Energy Efficiency and Net Zero Carbon Advice

St Mary's Church, West Harptree
PCC of St Mary's Church

DIOCESE OF Bath&Wells

Author	Reviewer	Date of Audit	Version
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Contents

1. Executive Summary

An energy and decarbonisation survey of St Mary's Church, West Harptree was undertaken by Inspired Efficiency Ltd. to offer advice to the church on how it can be more energy efficient, provide a sustainable and comfortable environment, and move towards net zero carbon. This is part of the wider environment and parish support programme within the Diocese Bath and Wells.

St Mary's Church, West Harptree is a Grade II* listed parish church located in the rural village of West Harptree in the Chew Valley. The church has origins in the C12 and C13 but the main body of the church dates from C15 and was extensively restored in 1865. The church is constructed of random rubblestone for the most part with squared and coursed sandstone to the Chancel with freestone dressings. The church has a pitched tiled roof and exposed wagon roof internally. The church has a 3 bay arcade to the South aisle and there are mainly fixed wooden pews throughout. Heating is provided by an oil fired boiler (now condemned) providing heat to column radiators throughout the church. Both stored oil and 3-phase electricity are supplied to the site.

The church has a number of ways in which it can be more energy efficient and a clear path towards net zero carbon. 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 diagram below are used as the action plan for the church in implementing these recommendations over the coming years.

Energy and decarbonisation actions	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/yr)
Contact suppliers to arrange for the meters to be changed to smart meters	Helps monitor use and savings	None	Nil	N/A	None	N/A
Switch electricity suppliers to ones which provide 100% renewable supplies	None	None	Nil	N/A	None	Offset 0.29 tonnes
Upgrade incoming electrical supply capacity to power decarbonised heat solution	0	£-	£1,650	N/A	Faculty	-
Replace heating system for electrical based heating solution	10,003	£1,082	£24,366	22.52	Consult DAC	2.73
Draught proof external doors	321	£39	£880	22.85	Consult DAC	0.09
Change existing lighting for low energy lamps/fittings	9	£2	£123	49.70	Consult DAC	0.00
Consider registering for Eco Church	The Eco Church programme, which is recommended by the Church of England, helps congregations care for the environment in all aspects of church life. The programme is free; you can, however, donate to A Rocha UK towards its costs.					
Create a procurement policy for appliances (and other goods)	Commit to buying only appliances with the new energy efficiency ratings of A, B or C at the lowest when those you currently have reach the end of their useful life. (NB ovens, air conditioners and space or water heaters are still on the older rating scale, so for these, try for A+++.)					

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

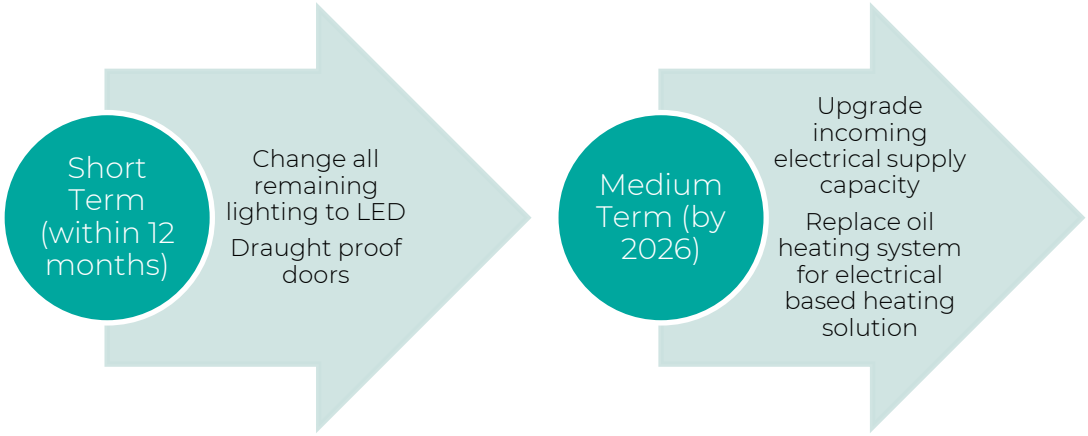
Figures in the table are based on current market prices of 29p/kWh for electricity and 12p/kWh for heating oil respectively. The carbon figures are based on the DEFRA 2023 carbon emission factors of 0.22499 for electricity and 0.27 for oil. Do note that as energy prices vary, payback periods will also vary.

2. The Route to Net Zero Carbon

The UK 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 carbon by 2030 by undertaking the following steps:



3. Introduction

This report is provided to the PCC of St Mary's Church, West Harptree to offer advice and guidance as to how the church can be made more energy efficient and work towards net zero carbon. In doing so the church will also become more cost effective to run and potentially have higher 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 St Mary's Church, West Harptree, (West Harptree, Bristol BS40 6HF) was completed on the 11th of July 2024 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 Mary's Church, West Harptree	
Church Code	601317
Gross Internal Floor Area	238 m^2
Listed Status	Grade II*
Average Congregation Size	30

The church is typically used for 1 hour per week for the following activities:

Type of Use	Hours Per Week (Typical)
Services	1 hour per week (1 service/month)
Meetings and Church Groups	Ad hoc use only
Community Use	Ad hoc use only
Occasional Services (weddings, funerals, etc averaged out over a year)	Less than 1 service per month

4. Energy Usage Details

St Mary's Church, West Harptree uses 982 kWh/year of electricity per year, and 10,700 kWh/year of oil. The total carbon emissions associated with this energy use are 3.1 CO_2e.

This data has been taken from the annual energy invoices provided by the suppliers of the site.

The energy meters on the site are as detailed below:

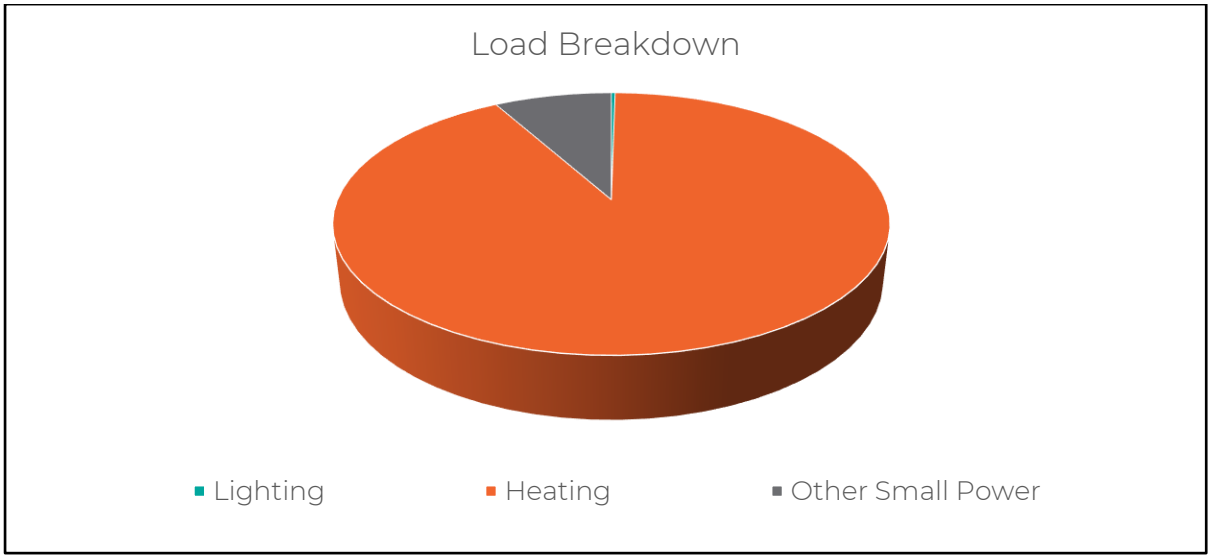
Utility	Meter Serial	Type	Pulsed output	Location
Electricity	17S0075881	1 phase 100A	Fully AMR connected	Vestry

All the meters are AMR connected so accessing an 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.

4.1 Energy Profiling

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

Service	Description	Estimated Proportion of Usage
Lighting	Almost exclusively LED but some CFL and AR111 spotlights remain.	0.3%
Heating	Condemned oil fired boiler to column radiators throughout.	91.6%
Other Small Power	Organ power, sound power and other plug in appliances.	8.1%



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

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. 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 near future. 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' in the foreseeable future[1].

It is therefore important to review and set out a plan to make heating more efficient and less carbon intensive. One way to achieve this is to consider a transition to electrical heating where this also represents an efficient and comfortable solution for churches. Electricity currently has carbon emissions of 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 its remaining oil and coal-fired power stations.

The church is currently heated by an oil fired boiler which was installed in the 1990s and appears to have reached the end of its serviceable life as it has been condemned and is now requiring replacement. The boiler provides heating to column radiators around the church, including to the altar and chancel. In addition, there is exposed pipework which contributes to the heating of the church.

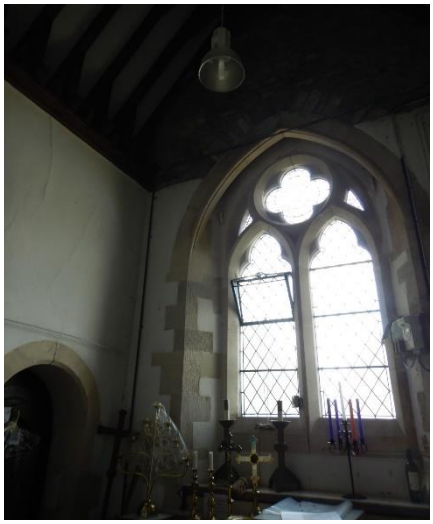
The church makes use of fixed wooden pews in the main, with some moveable pews mainly to the South aisle as well as the choir stalls.

The church is used once per month on a Sunday for service and the typical congregation size is around 30. The heating is set to come on up to 8 hours earlier in the winter to ensure the church is warm for this service.

The various options for a decarbonised heating solution have been reviewed in the table below.

[1] https://www.churchofengland.org/resources/churchcare/advice-and-guidance-church-buildings/hydrogen-and-hydrotreated-vegetable-oils

Decarbonisation Heating Solution	Viable
Air-to-Water Source Heat Pump	No – unsuited to current heating pipework and heat emitters
Air-to-Air Source Heat Pump	No – does not suit use of building
Water Source Heat Pump	No – no water source locally
Ground Source Heat Pump	No – does not suit use of building, significant archaeology and capital cost
Under Pew Electric Heating Panels	Yes – preferred heating system where fixed pews exist
Electric Panel Heaters	Yes – far infrared heaters to Lady Chapel, vestry and altar as required
Over Door Air Heater	Yes – to provide a supplemental warm welcome at the door only but architecture around door may be contentious
Overhead Infra-Red Heaters	Yes – to small areas only (e.g. choir stalls) as visual intrusion to the church, high capital cost
Heated Chair Cushions	Yes – viable option for moveable South aisle pews and can be interchanged with choir stalls



The recommendation is therefore that the church consider the use of under pew heaters throughout the church where fixed pews exist. In those areas where there are no pews, consideration should firstly be given to whether heating is absolutely required given the low hours of use of the church. The organist seat can also make use of an under pew heater on a flex cord (only to be moved for maintenance). If heating is required, a mix of different heating solutions is proposed to provide a balance between capital cost, visual impact and thermal comfort for all occupants (as discussed on site).

The moveable South aisle pews could make use of heated pew/seat cushions as this area is infrequently used and only when the church is full. These cushions could be utilised within the choir stalls to make best use of these. To provide a warm welcome to the church but also to provide heating for the font, an overdoor heater is proposed. Finally, within other areas (chancel, altar, vestry, pulpit) far infrared heaters, most likely in a bar format (e.g. Herschel Summit) can be used to provide localised heating. Further details about these recommendations are given below.

5.1 Install Electric Under Pew Heaters

Electric under pew heaters provide a high level of thermal comfort to people sitting in the pews. They are not installed to try and heat the entire air volume of the church; instead, thermal comfort is achieved through a flow of warm air rising past the person in the pew. This means that the heaters should be installed under the entire length of all the pews that are likely to be used.

These heaters warm up almost instantly and a flow of warm air over the pew area is created within around 15 minutes of their being turned on. This significantly reduces the amount of preheating required before each use of the building and can make electric heating cost competitive with gas. It is important that this reduced 'on time' is properly reflected in any comparisons with other types of heating.

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

Install under pew heaters suspended from brackets from the underside of the pew seat as follows:

Area	Type/ Size	Length (mm)	Watts	Area Heated	Number (or m) Required
Centre pews	Electric Under Pew 650W	948	650	Pew Only	16
N aisle pews	Electric Under Pew 650W	948	650	Pew Only	20
Organist	Electric Under Pew 650W	948	650	Pew Only	1
S aisle rear	Electric Under Pew 450W	702	450	Pew Only	8

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.

A case study of a church which has adopted this solution is available at https://www.churchofengland.org/about/environment-and-climate-change/st-andrews-chedworth-electric-heating

Photos of installations are shown below. In addition, several churches have recently installed such systems. If you would like to find out about churches whom you could ask about their experiences, please contact the diocese.

Brown BN Thermic 650W under pew heaters fixed to underside of pew seats for pews which have no solid backs.

Black 650W Norel under pew heaters fitted to solid pew backs.

5.2 Install an Over Door 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 south entrance of the church. Such an over door unit must be sized to cover the whole width of the door.

A variety of over door air heaters are available on the market and can be installed by an electrician. The heaters that will cover the entire width of the door tend to be larger output units, which will require a dedicated electrical cable of the correct size run to them. The church should resist the temptation to reduce the size and output of the heater to avoid running a new cable, as the output from smaller heaters and of those with insufficient width tends to be disappointing.

5.3 Overhead Infrared Heaters

In areas where there are no fixed pews on to which heaters could be fitted, an option for heating the people, rather than all the air in the space, is to use overhead infrared heaters. These come in a variety of forms from the traditional models that emit a visible red-light glow, to ceramic units and the more modern 'black heat' units which emit no visible light. In most cases the distance from the heater to the people being heated needs to be no more than around 2.5 to 3m, although this varies slightly between heater types (therefore a mounting height of between 3m to 4m is typical). Units mounted outside of their heating range are likely to give poor performance.

This form of heating provides heat from above and can leave lower limbs and feet feeling cold; therefore, some people find this form of heating less comfortable, especially for longer periods of time. Comfort perceptions tend to improve in spaces where people are standing and more able to move around but reduce in areas where they are sitting in a fixed position for more than around 15 minutes. Some of these units can also have extremely high surface temperatures, and care should be

taken not to mount them directly next to historic timbers or fabric that may be impacted by high heat levels.

A new style of chandelier heater has recently come onto the market that addresses some of the previous concerns over this type of heating and is much more visually acceptable within a heritage church setting. See Radiant Heating Trial, St Matthew's, Bristol | The Church of England.

In this church it is recommended that overhead radiant heaters could provide a useful heating solution to the areas below.

Area	Type/ Size	Length (mm)	Watts	Area Heated	Number (or m) Required
Choir stalls	Summit 2600W	1500	2600	9-16 m2	2
Font	Summit 2600W	1500	2600	9-16 m2	
Vestry	Overhead Far IR Bar Heater 1.5kW	1580	1500	8-11 m2	1
Lady Chapel	Summit 2600W	1500	2600	9-16 m2	2

5.4 Heated Pew / Seat Cushions

Most people are now familiar with the concept of heated seats within cars; the same solution is also used in some outdoor venues such as alfresco dining and sports stadiums. These provide a heated cushion to sit on: the direct warmth from the contact areas provides a degree of comfort even when the surrounding space is cold. This can be a useful solution for churches which only have chairs (having removed pews) and/or for small congregations where there are few other alternatives.

There are a variety of heated seat cushions on the market. Some are directly plugged into a power socket (similar to an electric blanket). Others have battery packs, which can be charged and then connected to a seat cushion. This makes them more flexible and avoids trailing leads. The more advanced products have a pressure sensor which means heat is only provided when someone is sitting on the cushion. Heated pads for 'benches' can also be used to heat a pew or could even be adapted to form a heated kneeler for the communion rail.

It is recommended that the church consider using a set of 12 heated chair covers to provide heating to the south aisle and choir stalls areas which would be suitable for smaller services.

A case study of a church using heated cushions is available at https://www.hrballiance.org.uk/news/roving-reporter/heated-pew-cushions/

Recommendation: Replace heating system for electrical based heating solution.

5.5 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 a single-phase 100A supply to a split phase (or 2-phase) 100A supply.

From a visual inspection of the electricity meter within the church, it is obvious that 3 phase power used to be supplied to the church as the Henley blocks are still in situ.

The upgrade to the supply has to be carried out by the District Network Operator in the areas.

The DNO in your area is thought to be National Grid (formerly Western Power Distribution) - www.nationalgrid.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. The DNO will provide a quotation for free, so it is well worth obtaining a quotation even if plans are not yet certain, so that decisions can be made on a well-informed basis.

> Recommendation: Upgrade incoming electrical supply capacity to power decarbonised heat solution.

6. Energy Saving Recommendations

In addition to revising the heating strategy, the parish can also undertake other measures to reduce the amount of energy used within the church.

6.1 New LED Lighting

The lighting makes up a relatively small proportion of the electricity used within the church. There are some areas of the building which have had efficient LED lights installed but there are still a number of inefficient CFL and AR fittings within the vestry and lady chapel

It is recommended that the fittings scheduled in Appendix 1 are all changed for LED fittings. There are numerous specifications of LED light fittings on the market, but it is recommended that any purchased should come with branded chips and drivers and offer a 5-year warranty. An example of such a range of fittings is available through Parish Buying.

If all the light fittings were changed on a simple 'like-for-like' basis the total capital cost (supplied and fitted) would be £123. The annual cost saving would be £2, resulting in a payback of around 50 years. This estimate includes the supply of the lights, the labour to install them and the access required. It does not include 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/

> Recommendation: Change existing lighting for low energy lamps/fittings.

6.2 Draught Proof External Doors

There are a number of external doors in the church. The historic timber doors do not close tightly against the 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 timber frame a product called QuattroSeal is often used in heritage environments to provide appropriate draught proofing.

It is necessary to check with the DAC before undertaking any form of draughtproofing that involves work on the fabric of the door.

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.

Such measures should be considered carefully around bat conservation needs to ensure that any access points used by bats are not disturbed. Check your draught excluding plans with the Bat Conservation Trust's free helpline: 0345 1300 228 www.bats.org.uk

Recommendation: Install Draughtproofing to External Doors.

7. Photo Voltaic Electricity Generation Potential

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

Renewable Energy Type	Viable
Solar Photo Voltaic (PV)	No – not sufficient demand, visible roof
Battery Storage	No – no viable solar 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.

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/

The Church of England's webinars on getting to net zero programme includes a series of webinar recordings on environmental fundraising: https://www.churchofengland.org/about/environment-and-climate-change/webinars-getting-net-zero-carbon

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 includes the installation of under pew heaters to pews which are made in or after 1850 and are not of historic interest.
>
> All other works, including the like for like replacement of gas and oil boilers 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. This includes items such as solar PV installations.

10. Other Observations

10.1 Bats in Churches

The Bat Conservation Trust has a project with the Church Buildings Council Natural England, the Church of England, Historic England and the Churches Conservation Trust to address bat issues:

www.churchofengland.org/resources/churchcare/advice-and-guidance-church-buildings/bats-churches

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Vestry	1	LED GLS	£0	£12	38.23
Lady Chapel	2	AR111 LED	£2	£85	39.14

Note: the costs in the table above are for the supply and installation of the number of light fittings in that space. They do not include wider project costs such as management, access equipment and the like which is included in the costs in the main table of this report.

Appendix 2 – Increase in Capacity Application Guidance

Before you start, you will need:

- Location plan(s)
- Site layout plan(s)
- Manufacturer's specification sheet

Your MPAN is 2200013493868

Apply for a quotation for an increase in capacity by using the 'Increase Capacity' form online at
https://connections.nationalgrid.co.uk/connections-online-application-form/

Do you require?
An increased load (including fuse upgrade)

Do you require an indicative Budget Estimate or a firm Connection Offer?
Connection Offer

Would you like a connections offer for all of the connections work or for Non-contestable works only?
All Connection Works

What is/are the connection(s) for?
Commercial properties

How many electricity connections do you need to make?
One

Do you require a temporary connection?
No

Maximum power capacity for site connection? (kVA)
46 kVa (following agreement on heating option)

Date connection is required?(dd/mm/yyyy)
02/09/2024 (following agreement on heating option)

Disturbing Loads
Motors – N/A
Welders – N/A

Do you require electric vehicle charging or heat pump installation?
No

Will there be any on-site electricity generation?
No

Build out programme
Number of Business Premises – 1
Annual Capacity Requirement (kVa) – 46 kVa

Should you wish to provide any further information regarding your build out programme, please enter below.

To increase the supply capacity from a 100A single phase to a 100A split phase (2 phase) connection to provide sufficient capacity to install an electric under pew heating system as well as far infrared heaters into the building to provide heating

Is your building steel framed and subdivided into units?
No

Please provide a plan clearly showing the ownership and boundaries of your site. Where appropriate, we will design a cable route that is within the boundary of your land avoiding the need for third party agreement. This can reduce legal costs and lead times required to complete the work. This information may be available from:

- The Land Registry
- Your planning application
- Your property deeds
- Hand drawings on an existing plan

If the boundary plan is not available, we'll accept the boundary being marked on the Location Plan instead. Please make sure the detail is accurate, so we can avoid delays later.
<Upload location plan>

Please provide any information that may be relevant to your application.
This may include:

- Any site conditions that you need to make us aware of, such as asbestos, air pollution, ground contamination
- Any other information about electrical loading
- Anything else you deem appropriate that has not been covered so far

Customer Details (mandatory marked with a *)
Title*
Initials*
Surname*
Telephone
Mobile
Email*
Company Name
Company Registration Number
Building Name/Number*
Street*
Town*
City*
Postcode*

Address for correspondence (if different from customer)
Same as customer address – Y/N (complete as necessary if N)
Site Address (where connections are required)

Does the site have an address?
Yes <Search using postcode BS40 6HF>

Same as customer address?
Yes

Confirmation of Details & Legal Statement
We'd like to send you updates about the progress of your connection. Please tell us if you would like us to do so.

I would like to receive regular updates about my enquiry
Yes/No (choose as appropriate)
Legal

I accept the Terms & Conditions (please tick)
Click 'Submit'

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