ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Andrews, Caversham
PCC of St Andrew's Church

DIOCESE of OXFORD

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1. Executive Summary

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

St Andrews was built in 1911 and is of a stone construction with a pitched roof. The heating is provided by a gas condensing boiler to radiators. The lighting is all LED, and the heating and hot water to the hall is all electric. There is both gas and electricity supplied to the site. The church should be commended for having already undertaken many positive actions to reduce energy consumption. The LED lighting and large PV array on the hall along with a high efficiency heating system to the church result in this church being a good example of a church having taken positive action to reduce its carbon footprint. It already purchases all its electricity from 100% renewable sources and uses electric heating and hot water to its hall.

The church has a number of ways in which it can be even 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)
Remove background heating of church to 10 degrees	6,685	£151	Nil	Immediate	List A (None)	1.23
Install Endotherm advanced heating fluid into heating system	6,685	£151	£800	5.29	List A (None)	1.23
Insulate exposed pipework and fittings in plantrooms	3,342	£76	£400	5.29	List A (None)	0.62
Inject cavity wall insulation into walls of hall	1,829	£243	£4,000	16.47	Faculty	0.46
Change remaining existing lighting to the link corridor for LED fittings	211	£28	£613	21.91	Faculty	0.05

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

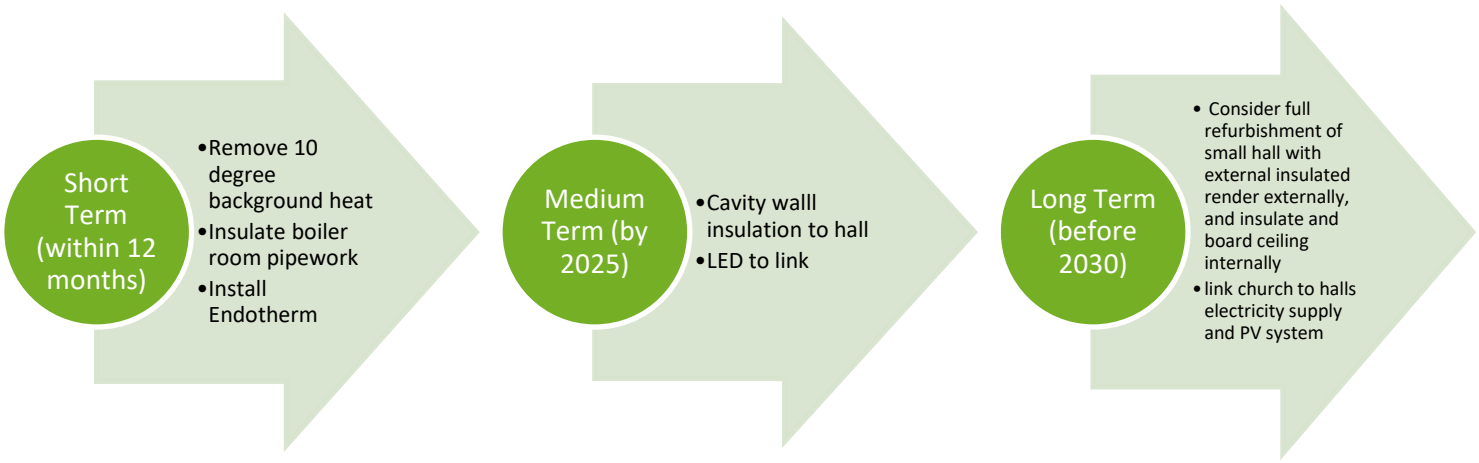
Based on current contracted prices of 13.27p/kWh and 2.26p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £649 per year.

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years. Furthermore, the Diocese of Oxford, to which this church belongs, has also declared a climate emergency and has an ambition to be carbon neutral by 2035 and has recently implemented a policy that will not allow the replacement of oil heating systems.

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Andrews 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 Andrews, Albert Road, Reading, RG4 7AW was completed on the 28th October 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 Andrews	
Church Code	627445
Gross Internal Floor Area	384 m^2 (church only)
Listed Status	Unlisted

The church typically used for 10 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	6 hours per week	60
Community	3 hours per week	
Other	1 hour per week	

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

4. Energy Usage Details

St Andrews (both church and hall) uses 25,370kWh/year of electricity, costing in the region of £3,368 per year, and 66,845kWh/year of thermal, costing £1,511.

This data has been taken from the annual energy consumption data provided by the church. St Andrews has two electricity meters. There is one gas meter serving the site, serial number 8507196S.

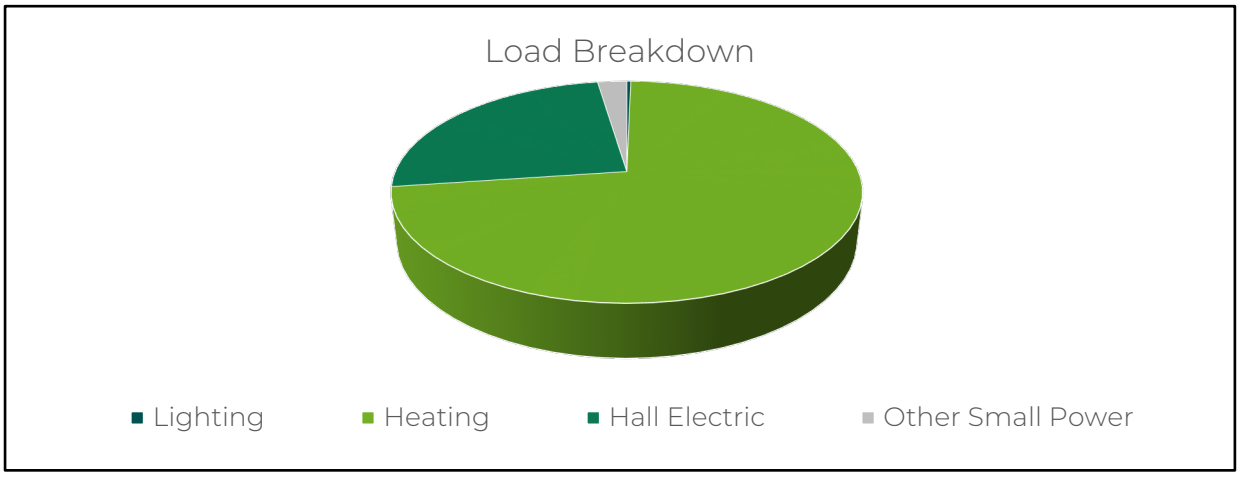
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church			No	Vestry
Electricity – Hall			Full AMR Connected	Gents WC lobby
Gas – Church	8507196S	Schlumberger	No pulse, but pulse capable	Boiler room

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 consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	All LED lighting throughout (except Link walkway)	0.3%
Heating	Gas fired heating to church using good condensing gas boiler.	72%
Hall Electric	Heating and hot water to hall, kitchen appliances and the like	25%
Other Small Power	Organ, sound equipment, kitchen and cleaning appliances and the like.	2%



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 electricity for the hall heating and hot water.

4.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Andrews uses 67% less electricity and 16% more heating energy than would be expected for a church of this size. The increased heating (gas) usage is due to the background heating operation which should be reconsidered (see later in report).

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Andrews (elec)	384	2,505	6.53	20.00	-67%
St Andrews (gas)	384	66,845	174.29	150.00	16%
TOTAL	384	69,350	180.82	170.00	6%

5. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Heating also often uses gas or oil as its primary fuel, these are fossil fuels with high carbon emissions and little opportunity to decarbonise in the future. Electricity currently has carbon emissions around the same level as mains gas but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions it remain coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of bio gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. It is therefore a critical element to review and set out a plan to make more efficient and less carbon intensive and one way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches.

The overall heating strategy within the church is good with electric heating and hot water to the halls and the use of efficient gas heating to the church which is appropriate for the size and nature of the space in the church. The one aspect that should be reconsidered is the background heating set up within the church which is considerably increasing the gas use.

5.1 Discontinue with Background Heating Strategy

Most traditional churches were constructed without any form of heating. The modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. 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 only times when background heating may be required is if there are historic wall paintings or to for the preservation of large artefacts such as tapestries. 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. The fabric is often subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates)

Providing constant background heating to the church building as a whole is excessive and wasteful of energy. This church currently runs the background heating to 10 degrees which is rather too low for comfort or even much humidity control and therefore achieves no real benefits whatsoever, it should therefore be avoided all together.

6. Improve the Existing Heating System

As the existing heating system is being retained it is recommended that measures are taken to improve the efficiency of the existing heating system, this should include:

6.1 Endotherm Advanced Heating Fluid

In order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid (http://www.endotherm.co.uk/) is added to the heating system.

This fluid in in addition to, and complements any existing inhibitors in the heating system and is added in a similar way. The fluid works to improve the ability of the boiler to transfer heat into the heating system and for the radiators and other heating elements to give out their heat into the rooms. It does this by reducing the surface tension of the water and increasing its capacity to transfer and hold heat. Case studies have demonstrated that the addition of this fluid into heating systems reduces heating energy consumptions by over 10% as well as helping the building heat up quicker.

Endotherm can be self-installed.

7. Energy Saving Recommendations

In addition to the measures below the small hall represents a space which is highly used but thermally inefficient. This space would benefit from substantial refurbishment during which time it is recommended that though be given to adding an external insulated render to the outside of the existing walls and adding in a boarded ceiling internally with insulation above.

7.1 New LED Lighting

Almost all the lights within the church and the hall have been changed for LED already, an action for which the church should eb congratulated. The one remaining area where the fittings are not LED is in the Link Corridor between the church and the halls.

If all the lights in this link corridor were changed on a simple “like for like” the total capital cost (supplied and fitted) would be £613. The annual cost saving would be £28 resulting in a payback of around 22 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.

7.2 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.

A free survey and quotation for the supply and installation of insulation of pipework fittings can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

7.3 Cavity Wall Insulation

The church hall is constructed with a cavity wall method and the inspection of the wall showed no signs that insulation has been added. Prior to the early 1990's, building regulations did not require walls to be fully insulated and therefore it is likely that there is no insulation present but it could be added through injecting it into the cavity walls.

It is recommended that cavity wall insulation is considered and added to the walls where appropriate. A survey to check the width of the cavity, exposure of the wall and condition of the cavity should be carried out by a CIGA approved installer who will then be able to provide you with a quotation to undertake the works. Installing cavity wall insulation will help to reduce heat loss and improve the comfort of the space, but needs to be considered alongside other control measures such as TRV's or room sensors to ensure that the space does not over heat because of the additional insulation.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

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	No – already have 34 PV array on hall roof
Wind	No – no suitable land away from buildings
Battery Storage	Yes - link to existing array
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	No – insufficient electricity supply
Ground Source Heat Pump	No – archaeology in ground and radiator system

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, this could be installed to work with the existing PV array to increase the amount of energy generated by the church to be used in the church itself.

There are also two electricity meters on the site, one for the hall and one for the church. The churches use of electricity is minimal and limited to a few appliances and the LED lighting. At present, as the PV system is linked into the hall electricity meter, it does not serve the church. An improve electrical arrangement would be for the church to be fed from the halls meter and therefore this too would benefit from the PV panels. This would allow the church meter to be removed and standing charges avoid but it would mean a cable being run from the hall to the church which is not an insignificant element of work. It is recommended that this is considered as a long term action alongside potential battery storage.

9. Funding Sources

This audit programme offers each participating church the chance to apply for a grant of up to £150 towards implementing some of the audit's recommendations. An application form is included with this report.

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2019.pdf .

10. Faculty Requirements

It must be noted that all works intended to be undertaken should be discussed with the DAC at the Diocese.

Throughout this report we have indicated our view on what category of permission may be needed to undertake the work. This is for guidance only and must be checked prior to proceeding as views of different DACs can differ.

Under the new faculty rules;

List A is for more minor work which can be undertaken without the need for consultation and would include changing of light bulbs within existing fittings, repair and maintenance works to heating and electrical systems and repairs to the building which do not affect the historic fabric.

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also the replacement of existing boilers so long at the same pipe work, fuel source and flues are used. It can also be used to replace heating controls.

All other works will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
The Link	9	2D LED 11W	28	613	22years