Energy Audit and Survey Report

St Peter and Paul's Church, Newport Pagnell

"There is a plan to reduce global carbon emissions to net zero by 2050. The plan will work. It involves all of us. We need to begin now, in our homes and workplaces and churches"

Revd Dr Stephen Croft, Bishop of Oxford

Version Control

Author	Reviewer	Date	Version
Matt Fulford	Marisa Maitland	11th March 2020	1.0

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1. Executive Summary

An energy survey of St Peter and Paul's Church, Newport Pagnell was undertaken by Inspired Efficiency Ltd to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use.

St Peter and Paul's Church, Newport Pagnell is Grade 1 listed parish church dating back to the 14th century with various additions and alterations occurring up to the 20th century. 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 (£)	Payback	Permission needed	CO2 saving (tonnes of CO2e/year)
Contact suppliers to arrange for the meters to be changed to smart meters	None	None	Nil	N/A	None	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
Change existing lighting for low energy lamps/fittings	2,909	£384	£1,404	Low	List A / List B	0.89
Install PIR motion sensors on selected lighting circuits	37	£5	£35	Low	List B	0.01
Install Endotherm advanced heating fluid into heating system(s)	5,244	£109	£1,440	Moderate	List A	0.96
Optimise control settings to reduce background heating in afternoons	10,488	£411	£600	Very Low	List A	2.14
Install 6kWp small PV array on south aisle roof	5,400	£713	£8,000	Moderate	Faculty	1.66
Fit draft proofing to historic doors	1,049	£22	£800	High	List B	0.19

Insulate ceiling, floor and add secondary glazing to vestry and create more comfortable meeting space	2,098	£43	£4,000	High	Faculty	0.39
With proposed reordering, install insulation under existing pew platform areas, relocate some radiators and replace boilers	5,821	£120	£30,000	High	Faculty	1.07
Convert chancel to electric heating (under choir stalls, panel to altar and remove column radiators)	6,597	£137	£5,000	High	Faculty	1.21
To parish office, install secondary glazing at window, insulate floor and ceiling, use chimney balloon	543	£72	£5,000	High	Faculty	0.17

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

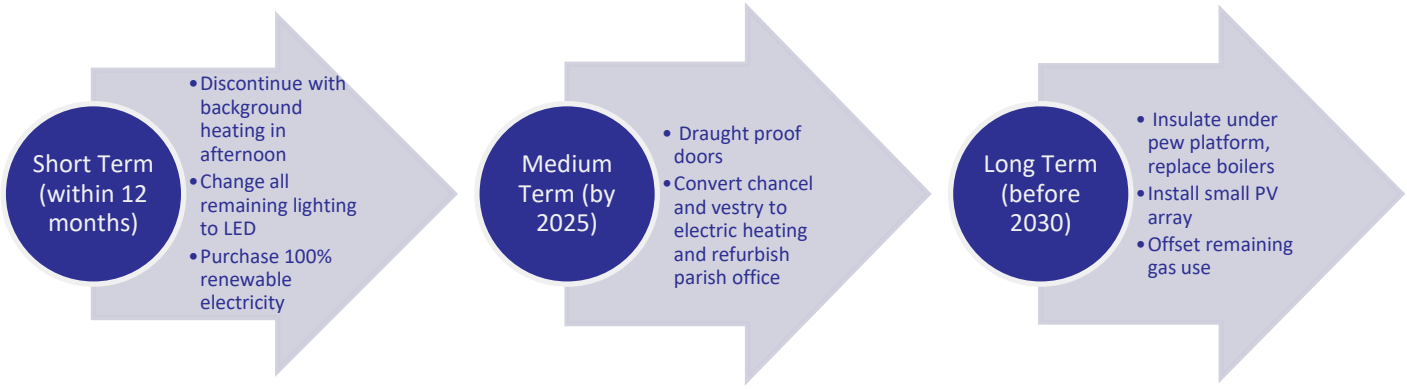
Based on current contracted prices of 13.21p/kWh and 2.07p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £2,000 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 also declare a climate emergency and have an ambition to be carbon neutral by 2030.

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 St Peter and Paul's Church, Newport Pagnell 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 St Peter and Paul's Church, Newport Pagnell, High Street, Newport Pagnell, MK16 8AR was completed on the 27th February 2020 by Matt Fulford. Matt is a highly experienced energy auditor with over 15 years' experience in sustainability and energy matters in the built environment. He is a chartered surveyor with RICS and a CIBSE Low Carbon Energy Assessor. He is a Member of the DAC in the Diocese of Gloucester and advises hundreds of churches on energy matters.

St Peter and Paul's Church, Newport Pagnell	
Gross Internal Floor Area	680 m^2
Listed Status	Grade I
Typical Congregation Size	60

The church typically used for 26 hours per week for the following activities

Services	6 hours per week
Parish Office	20 hours per week
Community Use	-

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 Peter and Paul's Church, Newport Pagnell and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	13.212p/kWh	In line with current market rates
Standing Charge	34.164p/day	N/A

The current gas rates are:

Single / Blended Rate	2.0698p/kWh	In line with current market rates
Standing Charge	£2.75/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. We would therefore recommend that the church obtains a quotation for its gas and electricity supplies from the Diocese Supported parish buying scheme, http://www.parishbuying.org.uk/energy-basket. This scheme only offers 100% renewable energy sourced energy and therefore it is 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.

5. Energy Usage Details

St Peter and Paul's Church, Newport Pagnell uses 10,433 kWh/year of electricity, costing in the region of £1,380 per year, and 52,439kWh/year of gas, costing £1,090.

This data has been taken from the annual energy invoices provided by the suppliers of the. St Peter and Paul's Church, Newport Pagnell has one main electricity meter, serial number E14UP10165. There is one gas meter serving the site, serial number M025K0214216D6.

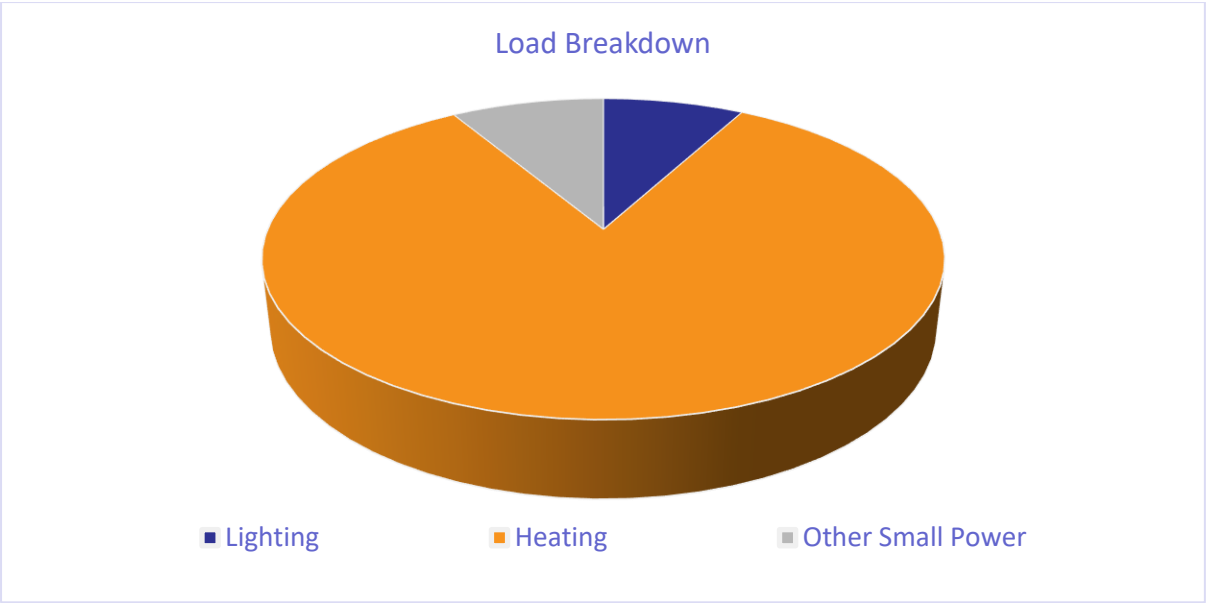
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E14UP10165	3 phase 100A	Yes – full AMR meter	Internal to left of main door
Gas – Church	M025K0214216D6	Elster BK-G16M	Yes – full AMR connect	Vestry

All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has not been provided for the purpose of this report and access to the suppliers data portal should be arranged to facilitate the church being able to review its consumption patterns.

5.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	LED lighting to chancel, compact fluorescent to nave.	8%
Heating	Gas fired boiler providing heating to all main areas of the church	83%
Other Small Power	Electric heating and office appliances to parish office, sound system, organ and the like	9%



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 Peter and Paul's Church, Newport Pagnell uses 23% less electricity and 49% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St Peter and Paul's Church, Newport Pagnell use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Peter and Paul's Church, Newport Pagnell (elec)	680	15.34	20	10	-23%
St Peter and Paul's Church, Newport Pagnell (heating fuel)	680	77.11	150	80	-49%
TOTAL	680	92.45	170	90	-46%

6. Energy Saving Recommendations

6.1 Lighting (fittings)

The lighting within the chancel has already been replaced with a good quality LED lighting scheme. The lighting in the nave is on pendant fittings and the lamps (bulbs) within these would be easily replaced with a new lower energy LED lamp. These fittings are widely available on the market. The church may wish to consider a completely new light scheme in the nave but the costs of such have not been considered in this report. If a new lighting scheme is consider it should be LED and the energy usage considered as key consideration of the project.

There are also three lights in the vestry that would benefit from change to new LED fittings and a fitting similar to https://www.qvisled.com/copy-of-proteus would be very suitable.

If all the lights were changed the total capital cost (supplied and fitted) would be £1,404. The annual cost saving would be £384 resulting in a payback of around 3.7 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.

6.2 Lighting (control for internal lights)

In addition to the above it is recommended that a motion sensor is installed on the vestry lighting circuit 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

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.

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 supplied and self-installed.

6.4 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)

The church currently schedules the heating to be on from 3pm to 5pm every afternoon as a form of background heating. The church is closed during these times. The heat that will be put into the church during this time would have dissipated by the morning and therefore will not be providing any useful purpose to provide comfort. It is recommended that this practice is discontinued and that the church is heated for the morning period only when it is occupied.

6.5 Revised Heating Strategy

The church is currently considering a reordering of its nave and is therefore considering heating solutions as part of this. It was noted that this reordering also includes the creation of additional meeting room type space.

After much consideration on site, the recommendation is to remove some specific areas off the gas boiler system so that these can be heated up independently and with a method that responds to the net zero carbon future. This would mean electrically heating the vestry and chancel. The parish office would continue to be electrically heated but would benefit from greater insulation and draught treatment. The nave itself would be most efficiently heated by continuing to use the current gas fired radiator system but only for times when it is used. This approach would avoid the need for extensive (and carbon intensive) construction works associated with running in an entirely new system for the nave.

Vestry: The vestry could be refurbished and used as a very comfortable meeting space. To achieve this, it is recommended that the suspended timber floor is insulated from below, the ceiling has insulation added to it and the plain, domestic scale windows a have secondary glazing installed on them. Suitable good quality secondary glazing can be obtained from companies such as https://www.selectaglaze.co.uk/heritage-listed-buildings. The external door should also be fully draught proofed. This space could then be very successfully heated using suitable electric panel heaters, these would be far infrared panels such as https://www.warm4less.com/p/1200-watt-platinum-white/ . It is recommended that they are fitted with a time delay switch such as https://www.danlers.co.uk/time-lag-switches/77-products/time-lag-switches/multi-selectable-time-lag-switch/159-tlsw-ms so they cannot be left on accidently after use.

Chancel: The chancel has a number of choir stalls down each side (although it was noted that to make these usable some adaptation would be required to establish a comfortable seating position especially on the front row). To heat these and the space around them it is suggested that electric under pew heaters are installed.

The two most popular under pew heaters within churches are 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 under the pew platforms (all cabling should be in armoured cable or FP200 Gold when above ground) to the both rows of choir stalls quite easily.

A panel heater could then be installed directly behind the altar and the two radiators and pipework running to these from the vestry could then be removed. This would allow the chancel and altar area to be heated and used independently of the rest of the church which may be suitable for smaller services. There would be some sense in undertaking this work as an early phase so that there is a heated area in which services can be held in case of the existing boiler failing and/or while reordering works are going on in the nave.

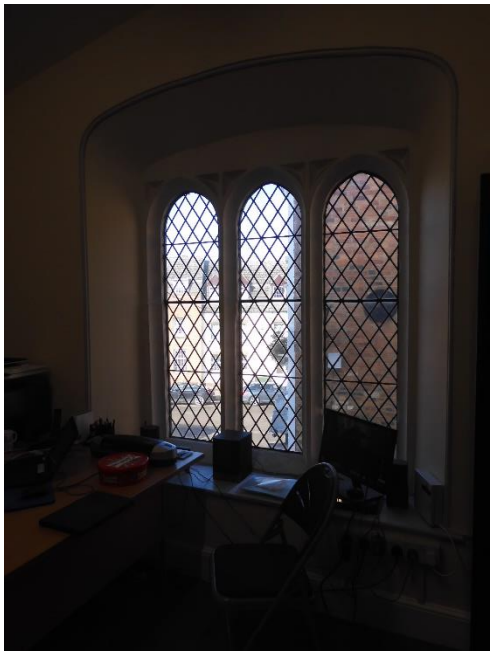
Nave: Within the nave the current heating system does provide adequate levels of comfort. The large space, when cleared, would be most challenging to heat in a radically different way and the usage of the church does not support the use of underfloor heating which is only advisable where there is almost constant daytime use on every day.

By heating other areas independently, the gas heating to the radiators in the nave could be used conservatively and limited to service and event times only. With the re-ordering the existing pew platforms would need to be levelled and when this occurred the opportunity to add insulation (of whatever thickness but ideally as much as possible) must be taken as this will be a once in about 200 year chance to improve the thermal performance of the floor which is often the source of much cold and discomfort within a church.

Some radiators will require minor relocation and positioned onto external walls under the windows and the wall space at the front of the nave where there is a clear section of wall between the first and second arches. In this location both sides of the wall should have a radiator positioned on them. All of the existing radiators can either be left in situ or relocated. It was noted that the valves on some radiators had failed and these should be replaced (many online stores offer traditional style ½ and ¾ inch valves which would fit as a straightforward replacement i.e. https://www.thevictorianemporium.com/store/category/radiator_valves). The existing boiler should also be replaced for a modern, high efficiency, gas condensing boiler as part of the reordering.

Parish Office: The parish office is the most frequently used space in the building and would therefore justify the most considerable focus for heating conservation and improvement.

It is recommended that a carefully considered package of measures is implemented in this space to include, the insulation of the ceiling and the fixing of good quality secondary glazing on the window (as recommended to the vestry). The floorboards should also be lifted and the void between the joists filled with insulation. The chimney in the space should be fitted with a chimney balloon (https://www.chimneyballoon.co.uk/) or umbrella (https://www.chimella.com/) to prevent warm air escaping in winter (these can be removed in summer to assist with ventilation and cooling the space). The use of permanent electric heating panels (as recommended to the vestry above) should also be considered.



6.6 Quattro Seal

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.

It is recommended that draught proofing is fitted to all external doors. 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. 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 – non visible roof available on the south aisle
Battery Storage	Yes – in conjunction with the above
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 – not suitable for church of this size and nature
Biomass	No – difficulties with deliveries and storage as well as air quality issues

The roof over the south aisle is ideally suited to a PV installation as it is south facing, unshaded and entirely non-visible behind the parapet. The fixing could prove to be a bit of a challenge on the historic roof but self weighted systems have been used successfully in these circumstances (see St Michael's, Withington and Gloucester Cathedral)

The church would not need to install a large array as the installation of solar panels is now only viable if the majority of the electricity generated is used on site at or around the time of generation. The use of the parish office and other background electrical usage will mean there is always some need for electricity and therefore a system around 6kWp comprising of around 18 panels is likely to be the maximum that would be sensible to install. The use of an invertor with a battery storage capacity will help to increase the viability of the system and provide some electrical back up to lighting in the church in case of power failure.

8. Funding Sources

This audit programme offers each participating church the chance to apply for a grant of up to £150 towards implementing some of the audit's recommendations. An application form is included with this report.

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 .

Trust for Oxfordshire's Environment (TOE) does have some funds available (over and above the small implementation grants of £150 available through this scheme) to support energy efficiency improvements in community facilities. If your church is used by the wider community, visit www.trustforoxfordshire.org.uk or contact admin@trustforoxfordshire.org.uk to find out if your project is eligible for a grant of up to about £5,000.

9. 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.