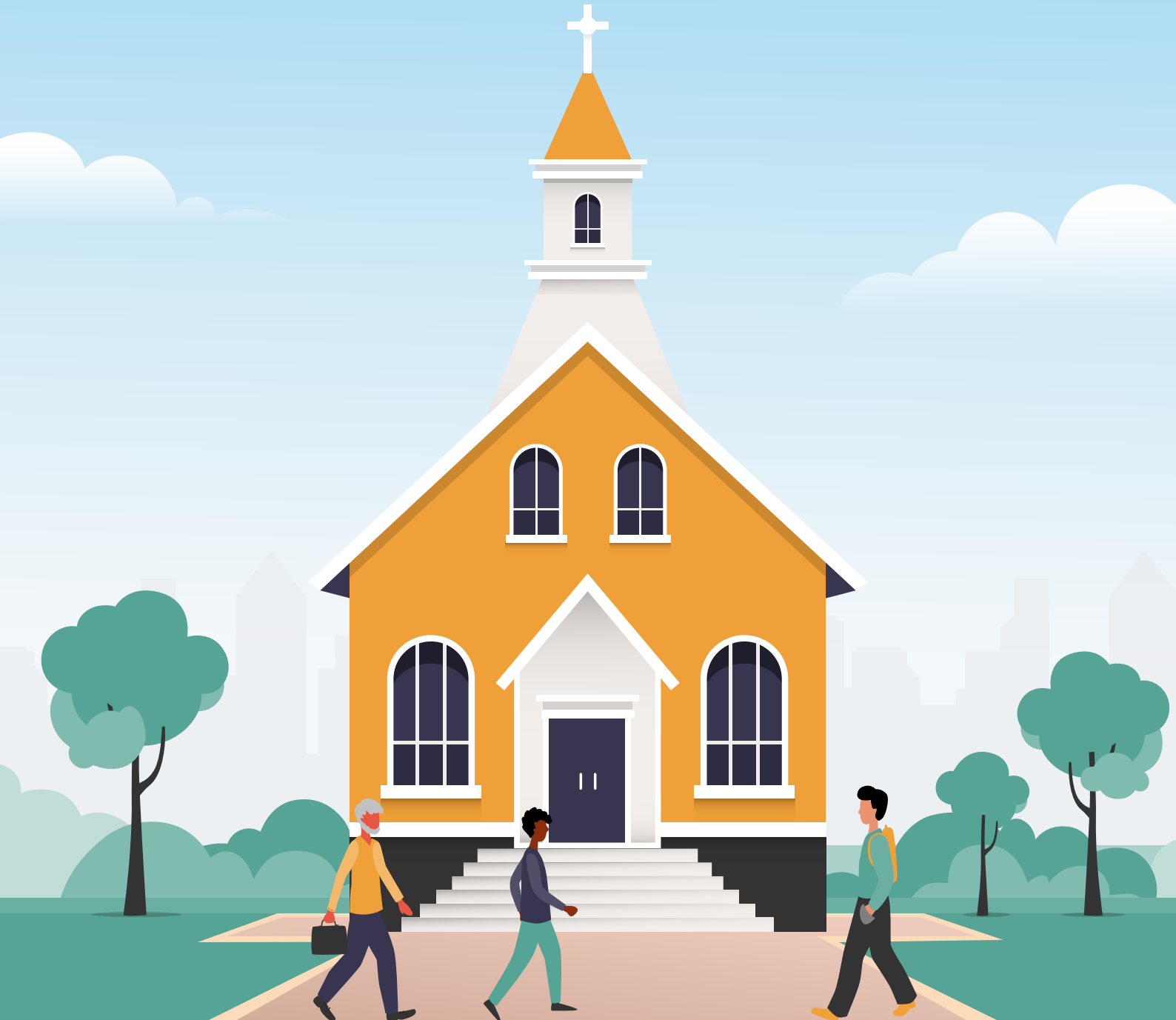
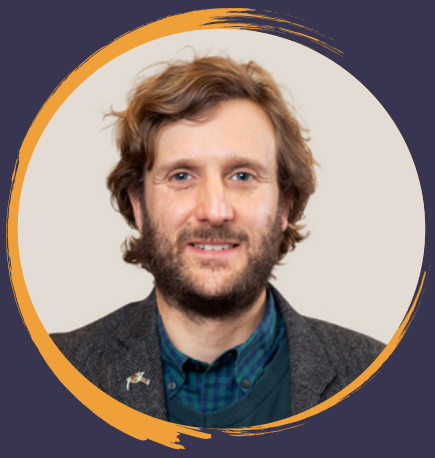
actionsustainability

Action Sustainability
Church Net Zero Report Northamptonshire



About the Authors



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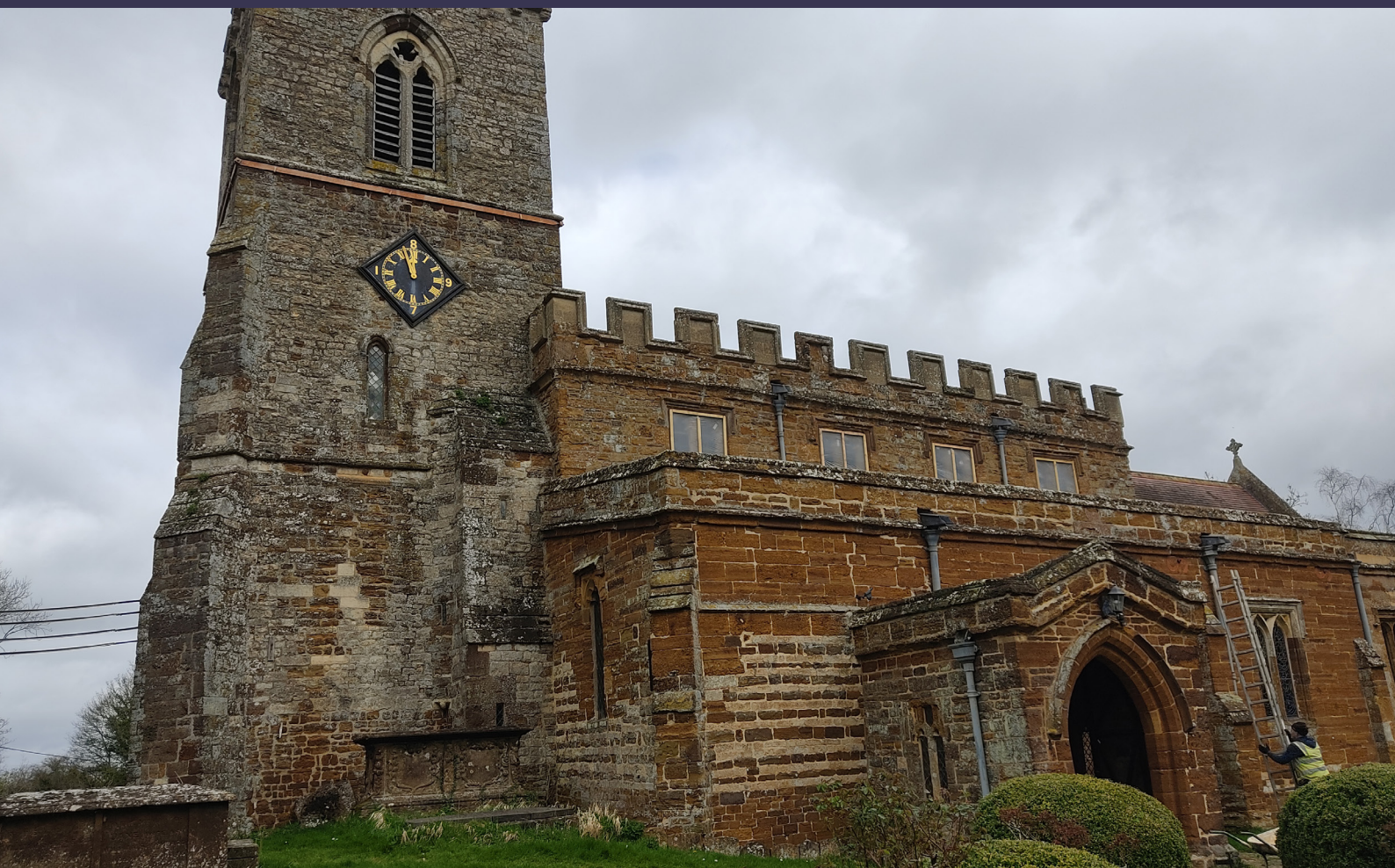
Action Sustainability

Ross Primmer is a senior consultant within the Action Sustainability team and the author of this report. Ross has 10 years-experience in the sustainability consultancy sector and has experience helping a variety of clients with their sustainability challenges across a range of sectors, industries and geographies. This report has been developed by Ross on a pro-bono basis in collaboration with Action Sustainability Community Interest Company. If you would like to find out more about the report or Action Sustainability CIC then please do get in touch.



Why is this project needed?

Background

This survey and report was developed free of charge by Ross Primmer as part of the Action Sustainability volunteering scheme.

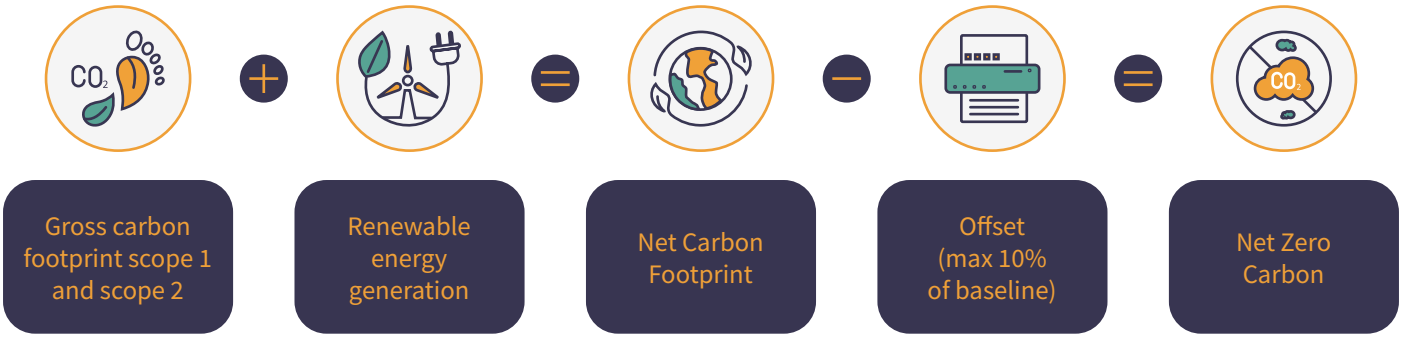
The Church of England has developed a Net Zero Carbon Routemap which sets out a plan for the Church to achieve net zero carbon by 2030. This presents a challenge to all Churches across the UK. To achieve net zero Churches will need to devise new and innovative ways to improve efficiency and consider how new technology can help to reduce or even eliminate greenhouse gas emissions.

The Church also faces the challenge of managing a building stock which is old (or even ancient), used infrequently, and often have large footprints and volumes. These factors together can mean that heating and lighting requirements are significant, and subsequently the transition to net zero a challenge.

The Church defines Net Zero in its 2030 Routemap as:

> *The Church of England defines Net Zero Carbon as the reduction as far as possible of all in-scope carbon emissions (from the oil, gas and electricity we use in our buildings and petrol and diesel transport) and the removal of an equivalent amount of carbon from the atmosphere for the remaining in-scope emissions by use of accredited offsetting schemes*[1]

Or, in numerical terms:



The plan states that the following emissions will be in-scope for the 2030:

- **Scope 1** = building emissions from oil and gas heating churches & church buildings; cathedrals; housing; offices; TEIs; schools over which the Church has significant influence.
- **Scope 2** = generation emissions from electricity we use to run our buildings.

The plan also states that the following Scope 3 emissions will be in scope for 2030:

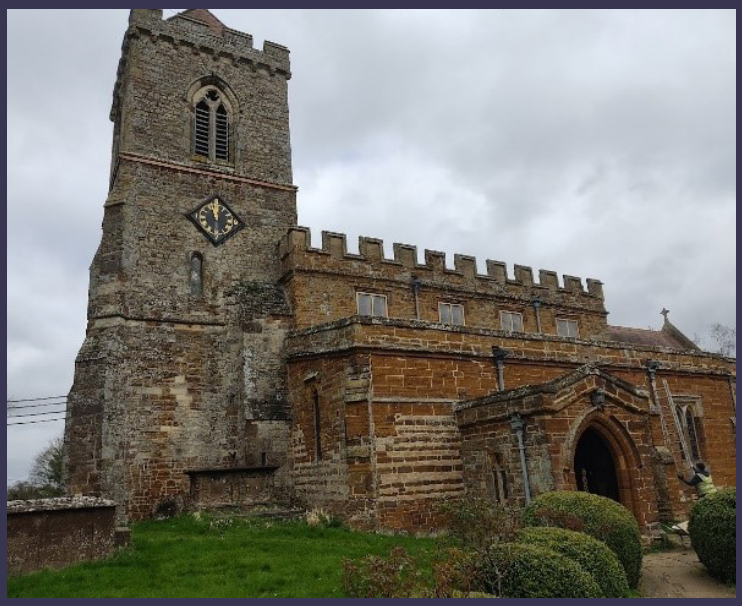
- **Scope 3** = business travel in non-owned transport.

[1] https://www.churchofengland.org/sites/default/files/2022-09/RoutemapToNetZeroCarbonFinal.pdf

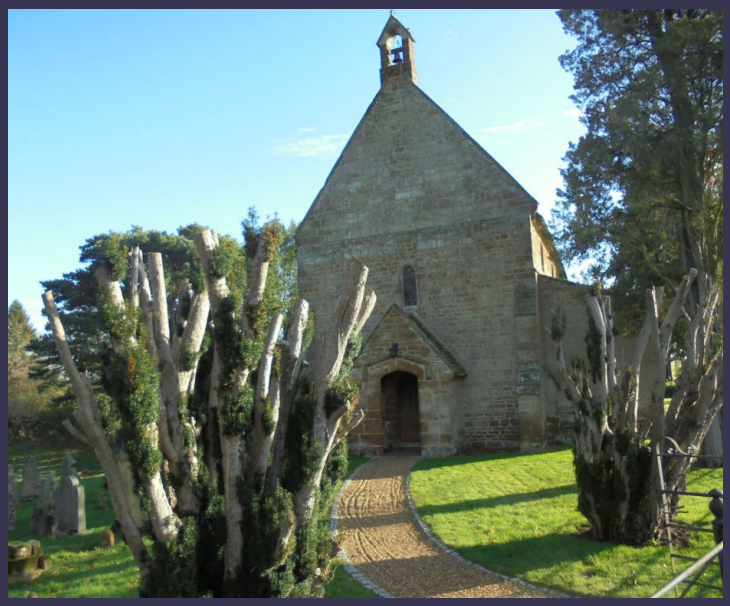
It should be noted that Net Zero Carbon commonly has a wider scope than defined by The Church in its Routemap. Commonly Net Zero encapsulates a wider definition of Scope 3, including all purchased goods and services. It is recommended that this is included in any future carbon assessment done by the church.

The project

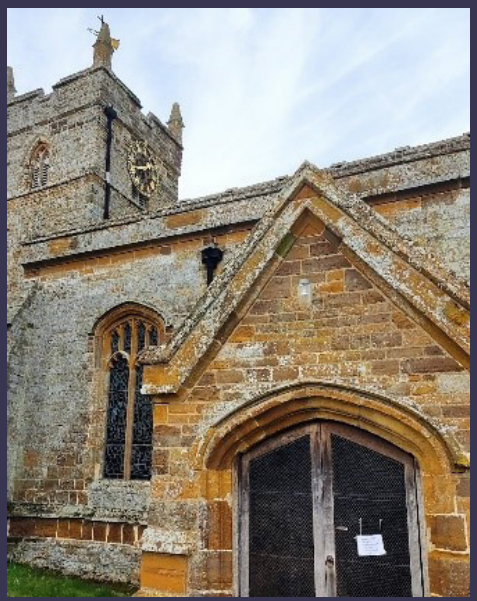
This project involves surveying 5 Churches in rural Northamptonshire to establish how they are currently performing, and what changes they might be able to align with the CofE Routemap by 2030. The Churches in question are shown overleaf.



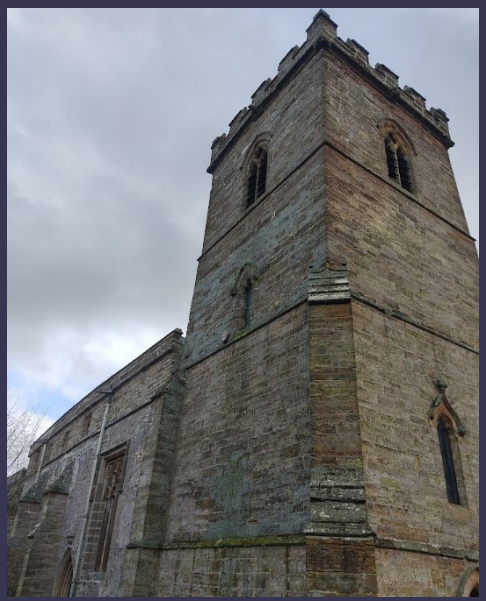
St Mary's Church
Church Street, Blakesley, Towcester,
NN12 8RA



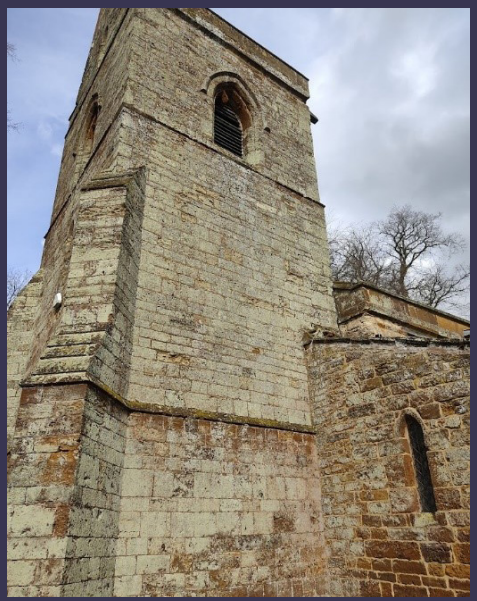
All Saint's Church
School Lane Adstone
NN12 8DU



St Mary the Virgin
Farthingstone, Towcester
Northamptonshire
NN12 8HE



St. Martin's Church
The Green, Litchborough Towcester
NN12 8JG



St Peter and St Paul
New Road Maidford
NN12 8HX

Surveys

This section of the report provides a summary of the surveys undertaken on the 18th of March 2024. Each church was subject to a survey in line with the template shown in Appendix 1.

The results for each survey are shown in Tables 1-5. These tables are significantly abridged from the survey template in Annex 1 as on commencement of surveys the survey template was found to be more complex than required. However, it has been included in its entirety in this document as it may be a useful reference point for the Church of England in the future.

Some general observations/considerations in relation to the surveys:

- All Churches were of a broadly similar age and construction.
- Church towers were considered out of scope for survey work as they are not subject to regular occupation/use by the general public.
- It was not possible to rate some of the fixtures and fittings due to their location (height being the usual limiting factor). Where this is the case a reasonable assumption on the likely consumption of each fixture has been undertaken. This is:
    - 40w for a bayonet bulb
    - 200w for a spotlight
    - 4,000 watts for an electric bar heater (based on being able to see a power rating in one location. Heaters used in other locations looked identical).
- There appeared to be an ad-hoc practice of replacing blown bulbs with modern energy efficient LED units. However, most light fittings appeared to use traditional tungsten filament bulbs. The assumption was made that each bulb was a traditional tungsten bulb rated at 40w.

A note on conservation: all churches in this survey are grade listed to some degree. Designations intended to protect the historical nature of buildings can present a challenge to the installation of low carbon technologies if they are deemed not in character with the building by local planning officers. It is unknown how sympathetic Northamptonshire County Council are to modifications to Churches in the area and this could be a consideration for any future works to the buildings surveyed in this report.

St Mary's Blakesley

The results for the site survey of St Mary's is shown in Table 1.

Table 1 Survey Summary – St Mary's Blakesley

Church	Building Characteristics	Energy Sources & Consumption	Building Services Requirements	Other Observations
St Mary's Blakesley	Grade 2* listed Solid wall construction from local ironstone and limestone with timber framed lead and tiled roofs Single pain leaded glazing Small churchyard, no parking Approximate Volume – 1,408m^3	Electricity - grid connection 01/12/22-31/12/22 = 626.6kWh £232.11 01/12/23 – 31/12/23 = 416.4kWh £147.42	**Space Heating** Electric strip heater 4,000W x 9 Double bar electric strip heater (unknown consumption) x 3 **Hot water** Electric under sink boiler – 3,000W **Lighting** Bayonet 10w energy efficient x 6 Spotlights (unknown power) x 30 Chandelier 40 watt tungsten filament x 6	Note 400v distribution board Unable to determine power consumption of some heaters due to location. Electric strip heaters appear to be the same as those in All Saint's Church, Adstone so have assumed they are Unable to determine spot-light power consumption due to location. They are large and look like tungsten filament bulbs Energy efficient bulbs being used as replacements in bayonet fittings as required

St Mary's – key findings

St Mary's was the largest church surveyed in this report and it is constructed in stone with traditional solid wall construction and a timber roof. The only energy supply is through grid electricity.

Energy Consumption

Available bills for the church indicate that the Church has managed to decrease energy consumption in comparative Decembers between 2022-23. As the figures for December are the only ones available it is difficult to do much analysis beyond this.

Building Services

Greatest energy demand in the Church is from space heating. The total potential power consumption from space heating could be as much as 48,000 watts if all 12 space heating appliances turned on (assuming all heaters are rated at 4,000 watts). This means that if all space heating appliances were turned on for **1 hour** it would equate to 48kWh. For context, the average **daily** energy consumption for a typical 2-3 bedroom house in the UK, including electricity and gas consumption, is 39kWh[2] .
In short – running all the heating appliances in the Church for a 24hr period would consume almost as much energy as an average house consumes in a month. This does not include additional consumption from lighting. It is perhaps not surprising that the church has a 400v commercial energy supply to cope with this potential load.

The church has a range of lighting systems. Unfortunately, it was not possible to assess the power consumption of spotlights due to height. Assuming each fitting is a relatively power hungry 200watts then the 30 in place would consume approximately 6kWh per hour – or about 1.5 bar heaters. The bayonet bulbs from the chandeliers have the potential to consume 0.24kWh.

Owing to predicted low levels of hot water use hot water energy consumption is likely to be insignificant compared to space heating and lighting requirements.

[2] *https://www.ofgem.gov.uk/information-consumers/energy-advice-households/average-gas-and-electricity-use-explained*

All Saints Church, Adstone

The results of the survey at All Saints Church in Adstone is shown in Table 2

Table 2 – Survey Summary – All Saints Adstone

Church	Building Characteristics	Energy Sources & Consumption	Building Services Requirements	Other Observations
All Saints Adstone	Grade 2 listed Solid wall construction from local ironstone and limestone with timber framed lead and tiled roofs Single pain leaded glazing Small churchyard, no parking Approximate Volume – 622.02m^3	Electricity - grid connection 12/22 – 06/23 = 276kWh £111.11 06/23-12/23 = 168kWh £88.44	**Space Heating** Electric strip heater (unknown consumption)-2 Electric strip heater 4,000w x 5 **Lighting** Chandelier x 6, 40 watt bulb 24 bulbs total Chandelier x 2, 40 watt bulb 12 bulbs total Spotlights x 2 (unknown consumption) Spotlights 40w x 2 Spotlights 7w x 1 Outside light 40w x 1	Electric strip heaters rated at 4,000 watts Unable to determine spot-light power consumption due to location. They are large and look like tungsten filament bulbs. Assume 200 watts

All Saints – Key Findings

All Saints church in Adstone was the smallest church surveyed for the purposes of this report. It is constructed in stone with traditional ironstone solid wall construction and a timber roof. The only energy supply is through grid electricity.

Energy Consumption

Available bills for the Church indicate that energy consumption is greatest in the winter months of December, January and February.

Building Services Requirements

By far the greatest potential consumer of energy in the church is from space heating. If all 7 heaters are assumed to be 4,000w (including the x2 which were impossible to rate in the survey) then the maximum power consumption for space heating will be 28kWh. Running these appliances for 1 hour is roughly equivalent to the daily expected energy consumption of a small flat.

It was not possible to rate the x2 spotlights due to height. If they are assumed to be 200w then total consumption will be 400 watts.

Other bulbs total consumption is likely to be approximately 1,560 watts, assuming a 40 watt tungsten bulb in each fitting. However, more energy efficient bulbs are being fitted as replacements are needed.

St Mary and the Virgin

The results of the survey at St Mary and the Virgin in Fathingstone is shown in Table 3.

Table 3 - Survey Summary, St Mary and the Virgin

Church	Building Characteristics	Energy Sources & Consumption	Building Services Requirements	Other Observations
St Mary and the Virgin Fathingstone	Grade 2* listed Solid wall construction from local ironstone and limestone with timber framed lead and tiled roofs Single pain leaded glazing Small churchyard, no parking Approximate Volume – 1318.39m^3	Electricity - grid connection 02/23-04/23 = 124.2kWh £74.02 04/23-05/23 = 212.7kWh £176.91 06/23-08/23 = 20.4kWh £32.18	**Space Heating** Wall mount electric heater 2,000w x 11 **Lighting** Spotlights unknown consumption x 17 Bayonet bulbs. 40w x 2	Unable to determine spot-light power consumption due to location. They are large and look like tungsten filament bulbs. Assume 200 watts

St Mary and the Virgin - Key Findings

St Mary and the Virgin is a similar size to St Martin's Church in Litchborough from a volume perspective. It is constructed in stone with traditional solid wall construction and a timber roof. The only energy supply is through grid electricity.

Energy Consumption

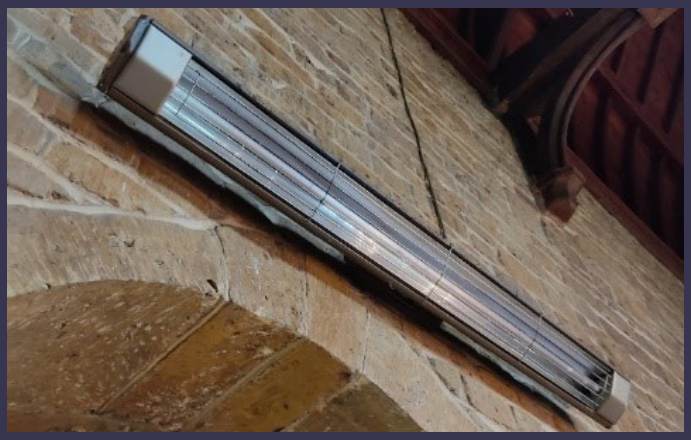
Energy consumption in the church is comparatively low. It is interesting to note that more energy was consumed in April to March 2023 when compared to February to April.

Building Services Requirements

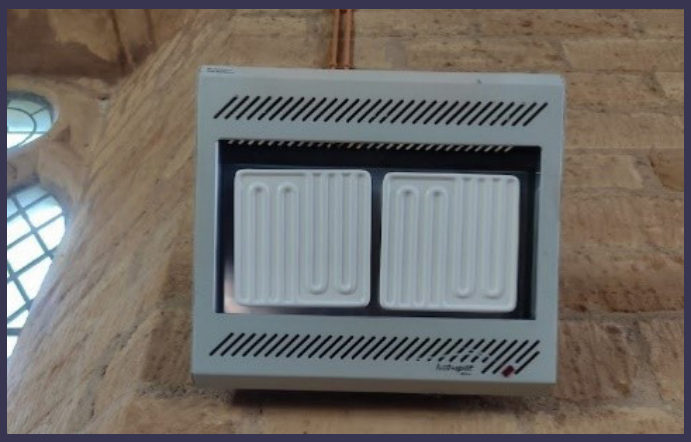
The Church has 11 heaters rated at 2,000watts. This equates to a maximum load of 22kWh. Interestingly this is less than half the maximum load at St Mary's in Blakesley and comparable to the much smaller All Saints Church at Adstone. St Mary's is around 90m^3 smaller than St Mary's and 690m^3 larger than All Saints. These heaters appear to be more modern than the bar heaters fitted elsewhere, and it would be interesting to know if parishioners here feel as warm as those at St Mary's when heating systems are operational. The bills from this church also suggest that it may use less energy compared to its size than the other locations in this survey. More detailed analysis of bills over a longer period of time will be needed to confirm this.

Figure 1 Bar Heater Types

Older? style 4,000 watt bar heater at Adstone Church



Newer? style 2,000 watt bar heater at St Mary's Church



As energy consumption for space heating is comparatively less lighting may be more of a consideration in this location. However, with 17 large spotlights the maximum load this is estimated to be is around 3.6kWh, assuming 200 watt bulbs in each fitting. Making these assumptions, consumption from lighting would still be 18.4kWh less than space heating requirements.

St Martin's Church, Litchborough

The results of the survey at St Martins in Litchborough is shown in Table 4.

Table 4 – Survey Summary, St Martins Litchborough

Church	Building Characteristics	Energy Sources & Consumption	Building Services Requirements	Other Observations
St Martin's, Litchborough	Grade 2* listed Solid wall construction from local ironstone and limestone with timber framed lead and tiled roofs Single pain leaded glazing Small churchyard, no parking Approximate Volume – 1,351.59m^3	Electricity - grid connection 2022 = 9,903 kWh £2,029.26 2023 = 7,697 kWh £2,920.74	**Space Heating** Pew heaters 500w x 52 **Lighting** Spotlights Unknown consumption x 22 Bayonet pendant. 15w (energy efficient) 2 Potential seasonal use of outside lighting – unknown power consumption **Hot Water** Under sink electric boiler for tap 3,000w	Note 400v distribution board (looks new). Probably installed for pew heating system Unable to determine spot-light power consumption due to location. They are large and look like tungsten filament bulbs. Assume 200 watts

St Martins – Key Findings

St Martins Church, as with all others in the survey is a solid wall construction made from local ironstone with a timber roof. It had the highest interior roof of any of the surveyed Churches at 8.8m.

Energy Consumption

The Church has potentially the highest energy bills of any Church – it is difficult to estimate properly as complete bills for every church are not available. It would be interesting to know if all the pew heaters are switched on during services, or if heaters are switched on individually as required. Also, Vicar Sue Stanley mentioned that the Church has had seasonal outside lighting. It was not possible to rate this system as it was not in place during the visit.

Building Services Requirements

St Martins differs from many of the other Churches in the survey as the only source of space heating is from under pew heaters. Most pews have an under seat electrical heater rated at 500 watts, with 52 units installed in the Church in total. With all heaters on total consumption would be 26kWh. This is significantly less than the 4,000 watt bar heaters seen in other locations on this survey.

The Church has a large number of spotlights but as with other locations this is a comparatively small part of overall consumption, not likely to exceed 4.4kWh if 200 watt bulbs are used in the fittings.

The Church was also able to give yearly energy consumption for 2022 and 2023, which seems quite reasonable from a cost perspective when compared to other locations.

St Peter & St Paul

The results of the survey at St Peter & St Paul is shown in Table 5.

Table 5 – Survey Summary, St Peter & St Paul

Church	Building Characteristics	Energy Sources & Consumption	Building Services Requirements	Other Observations
St Peter & St Paul, Maidford	Grade 2* listed Solid wall construction from local ironstone and limestone with timber framed lead and tiled roofs Single pain leaded glazing Small churchyard, no parking Approximate Volume – 967.32m^3	Electricity - grid connection 4,098 kWh £2,017.64	**Space Heating** Electric heater 2,000 watts x 2 Storage heaters 0.75kW x 3 Pew heaters Unknown consumption x 36 **Lighting** Chandelier 40w x 3 bulbs Wall lights 40w x 6 bulbs	Unable to determine spot-light power consumption due to location. They are large and look like tungsten filament bulbs. Assume 200 watts White walls – good for reflecting light Church is/has until recently been heated when not in use. Unsure if pew heaters are operational or not?

St Peter & St Paul – Key Findings

St Peter & St Paul is the second smallest church surveyed as part of this project. As with other locations it is of solid wall construction from local ironstone with a timber/tiled roof.

A unique feature of the Church when compared to others in this survey is the fact that it has a whitewashed interior. Anecdotally this does make for a brighter space inside and perhaps an example of a passive way to reduce the need for lighting.

Energy Consumption

The Church consumed the second highest amount of energy from recorded bills in the survey. However, this is somewhat difficult to analyse as complete bills for all Churches are not available.

In conversation with Vicar Sue Stanley, it became apparent that the Church has been, until recently, heated to a constant temperature to prevent degradation of the building. This may go some way towards explaining why the Church has a comparatively high energy bill in relation to its size.

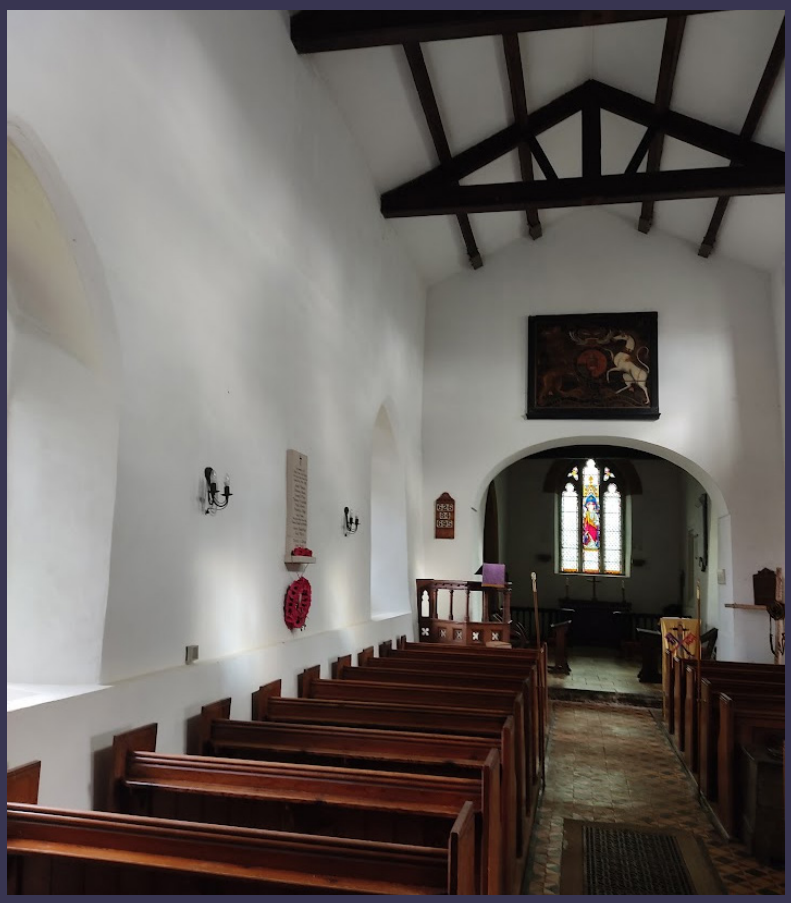
Building Services Requirements

The presence of storage heaters means that the peak consumption of the Church for space heating is just 6.2kWh, significantly less than those heated purely by electric bar heaters. However, with lower power outputs these appliances will need to be on for much longer to achieve the same heating effect.

The Church also appears to have pew heaters installed, although it was not possible to assess what the power consumption of these on the survey.

Load from lighting is 360 watts.

Figure 2 – Interior of St Peter & St Paul



Interior of St Peter & St Paul – whitewashed walls make for a brighter space without artificial lighting.

Recommendations

The survey has found that, perhaps unsurprisingly, the most significant consumer of energy in all Churches is space heating. Space heating requirements are universally met with electrically powered heaters, which are predominantly bar heater units used during services. The Church of St Peter and St Paul is unique as it has night storage heaters and a history of the building being heated when not in use for conservation reasons.

The use of electric bar heaters makes sense in a church as they provide an instant source of radiant heat which can be directed towards parishioners during services. Other forms of heating system (such as storage heaters) rely on convection and subsequently take longer to have an effect. The large volume of the Churches means that a traditional heating system, relying on convection, will take a long time to warm a space up. Other considerations such as roof height, lack of insulation, single glazing, and drafts will significantly reduce the effectiveness of a heating system, particularly one relying on convection.

This report recommends that the following things are considered to align with the Church of England's Net Zero by 2030 plan:

Easy Wins

1) **Ensure grid electricity is 'zero carbon':** Electricity is the only source of energy for all the churches surveyed. If the Churches, ensure that they are on to a zero-carbon energy tariff then it would not be unreasonable to claim that all Scope 2 emissions from the church are carbon free. This would meet the requirements of the 2030 Net Zero report. These will need to be backed with REGOs (Renewable Energy Guarantees of Origin).
2) **Follow the energy and carbon hierarchy:** with priority from A-C.
    a. **AVOID:** don't use energy if you can avoid the need for it in the first place.
    b. **REDUCE:** use less by smart design, better equipment, less materials, and better behaviours.
    c. **SWITCH:** to low carbon and renewable sources of energy, and low carbon materials.
3) **Seek ways to improve energy efficiency:** There are many things that the Churches can do to improve energy efficiency and hopefully reduce bills. Some easy wins could include:
    - **Communication:** telling church wardens that 1hr of all the heaters on at St Mary's Church is equivalent to a day's consumption of energy for the average 3-bedroom house may inspire people to think and use them efficiently.
    - **Efficient Use:** it would be very worthwhile to check how heating is used. If heaters are switched on in areas of the church where parishioners are not, then energy will be wasted. Ensuring that heaters are only switched on where people are could have a significant impact on energy use. This is equally relevant for wall mounted bar heaters and pew heating systems.

      It is recommended that all Churches install switches which allow each heater to be turned on and off individually if not already the case. Timer switches may be particularly effective where possible, to ensure that heaters are not inadvertently left on.

- **Replacement:** as heating units reach end of life then, as a minimum, they should be replaced with the most efficient modern replacements available. As a first step it would be interesting to informally ask parishioners at St Mary's church if they feel cold in the winter as the heating system in this church appears newer and uses lower consumption units than others.

  If funds allow it may also be beneficial to replace bar heaters with pew heaters as they appear to be more efficient. However, further analysis of energy use at St Martin's will be needed to determine if this is the case.

  Specialist advice, either from installers or manufacturers could be highly advantageous in deciding on how to approach replacement. There may be economies of scale and cost savings in this if the Churches work together and negotiate as one in this regard.

  Lighting systems should be replaced with modern energy efficient equivalents – although this appears to be happening as a matter of course. At the next opportunity it would also be advantageous to look closely at the large spotlights used in many of the Churches to accurately understand what the energy consumption from these units is. Interior white-washing may also reduce the need for artificial light.

For the future

This section of the report outlines some potential ideas and opportunities which might be explored in the future.

Space Heating

If parishioners are cold during church services a simple, potentially lower-cost option could be to provide heated pew cushions. Although exact specifications for these products are not easily obtainable on manufacturers websites it is fair to assume that they will be orders of magnitude more efficient than electric bar heaters.

Case studies of Churches which have done this include:

- Holy Trinity, Cumbria
- Marrowan Parish, Isle of Man

Suppliers of specialist providers of heated pew cushions might be worth investigating and include:

- PR Havener
- Kovo Schmidt

The presence of 400v electrics in two of the Churches may be advantageous for the installation of renewable energy systems such as solar PV. There is potential for this to offset bills and generate a small income (note with current feed in tariffs this is likely to be very small). Examples of Churches which have done this include:

- St Paternus Church, Cornwall (solar PV and wind)
- St John's Waterloo
- St Michael's - Dartmoor
- All Anges, Withington - Arguably the most similar to the churches in this survey.
- Dalehead Church – lighting only

The big advantage of solar PV is that it generates energy whenever the sun is shining. Although comparatively high, Church requirements for energy are likely to be restricted to certain times and days. This means that, with an appropriate energy storage system (like a battery), use of generated energy on site could be maximised. Rural Churches may also be able to take advantage of any land they own by installing PV here too.

A more energy efficient heating system will also be of benefit for reducing cost and energy demand – for example heated pew cushions. Technology such as heat pumps have been used by Churches elsewhere, however, this technology is not one generally associated with the large open spaces exhibited by Churches. Specialist advice will be needed to understand how feasible differing options might be and what costs might look like.

Other opportunities / considerations

Gaining a more complete picture of each Church's electricity bill would allow an accurate comparison of each location's consumption of energy per m^3. This would enable a better understanding of what energy systems are more efficient and potentially inform future decisions on energy efficiency.

A consideration which was out of scope in this report is how parishioners get to Church services. Understanding car use is likely to be the next step in reducing the overall carbon footprint of the Church's activities. Reducing mileage, lift sharing, or encouraging other forms of transport such as cycling or electric vehicles are all good ways to reduce carbon in this regard and could be investigated. Note, any vehicles owned by the church should be considered Scope 1 and parishioner owned transport Scope 3.

An additional area where further research is required is the Scope 3 carbon associated with the purchase of goods and services by the Church – for example materials required for building maintenance work. These could be significant and need to be understood to develop a full picture of the Scope 3 carbon emissions from each location.

Thinking more broadly, parishioners could even consider collaborating on the development of one large PV array which provides equivalent renewable energy for all Churches in one centralised location. 400v electrics in some Churches could also be advantageous for installing other technology such as electric vehicle charging points which could also be a potential source of revenue in the future.

Each Church could also think more widely about how they contribute to all aspects of sustainability. There may be opportunities for delivering local benefits to biodiversity – for example through management of Church grounds for local wildlife, or the local community – for example by using local companies and encouraging apprenticeships during building works.

Appendix 1

Basic Survey Template

Building Characteristics

Church Name	
Address	
Listing status	
Approx age	
Local Authority	
Basic Construction (description)	
Church Grounds – brief overview	
Does the property have a SAP, SEBM or EPC Certification?	Yes/No *If yes, please attach copies to this report*

Basic floor plan and volume

FLOORPLAN

Church floorplan approx. m^2 =

ROOF PROFILE (EXCLUDING TOWER)

Church Volume m^3 =

Site Energy Sources

Use of fossil fuels – Fuel 1

Fuel Type			
Units of consumption			
Supplier			
Capacity (if appropriate, specify units)			
Consumption			
Period	Meter reading (start)	Meter reading (end)	Cost

Use of fossil fuels – Fuel 2

Fuel Type			
Units of consumption			
Supplier			
Capacity (if appropriate, specify units)			
Consumption			
Period	Meter reading (start)	Meter reading (end)	Cost

Use of Electricity

Brief description of system			
Phase			
Rough age of install			
Supplier			
Capacity (amps – main fuse rating)			
Consumption			
Period		Units used	Cost
December 2022- Jun 2023			
June 2023 – December 2023			

Building Services Requirements

Space Heating

Fitting Description	Fuel Source	Max power rating	Number of fittings

Hot Water

Fitting Description	Fuel Source	Max output rating/power consumption	Number of appliances

Lighting

Fitting Description	Power rating	Number of fittings

Other Significant Energy Consumption

e.g. lifts, ventilation systems, air conditioning, kitchen appliances, booster pumps or sewage pumps

Description	Fuel Source	Power rating	Number of fittings

Energy efficiency measures

If applicable – have any energy efficiency measures in place – and if so what

Energy Efficiency Measures (if applicable)

Additional Notes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