ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Stephen's Church, Prenton
PCC of St Stephen's

THE CHURCH OF ENGLAND
Diocese of Chester

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St Stephen's Church, Prenton 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 Stephen's Church, Prenton is a large parish Grade II listed church located in a suburban area in Prenton, Birkenhead. The church was built in 1897 of coursed, squared rubble externally and brick walls internally and has a red pitched, tiled roof. 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)
Consider install Electric Vehicle Charging Points	0	N/A	N/A	N/A	Faculty	N/A
Phase 1 - Replace heating system for electrical based heating solution	23,474	£1,590	£7,363	4.63	Faculty	4.03
Insulate exposed pipework and fittings in plantrooms	2,785	£334	£1,000	2.99	List A (None)	0.51
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	4,259	£1,704	£8,633	5.07	Faculty	1.08
Change existing lighting for low energy lamps/fittings	2,181	£873	£4,796	5.50	Faculty	0.55
Install Draughtproofing to External Doors	1,671	£201	£1,600	7.98	List B	0.31
Install PIR motion sensors on selected lighting circuits	5	£2	£60	27.75	List B	0.00
Phase 2 - Replace heating system for electrical based heating solution	9,659	-£3,936	£12,078	n/a	Faculty	0.53

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

Based on recently announced protected energy cap prices, we have used representative rates of 40p/kWh and 12p/kWh for electricity and mains gas respectively.

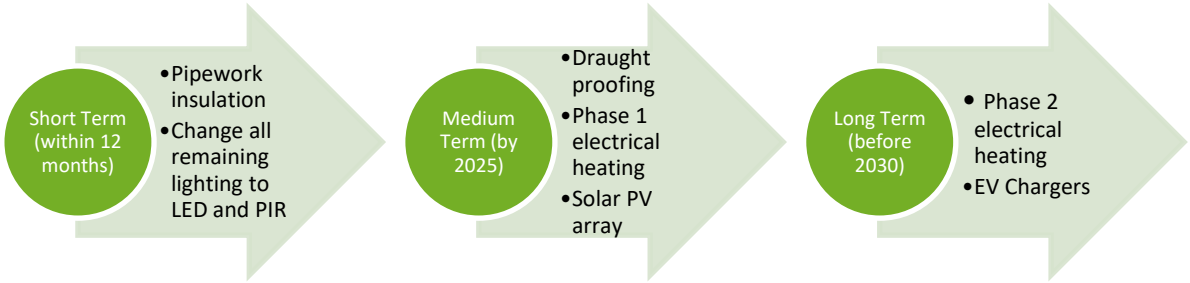
If all measures were implemented this would save the church £768 per year and reduce its carbon footprint by 7.02 tonnes (56%).

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 Stephen's Church, Prenton 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 Stephen's Church, Prenton, Prenton Lane, Prenton, Birkenhead CH42 8LA was completed on the 5th July 2022 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

St Stephen's Church, Prenton	
Church Code	609011
Gross Internal Floor Area	730 m^2
Listed Status	Grade II

The church typically used for 6 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**	**Average Number of Attendees**
Services	5.5 hours per week	85
Ad Hoc Use	0.5 hours per week	Varies

4. Energy Usage Details

St Stephen's Church, Prenton uses 8,828 kWh/year of electricity, costing in the region of £1,504 per year, and 55,710 kWh/year of gas, costing £2,259. The total carbon emissions associated with this energy use are 12.52 CO_2e tonnes/year. Due to recent price rises, costs are estimated to rise to £3,530 for electricity and £6,685 for gas when contracts renew.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Stephen's Church, Prenton has one main electricity meter, serial number N6111J00118. There is one gas meter serving the site, serial number E025 K02891 18D6.

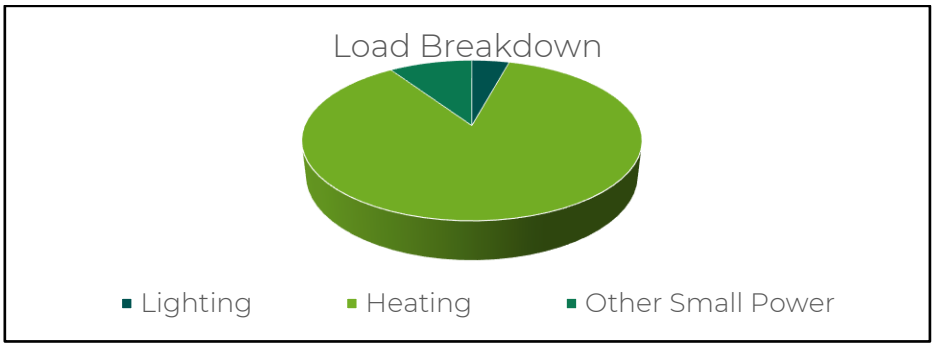
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	N6111J00118	3 phase 100A	Yes but not fully AMR connected	Boiler room
Gas	E025 K02891 18D6	G16	Fully AMR connected	Boiler room

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	A variety of lighting types, predominantly SON discharge floodlights, T8 fluorescent tubes, halogen spotlights and CFL lamps	4%
Heating	Provided by 3no. Keston gas fired boilers to perimeter column radiators throughout. Redundant infrared heaters at high level and portable LPG heaters in lady chapel.	86%
Other Small Power	Sound systems, alarms and security, under pew heaters to choir stalls, and other plug in loads.	10%



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.

4.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Stephen's Church, Prenton uses 40% less electricity and 49% 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 Stephen's Church, Prenton (elec)	730	8,828	12.09	20.00	-40%
St Stephen's Church, Prenton (gas)	730	55,710	76.31	150.00	-49%
TOTAL	730	64,538	88.41	170.00	-48%

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. 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 bio gas 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 church is currently provided with heating via oversized pipework and perimeter column radiators which have reached the end of their life. The boilers were installed in 2016 and therefore have a further 15 years until they reach the end of their serviceable life. As the heating system will remain in place until around 2036, it is suggested that a two phase approach to introducing a decarbonised heating system is introduced.

The first phase would involve installing direct electric heating to several areas. The church is currently used primarily on Sundays and Wednesday mornings only and for a number of these services, less than 30 people are in the church. The current heating system is attempting to heat the entire air volume of the church to provide thermal comfort to the occupants. However, with

localised direct electric heating, a small area of the church could be heated which would provide good levels of thermal comfort without the need to heat the entire church.

For the second phase of work, when the boiler reaches the end of its life, the heating strategy will depend on the frequency of use and the congregation numbers at this stage. However, assuming the same congregation and usage, it is recommended that electric heating is installed as this will provide a more responsive heating system for a lower capital cost than installing an air source heat pump.

5.1 Install Electric Panel Heaters

For phase one, it is recommended that the PCC consider installing electrical panel heaters in the following areas on a time delay switch.

Area	Type/ Size	Length (mm)	Watts	Number (or m) Required
Choir vestry	Pulsar 2400W	-	2400	1
WC	Overhead Far IR Bar Heater 1kW	1080	1000	2
Vestry	Overhead Far IR Bar Heater 1kW	1080	1000	1
Organist heater	Electric Under Pew 300W	525	300	1
Chancel	Electric Far IR Wall Panel 900W	1200	900	2
Lady chapel	Near IR Overhead Heater 3kW	960	3000	4

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-tlsw-ms so they cannot be left on accidently after use.

These heaters have a strong radiative effect (where heat is reflected to people from the surface) as well as a light convective effect (where air is warmed and moves around to heat the general space). As such these heaters tend to provide a relative instant sense of heat and comfort within the space and only need to be on for short periods of time.

For phase two, it is recommended that the PCC consider installing electrical panel heaters in the following areas on a time delay switch and remove the existing radiators and boilers from the church and disconnect the gas meter.

Area	Type/ Size	Length (mm)	Watts	Number (or m) Required
Main nave	Near IR Overhead Heater 4.5kW	1440	4500	18

6. Energy Saving Recommendations

In addition to having a revised heating strategy there are also a number of other measures that can be taken to reduce the amount of energy used within the church.

6.1 New LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church. There still remains a large number of inefficient fluorescent, halogen and SON fittings within the church, with predominantly SON floodlight fittings within the nave, chancel and lady chapel.

It is recommended that the fittings scheduled in Appendix 1 are all changed for 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 £4,796. The annual cost saving would be £873 resulting in a payback of around 5.5 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/

There are some fittings such as the PAR38 spotlights and the CFL lamps where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to w new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

6.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as vestry, toilet areas and the like. Some of these areas are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows where artificial lighting is not required for much of the year during the day.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be consider alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors (commonly called PIRs) also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

6.3 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).

6.4 Draught Proof External Doors

There are a number of external doors in the church. 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.

It is recommended that the draughtproofing around the door is improved and draught strips are added. This could be achieved in a number of ways.

For timber doors that close onto a timber frame 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

For timber doors that close onto a stone surround more traditional solutions such brush draught strips rebated into the edge of the door by a skilled joiner. Other traditional methods such as

using hessian or felt pads tacked to the door could be used and keeping the door maintained in a good condition is important.

Simple measures such as having a 'sausage dog' style draught excluder laid along the base of a door, using plasticine of the right colour to fill gaps where daylight can be seen and putting painted fridge magnetic over large keyholes can all be simple DIY measures which are effective.

7. Other Recommendations

7.1 Electric Vehicle Charging Points

The church has a car park to the front 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 both visiting the church and 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 car.

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.

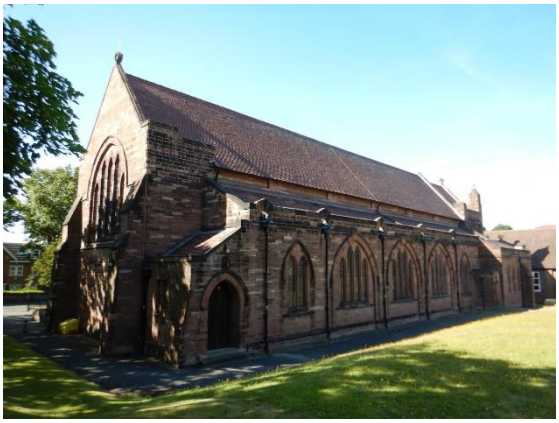
8. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

Renewable Energy Type	Viable
Solar PV	Yes – very limited demand in church but neighbouring hall could use
Wind	No – no suitable land away from buildings
Battery Storage	No – not pragmatic for church
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

Now that the Feed in Tariff scheme has come to an end the installation of solar PV panels in situations where there is not almost full usage of the electricity generated on site is not really viable. However, the neighbouring church hall would most likely be able to make use of the

electricity generated by a small PV array as it is used in the daytime more frequently than the church itself.



There is potential for a small PV array on the roof of the South East Aisle, which does not have any significant issues. 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.

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 and hall. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

Wind turbines require highly exposed sites and should be located 250m way from buildings as such this site is not suitable for a wind turbine to be installed.

Hydro electricity is a highly efficient source of renewable energy but requires a body of flowing water with a differential height which is not present on this site.

Solar thermal installations are best suited to heat water for use in washing up, hand washing and bathing. There is minimal hot water demand at this church so such an installation would not be viable.

Heat Pumps are a low carbon method of creating heat, there use and suitability for this church have been review in the section earlier on in this report on Efficient and Low Carbon Heating Strategies.

Biomass is an alternative boiler and fuel to oil or gas. It requires wood chips or pellets to be delivered on site, stored and then fed into a large boiler for burning. While the fuel is not a fossil fuel there are emissions from the burning of wood and these can be detrimental to local air quality particularly in more built up areas for all these reasons it is not considered a viable recommendation for this site.

9. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available on this Parish Resources page:
https://www.parishresources.org.uk/resources-for-treasurers/funding/

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.

11. 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
Nave	8	50W LED Flood	£298	£960	3.23
Nave	22	PAR38 LED	£340	£374	1.10
Boiler room	2	5ft Single LED	£14	£176	12.70
Choir vestry	1	5ft Single LED	£7	£88	12.70
WC	2	LED GLS	£5	£24	4.62
Vestry	1	5ft Single LED	£7	£88	12.70
Lady chapel	1	LED GLS	£15	£71	4.62
Lady chapel	3	50W LED Flood	£12	£360	30.82
Lady chapel	1	PAR38 LED	£15	£17	1.10
Lady chapel	2	R63 LED	£8	£43	5.58
Nave	6	50W LED Flood	£23	£720	30.82
Lobby	2	2D LED 11W	£5	£118	22.52
Chancel	4	50W LED Flood	£16	£480	30.82
Chancel	2	50W LED Flood	£31	£240	7.75
Chancel	5	PAR38 LED	£77	£85	1.10