ESOS-ENERGY
Energy efficient solutions

# Energy Efficiency and Zero Carbon Advice


## St Ambrose Church Hall, Leyland
## PCC of St Ambrose

THE DIOCESE OF BLACKBURN
THE CHURCH OF ENGLAND IN LANCASHIRE

| Author | Reviewer | Date | Version |
|---|---|---|---|
| David Legge | Matt Fulford | 13th September 2022 | 1.0 |

# Contents

# 1. Executive Summary

An energy survey of St Ambrose Church Hall, Leyland 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 Ambrose Church Hall, Leyland is linked to the neighbouring church by a link corridor and located in a suburban area in Leyland, near Preston. The church hall was built in 1938 with a further annex constructed in 1959. Further works to extend the entrance and undertake refurbishment was completed in 2010 with a kitchen refurbishment in 2017. The hall is predominantly of brick cavity construction with a pitched tiled roof and uPVC double glazed windows. The church hall comprises of a large main hall, second small hall (annex), conference room, kitchen, WCs and smaller cellular spaces. There is both gas and electricity supplied to the site.

The church hall 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) | CO2 saving (tonnes of CO2e/year) |
|---|---|---|---|---|---|
| **Move to Electric / Induction Kitchen Appliances** | None (Fuel Switch) | -£1,097 | £2,200 | N/A | -0.3 |
| **Install SavaWatt devices on fridges and freezers** | 540 | £220 | £187 | 0.8 | 0.1 |
| **Fit timed fused spurs to hot water heaters** | 868 | £354 | £495 | 1.4 | 0.2 |
| **Change existing lighting for low energy lamps/fittings** | 3,939 | £1,606 | £3,895 | 2.4 | 0.9 |
| **Fit flow regulators onto existing taps** | 221 | £28 | £116 | 4.2 | 0.0 |
| **Install and adjust PIR motion sensors on selected lighting circuits** | 151 | £62 | £820 | 13.2 | 0.0 |
| **Install an Air-to-Air Source Heat Pump to replace the existing heating system served from the hall boiler room** | 142,301 | £6,416 | £139,590 | 21.8 | 24.2 |
| **Inject cavity wall insulation into walls** | 3,689 | £464 | £11,000 | 23.7 | 0.7 |

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

Based on recently announced protected energy cap prices, we have used representative rates of 40p/kWh and 12p/kWh for electricity and mains gas respectively.

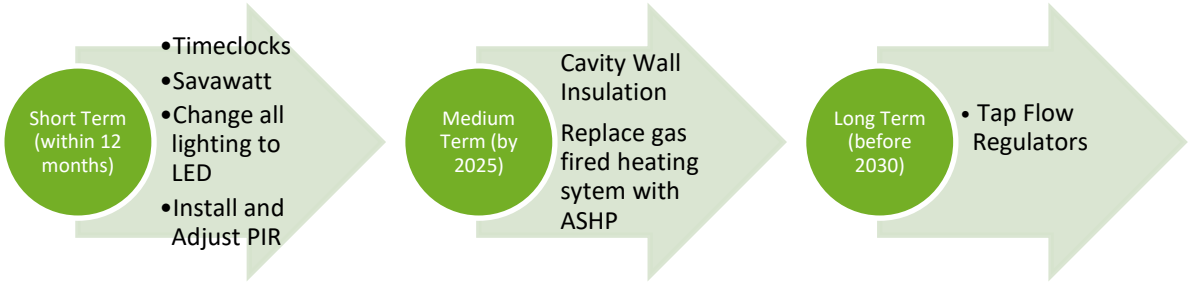
**If all measures were implemented this would save the church £8,052 per year and reduce its carbon footprint by 25.89 tonnes (69%)**.

## 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 hall 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 Ambrose Church Hall, Leyland 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 Ambrose Church Hall, Leyland, Moss Lane, Leyland, Preston PR25 4XA was completed on the 6th July 2022 by David Legge. David is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment. David is a fully qualified ESOS lead assessor with CIBSE and a CIBSE Low Carbon Consultant and a fully qualified ISO50001 lead auditor.

| **St Ambrose Church Hall, Leyland** | |
|---|---|
| Church Code | 603121 (church) |
| Gross Internal Floor Area | 880 $m^2$ |
| Listed Status | Unlisted, but attached to Grade II listed church |

The church typically used for 9 hours per week for the following activities

| **Type of Use** | **Hours Per Week (Typical)** | **Average Number of Attendees** |
|---|---|---|
| Conference room | 7 hours per week | Varies |
| Annex (small hall) | 20 hours per week | Varies |
| Main hall | 34 hours per week | Varies |

There is additional ad hoc usage over and above these times for other events.

# 4. Energy Usage Details

St Ambrose Church Hall, Leyland uses 9,210 kWh/year of electricity, costing in the region of £1,754 per year, and 192,716 kWh/year of gas, costing £10,871. The total carbon emissions associated with this energy use are 37.4 $CO_2e$ tonnes/year. Due to recent price rises, costs are estimated to rise to £3,750 for electricity and £24,220 for gas when contracts renew.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St Ambrose Church Hall, Leyland has one main electricity meter, serial number D08W673968. There is one gas meter serving the site.

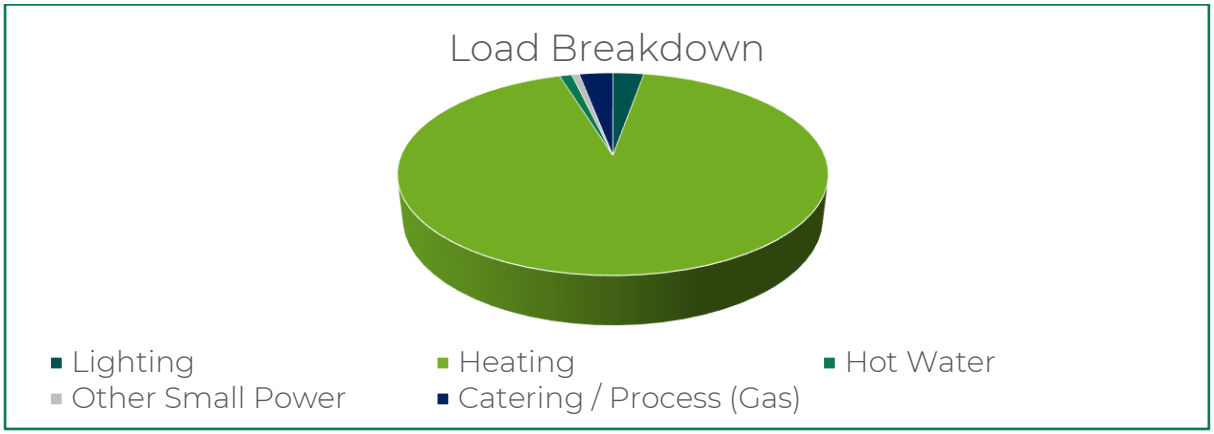
| Utility | Meter Serial | Type | Pulsed output | Location |
|---|---|---|---|---|
| **Electricity** | D08W673968 | 3 phase 100A | Yes but not fully AMR connected | Gardening room |

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.

## 4.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

| Service | Description | Estimated Proportion of Usage |
|---|---|---|
| **Lighting** | A mix of LED in some areas whilst other areas including the main hall, annex and conference room have inefficient T8 and T12 fluorescent fittings | 3% |
| **Heating** | Provided by gas fired boilers to perimeter panel and column radiators | 92% |
| **Hot Water** | Electric point of use water heaters to wash hand basins and sinks | 1% |
| **Catering (gas)** | Gas consumption for kitchen hobs | 3% |
| **Other Small Power** | Sound system, alarm and security systems and other plug loads | 1% |




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

## 4.2 Energy Benchmarking

In comparison to national benchmarks for church hall energy use St Ambrose Church Hall, Leyland uses 48% less electricity and 109% more heating energy than would be expected for a church hall of this size.

| | Size ($m^2$ GIA) | Annual Energy Usage (kWh) | Actual kWh/$m^2$ | Benchmark kWh/$m^2$ | Variance from Benchmark |
|---|---|---|---|---|---|
| **St Ambrose Church Hall, Leyland (elec)** | 880 | 9,210 | 10.47 | 20.00 | -48% |
| **St Ambrose Church Hall, Leyland (gas)** | 880 | 192,716 | 219.00 | 105.00 | 109% |
| **TOTAL** | 880 | 201,927 | 229.46 | 125.00 | 84% |

# 5. 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 hall.

Our recommendations on heating generally fall within three major areas. Firstly, for all churches and halls 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 and halls that focus on heating people rather than the full volume of the church or hall. 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 and halls, 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 bio gas 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 church hall is currently heated by gas fired boilers which have passed the end of their serviceable life and require replacement with a zero carbon heating source. The current heating arrangement does not give the desired flexibility on heating individual spaces and is therefore wasteful of heat in this regard.

It is recommended that the heating system be fully replaced by an air to air source heat pump which is capable of providing heating to each individual space in a responsive manner allowing spaces to heat relatively quickly and providing an efficient zero carbon heating solution.

### 5.1

### 5.2 Replace the Existing System for an Air Source Heat Pump

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. An air to air source heat pump can create around 4.5 units of heat for every one unit of electricity.

The existing boiler has passed the end of its serviceable life and it is therefore recommended that the replacement of the existing boiler for an air source heat pump is considered now.

A new air source heat pump is likely to need a heating capacity of around 80kW and could be located in the current boiler room and external units where the bin store is currently with a compound that attenuates some of the noise from neighbouring properties as well as keeping the units secure. As heat pumps operate on a low temperature basis some of the radiators and other heat emitters around the site may require upgrading. 3 phase electrical power will be required to power the units which is already installed.

Good local renewable companies can be contacted for further detailed assessment of heat pumps and quotes or contact www.yourfutureenergy.co.uk

# 6. 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 hall.

## 6.1 New LED Lighting

The lighting makes up a relatively large overall energy proportion of the electricity used within the hall. Several areas of the building have had efficient LED lights installed but there still remains a large number of inefficient T12 and T8 fluorescent tube fittings within the main hall, annex and conference room; all of which are heavily used.

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/

If all the lights were changed on a simple "like for like" the total capital cost (supplied and fitted) would be £3,895. The annual cost saving would be £1,606 resulting in a payback of around 2.4 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/

Some of the existing fittings can also be made more efficient by simply changing the bulb/lamp within the existing fitting to a new LED bulb/lamp such as the GLS lamps in the choir vestry and CFL lamps in the WCs. This could be carried out by competent members of the churches internal team, very cost effectively and would be a List A item so no permissions would be required.

## 6.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as entrance, lobby, corridors, toilet areas 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.

Where motion sensors already exist in some of the WCs and store rooms, it is recommended that the settings are checked and reduced as much as practically possible to reduce the time that lights remain on in these spaces.

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

### 6.3 Timers on Fuse Spurs to Water Heaters

There are a number of electric point of use water heaters to provide hot water for hand washing. This only needs to heat the water to the required temperature when the building is in occupation but at the moment this heater is directly wired in without any form of time control and therefore maintains it set temperature 24/7.

It is recommended that the heaters are fitted with a 24 hour/7 day timeclock to replace the fused spur switch. An example of such a unit would be a TimeGuard FST77. They should be set up with times to match the times that the building is occupied and this will prevent the standing losses from the unit wasting energy during periods when the building is not occupied.

Such units can be purchased at any electrical wholesaler and fitted by your existing electrician or any NICEIC registered electrical contractor.

### 6.4 Refrigeration Control

Within the kitchen, there is a large commercial kitchen fridge and freezer. 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 SavaControl 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 http://savawatt.com/. The installation does not cause any significant disruption to operations and can be undertaken during normal operating times.

### 6.5 Cavity Wall Insulation

The hall building 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 cavity walls did not require to be 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.

A free survey and quotation for the supply and installation of insulation to the loft spaces can be arranged through ESOS Energy Ltd (contact Adrian Newton 0117 930 9689, adrian@esos-energy.com).

### 6.6 Kitchen Procurement and Decarbonisation

The procurement of replacement and new equipment offers an opportunity to improve the energy efficiency and it is recommended that the following is considered at the time of replacement:

Buy induction hobs or ranges and hot plates which only provide heat when a pan is placed on top of them. Such specifications are now becoming more common in top professional kitchens. (i.e. Dinner by Heston Blumenthal at the London's Mandarin Oriental and Glynn Purnell's Michelin-starred restaurant in Birmingham) (https://www.thecaterer.com/articles/343115/induction-10-years-on)

Procure dishwash units which recover and recycle the heat and avoid the need to extraction. https://www.winterhalter.com/uk-en/products/dishwashers/commercial-passthrough-dishwashers/

Review the annual energy consumption of all new units, including refrigeration units which remain on all the time. As an example, the Gram Superior Plus K72 uses around half the energy when compared to similar models from other manufacturers such as Foster over the course of a year https://www.eco-catering-equipment.co.uk/gram-superior-plus-k72-single-door-upright-refrigerator-cabinet-2-10c/

Locate ovens and chillers away from each other to avoid heating and cooling conflicts within the area.

Consider installing heat recovery on the supply and extract system so that the heat extracted from the kitchen is used to pre-heat the fresh air being supplied into the kitchen and dining area.

### 6.7 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 over 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. 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.

## 7. Renewable Energy Potential

The potential for the generation of renewable energy on site has been reviewed and the viability noted.

| Renewable Energy Type | Viable |
|---|---|
| **Solar PV** | No – large trees to South of building |
| **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** | No – insufficient electricity supply |
| **Ground Source Heat Pump** | No – archaeology in ground and radiator system |

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. However, the main limiting factor for the hall is the presence of large trees which are in very close proximity to the hall, meaning that shading of any solar PV array would be so significant that output would be severely reduced and therefore makes this currently unviable.

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.

Wind turbines require highly exposed sites and should be located 250m way from buildings as such this site is not suitable for a wind turbine to be installed.

Hydro electricity is a highly efficient source of renewable energy but requires a body of flowing water with a differential height which is not present on this site.

Solar thermal installations are best suited to heat water for use in washing up, hand washing and bathing. There is minimal hot water demand at this church so such an installation would not be viable.

Heat Pumps are a low carbon method of creating heat, their use and suitability for this church hall have been review in the section earlier on in this report on Efficient and Low Carbon Heating Strategies.

Biomass is an alternative boiler and fuel to oil or gas. It requires wood chips or pellets to be delivered on site, stored and then fed into a large boiler for burning. While the fuel is not a fossil fuel there are emissions from the burning of wood and these can be detrimental to local air quality particularly in more built up areas for all these reasons it is not considered a viable recommendation for this site.

## 8. 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/

## 9. Faculty Requirements

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

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

Under the new faculty rules;

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

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

All other works will be subject to a full faculty.

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

## 10. 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 office** | T8 5ft | 2 | 5ft Single Batten LED | £188 | £171 |
| **WC** | CFL | 2 | 2D LED 7W with PIR | £7 | £140 |
| **Choir vestry** | t8 6ft | 2 | 5ft Single Batten LED | £22 | £171 |
| **Choir vestry** | GLS | 4 | LED GLS | £40 | £38 |
| **WC** | CFL | 2 | 2D LED 7W with PIR | £7 | £140 |
| **Main hall** | T12 5ft | 8 | 5ft Single College LED | £804 | £897 |
| **Entrance** | T8 5ft | 6 | 5ft Single College LED | £441 | £673 |
| **Annex lobby** | t8 5ft | 1 | 5ft Single Batten LED | £17 | £86 |
| **Conference room** | t8 5ft | 3 | 5ft Double College LED | £45 | £344 |
| **Under stage storage** | T8 5ft | 4 | 5ft Single Batten LED | £34 | £343 |