ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St John the Baptist
PCC of St John the Baptist

Diocese of Liverpool

Author	Reviewer	Date	Version
Tamsin Hockett	David Legge	8th June 2021	1.0

Contents

1. Executive Summary

An energy survey of St John the Baptist was undertaken by ESOS Energy to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St John the Baptist church was built around 1875. The church is heated from a direct fired gas blown air system mounted within the tower, as well as a handful of electric panel and infrared heaters to ancillary spaces. The hot water is provided by point of use hot water heaters to the kitchen and WCs. The lighting in the church is provided by inefficient SON floodlights and metal halide spotlights. 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)
Install SavaWatt devices on fridges and freezers	140	£20	£50	2.55	List A (None)	0.04
Fit timed fused spurs to hot water heaters	324	£45	£180	3.97	List A (None)	0.08
Fit flow regulators onto existing taps	109	£3	£15	4.58	List A (None)	0.02
Add or Replace draught strips to external doors	2,247	£67	£600	8.90	List A (None)	0.41
Fit 270mm of insulation into the roof space	11,235	£337	£4,400	13.05	Faculty	2.07
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	8,345	£1,168	£16,187	13.85	Faculty	2.11
Replace heating system for electrical based heating solution	97,252	£1,257	£46,560	37.04	Faculty	16.91
Install PIR motion sensors on selected lighting circuits /	49	£7	£421	61.76	List B	0.01

Adjust settings on existing PIRs						
Add secondary glazing to windows	11,235	£337	£24,000	71.21	Faculty	2.07
Change existing lighting for low energy lamps/fittings	1,490	£209	£38,002	182.23	Faculty	0.38

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

Based on current contracted prices of 14p/kWh and 3p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £3,450 per year.

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 St John the Baptist has also declared a climate emergency and has an ambition to be carbon neutral by 2035 and has recently implemented a policy that will not allow the replacement of oil heating systems.

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

An energy survey of the St John the Baptist, St John Street, Earlestown, WA12 9NW was completed on the 23rd March 2021by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

St John the Baptist	
Church Code	622203
Gross Internal Floor Area	554 m^2
Listed Status	Unlisted

The church typically used for 8 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	3 hours per week	
Community Use	4 hour per week	

There is additional usage over and above these times for festivals, weddings, funerals and the like.

4. Energy Procurement Review

Energy bills for gas and electricity have been supplied by St John the Baptist and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single	14p/kWh	Below current market rates

The current gas rates are:

Single	3p/kWh	In line with current market rates
Standing Charge	0.39p/day	N/A

The above review has highlighted that the current rates being paid are in line or below current market levels and the organisation can be confident it is receiving good rates and should continue with their current procurement practices.

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	100% not charged	The correct CCL rate is being applied declaration will remove this charge.

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

5. Energy Usage Details

St John the Baptist uses 9,058 kWh/year of electricity, costing in the region of £1,268 per year, and 112,348 kWh/year of gas, costing £3,370.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St John the Baptist has one main electricity meter, serial number A02M41491. There is one gas meter serving the site, serial number E040K00766 14D6.

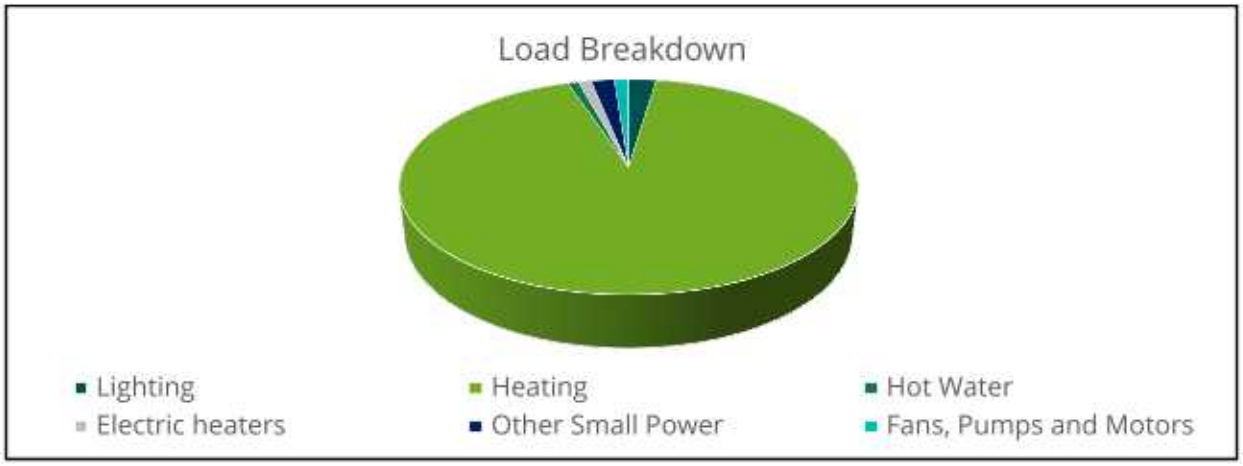
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	A02M41491	Ampy 5192F	Yes but no AMR connected	Organ chamber east wall
Gas – Church	E040K00766 14D6	Elster BK-G25E MDK40	Pulse Capable, no pulse block or AMR connected	South porch, base of tower

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

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Main church is lit by inefficient SON floodlights and metal halide spotlights	2%
Heating	Provided by a direct gas fired blown air system supplemented by ceiling mounted de-stratification fans.	93%
Hot Water	Electric point of use water heaters to kitchen and WCs	1%
Electric Heaters	Smaller areas heated by electric panel and near infrared heaters.	1%
Other Small Power	Sound system, organ, screens, alarm systems, kitchen appliances and other plug-in loads	2%
Fans, Pumps and Motors	Heater and de-stratification fans	1%



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 for church energy use St John the Baptist uses 18% less electricity and 35% more 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
St John the Baptist (elec)	554	9,058	16.35	20.00	-18%
St John the Baptist (gas)	554	112,348	202.79	150.00	35%
TOTAL	554	121,406	219.14	170.00	29%

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. Putting in place a heating strategy that is energy efficient and low carbon is, therefore, of the highest priority

The Church of England is in the process of reviewing its heating guidelines. The process has already established some principles for heating that can help churches as they seek an acceptable combination of comfort, conservation, affordability, and environmental care. The principles can be found at https://www.churchofengland.org/sites/default/files/2020-04/CBC%20Heating%20guidance%20principles%20FINAL%20issued.pdf

As the principles make clear, every church's strategy will be unique to it, informed by many factors, including the nature of its usage, the system it's starting from, the conservation needs of the building, and the resources available. The strategies in this audit are designed specifically for your church.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches we make recommendations that will help to reduce energy wastage and, as a starting point, to optimise the system that you already have

Secondly, we recommend options for many churches that focus on heating people rather than the full volume of the church. Some of the changes that can help with this will be 'soft' changes – others will relate to the heating system itself.

Finally, we make recommendations about moving away from fossil fuels. Moves away from fossil fuels are key to cutting emissions. For most churches, this will involve moving from gas, oil or LPG to electricity. Electricity currently creates carbon emissions around the same level as mains gas, but the carbon emissions associated with it are reducing rapidly as the UK builds more renewable energy and decommissions its remaining oil and 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'. Some local areas may also be considering the option of district heating networks.

While moving away from fossil fuels may not always be possible, as the principles state, "churches should be expected to have at least carefully considered the option of moving away from fossil-fuel based heating (gas and oil boilers) towards electric-based heating." And if such options are not viable now, the churches "can try to be ready for a future retro-fit when technology and the grid has progressed."

The current gas blower arrangement replaced an oil heating system to perimeter radiators. However, it is reported that the system creates draughts throughout the church and isn't particularly effective.

The primary issue comes when pews are removed from the church and a large space is created that does not allow any fixing of heat sources – i.e. there are no fixed walls or seating to site radiators/heaters and it then becomes very difficult to heat the large open space. Therefore, the current solution probably isn't an altogether bad one and the use and control of the heater was well understood by the wardens. In future, services (where congregation sizes and Covid-19 rules allow) could be held in the chancel as it is slightly more enclosed and wall mounted electric

far IR panels could be mounted to the walls here to provide more localised heating and thus make the need for the gas heater redundant. If services are to be held in the church using the nave for seating, the central area of the nave will remain cooler due to the issues of siting heaters. Alternatively, ceiling hung pulsar heaters could be introduced but would be unsightly and not fit aesthetically well. This may be worth considering in the longer term as once the gas fired heater has reached the end of its serviceable life, it should be replaced with electric heating in some form.

As a related note, underfloor heating is not recommended unless the church is used for the majority of the week; for the current twice weekly usage, underfloor heating would not be viable due to the long warm up times and the heat loss to the air volume and through the building fabric.

If ceiling mounted pulsar heating were to be introduced to the nave to create a warmer environment, we recommended installing 24 Infrared heaters in the church, called Pulsar 2400W. An example of what they are https://www.theecostore.co.uk/eco-store/herschel-advantage-pulsar-infrared-heater/. They would require to be ceiling hung on a gripple so would detract from architecture but would be the most effective way to heat the area.

7. 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.

7.1 New LED Lighting

The lighting makes up a relatively small overall energy proportion of the electricity used within the church, and large areas are lit by relatively inefficient fluorescent/SON fittings within the church.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. 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 all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £38.002. The annual cost saving would be £209 resulting in a payback of around 182 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.

There are some fittings such as the hall, WC's, store and porch where the existing fitting 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.

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as corridors, toilet areas, staircases, and the like. Some of these areas are only used occasionally and for a short amount of time so that, in actuality, the light does not need to remain on constantly. There are also spaces which benefit from a good amount of natural daylight coming in through the windows, such that artificial lighting is not required for much use during the year.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some fluorescent lights). These movement sensors, commonly called PIRs, also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

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.

7.3 Refrigeration Controls

There is a domestic fridge-freezer unit in the kitchen. This unit runs 24/7 and contribute to the baseload electrical consumption of the building.

To reduce the electrical consumption of these appliances it is recommended that they are all fitted with a SavaControl unit. These units work by automatically detecting the load of the compressor and turning down the power when it is not in full load. This reduces the energy consumption of the refrigeration unit by around 18% while maintaining the cooling of the appliance. It does this by reducing the voltage delivered to the unit when it is idling but allowing the full energy to the unit when it is required.

Supply and installation and further details can be undertaken by SavaWatt directly http://savawatt.com/. The installation does not cause any significant disruption to operations and can be undertaken during normal operating times.

7.4 Timers on Fused Spurs to Water Heaters

There are various electric hot water heaters (hand washing) and water boilers (for tea making and the like) located in the WC and kitchen areas. These only need to heat the water to the required temperature when the building is in occupation but at the moment these heaters are

directly wired in without any form of time control and therefore maintain their set temperature 24/7.

It is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied. This will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

Such units can be purchased at any electrical wholesaler and fitted by your existing electrician or any NICEIC registered electrical contractor.

7.5 Draught Proof External Doors

There are a number of external doors in the building. These have the original historic timber doors on them, but these do not close tightly against the stone surround and hence a large amount of cold air is coming into the building around the side and base of these doors.

It is recommended that draught proofing is fitted to all external doors where there is timber doors closing 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

7.6 Secondary Glazing

The windows of the building are singled glazed with metal frames and whilst double glazing could be installed, it is not considered that this would offer a financially viable measure and would also be a significant disruption to operations.

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 can provide very discrete and appropriate systems for all types of spaces.

7.7 Insulation to Roof

The loft void above the barrelled ceiling was reported 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.

Because heat rises, the ceiling/roof of a building is the largest contributing area to heat loss from a building. The insulation of such spaces can therefore have a dramatic impact on both the efficiency of the heating system and the temperature of the space below. Insulation measures such as this also need to be combined with control measures such as TRV's or room sensors to ensure that the space does not overheat because of the additional insulation.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 930 9689, adrian@esos-energy.com).

8. Saving Recommendations (Water)

8.1 Tap Flow Regulators

The taps to the wash hand basins within the building have been checked as part of the audit and the average flow rate within these has been estimated to be 8l/min based on the type of taps. The recommended flow rate for hand washing is 4.8l/min and therefore the taps are providing around double the amount of water that is necessary.

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. 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 - panels viable on south aisle and south nave roof, although visible
Wind	No – no suitable land away from buildings
Battery Storage	No – no viable PV
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	No – insufficient electricity supply
Ground Source Heat Pump	No – archaeology in ground and radiator system

There is potential for a small PV array on the roof of the South Aisle and south facing Nave roofs. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. As and when electric heating is introduced to replace the gas heater in the longer term, solar panels may be more viable but it is likely they would be installed alongside batteries.

Battery Storage is not strictly a renewable energy solution, but battery storage does however provide a means of storing energy generated from solar PV on site to be able to be used at peak times or later into the day when the PV is no longer generating. It therefore extends the usefulness of the existing PV system particularly in this sort of church. This is a new but fast-growing technology with prices expected to fall substantial over the next 2 to 3 years.

10. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available at https://www.parishresources.org.uk/wp-content/uploads/Charitable-Grants-for-Churches-Jan-2019.pdf .

11. Faculty Requirements

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

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

Under the new faculty rules;

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

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also 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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Church	18	3 Spot Track lights	£66	£18,000	272.54
Church	12	3 Spot Track lights	£44	£12,000	272.54
Organ room	3	5ft Single LED	£8	£263	31.10
Vestry	2	600 x 1200 50W Panel (AG)	£9	£244	26.48
Choir vestry	5	2D LED 11W	£12	£294	23.90
First floor	3	2D LED 11W	£13	£176	13.97
Rear prayer rooms	6	2D LED 11W	£15	£353	23.90
Porch	3	2D LED 11W	£4	£176	45.43
Porch	2	50W LED Flood	£13	£240	18.99
Hall lobby	2	LED GLS	£6	£24	3.85
WC	1	2D LED 11W	£1	£59	55.16
Hall	8	2D LED 11W	£9	£470	55.16
Kitchenette	1	5ft Single LED	£7	£88	13.17
Store	2	2D LED 11W	£2	£118	55.16