Energy Audit and Survey Report

St Swithun's Church, Kennington

"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	27th March 2020	1.2

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1. Executive Summary

An energy survey of St Swithun's Church, Kennington 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 Swithun's Church, Kennington is a brick built church of cruciform plan constructed in 1958 with a pitched roof. 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?
Install draughtproofing measures	5% 1,600	£66	£50	1	List A	Warden
Purchase a temperature datalogger to optimise heating times	5% 1,600	£66	<£50	<1	None	Warden
Change lighting to LED bulbs	50% of lighting 10 % of total	£46	£200	<5	None	Warden
Install Presence Detectors to control lighting	10% of lighting	£10	£400	40	None	PCC
Install wall insulation in north transept area	Increased comfort	0	£500 (boards) to £2,500 permanent	\	Faculty for permanent panels	PCC

Medium 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?
Install far infra-red electric heating in north transept area	Reduce extra heating required with new use of area	N/A	£1-2k	N/A	Faculty	PCC
Install insulation in ceiling void	10% 3200	£132	£2,500	19	List B/Faculty	PCC

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?
Replace gas heaters with Air Source to Air Heat Pumps	20,000	Even	£15,000	N/A	Faculty	PCC
Reconsider installing solar panels	7,800	£1,200	£14,400	12	Faculty	PCC

The Church should check any faculty requirements with the DAC Secretary at the Diocese before commencing any works. Figures are based on current contracted prices of 15.58p/kWh and 3.80p/kWh for electricity and mains gas respectively.

If all short and medium term measures were implemented this would save the church around £320 in operating costs per year.

2. Introduction

This report is provided to the PCC of St Swithun's Church, Kennington 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 Swithun's Church, Kennington, OX1 5PL, was completed on the 9th March 2020 by Dr. Paul Hamley.

St Swithun's Church, Kennington	**627308**
Gross Internal Floor Area	280 m^2
Listed Status	Unlisted
Typical Congregation Size	50

The church is typically used for 12.5 hours per week for the following activities:

Services	5 hours per week
Meetings and Church Groups	6 hours per week
Community Use	1.5 hour per week
Occasional Offices	1 Wedding 6 Funerals 4 Baptisms

Estimated annual hours of use: 650 hours

Estimated annual heating hours: 450 hours (420 if heaters are always on full)

Estimated annual footfall: 11,500

3. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	15.58p/kWh	Slightly above current market rates
Standing Charge	24p/day	N/A

The current gas rates are:

Single / Blended Rate	3.80p/kWh	Above current market rates
Standing Charge	25.35p/day	N/A

The above review has highlighted that there are opportunities to gain cost savings from improved procurement of the energy supplies at this site. 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.

4. Energy Usage Details

St Swithun's Church, Kennington uses around 2,500 kWh/year of electricity, costing in the region of £500 per year, and approximately 32,700kWh/year of gas, costing around £1,300.

This data has been taken from information provided by the church from the utility bills.

Utility	Annual use/ kWh	from	to	Cost
Electricity	2,564	01/03/19	23/02/20	£485
Gas	32,727	01/03/19	23/02/20	£1334

St Swithun's Church, Kennington has separate electricity and gas meters for the 1958 church and 1828 hall.

Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	E12Z023831	EDMI Atlas Mk7c	Y	Basement, disabled toilet
Gas – Church				

The electricity meter is AMR connected and as such an energy profile for the annual energy usage should be available from the supplier.

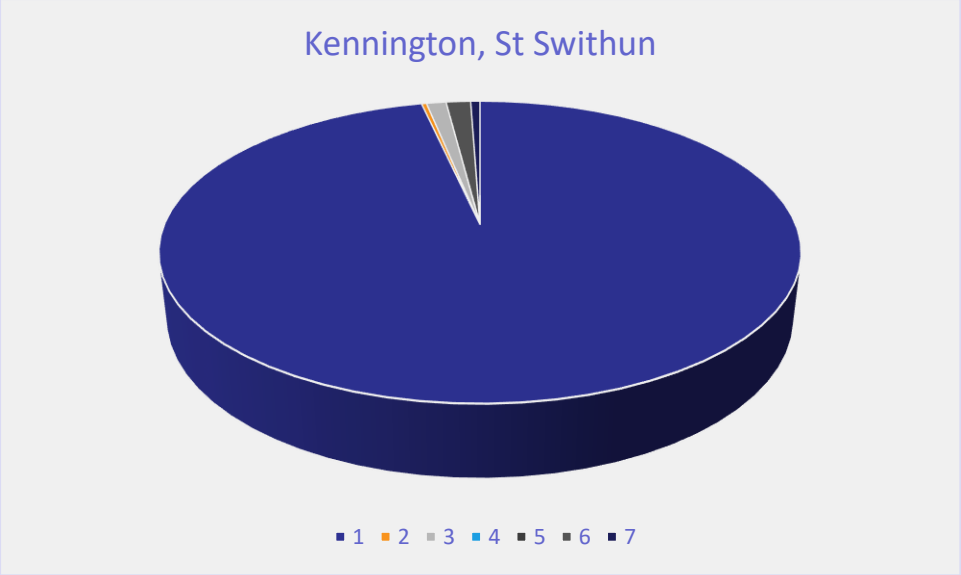
4.1 Energy Profiling

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

Service	Description	Power	Annual Use/ kWh	Estimated Proportion of Usage %
Gas Heating	6 x 13kW flued gas heaters 420 hours annual use *if always on fully*	78kW	**32,700**	92.7%
Lighting **Nave**	West end chandeliers 4 x 3 CFL @20W	240W		
	Transept chandeliers 4 x 3 CFL @20W	240W		
Chancel	2 x 3 CFL @ 20W 650 hours annual use	120W		
	TOTAL	**600W**	**390**	
Basement				1.1%
	2 toilets, foyer, 2 rooms (occasional use)	**100W**	**10**	
Heating [Electric]	Portable radiant heaters in basement			
	1 Honeywell	1kW	20	
	2 Choir vestry fan heater	1kW	80	
	TOTAL		**100**	0.3%
Hot Water	Urn (messy church use)	3kW	40	
	Ariston water heater		40	
	Handwashing heater in toilet		20	
	TOTAL		**100**	0.3%
Other Small Power	Sound system	1kW	260	
	Projector	1kW	200	
	Vacuum cleaner	1.5kW	40	
	TOTAL		**500**	1.4%
Organ	Organ	1kW	156	
	Keyboard	500W	25	
	TOTAL		**190**	0.5%

Total Annual Consumption 2019-20: 2564kWh

The estimates tabulated above account for only around half of the electricity use. This suggests that either the building and lighting is used for considerably more hours, or that the heating in the basement is used more regularly.



KEY 1 Gas heating 2 Electric heating 3 lighting 4 external lighting (zero)

5 Hot water 6 Small power 7 Organ

4.2 Energy Benchmarking

In comparison to national benchmarks[1] for Church energy use St Swithun's Church, Kennington uses 45% electricity and 77% heating energy than average figures for a church of this size.

	Size (m^2 GIA)	St Swithun's Church, Kennington use kWh/m^2	Typical Church use kWh/m^2	Efficient Church Use kWh/m^2	Variance from Typical
St Swithun's Church, Kennington (elec)	283	9.0	20	10	45%
St Swithun's Church, Kennington (heating fuel)	283	115	150	80	77%
TOTAL	283	125	170	90	73%

There is currently no benchmark data which takes hours of use and footfall into account.

[1] CofE Shrinking the Footprint – Energy Audit 2013

5. Building Overview and Performance

5.1 Overview and Options

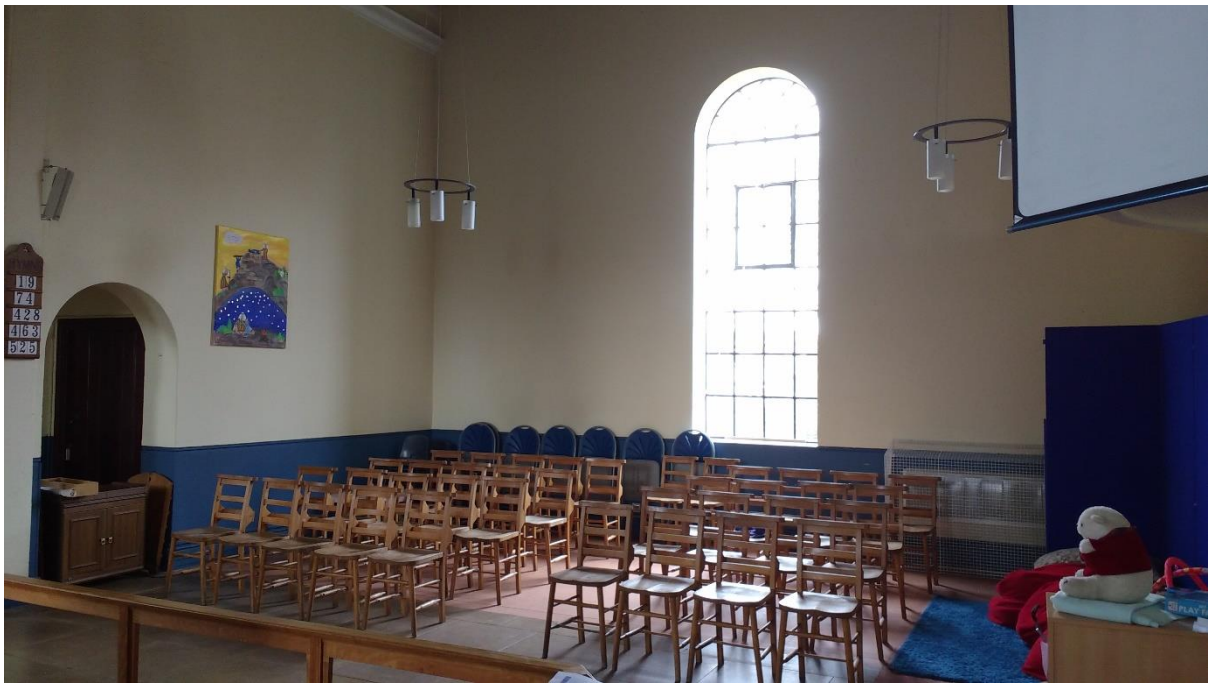
The building is currently heated by six 13kW flued gas heaters which directly vent their exhaust through the walls. These heaters are now surrounded by mesh guards as they can get very hot and have caused damage to chairs and set fire to a coat. They are reported to have been installed recently (2017/18), but one has already failed.

It is planned to bring the building into greater use as an open community building by installing a small area of desking into the north transept which will be available for people from the community to use, e.g. the self-employed, or to assist social entrepreneurs and start-ups.

Chairs preclude the installation of under pew heating, and under floor heating is extremely expensive and only suited to a very regularly used building. There is no radiator network.

Alternatives to gas heating are direct electric heating using far infra-red radiant panels (which offer rapid heat up times), or use of Air to Air Heat Pumps in place of the gas heaters (see Section 6.3)

Direct electric heating can offer the advantage of much less preheating time compared to a gas central heating system (which often require 8-12 hours preheating). As St Swithun's has a flued gas heater system installed recently this will require much less preheating, so there are less energy reduction advantages from switching to IR panels. However, they do offer the advantage of more rapid heating of just part of the church and are suggested for consideration for the north transept "workspace" area.



South Transept seating area

5.2 Performance

Heat rises by convection, but much radiant heat is absorbed by the closest row of chairs.

In this image the coldest surfaces (the floor and window frame) are at 13°C, whilst the heater surface is at 50°C.

The central altar. The OHP screen on the left has collected heat – it is not a TV left on standby.

Two of the external flues.

The doors are firmly closed, but much thinner than the walls so are allowing heat to escape by radiation. This shows the importance of having a draught lobby inside.

6. Energy Saving Recommendations – Electrical and Heating

6.1 Lighting (fittings)

The lighting appears to consist of mostly 20-25W Compact Fluorescent Lamps which are suspended from chandeliers. In addition, there is one spotlight to illuminate the altar.

It is recommended that these bulbs be changed to LED, which will reduce lighting energy consumption by about half, and also reduce the frequency with which bulbs have to be changed. It is suggested that a bulk purchase is made of 120% of the number of bulbs required to give some spares. This intervention will also prevent electricity use rising as the church is brought into greater use during the week when the plans to install an office / working hub in the north transept materialise.

6.2 Lighting (control for internal lights)

When the church begins to be used for more hours during the week, there is a danger that all of the lighting will be turned on when only a small portion of the building is in use.

It is recommended that the lighting control system is modified such that:

The north transept area lighting is controlled by a presence detector.

Other areas of the church should normally be unlit during daylight hours when the north transept is used.

Presence detectors are used along with timers set for short duration to light the basement and toilets (assume users of the transept office area will be unfamiliar with the location of light switches).

6.3 Use of Electric Panels for Heating Specific Areas only

The use pattern of the proposed north transept office space area is unknown. If people may be turning up at short or no notice to use the facility, it requires a rapid reaction heating system which ideally just heats that part of the building.

It is recommended that far infrared panel heaters are installed in this area.

Panel heaters are most commonly produced in white, but can be coloured or have a design or picture printed on them, one supplier being the Surya company https://www.suryaheating.co.uk

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 cannot be left on accidently after use.

6.4 Air Source to Air Heat Pumps

These devices are electric powered heat exchangers using reversed refrigeration technology to heat the air inside a building using small fan assisted radiator units. Outside of the building, units similar to air conditioning modules would be fitted in a well ventilated places. They can also be used for cooling in the summer.

Daikin claim a COP of 4 for their product (probably a best case scenario). This would require 8,000kWh of electricity, or more likely 10,000kWh at a COP of 3, which would cost £1,558 at current rates, which compares favourably with the current gas annual cost for the church of £1,334.

Although it is a 17% price increase, if the electricity is procured from 100% renewable sources this would lower the churches carbon footprint by 6.0 tons per annum.

The cost of offsetting this amount of carbon (e.g. by tree planting) varies widely between different organisations, types of carbon generating activity and cost model. Climate Stewards, who organise tree planting schemes, use a figure of £20 per ton offset. £1334 + (6 x £20) = £1454. An AAHP may be slightly more expensive to run than gas + offsetting cost – but of a similar order of cost.

A second reason in favour of installing ASHPs is that they can operate in reverse to supply cooling in the summer. As longer periods of heat look likely as the UK climate continues to warm, installation of ASHPs would allow the church to become a cool community asset during the summer.

(Although this would increase the electricity bill more by running the pumps for cooling, you could ask users of the building to donate to offset the heat!)

https://www.greenmatch.co.uk/blog/2015/09/the-pros-and-cons-of-an-air-to-air-heat-pump

https://www.daikin.co.uk/en_gb/product-group/air-to-air-heat-pumps.html

It is envisaged that the existing heaters could be replaced by ASHP units. The external modules could be hidden behind low hedges or similar shrubs.

7. Energy Saving Recommendations – Building Fabric

7.1 Roof Insulation

The internal profile of the roof is rounded, with a pitched exterior thus creating a void which has potential for insulation. If the church is to be brought into greater use it becomes increasingly worthwhile to insulate. The churches inspecting architect should be consulted to ascertain whether the existing ceiling structure is safely accessible to install insulation.

7.2 Wall Insulation, Internal

It is also recommended that insulation is added between the desk/ seating areas and external walls (so that the walls will not be accepting radiant heat from occupants). This might consist of lining the internal walls with 50mm of insulating board (creating work for your architect), or alternatively installing poster boards on the walls (such as K quality Sundeala board, either purchased suitably coloured or faced with felt), or by positioning moveable poster boards on wheels next to the walls. The latter could be used to construct temporary bays around the working spaces.

7.3 Draughtproofing Measures

External doors to the building should be kept well maintained and draught proofed. Any gaps will result in a large amount of cold air is coming into the church during cold and windy conditions, 24/7. Draughtproofing can save a considerable amount of energy.

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

For non-listed environments, cheaper methods of insulation include rubber E and P cross section strips, lining door edges with felt and other “home-made” interventions which should be made suitable for each particular door.

7.4 Windows

Windows should be kept well maintained. Where draughts can be identified in opening panels, these can be filled using plasticine which can easily be removed when required.

Hopper windows often do not close properly and benefit from maintenance and draughtproofing measures.

The basement area is single glazed, each area has a small portable heater. Unless it is to be used and heated regularly, there would be no benefit from installing double glazing here.

8. Saving Recommendations (Water)

8.1 Tap Flow Regulators

With increased use of the building planned, it is recommended that tap flow regulators are installed.

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. Regulators can be self-installed or by any good facilities staff.

8.2 Reduce Toilet Flushing Volume

This can be achieved either by installing a duo flush cistern, or (cheaply) by reducing the flushing volume using a toilet hippo, or alternatively placing some suitably sized glass jars full of water (with lids) in the cistern.

9. Other Recommendations

9.1 Electric Vehicle Charging Points

The church has a car park at the front which serves the church and the frequently used church hall. 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

9.2 Carbon Offsetting

There are a number of carbon offsetting schemes available. The Church of England often works with Climate Stewards (www.climatestewards.org), whose calculator has been used for illustrative purposes earlier in this report

9.3 EcoChurch

A Rocha's EcoChurch programme is a very useful scheme offering a structure and resources for the church to improve its environmental performance and engagement in several areas including buildings, liturgy, children's work, creation care, lifestyle.

10. 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 – unlisted building (but tree shading)
Battery Storage	Yes
Wind	No
Micro-Hydro	No
Solar Thermal	No
Ground Source Heat Pump	No – no radiator network
Air Source Heat Pump	Possible air to air installation
Biomass	No – irregular load

10.1 Solar PV potential

St Swithun's church is an unlisted building with a visible roof. A previous study has indicated that shading from nearby trees (protected by a TPO) would make an array unviable. Shading does not prevent generation but can reduce efficiency by 20-25% depending on severity. Note that PV panels will generate electricity when it is light, and do not need direct sunlight although it will be needed for maximum output.

Mature trees on the south boundary of the site.

Approximate calculations are as follows:

The south facing roof offers two areas giving a maximum useable area of 11m x 5m and 6m x 5m = approximately 80m^2.

An area of 80m^2 would generate 0.15kWpeak/m^2 giving a 12kWpeak system. A 1kWpeak system can generate 800kWh annually, applying an over shading factor gives 650kWh per kW peak and a total annual generation of 7,800kWh. This is much greater than the church's current annual electricity use (2,564kWh). The combined total for church and hall is just over 5,000kWh.

It is clear that shading by the trees will occur throughout the summer; but given that the area available is able to generate more than the churches current electricity needs it is worth obtaining further detailed advice to assess viability.

If air source to air heating were to be installed in future, on site generation of electricity would make this more viable and lower operating costs.

Using average 2018 domestic installation costs for larger systems (£1,200 per kWpeak); a 12kWpeak system would cost £14,400. This does not include cost of any battery.

It would have to be confirmed with your architect as to suitability for extra weight and wind loading on the roof structure.

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 this may be worth delaying at this stage.

The government has advertised a "Smart Export Guarantee" to begin in 2020 which would pay for electricity generated and exported to the grid (the Feed in Tariff having ended). However, it appears that rates will be no more than 5.5p/kWh and have to be negotiated with the utility company. It does not offer a financial incentive towards installation of SPV panels.

Fully detailed PV design and calculations and quotation can be obtained from Batchelor Electrical, contact Stuart Patience on 01202 266212; 07793 256684; stuart@batchelor-electrical.co.uk.

11. 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.

12. 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.