Energy Audit and Survey Report

St Paul's Church, Wokingham

"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
Paul Hamley	Matt Fulford	28th December 2019	1.0

Contents

1. Executive Summary

An energy survey of St Paul's Church, Wokingham was undertaken by Inspired Efficiency Ltd on Tuesday 5th November 2019 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 Paul's Church, Wokingham is a Grade II* listed Victorian church built in 1864 and constructed of stone. 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.

Short Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	To be actioned by who / when?
Complete relighting scheme with LED bulbs and zoned control system	400	nil		N/A	Faculty	PCC
Investigate turning off heating earlier	Potential for up to 10%; 8,600	£200	Nil	Immediate	none	warden
Draught proofing strategy for entrance doors	Few %	limited	£50	<1		warden

Long Term: Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Simple Payback (years)	Permission needed	To be actioned by who / when?
Hydrogen ready gas boiler	nil				List B	PCC
OR						
Electrical heating method	Potentially 50%	Similar cost to current system	£30k +		Faculty	PCC

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

Based on current contracted prices of 13.97p/kWh and 2.31p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £200 per year.

2. Introduction

This report is provided to the PCC of St Paul's Church, Wokingham 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 Paul's Church, Wokingham, was completed on the 5th November 2019 by Paul Hamley. Paul is an energy auditor with experience of advising churches and small businesses. He is part of the Diocesan Environment Officers Energy Group who are developing advice for the Church of England and authored the 2018 "Assessing Energy Use in Churches" report for Historic England. He is a CIBSE Associate member and a Chartered Scientist, with experience of the faculty process gained from chairing the building committee of a Grade I listed church.

St Paul's Church, Wokingham	
Gross Internal Floor Area	535 m^2
Listed Status	Grade II*
Typical Congregation Size	

The church typically used for 10 hours per week for the following activities

Services	0800-0900 0930-1030 1600-1800 rehearsal 1800-1900 6 use hours/ 12 heating hours
Meetings and Church Groups	2 hours per week
Community Use	~ 32 hours per year 5 concerts 3 school concerts
Occasional offices	3 weddings, 6 funerals, 13 afternoon baptisms in heating period

Estimated hours:

Annual hours of use 600h

Annual heating hours (October to May) 776h (from heating timing notice)

3. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	14.86p/kWh	In line with current market rates
Standing Charge	29.86p/day calculated from data supplied	N/A

Electricity is obtained from SSE. We recommend that the church obtains a quotation for both 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.

The current gas rates are:

Single / Blended Rate	2.31p/kWh	Below current market rates
Standing Charge	p/day uncertain due to very large entry for 05 Oct 2019	N/A

The church already procures gas through the Parish Buying scheme.

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.

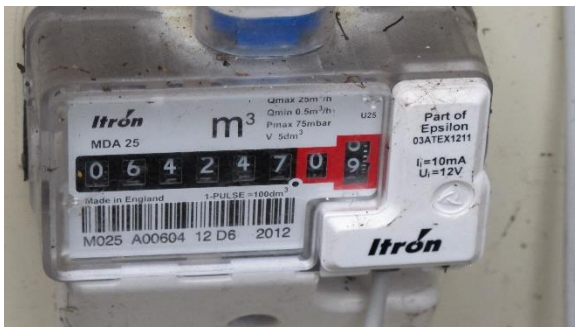
4. Energy Usage Details

4.1 Energy Consumption

St Paul's Church, Wokingham uses 5,740 kWh/year of electricity, costing in the region of £940 per year, and 81,490 kWh/year of gas, costing in the region of £2,900.

This data has been taken from a record of monthly charges supplied by the church. St Paul's Church, Wokingham has one electricity meter located in the organ loft which was not accessible during the audit. There is one gas meter serving the site.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	Not viewed		Not viewed	Organ loft
Gas – Church	M025 A00804 12D6		Yes	External gas meter cupboard in boiler compound

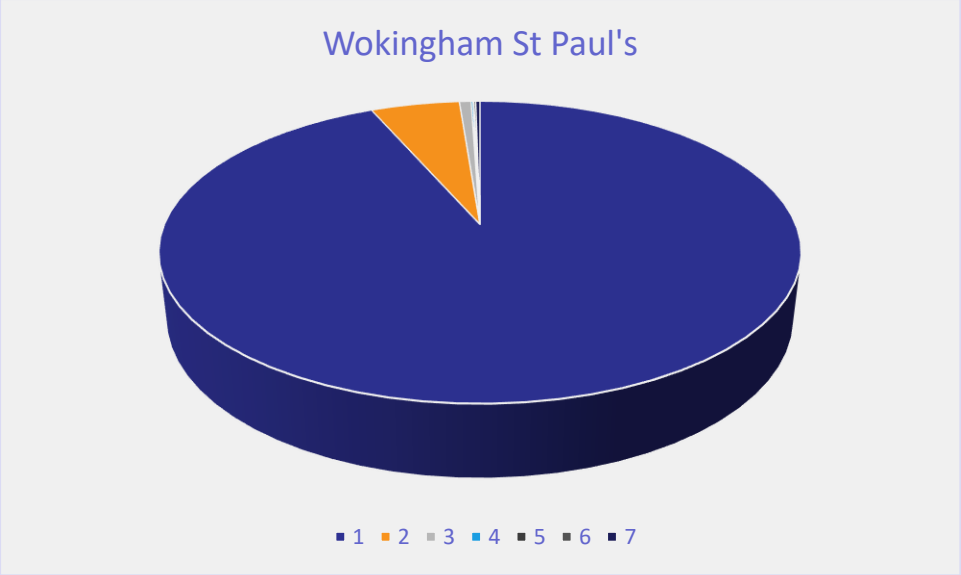


It is recommended that the church consider asking their suppliers to install smart meters so that the usage can be monitored more closely and the patterns of usage reviewed against the times the building is used.

4.2 Energy Profiling

The main energy use within the church can be estimated as follows, the entries in bold being certain:

Service	Description	Power	Annual Use/ kWh
Heating (Gas)	Gas boiler, **776 hours scheduled use**	105kW average	**81490**
Heating (electric)	Gas boiler: Electric Fan forced air system **6kW fan, 776 heating hours**		**4656**
Lighting			
Nave & Aisles	**21** pendant bulbs x LED 25W	525W	315
Chancel	**1** floodlight	250W	150
Vestry		200W	80
Porch	6 lights for notices, est 20W Estimated 600 Occupancy hours, less for some areas	120W	72
Outside	Daylight sensing to light path	150W?	~100
	TOTAL		717
Hot Water	Urn, estimated 20 hours use	**2kW**	40
Other Small Power	Sound system (est. 200 hours use)	500W	100
Organ	Organ (est. 200 hours use)	**1.12kW**	224
	Sum		5737 kWh
	Total Annual Electricity Consumption 2019:		**5739 kWh**



KEY 1 Gas Heating 2 Boiler fan electricity use 3 Lighting internal 4 Lighting external

5 Hot water 6 Small power (sound system) 7 Organ

As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site with a significant proportion from the boiler fan. The lighting load is small (the light bulbs are surrounded by diffusers and are thought to be LED or CFL bulbs).

4.3 Energy Benchmarking

In comparison to national benchmarks for Church energy use St Paul's Church, Wokingham uses 53% of electricity and an average amount of heating energy compared to other churches of this size[1].

	Size (m^2 GIA)	St Paul's Church, Wokingham use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Paul's Church, Wokingham (elec)	535	10.7	20	10	53%
St Paul's Church, Wokingham (heating fuel)	535	152	150	80	101%
TOTAL	535	163	170	90	96%

There is not currently any benchmark data which takes hours of use and footfall into account.

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Energy Saving Recommendations (Electricity)

5.1 Lighting

The lighting makes up a relatively small overall energy load within the building.

It is understood that the church intends to renew the current lighting system in order to enhance the lighting and introduce more flexible controls with the lighting being zoned. During the audit, Lux levels were measured during an overcast morning with all lighting on, values measured at head level in the pews were low at between 30 and 60 (20-24 in south west corner where there were some failed bulbs).

It is recommended that all new lights are LED; LED bulbs have a much longer life and hence reduce the need to replace the lamps in the ceiling as often as with CFL or halogen bulbs.

It is not possible to give an estimate of cost for a church relighting project as much of the expense is often with control systems, re-cabling and access, rather than the bulbs and fittings themselves.

6. Energy Saving Recommendation (Heating)

6.1 Heating System and Strategy

The church currently uses an electric fan assisted gas boiler to blow warm air to directly heat the church using the Victorian underfloor trenches. This is reported to work well and provides adequate thermal comfort into the church.

Given that the system is successful and does not incur huge operating costs it should be continued with in the medium term– however the lower operating costs are due to the relatively low hours of use of the church. If the church transitions to using its building more frequently during the week it will incur extra expense and will be worth considering an alternative heating strategy.

Long term, the boiler (or its replacement) will need to be made hydrogen ready. 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.

Sections 6.6 to 6.10 describe alternative heating systems.

6.2 Heating Timing: Avoid Background Heating

Currently the heating timing avoids any background heating, with the system turned on around 30 minutes or less before use. This should be continued.

Heating could be switched off in advance of the end of the service if the temperatures allow it – experimentation could save around 10%.

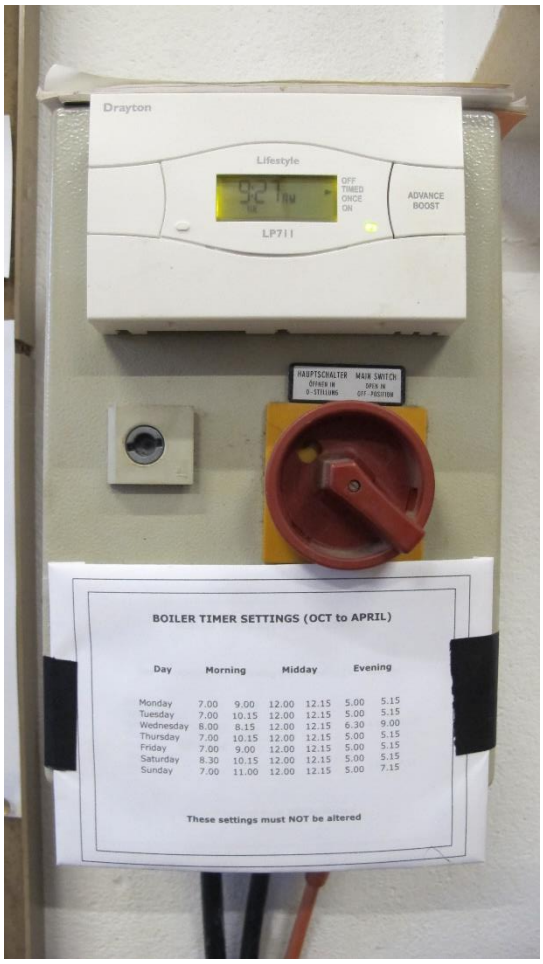
The contemporary requirement for heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. 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 would be excessive and wasteful of energy.

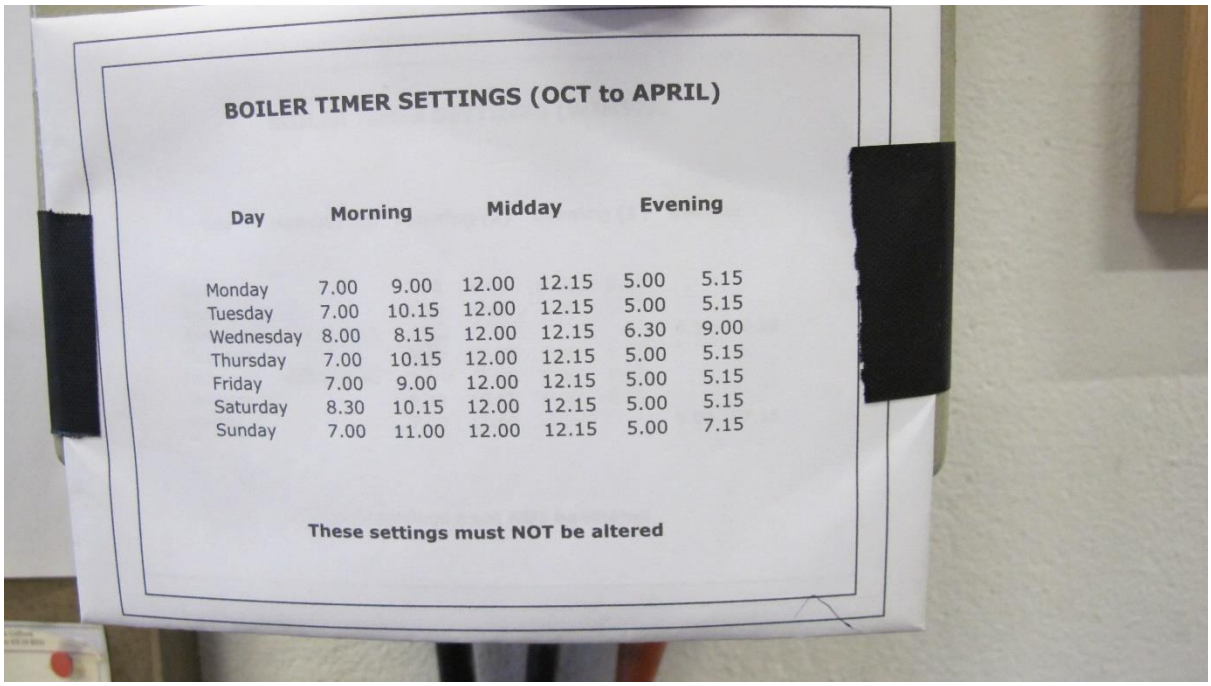
6.3 Space Temperature Set Point

The thermostat is located on a pillar at the front of church. The set point is 19°C.

6.4 Controls



Heating Hours; 7 months / 30 weeks; 24.25 hours per week.



6.5 Boiler Maintenance

The boiler is a Dravo floor standing warm air heater, Model PKE250N-20A. It has a maximum output of 310kW, with an average output over the measured year of 105kW. It was noted that literature indicated that fan belt maintenance is required every 6 to 8 weeks.

It was noted that the annual service charge is £450.

6.6 Alternative Heating Strategies

Currently, the church has a heating system which heats all of the building. It is inflexible and expensive to use if any small meetings are to be held.

Installation of electric heating in either of the chapels, or the vestry could be used to turn these areas into useable rooms for small meetings. Radiant panel heaters can be used with or without pews. Underpew heating can be installed under all the pews, or just a selected area to begin with. Underfloor heating is only viable when a building (or room) is used regularly (6 to 8 hours a day) throughout the week (5 days a week).

6.7 Use of Electric Radiant Panels for Heating Specific Areas only

To avoid having to heat up the entire church building for any smaller mid-week services it is recommended that the PCC consider installing electrical panel heaters in any spaces which are needed for small midweek or evening meetings. This might free up the nearby church hall for hire.

Suitable electric panel heaters would be far infrared panels such as https://www.warm4less.com/product/63/1200-watt-platinum-white- . These can be purchased widely and fitted by any competent electrician. 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 can not be left on accidently after use.

6.8 Under Pew Heating

An alternative to the present gas fired / fan assisted heating system which is compatible with a church with a "Mostly Sunday" use profile is to install under pew heating. An advantage of this system is that small areas could be equipped at a time.

For replacement, 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 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.

6.9 Under Floor Heating

Under floor heating is only viable in a church which is regularly used, i.e. has a useage pattern covering much of the time throughout the week. This is because of the long heat up time.

Also, installation is expensive and disruptive, and only possible in churches without archaeology under the floor, and where the floor itself can be lifted and lowered (or raised). St Paul's does not have a use pattern which can justify this heating method.

7. Energy Saving Measures (Building Fabric)

7.1 Draught Proofing to Doors

There external doors to the vestry and tower are not reported to have draught problems. The south door is made draught proof with a draught excluder (below). The main door under the tower is considered draughty; if it were possible to arrange for two welcomers to alternately open and shut the pair of doors under the tower to create a draught (prevention) lobby it might help.

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.

7.2 Other Fabric Measures

The north and south aisle roofs were reported to be leaking. This should be addressed to prevent deterioration of the building.

8. Other Recommendations

8.1 Electric Vehicle Charging Points

The church has a frequently used church hall nearby with parking for around 30 cars. 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, probably on the side of the church hall to allow visitors to charge their electric car.

Installing a unit such as a Rolec Securi-Charge http://www.rolecserv.com/ev-charging/news/view/Robust-EV-Charging-With-Rolecs-SecuriCharge-EV-Wall-Unit-Coin-Token-PAYG would allow the 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 – insufficient demand, visible roof
Battery Storage	No – no viable PV
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
Air Source Heat Pump	No – incompatible with heating system
Biomass	No – not enough heating load as well as air quality issues

10. 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.

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
Nave & Aisles	21 If all LED @30W; = 630W If all halogen @80 W; = 1680W	LED relighting planned			
Vestry	200W				
Chancel Altar Floodlight (temporary)	1 500W	LED relighting planned			
Porch Daylight sensor controlled	150W				
Porch notice lights	6 x 50W				

A relighting scheme is planned which includes zoning the church with a comprehensive control system. If this also includes a full rewire and extra light fittings, this will be a significant expense and not costable by this survey. [Individual lamps can be costed].

Lux levels in the church at 10am on an overcast day with the lighting all on were:

North Aisle 40-50, Nave 30-60, South Aisle 20-55, Chancel 11-50. mmThese values are all low; Lux levels at one metre from the ground in the pews should ideally be around 100 for reading.