Energy Efficiency and Zero Carbon Advice

St Peter's Church, Stoke Hill, Guildford
PCC of St Peter's Stoke Hill

Author	Reviewer	Audit Date	Version
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1. Executive Summary

An energy survey of St Peter's Church, Stoke Hill, Guildford 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 Peter's Church, Stoke Hill, Guildford consists of two buildings; the original church to the rear constructed in 1968 with a shallow angle roof, now in use as the hall and a later building which now forms the church with a very steep 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 and a clear path towards net zero carbon. 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 diagram below are used as the action plan for the church in implementing these recommendations over the coming years.

Energy and decarbonisation recommendations	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Contact suppliers to arrange for the gas meter to be changed to a smart meter	None	None	Nil	N/A	None	N/A
Manage Hot Water unit by installing timer control	Up to 900	£256	£200	1	None	0.2
Complete LED lighting (including 8 strip lights)	1,200	£340	£1,000	3	List B	0.2
Install presence detector controls for selected lighting	200	£56	£200 per unit		List B	0.04
Install double glazing in regularly used areas	15%	£400	Unknown		Faculty	
Install Cavity wall insulation	8%	£200	£7,500	37	Faculty	
Install roof insulation to church	10%	£250	Unknown		Faculty	
Replace heating system with air to air heat pumps	See below				Faculty	
Install Solar photovoltaic panels	29,000 - maximum sized system	£8,300 (if all used)	£39,000	5	Faculty	6.1
Consider registering for Eco Church	The Eco Church programme, which is recommended by the Church of England, helps congregations care for the environment in all aspects of church life. The programme is free; you can, however, make a donation to A Rocha UK towards its costs.					

Create a procurement policy for appliances (and other goods)	Commit to buying only appliances with the new energy efficiency ratings of A, B or C at the lowest when those you currently have reach the end of their useful life. (NB ovens, air conditioners and space or water heaters are still on the older rating scale, so for these, try for A+++.)

Alternative Options	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Church – Air to Air Heat Pumps	c.16,000 gas 4,000 electric use	£316	£24,300		Faculty	2.0
Hall - Air to Air Heat Pumps	c.14,000 gas 3,500 electric use	£277	£10,800	39	Faculty	1.8
Hall - Air to Water Heat Pumps (utilising existing radiators)	c.14,000 gas 5,600 electric use	£300 greater cost	£9,600	Not recovered	Faculty	1.3

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

Figures in the table are based on current contracted (but discounted) prices of 28.43p/kWh and 9.085p/kWh for electricity and mains gas respectively. The carbon figures are based on the DEFRA 2022 carbon emission factors of 0.211 for electricity, 0.18 for gas and 0.27 for oil.

Do note that as energy prices increase (as is likely if the discounts end in April), payback periods decrease.

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:

Short Term (within 12 months)

- Hot water management
- Change all remaining lighting to LED

Medium Term (by 2025)

- Install Insulation to roof and walls
- Install double glazing

Long Term (before 2030)

- Replace gas fired heating system with Heat Pumps

3. Introduction

This report is provided to the PCC of St Peter's Church, Stoke Hill, Guildford 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 Peter's Church, Stoke Hill, Guildford, GU1 1NP was completed on the 18th January 2023 by Dr Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church.

St Peter's Church, Stoke Hill, Guildford	
Church Code	617095
Gross Internal Floor Area	600 m^2
Volume	2,800m^3
Heat requirement	88kW
Listed Status	Unlisted
Average Congregation Size	60 (morning) + 70 (evening)

The site is typically used for 44 hours per week for the following activities

Type of Use	Hours Per Week (Typical)
Services	4 hours per week
Meetings and Church Groups	2 hours per week
Community Use	38 hours per week
Occasional Offices	1 Wedding 10 Funerals

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by the church.

The current electricity rates are:

Single / Blended Rate	62.93p/kWh discounted to 28.43p/kWh
Standing Charge	27.40p/day

The current gas rates are:

Single / Blended Rate	18.185p/kWh discounted to 9.085p/kWh
Standing Charge	27.40p/day

The electricity is supplied by Bulb, and is purchased on a renewable tariff. The church is congratulated for procuring its supplies from a 100% renewable tariff and is encouraged to continue this.

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.

The church is a charity and therefore can claim VAT exemption status. A VAT declaration should always be supplied when changing supplier. 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.

5. Energy Usage Details

5.1 Consumption Data

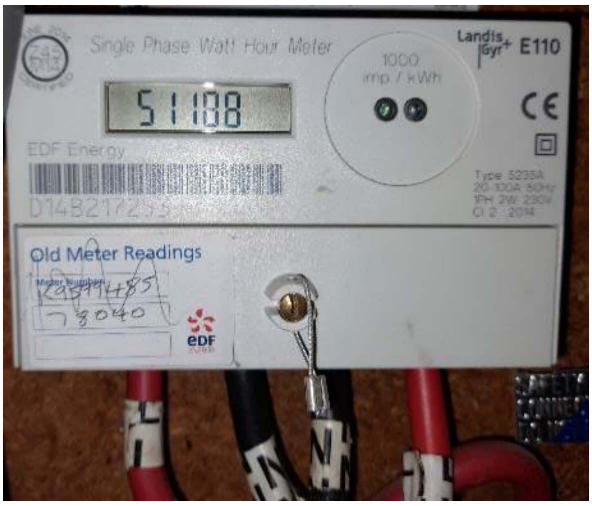
St Peter's Church, Stoke Hill, Guildford used 6,983 kWh/year of electricity in from 13/11/2021 to 13/11/2022, costing £2,340 per year. Gas use was reported as 30,777 kWh/year costing £1,573 on the EFT submission – this may represent a normal year with both boiler and gas fired warm air blower in operation.

With just the boiler for the 1968 hall, mains gas use during 2022 (13/11/2021 – 13/11/2022) was 14,392kWh costing £1,453. There was an additional 2,690kWh from burning of 195kg of bottled butane at cost of £625.

The total carbon emissions associated with this energy use are 6.92 CO_2e tonnes/year.

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	D14B217253	Landis & Gyr Single phase	Yes	Old hall, stage
Gas – Church	1635697	Imperial Cubic feet	No	External cabinet, NE side of old building



It is recommended that the church consider asking their supplier to install a smart gas meter so that the usage can be monitored more closely, and the patterns of usage reviewed against the times the building is used.

The gas meter, its fittings and emergency isolation valve (left) are suffering from the effects of weather leading to corrosion. Replacement with a smart meter should give the opportunity to install a new isolation valve and meter housing– this work should be dovetailed into the site development works (i.e. to ensure the meter location is not in the way of any planned works.

5.2 Energy Profiling

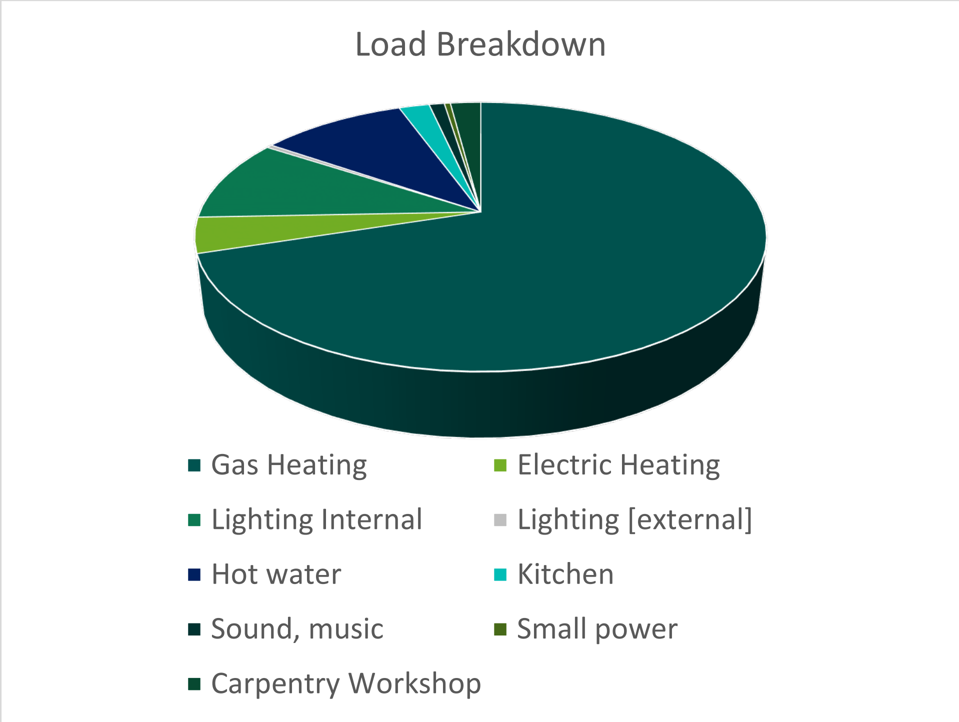
The main energy consuming plant can be summarised as follows:

	Equipment	Power kW	Annual Consumption kWh
Heating [Gas]	Old Hall – Glo Worm Hide Away non condensing boiler Church – Powermatic hot air blower (failed November 2021) Butane gas canister heater [195kg used 2021-22]	40? 60?	14,392 0 2,700 17,000 but normally 30,000
Heating [Electric]	Boiler circulation pump [360 hours] 2 wall mounted heaters in woodwork room	120W 6	40 1000
Lighting [Internal]	Church 500 hours use Hall 1800 hours use Theatre lights (old hall) 2 x 500W Floodlight 1 x 250W Spotlights / non LED 19 x 80W ? Fluorescent T12 size 3 x 70W Strip light 5 x 58W Bulkhead 8 x 28W Chandelier mounted. 24 x 6W TOTAL	 1000W 250W 1520W 210W 290W 324W 144W 3.74kW	TOTAL 2,400
Lighting [External]	2 LED floodlights x 100W 1 halogen floodlight 500W 1 bulkhead light 40W	200W 500W 40W	 100
Hot Water (electric)	Industrial dishwasher Fixed water heater under sink (Strom) (left on) Urn kettles	5 3 2 3	1000 1000 200 200
Kitchen	Fridge Microwave oven	150W 1	450 50
Sound, Music	Sound system	0.5	250
Small Power	Vacuum cleaner	1.5	100
Carpentry Workshop	Tower drill Bandsaw Belt sander Dust extractor	1 1 1 0.5	 500

Sum of electricity use estimates: 6,990kWh

Annual church electricity consumption, 2022: 6,983kWh

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 loads are lighting and hot water.



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 loads are lighting and hot water.

6. Site Description

Reorder Plans: "We are at the start of pursuing a four phase building masterplan which would involve reordering rooms and updating the building. The first stage of this is something we want to start soon as it includes replacing the heating system for the church, as this has been unusable for over a year now (we are currently using portable gas heaters). "

The main entrance foyer which is proposed to be replaced by a larger atrium running between the new church (left) and the 1968 hall to the right and rear (below).

1968 hall from rear, above and interior, below.   The roof has recently been insulated and this is reported as having led to a significant improvement in temperature.   The carpentry skills workshop is on the left.

Kitchen in 1968 hall.

 A side room to the 1968 hall accommodates a carpentry skills training project using light industrial scale equipment.

 DIY secondary glazing has been installed using twin wall polycarbonate panels held in place using foam pipe insulation tubing which provides an airtight seal and is easily removable.

 Most of the windows in the 1968 building are single glazed and metal framed.   For a frequently used building it would be beneficial to replace with double glazing, or install secondary glazing (where cheap, DIY solutions may be suitable for the storage rooms, stage, etc).

The area between the two buildings houses the failed hot air blower (left).   It is proposed to clear this area and construct a new glazed atrium linking the two buildings.

Redevelopment of the interior section of the site would give an opportunity to upgrade windows and doors as part of the project – potentially reducing costs compared to a standalone installation of new windows.

The rear aspect of the "new" church is timber clad.   If heat pumps were installed, one option would be to mount some small Air to Air individual units just under the roof line on the wall to the right.

The timber framed building is seated by chairs. A considerable proportion of its surface is roof. It may be possible to insulate by addition of rigid polyisocyanurate panels between the structural woodwork (the other option involves re-roofing and addition from outside).   In either case, a structural engineer is required to assess the impact of the extra loading on the laminated wooden frame.   The church itself appears to have sporadic hours of use.   An air to air heat pump system (there are no radiators as it has direct blown air space heating) would give more rapid heating than underfloor.

The frontage of the building (seen from inside, above) is entirely single glazed with metal framed windows. The foyer (below) appears to be little used and is not really a seating / activity area in winter – thus it could be considered to add some insulation to the inside, if it is kept draught free (with the entrance in winter always being the main foyer).

The upper glazing is a candidate for secondary or double glazing, as is the large window on the north side. It is understood that there have been problems with vandalism; thus double or external secondary glazing of the large window below (e.g. with polycarbonate sheeting) would improve security.

The cold weather during the audit allowed the thermal performance of the building to be experienced, with temperatures of 7 to 8^{o}C recorded inside this building.

7. Efficient / Low Carbon Heating Strategy

7.1 Overview

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 near future. 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' in the foreseeable future.

It is therefore important to review and set out a plan to make heating more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents an efficient and comfortable solution for churches. 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 oil and coal-fired power stations.

7.2 Current Heating Systems

The hall (original church) is currently heated by a gas fired boiler which is thought to have been installed prior to 2000. It is likely to require replacement within the next five years.

The boiler provides heating to pressed steel radiators around the perimeter of the hall.

The church was heated by a gas fired blown air system. This failed in November 2021 since which portable butane fuelled heating has been used for services. The use of portable gas cylinders is not recommended in churches. You must contact your insurer to check that they will continue to insure you while using these. The storage of gas cylinders is tightly regulated and and spare (but full and empty) cylinders but be secured stored in an outside caged area and not stored inside. Liaison with the local fire office should also occur as the presence of gas cylinders in a building can serious impact their ability to fight fires. It should be noted that combustion products including water are vented directly into the occupied space by a portable gas heater, these units do not have a flue. Therefore this will lead to a build-up of moisture (damp) within the building unless it is very well ventilated after use. Other combustion products will be emitted into the atmosphere inside the building leading to very poor indoor air quality and this could be potentially harmful to the health of those inside the building. Any build-up of soot on the apparatus indicates incomplete combustion and is a sign that poisonous carbon monoxide is being produced – if this is seen the equipment should be turned off immediately. Carbon monoxide alarms must be installed and used within the building if gas heaters are being used.

The church is seated with moveable chairs.

The church is used once per week on a Sunday for service and the typical congregation size is 60 in the morning and 70 in the evening. Lack of heat precludes use at other times.

If the church is fitted with a new heating system before the new atrium development in the present foyer area is constructed, the church could then become the space used for most or all activities whilst access to the hall behind is limited by building works, with lower heating costs.

Hall Glo Worm boiler

7.3 Future Heating Options

The various options for a decarbonised heating solution have been reviewed in the table below.

Decarbonisation Heating Solution	Viable
Air to Water Source Heat Pump	Potential for original hall, may need larger or fan assisted radiators
Air to Air Source Heat Pump	Yes for church Possible for original hall – lower operating cost than above
Water Source Heat Pump	No – no water source locally
Ground Source Heat Pump	Yes but extra expense. Air to Air equal running cost
Under Pew Electric Heating Panels	No – no pews
Electric Panel Heaters (to provide supplemental heating only)	No – not required
Over Door Air Heater (to provide a supplemental warm welcome at the door only)	Yes – may be included in new atrium design (suggest not next to outermost doors)
Overhead Infra-Red Heaters	No –least preferred heating source due to comfort
Heated Chair Cushions	No – other solutions preferred

The recommendation is therefore that the church consider installing an Air to Air heat pump system for the main church (and for the new construction). Future replacement of the hall boiler when necessary could use an Air to water heat pump (if the radiator / pipework system is suitable) or another AASHP installation as described below.

7.4 Air to Air Source Heat Pumps

Air-to-Air Source Heat Pumps (AASHP) work by having an external unit which sucks air in and extracts the heat from it. The pumps concentrate this heat and put it into a refrigeration gas (in the same way as a fridge or freezer works). This refrigeration gas is then piped inside the building in a small pipe where is it then allowed to expand in an internal unit with a fan. This heat is then blown out into the space. This system is identical to an air conditioning system, but it works in reverse to heat the space. As warm air is blown into the space this type of system can heat spaces from cold relatively quickly. AASHPs provide around 4.5 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of up to 4.5.

The Centre for Sustainable Energy model[1] can be used to estimate heat load for the building.

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

<u>Insulation Factors</u>

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	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Church	1800	0.03	54
Hall and side rooms [not including foyer]	720	0.028	24

Therefore, a heat pump of 54 kW output would be required for the church and 24kW for the hall and associated rooms.

AASHPs require the installation of external units which look like air conditioning modules in well-ventilated external locations. These external units will need an electricity supply and pipework running from them to the heating system. They will also need a drain nearby as the back of the units can build up moisture, which condenses and sometimes freezes on the coils. The larger

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

units do create some low-level noise and therefore the location and baffling of the units may need to be considered carefully.

For St Peter's, a series of small wall mounted external units, each supplying one or two internal units may be the optimum solution as this will minimise the amount of pipework required, cutting capital and installation costs.

Examples of external units for AASHP comprising of three smaller 3kW units (delivering 10kW each) and two larger 10kW units (37.5kW output each).

Internal units come in a variety of styles. The most appropriate internal units for most churches are floor mounted units which look very similar to a fan convector heater.

FUA-A - Under ceiling cassette air conditioning unit

Unique under ceiling cassettes for high rooms with solid ceilings or false ceilings with a shallow void. Suitable for all types of commercial applications.

The FUA-A range provides comfortable heating and cooling even for rooms with high ceilings and has individual louvre control flexibility to suit every room layout.

FTXM-R - Wall mount air conditioning unit

Attractive, wall mounted design with perfect indoor air quality. 2 area motion detection sensor: air flow is sent to a zone other than where the person is located at that moment; if no people are detected, the unit will automatically switch over to the energy-efficient setting.

FVXM - Floor Mount Air Conditioning Unit

Designed to fit rooms of any size and shape, it blends well with the interior due to the new design which incorporates more flowing lines and softer edges. These units are ideal when it is not possible to fit a high level wall mount unit for aesthetic or practical reasons.

They are suitable for a wide range of applications including domestic, small to medium offices and commercial uses.

All these units do have a fan element within them and therefore a small amount of fan noise is emitted. This tends to be less than a fan convector heater on a boiler-based system and similar to the noise from a fridge or freezer. Air conditioning units are commonplace in hotel rooms, indicating that the noise is low enough even to be suitable for sleeping environments.

A case study of a church which has installed such a solution is available at [5. Air-source heat pumps at Hethel Church - All Saints Church, Hethel - A Church Near You]

7.5 Air to Water Source Heat Pumps

Air-to-Water Source Heat Pumps (AWSHPs) work by having an external unit which sucks air in and extracts the heat from it. It concentrates this heat and puts it directly into water that can then flow through the heating system. They work most efficiently when trying to produce water temperatures in the heating system between 40°C and 50°C. They tend to warm up slowly and steadily and are therefore well suited to situations where the heating is required for long periods of the day, and with heating systems that have a low temperature requirement such as underfloor heating systems. As they warm up spaces slowly, it is important that the warmth being slowly emitted is retained within the building so that the overall heat levels build up. This requires good levels of insulation and air tightness to ensure that the heat loss is lower than the heat being emitted. AWSHPs provide around 3 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of 3.

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 – Roof insulation fitted	Estimate value
Well insulated	0.022

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

Insulated to 2010 regulations	0.013

Area	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Hall and side rooms [not including foyer]	720	0.028	24

Therefore, a heat pump of 24 kW output would be required.

AWSHPs require the installation of external units, which look like air conditioning modules in well ventilated external locations. These external units will need an electricity supply and pipework running from them to the heating system. They will also need a drain nearby as the back of the units can build up moisture, which condenses and sometimes freezes on the coils. The larger units do create some low-level noise and therefore the location and baffling of the units may need to be considered carefully.

A case study of a church which has installed this solution is available at Heat pumps and fabric improvements make a rural church warm and well used : St Anne in Ings | The Church of England

7.6 Upgrade to 3 Phase Electricity Supply

To be able to have sufficient electrical power to supply enough energy into an electrical heating system, the church will need to increase the existing electrical supply from single phase 100A supply to a 3 phase 100A supply.

The upgrade to the supply has to be carried out by the District Network Operator in the areas.

The DNO in your area is ww.ukpowernetworks.co.uk

The cost of bringing in a new 3 phase supply can range from £300 to £30,000. The DNO will provide a quotation for free, so it is well worth obtaining a quotation even if plans are not yet certain, so that decisions can be made on a well-informed basis.

8. Energy Saving Recommendations

There are a number of measures that can be taken to reduce the amount of energy used within the church.

8.1 Complete LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church.

Energy savings can be achieved by replacement of the following:

External 250/500W halogen floodlight – replace with a third LED floodlight

Theatre lights in hall – often have 500W lamps. Investigate replacement by LED lamps

T12 (1.5 inch diameter) fluorescent tubes – three of different lengths – replace by LED lighting, either strip lights or bar mounted individual lamps. Do not try to source LED tubes to fit the existing luminaire – control and ballast provision are different.

T8 (1 inch diameter) fluorescent tubes (5) – as above.

Non LED spotlights, using the same fittings.

[These fittings can be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and, unlike a change of fittings, would be a List A item, so no permissions would be required.]

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/

8.2 Lighting Controls (Internal)

As part of the new build / refurbishment programme it is recommended that lighting be fitted with presence detectors. Installing a motion sensor on specific lighting circuits will ensure 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 considered 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.

Some areas such as toilets are only used occasionally and for a short amount of time. The light, therefore, does not need to remain on constantly. The proposed construction should benefit from a good amount of natural daylight coming in through the windows, such that artificial lighting is not required for much use during the year.

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.

8.3 Timers on Fuse Spurs to Water Heaters

The water heater located under the sink is managed using a notice which informs when to turn it on, but not to turn it off after use. If left running these heaters (which are themselves insulated) lose heat along the copper pipes, roughly equivalent to the heat through a 100W incandescent light bulb; 900kW per year typically costing £150.

With a regularly used kitchen, it is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. They should be set up with times to match the times that the building is occupied. 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.

8.4 Draught Proof External Doors

There are a number of external doors in the church. The refurbishment project should be seen as an opportunity to ensure all doors are sufficiently draught proofed. Use of self-adhesive polymer seals and possibly upstands inserted into the flooring if necessary should be considered.

It is necessary to check with the DAC before undertaking any form of draughtproofing that involves work on the fabric of the door.

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

8.5 Secondary Glazing

The windows of the building are singled glazed with metal frames.

The introduction of secondary glazing would considerably reduce the heat loss through the existing windows and improve both thermal comfort and noise levels, as well as providing added security.

Any possible installation would need to be carefully specified.

Some windows may be suited to "DIY" secondary glazing using polycarbonate or acrylic sheet which is sold cut to size for such purposes.

8.6 Cavity Wall Insulation

The church 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. It could, however, be added through injection 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 overheat because of the additional insulation.

8.7 Insulation to Roof

The roof of the 1968 hall has recently been insulated and is reported to have increased comfort levels. The church roof is a major percentage of the building envelope. Adding insulation would reduce long term running costs and also reduce the output required from a heat pump, so smaller plant would be needed, reducing capital costs.

Because heat rises, the ceiling/roof of a building is the largest contributing area to heat loss from a building. The insulation of such spaces can therefore have a dramatic impact on both the efficiency of the heating system and the temperature of the space below.

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 Photo Voltaic (PV)	Yes
Battery Storage	Yes

There is potential for a solar PV array on the south facing side of the church or on the roof of the 1968 hall. With a site with regular use throughout the week most electricity generated can be used. An oversized system is not recommended due to the low feed in tariffs now applying.

It is worth waiting until a decision has been made about heat pump installation as this will significantly increase the electrical load. The installation needs to be of sufficient size to run lighting, office and kitchen equipment, summer cooling (provided by the heat pumps) and make a contribution to winter heat pump requirements.

The following formula calculates annual generation:

Annual Generation (kWh) = Area x 0.15kWp/m^2 x 1000kWh/kWp x Orientation Factor x Overshading Factor.

Panels mounted in the hall roof could be on supports at the optimum angle. The optimum size of installation may be smaller than the maximum outlined below.

Roof Section	Area / m^2	System Size / kW peak	Orientation factor	Shading factor	Annual Generation, kWh
Church	140	21	180 degrees / 50^0 0.97	1	20,370
Hall	60	9	180 degrees / 35^0 1.0	1	9,000

A 30kW peak system would cost in the region of £39,000.

Battery storage is not strictly a renewable energy solution, but it does 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 solar PV is no longer generating. It therefore extends the usefulness of the existing solar PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantially over the next 2 to 3 years.

10. 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/

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 includes the installation of under pew heaters to pews which are made in or after 1850 and are not of historic interest.

All other works, including the like for like replacement of gas and oil boilers 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. This includes items such as solar PV installations.

12. Offsetting

12.1 Bats in Churches

The Bat Conservation Trust has a project with the Church Buildings Council Natural England, the Church of England, Historic England and the Churches Conservation Trust to address bat issues: *www.churchofengland.org/resources/churchcare/advice-and-guidance-church-buildings/bats-churches*