ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Alban's Church, South Norwood
PCC of St Alban's Church

Author	Reviewer	Audit Date	Version
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1 Executive Summary

An energy survey of St Alban's Church, South Norwood 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.

St Alban's Church, South Norwood is a Grade II listed church built between 1891 and 1925. [Historic England reference 1079288]. The adjoining unlisted hall is situated to the east and is the subject of a separate report. There is both gas and electricity supplied to the site.

The church has a number of ways in which it can become 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)
SHORT TERM						
Procure utility supplies using a group purchasing scheme offering economies of scale	N/A	10%	None	Immediate	None	N/A
Install magnetic particle filter to heating system.	1%, 2000 increased system lifetime	£50	£250 inc. installation	5	List B	0.37
Insulate pipes under ceiling in basement	2% 4000	£100	£100	1	List A	0.74
Manage use of fixed hot water heater	900	£132	none	Immediate	None	0.23
Draughtproofing interventions to doors and windows, and minor repairs	2% 4000	£100	£100	1	List A	0.74
MEDIUM TERM						
Proceed with LED lighting scheme	14,950 [CES data]	£2,193 [CES data]	£38,615 + VAT	18	Faculty	3.78
LONG TERM						
Review heating system options in 2029						

The church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works. Based on current contracted prices of 14.68p/kWh and 2.488p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church around £2,600 per year in operating costs.

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.

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 Alban's Church, South Norwood 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 with improvements in 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 Alban's Church, South Norwood, SE25 6RD was completed on the 19th May 2022 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Church Energy Advisors Network developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE affiliate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church and has been an assessor for EcoCongregation.

The church was represented by Jennifer Sturtevant, Church Warden and Shelley Leckey, Associate Warden.

St Alban's Church, South Norwood	
Church Code	637402
Gross Internal Floor Area	885m^2
Volume	7850m^3
Heat requirement	259kW
Listed Status	Grade II Historic England reference 1079288

The church is typically used for 11 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	Sundays 5 hours per week Weekdays 4 hours	70 10 daily
Church Meetings and Groups	1 hour per week	40
Community Use	Thursday coffee morning 4 hours per week	60
Occasional Offices	2 weddings 6 funerals	100 100

Annual Occupancy Hours: 600

Estimated Footfall: 10,500

4 Energy Procurement Review

Energy bills for gas and electricity have been supplied by St Alban's Church, South Norwood and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	14.68p/kWh	Below current market rates
Standing Charge	25.89p/day	N/A

The current gas rates are:

Single / Blended Rate	2.488p/kWh	Below current market rates
Standing Charge	204	N/A

The above review has highlighted that when the current contracts expire, there will be opportunities to gain cost savings from improved procurement of the energy supplies at this site using a group purchasing scheme. The current rates are lower than the market rate and should be retained at present.

We would therefore recommend that the church looks into 100% renewable tariffs and obtains quotations for its gas and electricity supplies from group purchasing schemes such as the Big Church Switch scheme, Charity Buying Group or the Diocese Supported Parish Buying scheme, http://www.parishbuying.org.uk/energy-basket.

These scheme offers 100% renewable electricity and a proportion of renewable gas and therefore are an important part of the process of making churches more sustainable.

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.

Whenever monthly electricity consumption exceeds 1,000kWh, or gas consumption exceeds 4,397kWh (52,000kWh per annum), 20% VAT is charged unless the customer has submitted a VAT declaration form. This should always be done when changing supplier.

The church is a charity and therefore can claim VAT exemption status.

Excess VAT paid can be reclaimed for the past three years.

VAT declarations are available from the suppliers website and can usually be found by typing the suppliers name followed by "VAT Declaration Certificate" into most website search engines.

A detailed explanation is available here: https:// perfect-clarity.com/vat-on-church-utility-bills/#:~:text=There%20is%20no%20VAT%20chargeable%20on%20Church%20water%20bills

St Albans, Thornton Heath, South Norwood is a large building. The nave is 44m long, and it is 15.4m wide including the aisles. The nave rises to 15m height from 11.5m above the clerestory windows.

It is seated using chairs which are moveable, and the rear of the nave with portable seating.

5 Energy Usage Details

5.1 Annual Consumption

St Alban's Church, South Norwood used 13,381 kWh/year of electricity in the year from 22nd January 2021, costing in the region of £2,250 per year. 204,371kWhof gas was consumed by the church during the calendar year 2021, costing £6,117.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity - Church	21E 1035858	EDMI ES-3UB	Yes	Cabinet at rear of "south" aisle
Gas – Church	E025 K02947 19 D6		Yes	Basement corridor next to steps

All the meters are AMR connected and as such an annual energy use profile for the site could be obtained from the supplier.

5.2 Energy Profiling

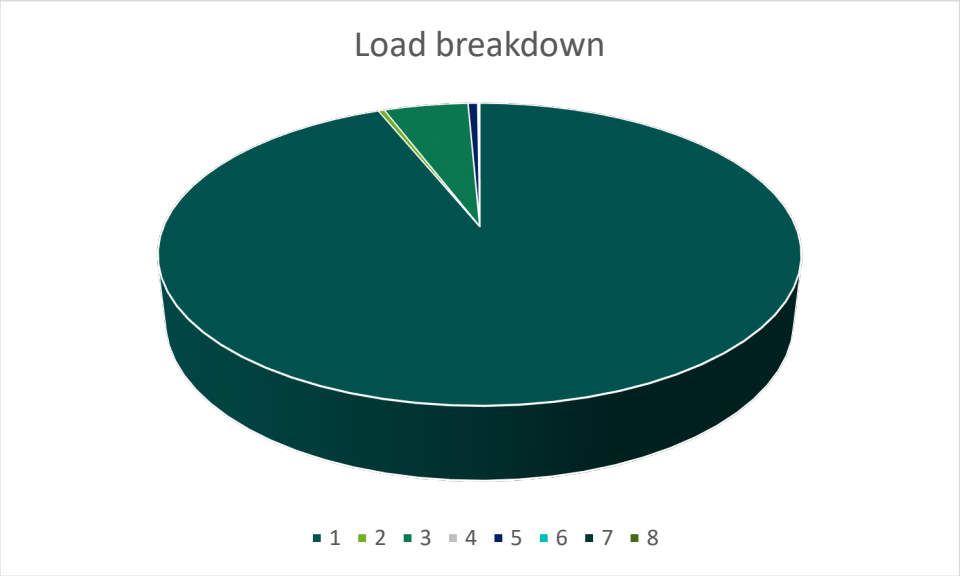
The main energy consuming plant can be summarised as follows:

Equipment		Power kW	Annual Consumption kWh	Portion
Heating [Gas]	2 x Vaillant EcoTec plus boilers, installed 2019. Thought to be 100kW input each (92kW output)	200	205,000	93.8%
Heating [Electric]	Sacristy: 3 radiant wall mounted 1 hour/week Vestry: 4 radiant wall mounted 4 hours/week	3 3	78 312	 0.18%
Lighting [Internal]	169 lights Est. 600 hours Basement: Office 10 hours/week Sacristy 2 hours/week	18.6 0.4 0.6	11160 200 60 TOTAL 11420	 5.2%
Lighting [External]	2 bulkhead lights	80W	10	0.01%
Hot Water	Fixed 10 litre water heater, under kitchen sink (1-2 uses/ week, normally turned on) Kettle – staff use Urn	3 3 3	900 150 200 TOTAL 1,250	 0.58%
Office	Computer, 8 hours/week Photocopier, 1.5hours/week	100W 500W	40 40	 0.04%
Sound, Music	Sound system, 5 hours/week Organ, electronic 3 hours/week	0.5 0.2	130 30	 0.07%
Small Power	Vacuum cleaner Stairlift – sporadic use	1.5	40	 0.02%

Sum of estimates: 13,380kWh

Annual site electricity consumption, 2021: 13,381kWh

The difference arises from the consumption data being from 2021 before completion of LED lighting in the church.



KEY *1 Gas heating* *2 electric heating (zero)* *3 Lighting internal* *4 Lighting external* *5 Hot water* *6 Office* *7 Sound, music* *8 Small power*

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 lighting.

5.3 Energy Benchmarking

In comparison to national benchmarks for church energy use St Alban's Church, South Norwood uses 42% less electricity and 48% more heating energy than is average 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 Alban's Church, South Norwood (elec)	885	13,881	15.7	27	-42%
St Alban's Church, South Norwood (gas)	885	204,371	231	156	+48%
TOTAL	885	218252	246	183	+34%

There is currently no benchmark data available which takes hours of use and footfall into account. [1] CofE Shrinking the Footprint – Energy Audit 2013.

6 Efficient / Low Carbon Heating Strategy

6.1 Reducing Environmental Impact

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 of 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 its remaining 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 important to review and plan to increase building efficiency and become less carbon intensive. 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.

6.2 Forward Planning

Whilst there are plans to add hydrogen to the network, and "green" gas from anaerobic digestion; some suppliers offering up to 20% "green gas" tariffs, the majority of the gas supply will continue to be fossil fuel for the next decade. The economics of hydrogen production and the need to replace some pipework make full decarbonisation of gas unlikely.

Some hydrogen is due to be added to the gas grid over the next five year period. If plans to decarbonise the gas grid are implemented; the hydrogen mix will eventually exceed 20%. The transition will be overseen by the regulatory bodies in a similar way to that between town gas and north sea gas.

The current boiler and radiator system was installed in 2019. It would be expected to have a lifetime of 10 years or more. This could be extended by installing a magnetic particle filter.

The cast iron radiators have a smaller surface area than multi wall pressed steel radiators of similar length. It is probable that they are too small to be sufficient to work with a heat pump, current models of which deliver water sat below 55°C rather than 70-80°C as with conventional gas fired heating systems. The church has virtually no external land; so a Ground Source Heat Pump could only be installed using a borehole at the front of the site or in the car park which may be too congested to accommodate the drilling rig. An Air Source system would require some large external units which would have to be located in the confined space between church and hall. The potential difficulties appear greater than at many churches.

It is recommended that a review of heating options is conducted in 2029 when the boiler system is ten years old to assess its condition and the availability of alternative technologies.

For instance, heat pumps which supply high temperature water may have become affordable, or an Air to Air Heat Pump system, replacing the radiators is viable.

6.3 Site Heat Demand

The Centre for Sustainable Energy model[2] can be used to estimate heat load for the building.

Heat Load (kW) = Volume V (m^3) x Insulation Factor

Insulation Factors

Condition	Factor kW/m^3
Poorly insulated with open or broken windows, draughty doors (add 5%)	0.034
Poorly insulated (assume no interventions)	0.033
Some insulating features	Estimate value
Well insulated	0.022
Insulated to 2010 regulations	0.013

Area	Area m^2	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Nave and aisles	680	7225	0.033	238
Crypt	205	630	0.03	19
Total	885	7855		257

2 www.cse.org.uk/local-energy/download/estimating-the-heat-demand-of-a-hypothetical-community-building-79

The site uses around 205,000kWh of gas yearly. Two boilers of 100kW power each indicate 1025 hours of heating operation at full power.

Cost per hour = Boiler power 200 kW x gas price 2.488p/kWh = £4.98

[Useful for comparison between different heating methods when the total number of hours is either uncertain, or may change with modified building use].

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7 Improve the Existing Heating System

7.1 Current Installation

The two Vaillant boilers, thought to be 100kW each were installed in 2019.

In the years before the replacement of the existing heating system it is recommended that measures are taken to improve the efficiency of the existing heating system, this should include:

7.2 Insulation of Pipework and Fittings

The pipework suspended from the ceiling in the vestry in the crypt is unlagged. This will be contributing little to heating to the room (as heat rises), so would be worthwhile insulating.

It is recommended that these areas of exposed pipework and fittings are insulated with bespoke flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

7.3 Magnetic Particle Filter

The recent boiler installation does not seem to be fitted with a magnetic particle filter. These devices capture magnetic sludge which is a corrosion product and circulates in pipework. It reduces the ability of heat exchangers to transfer heat and can cause blockages in radiator valves. It is recommended that a device is fitted immediately upstream of the boilers.

7.4 Radiator Reflective Panels

The church is heated by radiators served from the boiler. These radiators are located on the external, uninsulated walls and have no reflective or insulated surfaces directly behind them at present. They therefore lose much of their heat into the masonry of the wall behind the radiator rather than giving it out into the body of the church.

In order to improve the insulation directly behind the radiators, a reflective panel can be installed. This helps to make sure more of the heat from the radiator goes into the space and requires less overall heating from the boiler to achieve the set point. There are a wide variety of reflective panels for installing behind radiators on the market. It is recommended that these panels are installed behind all radiators within the building

The installation of radiator panels can be carried out by anybody competent in basic DIY and does not require the radiators to be removed.

8 Energy Saving Recommendations - Equipment

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.

8.1 Fixed Water Heater: manage use

A Ferrol 10 litre 2kW water heater is located under the kitchen sink. This was turned on all the time, although it was only said to be used sporadically. Whilst the tank itself is well insulated, the copper pipework is not and is a constant source of heat loss of around 100W (incandescent light bulb) and will waste around 900kWh per year, costing £132.

It is recommended that, *if used regularly*, it is fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. This should be set up with times to match the times that the building is occupied and hot water is required. This will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

Such units can be purchased at any electrical wholesaler and fitted by your existing electrician or any NICEIC registered electrical contractor.

Note that a 10 litre tank will only deliver half this volume of hot water. As the water is drawn, it is replaced by cold, so the second half of the tank will be lukewarm.

Alternatively, the cost effective management method is to keep the heater turned off and post a notice next to the switch (below, with cable leading downwards).

8.2 New LED Lighting

The lighting makes up a relatively large overall energy proportion of the electricity used within the church, and large areas are lit by relatively inefficient fittings.

Much of the extensive lighting provision is installed at high level. This is due to be replaced professionally by CES Ltd.

CES have measured the total present installation at 169 bulbs summing to 18,659W load.

This is to be replaced with LED replacements giving a load of 3,962W.

An annual saving of £2,193 is predicted (at today's electricity price) against capital cost of £38,635 +VAT – probably recoverable under the Listed Places of Worship Scheme). The payback period of 18 years may well be reduced as electricity costs rise.

Given that the church has a new boiler system and that lighting is the major electricity use, proceeding with relighting, although expensive is the logical option for reducing electricity use and carbon footprint.

8.3 Lighting Controls (Internal)

It is recommended that as part of the relighting scheme, certain circuits are fitted with presence detectors so that lights come on automatically for visitors and are turned off two minutes after movement stops.

9 Energy Saving Recommendations – Building Fabric

9.1 Draught Proof External Doors

There are a number of external doors to the church. These have the original historic timber doors on them, but some do not close tightly against the stone surround and hence a large amount of cold air is coming in to the church around the side and base of these doors.

It is recommend 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, a more traditional solution such brush draught strips rebated into the edge of the door by a skilled joiner could be used. 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.

Occasionally, doors such as that exiting the crypt office should be fitted with "sausage dog" type draught excluders filled with pea gravel or similar. Plasticine of the right colour can be used 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.

9.2 Windows

Several metal framed windows have hinged opening panels which can be used for ventilation. It is recommended that where damage such as rust is identified, it is repaired before further deterioration occurs.

Rust has a greater volume than the base metal, the expansion causing bending which prevents closure and leads to further water ingress. Any small gaps leading to draughts can be filled with Plasticene (recommended by Historic England – it is easily removable).

9.3 Secondary Glazing

Glass secondary glazing is expensive. Seasonal glazing film is very cheap and effective, but awkward to install and a new packet is required every time it is removed.

Use of 2mm thick flexible polycarbonate sheet, which can be cut with a craft knife is recommended for “unseen” windows in the crypt. This can be positioned using a flexible magnetic strip attached to each of the plastic sheets and a flat surface of the window frame.

10 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, visible roof on both sides
Battery Storage	No
Wind	No – no suitable land away from buildings
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 – low hours of use
Ground Source Heat Pump	Small land area, small radiators
Air to Air Source Heat Pump	Future potential

As can be seen, the roof is visible on all sides, including from the road on the opposite side.

10.1 Future Heating Options

The current heating system is recently installed in 2019.

The church should look at heat pumps for future use when the current system eventually requires replacement. The planned rapid expansion of heat pump use in the UK should considerably lower costs. Advances in technology may make heat pumps suitable (using the existing radiators) although the church hours of use, 11 per week are too low for the current technology to be viable.

Air to Air heat pumps requiring new internal heat emitters with fans are beginning to be installed in smaller churches and this technology should be well understood for church use in a decade.

11. Other Issues

The two boiler flues exit the building at approximately 60cm from the ground into the car park adjacent to the nursery entrance. This delivers boiler exhaust gases, CO_2 and potentially carbon monoxide at a child's head level.

It is recommended that you consult your Inspecting Architect (to check if it has been installed according to regulations) and the boiler installers to extend the flues upwards to a safe level.

12. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at www.parishresources.org.uk/resources-for-treasurers/funding/

This includes a 77 page guide to funders and their criteria:

https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2020.pdf .

13. 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.