ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice

St John the Baptist, Sampford Peverell
PCC of St John's

Author	Reviewer	Date	Version
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Contents

1. Executive Summary

An energy survey of St John the Baptist 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 John the Baptist is a Grade I listed church which dates back to the 13th Century with the South Aisle being added in the 15th Century. The church is heated from an oil boiler to fan convector heaters around the nave. The choir stalls all have pew panel heaters. The lighting is a mix of LED, fluorescent, GLS and PAR 38 lamps. There is electricity supplied to the site.

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)
Fit timed fused spurs to hot water heaters	324	£55	£180	3.26	List A (None)	0.08
Change existing lighting for low energy lamps/fittings	754	£129	£736	5.73	Faculty	0.19
Install a Solar PV array to roof of building (assumed 100% of energy generated used in building)	2,770	£472	£5,396	11.44	Faculty	0.70
Install PIR motion sensors on selected lighting circuits	92	£16	£330	21.14	List B	0.02
Add or Replace draught strips to external doors	223	£9	£300	32.00	List A (None)	0.06
Replace heating system for electrical based heating solution	7,783	-£123	£11,705	Carbon saving	Faculty/List B (from July 2022)	1.20
Install an Air Source Heat Pump into the building to replace existing heating system	6,138	-£403	£30,000	Carbon saving	Faculty	0.79

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

Based on current contracted price of 16.09 p/kWh for electricity and a market price of 4.2p/kWh for oil.

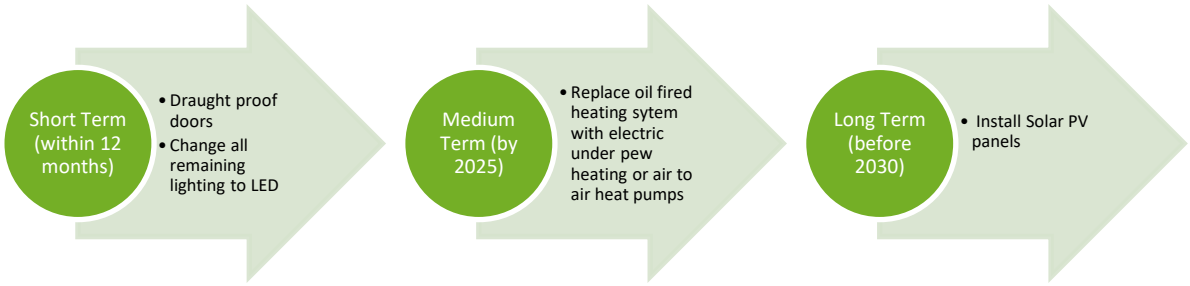
This report contains two recommendations for heating, depending on the retention or removal of the pews, and therefore the total cost and savings is not able to be totally added up.

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 are:



3. Introduction

This report is provided to the PCC of St John the Baptist 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 the Baptist, 3 Higher Town, Sampford Peverell, Tiverton EX16 7BP was completed on the 13th May 2022 by Marisa Maitland. Marisa is an experienced energy auditor with over 10 years' experience in sustainability and energy matters in the built environment and a CIBSE Low Carbon Energy Assessor

St John the Baptist	
Church Code	615112
Gross Internal Floor Area	344 m^2
Listed Status	Grade I

The church on average is used for ~5 hours per week for the following activities

Type of Use	Hours Per Week (Typical)	Average Number of Attendees
Services	3 hours per week	20
Meetings and Church Groups	1 hours per week	-
Bell ringing	1 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 oil and electricity have been supplied by St John the Baptist and have been reviewed against the current market rates for energy.

The current electricity rates are:

Day Rate	16.9p/kWh	In line with current market rates
Night Rate	15.58p/kWh	In line with current market rates
Standing Charge	25p/day	N/A

The above review has highlighted that the current rates being paid are in line with market levels and the organisation can be confident it is receiving good rates and should continue with their current procurement practices.

A review has also been carried out of the taxation and other levies which are being applied to the bills. These are:

VAT	20%	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 John the Baptist uses 2,015 kWh/year of electricity, costing in the region of £350 per year, and 11,160 kWh/year of oil costing £470. However the period that this energy use was recorded in was from August 2020 to August 2021, much of which was during the COVID 19 pandemic lockdown periods so it would be reasonable to expect that this usage will be higher during non lock down periods. The total carbon emissions associated with this energy use are 3.5 CO_2e tonnes/year.

This data has been taken from the annual energy invoices provided by the suppliers of the site. St John the Baptist has one main electricity meter, serial number 19L3903009.

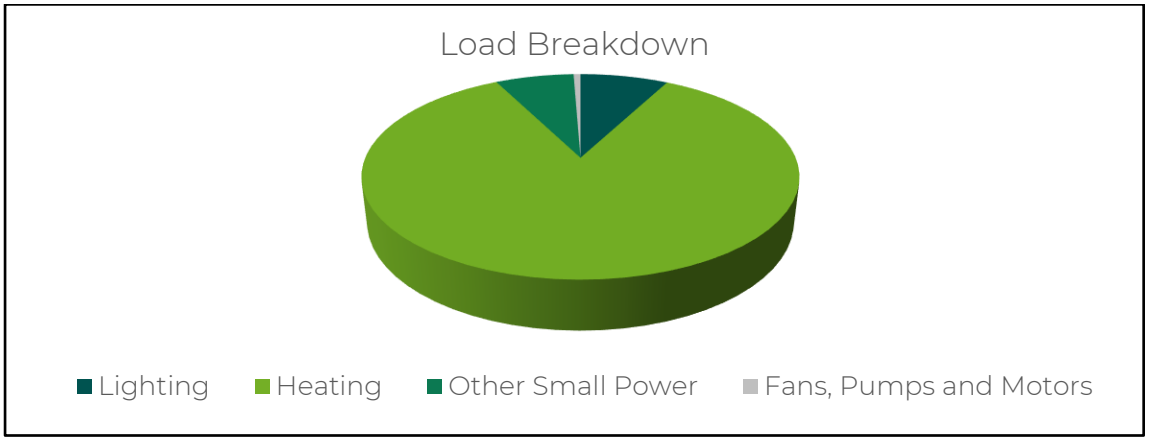
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	19L3903009	1 phase 100A	No but capable	Vestry

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.

5.1 Energy Profiling

The main energy consuming plant can be summarised as follows:

Service	Description	Estimated Proportion of Usage
Lighting	Mix of LED, fluorescent, GLS and PAR 38 lamps	8%
Heating	Oil boiler to fan convector heaters and some pew panel heaters	85%
Other Small Power	Electric hot water heaters, small kitchen appliances	7%
Fans and pumps	Small kitchen appliances	1%



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 the Baptist uses 71% less electricity and 78% less heating energy than would be expected for a church of this size. However, as indicated in the introduction, the energy data provided for the church was during the COVID lockdown period, so typical use is likely to be higher than this.

	Size (m^2 GIA)	Annual Energy Usage (kWh)	Actual kWh/m^2	Benchmark kWh/m^2	Variance from Benchmark
St John the Baptist (elec)	344	2,015	5.86	20.00	-71%
St John the Baptist (gas)	344	11,160	32.44	150.00	-78%
TOTAL	344	13,175	38.30	170.00	-77%

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.

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."

This church is currently heated by an oil boiler which was reported to be over 30 years old. The boiler heats water which is distributed into the church space by fan convector heaters.

The PCC of the church are currently in discussion with Diocesan Advisory Committee regards to the future of the church, in particular with regard to the pews if they are able to be removed, or if this will not be permissible. This report therefore proposes two heating strategies for the church, one with the pews being retained and the other with them being removed.

If the pews are not able to be removed, the most efficient heating to replace the oil boiler would be to move to electric pew heating in combination with electric panel heaters. This is based on the principle of heating the people and not the space.

If the pews are able to be removed the recommendation would be to install an air source heat pump based system. Both of these options are detailed below (see sections 6.1 and 8.2).

6.1 Install Electric Under Pew Heaters

As indicated above, if the pews are not allowed to be removed, the most efficient heating system for this church is pew heating. This system will heat the people in the church and not the space. They would only need to be put on a short time before the service and will be position under the pew seats for the warm up to filter up over people in the pews.

There is already an older version of pew heating in the choir stalls, so the church is familiar with this type of heating system. The number of pew heaters to install in the church would be for discussion based on how many pews the church would like to heat and also the available funds.

Two of the most popular under pew heaters within churches are BN Thermic PH65 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar from http://www.electricheatingsolutions.co.uk/Content/PewHeating.

It would be costly to provide pew heating to all of the pews in the church considering the number of the congregation, therefore the costs for these heaters are based on the assumption of installing pew heaters to front 4 pews on both sides of the nave.

The church could propose to only remove only the pews at the rear half of the church and retain the front 4 pews on each side of the nave, thereby providing some flexible space at the rear of the church but retain enough pews for pew heating. This would then provide the church with a cost and carbon effective form of heating whilst providing some flexible space for alternative activities in the church. The flexible space could then be heated by electric panel radiant heaters, which is detailed in the following section.

We would therefore suggest that the following works could be considered:

Install BN Thermic Under Pew Heaters suspended from brackets from the underside of the pew seat as follows:

North side, 4 rows with three heaters in each row between uprights.

South side, 4 rows with three heaters between uprights.

Cable runs to the pew heaters should run along the along the existing routes (all cabling should be in armoured cable or FP200 Gold when above ground) to both rows of pews. Each pew heater to be switched with a neon indicated fused spur located underneath the pew seat.

The under pew (see photo below) and panel heaters have been recently installed at St Andrews Church, Chedworth, Gloucestershire, GL54 4AJ. The church is open in daylight hours so can be viewed at any time.

6.2 Install Electric Panel Heaters

As detailed above, if the front half of the pews remain, the rest of the church space at the rear and to the side nave could be heated by electric panel heaters on a time delay switch and remove the existing radiators.

Suitable electric panel heaters would be far infrared panels such as https://www.warm4less.com/category/infrared-heaters/?filters=colour/37/wattage/81. 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.

These heaters have a strong radiative effect (where heat is reflected to people from the surface) as well as a light convective effect (where air is warmed and moves around to heat the general space). For this reason, these heaters tend to provide a relatively instant sense of heat and comfort within the space and only need to be on for short periods of time. This reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It also means that the building can rapidly and economically be brought into used for short or unplanned meetings if needed.

6.3 Upgrade to 3 Phase Electricity Supply

To be able to have sufficient electrical power to supply enough energy into an electrical heating system the church will need to increase the existing electrical supply from single phase 100A supply to a 3 phase 100A supply.

The upgrade to the supply has to be carried out by the District Network Operator (DNO) in the area.

The DNO in your area is thought to be Western Power Distribution - www.westernpower.co.uk; 0800 0963080 (East Midlands, West Midlands, South Wales & South West England)

The cost of bringing in a new 3 phase supply can range from £300 to £30,000, and a provisional cost provided to the church from the DNO is £1,200.

7. 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.

7.1 New LED Lighting

The lighting makes up a relatively large 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 large number of inefficient fluorescent, PAR 38 and GLS fittings within the church.

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 £750. The annual cost saving would be £130 resulting in a payback of around 5.7 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/

There are some fittings such as the GLS and CFL where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to w new LED bulb/lamp. 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.

7.2 Lighting Controls (Internal)

There are several lights which currently remain on all the time in areas such as vestry areas and the like. 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. Also, if the church is open to the public it can be helpful to have some nave and alter lights in movement sensors, so that only one or two lights need remain on for a welcome to visitors and the rest come on as people move around the church.

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.

7.3 Timers on Fuse Spurs to Water Heaters

There are a couple of electric hot water heaters and water boilers (for, hand washing, tea making

and the like) located around the church. These only need to heat the water to the required temperature when the building is in occupation but at the moment these heaters are directly wired in without any form of time control and therefore maintain their 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 . 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.

7.4 Draught Proof External Doors

There are a number of external doors in the church. The historic timber doors do not close tightly against the stone surround and hence a large amount of cold air is coming into the church around the side and base of these doors.

It is recommended that the draughtproofing around the door is improved and draught strips are added. This could be achieved in a number of ways:

For timber doors that close onto a stone surround more traditional solutions such as brush draught strips rebated into the edge of the door by a skilled joiner. Other traditional methods such as using hessian or felt pads tacked to the door could be used. Keeping the door maintained in a good condition is also important.

Simple measures such as having a 'sausage dog' style draught excluder laid along the base of a door (it needs to be sufficiently heavy to stay in place), using plasticine of the right colour to fill gaps where daylight can be seen, and putting painted fridge magnets over large keyholes can all be simple DIY measures which are effective.

8. 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 – It might be possible to install a PV array above the nave behind the roof of the side aisle.
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 –to replace oil boiler, if pews are to be removed
Ground Source Heat Pump	No – archaeology in ground and radiator system

8.1 Solar PV

There is potential for a small PV array on the roof of the Nave roof behind the South Aisle roof, where is hidden from sight. The current arrangements around solar panels mean that to be financially viable the building on which they are mounted needs to consume the vast majority of the energy that they produce. The church's energy consumption is already very small and the consumption during the daytime when the sun is shining is likely to be very low indeed, therefore while technically viable only a very small number of panels (maximum of around 4) would be worth considering if at all.

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.

8.2 Heat Pumps

Heat pumps use refrigeration technology to extract heat from the air, ground or water (large amounts of which are cooled slightly as refrigerant evaporates). By compressing the working fluid, the heat is recovered.

The efficiency advantages of heat pumps mean that they consume between 2 and 4 times less electricity to provide heat than direct electric heaters (the Coefficient of Performance, CoP). With electricity prices rising, heat pumps are becoming steadily more cost effective. Refrigeration technology is mature and reliable; the units appear to offer lower maintenance costs compared to boilers.

If the church does decide to remove all of the pews then an air to air heat pump system would be suitable replacement, but this would be to heat the whole church space not the people. The heat emitters in the church can be floor standing units more similar to the fan convector heaters currently in the church.

At the time of the audit, the church was considering mains electric heating, however the benefit of the air source heat pump is that it is a renewable technology and will deliver warm air into the church similar to standard electric heaters. As it is a renewable technology the air to air source heat pump will have significant carbon savings over a mains electric heater.

9. Funding Sources

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 .

10. 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.

11. 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
Ringing chamber	1	5ft Single LED	£4	£88	20.15
Boiler room	1	5ft Single LED	£10	£88	9.12
Vestry	1	LED GLS	£3	£12	4.33
Controls cupboard	1	LED GLS	£3	£12	4.33
Nave	2	PAR38 LED	£11	£34	3.03
Side aisle	4	PAR38 LED	£22	£68	3.03
Porch	1	LED GLS	£1	£12	12.70