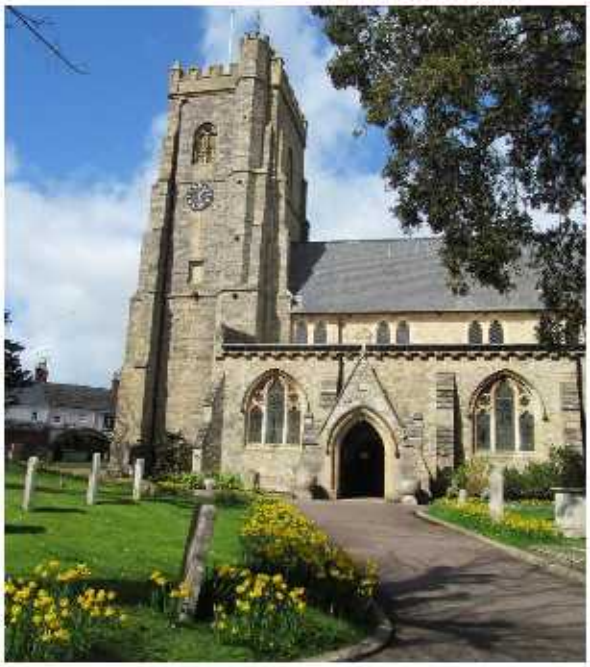
ESOS-ENERGY
Energy efficient solutions

Energy Efficiency and Zero Carbon Advice



Sidmouth Parish Church

PCC of Sidmouth Parish Church

DIOCESE OF EXETER
THE CHURCH OF ENGLAND IN DEVON

Author	Reviewer	Date	Version
Marisa Maitland	David Legge	21st April 2021	1.1

Contents

1. Executive Summary

An energy survey of Sidmouth Parish 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.

Sidmouth Parish Church has a long and varied history, there has been a church on this site from 13th Century, with subsequent additions or rebuilds in the 15thC and 18thC and finally reaching its present day form in the 19th Century, with a more recent reordering in 2009, with the addition of a toilet suite in 2015. The church is heated from a gas boiler to radiators and trench heaters throughout the space. The lighting is predominantly LED, with a handful of fluorescent lamps still in place. There is both gas and 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 is used as the action plan for the church in implementing these recommendations over the coming years.

Energy saving recommendation	Estimated Annual Energy Saving (kWh)	Estimated Annual Cost Saving (£)	Estimated capital cost (£)	Payback (years)	Permission needed	CO2 saving (tonnes of CO2e/year)
Insulate exposed pipework and fittings in plantrooms	5,697	£118	£350	2.97	List A (None)	1.05
Install reflective panels behind radiators	2,279	£47	£240	5.09	List B	0.42
Install new control system and optimise settings	22,786	£472	£4,000	8.48	List A (None)	4.21
Replace heating system for electrical based heating solution (partially now and partially once existing boilers reach end of life)	106,384	£1,313	£11,530	8.78	Faculty	19.12
Change existing lighting for low energy lamps/fittings	81	£11	£407	36.39	Faculty	0.02
Install PIR motion sensors on selected lighting circuits	9	£1	£47	39.01	List B	0.00

Install Draughtproofing to External Doors	34,18	£71	£3,200	45.23	List B	0.63
Install an Air Source Heat Pump into the building to replace existing heating system	79,752	-£2,375	£84,000	-35.36	Faculty	12.37

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

Based on current market prices of 13.85/kWh and 2.07p/kWh for electricity and mains gas respectively.

Excluding the ASHP, if all measures were implemented this would save the church £2,033 per year.

2. The Route to Net Zero Carbon

The General Synod of the Church of England has indicated that the Church of England should be Net Zero Carbon by 2030. Every church, cathedral, church school and vicarage will therefore need to convert to be a net zero building in the next 10 years. Furthermore, the PCC of Sidmouth Parish Church has also declared a climate emergency and has an ambition to be carbon neutral by 2030 and has recently implemented a policy that will not allow the replacement of oil heating systems.

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 Sidmouth Parish 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 Sidmouth Parish Church, Church Lane, Sidmouth EX10 8LG was completed on the 11th March 2021 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.

Sidmouth Parish Church	
Church Code	615205
Gross Internal Floor Area	670m^2
Listed Status	Grade II*

The church typically used for 7 hours per week for the following activities but is open for visitors and silent prayer 7 days per week for around 9 hours per day under normal circumstances.

Type of Use	**Hours Per Week (Typical)**	**Average Number of Attendees**
Services	6 hours per week	150
Meetings and Church Groups	1 hours per week	<15

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 Sidmouth Parish Church and have been reviewed against the current market rates for energy.

The current electricity rates are:

Single / Blended Rate	13.85p/kWh	Below current market rates
Standing Charge	26.95p/day	N/A

The current gas rates are:

Single / Blended Rate	2.07p/kWh	Below current market rates
Standing Charge	3.63p/day	N/A

The above review has highlighted that the current rates being paid are in line or below current 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	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

Sidmouth Parish Church uses 11,675 kWh/year of electricity, costing in the region of £1,988 per year, and 113,932 kWh/year of gas, costing £4,620.

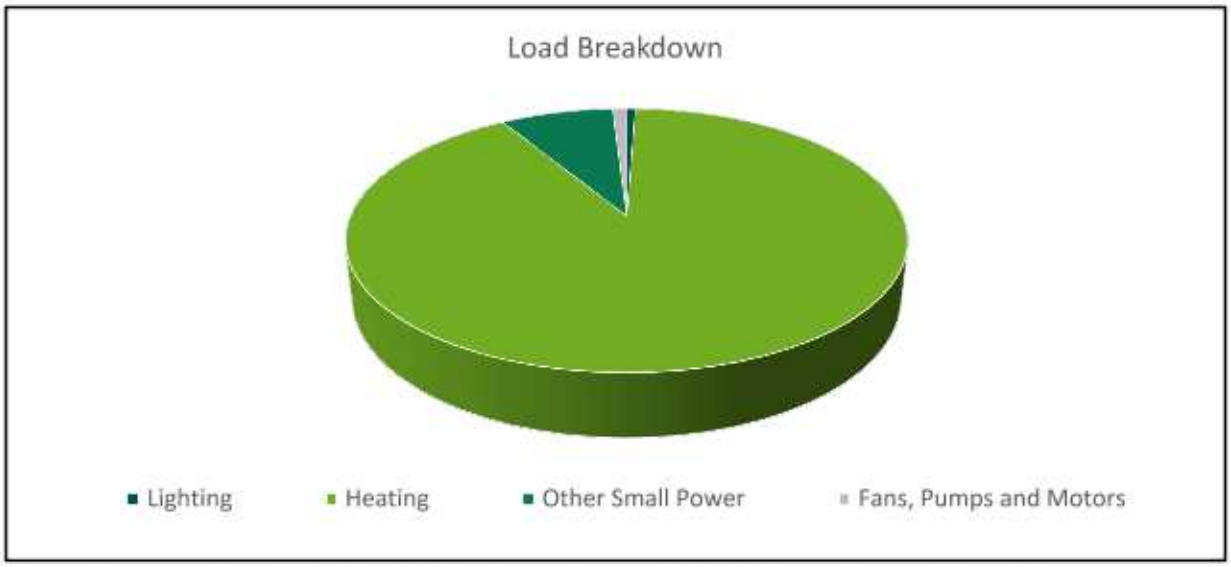
This data has been taken from the annual energy invoices provided by the suppliers of the site. Sidmouth Parish Church has one main electricity meter, serial number 2200018937498. There is

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	Almost exclusively LED lighting throughout with a minor number of T8 fluorescent tubes remaining	1 %
Heating	Provided by three Ideal gas fired boilers, supplying heating to trench heating and perimeter radiators	91%
Other Small Power	Organ, sound system, alarms and other plug loads	8%
Fans, Pumps and Motors	Heating pumps	1%



As can been seen from this data, the heating makes up by far the largest proportion of the energy usage on site due to the continual background heating of the space. The other significant load other small power.

5.2 Energy Benchmarking

In comparison to national benchmarks for church energy use Sidmouth Parish Church uses 13% less electricity, likely due to the installation of LED lighting, and 13% more heating energy, likely due to continual background heating, 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
Sidmouth Parish Church (elec)	670	11,675	17.43	20.00	-13%
Sidmouth Parish Church (gas)	670	113,932	170.05	150.00	13%
TOTAL	**670**	**125,607**	**187.47**	**170.00**	**10%**

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 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."

6.1 Outline Heating Strategy

Whilst the current heating system is only required for large Sunday services, smaller services can be facilitated in the chancel with the choir stalls being used for seating and electric under pew heaters installed.

The current gas fired boilers have not yet reached the end of their serviceable life and are expected to be serviceable for the next 5-10 years and therefore should be retained as they work

well at present. However, the controls have passed the end of their serviceable life and whilst they appear to offer some control, it is unclear if the PCC understand the controls and the current controls are dry cycling the boilers with some concern that the system is not optimally controlled and therefore is particularly wasteful of gas.

It is recommended that the heating system is power flushed and a magnetic sludge filter is installed (https://www.adey.com/category/filters) to maintain a clean heating system. In addition, a chemical inhibitor should be added following the power flushing of the heating system.

Following a discussion on site, it is reported that temperatures within the heating pipework may be struggling to reach temperature. Therefore, it is recommended that temperature checks should be made on the main heating flow within the boiler room and then again within the church (at both flow entry points, at mid-point and at the return point) to determine whether heat is being lost from the system due to an issue with heat distribution or under sized pumps or uneven distribution through the 4 different heating zones within the church.

Following this, a new control system should be implemented. There are many options for heating control systems, with many internet enabled control systems which allows control from anywhere in the world but does require an internet connection within the church for the controller. It may be that the installation of a new control system is in parallel with a move away from the current gas fired heating system. If this is the case, then the existing controls should be recommissioned in the short term to avoid boiler dry cycling and a service engineer should advise the churchwardens on the effective operation of the control system.

To reduce air ingress into the church as parishioners enter the church, an overdoor heater / air curtain could be installed to the main entrance doors to reduce the transfer of cold air into the church.

Finally, as the boilers approach their end of life, these should be replaced with air source heat pumps (ASHP) with additional wall mounted far infrared panels to the chancel and side aisles. For the heat pump solution, either a high temperature heat pump can be considered or a standard ASHP, supplemented by direct electric heaters within the existing trenches to boost temperatures during occupation. Further commentary on this approach is provided below. The cost for an ASHP is estimated to be £84,000 and for supplementary electric heaters to the side aisles and altar, the cost would be £5,990.

6.2 Discontinue with Background Heating Strategy

Most traditional churches were constructed without any form of heating. The modern additional of heating is not needed to preserve the fabric but only to provide thermal comfort to occupants. The previous trend of 'conservation heating' for fabric issues is now largely considered to be unnecessary and is being avoided by the likes of National Trust and English Heritage. The only times when background heating may be required is if there are historic wall paintings or to for the preservation of large artefacts such as tapestries. The organ (and other sensitive areas such as historic papers stored in the vestry) may require some local background heating specific to that area. In general, sensitive paper records should be removed for storage in the county archive and organs can be installed with a local background tube heater such as https://www.dimplex.co.uk/product/ecot-4ft-tubular-heater-thermostat within the organ casing in order to provide the heat where it is required. The fabric is often

subject to the greatest damage by humidity (which is naturally higher when the air is warmer as warmer air has greater capacity for holding more moisture), as a result of large temperature swings (from central heating systems turning on and off) and from the excessive drying out/baking of timbers where high temperature heating units have been fixed to them (such as overhead heaters fixed to timber wall plates)

Providing constant background heating to the church building as a whole is excessive and wasteful of energy. At the very least we would recommend that this background level is reduced to a maximum of 12°C and ideally avoided all together.

6.3 Install Church Under Pew Heaters

Introducing electric under pew heaters to the choir stalls would enable this area to be used for smaller services and the main heating plant would not need to run. The two most popular under pew heaters within churches are BN Thermic PH65 heaters (http://www.bnthermic.co.uk/products/convection-heaters/ph/) or similar heaters available from http://www.electricheatingsolutions.co.uk/Content/PewHeating.

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:

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 the 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.

The cost to install under pew heaters to the choir stalls only would be approximately £3,948 to allow smaller weekday services and choir practice to occur without the need for the gas boilers to run for these events.

6.4 Install Electric Panel Heaters

Following the installation of an ASHP and dependent on the heating calculations at that point, it is recommended that the PCC consider installing 8 wall mounted electrical far IR heaters on the side aisles and 2 wall mounted panel heaters near the altar, 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/product/63/1200-watt-platinum-white- . 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.

7. Improve the Existing Heating System

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

7.1 Install an Overdoor Heater

In order to achieve the sense of a 'warm welcome' into the church an over door air heater could be provided at the South Porch entrance. This would also help to provide warmth to this area of the church. Such an over door unit should be sized to cover the whole width of the door. The cost to install an overdoor heater is estimated to cost £1,592.

7.2 Clean / Flush Existing Heating System

The water in the heating system within the church was inspected as part of the audit in conjunction with thermal imagery on some elements of the heating system. This has identified that the system has magnetic sludge within it. This is preventing the proper and efficient operation of the system by reducing both the ability of the boiler to heat up the water and the output of the radiators. It is similar to how scale build up can adversely affect kettles and showers.

It is strongly recommended that the heating system is cleaned to remove this sludge from the system. This is done by using a chemical clean and/or power flush procedure where cleaning chemicals are put into the system, which is then turned on and run through a filter consisting of high-power magnetics to remove the sludge.

The cleaning of a heating system can be carried out by any competent heating engineer and typically increases the efficiency of a system by between 10 and 15%. This can dramatically improve comfort for the congregation.

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. Whilst the majority of lighting is already LED and a small area is lit by relatively inefficient fluorescent fittings within the vestry and notice board area.

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 £407. The annual cost saving would be £11 resulting in a payback of around 36 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.

The fittings within the vestry and notice board lights where the existing fitting can be made more efficient by simply changing the bulb/lamp within the existing fitting to a 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.

8.2 Lighting Controls (Internal)

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

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 Insulation of Pipework and Fittings

Insulate exposed pipework and fittings around boilers and tanks

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).

8.4 Draught Proof External Doors

There are a number of external doors in the church. These have the original historic timber doors on them, but these 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 timber frame a product called QuattroSeal (see link below) is often used in heritage environments to provide appropriate draught proofing.
http://www.theenergysavers.co.uk/application/files/1714/7197/4194/National_Trust_Case_Study.pdf

For timber doors that close onto a stone surround more traditional solutions such brush draught strips rebatted 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 and keeping the door maintained in a good condition is important.

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

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 – Structure not sufficient to support panels (previously investigated)
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 – once boilers have reached end of life / prior to 2030
Ground Source Heat Pump	No – archaeology in ground and radiator system

10. 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 .

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.

Appendix 1 – Schedule of Lighting to be Replaced or Upgraded

Room/Location	Number of Fittings	Recommended Upgrade	Annual Saving (£)	Total Cost (£)	Payback
Vestry and notice board	4	5ft Single LED	14	407	29