ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Andrew's, Huntington
PCC of St Andrew's

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1. Executive Summary

An energy survey of St Andrew's 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 Andrew's was built over an extended period from 1915 to 1950. There is a church and church hall at the site, which also includes the church office. A nursery school is run in the church hall during the week. The church and hall are heated from gas boilers, and direct fired gas heaters. The church have made great efforts already to improve the buildings and reduce the carbon emissions already by changing almost all lamps to LED, replace many of the windows with double glazing, and adding in good levels of insulation to the hall. There is both gas and electricity supplied to the site.

The church has a number of ways in which it 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 and the route to net zero carbon are 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)
Change existing lighting for low energy lamps/fittings to hall kitchen and store	394	£52	£195	3.76	Faculty	0.10
Replace windows (high level to hall)	964	£39	£5,500	140.72	Faculty	0.18
Consider install Electric Vehicle Charging Points	0	N/A	£-	0.00	Faculty	-
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	20,719	£2,736	£31,079	11.36	Faculty	5.25
Insulate under timber floor to church (accessed from undercroft)	2,409	£98	£1,200	12.28	List B	0.44
Install an Air to Air Source Heat Pump into the hall to replace existing hall heating system and	16,865	£23	£14,400	632.46	Faculty	2.62

electric point of use water heaters to kitchen and WC						

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

Based on current contracted price of 11p/kWh for electricity and market price of 4.05p/kWh for mains gas.

If all measures were implemented this would save the church £2,947 per year and reduce its carbon footprint by 8.58 tonnes (60%).

2. The Route to Net Zero Carbon

Our Government has committed to move towards Net Zero Carbon – the point at which we have reduced emissions as much as we can and then balanced any residual emissions through removal of carbon from the atmosphere. They have done this as part of a worldwide agreement which aims to limit global warming to well under 2 degrees Celsius, with an aim of keeping it below 1.5 degrees Celsius. This will help protect all of us from the impacts of climate change.

In February 2020, the Church of England's General Synod set its own Net Zero Carbon target. The first stage of this target covers energy used by churches, cathedrals, schools, vicarages, other church buildings, as well as emissions caused by reimbursed transport. The target date is 2030.

This church has a clear route to become net zero by 2030 by undertaking the following steps:

3. Introduction

This report is provided to the PCC of St Andrew's 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 Andrew's, Huntington Road, Huntington, York, YO32 9PX was completed on the 14th July 2021 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 Andrew's	
Church Code	643200
Gross Internal Floor Area	490 m^2
Listed Status	Unlisted

The church typically used for 43 hours per week for the following activities

Type of Use	Hours Per Week (Typical)
Services	4 hours per week
Meetings and Church Groups	4 hours per week
Community Use	35 hours 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 have been supplied by St Andrew's and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	13.2 p/kWh	In line with current market rates
Standing Charge	24.74 p/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.

5. Energy Usage Details

St Andrew's uses 21,058 kWh/year of electricity, costing in the region of £2,780 per year, and 48,187 kWh/year of gas, costing £1,954. The total carbon emissions associated with this energy use are 14.2 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Andrew's has one main electricity meter, serial number E10TB06159. There is one gas meter serving the site, serial number M014K7479114D6.

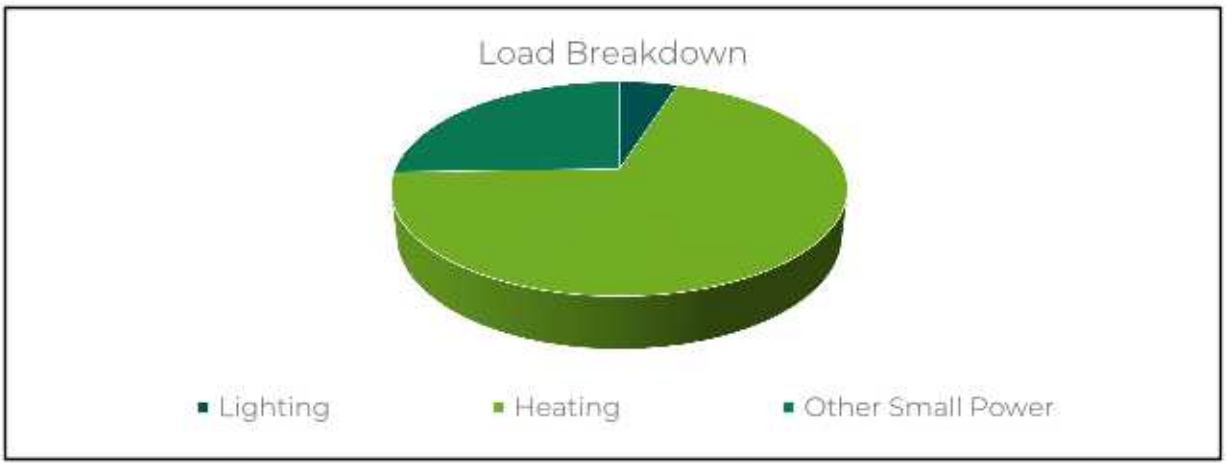
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	E10TB06159	EDMI Mk10D	Full AMR Connected	Cupboard in corner to top area
Gas	M014K7479114D6	Elster G16	Full AMR Connected	Gas Meter Cupboard

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 consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	A mix of LED and two remaining fluorescent lamps	5%
Heating	Gas combi boiler heating the hall hot water and direct fired gas heaters to walls. Church heated via direct fired gas heaters to perimeter walls	70%
Other Small Power	Kitchen equipment, projector, electric heaters, and the like	25%



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 small power.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Andrew's uses 115% more electricity and 34% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Andrew's (elec)	490	21,058	42.98	20.00	115%
St Andrew's (gas)	490	48,187	98.34	150.00	-34%
TOTAL	490	69,245	141.32	170.00	-17%

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. Putting in place a heating strategy that is energy efficient and low carbon is, therefore, of the highest priority

The Church of England is in the process of reviewing its heating guidelines. The process has already established some principles for heating that can help churches as they seek an acceptable combination of comfort, conservation, affordability, and environmental care. The principles can be found at https://www.churchofengland.org/sites/default/files/2020-04/CBC%20Heating%20guidance%20principles%20FINAL%20issued.pdf

As the principles make clear, every church's strategy will be unique to it, informed by many factors, including the nature of its usage, the system it's starting from, the conservation needs of the building, and the resources available. The strategies in this audit are designed specifically for your church.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches we make recommendations that will help to reduce energy wastage and, as a starting point, to optimise the system that you already have

Secondly, we recommend options for many churches that focus on heating people rather than the full volume of the church. Some of the changes that can help with this will be 'soft' changes – others will relate to the heating system itself.

Finally, we make recommendations about moving away from fossil fuels. Moves away from fossil fuels are key to cutting emissions. For most churches, this will involve moving from gas, oil or LPG to electricity. Electricity currently creates carbon emissions around the same level as mains gas, but the carbon emissions associated with it are reducing rapidly as the UK builds more renewable energy and decommissions its 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'. Some local areas may also be considering the option of district heating networks.

While moving away from fossil fuels may not always be possible, as the principles state, "churches should be expected to have at least carefully considered the option of moving away from fossil-fuel based heating (gas and oil boilers) towards electric-based heating." And if such options are not viable now, the churches "can try to be ready for a future retro-fit when technology and the grid has progressed."

The direct fired gas wall heaters currently heat this church adequately and given that the church has been cleared of pews and is a large open space, it is challenging to be able to recommend another other viable alternative at this moment in time which would perform as well. The heaters are used for a limited amount of time when the church is being used for services and the like and therefore the gas is being consumed in an efficient and effected manner.

The hall is used on a daily basis by preschool and the gas heating in here is likely to be by far the most significant source of gas consumption. There are the same direct fired gas heaters to the walls and also a gas combi boiler providing all the hot water to the WC's. It is recommended that this heating system should be the focus of the initial decarbonisation efforts. This should comprise of the use of electric point of use water heaters for the WC's and kitchen sink and then the installation of an air to air source heat pump into the hall. This could be supported from the existing 3 phase 100A electrical supply and the internal cassettes could be mounted into the suspended ceiling grid. There is plenty of suitable space externally for the external condensers.

The heating to the church should then be reviewed again in 10-15 years time when the existing heaters will be reaching the end of their serviceable life and further technology development may have provided a greater variety of solutions for this church.

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 church has made great progress with the lighting and have already converted the majority to

LED, and should be congratulated for having done so. There are only two more lights which are still fluorescent and we recommended that these are changed as well.

The fittings are scheduled in Appendix 1 for a change to 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. An example of such a range of fittings is available from http://www.qvisled.com/

If all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £195. The annual cost saving would be £95 resulting in a payback of around 3.7 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. Guidance on lighting, produced by Historic England for churches, can be found at https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/

7.2 Replace Windows in Hall

The high level windows in the hall are still single glazed with wooden casements and as such are very poor in terms of thermal quality. In addition, many of the openings do not close well against the frames and excessive cold air is being let into the space.

The introduction of new double glazed units would considerably reduce the heat loss from the building and improve thermal comfort. This measure would be costly and disruptive to install but could be considered as part of a refurbishment programme. The use of high quality windows will also reduce external noise transfer and provide added security. To enhance heat ingress in particularly cold areas, double glazing with low emissivity (Low-E) glass could be selected as this allows more solar gain than standard double glazing.

7.3 Move to Electric Point of Use for Hot Water

The halls WCs and kitchen is currently provided with hot water from a combi boiler located in the kitchen cupboard. As such the hot water is being heated by the gas boilers.

A more efficient method of generating hot water would be to remove the centralised large hot water storage tank and to have small, local electric point of use hot water heaters installed within each WC and kitchen area. Units such as https://www.zipwater.co.uk/shop/hot-water/zip-inline-instantaneous-hot-water-heater-6kw-es6 heat the hot water only when the tap is turned on and does not have any stored hot water element. As such it is very energy efficient and it only ever heats the hot water that is required. It has additional advantages that it is 'always on' so does not require to have timings reset for ad hoc uses and as it does not have any stored water element it represents the lowest possible legionella risk profile. Installing electric hot water units will remove the need for the gas boiler and associated pumps to have to operate outside of the heating season and will assist in the transition to net zero carbon as the hot water is no longer served by burning of fossil fuels on site.

The installation of electric point of use hot water units and the removal of the gas hot water system can be undertaken by any competent mechanical engineer.

7.4 Insulate Beneath Timber Floor to the Church

There is an undercroft beneath the church which has a timber boarded floor to some of the area. As the undercroft is open and vented to the outside air this floor can become cold and cold draughts can come up between and around the floorboards. It is therefore recommended that insulation is fixed to the underside of the floorboards by accessing this from the undercroft. This would be in a similar way that a loft space would be insulated but upside down! This could be carried out by any good local building company or even by someone competent in DIY and will require mineral wool insulation laid between the floor joists with some form of mesh stappled to the timber joist to hold it in place.

8. Other Recommendations

8.1 Electric Vehicle Charging Points

The church has a car park to the side and rear of it which serves the church and also the frequently used church hall. In order to make a visible statement on the churches mission of stewardship and to facilitate more sustainable transport choices by those visiting the church and/or using the hall, the church may wish to consider installing an electric vehicle charging point, probably on the side of the church hall to allow visitors to charge their electric cars.

Installing a unit such as a Rolec Securi-Charge http://www.rolecserv.com/ev-charging/news/view/Robust-EV-Charging-With-Rolecs-SecuriCharge-EV-Wall-Unit-Coin-Token-PAYG would allow the organisation control over who is allowed to use the unit with a key operated system. Or given the type of use of the building and control over the usage of the car park as a whole a simple 32 amp type 2 wall pod type charger may be most suitable and these are widely available through many suppliers such as http://www.rolecserv.com/ev-charging/product/EV-Charging-Points-For-The-Home.

Because of the parish office within the building, the church can be considered as a place of work and, as such, installation grants are available through the workplace charging scheme https://www.gov.uk/government/publications/workplace-charging-scheme-guidance-for-applicants-installers-and-manufacturers which will fund 75% of the installation cost up to £500.

9. 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 south pitch of roof
Wind	No – no suitable land away from buildings
Battery Storage	No – no viable PV
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	Yes – Air-to-Air heat pump would be suitable
Ground Source Heat Pump	No – archaeology in ground and radiator system

9.1 Solar PV

There is potential for a small PV array on the roof of the South Aisle. 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 electricity consumption is mainly during the day, for the nursery and the office, so most of the generated electricity will be able to be used on site at the point of generation. This size of the PV array suggested will meet most of the electrical consumption of the church.

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.

A separate solar PV study is provided alongside this audit report.

9.2 Air-to-Air Source Heat Pump

The building is currently heated from a direct fired gas heaters which provide hot air into the church and hall. The use of fossil fuels for heating means that it will not be possible for the building to become zero carbon without changing the heating system. A direct fired gas heater also has heat and other efficiency losses within it, which means that the efficiency of converting the gas into the heat is typically around 95% (with the remaining heat being lost through the flue gases. Air source heat pumps use electricity to power the heat pump which takes heat from the air and puts this into water which can then go into the heating system. A heat pump can create around 3 units of heat for every one unit of electricity.

A new air source heat pump is likely to need a heating capacity of around 12kW and could be located externally and used to provide heating to a warm air cassette located in the ceiling grid of the hall. This essentially looks like a split air conditioning system but should be used for heating only.

10. 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 .

11. 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.

12. Offsetting

As you take action to reduce your emissions, you may also wish to offset those that you cannot yet reduce. If you would like to engage in offsetting, it is important to use a reputable scheme. The Church of England recommends Climate Stewards, which has a simple calculator that can help you to work out how much you would need to offset. https://www.climatestewards.org/

Climate Stewards encourages people to 'reduce what you can and offset the rest' as part of your journey to Net Zero carbon emissions. They provide training and resources to help you understand climate change and its impacts, and to calculate the carbon footprint from your activities including travel, energy, expenditure, and food. Their online carbon calculators for individuals and smaller organisations are free to use, and they provide bespoke carbon footprint audits for larger organisations.

Having reduced as much of your organisation's carbon footprint as you can, there will always be unavoidable emissions from your work and travel. Carbon offsetting allows you to compensate for the negative impact of your carbon emissions by funding projects which take an equivalent amount of CO_2 out of the atmosphere. These either involve locking up ('sequestrating') CO_2 as trees grow, or reducing emissions by using low-carbon technology such as fuel-efficient cookstoves or water filters.

Climate Stewards has a close relationship with all their project partners in Ghana, Uganda, Kenya, Tanzania, Nepal and Peru. They work closely with them to design, develop, implement and monitor projects which will not only mitigate carbon, but also bring tangible benefits to the local community - including improved health, savings in time and money previously spent on buying or collecting fuel, and improvements in local biodiversity. Each project is assessed using their Seal of Approval protocol which enables us to assess and monitor carbon mitigation and ensure robust, sustainable and transparent partnerships.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Kitchen	1	5ft Single Vapour LED	£38	£81	2.13
Store	1	5ft Single LED	£14	£88	6.29