Energy Efficiency and Zero Carbon Advice

St Mark's Church, Battersea Rise

PCC of St Mark's Church

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St Mark's Church, Battersea Rise 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 Mark's Church, Battersea Rise is a brick built late Victorian Grade II* listed church built in 1874, with adjoining unlisted hall complex dating from 2007 to the north. [Historic England reference 1065551]. There is both gas and electricity supplied to the site.

The church has a number of ways in which it can be more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table 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)
Read Submeters to understand church energy use	0	£0	£0	0	None	0
Door draught proofing works	5% + 3625	£764	£500	1	List B	0.66
Minor window repairs (hole) And add plasticene to seal clerestory hopper windows	3% 2275	£480	£500 + access	2	List A	0.41
Repair leaking roof and slipped tiles					List B	
Install timer control switches for north transept radiant heaters	500	£105	£200	2	List B	0.09
Boiler Replacement with Heat Pump	72,500 gas Use 18,000 electricity	£2,980 gas Electricity cost 3,796	£40,000	Not recovered	Faculty	13.33 gas Generate 4,5 from electric
OR						
Replace Boiler with Condensing hydrogen ready boiler(s)	15% 11,000	£452	£8-10k	20 but replacement needed	Faculty	2.0

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

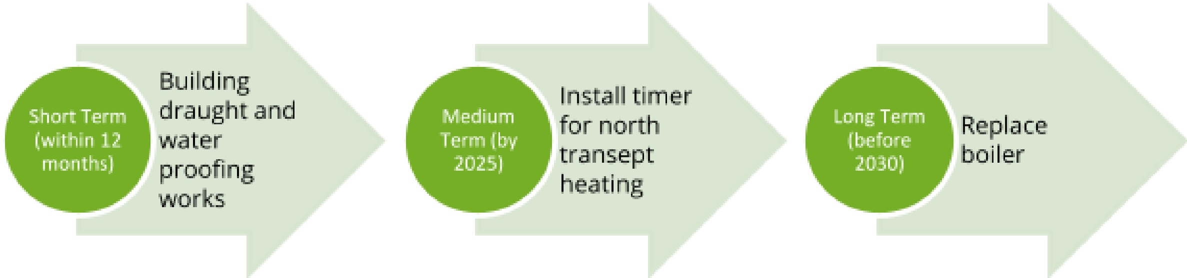
Based on current contracted prices of 21.09p/kWh and 4.11p/kWh for electricity and mains gas respectively.

If all efficiency measures were implemented this would save the church around £1,350 per year in operating costs.

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years.

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Mark's Church, Battersea Rise 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. 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 Mark's Church, Battersea Rise, London SW11 1EJ was completed on the 20th May 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 affiliate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church and has been an assessor for EcoCongregation.

The church was represented by Chu Yee Ong, Operations Manager.

St Mark's Church, Battersea Rise	
Church Code	637286
Gross Internal Floor Area	725 m^2
Listed Status	Grade II*

The church is typically used for 34 hours per week for the following activities

Type of Use	**Hours Per Week (Typical)**	**Average Number of Attendees**
Services	12 hours per week Continual use during Sundays, up to 5 services	200 morning 115 evening
Meetings and Church Groups	20 hours per week Youth, evening and toddler events	Toddler group 90
Community Use	2 hours per week Monthly events, School graduation, 2 x Charity dinners p.a.	100 250
Occasional Offices	3 weddings p.a. 2 funerals p.a.	100

Occupancy Hours: 1,800

Heating Hours: 900

Estimated Footfall: 28,000

4. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	21.09p/kWh	Above current market rates
Standing Charge	44.64p/day	N/A

Supplier: E On

The current gas rates are:

Single / Blended Rate	4.11p/kWh	Above current market rates
Standing Charge	24p/day	N/A

Supplier: n Power; contract to 22 January 2022, flexible with 30 days notice.

The electricity rate is the highest observed from 80 churches. Three higher gas rates were seen.

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 www.bigchurchswitch.org.uk

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 currently:

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.

Between march and September 2019 following a change of supplier from EOn to nPower in March, 20% VAT was charged for gas. This was noted on a bill, and the VAT rate reduced to 20%.

Was the excess VAT reclaimed? It can be reclaimed over the past three year period.

Whenever monthly gas consumption exceeds 4,397kWh (52,000kWh per annum), 20% VAT is charged unless the customer has submitted a VAT declaration form.

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

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

5. Energy Usage Details

St Mark's Church, Battersea Rise has used around 40,000 kWh/year of electricity for the whole site, which has cost in the region of £6,400 per year. This data is mostly from 2020, so the likely annual consumption could be in the region of 50,000kWh. 145,000 kWh/year of gas is used, costing around £5,000 p.a. It should be noted that both utility rates per kWh have increased significantly over the past three years. This may be due to one supplier being superseded by another without a new contract being negotiated. This gives a projected annual utility spend of over £15,000. These costs may be significantly reduced by joining a group purchasing scheme.

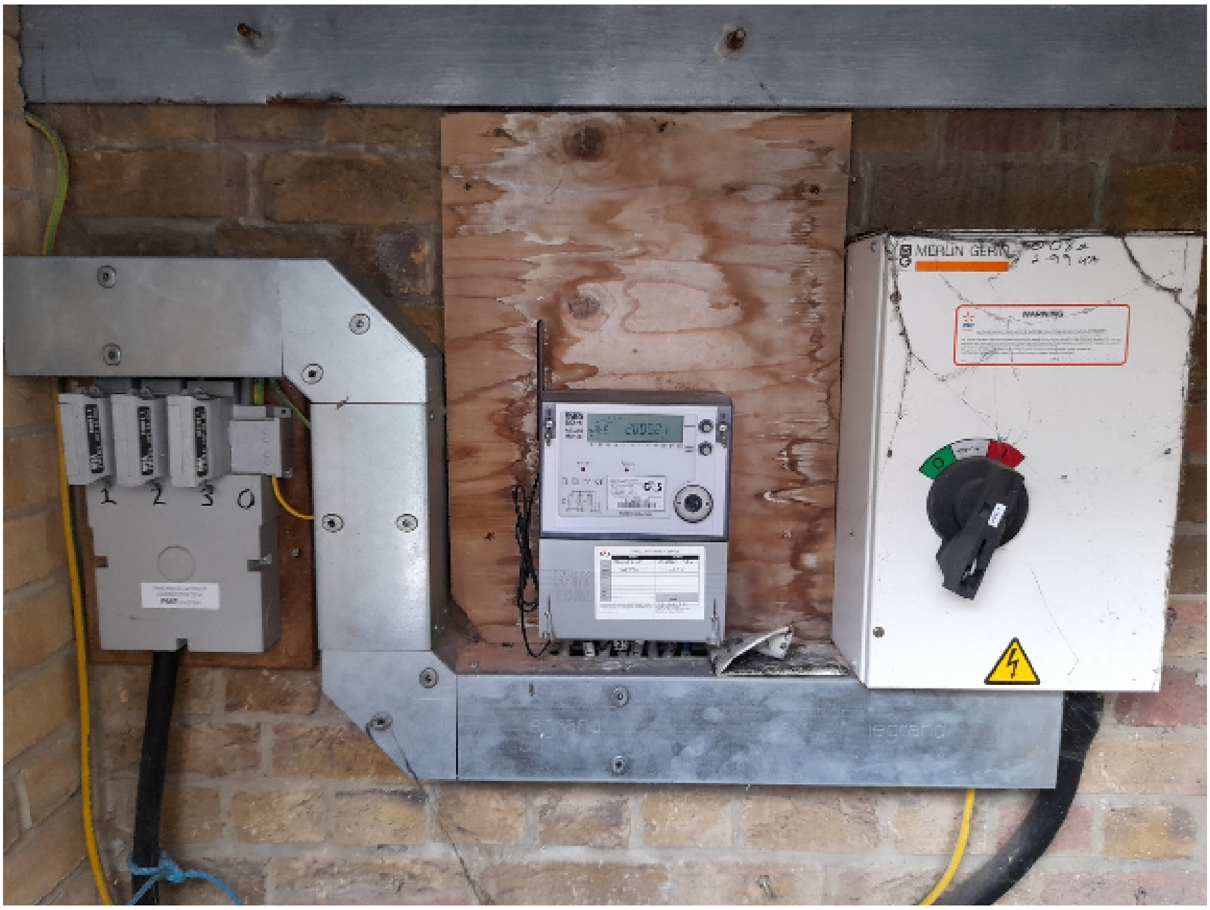
The supply to the whole site is measured by meters adjacent to the church centre. There are two sub meters installed in the church; these are neither billed or read, so there is no accurate data split between the two buildings.

It is recommended that church staff read the sub meters regularly to develop an understanding of church / centre energy use split.

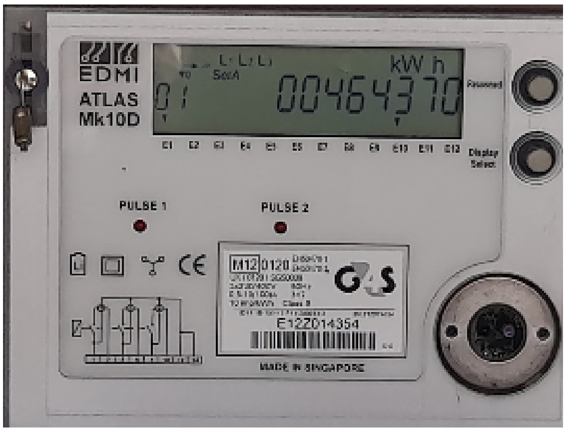
Utility	Annual Consumption/kWh	from	to	cost
Electricity TOTAL	40,000 (2020) Average over 12 months	23/10/19	19/01/21	£6,440 (at previous rate of 15.09p/kWh)
Electric – Church	Est 7,300			
Electricity – Hall	Est 32,700			
Electricity Projected			Estimated cost at 2021 rates including standing change and VAT	£9,028 at 21.09p/kWh
Gas TOTAL	145,300 Average consumption calculated from two years data	05/01/18	03/01/20	£4,775 (at previous rate of 3.07p/kWh)
Gas – Church	Est 72,500			
Gas - Hall	Est 72,800			
Gas Projected			Estimated cost at 2021 rates including standing change and VAT	£6,362 at 4.11p/kWh

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Billed meter	E12Z 014354	EDMI Atlas Mk10D	Yes	External meter cupboard
Electricity – Church sub meter	K81A 12617	GEC, London Electric Board	No	Plant room off crypt kitchen
Gas – Billed Meter	E040 K00087 20 D6	Bk-G25E	Yes	External meter cupboard
Gas – Church sub meter	434422	Not known	No	Cupboard in gents toilet in crypt

The two billed meters are AMR connected and as such energy profile for the entire energy usage should be possible. Daily use data has been included in the most recent bill.



The electric and gas meters for the whole site are located in a cupboard on the pavement of Boutflower Road.



An electric submeter (which is not billed) is located in a plant room accessed from the crypt kitchen. Three phases of power are supplied.

A gas submeter (which is not billed) is located in a cupboard in the gent's toilet in the crypt (which is adjacent to the boiler room).

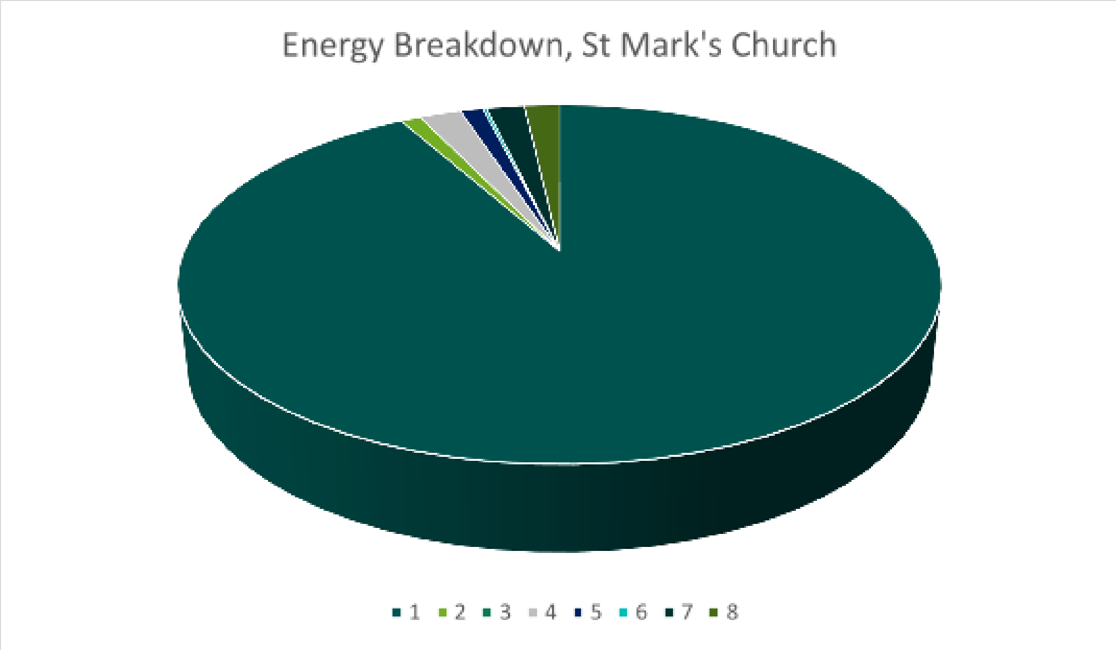
It is recommended that meter readings are taken monthly (especially January to March and in July-August) to obtain accurate gas use for the church and confirm the estimates made in this report.

5.1 Energy Profiling

The main energy consuming items can be summarised as follows:

Service	Description	Annual Use kWh	Estimated Proportion of Usage
Gas Heating	274kW gas boiler Estimated 900 hours	**145,300 Whole site 72,500 church only**	91%
Electric heating	4 x radiant heaters, north transept first floor room – use as required. 4 x 2kW x 100 hours Boiler pumps, 740W Boiler injector, 250W	800 900	2%
Lighting internal	All LED, installed 2014 or before Nave 9 x 18 element downlights @ 20W 10 uplights @ 6W Aisles 12 x 18 element strip lights est @10W Crypt Kitchen, 2 bulkhead @ 40W Crypt office, 4 x T8 F58W Total ~ 920W, 1800 hours use	1650	2%
Lighting external	LED floodlights 4 x 70W, 4 x 50W Average 5 hours per night	900	1%
Music, PA, [Organ]	Projector, 1kW Sound system, 2kW Est. 500 hours use	1500	2%
Other Small Power	Vacuum cleaner 1.5kW	150	0.2%
Kitchen (in Crypt)	Fridge 200W Fridge 150W Kettle @ 1 hour per week use Toaster Microwave	600 450 100 100 150	2%

Total Electricity use estimate 7,300kWh



KEY 1 Gas heating 2 Electric Heating 3 Hot water 4 Internal lighting

5 External lighting 6 Small power 7 Sound and music 8 Kitchen

As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site.

5.2 Energy Benchmarking

In comparison to national benchmarks[1] for church energy use St Mark's Church, Battersea Rise uses less energy than would be expected for a church of this size. This is largely because of installation of LED lighting, little use of electric heating and office and kitchen functions being allocated to the adjacent hall.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Mark's Church, Battersea Rise (elec)	725	7,300 estimated	10.0	27	Not reliable
St Mark's Church, Battersea Rise (gas)	725	72,500 estimated	100	156	-36%
TOTAL	725	79,800 estimated	110	183	-40%

1 Church of England, Shrinking the Footprint Energy Audit Report 2012/13

6. Building Overview

The church has a large nave with aisles, a raised chancel which is surrounded by a walkway (ambulatory) which descends at the east to access the crypt under the chancel – this area is used for youthwork, and hosts an office and kitchen. The tower is located at the south west corner, a corridor area is located at the west end forming an entrance to the road and connection into the church centre on the north side. There is a small parking area in the church curtilage.

The vent for church boiler is thought to be the feature right of the ground floor window (the crypt men's toilet). The boiler room is behind this; this area has potential for directionally drilled GSHP boreholes.

The church centre adjoins the church to the north, joined by a glass atrium which encloses a reception, foyer and large meeting room with office accommodation above. To the right, the building contains several smaller meeting rooms.

It was reported that a leak in the apse roof, thought have been present for many years, has worsened, resulting in a bucket positioned on the altar.   This appears to be related to where the leaded base of the cross meets the ridge tiles.

It is strongly recommended that this issue is addressed urgently before water causes structural damage to roof timbers, or finds it's way down through the roof and into the walls.

Above: the nave. Below: the crypt.

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 a 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 its remaining coal fired power stations by 2025. 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 at present and will be unable to deliver 'zero carbon mains gas'. It is therefore critical to review and set out 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.

St Mark's has engaged consulting heating engineers to deliver a report with costed options.

This report makes initial suggestions based on the walk round audit and on average capital costs for different types of plant. It shows which technologies are worth obtaining detailed quotations from installers, and which are clearly unsuitable (often due to low hours of use).

The need to aim for net zero carbon dioxide output encourages the adoption of electrical heating methods. If it is not possible to switch to an electrical heating method, a replacement gas boiler must be hydrogen compatible, as it is likely that there will be an amount of H_2 added to the gas grid. The existing boiler does not appear to be condensing: any new boiler will be – and must be operated with a return water temperature of less than 55ºC to allow heat recovery from the exhaust gases. This will provide an efficiency enhancement of at least 10% over the existing unit.

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

If the gas boiler is repaired or replaced, then long term, the boiler will need to be made hydrogen ready. Some hydrogen is due to be added to the gas grid over the next five year period. If plans to decarbonise the gas grid are implemented; the hydrogen mix will eventually exceed 20% and a hydrogen compatible boiler (and piping) will be required. The transition will be overseen by the regulatory bodies in a similar way to that between town gas and north sea gas.

Rather than replace the (overly large?) 274kW boiler with an equivalent commercial boiler; a more efficient condensing boiler could be only 200kW, instead it is suggested that a bank of light commercial or large domestic boilers are installed. Four at 50kW, or three 65kW for example; for much of the time only one would be required. This may have the added advantage of allowing domestic registered CORGI installers, who can only work on 70kW appliances or less, to undertake maintenance which may lower servicing costs.

7.2 Electrical Heating Methods to Consider

Infra red radiant panel heaters: the nave ceiling is too high (14m), and low level wall mounted panels would have to be powerful to reach the nave centre – with the effect of making the aisles too hot. This is not recommended.

Infra red bar heaters, suspended from chandeliers. Eight sets, probably of six would be suspended from the arch centres. This would give a good distribution of heat over the aisles and nave. Whilst ideal for occasionally used churches as they require less preheating than a convection space heating method where heat first rises to the ceiling, they become much more expensive to operate than gas for regularly used buildings (as electric prices currently paid by St Mark's are 5 times those for gas). Also, there may be an issue with sight lines due to the raised chancel and position of the projector screen.

Costs of around £20,000 for 48 heaters are indicated by comparison with the installation at St Catherine's, Faversham.

Ground Source Heat Pump: this would be an ideal technology but for the high capital cost (at present) and the need for either enough ground space (not available) or borehole(s). Heat output is around 4 times electricity input in kW. There is space for plant in the current boiler room. Advice from installers is required to determine technical viability. The area of ground outside the crypt toilets is larger than the churchyard corner of St Mary the Virgin, central Ashford where directionally drilled boreholes are installed.

Air Source Heat Pump: heat output is around 2.5 times electricity input. The church has over 30 hours of use per week, although much of that is on Sundays. Offices heated by ASHPs may have as little as 40 hours use. To be viable, the building needs to be in regular use; 34 hours per week is possible. There would need to be enough space (and strength) to install plant on the flat roof of the centre, with considerable extra plumbing to connect to the existing network of fan assisted radiators in the church. Extra radiators are likely to be required.

Heat Pump technology is expected to fall in price over the next decade due to economies of scale.

8. Improve the Existing Heating System

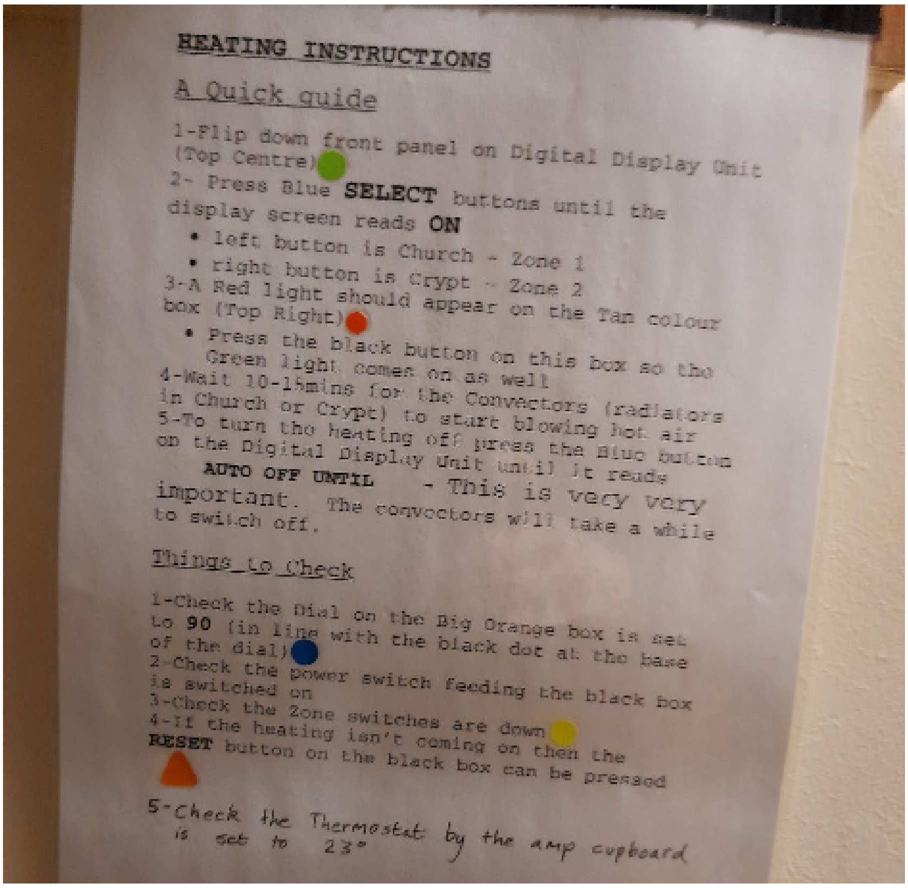
In the period before the replacement of the existing heating system, it is recommended that measures are taken to improve it's efficiency. In the short term, there are interventions which will improve the existing system and protect the pipework and radiator network which may be needed to work with a future heat pump or hydrogen ready condensing boiler.

It is recommended that the existing church heating network is studied to recover lost information in advance of receiving the consultants heating option report.

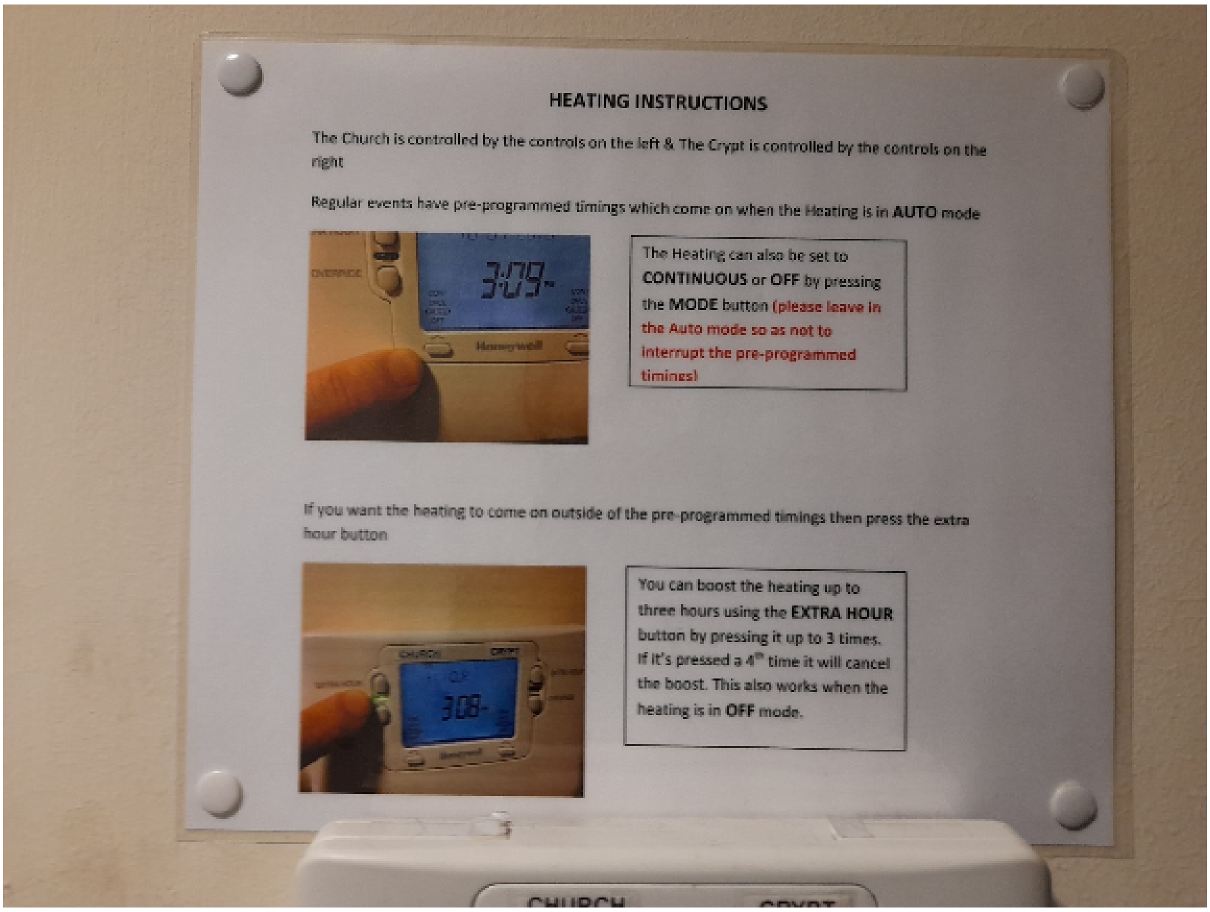
This is because some options may involve retention of the radiator network. During this audit, two circulating pumps were noted in the boiler room (red items in image above). These should serve the crypt (small pump) and church (large pump). It was reported that both areas become heated irrespective of whichever zone heat is called for in. This may be due to circulation occurring by gravity as warmer, less dense water travels upwards. No electrically operated zone isolation valves were found. Their existence or absence should be confirmed by discussions with former wardens, and the ex facilities manager.

The equipment pictured below can then be evaluated – does it still work?

The orange box above appears to contain a Variac (variable AC transformer). The digital display (green button below) has been removed, but switches are on and the system could be powered.



Has this control system been superseded by the Honeywell controller, below? It is presumed that the latter, which has two outputs to control different devices, is connected to the two recirculating pumps.


HEATING INSTRUCTIONS
The Church is controlled by the controls on the left & The Crypt is controlled by the controls on the right
Regular events have pre-programmed timings which come on when the Heating is in AUTO mode
The Heating can also be set to CONTINUOUS or OFF by pressing the MODE button (please leave in the Auto mode so as not to interrupt the pre-programmed timings)
If you want the heating to come on outside of the pre-programmed timings then press the extra hour button
You can boost the heating up to three hours using the EXTRA HOUR button by pressing it up to 3 times. If it's pressed a 4th time it will cancel the boost. This also works when the heating is in OFF mode.
CHURCH
CRYPT

8.1 Reflective Radiator Panels

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

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

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

8.2 Endotherm Advanced Heating Fluid

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 repressurise the system.

Calculation: 72,500kWh/(30 hours per week x 30 weeks) = 80kW average

80kW x 8 = estimated system volume = 640Litres. Divide by 100: 6.4 litres = 13 x 500ml bottles @ £20ea.

8.3 Install a Magnetic Particle Filter

These filters collect magnetic sludge which is the result of corrosion. Sludge reduces the efficiency of boilers and radiators by forming a coating which lessens heat transfer, and can block small pipes and seize radiator valves.

8.4 Electrical heating – North Transept

The upper portion of the north transept has been floored and separated by a glass screen to form an independent room, which is heated by four wall mounted infra-red radiant heaters.

These are reported to work efficiently and can rapidly heat the space, but have often found to be left turned on. It is recommended that the on/off switches are replaced by timed plunger switches which give 30 minutes of heat.

9. Energy Saving Recommendations

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

9.1 Draught Proof External Doors

There are a number of external doors in the church. These have the original historic timber doors on them, but these do not close tightly against the frames and hence a large amount of cold air is coming in to the church around the side and base of these doors, and especially at the joint between the two leaves as can be seen below.

The south porch is used as a store. There is a large gap between the leaves of the outer door.

The inner door, above right, could easily be fitted with simple draughtproofing (e.g. E or P section rubber strip)

The south west main entrance outer pair of doors are poorly fitting and may have warped or the hinges have dropped causing the gap above and at the bottom right of the left leaf. These doors appear to be in need of some professional restoration. Having constant large gaps such as these contributes to continual cooling of the building throughout the entire winter, adding 3 to 5% to the fuel bill per door. The effect here is reduced by two further sets of inner doors – this can be used as a draught lobby to keep the worst of the weather out and heat in as people arrive (with some friendly welcomers closing the inner doors!).

Three sets of doors lead from the outside to the nave (left) and there is a connection into the church centre through further doors behind the camera.

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

For timber doors that close onto a timber frame a product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing. http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

For timber doors that close onto a stone surround more traditional solutions such brush draught strips rebated into the edge of the door by a skilled joiner. Other traditional methods such as using hessian or felt pads tacked to the door could be used and keeping the door maintained in a good condition is important.

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

9.2 Windows

As with gaps in doors, holes in windows cause a constant loss of any heat, and ingress of rain during bad weather. Some of the repair cost of the small broken window could be covered by insurance (expect a £300-500 excess). Having arranged scaffolding, it could also be used to change the failed main downlight lamp, inspect the clerestory hopper windows (which should be sealed with plasticene to prevent draughts; they are never opened). Finally, the scaffolding could be used to access the interior of the apse if internal access is required to repair the leak at the base of the cross.

10. Saving Recommendations (Water)

10.1 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/

11. Renewable Energy Potential

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

Renewable Energy Type	Viable
Solar PV	No – visible roof [Suitable for Centre]
Battery Storage	No – no viable PV
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – air quality issues
Air Source Heat Pump	Possible located on centre roof
Ground Source Heat Pump	Possible if sufficient space for borehole

Solar PV will be discussed in the separate report for the Church Centre. As the site receives one electricity supply this would also supply the church.

It is recommended that plans are developed for replacement of the boiler by the end of the decade,

If a heat pump is selected, some of the extra electricity required to run the pump can come from solar PV panels situated on the centre roof.

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 pipes, or a borehole.

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 church once a week from cold. But with the church having over 30 hours of use per week normally, an ASHP is an option which can be considered in detail.

Heat pumps generally deliver water at around 55ºC (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.

An assumption that the church uses approximately 72,000kWh of heat annually has been made based on its size and hours of use.

If this amount of heat were supplied by a Ground Source Heat Pump operating at a Coefficient of Performance [CoP] of 4, this would require 18,000kWh of electricity. An Air Source Heat Pump with CoP of 2.5 would require 28,800kWh of electricity to run.

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

The current boiler is of 274kW capacity. The current annual heat input is around 72,000kWh, with the building having around 1,800 hours of use annually and estimated 900 heating hours. This is an average heat input of 80kW.

Instead of installing plant sized at 80kW output (and running this for 900 hours as at present); smaller plant which operates for longer hours is suggested. Heat pumps are designed to deliver warm water constantly or semi constantly and are not suited to delivering once a week bursts of heat to raise a building from cold. The use pattern of the church suggests that supplying heat throughout the week (with, perhaps more on Sundays) is viable.

The capital cost estimates will use a 40kW capacity heat output pump, so it should be understood that it would run for longer hours than the existing boiler, around 1800 hours annually compared to 900 at present would be 60 hours per week spread over a 30 week heating season.

Air Source Heat Pumps are less efficient at night when the air temperature is less; so these will be running for part of the day. Ground Source Pumps may run constantly, which may reduce the plant capacity further.

In both cases the radiators will be cooler than at present with water temperatures at 50-55^{o}C rather than 70-75^{o}C. This may require some extra, or larger fan assisted radiators to be fitted.

ASHP

Capital cost, 40kW output unit: £16,000

Operating cost: 72,000kWh output/CoP2.5 = 28,800kWh. Without solar, x 21.09p/kWh = £6,074

[NB electricity rates of 12-13p may be accessible via group purchasing]

GSHP

Capital cost, 40kW output unit £40,000

Operating cost: 72,000kWh output/CoP4 = 18,000kWh. Without solar, x 21.09p/kWh = £3,796

12. Funding Sources

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

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

https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2019.pdf .

13. Faculty Requirements

It must be noted that all works intended to be undertaken should be discussed with the DAC at the Diocese.

Throughout this report we have indicated our view on what category of permission may be needed to undertake the work. This is for guidance only and must be checked prior to proceeding as views of different DACs can differ.

Under the new faculty rules;

List A is for more minor work which can be undertaken without the need for consultation and would include changing of light bulbs within existing fittings, repair and maintenance works to heating and electrical systems and repairs to the building which do not affect the historic fabric.

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also the replacement of existing boilers so long at the same pipe work, fuel source and flues are used. It can also be used to replace heating controls.

All other works will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.