Energy Efficiency and Zero Carbon Advice

St Stephen's Church, Tonbridge
PCC of St Stephen's Church

Author	Reviewer	Audit Date	Version
Paul Hamley	Tamsin Hockett	27th June 2022	1.2

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1. Executive Summary

An energy survey of St Stephen's Church, Tonbridge was undertaken by ESOS Energy to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use.

St Stephen's Church, Tonbridge is an unlisted Victorian church dating from 1852. The adjoining unlisted hall is to the north, followed by a former cottage used as offices and a building used as a Community Centre. There is both gas and electricity supplied to the site.

The church has a number of ways in which it can become more energy efficient. Our key recommendations have been summarised in the table below and are described in more detail later in this report. It is recommended that this table is used as the action plan for the church in implementing these recommendations over the coming years.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
CHURCH						
Fit magnetic particle filter to boiler	N/A Reduced maintenance		£500		List B	
Purchase temperature datalogger	Potentially 5%, 3,500	£68	£50	1	None	0.64
Draughtproofing	700	£14	£100	7	List A	0.13
LED relighting scheme	12,000	£1,867	£15,000	8	Faculty	3.0
Investigate potential for Ground Source Heat Pump	100,000 to 150,000gas	£3,200	£78,000	24	Faculty for installation	18.4 To 27.6
Install solar photovoltaic panels on south aisle roof	23,500	£3,656	£43,500 If maximum sized	12	Faculty	5.9
HALL						
LED relighting	1,000	£155	Purchased	6	Obtained	0.25
Replace metal framed single glazed windows	4,500	£250	£6,600	26	Faculty	0.8
Install loft insulation	3,000	£467	£1,660	3.5	List A	0.5
Install cavity wall insulation	2,400	£373	£3,000	8	List B	0.4
Install Heat Pump	30,000 gas	£586	£6,000	10	Faculty	5.5
OFFICE						
Replace large hot water tank with point of use instantaneous water heater	2,000	£311	£300	1	None	0.36
Install loft insulation	1,000	£155	£500	3	None	0.18
Replace fluorescent lighting with LED	1,000	£155	£1,000	6.5	None	0.25
Install Heat Pump	15,000 gas	£293	£2,800	10	List B	2.7
COMMUNITY CENTRE						
Door draughtproofing	250	£5	£100		None	0.04
LED lighting	400	£62	£500	8	None	0.1
Install Air to Air Heat Pumps allowing zoned heating	50,000 gas	£1,000	£19,350	19	List B	9.2

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

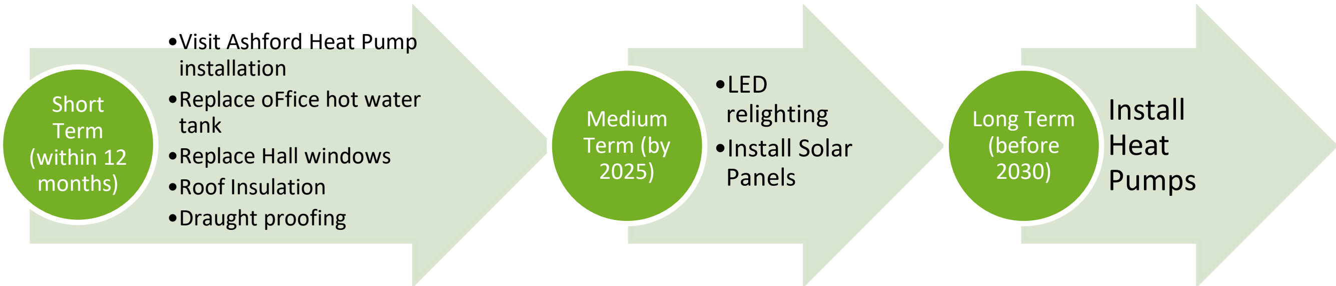
Based on current contracted prices of 15.56p/kWh and 1.9350p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church around £4,000 per year in gas costs and up to £6,000 per year in electricity costs by generating a significant proportion of electricity on site in addition to the energy efficiency measures.

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 Stephen's Church, Tonbridge to give them advice and guidance as to how the church can be improved to be more energy efficient. In doing so the church will also become more cost effective to run with improvements in the levels of comfort. Where future church development and reordering plans are known, the recommendations in this report have been aligned with them.

An energy survey of the St Stephen's Church, Tonbridge, 37 Waterloo Rd, Tonbridge TN9 2SW was completed on the 27th June 2022 by Dr. Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Church Energy Advisors Network developing advice for the Church of England and authored the "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE affiliate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church and has been an assessor for EcoCongregation.

The church was represented by Chris Blackman.

St Stephen's Church, Tonbridge	CHURCH	HALL [NURSERY]	OFFICE	COMMUNITY CENTRE
Church Code	631244			
Gross Internal Floor Area	550m^2	150m^2	40m^2	275m^2
Volume	4350m^3	450m^3	220m^3	1300m^3
Heat requirement	143kW	15kW	6.5kW	42kW
Listed Status	Unlisted	Unlisted	Unlisted	Unlisted

The church is typically used for 25 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	5 hours per week	150
Church Meetings and Groups	2 hours per week	
Community Use	16 hours per week	Daily café Weekly food bank 20 School visits
Occasional Offices	6 weddings 8 funerals	100 100

The hall is used for 40 hours per week by a nursery and the Office for 48 hours per week.

The centre is in sporadic use with evening and weekend hires.

Annual Occupancy Hours: Church 1300 Hall 2100 Office 2500 Centre 440

Estimated Footfall: 40,000

4. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	15.56p/kWh	Below current market rates
Standing Charge	139p/day	N/A

Supplier: Total Gas & Power

The current gas rates are:

Single / Blended Rate	1.9530p/kWh	Below current market rates
Standing Charge	368p/day	N/A

Supplier: Total Gas & Power

The current rates are lower than the market rate and should be retained at present.

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

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

A review has also been carried out of the taxation and other levies which are being applied to the bills. These are:

VAT	5%	The correct VAT rate is being applied
CCL	not charged	The correct CCL rate is being applied.

The above review confirmed that the correct taxation and levy rates are being charged.

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

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

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

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

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

5. Energy Usage Details

5.1 Annual Consumption

St Stephen's Church, Tonbridge [Church and hall only] used 30,479 kWh/year of electricity during 2021, costing £4,940 per year. Gas use for the church and adjacent hall was 74,578kWh over a 10 month period, January to October 2021, implying an annual use of 100,000kWh costing £3,200. Annual pre pandemic use was considerably greater than this, between 120,000 - 150,000kWh.

This data has been taken from spreadsheets of monthly electricity and gas expenditure provided by the church.

Utility	Meter Serial	Type	Pulsed output	Location	Annual use/ kWh +
Electricity - Church	K13B 000711	Elster A1100	Yes	Tower base room	Hi 54,970 Lo 30,753
Electricity - Hall	S94 111211			Kitchen cupboard	Hi 7123 Lo 5622
Electricity – Community Centre	E17ML 00682	EDMI Atlas Mk7d Single phase	Yes	Community centre Long hall	Hi 6424 Lo 3146
Electricity - Office	S09B 07599	Actaris ACE 1000 Single Phase	No	Near entrance	Hi 6176 Lo 4346
Gas – Church plus Hall	K00991 15 D6	Elster Bk-G16E	Yes	Shed used to store nursery toys	Hi 153,33 Lo 120,102
Gas – Office	K0024645	Elster Bk-G4M	yes	Office entrance area	Hi 15,000 Lo 11,311
Gas – Community Centre kitchen	K0024692	Elster Bk-G4M	yes	Community centre	Hi 33,655 Lo 21,043
Gas – Youth Hall	E016 K02398 15 D6	Elster Bk-G10E	Yes	Long (youth) Hall, cupboard	Hi 25,939 Lo 21,845

+ Electricity figures are from the period 2017-2021, ignoring 2020. Gas figures compare 2015-2018. Highest and lowest annual consumptions are listed.
There is a large variation in gas use between years with a 20% difference in church + hall load. Differences in Community Centre use will reflect different use patterns, number of hires, etc. Electricity use is seen to decline across each of the four buildings prior to the pandemic.

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

Above, church electricity

Above, office electricity

Below, community centre electricity

Below, church gas

Below, office gas

Above left, community centre kitchen and yellow hall gas. Right, Youth hall gas

5.2 Energy Profiling

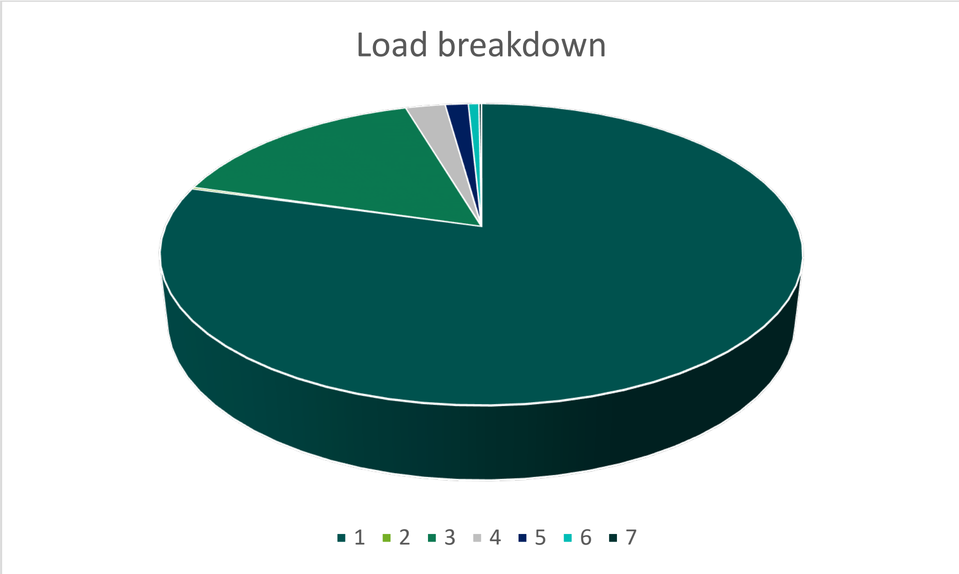
The main energy consuming plant can be summarised as follows:

	Equipment	Power kW	Annual Consumption kWh	Portion
Heating [Gas]	CHURCH Ferroli Atlas 78. Non condensing boiler HALL Domestic 30kW boiler	78 30	70,000 30,000 TOTAL 100,000	79%
Heating [Electric]	Boiler circulating pumps	0.3	250	0.2%
Lighting [Internal]	CHURCH 1300 hours use 37 halogen floodlights, 400W each 12 theatre spotlights, 250W each 66 Spotlights, 70W 4 Chancel floodlights, 150W each HALL 2100 hours use *Nursery in session – not counted.* Fluorescent lighting to be replaced by 600x600mm LED units Entrance foyer, toilets, nursery staff room	 4100W 3000W 4620W 600W Present Est 2000W 1000W	15,000 4000 1,000 TOTAL 20,000	16%
Hot Water	Commercial dishwasher Short cycle, 45 uses weekly x 10 minutes Church – café. Point of use instantaneous Zip water heater	5 3	2000 1000 TOTAL 3,000	2.4%
Kitchen	Wine fridge Large fridges (3) Freezer	50W 450W 100W	TOTAL 1,750	1.4%
Sound, Music	Sound system, 2 projectors Organ (20 hours per year)	2 0.5	790 10	0.6%
Small Power	Vacuum cleaner Televisions	1.5 0.3	100 100	0.15%

Sum of estimates: 26,000kWh

Annual Church plus hall electricity consumption, 2021: 30,479kWh

This breakdown highlights the major uses of energy. Closer scrutiny of each entry will enable the church to produce a more accurate breakdown if desired. The shortfall may be due to extra use of the church lighting which is the main load, or a longer dishwasher cycle.



KEY *1 Gas heating* *2 electric heating* *3 Lighting* *4 Hot water*

5 Kitchen *6 Sound, music* *7 Small power*

As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is lighting.

5.3 Energy Benchmarking

In comparison to national benchmarks for church energy use St Stephen's Church, Tonbridge uses 61% more electricity and 8% less heating energy than is average for a church of this size.

Area refers to church plus hall as meters supply both. The high electricity consumption is largely due to the lighting.

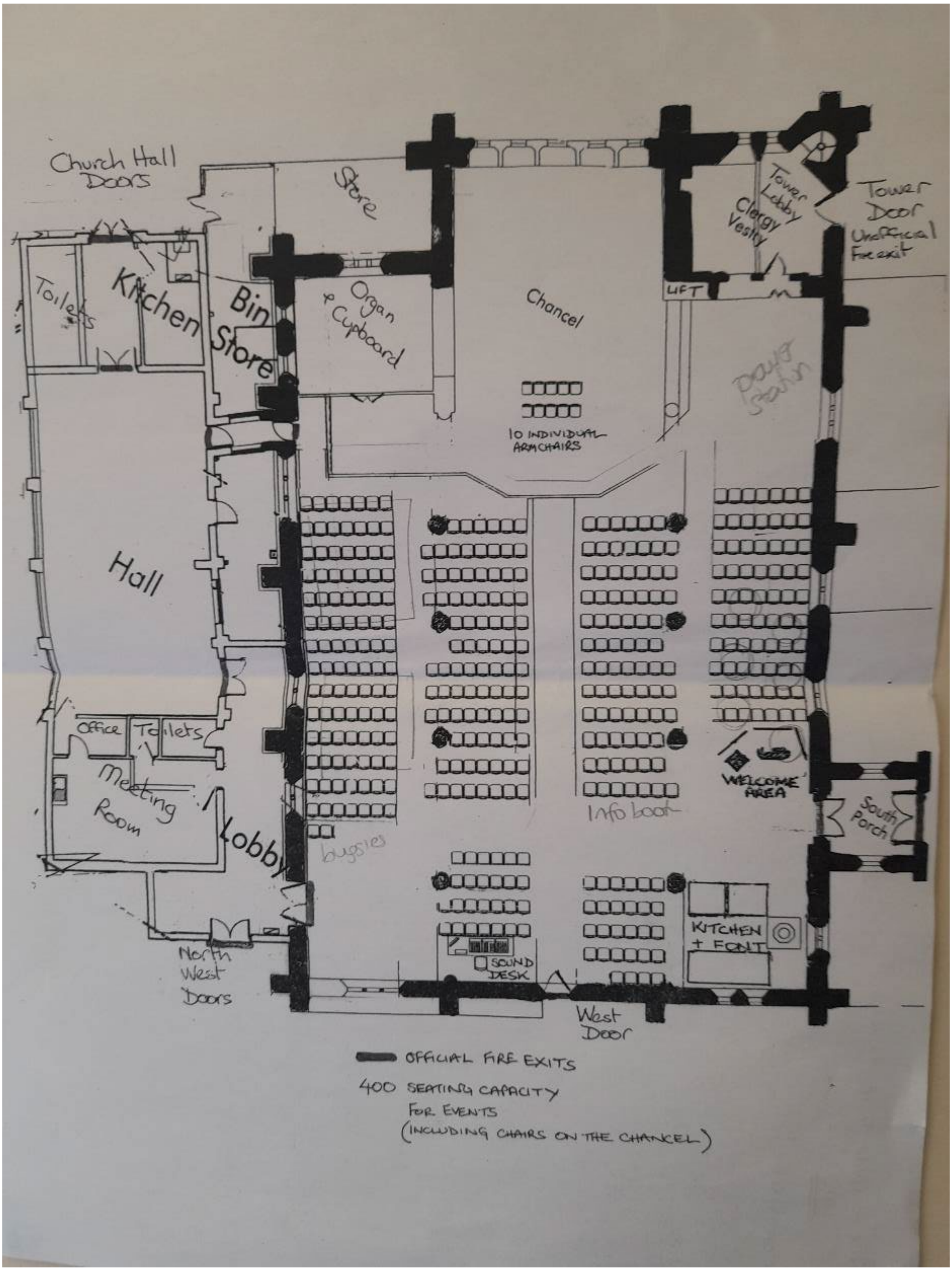
	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Stephen's Church, Tonbridge (elec)	700	30,479	43.5	27	+61%
St Stephen's Church, Tonbridge (gas)	700	100,000	143	156	-8%
TOTAL	700	130,479	186	183	+2%

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

6. Site Overview

The church is connected to the church hall to the north as shown below.

Further north is located the office (a former dwelling house), which is attached to the three halls forming the community centre. In total there are three electricity and four gas meters, (church plus hall, office, community centre kitchen and "yellow" hall, community centre youth hall).



7. Efficient / Low Carbon Heating Strategy

7.1 Reducing Environmental Impact

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Heating also often uses gas or oil as its primary fuel, these are fossil fuels with high carbon emissions and little opportunity to decarbonise in the future. Electricity currently has carbon emissions of around the same level as mains gas but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions its remaining coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of bio gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'.

It is therefore important to review and plan to increase building efficiency and become less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches.

7.2 Forward Planning

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

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.

The church should develop plans to replace the boilers in each building, by obtaining detailed quotations for the options presented in this report. Where electric heating can be obtained at similar or lower operating cost, this is recommended.

Interventions are detailed on a building by building basis in Sections 8 to 11.

7.3 Site Heat Demand

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

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

Insulation Factors

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

Area	Area m^2	Volume m^3	Insulation Factor kW/m^3	Heat Required (Space heating) kW
Church	550	4350	0.0031 (a)	135
Hall No roof insulation, single glazed	150	450	0.0033	15
Office	40	220	0.0030	6.6
Community Centre	275	1300	0.033	43

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

a) it is assumed that there is insulation below the underfloor heating

The church plus hall use around 100,000kWh of gas yearly. The church is estimated to be in use for 1300 hours, with a boiler of 78kW (maximum power output) using 70,000kWh. The heating system is operated from 05:00 to 12:00 from early October to April (weather dependent), which is around 1400 hours annually.

The hall is in use for around 2,200 hours annually by the nursery (c. 40 hours per week).

A Worcester Greenstar 8000 gas boiler (installed October 2021) is thought to be used for up to 10 hours daily in the heating season; at 15kW average load, using 30,000kWh.

7.4 Heat Pump Overview

As the hours of use of a building increase, so do heating costs. Heat Pumps are a low carbon method of creating heat.

Electrically operated heat pumps can provide between 2.5 times and 5 times the amount of heat in kW which they consume in electricity (This is termed the Coefficient of Performance, CoP). They are compatible with underfloor heating, which typically runs at fairly low water temperatures, but not with high temperature heating systems. When replacing gas boilers directly, sometimes larger radiators are required, or fan assisted radiators, or running the system for longer periods to achieve the same temperature (but at less power input).

With electricity prices now only three times more per kWh than gas (it was about four times), heat pumps are becoming steadily more cost effective. Refrigeration technology is mature and reliable; the units appear to offer lower maintenance costs compared to gas boilers.

The efficiency advantages of heat pumps mean that in some circumstances they can work out at equivalent or cheaper operating cost than gas despite the higher cost of electricity per kWh. This effect is increased if electricity is generated on site by solar power.

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.

Air source systems deliver between 2.5 and 3 times the amount of heat in kWh to water that they consume.

Ground Source systems are more efficient (since the average ground temperature is higher than the average air temperature), but require either a borehole, or extensive trench digging.

Ground Source Heat Pumps supplying water at around 50°C are more efficient than their Air Source equivalent. Where a site has a daily requirement for heat (and thus high daily expenditure), the lower operating costs of a ground source pump outweigh the higher capital costs.

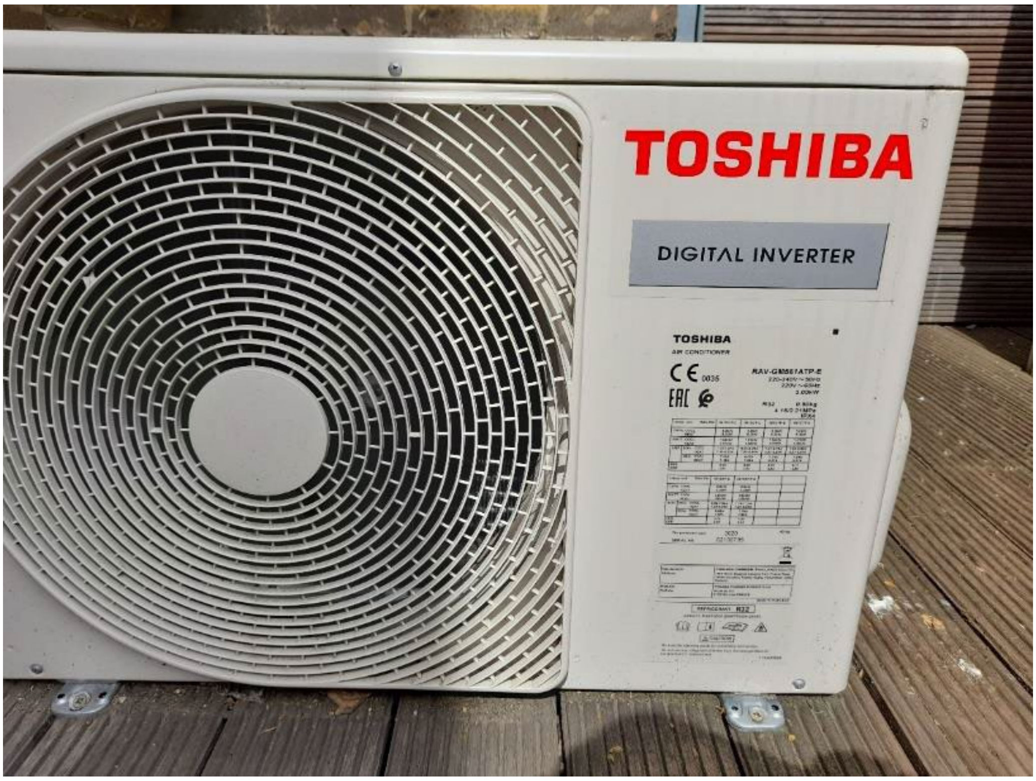
Air to Air systems deliver warm air through indoor fan units and have a CoP rating of up to 5 and they can also provide cooling. The latter would be suitable where there are no radiators, or life expired / poorly sited units and spaces heated intermittently.

Some of the extra electricity required to run heat pumps can be obtained from solar PV panels. Some types of heat pump can provide cooling – solar powered cooling in summer is very efficient.

7.5 Air to Air Source Heat Pump Details

Air to Air Source heat pumps require internal fan units, blowing warm air, connected to external units – they do not require radiators. Systems provide summer cooling as well as winter heating and can deliver up to 4 to 5 times the amount of heat which they consume in electricity.

Four of the units below supply one floor of an office of area 165m^2, which is similar to the total of the main hall, toilets, nursery office and kitchen areas. This gives a heating capacity of 21kW for an electrical load of around 1.5kW. The CoP is between 3.2 and 3.9 depending on the type of internal unit chosen.



There are a wide variety of internal units for ceiling, high wall and low wall mounting.

8. Improve the Existing Heating Systems

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

8.1 Church: Install a Magnetic Particle Filter

A magnetic particle filter should be fitted to the church boiler to protect the system from any corrosion products which can circulate and reduce the efficiency of the boiler.

The new hall boiler is fitted with one.

8.2 Hall: Thermostatic Radiator Valves

It was not possible to inspect the radiators in the hall as the nursery was in session.

The boiler heats the main room used by the nursery and also the small room at the north end used as a nursery staff room. Ensuring that there are thermostatic valves fitted will allow adjustment of heating between the spaces.

8.3 Hall, Office, Community Centre: Install Radiator Reflective Panels

The 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.

9. Church

9.1 Overview

The church is large with a long nave [30.75m in total] and aisles. A café is regularly held with a kitchen area at the rear and a screened off area accommodating fridges. The building is seated with movable chairs and tables in the café area.

It was re-floored with underfloor heating installed in 2012. This requires a 4 hour warming time and is normally heated from 05:00 to 12:00 daily from early October. Several (about six) thermostats are set to between 20 and 23ºC.

Recommendations are listed with short term "easy" interventions first, and long term interventions requiring investigation, planning and fundraising later

It is fitted with a 78kW Ferroli gas boiler.

9.2 Purchase a Temperature Datalogger

This can be used to understanding how temperature varies across the building and adjust thermostats to minimise heat demand. A 1 degree lowering of temperature can save around 10% in gas bills.

One suitable item is the Lascar Easylog EL-USB-1 which retails for around £50, or similar.

9.3 Draughtproofing works

Minor works to maintain doors and ensure draught and weather proofing should be conducted, to ensure that the doors continue to be well maintained.

Where there are any windows with opening panels, draughts can often occur. These can be addressed using black plasticene which allows windows to be opened again easily. Any rust or water ingress should be properly repaired – rust has a larger volume than the iron and will result in distortion of the frame and damage to any lead.

9.4 Relighting Scheme

The church is lighted with a large number of 70W spotlights (66) , 118mm halogen floodlights and large 400W floodlights, plus 12 theatre lights. This has an estimated load of about 18kW.

Replacement 118mm LED units have been tried, but found to flicker, and have not been as bright as the originals. Larger LEDs of higher lumen output will not fit in the luminaires.

The church wants to retain a dimmable system, and has been quoted £15,000 for a relighting scheme with new controllers.

It is recommended that the church replaces its lighting with LED units which will lower operational expenses. Lowering a15,000kWh annual use by 80% will save £1,867 at current prices.

9.5 Heating – Investigate Ground Source Heat Pump to Replace Gas Boiler

The church is fitted with underfloor heating which is compatible with a Ground Source Heat Pump. The unit could be accommodated in the existing boiler room.

The church has very little surrounding land within its curtilage.

It is recommended that the wardens visit St Mary the Virgin church in nearby Ashford, a large town centre church with a GSHP system using boreholes radiating under the churchyard to serve underfloor heating in the nave.

An Air Source system has lower efficiency and would require a site to be found for large external fan units – the space between church and hall may not be sufficient, and this would then take space out of the playground area to the east of the building, behind the wall on the right below.

GSHP Capital costs at £1,000 per kW, replacing a 78kW boiler= £78,000

GSHP Operating costs

At CoP 4; 70,000kW annual heat requirement needs 17,500kWh electricity, with 78kW heat requiring 19.5kW electricity input.

At 15.56p/kWh, the cost is £2,723 p.a. (without solar panels)

9.6 Solar Photovoltaic Panels

Current church plus hall electricity use is around 30,500kWh.

Reduction of lighting use by 80% following the relighting scheme could lower this by 12,000kWh, in addition the hall is to be relit giving savings of around 1,000kWh.

A GSHP would add 17,500kWh. Not all of this could be supplied by a solar PV installation as the main heating demands occur during evenings and winter days with low light levels. However, and underfloor system can be used to store heat when the sun is shining.

The new total load would be around 35,000kWh. It is worth obtaining detailed figures for consumption post LED and heat pump installation, because a solar PV system needs to be appropriately sized. The former feed in tariff scheme has ended, so it is no longer the case that a maximum sized system can recoup its cost by exporting to the grid.

It is recommended that an SPV system is added after relighting and a heat pump, so it can be optimally sized.

The roof has valleys between the north aisle and nave, and nave and south aisle, which offer up to 200m^2 of area. At 0.15kW peak/m2 this can generate 30kW. A 1kWpeak system can generate up to 1000kWh annually.

Assuming that the *maximum* amount of roof space could be, and was used for panels, the following formula calculates annual generation.

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

The angle of the church roof is approximately 40^o.

Roof Section	Useable area / m^2	System Size / kW peak	Orientation factor	Shading factor	Annual Generation, kWh
Church	200	30	170 degrees / 40^0 0.98	0.8	23,500

During summer there would be an oversupply. There would still be reliance on grid electricity for winter (which should be sourced from a 100% renewable supplier).

The system should be specified for future addition of a battery, when battery costs reduce as this would extend system usefulness into the evening.

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 30 kWpeak system would cost £43,500.

10. Hall

10.1 Install LED lighting

This project has already been initiated and the 600x600mm lighting units delivered.

This is likely to reduce lighting electricity consumption by around two thirds (if 18W fluorescent tubes are replaced by 6W LED).

10.2 Replace Single Glazed Windows

The hall is currently fitted with metal framed Crittall single glazed windows which form approximately one third of the elevation below.

A building with over 40 hours weekly use hosting a nursery where the temperature may well be above 20^{o}C will benefit from double glazing.

The building has an estimated 12m2 of windows, at £550/m^2 double glazed replacements would cost £6,600

10.3 Install Loft Insulation

The loft void above the ceiling was inspected as part of this audit and found to have little or 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.

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.

For an area of approximately 175m^2 at £9.50/m^2 this would cost £1,662.

10.4 Inject Cavity Wall Insulation into Walls

The 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.

10.5 Future Installation of a Heat Pump

Retrofitting the building with new windows and insulation will reduce the heat requirement by 33%. When the boiler requires replacement (by 2035), installing a heat pump with a 10kW output (the current building heat requirement is 15kW) will allow the building to become zero carbon buying 100% renewable electricity.

Closer to the time, quotations should be sought for installers for an Air Source Heat Pump (giving around 2.5 times heat per kWh of electricity used) if the radiator network is in good health.

In addition, Air to Air Source Heat Pumps should be investigated. This will require internal fan units; probably two to three external units located under windows can supply fan units directly inside, so there would be no long runs of pipework.

In both cases, systems which can deliver cooling as well as heating should be specified.

Capital costs are currently around £400 per kW output, but these may fall in real terms as the technology becomes widespread.

11. Office

The office building is a former house with two or three workstations inserted in most rooms except the kitchen, eleven workstations in total. It is in use from 07:30 to 17:00 five days per week and thus would benefit from a full range of energy saving and insulation measures.

It is constructed of brick with solid walls and a tiled upper storey, which may be wooden framed.

The windows appear to be double glazed.

11.1 Hot Water Tank

A domestic sized hot water tank is fitted upstairs. This is likely to be a 50 to 60 litre tank, which keeps this volume of water heated to above 65oC (for salmonella safety). It is considered unlikely that this amount of hot water is used regularly if at all. If the tank is to be kept, then it should be insulated properly at the rear as the jacket is poorly fitted. If large amounts of hot water are not required for showering or laundry, it should be removed (gaining extra storage space).

It is recommended that an instantaneous point of use water heater be fitted if there is a regular requirement for hot water for washing up, etc. A "Zip" unit similar to that installed in church (but probably smaller) is suggested. If use is very low, a kettle will suffice.

11.2 Computer Power Management

Adjust settings on workstations to allow prompt automatic hibernation of PC's and monitors when not in use.
All computers can be shut down or put into a hibernate mode. This tends to be due to the multi-function process that is required to do this. It is therefore recommended that all computer workstations set to go into hibernate mode after a short period of time of not being used.

This can be set on the computers by going into the Power Options settings on the computers control panel and adjusting the times on the 'change when computer sleeps' option. It is recommended that computers should turn off their display after 2 minutes and put the computer to sleep after 5minutes. Putting the computer to sleep will not lose any unsaved work but will require the user to power up the computer again when returning to their desk. Having shorter hibernate modes not along helps to save energy but also improves security by reducing the time that computers are left on but unsupervised.

11.3 Loft Insulation

The loft was not inspected.   It should be insulated up to the current standard of 270mm of insulation.

11.4 Replace Fluorescent Lighting with LED

When the lighting requires replacement, the current fluorescent lights, mostly 58W units should be relaced by LED units.   Equivalent step lights of around 30W, or individual posable LED lighting e.g. 4 x 5W bulbs on a bar.

11.5 Replace Hall Boiler with a Heat Pump

The current boiler is a Thorn Olympic, which has a visible pilot light, suggesting it is around 30 years old.

Quotations should be sought and a plan made to replace the boiler before it fails.

it is recommended that the heat pump does not supply hot water – this should come from an instantaneous heater or kettle.

installing a heat pump with a 7kW output will allow the building to become zero carbon buying 100% renewable electricity. It will probably be cost effective to size heat pump for "normal" winter requirements, and use portable electric heaters if there is an extremely cold period, rather than installing a larger and more expensive unit than is required for 99% of the time.

Quotations should be sought from installers for an Air Source Heat Pump (giving around 2.5 times heat per kWh of electricity used) if the radiator network is in good health.

In addition, Air to Air Source Heat Pumps should be investigated. This will require internal fan units which would require some disruption during fitting. The appearance of the building does not support external AASHP units on the outside at all positions – as for an ASHP there would need to be one unit, probably at the back (in the courtyard / bin area below?).

In both cases, systems which can deliver cooling as well as heating should be specified.

Capital costs are currently around £400 per kW output, but these may fall in real terms as the technology becomes widespread.

12. Community Centre

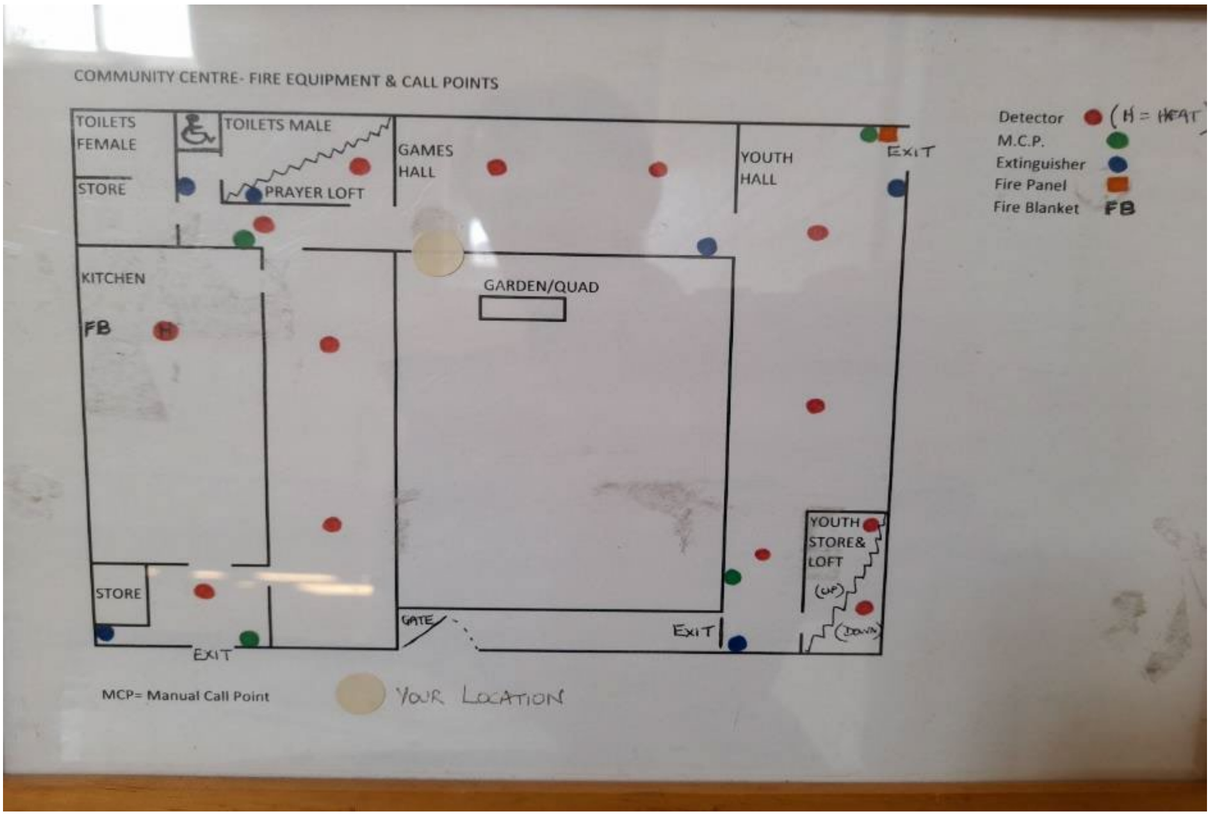
This building, which is similar in form to a small primary school, consists of three halls surrounding a central courtyard.

These are:

Entrance lobby (left of site) + Kitchen + “Yellow” Hall (left hand gable roof) with small room on second floor at rear (the Prayer Room)

Games Hall

Youth Hall (right hand gable roof)



Both boilers appear relatively old.

The use pattern has become sporadic. It is recommended that each hall is heated separately, rather than having to heat the whole complex if only a third or less is in use.

Recommended Interventions are as follows:

12.1 Door draughtproofing

The main entrance door would benefit from some draughtproofing. This could employ "E" or "P" cross section adhesive rubber.

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

12.2 Relighting

In the areas presently lit by fluorescent tubes, the 20 x 58W units can be replaced by 35W LED equivalents. This becomes worth doing with significant hours of use, but is not a priority if use remains light.

12.3 Install Air to Air Heat Pumps

Ideally, each hall should be heated separately. Installation of Air to Air heat Pumps with individual external units (located under windows) serving one or two internal fan units will mean limited new plumbing. The higher CoP (about 4) of AASHP compared to ASHP of about 2,5 gives greater operating efficiency, lower running cost and the fan units should be arranged to blow warm air across the floor. This will achieve much quicker heating than a radiator based system and reduce maintenance. AASHP units could be installed one hall at a time to spread the costs.

The whole building has an estimated heat load of 43kW. Unless it transitions to becoming a regularly used building, like the nursery hall, it is not worth double or secondary glazing the remaining single glazed windows (if windows do require replacement, DG units should be specified).

Estimated ASSHP costs for the whole building at the current estimate of £450 per kW delivered = £19,350.

13. Saving Recommendations (Water)

13.1 Tap Flow Regulators

In toilets, which are regularly used by children, it is recommended that tap flow regulators are installed. 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.

14. 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 – see section 9.6
Battery Storage	Future potential
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 for office, possible for hall
Ground Source Heat Pump	Yes for church
Air to Air Source Heat Pump	Yes for hall, community centre.

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-2020.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.