Energy Audit of St Mary's, North Leigh (I)

January 2014

Table of Contents

1.0 Introduction

This report has been prepared to detail the energy saving measures and renewable energy generation potential that exist at St Mary's, North Leigh.

The report was prepared following a site audit conducted by Marisa Maitland, Sustain on 7th January 2014. She was accompanied by Dave, Church Warden.

A summary of recommendations is made in Section 8.0 of this report.

The findings of this report in no way negate the PCC of St Mary's 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 Mary's, North Leigh is the local parish church serving the community. It is located in North Oxfordshire and dates back to the 11th century.

2.1 Listed Status

St Mary's is of Grade I 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 310m^2.

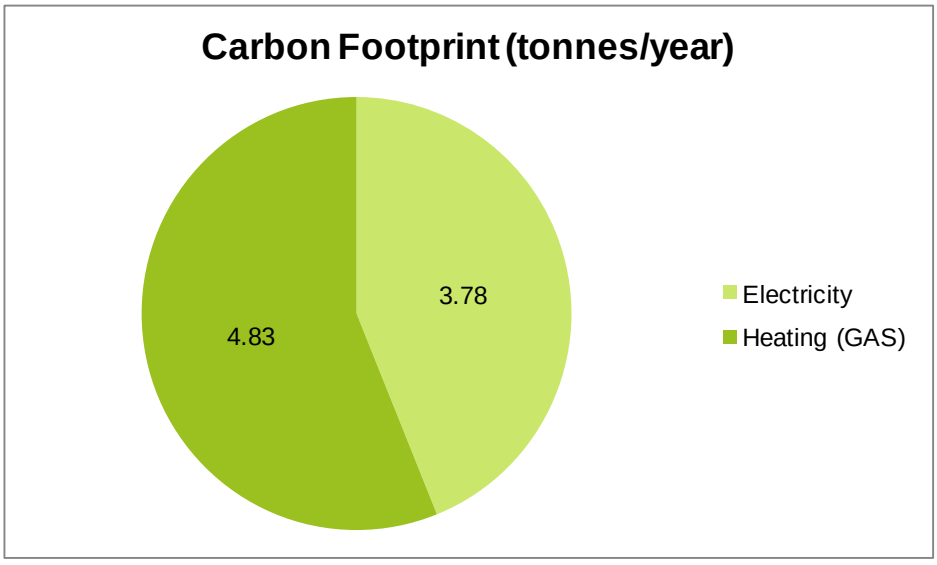
From discussions on site during the audit it has been established that the typical usage of the church is for 20 hours per month.

	Description	Average Monthly Use
Church Use	2 or 3 services per week	15 hours/month
Community Use	n/a	
Administration	n/a	
Catering and Events	Weddings and funerals	2 hours/month
TOTAL		**230 hours/year**

The average congregation size is dependent on the service, and is approximately 50 people.

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 8.62tCO_2e per year.



The annual energy consumption has been taken from the energy bills provided from June 2012 to May 2013 for the electricity and December 2012 until December 2013 for the gas

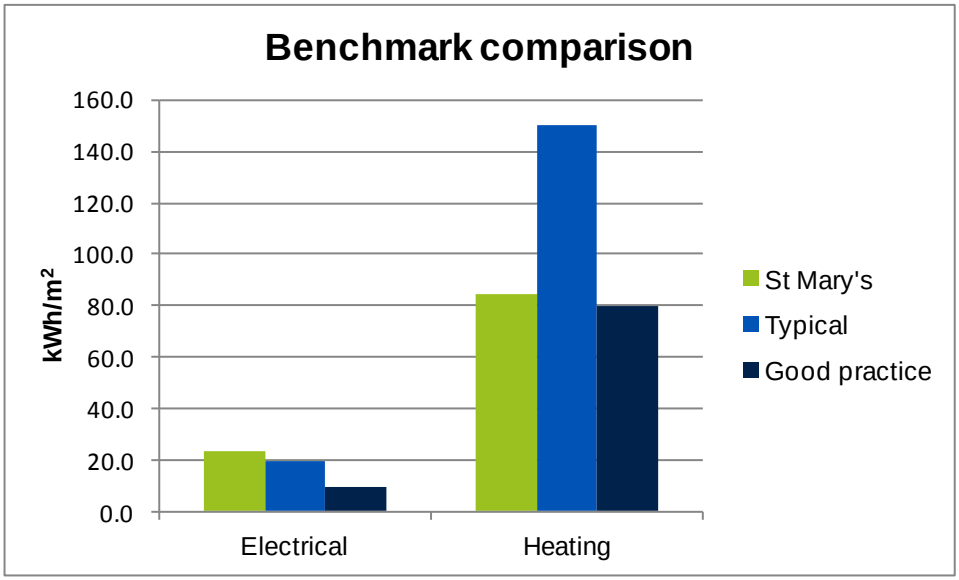
usage. These may include the use of estimated readings where actual readings have not been taken.

	kWh/year	Cost/kWh	Total £	Total CO_2e (tonnes)
Electricity	7,209	£0.0980	£706	3.78
Gas	26,261	£0.0455	£1,196	4.83
TOTAL	**33,470**		**£1,902**	8.62

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

In comparison with national benchmarks[1] St Mary's consumes a similar amount of gas for a church of this size but more electricity. A focus on reducing the electricity consumption is therefore advisable and the recommendations within this report should help to bring the church within the expected benchmarks.

	St Mary's kWh/m^2	kWh/m^2 benchmark (typical)	kWh/m^2 benchmark (good)
Electricity	23	20	10
Gas	85	150	80



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.

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.

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

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 and Controls

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 found that all the internal lights are CFLs, which are an efficient lamp to use. When the church is open during the day no lights are left on for general visiting.

The light switches are well labelled and simple to use.

CLF lamps

Labeled light switches

3.2 External Lighting

This church only has minor external lighting to the outside of the church and these lights are controlled by a time switch from 7pm-7am and a movement sensor. So the light will only come on during that time if there is someone in the vicinity. This is a suitable method of controlling the light.

3.3 Small Power

During the site visit it was noted that there are number of small electric appliances, such as the hot water heater and additional electric heaters, but these appear to be used appropriately. There is also a night storage heater located in the vestry, which was timed to be on, however it was not releasing any heat into the room. We recommend that the settings for this heater are checked to make sure it is only being used when required.

As was shown by the benchmarking graph in section 2.3 the electrical consumption at St Mary's is higher than a typical church of this size. During the audit electrical appliances were reviewed, but there was nothing obvious to be seen that would contribute to the high usage. This high usage maybe in part due to the fan convector

Night storage heater in the vestry

heaters, as all other electrical use in the church appears to be well controlled and the lighting is of a lower wattage. We recommend that the church carries out an internal audit of electrical equipment used in the church and identify if any electrical appliances are left on all of the time, or is of a particularly high consumption. Nothing obvious was noted on the day of the audit, however there may be items that were not seen.

4.0 Heating System Saving Recommendations

4.1 Boiler

The heating at the church is currently provided by a 2 gas boilers located in the kitchen area. They are approximately 50 kW in size each and were installed between 10-15 years ago. They appear to be in good working order and are regularly serviced.

4.2 Pipework and Distribution

The water circulating within the heating system was not able to be drawn off and inspected. If this can be done by the church they can determine the state of the circulating water.

If it is found that the water within the heating system is not fully clear, it would indicate that the system has not got adequate corrosion inhibitor within it. If that is the case, it is recommended that the system is emptied, power flushed and refilled with a suitable inhibitor. This will improve the performance of the boiler by reducing energy use and allow the building to be heated quicker and more effectively. It will also improve the performance of units with small hot water elements such as fan convector heaters.

4.3 Radiators and other heat emitters

The heating within the church is supplied via forced air fan convectors heaters. This system was installed at the same time as the boilers. The church is reported to heat up quickly with the current heating system and the fan convectors provide a fast distribution of heat.

4.4 Controls and Frost Protection

The heating system is controlled by two Danfoss programmers located in the kitchen. These are labelled as three times/zones, CH1 - Comfort, CH2 – Conservation, and CH3 – Perrott Isle. Unfortunately we were not able to interrogate the running times set on the programmer as it was locked at the time of the visit, and the churchwarden on site at the time of the visit is not involved in the control of the heating.

It was understood that the heating comes on twice a day, and there is also a boost button which is used for any adhoc uses in the church, which can be used by anyone. This boost can be set for 30mins, 1 hour or 2 hours. At this can be used by any one accessing the church, the heating may be on during the week more than is realised or recorded.

Thermostat and boost control

It was noticed however that the time on the controller for the Perrott Isle is not correct and at the time of the visit at 12.50pm, it was set to a time of 1.56am (based on the assumption that it is a 24 hour clock time display). If this is not known about, it may be causing to the heating coming on when it is not required. We recommend that this is reviewed and set correctly.

The heating oneswhat ones? are controlled by thermostats located in the Perrott Isle and the another next to the choir stalls and is protected against frost by a frost stat located on the wall next to the kitchen.

Both of the thermostats are set to 19^0C and the frost is set to 8^0C, both settings are appropriate for this type of building.

It is not unusual for over 30% of the heat energy used in churches to be used to protect the heating system itself from frost damage. As an alternative to firing the boiler to warm up the water to prevent it from freezing the system can instead be filled with an antifreeze based inhibitor such as X500 from Sentinel. As the recommendation above is to flush and clean the system it is further recommended that the system be re-filled with a Glycol based inhibitor and the frost stat removed.

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

There were no opportunities to install any insulation in the floor at the church.

5.4 Windows

The windows are in good condition, with no broken window panes or gaps between the glass and the abutments witnessed.

5.5 Doors

There are a number of doors in the church which have gaps around them which will be creating draughts. It is estimated that up to 15% of heat generated can be lost through draughts and gaps in doors and windows, so it is a good idea for this to be reduced where possible and draught proofing doors is a simple and quick measure to install.

There is a significant gap under the main South door, which can be eliminated if a brush strip is installed. In addition to this the edges around the door can be sealed using the Quattro seal method which is suitable for historic buildings is recommended (www.quattroseal.com) for your doors. Their product is recognised by English Heritage for listed buildings as it is fully reversible which makes it ideal to be used in churches.

An air curtain is a device used for separating two spaces from each other, usually at the exterior entrance. 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 though the opening. 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 and reduce the need for longer warm up times. 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

Example of an air curtain in a church

are many manufactures of air curtains, and Dimplex have a large range. You will need to employ an electrician to carry out the installation.

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 church does have an ideal south facing roof onto which photovoltaic panels could be attached, however, these would be able to be seen by the house next door which is situated slightly higher than the church. As the church is Grade I listed an application to install the panels would not currently be approved by the DAC. Planning permissions do change, so it is worth the church revising the potential to install PV panels on the roof in the future.

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. The demand for hot water is very minimal within the church and therefore the use of renewable heat for such a small demand is not recommended.

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.

6.6 Air Source Heat Pump

Air source heat pumps are most effective in very well insulated buildings with long occupancy hours. They are also unlikely to be approved by the DAC therefore not deemed appropriate for this site.

6.7 Biomass

A biomass boiler could be made to be viable at this church but given the availability of the mains gas and other features on site this should have a low priority and it is recommended that the energy efficiency measures are the main areas of focus.

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. Also please take into consideration that the more the church is used, the greater the savings will be in the below table, as these are based on current usage times of the church.

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**	**Estimated Carbon Saving per year**	**To be actioned by**
Measure	£0	The savings depend on how much energy wastage there is currently. A fair estimate is 2-5% of energy consumption a year ~ £75.	?tCO_2^e	
Calculate and monitor	£0			
Communicate	£0			
Housekeeping	£0			
Carry out an electrical audit	£0	Dependent on results of audit		
Review how the time settings for the heating	£0	Dependent on settings	~	
Adjust time on heating controller to make sure heating is on when required	£0	~	~	
Draught proof South door	£45	£24	0.10 tCO_2^e	

Medium Term Improvement Measures				
Description	**Estimated Cost**	**Estimated Saving per year**	**Estimated Carbon Saving per year**	**To be actioned by**
Glycol inhibitor instead of a frost stat	£480	£60	0.24	

Long Term Improvement Measures				
Description	**Estimated Cost**	**Estimated Saving per year**	**Estimated Carbon Saving per year**	**To be actioned by**
Install an air curtain above the South door	£1,400	Improved comfort. There may also be some saving in heating use but probably church would just be heated to higher temperature	~	

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