Energy Efficiency and Zero Carbon Advice

St John and St Stephen

PCC of St John and St Stephen

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St John and St Stephen 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 John and St Stephen is a modern church building, built about 42 year as ago, with an extension added 15 years ago and a church gallery 6 years ago. 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 (years)	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
Fit flow regulators onto existing taps	643	£ 26	£ 38	1.45	List A (None)	0.12
Install Endotherm advanced heating fluid into heating system(s)	3,641	£ 147	£ 216	1.47	List A (None)	0.67
Fit 270mm of insulation into the roof space	3,641 (also improve comfort)	£ 147	£ 1,500	10.22	Faculty	0.67
Replace hot water for electric point of use units to WC and kitchen	5,140	£ 207	£ 3,000	14.48	Faculty	0.95
Add or Replace draught strips to external doors	728 (also improve comfort)	£ 29	£ 450	15.33	List A (None)	0.13
Change existing lighting for low energy lamps/fittings	3,258	£ 485	£ 7,513	15.50	Faculty	0.82
Inject cavity wall insulation into walls	2,913	£ 117	£ 2,000	17.04	Faculty	0.54
Install PIR motion sensors on selected lighting circuits	30	£ 5	£ 84	18.51	List B	0.01

Install SavaWatt devices on fridges and freezers	140	£ 21	£ 50	2.40	List A (None)	0.04
Replace windows to offices	5,461 (also major comfort improvement)	£ 220	£ 5,100	23.17	Faculty	1.01
Insulate exposed pipework and fittings in plantrooms	2,142	£ 86	£ 300	3.48	List A (None)	0.40
Optimise control system by install 7-day programmer, revise and relocated thermostat and taper proof TRVs	6,425	£ 259	£ 1,800	6.95	List A (None)	1.19
Install an Air Source Heat Pump to replace the existing air handling unit fired from the schools gas boilers	26,579	£ 5 (mainly a carbon, not a cost saving)	£ 20,000	None	Faculty	4.23
Add over door air heater to improve comfort and reduce heat loss from church	None	£ -	£ 796	-	Faculty	-
Replumb office radiators to come off café boiler system	None	£ -	£ 900	-	Faculty	-
Consider Air Source Heat Pump to replace gas boiler in café area when at end of life	None	£ -	£ 12,000	-	Faculty	-

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

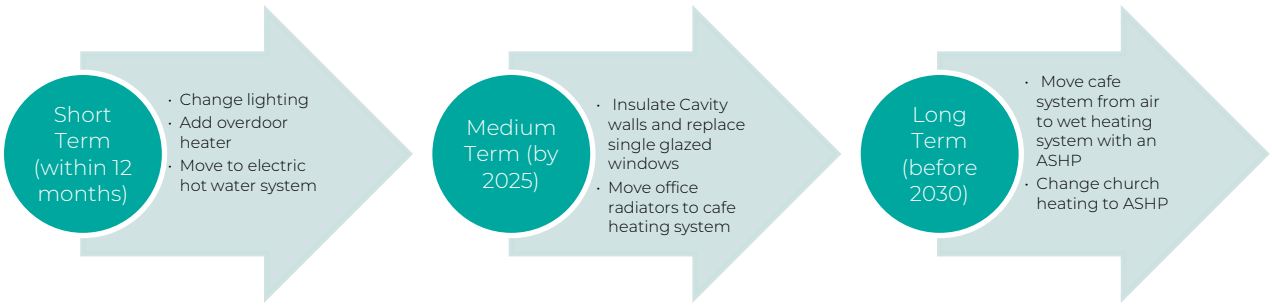
Based on current contracted prices of 14.88p/kWh and 4.03p/kWh for electricity and mains gas respectively.

If all measures were implemented this would save the church £1,753 per year.

2. The Route to Net Zero Carbon

The Diocese of Oxford's Diocesan Synod has set a target of reaching Net Zero Carbon by 2035, or as soon thereafter as is possible. General Synod, meanwhile, has set a target for the Church of England to reach a limited-scope Net Zero Carbon target by 2030. Our diocese will need to respond to the national target. which, as it is presently framed, means that every church, cathedral, church school and vicarage in the C of E will need to reach net zero - or compensate for residual emissions - within the next ten years..

This church has a clear route to become net zero by 2035 by undertaking the following steps:



3. Introduction

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

An energy survey of the St John and St Stephen, 121-147 Orts Road, Reading RG1 3JN was completed on the 6th October 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 John and St Stephen	
Church Code	627458
Gross Internal Floor Area	750 m^2
Listed Status	Unlisted

The church typically used for 25 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	4 hours per week	100
Meetings and Church Groups	4 hours per week	20
Community Use	2 hours per week	20
School	20 hours per week	250

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

4. Energy Procurement Review

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

The current electricity rates are:

Single / Blended Rate	14.88p/kWh	In line with current market rates
Standing Charge	21.23p/day	N/A

The current gas rates are:

Single / Blended Rate	4.03p/kWh	In line with current market rates
Standing Charge	18.38p/day	N/A

The electricity and gas is supplied by Ecotricity which is a 100% renewable electricity source and the whole gas emissions are offset by Ecotricity (they are currently developing their own (vegan!) renewable gas generation)

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.
FiT	100% charged	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.

5. Energy Usage Details

St John and St Stephen uses8,474kWh/year of electricity, costing in the region of £1,260 per year, and 42,835 kWh/year of gas, costing £1,726.

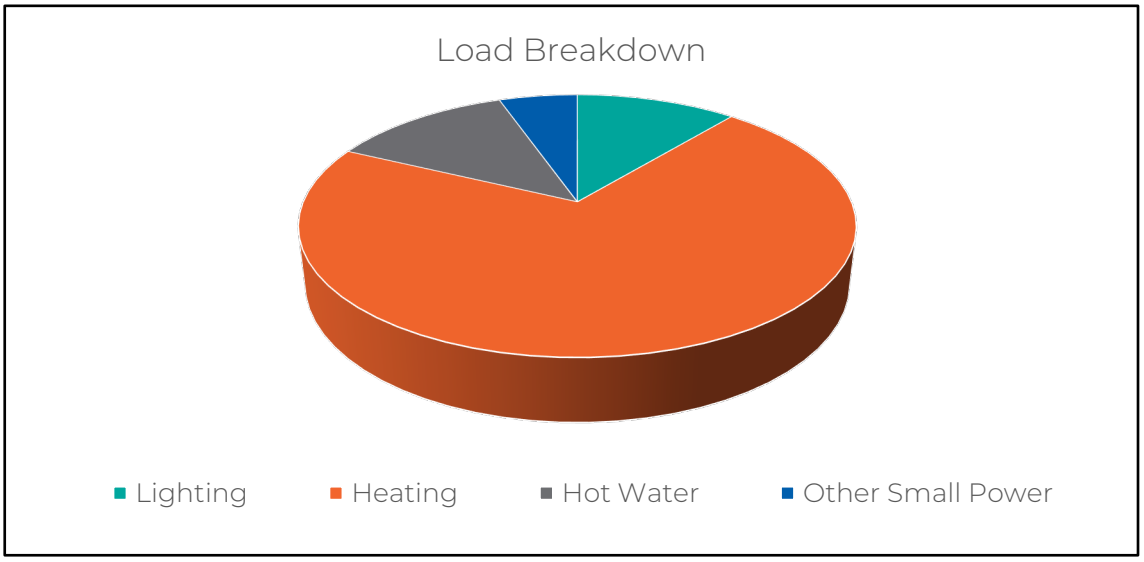
This data has been taken from the annual energy invoices provided by the suppliers of the site. St John and St Stephen has one main electricity meter, serial number S04R38061. There is one gas meter serving the site, serial number G4W01023240601.

Utility	Meter Serial
Electricity – Church	S04R38061
Gas – Church	G4W01023240601

5.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Lighting throughout the church and other areas, much LED and T5 but some older inefficient fittings remain	11%
Heating	Two gas heating systems, one from school boilers into air handling unit for church and one for café area from gas condensing boiler serving radiators	71%
Hot Water	Hot water to kitchen and WC's provided from gas combi boiler in café area	13%
Other Small Power	Kitchen appliances, sound equipment, office equipment and the like.	5%



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

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St John and St Stephen uses 44% less electricity and 62% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	St John and St Stephen use kWh	St John and St Stephen use kWh/m^2	Typical Church use kWh/m^2	Variance from Typical
St John and St Stephen (elec)	750	8,474	11.30	20.00	-44%
St John and St Stephen (heating fuel)	750	42,835	57.11	150.00	-62%
TOTAL	750	51,309	68.41	170.00	-60%

6. Efficient / Low Carbon Heating Strategy

The energy used for heating a church typically makes up around 80% to 90% of the overall energy consumption. Heating also often uses gas or oil as its primary fuel, these are fossil fuels with high carbon emissions and little opportunity to decarbonise in the future. Electricity currently has carbon emissions around the same level as mains gas but the carbon emissions associated with electricity are reducing rapidly as the UK builds more renewable energy and decommissions it remaining oil and coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of bio-gas and hydrogen but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. It is therefore a critical element to review and set out a plan to make more efficient and less carbon intensive and one way to achieve this is to consider a transition to electrical heating where this also represents a more efficient and comfortable solution for churches..

This church does have the potential to move of gas altogether as the existing heating elements fail. The first stage in this is to reduce the gas need by:

- Insulating the walls with cavity wall insulation
- Replacing the single glazed windows in the offices and the like
- Moving the hot water away from the gas boilers to electric point of use units

The radiators to the offices are currently served from the schools gas boilers (with the church being recharged for the use) and given their proximity to the café and there being some alignment between the office and the café being the more frequently used spaces, there would be much sense in these few radiators being replumbed to come off the café boiler system rather than the school system.

It would then be possible for the church to be heated by an air to air heat pump system to replace the existing large air handling unit linked to the schools gas boilers. This could be carried out when the current air handling unit fails.

It would also be possible to change the gas boiler in the café to an air source heat pump to serve the radiators, this only need to be considered when the existing gas boiler fails. This is currently a good, relatively new and efficient gas boiler and it is therefore likely to be many years before this needs to be undertaken.

In future, this church may be able to benefit from connecting onto a district heating system currently being considered by Reading Borough Council. If this does materialise connections to this, rather the heat pumps, would be beneficial.

7. Improve the Existing Heating System

In the years before the replacement of the existing heating system it is recommended that measures are taken to improve the efficiency of the existing heating system, this should include:

7.1 Install an Overdoor Heater

In order to achieve the sense of a 'warm welcome' into the church an over door air heater could be provided. This would also help to provide warmth to the entrance of the church and prevent large heat loss at the start of a service. Such an over door unit should be sized to cover the whole width of the door. A heater with a 6kW output would work well and could be connected to the existing single phase supply.

7.2 Improve Heating Control Settings

The café heating is controlled by a Drayton Lifestyle LP522 controller located in the boiler room. The churches heating is controlled via a TREND IQ2 control system (possibly linked to the schools BMS) located in the flower room.

The Drayton controller for the café only allows the times to be set in two blocks. One for Monday to Friday and one as Saturday and Sunday. As each individual day is likely to have a different type and time of use it would be prudent to change the current controller to a LP711 type. These are very widely available in all DIY stores for around £50 and should be able to be simply clipped onto the existing backplate without need for any rewiring. The thermostat for the control of this system is located in the lobby area to the café and change be changed by anyone. The location is not ideal as the sensor will be influenced by the doors opening. It would be ideal if this sensor could be relocated to the inside of the café space and also changed to a tamper-proof room stat type.

Within the church area the controls are now outdated and there are concerns that the temperature sensors are not calibrated correctly as they were reading around

20.3°C when the actual room temperature was 18.6°C. This was mentioned to the school who maintain the system. It would be recommended that the controls to this are changed when the system is replaced in the future.

7.3 Replumb Radiators in Office

The panel radiators within the office/vestry area are current run from a heating circuit from the school boilers which are located on the other side of the church. This is rebilled to the church via an historic arrangement. It would improve the efficiency and management of the system if these radiators were supplied with heat from the small gas condensing boiler located in the café. This would then allow the control of heat to the office areas to be set by the church to more closely meet their needs.

7.4 Endotherm Advanced Heating Fluid

In order to improve the efficiency of the heating system further it is recommended that an advanced heating fluid is added to the café 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.

8. Energy Saving Recommendations

In addition to having a revised heating strategy there are also a number of other measures that can be taken to reduce the amount of energy used within the church.

8.1 New LED Lighting

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

There are some areas of the building which have had efficient LED lights installed but there still remains a number of inefficient fluorescent fittings that can be replaced.

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED. There are a vast number of specifications of LED lights on the market but it is recommended that any LED light should come with branded chips and drivers and offer a 5 year warranty.

If all the lights were changed on a simple “like for like” the total capital cost (supplied and fitted) would be £7,513. The annual cost saving would be £485 resulting in a payback of around 15 years. This estimate includes for the supply of the lights, the labour to install them and the access required. It does not include for any upgrade to the wiring or a new lighting design both of which the church may wish to consider.

8.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the entrance, store room, boiler room, flower room 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 consider 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.

8.3 Refrigeration Controls

Within the church there is a fridge within kitchen. These units run 24/7 and contribute to the baseload electrical consumption of the building.

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

Supply and installation and further details can be undertaken by SavaWatt directly. (Note the self-installed SavaPlug has been discontinued but the professionally install savacontrol option is available)

8.4 Electric Point of Use Hot Water

The building is currently provided with hot water from the gas combi boiler in the café area. As such the hot water is being heated by the gas boilers during the summer time when they otherwise would not need to be on.

A far more efficient method of generating hot water would be to remove the centralised large hot water storage tank and to have small, local electric point of use hot water heaters installed within each WC and kitchen area. Units such as these heat the hot water only when the tap is turned on and does not have any stored hot water element. As such it is very energy efficient and it only ever heats the hot water that is required. It has additional advantages that it is 'always on' so does not require to have timings reset for ad hoc uses and as it does not have any stored water element it represents the lowest possible legionella risk profile. Installing electric hot water units will remove the need for the gas boiler and associated pumps to have to operate outside of the heating season and will assist in the transition to net zero carbon as the hot water is no longer served by burning of fossil fuels on site.

The installation of electric point of use hot water units and the removal of the gas hot water system can be undertaken by any competent mechanical engineer.

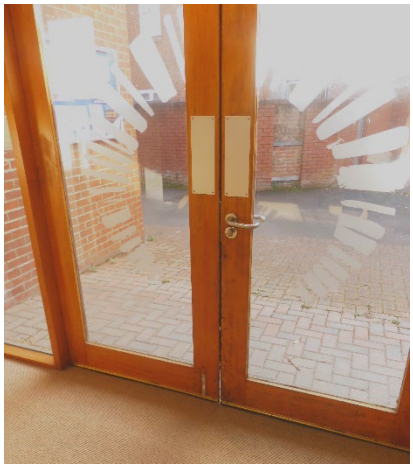
8.5 Insulation of Pipework and Fittings

The pipework within the boiler 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 exposed 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.

8.6 Draught Proof External Doors

There are a number of external doors in the church. These are more modern timber doors, however there are visible gaps between the doors.



It is recommended that the draughtproofing around the door is improved and draught strips are added. This can be simply achieved by asking a good joiner to replace the existing draught strips, and add more in where possible and readjust the doors.

8.7 Replace windows to office

The three windows to the side elevation to the offices and also the three long thin windows to the front of the church are all single glazed units. These would benefit from being replaced for double glazed units which as well as reducing the heat loss will make the office environment much more comfortable to work in.

As the units are relative straight forward window units these could be replaced by most competent window contractors.

8.8 Cavity Wall Insulation

The church is constructed with a cavity wall method and the inspection of the wall showed no signs that insulation has been added. Prior to the early 1990's, building regulations did not require walls to be fully insulated and therefore it is likely that there is no insulation present but it could be added through injecting it into the cavity walls.

It is recommended that cavity wall insulation is considered and added to the walls where appropriate. A survey to check the width of the cavity, exposure of the wall and condition of the cavity should be carried out by a CIGA approved installer who will then be able to provide you with a quotation to undertake the works. Installing cavity wall insulation will help to reduce heat loss and improve the comfort of the space, but needs to be considered alongside other control measures such as TRV's or room sensors to ensure that the space does not overheat because of the additional insulation.

8.9 Insulation to Roof

The loft void above the flower room ceiling was inspected as part of this audit and found to have little or no insulation present. In all cases where there is 100mm or less of insulation within accessible roof spaces it is recommended that insulation be added to prevent heat loss and create a more comfortable environment for the occupants of the building. The loft hatch to this space also need to be replaced to avoid the chimney effect of this pulling warm air out of the church.

The ceiling/roof of a building is the largest contributing area to heat loss from a building as heat rises. The insulation of such spaces can therefore have a dramatic impact on both the efficiency of the heating system and the temperature of the space below. The insulation in other spaces such as above the suspended ceilings to the offices and entrance lobby should be checked and insulated where required.

9. Saving Recommendations (Water)

9.1 Tap Flow Regulators

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

The over provision of water for hand washing is not only a source of excessive water use, but in the case of hot water, it is also a source of wasted energy in the heating that has to go into providing the hot water.

The flow rate of the taps can be easily regulated by fitting flow regulators within the taps. These are available from most water companies and are fitted into all the viable hand wash basin taps to save on both water and heating of the hot water.

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

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	Unsuitable roof shape and profile
Wind	No – no suitable land away from buildings
Battery Storage	No – no viable PV
Micro-Hydro	No – no water course
Solar Thermal	No – insufficient hot water need
Biomass	No – not enough heating load as well as air quality issues
Air Source Heat Pump	Yes – possible to replace
Ground Source Heat Pump	No – insufficient ground space

Air Source Heat Pump

The café part of the building is currently heated from a gas boiler which provides hot water into the heating system. The use of fossil fuels for heating means that it will not be possible for the building to become zero carbon without changing the heating system. A boiler also has heat and other efficiency losses within it, which means that the efficiency of a boiler in converting the gas into the heat is typically around 80 to 95% (depending on the age and type of boiler). Air source heat pumps use electricity to power the heat pump which takes heat from the air and puts this into water which can then go into the heating system. A heat pump can create around 3 units of heat for every one unit of electricity.

The existing boiler is currently in good condition but when it reaches the end of its serviceable life it would be prudent to consider replacing this for an air source heat pump..

A new air source heat pump is likely to need a heating capacity of around 20kW and could be located on the roof of the building. As heat pumps operate on a low temperature basis some of the radiators and other heat emitters around the site may require upgrading and this should be considered when replumbing the office radiators.

There are currently government incentives available for installing air to water heat pumps but these are subject to future change and adaption so should be reviewed at the time of implementation.

With the church heating system this is currently heated via and air handling unit heated from the boilers in the school. As this approaches the end of its life it is suggested that the church replace the system with a new air to air source heat pump system which would work very much like small air conditioning systems work with an external unit, located on the roof, and internal units blowing warm air into the space through the existing grilles.

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 .

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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Café	14	Virgo 8W (110m dia)	£141	£604	4.29
Café	4	REMOVE	£25	£105	4.19
Store	1	2D LED 11W	£4	£59	14.31
Boiler Room	1	2D LED 11W	£4	£75	18.19
Kitchen	4	600 x 600 25W Panel	£45	£299	6.68
Accessible WC	2	600 x 600 25W Panel	£8	£122	15.95
Ladies WC	1	600 x 600 25W Panel	£1	£122	89.54
Prayer Room	2	Virgo 8W (110m dia)	£20	£86	4.29
Flower Room	1	2D LED 11W	£5	£59	11.79
Worship area	48	5ft Single LED	£188	£4,214	22.46
Entrance	4	2D LED 11W	£20	£235	11.79
Office	2	5ft Single Proteus LED	£19	£255	13.09
Office 2	2	5ft Single Proteus LED	£4	£255	56.85

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