ESOS-ENERGY
Energy efficient solutions

Energy Audit and Survey Report

Holy Trinity, Westbury on Trym

PCC of holy Trinity

Version Control

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of Holy Trinity was undertaken by ESOS Energy 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. 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.

Holy Trinity is a Grade I listed church dating from 1194, with an early C13 nave and aisles and C15 chancel, chapels and tower. The church has C19 reredos. There is both gas and electricity supplied to the site.

The church has a number of ways in which is 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 (£)	Simple Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)	£/tonne of CO2
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	N/A	N/A
Switch electricity (and gas) suppliers to ones which provide 100% renewable (or green gas) supplies	None	None	Nil	N/A	None	N/A	N/A
Reduce background heating	5,361	£111	£0	Immediate	List A	0.99	£0
Insulate exposed pipework and fittings in plantrooms	5,462	£113	£200	1.76	List A	1.00	£199.06

Fit Quattroseal draft proofing to historic doors and review lift draught proofing	3,217	£441	£800	1.81	List B	0.99	£809.53
Fit timed fused spurs to hot water heaters	324	£44	£180	4.05	List A	0.10	£1,808.45
Change existing lighting for low energy lamps/fittings	1,941	£266	£2,091	7.85	List A / List B	0.60	£3,505.25
Install Endotherm advanced heating fluid into heating system	10,723	£223	£1,920	8.62	List A	1.97	£973.33
Install pew heaters to lady/side chapels for weekday services	10,723	£223	£3,200	14.36	Faculty	1.97	£1,622.22
Install PIR motion sensors on selected lighting circuits	14	£2	£48	25.19	List A	0.00	£11,242.28

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

Based on current market prices of 13.71p/kWh and 2.07p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £1,424 per year.

2. Introduction

This report is provided to the PCC of Holy Trinity to provide them with 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 Holy Trinity, Church Road, Westbury on Trym, Bristol BS9 3EQ was completed on the 13th December by 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.

Holy Trinity	605122
Gross Internal Floor Area	655 m^2
Listed Status	Grade I
Typical Congregation Size	250

The church typically used for 14.25 hours per week for the following activities

Services	8 hours per week
Meetings and Church Groups	3 hours per week
Community Use	3 hour per week
Other	0.25 hours per week

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

3. Energy Procurement Review

Energy bills for gas and electricity have been supplied by Holy Trinity and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	14.38p/kWh	In line with current market rates
Night Rate	11.28p/kWh	In line with current market rates
Standing Charge	25.62p/day	N/A

The current gas rates are:

Single / Blended Rate	2.08p/kWh	In line with current market rates
Standing Charge	341.0p/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	Not listed on invoices viewed	It should be checked that the correct CCL rate is being applied.
FIT	Not listed on invoices viewed	If a FiT charge is being applied, it should be checked that this is being charged in accordance with the supply contract.

The above review confirmed that the correct taxation and levy rates are being charged where listed on the invoices viewed.

4. Energy Usage Details

Holy Trinity uses 12,837 kWh/year of electricity, costing in the region of £1,760 per year, and 107,230kWh/year of gas, costing £2,227.

This data has been taken from the annual energy invoices provided by the suppliers of the site (see Appendix 2). Holy Trinity church has one main electricity meter, serial number E15UP12087. There is one gas meter serving the site, serial number M016A0523214A6.

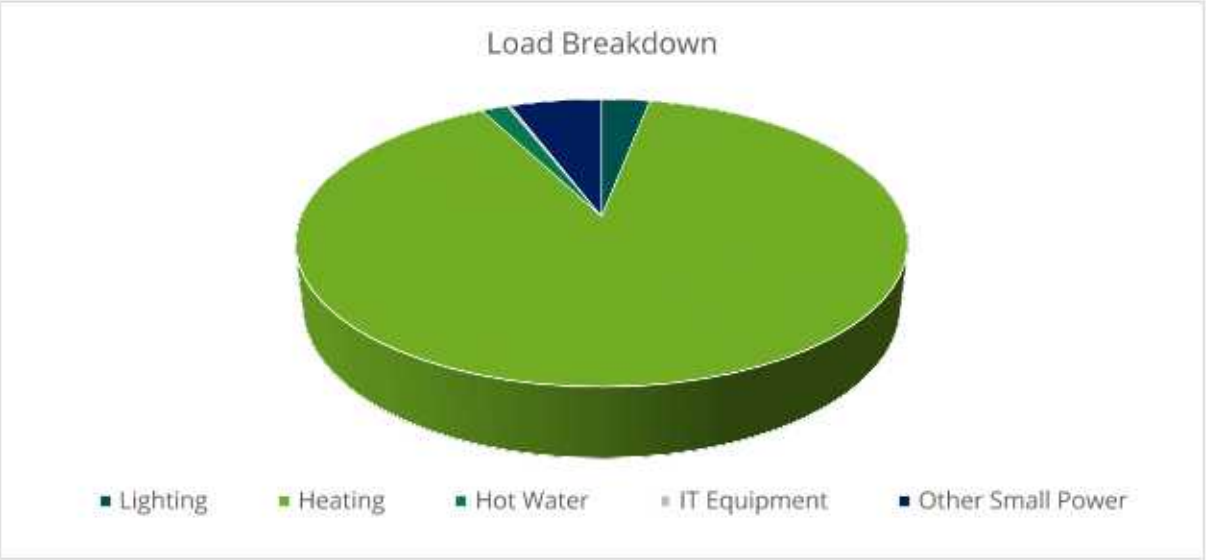
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E15UP12087	EDMI Atlas Mk 7C	Pulse output, no AMR connected	Cupboard at base of stairs
Gas – Church	M016A0523214A6	MDA 16	Full AMR Connected	Outside church office

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.

4.1 Energy Profiling

The main energy use within the church can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Predominantly LED lighting with some inefficient T8 fluorescent tube fittings in parish office, vestry, other rooms and metal halide spot lights as well as SON floodlights externally	3%
Heating	Provided by 2no. Gas fired condensing boilers to perimeter radiators throughout	89%
Hot Water	Electric point of use water heaters to wash hand basins	2%
IT Equipment	Computer workstation in parish office	0%
Other Small Power	Overdoor heater, small kitchen appliances, organ, sound system, alarms, CCTV and other plug loads	6%



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

4.2 Energy Benchmarking

In comparison to national benchmarks[1] for Church energy use, Holy Trinity uses 2% less electricity and 9% more heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Holy Trinity use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
Holy Trinity (elec)	655	12,837	19.60	20.00	-2%
Holy Trinity (heating fuel)	655	107,230	163.71	150.00	9%
TOTAL	655	120,067	183.31	170.00	8%

[1] CofE Shrinking the Footprint – Energy

5. Energy Saving Recommendations (Electricity)

5.1 Lighting (fittings)

The lighting makes up a relatively small overall energy load within the building. The church has clearly made a dedicated effort to up-grade the majority of the lamps in the church over time to LED fittings. There are however a small number of lamps which are still the relatively inefficient fluorescent and SON fittings.

In the Chancel and Lady Chapel there are a number of AR111 spot lights, which can be replaced with new LED fittings. The other areas noted were a number of fluorescent tube fittings in the St Peters Room, the Vestry and the Parish Office. All of these fittings are widely available on the market and it is suggested that the complete fitting (not just the lamp) is replaced. Any new LED fitting would have a much longer life and hence reduce the need to replace the lamps in the ceiling.

For the replacement lights the Megaman range of LED lights https://www.megamanuk.com/products/led-lamps/reflector/ provides some very suitable substitutes to the current lamps.

It is recommended that all of the fittings, scheduled in Appendix 1, are changed for LED.

If all the lights were changed the total capital cost (supplied and fitted) would be £2,091. The annual cost saving would be £266 resulting in a payback of around 7.8 years. Many of the lights could be self-installed and therefore cost much less than the supply and fit cost above. In this case the £150 grant available through this process could be very usefully employed to fund the purchase of replacement LED lamps which the church installs themselves.

5.2 Lighting (control for internal lights)

There are several lights which currently remain on all the time in areas such as the Rooms, Robing Cupboard and the like. Some of these areas are only used occasionally and for a short amount of time and as such, 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 where artificial lighting is not required for much of the year during the day.

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.

5.3 Timed Fused Spur to Hot Water Heaters

There are a number of electric point of use hot water heaters for hand washing and water boilers (for tea making) located around the church. 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 hand washing water heater in the kitchen is fitted with a timer switch which can pressed to turn the power on for a predetermined amount of time, for example, from ½ and hour to 2 hours. An example of such a unit would be the 'Timeguard 2 Hour Electronic Boost Timer & Fused Spur'. Units with longer time periods are also available. This then allows the use of the unit to be flexible to meet the needs of the church. This could also be applied to the hot water boiler and the hand washing water heaters in the WCs.

If however, the church would prefer to choose a timer for predetermined and regular times, a 24 hour/7 day timeclock to replace the fused spur switch could be used instead. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied and this will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

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

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Pew Heaters

The church currently uses two gas boilers to heat the church and the adjacent church office. This is reported to work well and provides adequate thermal comfort into the church. Given that the system is successful and not overly wasteful of energy we would recommend that this system is continued with and consideration is given to the following improvements

The one adjustment that is recommended is for the installation of pew heaters in the side chapels for use in the smaller and more intimate services during the week where the congregation size is significantly smaller. The pew heaters would heat the people directly for the service, rather than the whole church, which would reduce the gas consumption and improve the thermal comfort of those attending.

Two of the most popular under pew heaters within churches are the BN Thermic PH30 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating. Cable runs to the pew heaters could run along the North and South walls (all cabling should be in armoured cable or FP200 Gold when above ground) to the both rows of pews quite easily.

6.2 Reduce / Discontinue Background Heating

As with most medieval churches, this church would have survived most of its life without any form of heating. The modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The only times when background heating may be required is if there are historic wall paintings or to for the preservation of large artefacts such as tapestries. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive and organs can be installed with a local background tube heater such as https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat within the organ casing in order to provide the heat where it is required. The fabric is often subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates)

Providing constant background heating to the church building as a whole at a level of 14°C is excessive and wasteful of energy. At the very least we would recommend that this background level is reduced to a maximum of 12°C and ideally avoided all together.

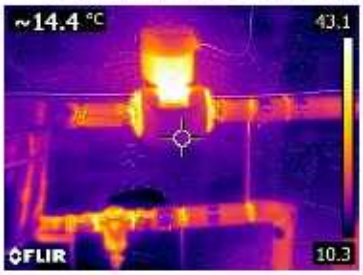
6.3 Endotherm Advanced Heating Fluid

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.

6.4 Insulation of Pipework and Fittings



The pipework within the plant room has the majority of its straight lengths insulated but the more complex shaped pipework fittings, such as valves, have been left uninsulated. These exposed areas of pipework contribute significantly to wasted heat loss from the system and make the plant room unnecessarily warm. The exposed hot surfaces also represent a health and safety risk of burns for those working in the area.

It is recommended that these areas of expose pipework and fittings are insulated with bespoke made flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

A free survey and quotation for the supply and installation of insulation of pipework fittings can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 9309689, adrian@esos-energy.com).

7. Energy Saving Measures (Building Fabric)

7.1 Draught Proofing to 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 church around the side and base of these doors.

The addition of the draft lobby at the front of the church, along with the automatic doors has reportedly made a significant difference in the amount of cold air coming into the church when the members of the congregation are arriving for a service. However it was noted during the audit that there is sizable gap at the bottom of the lift door, which is leading to a draft of cold air entering the church under it. Given the accessibility nature of the lift door, a draft strip attached to the door would be the most suitable solution.

For any of the other external doors, where a timber door closes against a timber frame it is recommended that draught proofing is fitted. 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. Note this cannot be used where the timber door closes directly against a stone surround.

Other simple measures such as using a small fridge magnet painted black over the large keyhole or the use of 'sausage dog' type draught excluders at the base of little used doors can prove to be very effective. Doors should be reviewed in daylight and gaps where the light shines through sealed or filled in whatever the most appropriate way is for the specific door.

8. Other Recommendations

8.1 Electric Vehicle Charging Points

The church has a small car park to the front of the church. 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.

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 church to be able to sell tokens or have a coin operated device that would at least cover the costs of the electricity use and could make a small income. As the hall is a place of work for the pre-school users it may be able to benefit from a grant to part cover the installation costs of a charger from https://www.gov.uk/government/publications/workplace-charging-scheme-guidance-for-applicants-installers-and-manufacturers

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	No – 4kWp array already installed
Battery Storage	Possible future consideration
Wind	No – no suitable land away from buildings
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Ground Source Heat Pump	No – archaeology in ground and radiator system
Air Source Heat Pump	No – insufficient electricity supply
Biomass	No – not enough heating load as well as air quality issues

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 therefore investment into batteries may be worth delaying at this stage.

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-Nov-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.

12. Report Circulation

In addition to the PCC, this report is also sent to:

1. Your DAC secretary and your DEO, because
    - They maybe be able to offer you help and support with implementing your audit
    - They want to look across all the audits in your diocese to learn what the most common recommendations are.

    Catherine Ross, the officer in the Cathedral and Church Buildings team centrally who leads on the environment, who wants to learn from all the audits across the country. She will be identifying cost-effective actions churches like yours might be able to make.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
St Pauls Room	2	5ft Single LED	£27	£187	7.05
St Peters Room	3	5ft Single LED	£17	£281	16.65
Robing cupboard	2	2D LED 7W	£1	£109	74.15
Vestry	1	5ft Single LED	£6	£94	16.65
Lady chapel / chancel	8	AR111 LED	£59	£356	6.09
Lady chapel / chancel	2	AR111 LED	£13	£89	6.62
Parish office	2	5ft Single LED	£27	£187	6.85
External	2	50W LED Flood	£74	£183	2.46
External	2	2D LED 11W	£42	£244	5.80