Energy Efficiency and Zero Carbon Advice

St Luke's Church, Maidstone
PCC of St Luke's Church

Author	Reviewer	Date	Version
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1. Executive Summary

An energy survey of St Luke's Church, Maidstone was undertaken by Inspired Efficiency Ltd 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 Luke's Church, Maidstone is a brick built late Victorian Grade II listed church built in 1897 [Historic England reference 1086280]. A 1972 built foyer links the church with a 1960s hall, a further hall and a prefabricated concrete building now used for storage. The church owns land on which a scout hut is situated and the curtilage includes the former vicarage. Neither of the latter buildings were included in the audit 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. Suggestions are made regarding how the site can be used to enable renewable energy to be deployed with increased energy efficiency. This will be dependent on how the church plans its future ministry and use of the various buildings. 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)
Draught proofing of doors	5% of total gas, 4,000	£131	£500	4	List A	0.74
Gutter cleaning / remove vegetation from roof	Prevent water ingress		£300		None	
Fill holes in heating duct	5% of church gas, 1,500	£50	£50	1	None	0.27
Install extra doors to create draught excluding lobby in foyer	5% of hall gas, 2,500	£82	£3,000	36 Enhancement of space	Faculty	0.46
Install light pipes in foyer	200	£30	£2,000	67	List B ?	0.05
Install Cavity wall insulation in hall	8% of hall gas, 4,000	£131	£6,000	46 (less if hall use increases)	Faculty	0.74
Install double glazing in hall	10% of hall gas, 5,000	£164	$50m^2$ of glazing £25,000	152	Faculty	0.92
Install new insulated roof to hall	10% of hall gas, 5,000	£164	£1,800 insulation only £12,000 new roof	11 Not recovered	Faculty	0.92
Install solar panels to hall roof	11,730	£1,715	£18,475	11	Faculty	2.99

Install solar panels on nave roof	14,355	£2,100	£23,925	11.5	Faculty	3.63
Install Ground Source Heat Pump for main hall	Save 50,000 gas. Use 9,000	£1,639	£36,000	22	Faculty	9.23
Install Air to Air Source Heat Pump for Miss Coppen Room	Use 375	N/A	£2,000	N/A		
Install Air to Air Source Heat Pump for church	Save, 30,000 gas. Use 7,500 electricity	All gas charges c. £1,100	£12,000	11	Faculty	5.53

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

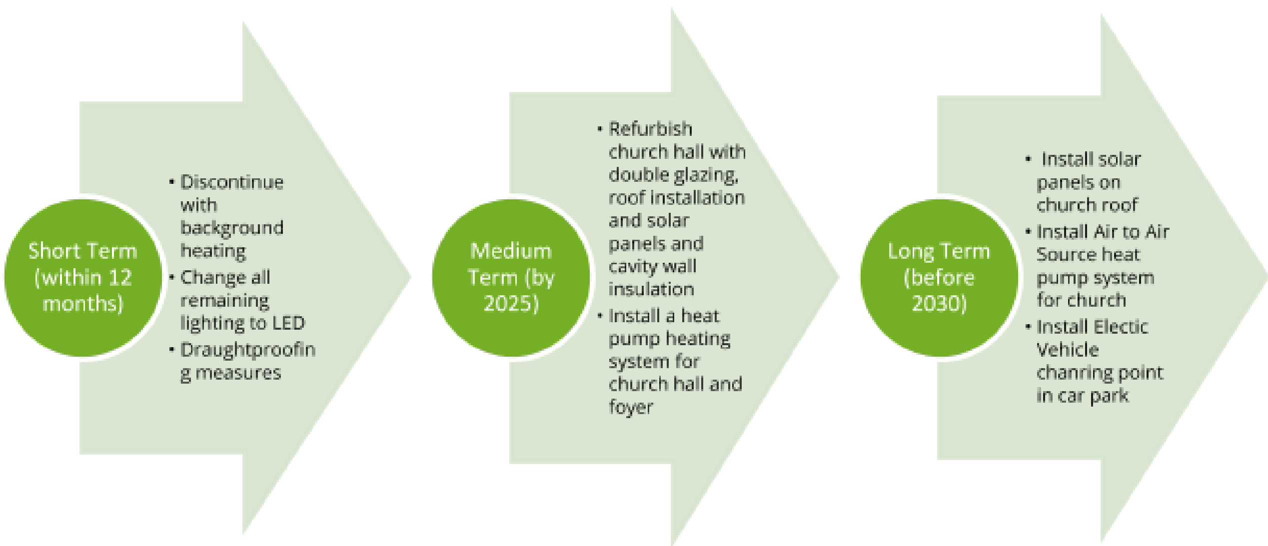
Based on current contracted prices of 14.625p/kWh and 3.279p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church around £6,000 in operating costs per year (All gas costs plus up to 50% of electricity 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 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Luke's Church, Maidstone 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 Luke's Church, Maidstone, Foley Street, ME14 5AR was completed on the 19th March 2021 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 Associate 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 Melanie Williams.

St Luke's Church, Maidstone	
Church Code	606334
Gross Internal Floor Area	Church 530m^2 Halls 440m^2
Listed Status	Church Grade II Halls unlisted

The church typically used for 9 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	4.5 hours per week	170
Meetings and Church Groups	3 hours per week	50
Community Use	0 hour per week	
Occasional Offices	1 wedding 4 funerals per annum on average	100

Church annual use: 450 hours

Heating hours: Church: 4.5hours per week x 30 = 135hours (166,784kWh / kW average)

Estimated footfall: 10,500 people

Halls annual use: 1,000+ hours

Heating hours 1,000

Estimated footfall 15,000

4. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	14.625p/kWh	Above current market rates
Standing Charge	19.00p/day	N/A

The current gas rates are:

Single / Blended Rate	3.279p/kWh	Above current market rates
Standing Charge	16.44p/day	N/A

Both utilities are supplied by SSE with the contract ending on 31st March 2024.

The above review has highlighted that there are opportunities to gain cost savings from improved procurement of the energy supplies at this site. We would therefore recommend that the church looks into 100% renewable tariffs and obtains quotations for its gas and electricity supplies from the Big Church Switch scheme and the Diocese Supported Parish Buying scheme, http://www.parishbuying.org.uk/energy-basket.

These schemes 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	20% on hall gas	The organisation is understood to be a charity and therefore should be benefiting from only be charged a 5% VAT rate. A VAT declaration should be sent to the supplier to adjust this.
CCL	Applied when 20% VAT is charged	As above

The above review has highlighted that VAT and CCL have been charged. The church is a charity and therefore can claim VAT exemption status. Whenever monthly gas consumption exceeds 4,397kWh (52,000kWh per annum), 20% VAT is charged unless the customer has submitted a VAT declaration form.

As such the PCC of St Luke's Church, Maidstone should send the supplier a VAT declaration confirming this. 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.

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

5. Energy Usage Details

Accurate gas and electricity use figures are not available for the church. The electricity meter was broken for a period of about two years until replacement in December 2020. A large leak on the customer's side of the gas meter led to extremely large consumption during 2019 (166,784kWh).

An approximate use has been estimated from the hours of use of the church, assuming a 200kW input blown air gas heater for 150 hours, of 30,000kWh.

Utility bill information for the halls has been provided for a four to five month period in winter 2018-19 and extrapolated; 3,029kWh electricity for 138 days over winter suggests 6,000kWh annually. 39,552kWh of gas for 167 days covering most of the winter suggests 50,000kWh annually.

St Luke's Church, Maidstone uses an estimated 5,000 kWh/year (church) of electricity and 6,000kWh/year (halls), costing in the region of £1,600 per year, and 30,000kWh/year (church) plus 50,000kWh/year (halls) of gas, costing around £2,600.

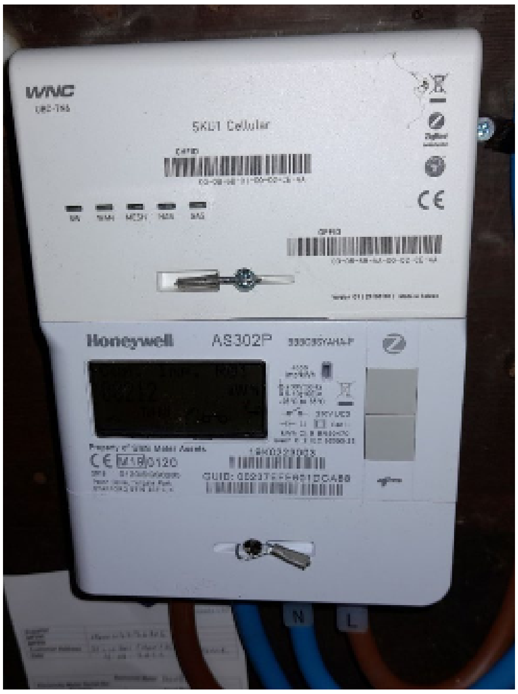
This data has been taken from the annual energy invoices provided by the suppliers of the site and further information provided by the treasurer.

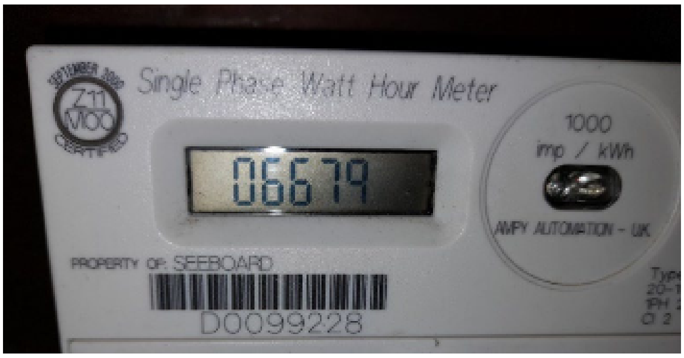
St Luke's Church, Maidstone has two electricity meters serving the church and two for the halls, with a gas meter each for church and hall.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church (left)	19K0223003	Honeywell AS302P 3 phase	Yes	Sound store, NE corner room
Electricity – Church (right)	D0099228	Single phase	Yes	Sound store, NE corner room
Electricity – Hall	K12B000523	Elster A1100 3 phase	Yes	Foyer electrical cabinet
Electricity – Hall	L7924867	Landis & Gyr Single phase	No – sub meter	Foyer electrical cabinet
Gas – Church	M025 K01669 10 D6 (new meter)	BK-G16	Yes	E side of building by gas blower
Gas - Hall	8614605	Parkinson Cowan	No	W side of hall facing Foley St.

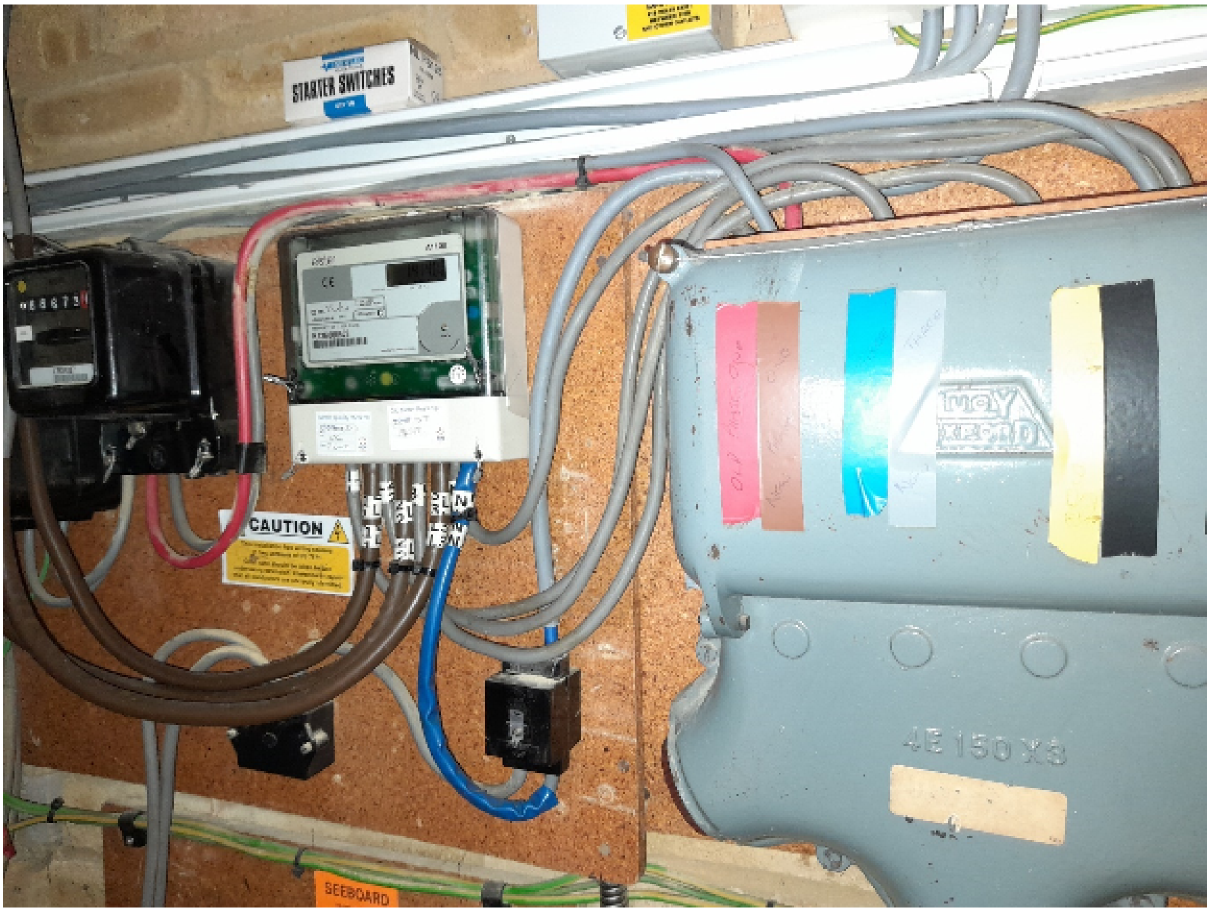
Utility	Meter Serial	Period	Annual Use/ kWh	Cost
Electricity – Church	Assumed 19K0223003	12/11/18 to 25/11/19	2,763	£630.31
Electricity – Hall	K12B000523			
Gas – Church	Old meter 7060655	XX/11/18 to 15/11/19	166,784	£5,620
Gas - Hall	8614605			

Church electricity meters





Hall electricity meters



Church Gas Meter

Hall Gas Meter

Where meters are AMR connected, obtaining an energy profile for that part of the building's energy usage from the supplier should be possible.

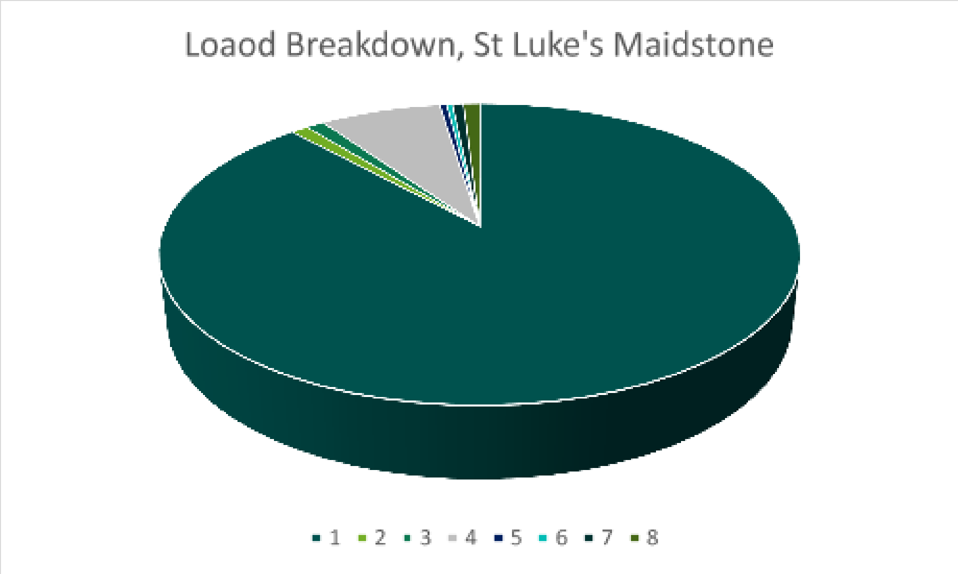
5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Annal Use kWh	Estimated Proportion of Usage
Heating (Gas)	Church warm air blower 200kW x 150 hours Main Hall warm air blower Main Hall CH boiler (first floor) Prefab area warm air blower Miss Coppen room Baxi Brazilia 2	30,000 Church 50,000 Halls	87.9%
Heating (electric)	Various wall mounted heaters, 2kW each 3 recirculating fans suspended from nave roof, 500W x 3 h.p.w Foyer curtain heater 1.5kw x 2 hour/ week	Church 500 Halls 500 Church 75 Hall 100	1.3%
Hot Water	Wall mounted water heater, kettles Industrial dishwasher, 5kW daily use, 100h	500 DW 500	1.1%
Lighting (internal)	Church 8 sodium floodlights = 400W Nave 12 theatre lights = 6kW Aisles 12 LED floodlights = 600W Chancel 13 spotlights = 1kW Vestry 8 x 15W CFL + 4 uplights, = 150W 450 hours use Total = 8kW Foyer Hall 10 floodlights = 1kW Miss Coppen Room 10 recessed = 800W Prefab 4 x T8, 2m = 240W Small kitchen 4x 40W = 160W Large kitchen 4 x T8, 2m = 240W 1000 hours use Total = 2.5kW	Church 1760 (in 2020) *3,600 normally* Hall estimate 3000	7.3%
Lighting (external)	PIR controlled security lights	Hall 400	0.4%
Organ, music, PA	Organ blower, 1.5kW Electric Piano, 500W PA system, 1kW total. Estimate 8 hrs/week services plus band rehearsal	Church 600	0.7%
Other Small Power	Vacuum cleaner, 1.5kW	300	0.3%
Kitchens **Regular use preparing food on site, 4 days/week cafe**	2 x Microwave ovens, ea. 1kW Large fridge, 200W 6 ring gas hob Extractor fan	Hall 200 600 100	1.0%

Church annual consumption, 2019 = 2,763kWh (unreliable figure). Mostly lighting + recirculating fans + Organ Estimated pre covid consumption = 5,000kWh.

Hall annual consumption estimate 6,000kWh (based on 3,029kWh for 138 days in winter)



KEY 1 Gas heating 2 Electric heating 3 Hot water 4 Lighting (internal)

5 Lighting (external) 6 Small power 7 Organ, music, P.A. 8 Kitchen

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.

5.2 Energy Benchmarking

In comparison to national benchmarks[1] for church energy use St Luke's Church, Maidstone uses half the electricity per square metre and less heating energy per square metre than would be expected for a church of this size. This is due to the low hours of use, and heating hours of the church itself. There is no comparative data for church halls.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Luke's Church, Maidstone (elec)	530	5,000 estimated	9.4	19	-51%
St Luke's Church, Maidstone (gas)	530	30,000	56	148	-61%
TOTAL	530	35,000	66	167	-60%

There is currently no benchmark data which takes hours of use and footfall into account.

1 CofE Shrinking the Footprint – Energy Audit 2013

6. Site Overview

The Church and the adjoining four halls present a complex site. Contained within the church curtilage are the 1897 built church aligned with the chancel to the NE, a flat roofed foyer with skylights (1972) linking to the metal roofed hall (1960/70s), the Miss Copping room to the SE (brick with slate roof) and a prefabricated concrete structure with asbestos roof. To the NE is a three storey late Victorian vicarage. To the SE, on church land is a scout hut, and the SW of the site is occupied by a car park with space for about 30 cars. The east of the site contains a garden and further car park for the vicarage.

The congregation is an Eco Church and has recently gained a bronze award. They are engaged in an analysis of their site and how to best develop it for ministry. An architect, who is also a member of the Diocese of Canterbury DAC is producing a feasibility study with various options for use of each part of the site, which also includes a three-storey former vicarage (not audited) which is currently subdivided into one rental flat, disused meeting rooms and the church office. The church has transitioned from employing several staff to volunteer run. It has a substantial congregation of around 170.

One option being considered is to move many of the midweek activities from the main hall into the church, which will have some impact on the choice of heating. This would facilitate refurbishment of the main hall which requires a new roof and windows. It would benefit from cavity wall insulation and can host solar panels. Refurbishment may involve raising the hall floor to eliminate a one metre height difference to meet disability needs. The work would also affect the single storey glass walled foyer connecting the two buildings, giving options for energy efficiency improvements.

To the west is a prefabricated building with concrete panel walls and a probable corrugated asbestos roof. This is currently used for storage only. The church architect has recommended that no money is spent on this building (which features at least one rotten wooden door with a hole in the corner). Removal of this structure would enhance access for main hall reconstruction. Consideration is being given to relocation of the scout hut on the south of the site to this location, releasing a plot of land for sale.

View from the south west corner of the site

6.1 Site Utilisation Strategy

An overall proposal which incorporates ideas presented regarding the scout hut land and former vicarage could include:

- Mortgage the scout hut land for capital for refurbishment.
- Demolish the prefabricated structure and then reroof and refurbish the main hall using this vacant plot for access.
- Construct a new church office / utility room / toilets / storage room for scouts on the vacant plot.
- Sell the scout hut site to repay mortgage on this site.
  (Scouts now have a smaller store room to rent 24/7, and would rent the larger hall weekly, as most uniformed organisations do
- Move church office and refurbish the former vicarage as three independent flats, giving long term income.

The overall proposals for the site and planned use for each area will influence the choice of heating:
Underfloor heating is extremely expensive at around £100/m2, so £15 to 20K for the hall. However, unlike with a church there would be no issues with floor lifting or archaeology.
It should be considered when room use exceeds a minimum of 40 hours per week (25%) and is an option for the main hall.
An underfloor system should be run from a Ground Source Heat Pump. There appears to be sufficient land around the building for either and array of ground coils (the car parks and lawn area) or a borehole system.
A GSHP could also supply extra wall mounted radiators in the main hall and foyer area.

SUGGESTED ORDER

1. Initiate draught proofing works to various doors and windows.
2. Asbestos Survey of whole site
3. Obtain land valuation for scout hut site and investigate if planning permission would be granted for housing.
4. Mortgage scout hut site to obtain capital for hall rebuild if necessary (ensure church can meet mortgage repayments plus building cost until land can be sold).
5. Move chairs from prefab to storage in former vicarage
6. Demolish prefab allowing good access to main hall
7. Refurbish main hall, install CWI, new roof with built in Solar Photovoltaic panels on metal panels (unsuitable for tiles or slates, roof angle is too shallow)
8. Refurbish foyer to create a draught (excluding) lobby with two sets of doors and double glazing. Ensure sufficient roof space insulation. Replace skylights with light pipes.
9. Install electric heating systems for main hall, foyer, Miss Coppen Room (run off solar): radiant IR panels for MCR (occasional use, quick heat up) OR air to air source heat pump, ground source for main hall and foyer (aim at regular use); possibility of underfloor heat in main hall IF raising the floor level, otherwise through radiators (larger ones if necessary).

10 Construct new office and store area on site of prefab. Office heat: connect to above system if due to be used regularly.

11 Sell scout hut site and move scout equipment into new store room
NB: if whole site use forecast shows that MCR will be little used, it could become the site for the new office and store rooms, rather than a new construction.

12 Move office and stored chairs out of former vicarage.

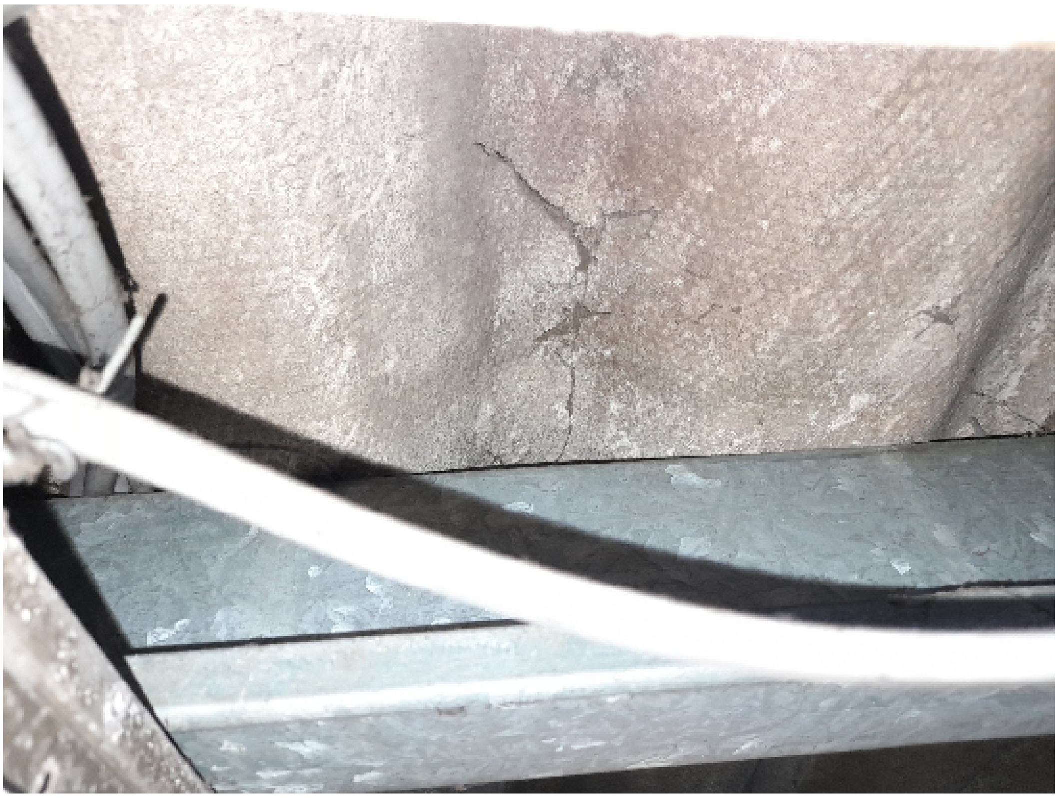
13 Refurbish former vicarage as three independent flats, providing a long term income source.

14 Replace blown air gas heating for church with electrical system (air to air source heat pump delivering warm air through original Victorian floor voids). This should occur *after* onsite electricity generation is installed.

15 Install electric car charging points in car park.

6.2 Preliminary Surveys

The church is considering proposals for the future use of the whole site including demolition of some structures and refurbishment of others. **It is recommended that a full site asbestos survey is conducted.** The prefabricated structure roof is known to be asbestos. An interior layer under the main hall roof (below) may also be asbestos.



Hall roof interior viewed from first floor storage & boiler area.

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 future. Electricity currently has carbon emissions around the same level as mains gas but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions it remain coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of bio gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. It is therefore critical to review and formulate a plan to make heating more efficient and less carbon intensive and one way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches.

The church should begin by evaluating which ministries it wishes to host, the frequency and duration of events and the number of people likely to attend. Will they be largely sedentary or active? Do they need background heat for activities such as games and sports in the hall, or do vulnerable people need to be kept warm?

Planned refurbishment of the main hall (at least) will move all activities into the main church for a period. Whilst it can host a variety of activities, only the main hall is suited to sports, having a hard floor.

It is recommended that the church should develop a boiler replacement plan. The General Synod's resolution calling on the whole church to aim at net zero carbon emissions by 2030 encourages a switch to renewable electricity. An electric heating method would ideally be installed *after* generation of solar power was installed on the church site.

Renewal of the current gas fired blown air system is not recommended as this would lock the church into gas use for decades to come.

7.2 Church – Underfloor Blown Air Heating System, Air to Air Source Heat Pump

The current blown air heating system is inefficient as the warm air is delivered to the south aisle and will immediately rise to the ceiling, then into the nave ceiling. The nave ceiling has a vent under the spire at the west end, losing more heat. Finally, the ducting can be seen to be perforated in several positions, so some hot air is lost before it enters the building.

The church was originally heated by a solid fuel fired hot water system – pipes travel under the floor where there are still a number of heating ducts – with modern grilles. The pipes then travel inside the walls, under the windows. There is potential to utilise the space to install a blown air system from below, delivering heat where it is required.

The hours of use of the church are insufficient for very expensive underfloor heating. The roof is high and the proximity of beams mean that ceiling suspended far infra-red electric panel heaters appear unsuitable for aesthetic and distance reasons. The building is very wide, so vertical wall mounted infra-red panel heaters would not reach the centre of the nave.

Church Heating Options

- Direct electric heated blown air using the present ducting. Allows transition to 100% renewable energy, but at around 4 times the price of gas with no opportunity for efficiency improvement, and most heat is delivered to the ceiling.
- Pew heating - there are no fixed pews, seating is by stackable chairs.
- Radiant infrared chandelier mounted heaters – the nave is very wide, so it would be difficult to heat the centre of the space evenly. Cost ~ 4x compared to gas – but likely to be less as the heat is delivered direct to people, and does not begin by rising up to the ceiling
- Radiant near infrared (non glowing) rectangular panels. The height of the nave ceiling would dictate high temperature industrial panels. Both nave and aisles have closely spaced wooden beams, so it would be difficult to obtain an aesthetically pleasing installation and permission is unlikely. Wall mounted panels (if permissible) would result in very hot aisles in order to obtain any heat in the centre, 9m away from the walls.
- Underfloor heating (wet system) – extremely expensive to install a water pipe based system. Warm up takes more than a day, so it is only compatible with regularly used buildings, 40 hours per week minimum. This would be heat supplied by heat pump and also would require raising the floor level.

- Heat pump supplying water at around 50ºC to radiators - this would require installation of a network of large wall mounted radiators and associated piping, requiring lifting of sections of the floor. Without existing infrastructure it is not recommended because the existing hours of use of the church (9 hours per week) are too low. 40 hours of use per week are required. Any heat pump / radiator system is unsuited to occasionally used spaces, such as once a week heated churches; they are designed for constant use or very regular use, and heat up more slowly than a conventional gas central heating system.

- Air to Air Source Heat Pumps (multiple items of plant)
  These are effectively air conditioning units operating backwards. They are normally installed on roofs or walls of buildings, so obtaining permission for this listed building would be difficult. This is not necessarily impossible as the south aisle is not viewed by the public and the north is mostly obscured by a boundary wall and vegetation. Units would be installed below the windows with the internal unit located in the area currently occupied by the redundant heating pipes. Sections of wall below the windows would need to be cut out.

There are drawbacks to all of the above options

- Underfloor blown air – Air to Air Source Heat Pump - Recommended

  The existence of an underfloor void (depth and access unknown) points to a blown air underfloor option being possible. This would require an investigation of the space under the floor and an engineering feasibility study by either an installer or a heating and ventilation engineer familiar with air to air source heat pump technology.

  The principle is effectively an air conditioning unit in reverse. Many AASHP systems will use a number of small units located around the walls. The concept for St Luke's would be to locate one large piece of plant in the basement room. Air intakes at ground level on the south side of the aisle wall (or in the ground, then passing through the wall) would be required.

  The technical unknown is whether the underfloor void at present will allow for even distribution of warm air across the church (if so, good viability), or if ducting would need to be installed to ensure correct distribution (which might require sections of the floor to be lifted if the void is shallow and inaccessible, adding to installation expense).

  Some form of the latter is likely – the cheap option of relying on blowing air through the existing floor void will also disturb 124 years of dust! It may be that flexible wire wound ventilation ducting can be drawn through the void to each vent, rather than installing fabricated steelwork. www.ventilationland.co.uk/category/11927/greydec-polyester-ventilation-hose-grey-10-meters.html

  www.ventilation-alnor.co.uk/index/products-en/flexible-hoses/alnor-flexible-ducts/

  Use of a heat pump would supply around twice the amount of heat to the amount of electricity consumed in kWh, so is recommended compared to direct electrical heating.

The cost of electricity is around 4 x that of gas, so overall that would deliver a doubling in price – hence on site generation is useful.

If it is possible to obtain the original plans for the church, this would help in planning any underfloor plant. It they are not in the churches keeping, they may be with the Diocese, or at the CofE archive at Bermondsey.

This proposal for the church does not involve either laying underfloor heating pipes, raising the floor, or refurbishing the (very rusty) Victorian heating pipe system.

Blown air would be supplied through the existing floor void, ducted through flexible hoses (they are readily available in 10m lengths. Some longer, or joined ones would be required. [Without hoses, blowing air into the floor void means uncontrolled air distribution, mostly on one side, with over a century of dust]. The air would be heated by an air to air source heat pump, rather than directly with gas.

This is effectively an air conditioning unit, and modules are normally about 1m x 1m and spaced around the outside of a building. In this case, not being able to do that for heritage reasons, one large plant is envisaged located in what is probably the original boiler room under the south aisle.

Unknowns for the church to investigate include the ease of access into the floor void, material of construction of the floor (could it be partially lifted to install the hoses, or would they have to be dragged through?), and if the sealed gap allows access into a larger underfloor area.

St Luke's current electricity prices are 4.5 times those of gas. AASHPs are stated to offer a Coefficient of Performance of 4.5, which would bring parity. With on site generated electricity, the AASHP option then becomes cheaper. Furthermore, quoted process for (small) AASHP units are much cheaper than ASHPs which supply warm water.


Grilles under each window allowed warm air to rise from the hidden heating pipes below.

Under window voids with heating pipes.

This feature above the basement store may be a trap door or an opening to a floor void

It was not possible to investigate whether there is a further space behind the polymer membrane.

The original vent on the west end of the nave roof is leaking, and has stained the carpet below.

7.3 Foyer

It is recommended that a double set of doors be installed serving the Foley Street entrance, to create a draught lobby and retain heat.

The current skylights (which are ageing) could be replaced by reflective light pipes channelling the maximum amount of light into the building and minimising electric lighting needs.

1) For light use, install radiant far infra red electric panel heaters. The foyer would normally be unheated, but a rapid heat up time would be achieved, thus allowing this space to be used for short notice small meetings.

2) The foyer could be heated using radiators as at present, connected to the same heat pump system as for the main hall. This implies that the space would be regularly heated and used, as heat up time would be slow.

Entrance from Foley Street

Area could benefit from instantaneous infra-red heating panels

7.4 Main Hall

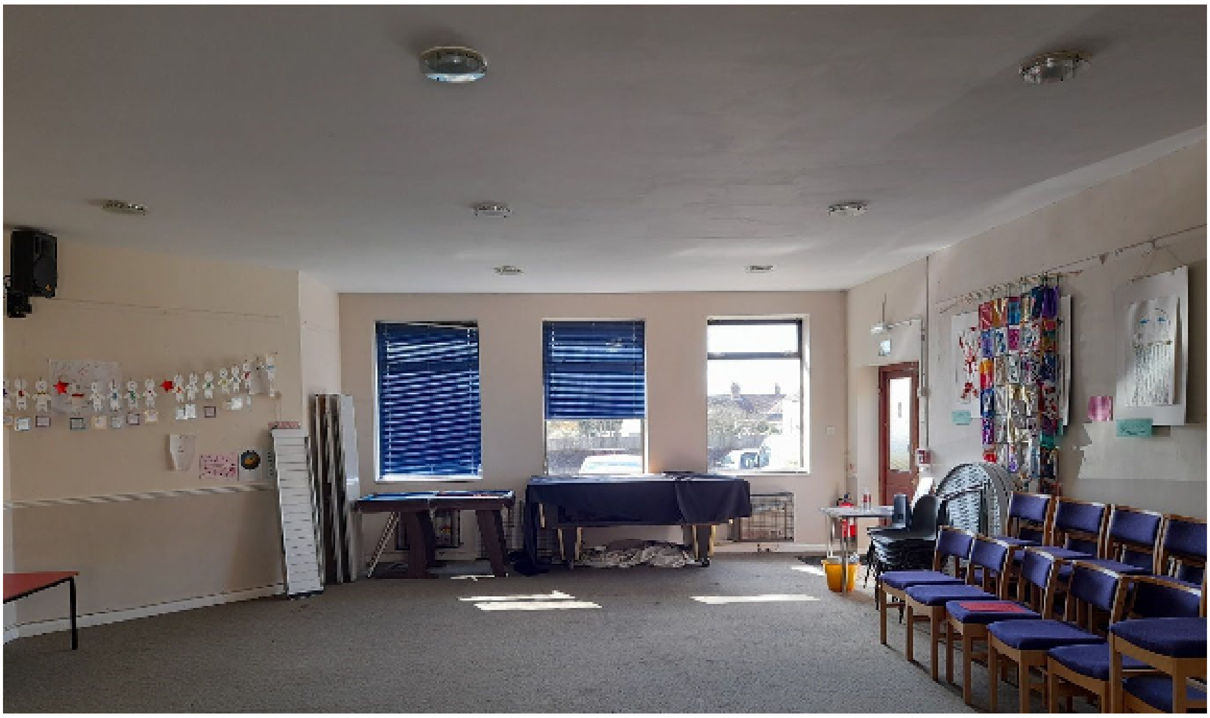
Main hall refurbishment offers the potential to achieve a zero carbon building. This could be achieved by a combination of solar photovoltaic panel installation (in conjunction with reroofing), cavity wall insulation (if not already installed), and double glazing. Heating should involve removal of the blown air system and installing either an underfloor heating system (where hall use of 50 hours per week or over is predicted), or connecting the existing radiator network to a heat pump. One option being considered by the church is raising the hall floor level by approximately one metre to remove a short flight of stairs; this would be compatible with installing underfloor heating as part of the project. Alternatively, a platform lift could be installed.

The hall roof panels show signs of condensation and corrosion, indicating a lack of sufficient (or any) insulation between the ceiling and roof exterior.

Windows are recommended to be double glazed.

7.5 Miss Coppen Room

This meeting room is presently heated by wall mounted gas fired heaters. There are several options which increase in cost.



The existing gas heaters should be replaced.

1) For light room use, compatible with short meetings at short notice, install radiant far infra-red electric panel heaters.
2) For medium use, install air to air source heat pumps in the positions of the current heaters (> 20 hours per week).
3) For regular use, install water radiators and connect to a ground source heat pump network. (This has a greater capital cost; including installation of plumbing but lower long term operating costs – *if* it is used frequently)

7.6 Prefabricated shed

The prefabricated structure with asbestos roof cannot be effectively insulated without spending much more money than the building is worth. A suggestion that a "cocoon" building be built around it is not recommended.

7.7 Install Electric Panel Heaters

Subject to discussions regarding the future use of the areas, it is recommended that the PCC consider installing electrical panel heaters in the foyer, vestry and Miss Coppen Room on a time delay switch and remove the existing radiators.

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

Locations for electric infra red (non glowing) panel heaters are small rooms which can be used for short meetings arranged at short notice such as in the foyer and the vestry (above).

7.8 Evaluate Effectiveness of Suspended Recirculation Fans

Use temperature monitors situated under and at other locations around the church to assess whether these small fans give any benefit.

8. Improve the Existing Heating System

Church

8.1 Church Blown Air System

Whilst this system is still in use in the short term, the gaps in the ducting which can be seen from the inside should be filled.

Church Hall

The main hall central heating consists of a Potterton 80e domestic sized 26kW boiler and radiators. This is quite old and a replacement plan should be agreed.

In the interim period, the following are suggested:

8.2 Clean the Existing Heating System

Where water radiator heating is to be retained, it is strongly recommended that the heating system is cleaned to remove magnetic sludge from the system. This is done by using a chemical clean and/or power flush procedure where cleaning chemicals are put into the system which is then turned on and run through a filter consisting of high power magnetics to remove the sludge.

Magnetic sludge prevents the proper and efficient operation of the system by reducing the ability of the boiler to heat up the water and reducing the output of the radiators. It is similar to how scale build up can adversely affect kettles and showers.

The cleaning of a heating system can be carried out by any competent heating engineer and typically increases the efficiency of a system by between 10 to 15%. This can dramatically improve comfort for the congregation.

8.3 Endotherm Advanced Heating Fluid

Where water radiator heating is to be retained, in order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid (http://www.endotherm.co.uk/) is added to the heating system.

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

Endotherm can be self-installed by anyone competent to depressurise and refill the system.

9. Energy Saving Recommendations - Fittings

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.

9.1 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 large wattage theatre lighting and relatively inefficient halogen spotlights within the nave and aisles.

It is recommended that the lighting in the church is changed for LED, with replacement of the theatre lighting first, using LED spotlights. 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/

Due to the height of the majority of the fittings, professional installation is likely to be needed. If all the lighting is not dimmable, cheap LED bulbs could be fitted. Where dimming is required, more expensive compatible bulbs are required.

Lighting estimates can vary widely in price from simply the supply of the lights, the labour to install them and the access required, to major schemes involving upgrading the wiring or a new lighting design or control schemes.

9.2 Install Light Pipes / Sun Tunnels in Foyer Ceiling

These are vertical ducts lined with reflective material which will allow much more light in than the current skylights. They will minimise the need for electric lighting during daylight hours.

Products are available from companies such as Monodraught, Solarspot (e.g. D-38 model) and Velux.

9.3 Lighting Controls (Internal)

There are several lights which are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly such as in toilets. 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, including the foyer.

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.

9.4 Timers on Fuse Spurs to Water Heaters

There are various electric hot water heaters and water boilers (for tea making and the like) located around the church. These only need to heat the water to the required temperature when the building is in occupation.

It is recommended that the heaters are 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. They should be set up with times to match the times that the building is occupied and 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.

10. Energy Saving Recommendations – Building Fabric

10.1 Church: Roof and Walls – Water Ingress

The north corner of the north transept (above) and the corresponding north corner of the south transept (below) have peeling paint which suggests water ingress.

It is recommended that a roof and gutter survey is completed to investigate the cause of the peeling paint on the north and south transept walls, and for vegetation growing on portions of the roof to be removed.

10.2 Church: Draught Proof – Heating Ducts

The church warm air heating duct has a number of holes in the metalwork allowing hot air to escape and cold air to enter when the system is not operating. The Spire assembly on the nave roof which is also a vent is leaking rainwater and should be repaired. It is suggested that there is a discussion with the inspecting architect as to whether this vent should be blocked to prevent escape of warm air.

10.3 Draught Proof External Doors

There are several doors to the buildings and many of them would benefit from draughtproofing. Cold air can enter the building constantly through gaps; this can account for 5-10% of heating costs.

Doors on unlisted parts of the building can be draughtproofed using commonly available rubber or plastic seals. Listed doors including that at the SW corner of the church below require a solution such as a product called QuattroSeal (see link below) which is often used in heritage environments to provide appropriate draught proofing for timber doors that close onto a timber frame.

http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

The door to the rear of the hall is in a poor condition with the base beginning to rot, requiring repair and painting as well as draught proofing strips.

The fire door at the end of the prefabricated shed corridor has rotted through at the bottom right hand corner and is a security risk. The hole should be filled.

10.4 Church: Hopper Windows

Hopper windows should be kept maintained and repaired if rust has begun to bend the framework. Where there are small gaps, these can be filled with black plasticene which can be easily removed for summer opening and causes no damage.

10.5 Main Hall: Cavity Wall Insulation

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

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

10.6 Main Hall: Insulation to Roof

The ceiling space of the main hall is visible from the area next to the boiler, above the main kitchen. It was seen to have no insulation present. In all cases where there is 100mm or less of insulation within accessible roof spaces it is recommended that insulation be added to prevent heat loss and create a more comfortable environment for the occupants of the building. This should occur as part of a re-roofing and solar photovoltaic panel project.

The ceiling/roof of a building is the largest contributing area to heat loss from a building as heat rises. 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.

10.7 Main Hall: Double Glazing

Refurbishment of the main hall should include consideration of double glazing as this will reduce operating costs and enable a zero carbon building. Costs of double glazing are high, with long payback periods, although if the roof is replaced, the glazing will probably have to be removed to facilitate this. The upper level windows on the north and south sides appear to be around 1.2m high with a 15m length glazed. At the west end are three columns of glazing each about 0.6m wide and 5m high, with six opening panels. There is also a low level window on the north side.

This gives a total of 50m^2 of glazing. Costed at £80/m^2 for plain glazing and £850 for each opening unit gives a total around £9,000

11. Saving Recommendations (Water)

11.1 Tap Flow Regulators

Over provision of water for hand washing is not only a source of excessive water use, but in the case of hot water, it is also a source of wasted energy in the heating that has to go into providing the hot water.

The flow rate of the taps can be easily regulated by fitting flow regulators within the taps. It is recommended that flow regulators such as those manufactured by neoperl (http://www.neoperl.net/en/) are fitted into all the viable hand wash basin taps to save on both water and heating of the hot water.

These regulators can be self-installed or by any good facilities staff.

11.2 Detergents for Cold Water Hand washing

Use of cold water for hand washing can be just as effective as using hot.

https://www.nhs.uk/news/lifestyle-and-exercise/cold-water-just-as-good-as-hot-for-handwashing/

12. Other Recommendations

12.1 Electric Vehicle Charging Points

The church has a car park to adjacent to it which serves the church and also the frequently used church halls. 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.

Because of the parish office within the site the church as be considered as a place of work and as such installation grants are available through the work place 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.

13. 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 – church SE side and hall roofs
Battery Storage	Yes – in conjunction with PV panels
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No –urban air quality issues
Air Source Heat Pump	Yes - Air to Air source for church Possibly for Miss Copping Room if medium use
Ground Source Heat Pump	Yes - for main hall

The site has good viability for solar photovoltaic system installation, and also for Heat Pumps.

13.1 Solar Photovoltaic Arrays

The South west facing nave roof offers potential for installation of solar photovoltaic panels. It is not visible from the public road to the north of the site (next picture), being hidden by the transept roof and the former vicarage.

There is potential for PV arrays on the roof of the church and on the roof of the main hall which has a slope of around ten degrees.

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. This would be the case at St Luke's, where on site generation of electricity would significantly enhance the viability of operating electrically powered heat pumps

The suitability of both roofs would have to be confirmed with your architect as to suitability for extra weight and wind loading on the roof structure.

The church roof (south end, facing SE) offers an area of around 110m^2. This could generate 0.15kWpeak/m^2 giving a 16.5kWpeak system. A 1kWpeak system can generate up to 1000kWh annually.

Orientation factor (roof slope 45^o and angle from south 54^o) is 0.87.

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

= 110m^2 x 0.15kWp/m^2 x 1000kWh/kWp x 0.87 x 1

= 14,355kWh

The hall roof offers an area of around $85m^2$. This could generate $0.15kWpeak/m^2$ giving a 12.75kWpeak system. A 1kWpeak system can generate up to 1000kWh annually.

Orientation factor (roof slope 10° and angle from south 36°) is 0.92.

Annual Generation (kWh) = Area x $0.15kWp/m^2$ x K factor x Orientation Factor x Overshading Factor

= $85m^2$ x $0.15kWp/m^2$ x 1000kWh/kWp x 0.92 x 1

= 11,730kWh

Total solar power generation = 26,085kWh

This is similar to the potential requirement for the whole site with LED lighting and heat pumps.

Furthermore, it may be possible to install panels on angled supports on the north side of the gentle roof slope, or on any new construction which replaces the prefabricated hut.

The hall roof could be replaced by metal panels integrating the solar array with the roof structure, such as manufactured by BiPVCo, The Building Integrated Photovoltaic Company.

The Smart Export Guarantee pays about 5p/kWh for electricity generated and exported to the grid (the Feed in Tariff having ended). One of the issues for churches is that most lighting use is at periods when the electricity is not being generated, so installation of a battery to make maximum advantage is recommended. Using a battery will extend the usefulness of the power generated during the day into the evening, but some exporting of power to the grid in summer, and purchase from the grid for winter evenings will occur. This is a new but fast-growing technology.

Using average 2019 installation costs (£1,450 per kWpeak); the two systems system would cost around £42,400. This does not include cost of any battery.

Sources: Tables H3 & H4, SAP 2009, http://www.bre.co.uk/filelibrary/SAP/2009/SAp-2009_9-90.pdf

13.2 Heat Pump Options – Main Hall

Heat Pumps are a low carbon method of creating heat, their use and suitability for this church have been review in the section earlier on in this report In Section 7, Efficient and Low Carbon Heating Strategy.

It is recommended that plans are developed for replacement of the blown air gas heater by the end of the decade, with the extra electricity required to run the pumps coming from solar PV panels.

Replacement of the 26kW domestic boiler and blown air heating system of the hall should occur as part of building refurbishment.

Ground Source Heat Pumps [GSHP] deliver more heat per kW of electricity consumed than for Air Source. (This is measured by the Coefficient of Performance, or COP, 4 is a reliable assumption).

They require either a sufficient area of land to lay subsurface, or a borehole. The two car park areas plus the lawn may offer enough area for heating of the hall; this would require confirmation by equipment providers. Alternatively, there is plenty of space to drill a borehole.

Installed costs are around £1000 per kW of heat required.

The area of land to the east of the site offers potential for Ground Source Heat Pump pipework.

The Main Hall requirements are below:

1,000 hours of use, 3 double radiators 26kW boiler + blown air system = 50kW total

50,000kWh at present

Reductions of heat requirement:

Ceiling insulation 10%, cavity wall insulation 8%, double glazed windows 10%, total 28%

Future heat requirement = 36,000kWh

GSHP Costs (recommended)

Capital cost, 36kW output unit £36,000

Operating cost: 36,000kWh output/COP4 = 9,000kWh. Without solar, x 14.625p/kWh = £1,316

With solar assume half of needs from grid during winter; 4,500kWh =£658, offset by some sale of surplus electricity generated during summer.

Air Source Heat Pumps [ASHP] have COP values between 2 and 3, which are weather dependent. They are least efficient when required to deliver large amounts of heat when the air is cold, so are incompatible with heating a building once a week from cold. Installed costs are around £400 per kW of heat required.

ASHP Costs

Capital cost, 36kW output unit: £14,400

Operating cost: 36,000kWh output/COP2.5 = 14,400kWh. Without solar, x 14.625p/kWh = £2,106

With solar, assume half of needs from grid during winter; 7,200kWh = £1,053, offset by some sale of surplus electricity generated during summer.

Both types of heat pumps described above generally deliver water at around 55^{o}C (although there are higher temperature ones on the market which require more energy to run); thus are compatible with a building which is regularly used and can be supplied with constant, medium heat, rather than a full power heat up on Sunday mornings.

Refurbishing the main hall to provide a well insulated space would be compatible with a heat pump, provided that the building was intended for regular use throughout the week – turning heat pumps on and off when providing water at 55^{o}C means the building will heat very slowly with an underfloor system.

13.3 Heat Pump Options – Miss Coppen Room

Air to Air Source Heat Pumps

The Miss Coppen Room (and the vestry) can be considered for use for smaller meetings, held at short notice. This room should not be connected to the heat pump (water circulating) network unless regular use is guaranteed; 40 hours per week or more. The expense of fitting water radiators and operation would not be justified. As described in Section 7.7 electric infra red panels would be suitable to rapidly heat it for short duration, or short notice meetings.

A further alternative is to use domestic sized Air to Air Source Heat Pumps. These are similar to air conditioning units, located on an outside wall with an outside module. They offer 4 to 4.5 times the heat energy input which they consume in electricity. Capital costs of £200 per kW are estimated.

There are 4 Baxi Brazilia 8S wall mounted gas heaters of 2.3kW each, totalling 9.2kW.

AASHP: 10kW output, capital cost in region of £2,000.

Operating cost 10kW/COP 4 = 2.5kW running x 5 hours/week light use x 30 weeks = 375kW

£55 grid electricity or free for solar PV

Infra Red wall mounted panels: 10kW output total, 8 of 1,200 watts each, Capital cost ~ £4,900

Operating cost 10kW x 5 hours/week light use x 30 weeks = 1,500kW

£219 grid electricity or free for solar PV.

With sufficient hours of use, AASHP heating of the air (requiring a warm up period) appears more cost effective. If only very occasional use is projected for short periods, the instantaneous heat from IR panels is suggested (perhaps installing less of them and heating half the space?).

13.4 Church – Air to Air Source Heat Pump

Heat Requirement and Costs

The current gas fired warm air blower is of large capacity, possibly 200kW. Current annual heat input is around 166,000kWh, with the building having only around 450 reported hours of use.

If heat were supplied for 30 weeks per year, at an average of 12 hours per day (generally daylight hours when solar power is being generated), this is 2,500 hours. An average heat input of 60kW for this period is 150,000kWh. An Air to Air Source Heat pump operating at a Coefficient of Performance of 4 requires 37,500kWh of electricity.

Capital cost at £200 per kW delivered [60kW unit] = £12,000

Church Heat Operating cost (all grid, no solar PV;, 37,500kWh x 14.625p/kWh = £5,484 (equal to the current gas cost)

Site Operating cost with 26,000kWh solar generation on site:

Total electricity use = 37,500 (church heat with AASHP) + 9,000 (hall heat) + 375 (Miss Coppen heat) + 5,000 (church other) + 5,000 (halls other) = 56,875kWh

Residual cost of grid electricity = 30,875kWh x 14.625p = £4,515.

This is similar to the current combined cost of electricity plus gas for the whole site.

Plant Location

The church, constructed in 1897, has an externally accessed basement on the south side below the aisle (approximately 3m x 8m). In the ceiling of this room is what may be a trap door or access to underfloor voids. There is a passageway at the north end of this room which has been partially sealed with a polymer membrane. The church floor contains several (c. 20) grilled ducts, further evidence of the original solid fuel heating system. There are two inch diameter heating pipes built into the lower wall structure below the windows, with removable metal plates uncovering the grilles above them, built into each window sill.

The church is currently heated by a blown air gas fired system (access to the equipment was not possible, as it all appeared to be contained within a riveted metal structure). Warm air enters through grilles high in the wall of the south aisle

Data, Ventilation and Humidity

The church was designed to be heated by an upflow of warm air. There is a ventilation duct at the ceiling apex near the west end of the nave roof, topped by a narrow spire. This structure is open and will contribute to cooling. Advice should be sought from the AASHP / heating and ventilation system designer as to the airtightness needed for the building for the system to work and whether this vent should be blocked.

In advance it is recommended that the church purchase a simple temperature and humidity monitor to record data which will provide very useful data for the design.

It is noted that the hopper windows are never opened, so extra ventilation has not been required in the summer.

14. Site Electricity and Heat Requirements

Solar PV arrays could generate around 26,000kWh per year.

If heat pumps are installed, solar power greatly enhances their viability, as the pumps can run whenever the sun shines adding heat to the building. With a well-insulated refurbished hall, this will lessen the need for grid electricity to provide evening heating.

Future electricity requirements are estimated at:

Church (AASHP at CoP 4)	7,500kWh (supplying 30,000kWh)
Main Hall (GSHP at CoP 4)	9,000kWh (supplying 36,000kWh)
Miss Coppen Room (AASHP)	375kWh (supplying 1,500kWh)
Church electricity present)	2,500kWh (LED lighting requiring 1,000kWh vs 3,600kWh at
Hall electricity	4,500kWh (LED lighting requiring 1,500kWh less than present)
Total	23,875kWh (all generated on site in summer, some in winter)

(Sale of surplus electricity to grid in summer, extra required from grid in winter).

To create a zero carbon church, any remaining grid electricity needs would need to be offset through a scheme such as that offered by Climate Stewards.

Detailed figures from various potential suppliers of solar and heat pump technology will be required to conform these initial estimates.

15. 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-2019.pdf .

16. 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.