ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

All Saint's Church, Canterbury
PCC of All Saint's Church

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1. Executive Summary

An energy survey of All Saint's Church, Canterbury 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.

All Saint's Church, Canterbury is an early Victorian Grade II listed church built in 1844 as a garrison church. It is constructed from Kent ragstone with Early English style lancet windows. Following closure it was partitioned internally in 1975 and reopened as a parish church. Both church and surrounding boundary wall and railings are listed. [Historic England reference 1096958/9]. 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)
Mend broken window	5% of gas 3,000	£155	£100	0.5	None	0.55
Draught proof doors	2,000	£100	£500	5	List B	0.37
Investigate roof leak					None	
Install reflective panels behind radiators	2% of gas 1,200	£42	£100	3	None	0.22
Ceiling / roof insulation to enhance suspended ceiling	5% of gas 3,000	£155	£5,500	35	Faculty	0.55
Install secondary double glazing in hall area	10% gas for that room 3,000	£155	£3,000	19	Faculty	0.55
Add endotherm fluid to heating system	10% 6,000	£315	£160	<1	List A	1.11
Change lighting to LED	2,500	£500	£3,000	6	Faculty	0.63
Install PIR person sensors	200	£33	£660	20	List B	0.05
Investigate solar PV tiles for SE facing roof	5,000	£1,000 electric + £3,100 gas	£41,325	11	Faculty	1.26
Install Heat Pump	60,000 gas	£3,150	£40,000	13	Faculty	11.07
Replace gas hot water heaters with electric	900 gas	£35	£300	9	List B	0.17

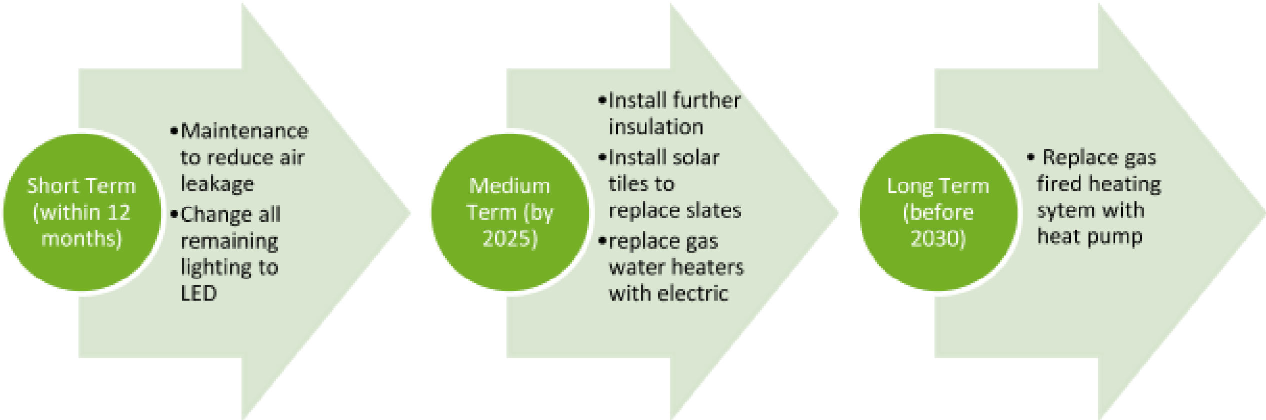
The church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works.   Based on current contracted prices of 16,570p/kWh (day), 11.520p/kWh (night) and 3.836p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £3,700 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. Furthermore, the PCC of All Saint's Church has joined the EcoChurch scheme.

This church has a clear route to become net zero by 2030 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of All Saint's Church, Canterbury 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 All Saint's Church, Canterbury, Military Road, CT1 1PA was completed on the 22nd March 2021 by 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.

The church was represented by the Curate, Rev. Lucy Henderson.

All Saint's Church, Canterbury	
Church Code	606046
Gross Internal Floor Area	550 m^2
Listed Status	Grade II

The church typically used for 48 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	4 hours per week	60
Meetings and Church Groups	7.5 hours per week	
Community Use	36 hours per week	
Occasional Offices	2 weddings p.a.	100

Church annual use: 2,500 hours

Heating hours: Church: 39 hours per week x 30 = 1170 hours (61,000kWh / 52kW average)

Estimated footfall: 26,000 people

The west end of the building is heavily used throughout each day and evening by a variety of community groups with the church sanctuary at the east end being used for some events.

The upper floor over the central lobby hosts a food bank and there is a storage area above the kitchen, toilets and west end entrance.

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by All Saint's Church, Canterbury and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	16.570p/kWh	Above current market rates
Night Rate	11.520p/kWh	In line current market rates
Standing Charge	25.990p/day	N/A

The current gas rates are:

Single / Blended Rate	3.836p/kWh	Above current market rates
Standing Charge	29.990p/day	N/A

Both utilities are supplied by British Gas, the contract ending on 17th Nov 2022.

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	5% / 20% dependent on monthly consumption	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	Charged when VAT at 20% is applied	As the organisation is being charged the wrong VAT rate they are also being charged CCL which should not be applied as they are a charitable organisation.

Whenever monthly gas consumption exceeds 4,397kWh (52,000kWh per annum), 20% VAT is charged unless the customer has submitted a VAT declaration form.   This was the case for most winter months including January to March 2020.

The above review has highlighted that VAT and CCL are being charged. The church is a charity and therefore can claim VAT exemption status.

As such the PCC of All Saint's Church, Canterbury should send the supplier a VAT declaration confirming this.

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

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

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

5. Energy Usage Details

All Saint's Church, Canterbury used 2,760 kWh/year of electricity (from December 2019 to 2020), costing in the region of £550 per year, and around 61,000 kWh/year of gas, costing in the region of £3,200 over the same period. It is likely that these values, particularly for electricity, underestimate the "normal" pre lockdown use where greater use of lighting would have occurred. Gas use from April until October 2020 was extremely low.

This data has been taken from the annual energy invoices provided by the suppliers of the site. All Saint's Church, Canterbury has one main electricity meter, and is provided with three phases of electricity.

The gas meter could not be located.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	215140793	EDMI	Yes	Locked cupboard in kitchen
Gas – Church	M016 A03565 16 A6	-	-	Not located

5.1 Energy Profiling

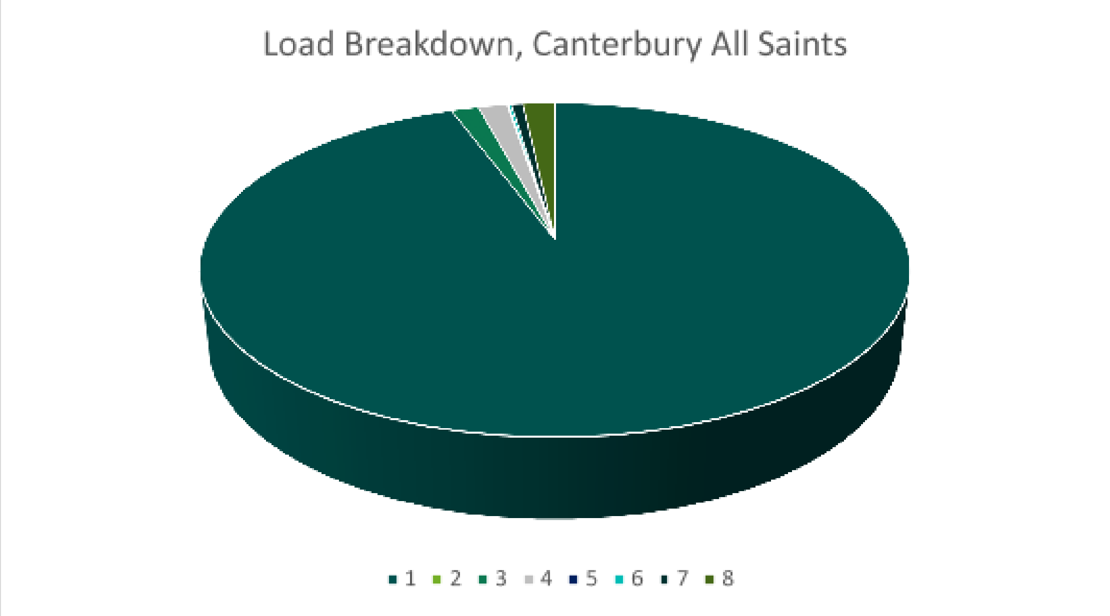
The main energy consuming plant can be summarised as follows:

Service	Description	Annual Use kWh	Estimated Proportion of Usage
Heating (gas)	Ideal Evomax 80 condensing boiler, 80kW	60,000	94.3%
Heating (electric)	Zero	0	0%
Hot Water	Two Chaffoteaux et Maury Brittony II T gas heaters of 23kW each Blizzard wall mounted water heater, 2kW	849 gas 100	1.5%
Lighting (internal)	Mostly non LED, halogen and CFL Main areas lit by 30 bulbs, total power estimated at 1.7kW. 2000 annual use hours out of 2,500 annual building use hours gives 3,400kWh. Less use in 2020 has occurred due to restrictions.	1,000	1.5% (More pre covid)
Lighting (external)	One PIR fitted floodlight on building corner, 500W	50	0.1%
Organ, music, PA	Organ, 1kW, PA system 1kW both 4 hours/ week	400	0.6%
Other Small Power	Vacuum cleaner, 1.5kW	100	0.2%
Kitchen	Electric cooker 3kW Extraction unit 500W Microwave oven 1kW Fridge 150W Freezer 150W Toaster 1kW	150 25 25 440 440 20	1.8%

Sum of estimates = 2,750kWh

Annual electricity use 2020 = 2,760kWh

Electricity use in a normal year is expected to be double the above, due to lighting being over 3 times the 2020 usage. Replacement with 30 LED bulbs of 10W each is expected to lower annual consumption for 2,000 hours use to around 600kWh.



KEY 1 Heating (gas) 2 Electric heating – zero 3 Hot water (electric plus gas)

4 Lighting (internal) 5 Lighting (external) 6 Small power 7 Organ, PA 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 All Saint's Church, Canterbury uses 75% less electricity (in 2020) and 25% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
All Saint's Church, Canterbury (elec)	550	2,760	5.0	19	-75%
All Saint's Church, Canterbury (gas)	550	60,850	110.6	148	-25%
TOTAL	550	63,610	115.6	167	-31%

The low electricity use will be partially due to less building use due to coronavirus. The simple rectangular shape of the church means it has a smaller surface area than the majority of CofE cruciform churches, and the suspended ceilings will have an insulating effect.
There currently no benchmark data which takes hours of use and footfall into account.

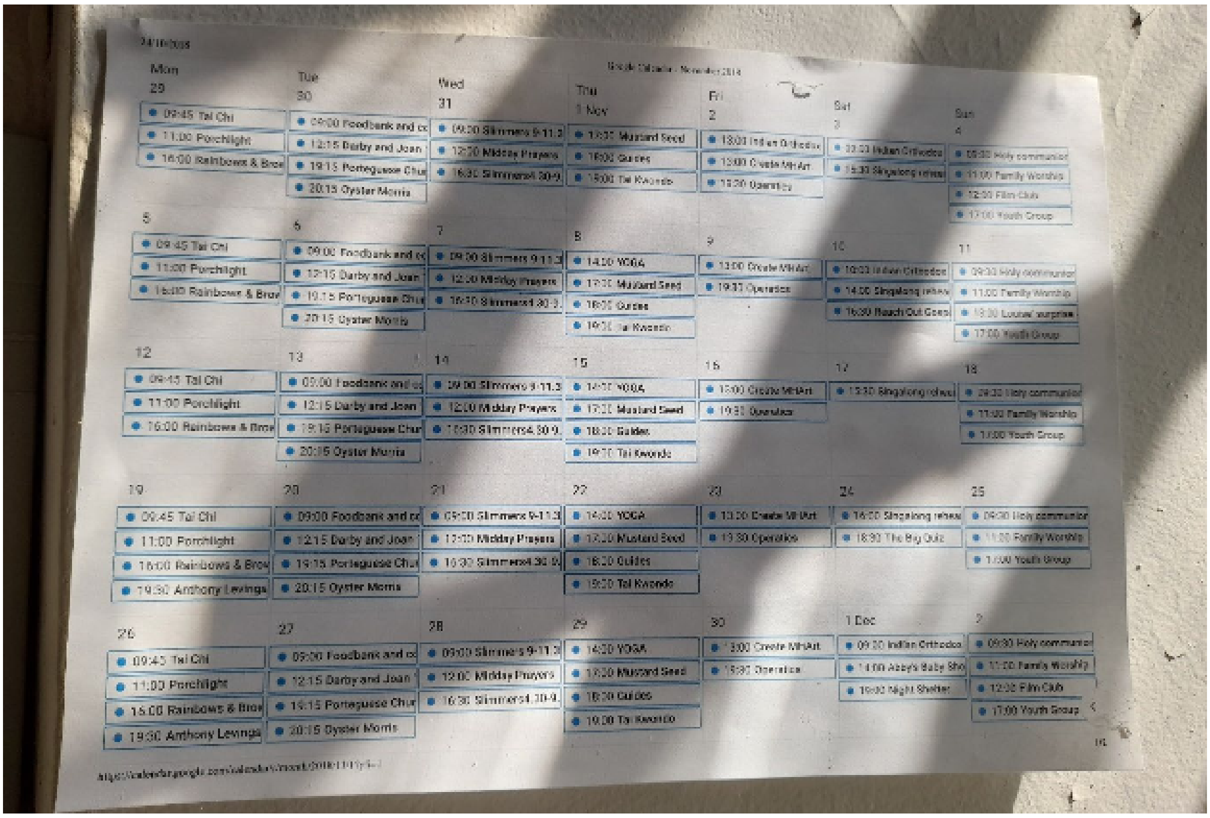
[1] CofE Shrinking the Footprint – Energy Audit 2013

6. Efficient / Low Carbon Heating Strategy

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 with 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 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 and will be unable to deliver 'zero carbon mains gas'. It is therefore a critical element to review and set out a plan to make 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.

6.1 Future Heating Strategy

As can be seen from the image below, the building is very well used throughout the week, with an estimated 48 hours of use. Much of this involves the smaller hall towards the west end of the building, which is comparatively well insulated as the external walls are the shorter side walls of about 7m length and there is also a suspended ceiling. Improving insulation here would be worthwhile due to it's regular use. Installing secondary double glazing, whilst is not normally cost effective in churches given they are heated only a couple of times per week, would not be the case here and is worth costing.



The church building hosts a considerable amount of activities during the whole week.

In addition to enhanced insulation, and maintenance of windows, and doors to ensure they are draught proof, the church heating appears to be divided into two zones. This should allow optimisation of heating provision, but requires some research to understand how to control the equipment.

The PCC have joined the EcoChurch scheme. For the Church of England and individual congregations to reach net zero carbon emissions by 2030, large steps have to be taken. This will inevitably involve capital costs, which should be seen as a missional activity (spending more money on plant which reduces emissions and causes less environmental damage means less work for development agencies. It is usually cheaper to spend to avoid a problem than spend to clean it up).

The current gas boiler is efficient, but nevertheless emits carbon dioxide. With high regular usage hours and some insulation already, the building is an ideal candidate for a heat pump.

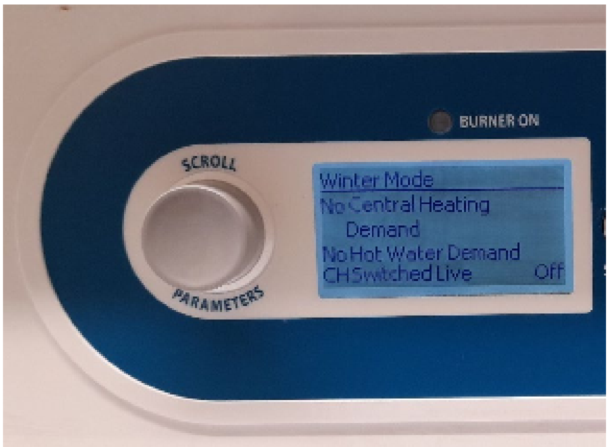
The main issue to be negotiated is plant location for a listed building.

All Saints has a very large SE facing roof, which is ideal for a solar photovoltaic array. Again, listed status is an issue. However, it is noted that the SE side of the building is only visible from the nursery which is not really a public area. The E end of the SE (ecclesiastical south) wall is effectively not visible to the public; the concrete area here could be used as a heat pump location should the existing boiler room prove unsuitable.

7. Improve the Existing Heating System

7.1 Source of Gas to Minimise Carbon Footprint

The Ideal Evomax boiler was installed in June 2019. A long term plan should be developed for its replacement, using the rest of the plumbing installation and radiators. In the interim period, the church should seek a gas tariff with the maximum amount of renewable gas generated from anaerobic digestion.



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

7.2 Clean the Existing Heating System

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 two magnetic particle filters fitted should be cleaned annually as part of the annual gas safety certification and inspection.

7.3 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 someone who is competent to depressurise and add fluid to the system via the magnetic particle filter pot.

Calculation: 60,000kWh/(39hours per week x 30 weeks) = 51kW average

51kW x 8 = estimated system volume = 408Litres. Divide by 100: 4litres = 8 x 500ml bottles @ £20ea.

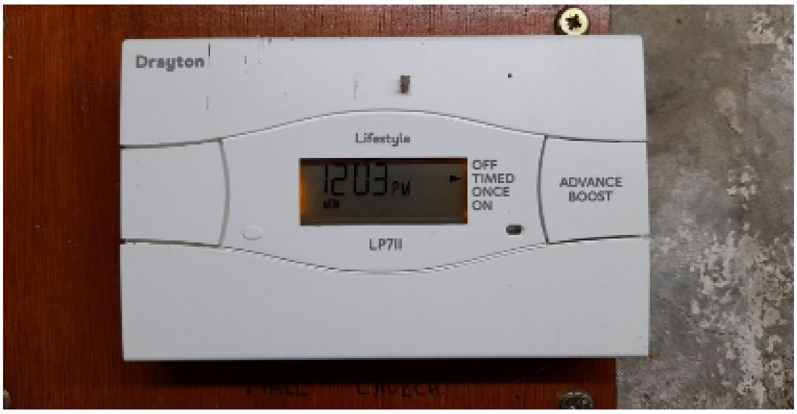
7.4 Radiator Zone Controls

The heating system is divided into two zones, with separate flow and return pipes exiting the boiler room. This is understood to allow the church end and hall end of the building to be heated separately so that, for instance, the hall could be heated Monday to Friday and the church on Sunday and selected short periods on other days.

The church representative did not know how the heating to the zones is controlled, or who holds the information. If the whole building is always heated when the boiler runs, this will waste heat at the church end during part of the week. Ideally, just the hall end should be heated when the church is not in use and the controls set to support this.

It is recommended that the controls are investigated and instructions provided on operating the zoning in the boiler room. Since the entire system dates from 2019, there should be a manual provided at installation. Otherwise, it should be possible to contact the installer and obtain instructions. These should then be posted on a laminated notice in the boiler room.

The wooden plinth is labelled "Hall" to the left and "Church" to the right. However, this particular controller does not have the left hand LED and OFF/TIMED/ONCE/ON markings which would normally come with a dual hot water and heating controller since it is purely for heating. The 1st and 5th buttons behind the lower cover *may* allow switching between the two zones for the hall and church systems, actuated by the orange electric ball valve motors. The controller manual is available at:



www.directheatingsupplies.co.uk/pdfs/Drayton%20LP711%20Quick%20Guide.pdf

The controller is connected to these orange actuators operating ball valves which allow either hall or church radiators to be supplied.   With both valves open the both zones are heated simultaneously.

Belimo rotary valve actuator, model NRFA

www.belimo.co.uk/shop/en_GB/Valves/Valve-Actuators/NRFA/p?code=NRFA

7.5 Reflective Radiator Panels

The church is heated by radiators served from the boiler. These radiators are located on the external, uninsulated walls and do not appear to be fitted with 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.

7.6 Hot Water Heating

The church is also equipped with two Chaffoteaux et Maury gas fired water heaters, located on the first floor store room area at the west end, the north side unit serving toilets and the south side the kitchens, both facilities being underneath on the ground floor. If the building transitions to a heat pump for heating, these should be replaced by electric point of use heaters.

For the toilets, a small unit such as the one pictured below would be suitable (although hand washing with cold water is acceptable, see Section 9.2)

Heatrae Sadia Concept point of use water heater.

8. 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.

8.1 New LED Lighting

The lighting makes up a relatively large proportion of the electricity used within the building. The church is aware that non LED bulbs are fitted. Many of these in the church and central foyer area will be halogen spotlights of around 80W rating, which can be replaced by LED bulbs of 5 to 10W each. There are approximately 30 lights, [plus the 2m length T8 fluorescent tubes fitted in the hall area and upper floor rooms]. If the lighting is not dimmable, this can be a relatively straightforward swap, although it will require a contractor due to the height involved. With dimming fitted, more expensive dimmer compatible bulbs are required.

There are a vast number of specifications of LED lights on the market but it is recommended that any LED light should come with branded chips and drivers and offer a 5 year warranty. An example of such a range of fittings is available from http://www.qvisled.com/

If the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £3,000. The annual cost saving would be around £350 resulting in a payback of around 6 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider.

A project to change the lighting in the church, which is recessed into the suspended ceiling, could be complementary to installing extra insulation in the space.

Where the existing fitting is at low level and is accessible, it can be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

The external light is a PIR controlled halogen R7 bulb, either 250 or 500W. This should be changed to an LED R7 bulb when the area is next accessed, e.g. to paint the wooden panel. It is probably a 118mm length model, although this is only speculation from the ground. LED bulbs are often of much wider diameter than the halogen bulbs they replace and will not fit into the luminaire; some varieties have off centre end fittings which will fit.

8.2 Lighting Controls (Internal)

There are several lights in the building which are only used occasionally and for a short amount of time and as such, the light does not need to remain on constantly. With a large footfall throughout the week 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. The west end entrance area, kitchen, toilets and central entrance area would benefit. (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.

8.3 Draught Proof External Doors

There are a number of external doors in the church which are the original historic timber doors. These all appear to be in good condition, but need to be kept draught proofed otherwise a large amount of cold air will continually enter the church around the side and base of these doors.

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

For timber doors that close onto a timber frame a product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing.

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

For timber doors that close onto a stone surround more traditional solutions such brush draught strips rebatted 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.

8.4 Window Maintenance

A broken window is located adjacent to the stairs leading from the central foyer to the first floor room. This will lead to a significant draught; which will be continuous and will account for about 5% of the heating load. It can be temporarily covered with clear plastic and tape until it can be properly repaired.

8.5 Secondary Glazing

The building, in particular the west end hall, is in regular use throughout the week and is heated.

The windows of the building are singled glazed with metal frames. It is not possible or desirable to change the windows as the building carries listed status.

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

Any possible installation would need to be carefully specified, and companies such as https://www.selectaglaze.co.uk/heritage-listed-buildings or https://www.stormwindows.co.uk/ can provide very discrete and appropriate systems for all types of spaces.

In addition, it is worthwhile obtaining quotes for the church windows at the same time, since this part of the building also appears to be in use at times apart from Sundays and achieving a well insulated building will facilitate reduction of heating costs and is recommended before installing a heat pump.

8.6 Insulation to Roof

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.

It is not known how much, if any insulation is provided within the 1975 era suspended ceilings.

This should be determined and your architect consulted to ascertain the feasibility of adding further insulation (it's weight, and the strength of the ceiling suspension being the issue).

9. Saving Recommendations (Water)

9.1 Tap Flow Regulators

The 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.

9.2 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/

10. Other Recommendations

10.1 Electric Vehicle Charging Points

The church has a car park adjacent to it which serves the church, the frequently used church hall and nursery. 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 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.

If nursery staff will use the facility it could 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.

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	Yes technically, but visible roof
Battery Storage	Yes
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	Yes, if GSHP not possible
Ground Source Heat Pump	Yes, probable borehole system

11.1 Solar Photovoltaic Panels

Permission for solar panels can be given for listed buildings where the panels are not visible from ground level. The PCC have obtained permission from the council for installation on the other side of the roof than shown below. It was not possible to obtain a photograph showing the south side of the roof due to the presence of a nursery, vicarage and the Post Office depot (on the left/ north of the site). The roof ridge lies approximately north east to south west, so the normal to the ridge is aligned to approximately 150°, or 30 degrees east of south. The SE facing roof is only visible from the adjacent nursery playground, which should not be considered to be publicly accessible. Rules on installation of renewable technology are being discussed by the Church of England (it is understood that the Dean of the Arches, who oversees the Faculty process is considering this), so it is hoped that the criteria for obtaining permission for solar panel installation will be relaxed. The PCC are encouraged to obtain support from the Diocese (Diocesan Environment Officer Theresa Redfern, Archdeacon of Maidstone Ven. Stephen Taylor) and apply for Faculty permission.

The south side of the building, ramp to the nursery with path to the boiler room next to the boundary fence. The roof is invisible from this angle.

For All Saints church, the steeply angled SE facing roof offers an ideal location – this would have to be confirmed with your architect as to suitability for extra weight and wind loading on the roof structure.

The roofs offer areas of around 190m^2. This could generate 0.15kWpeak/m^2 giving a 28.5kWpeak system. A 1kWpeak system can generate up to 1000kWh annually, giving a total annual generation of around 20,000kWh. Orientation factor (roof slope and angle from south) is 0.96.

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

= 190m^2 x 0.15kWp/m^2 x 1000kWh/kWp x 0.96 x 1

= 27,360kWh

This much larger than the church's annual recent electricity use (2,760kWh), and suspected use pre covid (over 5,000kWh) – although once the amount required to operate a heat pump is added, generation equals demand. If a heat pump is installed, solar power greatly enhances its viability, as the pump can run whenever the sun shines.

Electricity requirements of a heat pump are estimated at 15,000kWh (GSHP) or 24,000kWh (ASHP), which suggests that installing a large solar array would provide most of the church electricity needs with a heat pump, this would create a zero carbon church. Totals: GSHP + 5,000 = 20,000kWh p.a.

ASHP + 5,000 = 29,000kWh p.a.

The large area of the roof appears to be more than enough to support a heat pump system, although detailed figures from various potential suppliers of solar and heat pump technology will be required to conform these initial estimates.

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.

Battery Storage is not strictly a renewable energy solution but provides a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system. This is a new but fast-growing technology.

Using average 2019 installation costs (£1,450 per kWpeak); a 28.5kWpeak system would cost £41,325. 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

11.2 Heat Pump Installation

The boiler and radiator network were new in June 2019. The large number of radiators fitted suggest that they would be compatible with a heat pump which require a larger surface area than conventional radiators since water is supplied at around 55°C rather than 70 to 80°C.

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

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 (not enough is available from the car park and small area of grass), 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.

Heat pumps generally deliver water at around 55°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.

At All Saints church, ASHP could be installed on the concrete area at the east end of the south wall, which is practically non visible except while accessing the nursery. This would require a lower capital cost than GSHP, but higher running costs. Alternatively, a GSHP installation could also use this space, and/or the current boiler room. It is likely that a borehole would be drilled from the car park.

The South East corner of the building is surrounded by this concreted area, with the bridge to the nursery in the distance over the boiler room. This area provides ample space for heat pump plant which would not be visible. The image is taken through the fence of the adjacent GPO depot.

11.3 Costs (Church only, not incorporating the nursery).

The current boiler appears to be of 80kW capacity. Current annual heat input is around 60,000kWh, with the building having around 2,500 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 and an average heat input of 24kW. 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 84 hours per week rather than 39 as at present.

ASHP

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

Operating cost: 60,000kWh output/COP2.5 = 24,000kWh. Without solar, x 16,57p/kWh = £3,977

With solar, assume half of needs from grid during winter; 12,000kWh = ~ £2,000, offset by some sale of surplus electricity generated during summer.

GSHP

Capital cost, 40kW output unit £40,000

Operating cost: 60,000kWh output/COP4 = 15,000kWh. Without solar, x 16,57p/kWh = £2.485

With solar assume half of needs from grid during winter; 7,500kWh = ~ £1,240, offset by some sale of surplus electricity generated during summer.

The nursery is located on adjacent church owned land. It is suggested to investigate the practicality of a joint heating system serving both sites.

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.