portable temperature logger with temperature display was discussed with the church warden. This could be used to determine the time required to bring the church up to satisfactory occupancy temperature so that the heating was not put on earlier than necessary.

5.0 Building Fabric

While it is acknowledged that the potential to undertake significant improvements to the traditional and protected fabric is limited, there are a number of areas noted below where improvements can be made which will result in a reduced amount of energy consumed and improved levels of comfort being achieved.

5.1 Roof

There is no loft space in the roof in which to install any insulation. If the roof is replaced at a later date then insulation should be seriously considered.

5.2 Walls

Given the listed and historic nature of the building and that the walls are exposed both internally and externally no improvement recommendations have been made in this regard.

5.3 Floors

The floor is a stone floor with no void below.

5.4 Windows

On our visit we discovered one window which was not fully closed. This was rectified and we recommend that the church warden keeps a close eye that all windows are kept fully closed. We did not observe and cracks in the windows and the abutments were generally sound.

5.5 Doors

The main door at St.Margaret has gaps beneath it which will allow warmer air in the church to escape and cold draughts to enter when the wind is blowing in the direction of the door. A brush seal on each door leaf could be fitted to the bottom of the door to stop this.

Gaps beneath main door

There is already a fabric curtain installed which will be helping to stop warm air escaping and cold draughts entering . Another option is an air curtain which will continue to act even when the door is opened as the congregation enters. An air curtain is a device used for separating two spaces from each other. The most common configuration for air curtains is a downward-facing blower fan mounted over an opening, blowing air across the surface of the opening. Air curtains can come with, or without heaters to heat the air. It helps keep out outside air, reducing infiltration. They can also be used to avoid cold draughts by mixing in

warm air heated by the air curtain. The fan must be powerful enough to generate a jet of air that can reach the floor. This will help to reduce heat loss and cold air entering the building just prior to a service. The air curtain must go across the full width of the door way to be effective. It is likely that the DAC will need to be consulted before installing this measure. There are many manufacturers of air curtains, Dimplex has a large range. You will need to employ an electrician to carry out the installation.

Example of a Dimplex air curtain in a church

This church is planning to install a 1kW heater on the back of the pew adjacent to the door. This will help make the entrance more comfortable but will not be as effective as an air barrier which will keep cold air outside (a 1.5m air barrier on full power will be rated as high as 18kW on full power and 9kW on half power).

View of main door from inside showing where air barrier could be fitted

6.0 Renewable Energy Feasibility

The below reviews the viability of renewable technologies at your church and indicates if it would be possible for each of the technologies to be installed. More details on the major technologies can be found by going to the following website www.oxford.anglican.org/mission-ministry/environment/resources.

Also included in this website is a directory of installers who will be able to help you in providing you with specific costs for either a feasibility study or installation at your church depending on what your requirements are.

6.1 Solar Photovoltaics

The current planning guidance does not support solar photovoltaic (PV) arrays on Grade II* buildings where they are visible but this may change in time. Currently, at this time, planning permission would not be granted as any panels installed on the roof of the church would be visible.

Aerial view of church.
(Taken from Google Earth)

6.2 Micro-Wind

Micro wind units require highly exposed sites and should be located 250m away from buildings. They are not suitable to be located in the curtailage of listed buildings. Given these parameters it is concluded that micro wind generation is unsuitable at this site.

6.3 Micro-Hydro

Hydro electricity is a highly efficient source of renewable energy but requires a flowing body of water with a differential height, this is not present at this site and therefore such an installation would not be feasible.

6.4 Solar Thermal

Solar thermal installations are best suited to heat water for use in washing up, hand washing and bathing. There is no demand for hot water within the church and therefore this technology is not appropriate.

6.5 Ground Source Heat Pump

Given the church yard has numerous archaeological features with graves and the like it is not recommended that any consideration is given to the feasibility of ground source heating within this building. Also see 6.6 below.

6.6 Air Source Heat Pump

As the church will have a new electric heating system rather than a wet heating system, air source heat pumps are not appropriate.

6.7 Biomass

As the church will have a new electric heating system rather than a wet heating system, biomass boilers are not appropriate.

7.0 Energy Management

Energy savings can be achieved by simply keeping a closer eye on your church's energy use and communicating your carbon footprint to the congregation. Typical steps would be as follows.

7.1 Measure

- Nominate someone to have lead responsibility for energy management
- Take monthly meter readings and keep a record of these
- You could even take a meter reading at the start and end of when your church is used on a Sunday and use this to calculate the carbon footprint and costs of the service
- If you would like to establish how much it costs to run the church heating per hour you could take a meter reading at the beginning and end of an hour when only the heating is on (e.g. before a service if the heating is turned on more than an hour in advance).

7.2 Calculate and monitor

- Calculate the energy use using the meter readings and look for any stories behind the numbers e.g. how does this year compare with last? If it's greater, what are the reasons behind this? Is there anything that could be done to mitigate the increase?
- Calculate the church's carbon footprint.
- If you have not joined the scheme already, in order to provide more detailed review and measurement of the church's carbon footprint in the future, we recommend that the church join the CofE's national Shrinking the Footprint Energy Monitoring Scheme with sMeasure or a similar energy monitoring scheme. This will help the church estimate its future costs of energy and report on its carbon.
- For more information on the scheme please visit www.oxford.anglican.org/mission-ministry/environment/resources/energy-monitoring-scheme

7.3 Communicate

- Let the congregation know the carbon footprint of the church and the annual energy running cost
- Ask them to consider energy efficiency where it is under their control
- Ask for suggestions and ideas on how to reduce the church's carbon footprint
- Communicate to the congregation with a poster for example the latest carbon footprint figure each month / quarter and how it compares with the same period last year

7.4 Housekeeping

- Write up a procedure for energy efficiency in the church and associated buildings to help user of the building use the space more efficiently and effectively, and giving them the ability and know-how to make these changes.
- These procedures could include what to turn on (such as lighting and heating) when the building is being used for different functions, e.g. open for public during the day, services on a Sunday and midweek or larger public events such as flower displays.

8.0 Summary of Recommendations

This report has made numerous recommendations on improvements that can be carried out to reduce energy and carbon emissions from the operation and use of this church.

These have been summarised here in short, medium and long term measures taking into consideration the payback, capital investment and ease of carrying out each improvement.

These recommendations and this report should be presented to the next available PCC meeting and an action plan developed to implement as many of these actions as possible.

The costs below are indicative only based on our experience and are not specific to this church.

Short Term Improvement Measures			
Description	**Estimated Cost**	**Estimated Saving per year**	**To be actioned by**
Measure	£0	Low for this church but there will be small saving.	
Calculate and monitor	£0		
Communicate	£0		
Housekeeping	£0		
Label light switches	£10	£4.50 if assume lighting is 10% of energy use and 10% saved by shortening running hours due to labelling.	
Temperature logger/display (this depends on whether church warden would find useful)	£70	There will be some saving in heating use but as the heating system is to be replaced this is impossible to calculate.	
Consider changing light bulbs in main chandelier	£29	£2/year	

Medium Term Improvement Measures			
Description	**Estimated Cost**	**Estimated Saving per year**	**To be actioned by**
Consider installing air curtain	£1,400	Improved comfort. There will be some saving in heating use but as the heating system is to be replaced this is impossible to calculate.	
Replace lamps in	Depends on	Depends on current	

light fittings in nave and chancel as they fail	replacement chosen	specification and replacement chosen	

Long Term Improvement Measures			
Description	**Estimated Cost**	**Estimated Saving per year**	**To be actioned by**
N/A			

9.0 Funding options

You may wish to consider seeking funds to implement the energy efficiency improvements recommended in this report. For further information please contact:

- **Diocese of Oxford** – for the latest funding advice for energy efficiency improvements that the diocese is aware of please contact the Diocesan Environment Officer using environment@oxford.anglican.org or 01865 208745.

- **TOE2** – can consider applications for up to £10,000 for works recommended in the Sustain report, usually supported with funds from Grundon Waste Management through the Landfill Communities Fund (LCF). www.trustforoxfordshire.org.uk

- **Other Landfill Community Funds** – the following organisations may consider applications from projects within 10 miles of the relevant landfill sites.
  WREN – www.wren.org.uk
  Viridor Credits – www.viridor-credits.org.uk
  Biffaward – www.biffa-award.org

- **Renewable Technologies** – Technologies that produce heat or electricity may be eligible for an on-going payment based on the amount of energy produced.
  - For heat generating technologies, such as biomass boilers, the Renewable Heat Incentive (RHI) might be applicable. For further information, please go to www.energysavingtrust.org.uk/Generating-energy/Getting-money-back/Renewable-Heat-Incentive-RHI
  - For electricity generating technologies, such as solar PV, the Feed In Tariff (FIT) will be applicable. For further information please go to www.energysavingtrust.org.uk/Generating-energy/Getting-money-back/Feed-In-Tariffs-scheme-FITs