ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St Peter's Church
2buy2 Church of England Audits

Author	Reviewer	Date	Version
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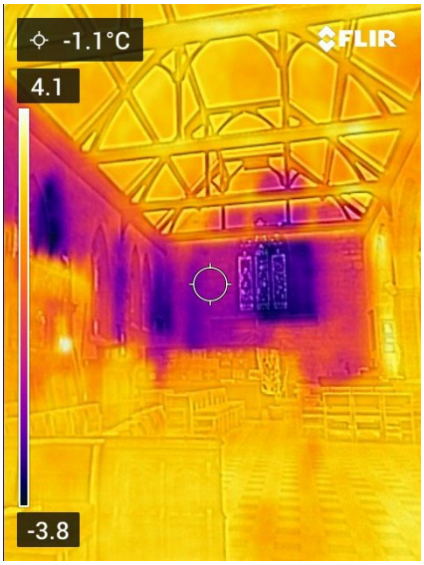
Contents

1. Executive Summary

An energy survey of St Peter's Church was undertaken by ESOS Energy to provide advice to the church on how it can be more energy efficient and provide a sustainable and comfortable environment to support its continued use. This audit has been provided in conjunction with 2buy2, the Church of England's Parish Buying scheme provider and is subsidised from Total Gas & Power, the Parish Buying schemes principal energy suppliers.

St Peter's Church is Victorian Grade II listed parish church which has a separate church hall (not within scope of audit). The church suffered a fire in the late 1980's and was substantially rebuilt and reordered opening again in 1992/3 including insulation to the roof. It is an open plan space with no pews, used most days of the week for various events and services. There is both gas and electricity supplied to the site and the heating is from an 80kW gas fired boiler dating from the early 1990's to a radiator system throughout.



The church has a number of ways in which it 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 and the route to net zero carbon are 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)
Change existing lighting for low energy lamps/fittings	3,143	£943	£5,391	5.72	Consult DAC	0.66
Install PIR motion sensors on selected lighting circuits	23	£7	£150	22.12	List B	0.00
Insulate exposed pipework and fittings in plantrooms	3,045	£304	Nil	N/A	List A (None)	0.55
Optimise control system settings	8,363	£836	£1,200	1.43	List A (None)	1.51
Add secondary glazing to windows	5,575	£558	£9,217	16.53	Faculty	1.00
Install a High Temperature Air-to-Water Source Heat Pump to replace the boiler	24,924	-£277	£76,000	No Payback	Faculty	4.06

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

Based on current supported market prices of 30p/kWh and 10p/kWh for electricity and mains gas respectively.

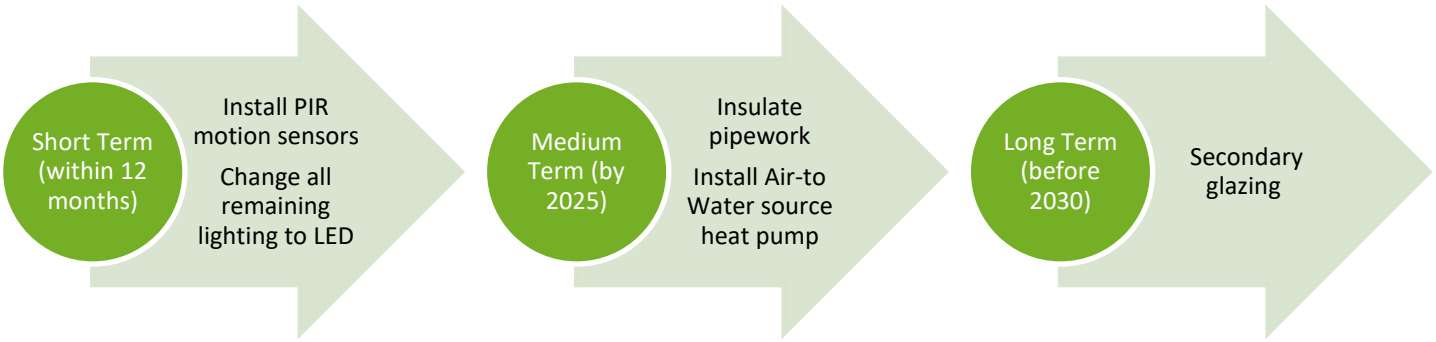
If all measures were implemented this would save the church £2,370 per year and reduce its carbon footprint by 7.78 tonnes (70%).

2. The Route to Net Zero Carbon

Our government has committed to move towards Net Zero Carbon – the point at which we have reduced emissions as much as we can and then balanced any residual emissions through removal of carbon from the atmosphere. They have done this as part of a worldwide agreement which aims to limit global warming to well under 2 degrees Celsius, with an aim of keeping it below 1.5 degrees Celsius. This will help protect all of us from the impacts of climate change.

In February 2020, the Church of England's General Synod set its own Net Zero Carbon target. The first stage of this target covers energy used by churches, cathedrals, schools, vicarages, other church buildings, as well as emissions caused by reimbursed transport. The target date is 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's Church 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 Peter's Church, 11 St Peter's Ave, Haslingden, Rossendale BB4 6NZ, was completed on the 30th of November 2022 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's Church	
Church Code	603020
Gross Internal Floor Area	824 m^2
Listed Status	Grade II

The church typically used for 23 hours per week for the following activities:

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	10 hours per week	40
Meetings and Church Groups	5 hours per week	
Community Use	8 hour per week	

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's Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	37.660p/kWh	Above current supported rates
Night Rate	15.285p/kWh	Below current supported rates
Standing Charge	3.06/month	N/A

The current gas rates are unknown as only the total energy cost has been provided.

Moving to 100% renewable supplies, especially for electricity, is an important step in moving to become Net Zero Carbon. Utility Warehouse has a higher than market average carbon intensity of its electricity supplies. 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 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's Church uses 5,141 kWh/year of electricity, costing in the region of £1,500 per year, and an estimated 55,750 kWh/year of gas, costing £2,059. The total carbon emissions associated with this energy use are 11.12 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Peter's Church has one main electricity meter, serial number K12W580752. There is one gas meter serving the site, serial number E016K0329219D6.

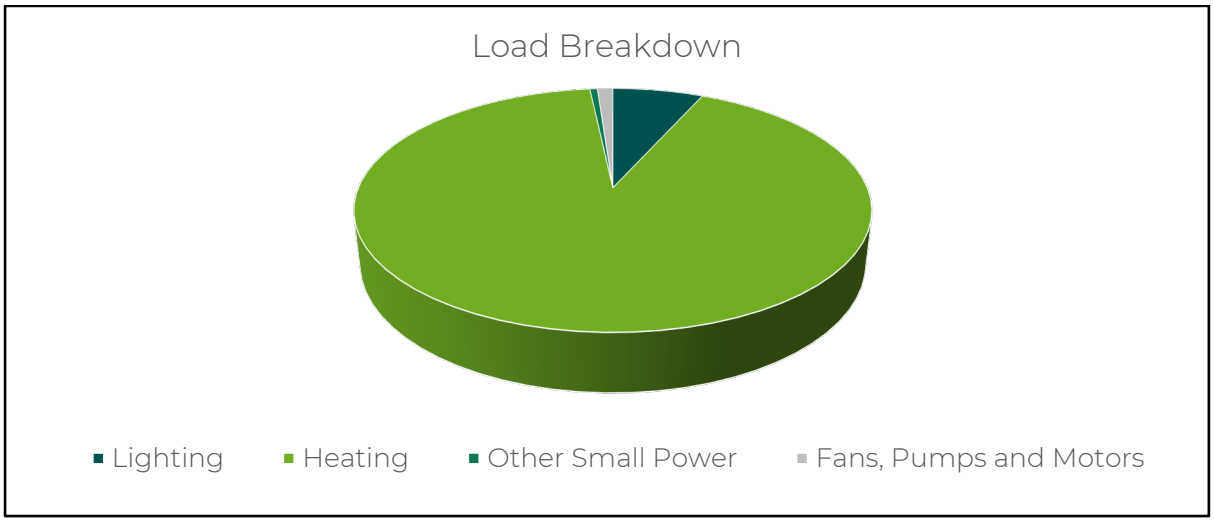
Utility	Meter Serial	Type	Pulsed output	Location
Electricity – Church	K12W580752	3 phase 100A	Yes	Cellar boiler room
Gas – Church	E016K0329219D6	BK-G10E	Yes	Cellar boiler room

All the meters are AMR connected and as such energy profile for the entire energy usage should be possible. Half hour meter data has been provided for the purpose of this report and this has been used to verify the data.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Mainly old T12 fluorescent tubes around wall plate of church, some 2D fittings, most spots are redundant. Much lighting has failed and light levels are poor.	6.7%
Heating	Gas fired heating from 80kW gas boiler installed in around 1990 to radiator system.	91.6%
Other Small Power	Kitchen, office and cleaning appliances, AV and the like.	0.6%
Pumps	Heating circulation pump - now switched to auto (was on constantly)	1.2%



As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site. The other significant load is lighting.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use St Peter's Church uses 69% less electricity and 55% less heating energy than would be expected for a church of this size.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St Peter's Church (elec)	824	5,141	6.24	20.00	-69%
St Peter's Church (gas)	824	55,754	67.66	150.00	-55%
TOTAL	824	60,895	73.90	170.00	-57%

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. Putting in place a heating strategy that is energy efficient and low carbon is, therefore, of the highest priority

The Church of England is in the process of reviewing its heating guidelines. The process has already established some principles for heating that can help churches as they seek an acceptable combination of comfort, conservation, affordability, and environmental care. The principles can be found at https://www.churchofengland.org/sites/default/files/2020-04/CBC%20Heating%20guidance%20principles%20FINAL%20issued.pdf

As the principles make clear, every church's strategy will be unique to it, informed by many factors, including the nature of its usage, the system it's starting from, the conservation needs of

the building, and the resources available. The strategies in this audit are designed specifically for your church.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches we make recommendations that will help to reduce energy wastage and, as a starting point, to optimise the system that you already have

Secondly, we recommend options for many churches that focus on heating people rather than the full volume of the church. Some of the changes that can help with this will be 'soft' changes – others will relate to the heating system itself.

Finally, we make recommendations about moving away from fossil fuels. Moves away from fossil fuels are key to cutting emissions. For most churches, this will involve moving from gas, oil or LPG to electricity. Electricity currently creates carbon emissions around the same level as mains gas, but the carbon emissions associated with it are reducing rapidly as the UK builds more renewable energy and decommissions its remaining oil and coal fired power stations. Mains gas does have some potential to reduce its carbon content through the use of biogas and hydrogen, but these are less developed solutions and will be unable to deliver 'zero carbon mains gas'. Some local areas may also be considering the option of district heating networks.

While moving away from fossil fuels may not always be possible, as the principles state, "churches should be expected to have at least carefully considered the option of moving away from fossil-fuel based heating (gas and oil boilers) towards electric-based heating." And if such options are not viable now, the churches "can try to be ready for a future retro-fit when technology and the grid has progressed."

The existing 80kW gas fired boiler is currently at the end of its serviceable life and should be expected to require replacement in the next few years. It serves radiators around the church and rear rooms through a modern flow and return pipework system. The open plan space does not lend itself to the use of pew heating or direct electric panel heaters. The regular daily use makes overhead heating less viable. It is suggested that installing an air to water heat pump onto the existing radiator system would be the most viable solution. To coordinate with the existing heating system without major adaption the unit would need to be a high temperature air to water source heat pump and packaged units such as Acer CO2 Air Source Heat Pump | Clade Engineering Solutions (clade-es.com) would be quite suitable.

6.1 Air to Water Source Heat Pumps

Air-to-Water Source Heat Pumps (AWSHPs) work by having an external unit which sucks air in and extracts the heat from it. It concentrates this heat and puts it directly into water that can then flow through the heating system. They work most efficiently when trying to produce water temperatures in the heating system between 40°C and 50°C but high temperature units (such as that outlined above) are capable of producing flow temperatures of 70°C. AWSHPs provide around 3 units of heat for every 1 unit of electricity used in the heat pump; they therefore have a Coefficient of Performance (CoP) of 3 when operating at around 45°C. High temperature units have a lower CoP and therefore there is not a financial payback achieved but there is a very significant carbon saving.

AWSHPs require the installation of external units, which look like air conditioning modules in well ventilated external locations. These external units will need an electricity supply and pipework running from them to the heating system. They will also need a drain nearby as the back of the

units can build up moisture, which condenses and sometimes freezes on the coils. The larger units do create some low-level noise and therefore the location and baffling of the units may need to be considered carefully.

Examples of external units for ASHP comprising of three smaller 3kW units and two larger 10kW units.

A case study of a church which has installed this solution is available at Heat pumps and fabric improvements make a rural church warm and well used : St Anne in Ings | The Church of England

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 Optimise Controls

The church's heating is controlled by range of control points located in the boiler room.

During the audit it was reported that the heating would frequently be on outside of the times it was set for. The frost stat was located in the boiler room and found to be set for 20°C. This means that the heating will fire whenever the temperature in the boiler room, which is ventilated to outside air, falls below 20°C, this will be the causes of the frequent heating running. During the audit this was reset to 3°C (frost stats should typically be set between 2°C and 4°C) . The timings of the heating may need to be reviewed and the on time extended slightly to provide a comfortable environment for services now that the heating is not firing constantly.

It was also noted that the pumps were set to manual but they ran successfully in auto. The pump was reset into auto to save the electricity from the pump running when it was not required.

It is recommended that the heating settings are recorded and a copy posted next to the control system, together with the name and phone number of a person to contact if there is a problem.

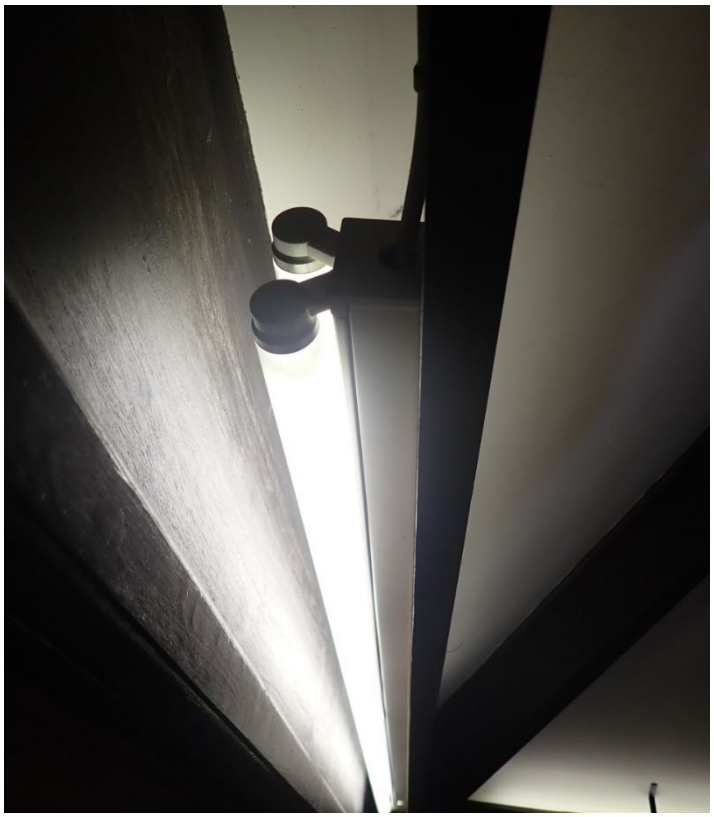
7.2 Install an Overdoor Heater

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 rear of the church. Such an over door unit should be sized to cover the whole width of the door

8. Energy Saving Recommendations

In addition to having a revise 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. There are some areas of the building which have had efficient LED lights installed but there still remains a number of inefficient fluorescent fittings within the main church building, the lower lobby, and the store.

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. An example of such a range of fittings is available from http://www.qvisled.com/. The colour of the LED lights should be carefully specified so that it is warm enough not to be too harsh for a softer church environment yet not too yellow that the blue and green hues in the flowers, stained glass and vestments are lost. We would therefore suggest that the colour temperature of around 3500K to 4000K is installed. Most good quality LED lights are supplied in a range of colour temperatures and this specification should be easily achievable.

If all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £5,400. The annual cost saving would be £2,400 resulting in a payback of around 2.3 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. Guidance on lighting, produced by Historic England for churches, can be found at https://historicengland.org.uk/advice/caring-for-heritage/places-of-worship/making-changes-to-your-place-of-worship/advice-by-topic/lighting/

8.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as the rear of the church, the lower lobby, and the store. Some of these areas are only used occasionally and for a short amount of time so that, in actuality, 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, such that artificial lighting is not required for much use during the year.

It is recommended that a motion sensor is installed on these specific lighting circuits so that the lights come on only when movement is detected in the space and turn off approximately two to five minutes after the last movement has been detected (note that the duration of the time lag after which the light goes off needs to be considered alongside the type of light that is fitted. LED lights are much more suited to being switched off after only a short duration than some

fluorescent lights). These movement sensors, commonly called PIRs, also have light sensors integrated into them so they can be used to make sure that the light does not come on if there is already sufficient daylight in the space.

Your existing electrician or any NICEIC registered electrical contractor can install PIR sensors onto existing lighting circuits. This can be carried out without significant disruption to the use of the space.

8.3 Secondary Glazing

The windows to the original church area are historic and a complex shape to their surrounds however to the south side there are more modern windows (thought to date from around 1988) which have a simpler, square surround. These more modern windows to South aisle, Side Chapel, Vestry, WC and Above Stairs would all be suitable to have secondary glazing installed on the inside of them.

The introduction of secondary glazing would considerably reduce the heat loss through the existing windows and improve both thermal comfort and noise levels, as well as providing added security.

Any possible installation would need to be carefully specified, and companies such as https://www.selectaglaze.co.uk/heritage-listed-buildings or https://www.stormwindows.co.uk/ can provide very discrete and appropriate systems for all types of spaces.

8.4 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 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 flexible insulation jackets. These wrap around the various elements but can be removed and then replaced for any servicing activities.

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

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 – not sufficient demand, visible roof
Battery Storage	No – no viable PV

Now that the Feed in Tariff scheme has come to an end the installation of solar PV panels in situations where there is not almost full usage of the electricity generated on site is not really viable.

Having reviewed the site it is not considered that there is good viability for any renewables and instead a good clear focus on reducing the energy demand of the building should continue with a targeted approach on reducing the heating energy.

10. Funding Sources

There are a variety of charitable grants for churches undertaking works and a comprehensive list of available grants is available on this Parish Resources page: https://www.parishresources.org.uk/resources-for-treasurers/funding/

11. Faculty Requirements

It must be noted that all works intended to be undertaken should be discussed with the DAC at the Diocese.

Throughout this report we have indicated our view on what category of permission may be needed to undertake the work. This is for guidance only and must be checked prior to proceeding as views of different DACs can differ.

Under the new faculty rules;

List A is for more minor work which can be undertaken without the need for consultation and would include changing of light bulbs within existing fittings, repair and maintenance works to heating and electrical systems and repairs to the building which do not affect the historic fabric.

List B is for works which can be undertaken without a faculty but must be consulted on with permission sought from the Archdeacon through the DAC. This includes works of adaptation (but not substantial addition or replacement) of heating and electrical systems and also the replacement of existing boilers so long at the same pipe work, fuel source and flues are used. It can also be used to replace heating controls.

All other works will be subject to a full faculty.

Works which affect the external appearance of the church will also require planning permission (but not listed building consent) from the local authority and this will be required for items such as PV installations.

12. Offsetting

As you take action to reduce your emissions, you may also wish to offset those that you cannot yet reduce. If you would like to engage in offsetting, it is important to use a reputable scheme. The Church of England recommends Climate Stewards, which has a simple calculator that can help you to work out how much you would need to offset. https://www.climatestewards.org/

Climate Stewards encourages people to 'reduce what you can and offset the rest' as part of your journey to Net Zero carbon emissions. They provide training and resources to help you understand climate change and its impacts, and to calculate the carbon footprint from your activities including travel, energy, expenditure, and food. Their online carbon calculators for individuals and smaller organisations are free to use, and they provide bespoke carbon footprint audits for larger organisations.

Having reduced as much of your organisation's carbon footprint as you can, there will always be unavoidable emissions from your work and travel. Carbon offsetting allows you to compensate for the negative impact of your carbon emissions by funding projects which take an equivalent amount of CO_2 out of the atmosphere. These either involve locking up ('sequestrating') CO_2 as trees grow or reducing emissions by using low-carbon technology such as fuel-efficient cookstoves or water filters.

Climate Stewards has a close relationship with all their project partners in Ghana, Uganda, Kenya, Tanzania, Nepal, and Peru. They work closely with them to design, develop, implement and monitor projects which will not only mitigate carbon, but also bring tangible benefits to the local community - including improved health, savings in time and money previously spent on buying or collecting fuel, and improvements in local biodiversity. Each project is assessed using their Seal of Approval protocol which enables us to assess and monitor carbon mitigation and ensure robust, sustainable, and transparent partnerships.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Church (4000K)	40	5ft Double LED	£2,153	£3,832	1.78
Church	1	50W LED Flood	£44	£120	2.70
Rear areas	9	2D LED 11W	£82	£529	6.45
Lower lobby	1	5ft Single LED	£20	£88	4.42
Store	1	5ft Single LED	£58	£88	1.51