



# Carbon Emissions Report 2021

Tracking Progress using the Energy Toolkit

*Tom Wood*

Data Services  
Church House  
Great Smith Street  
London SW1P 3AZ

Tel: 020 7898 1547

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Tom Wood, Church of England Research and Statistics, Great Smith Street, London SW1P 3AZ

Email: [statistics.unit@churchofengland.org](mailto:statistics.unit@churchofengland.org)

Twitter: [@cofestats](https://twitter.com/cofestats)

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## Executive Summary

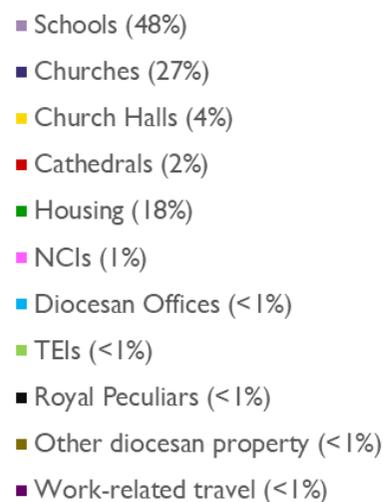
It is estimated that the energy used in in-scope Church of England buildings emitted around 410,000 tonnes of greenhouse gases, measured in tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) in 2021. Almost half of the estimated emissions from buildings in 2021 came from schools, with a further third of emissions coming from church buildings and halls. The breakdown of this figure and a graphical representation of percentage contribution by building type, can be found in Table 1 and Figure 1 respectively. Each building type has a more detailed section on its data in this report.

The figure of around 410,000 tonnes CO<sub>2</sub>e is based on data from 40% of all Church of England buildings (including 32% of churches and 68% of in-scope schools and as such is by far the largest survey ever taken of the energy use of these buildings. Where possible, estimates have been calculated for those buildings for which data were not received. While the dataset is unlikely to be perfect, this is the most robust and reliable dataset to date for calculating the carbon footprint of the Church of England.

Table 1. *Estimated net carbon footprint (tonnes) for all building types, calculated from data collected from the Energy Toolkit.*

Building Type	Number of Buildings	Completeness	Total Estimated Net CO <sub>2</sub> e
Churches	15,500	32%	110,000
Church Halls	3,000	9%	16,000
Schools	4,000	68%	196,000
Housing	9,500	41%	72,000
NClS	3	66%	2,100
Cathedrals	42	19%	8,700
TEIs	22	5%	1,100
Royal Peculiars	8	0%	340
Diocesan Offices	75	23%	1,900
Other diocesan property	84	29%	600
Work-related travel <sup>1</sup>	n/a	17%	1,100
<b>Total</b>	<b>32,000</b>	<b>37%</b>	<b>410,000</b>

Figure 1. *The percentage contribution of different building types to the total estimated net footprint of all Church of England buildings (2021)*



<sup>1</sup> For work-related travel, the completion rate refers to the percentage of churches and diocesan offices who submitted data travel data

## Tracking Progress to 2030

### In-Scope for 'Net Zero Carbon by 2030'

- The Energy use of the following buildings:
  - o Churches, including church halls and ancillary buildings
  - o Cathedrals
  - o Schools (generally Voluntary Aided and Diocesan Academy Trusts)
  - o Clergy housing and bishop's housing wholly owned by the Church
  - o Church bodies' offices, including National Church Institutions (NCIs), diocesan offices and bishops' offices
  - o Peculiars, if they come under faculty jurisdiction
  - o Other diocesan property, including common parts of tenanted properties
  - o Theological Education Institutions (TEIs)
- The petrol/diesel used for work-related travel.

Table 2. Total estimated net carbon footprint (tonnes CO<sub>2</sub>e) over time towards 2030.

Type	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Churches	159,000	118,000	110,000									
Church Halls	28,000	19,000	16,000									
Schools	N/A	195,000	196,000									
Housing	N/A	69,000	72,000									
NCIs	N/A	2,500	2,100									
Cathedrals	N/A	9,500	8,700									
TEIs	N/A	N/A	1,100									
Royal Peculiars	N/A	700	340									
Diocesan Offices	N/A	3,000	1,900									
Other Dio Property	N/A	600	600									
Work-Related Travel	N/A	N/A	1,100									
<b>Total</b>	<b>N/A</b>	<b>415,000</b>	<b>410,000</b>									

## The Energy Toolkit: A Background

In February 2020, the General Synod of the Church of England formally recognised the climate emergency and set a target for all parts of the Church of England to be net zero carbon by 2030.

The first step towards making radical reductions was to accurately measure starting points and baselines. At this point, the process of measuring the carbon footprint of church buildings was already in development. The Research and Statistics Team, working with Brian Cuthbertson and Enid Barron from the Diocese of London, had developed the Energy Footprint Tool (EFT) for church buildings. The EFT provided estimates for the carbon footprint of all Church of England church buildings for both 2019<sup>2</sup> and 2020<sup>3</sup>. The EFT won the “Digital Innovation of the Year: Services” award at The Energy Awards 2021.

Building on this success, the Research and Statistics Team were tasked with expanding the existing EFT into an Energy Toolkit for *all* in-scope buildings within the Church of England. The Energy Toolkit was trialled for 2020 data collection in 2021, with an accompanying report released in early 2022<sup>4</sup>.

To make the Energy Toolkit a useful instrument in monitoring progress towards the target of net zero emissions by 2030, a list of all eligible buildings had to be compiled. This included buildings such as schools, housing, offices, and other in-scope buildings (cathedrals, theological education institutions, royal peculiars etc.). In order to build this list, work was undertaken in collaboration with colleagues within the National Church Institutions (NCIs) and within the dioceses.

This report provides the second iteration in which the Energy Toolkit has been used to quantify the carbon footprint of all now in-scope Church of England buildings. Data have been collected for around 40% of all in-scope Church of England buildings, allowing for a workable estimate for actual 2021 emissions. As was the case with 2020, 2021 was not a typical year owing to the Covid-19 pandemic. The country began the year in lockdown, gradually unlocking over the course of the year. As a consequence, there will be some buildings that were used much less frequently than usual, and others that will have been used more than usual. Thus, the irregularity of 2021 will make it difficult to sensibly compare data in this report to a “normal” year, and figures should be used with caution. It is expected that data from 2022 will give a better picture of a typical annual carbon footprint for the in-scope Church of England buildings.

On behalf of both the NCIs Data Services department and the Church of England’s Environment Programme, we would like to thank all churches, schools, cathedrals, dioceses and any others who submitted data for 2021.

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<sup>2</sup> *Energy Footprint Tool 2019*, written by Dr Samuel Nunney, as part of the Research and Statistics team for the Church of England. Available from [https://www.churchofengland.org/sites/default/files/2021-02/Energy%20Footprint%20Tool%202019\\_0.pdf](https://www.churchofengland.org/sites/default/files/2021-02/Energy%20Footprint%20Tool%202019_0.pdf)

<sup>3</sup> *Energy Footprint Tool 2020*, written by Dr Samuel Nunney, as part of the Research and Statistics team for the Church of England. Available from <https://www.churchofengland.org/sites/default/files/2021-11/EnergyFootprintTool2020.pdf>

<sup>4</sup> *Carbon Emissions Report 2020*, written by Dr Samuel Nunney & Tom Wood, as part of the Research and Statistics team for the Church of England. Available from <https://www.churchofengland.org/sites/default/files/2022-03/Energy%20Toolkit%20Report%202020.pdf>

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## Church Buildings

It is estimated that the total net carbon footprint for the Church of England's approximately 15,500 church buildings (and further 3,000 church halls) in 2021 was around 126,000 tonnes CO<sub>2</sub>e.<sup>5</sup>

### Churches

The estimated total net footprint for churches or main church buildings alone in 2021 was around 110,000 tonnes CO<sub>2</sub>e. The average church has an annual net carbon footprint of around 7.2 tonnes CO<sub>2</sub>e. The gross carbon footprint for churches or main church buildings is 119,000 tonnes CO<sub>2</sub>e.

This estimate was based on responses from 32% of churches (the 4,900 churches who submitted useable data)<sup>6</sup>. The estimation process for accounting for churches that did not provide data was based on a variety of factors, including diocese, building size, whether the church was rural or urban, and utility bills retrieved from parish finance data

### Building Size

For the purpose of this analysis, a small church has been defined as under 250m<sup>2</sup>, a large church as over 650m<sup>2</sup> and a medium-sized church as between those two figures.

<sup>5</sup> The Diocese in Europe has been excluded from this exercise due to methodological issues around calculation of emissions from outside of the UK, but it is intended that data will be reported on behalf of this diocese in future iterations of this report.

<sup>6</sup> A further 1,100 churches engaged with the toolkit and submitted some data, but not a sufficient amount to allow their carbon footprint to be estimated (e.g. stating that they used gas and electricity, but not providing data on their kWh energy usage or amount spend on energy bills). These extra churches bring the overall rate of engagement with the toolkit up to 39%. A table of church engagement and completion rates is available on page 20 of this report.

As can be seen in Figure 2, there are significant differences in the average carbon footprint between the building sizes in 2021. The average net carbon footprint of a small church is around 1.6 tonnes, a medium-sized church is around 6.5 tonnes, and the average large church is around 19.6 tonnes. These averages are slightly smaller than their respective values in 2020.

Table 3. Average church net carbon footprints by building size category

Building size band	2021	2020
Small	1.6	1.8
Medium	6.5	7.4
Large	19.6	20.8
No size data	8.6	7
Overall Average	7.2	8

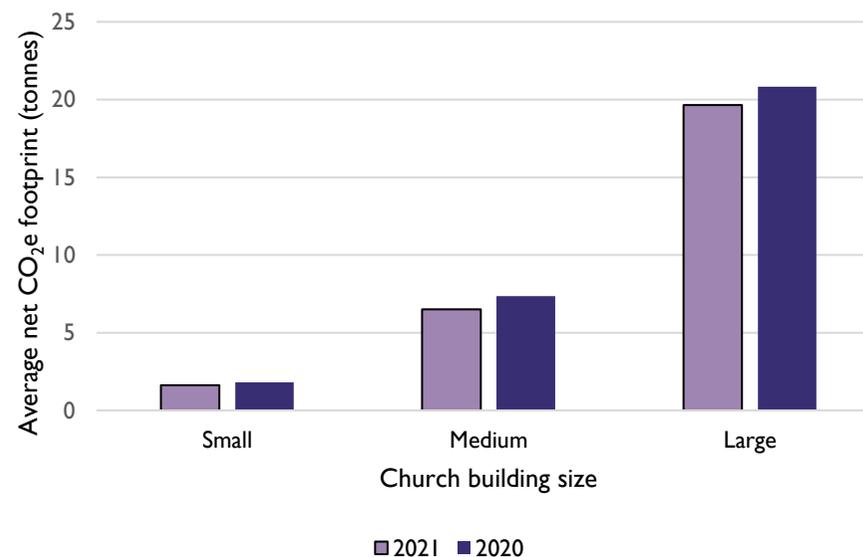


Figure 2. The average net carbon footprint in the Church of England by building size, 2020 & 2021

The amount each building size category contributed to the total carbon footprint of church buildings within the Church of England can be seen in Figure 3. This shows that small churches account for 6% of the total footprint from churches, medium-sized churches account for 40%, and large churches account for 31% of the total footprint from churches. 23% of the total footprint come from buildings for which do not have size data are not available.

Figure 4 highlights the differences between the proportions of particular building sizes and their percentage contribution to the total carbon footprint of church buildings. While only 12% of the church buildings were regarded as “large”, they account for almost one third of the total carbon footprint of church buildings in the Church of England. Only just over 5% of the total carbon footprint of church buildings in the Church of England were emitted by churches classified as ‘small’, despite these accounting for a quarter of all buildings.

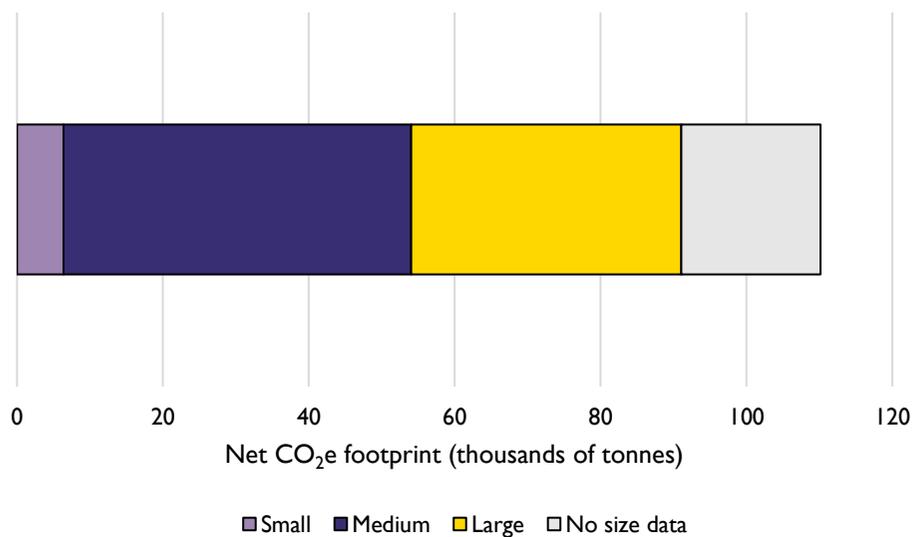


Figure 3. Proportions of total national carbon footprint in the Church of England based on building size.

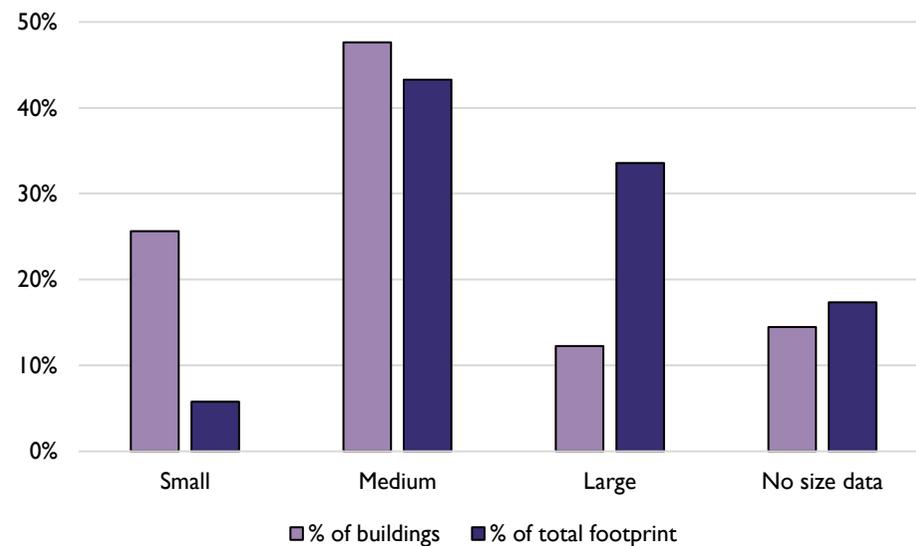


Figure 4. The proportions of church buildings sizes in the Church of England and their percentage contribution to the total carbon footprint.

## Urban vs Rural Churches

Alongside the significant differences between building size, significant differences can also be found in whether the church is within a rural or urban parish. Figure 5 highlights the differences that this can make, with the average large urban church emitting around 20 tonnes of net CO<sub>2</sub>e, while a small rural church emits less than 2 tonnes of net CO<sub>2</sub>e per year. The differences in emissions for urban and rural churches are proportionally greater for small and medium sized churches than for large churches.

Table 4. Breakdown of church building emissions by size band and urban/rural designation (2021).

	Rural	Urban
Number small buildings	3,600	370
Average net carbon footprint	1.5	2.6
Number medium buildings	5,100	2,200
Average net carbon footprint	5.9	7.9
Number large buildings	440	1,400
Average net carbon footprint	19.2	19.8

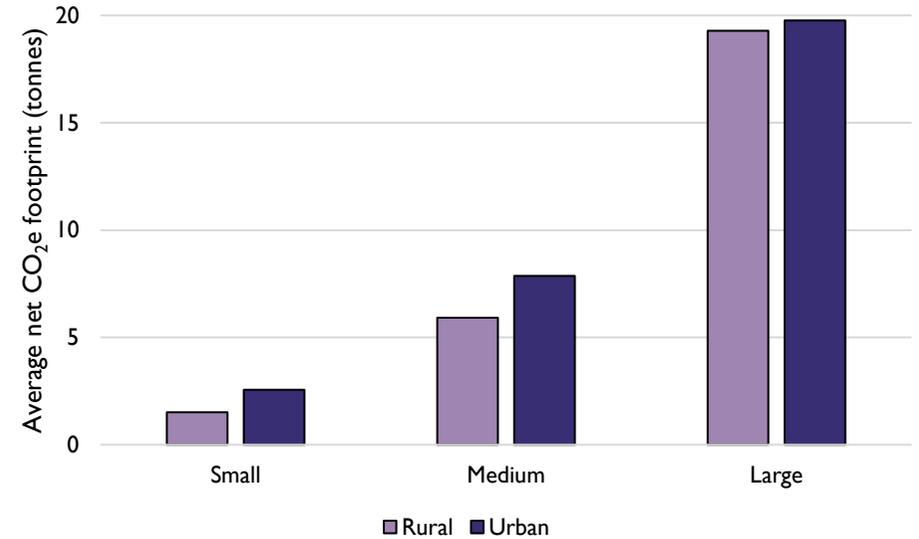


Figure 5. The average carbon footprint in the Church of England by building size and whether the church is in a rural or urban parish (2021)

## Contribution of Churches to Total Carbon Footprint

Regarding contributions to the overall carbon footprint of main church buildings, data suggest that around 50% of the net carbon emissions come from the 20% highest emitting churches. Less than 1% of the total net carbon emissions come from the 15% lowest emitting churches. This contribution can be seen in Figure 6.

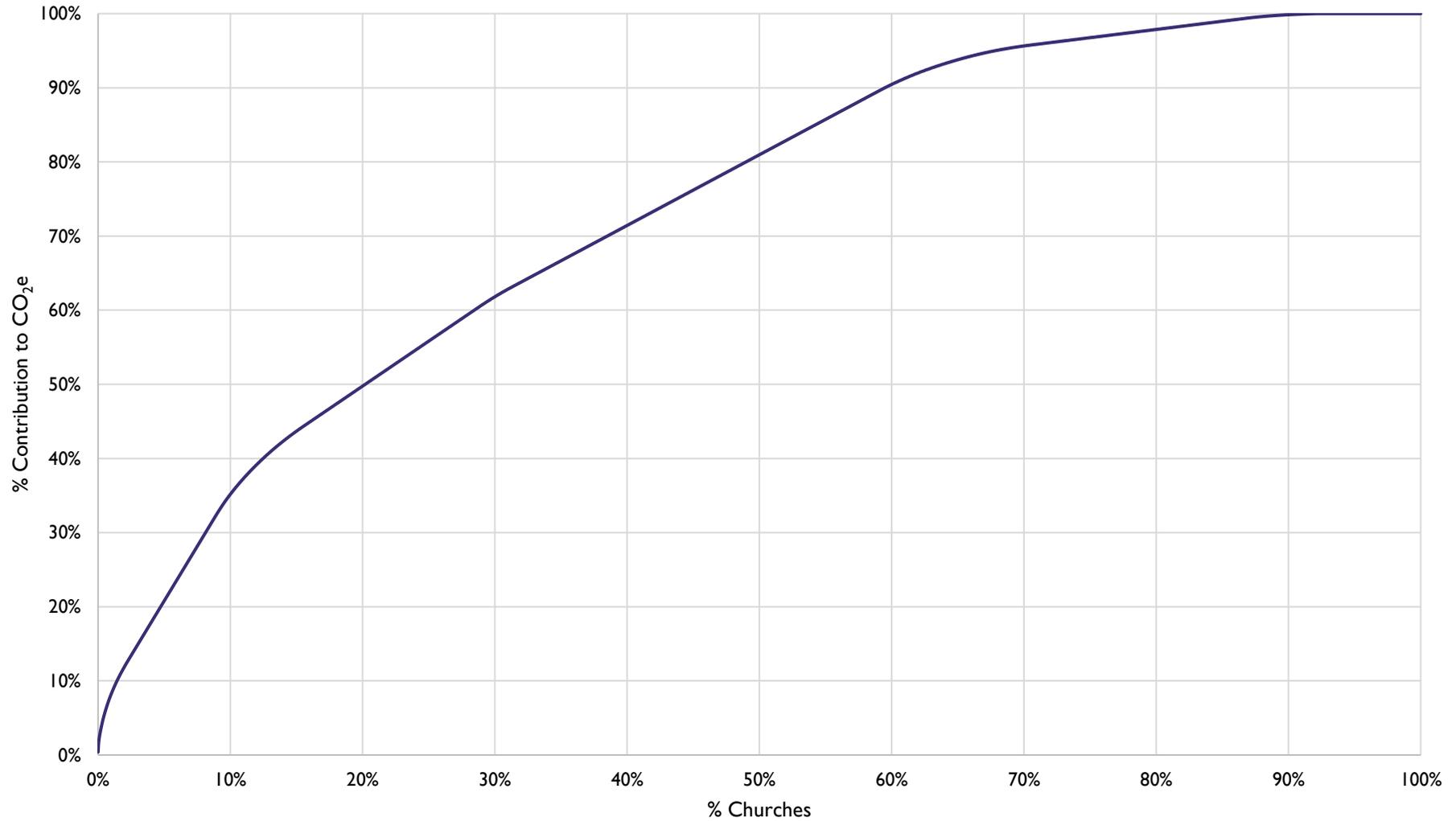


Figure 6. The percentage contribution to the net carbon footprint of churches by highest emitting churches (e.g., a value of 10 on the x-axis signifies the 10% highest-contributing churches).

## Types of Energy

94% of churches stated that they use electricity, 49% of churches state that they use gas, and 15% use oil. Less than 1% of churches stated that they use any other type of energy source (typically LPG or biomass fuel), and less than 1% of churches stated that they did not use any energy at all in the building.

Table 5 shows a breakdown of the most common energy types used by churches and the types of churches that use them. A mixture of Electricity and Gas is the most common energy type (46% of churches) and also has the largest average net CO<sub>2</sub>e footprint. However, it is also the case that it is this energy type that is used by the vast majority of urban churches and large-size churches. Churches that use electricity alone have the smallest average net CO<sub>2</sub>e footprint, although this is the most common energy type rural churches and small-sized churches, which tend to use less energy.

Table 5. A breakdown of different energy types used by churches and the types of churches that use them.

	<b>Electricity only</b>	<b>Electricity &amp; Gas</b>	<b>Electricity &amp; Oil</b>	<b>Gas only</b>	<b>Oil only</b>
% All churches with this energy profile	34%	46%	14%	3%	1%
Average net CO <sub>2</sub> Footprint	0.9	11.5	7.4	13.5	6.7
% Small-size churches with this energy profile	70%	15%	10%	1%	1%
Average net CO <sub>2</sub> Footprint	0.6	4.0	4.8	5.4	3.3
% Medium-size church with this energy profile	26%	49%	20%	3%	2%
Average net CO <sub>2</sub> Footprint	1.2	8.7	7.5	11.1	6.8
% Large-size churches with this energy profile	5%	85%	4%	5%	<1%
Average net CO <sub>2</sub> Footprint	4.2	19.7	15.0	22.3	25.9
% Rural churches with this energy profile	49%	25%	21%	2%	2%
Average net CO <sub>2</sub> Footprint	0.8	9.4	6.8	10.1	6.5
% Urban churches with this energy profile	8%	82%	3%	5%	<1%
Average net CO <sub>2</sub> Footprint	2.6	12.6	12.8	15.2	9.6

## Net Zero Carbon Churches and Renewables

407 (8% of all churches that filled out the EFT, or just under 3% of churches overall) churches had net zero carbon (or lower). This is up from 7% of the sample identified in 2020. Of these, just 1% were in large-size buildings, 36% were in medium-sized buildings, and 58% were in small-sized buildings (5% were in buildings with no size data).

In terms of the sources of energy used by these net zero churches, 43 (10%) were churches that used no energy at all and 364 (90%) of them used electricity only. None of these churches used any gas or oil and all of them used renewable electricity from one of our pre-verified suppliers of renewable energy<sup>7</sup>. Two of the net zero churches (0.5% of all net zero churches) had solar panels.

Regarding renewable electricity, a smaller number of churches in our 2021 sample used renewable electricity from one of our pre-verified suppliers (9% in 2021 vs. 18% in 2020). There was a slight increase in the number of churches stating that they were using renewable electricity more generally (around 33% in 2021 compared with 31% in 2020).

It was the second year that renewable gas was enabled as an option for churches using the Energy Footprint Tool. 10% of sampled churches stated that they were using renewable gas tariff. However, just under 2% of churches were using renewable gas from a pre-verified supplier.

Regarding renewables, of the sample of the data collected, less than 1% were using wood chips or pellets, less than 1% were using alternative heating technologies, and less than 1% were using on-site solar panels.

## Church Halls and Other Church Buildings

The estimated total net footprint for church halls and other church buildings in 2021 was around 16,000 tonnes CO<sub>2</sub>e. The equivalent figure for 2020 was 19,000 tonnes.

This estimate was based on responses from 279 churches in the 2021 sample who submitted data on a church hall or other church building. It should be noted that this is currently the best estimate that can be made for the carbon footprint of “other church buildings”, as the number of church halls nationally is not known. Estimates based on the 2019 or 2020 dataset are that there are around 3,000 “other church buildings” nationally.

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<sup>7</sup> That is to say, these churches used a supplier that had been verified to purchase its electricity directly from a renewable source, rather than simply purchasing guarantees that an equivalent amount of renewable energy exists within the grid

## Schools

It is estimated that the “in scope”<sup>8</sup> Church of England schools emitted around 196,000 tonnes CO<sub>2</sub>e in 2021, a figure which is more or less unchanged from the equivalent figure of 195,000 tonnes of CO<sub>2</sub>e in 2020. The average school had an annual net carbon footprint of around 48 tonnes CO<sub>2</sub>e, around seven times larger than that of an average church.

### Emissions by Primary/Secondary Designation

95% of “in scope” Church of England schools are Primary Schools, which make up 86% to the Church of England’s carbon footprint from schools (an estimated 167,000 tonnes CO<sub>2</sub>e in 2021). The 4% of Church of England schools that are secondary schools make up around 12% of the Church’s annual emissions (an estimated 25,000 tonnes CO<sub>2</sub>e in 2021). The schools recorded as “other” are a mixture of all-through schools, middle schools and schools where a primary/secondary designation was not recorded in the dataset. These schools make up 1% of the total Church of England Schools and 3% of the total school emissions of the Church of England. These data can be found below in Table 6.

The average secondary school has a larger carbon footprint (130 tonnes CO<sub>2</sub>e) than an average primary school (40 tonnes CO<sub>2</sub>e). However, secondary schools typically have more pupils (on average 750 pupils) than primary schools (200 pupils). The proportion of total emissions by school type is very similar to the proportion of pupils. There is a significant correlation between emissions and the number of pupils. This association suggests that the more pupils that there are in a school, the higher its emissions.

Table 6. *Estimated net carbon footprint (tonnes CO<sub>2</sub>e) for Primary and Secondary Schools and descriptive percentages.*

School Type	Number of Schools	Total Estimated Net CO <sub>2</sub> e	Average Building Footprint	% of Schools	% of School-Emissions	% of Pupils
Primary	3,800	167,000	40	95%	85%	83%
Secondary	170	23,000	130	4%	12%	14%
Other	40	5,300	160	1%	3%	3%
<b>Total</b>	<b>4,000</b>	<b>196,000</b>	<b>48</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

<sup>8</sup> Schools considered in scope of the Church of England’s net zero targets are those where a Diocesan Board of Education has a significant degree of influence. This is generally Voluntary Aided & Diocesan Academy Trusts, but may include other types of school at the discretion of individual dioceses.

## School Heating Systems

Of the schools for which data were received, 76% use mains gas as their primary heating fuel. Assuming that these figures are representative, then it is estimated that around 3,000 Church of England schools use mains gas as their primary fuel. There were 16% of schools that use oil as their primary heating fuel, 5% use electricity, 2% use liquefied petroleum gas (LPG) and 1% use Biomass.

## Urban/Rural Classification

Church of England schools are fairly evenly split between urban and rural locations, with 51% of Church of England schools being situated in rural areas, while 49% are in urban areas. Urban schools appear to be bigger emitters on average than rural schools, with 65% of emissions from schools coming from schools in urban areas. Schools in urban areas are estimated to contribute 122,000 tonnes CO<sub>2</sub>e to the Church's carbon footprint, while rural schools are estimated to contribute 74,000 tonnes CO<sub>2</sub>e.

However, urban schools typically have a greater number of pupils than rural schools. The average number of pupils in a rural school is 138, while urban schools have an average of 317 pupils. When the total numbers of pupils in Church of England schools in urban and rural areas are examined, emissions are again in line with the distribution of pupils across urban and rural schools. These Urban vs Rural comparisons can be seen visually in Figure 7.

It is important to mention that primary schools have a fairly even split between urban and rural locations, with 55% of primary schools being in a rural location and 45% in an urban location. However, this relatively equivalent split is not the case for secondary schools. Only 10% of secondary schools are in a rural location, while 90% of secondary schools are in an urban location. The average secondary school in an urban location emits around 137 tonnes CO<sub>2</sub>e, around 4 times more than an average primary school in a rural location (35 tonnes CO<sub>2</sub>e). The average figures for school type and location can be seen in Figure 8.

Figure 7. A graphical representation of the descriptive percentages of Primary and Secondary Schools, broken down by whether they are in urban or rural areas (2021).

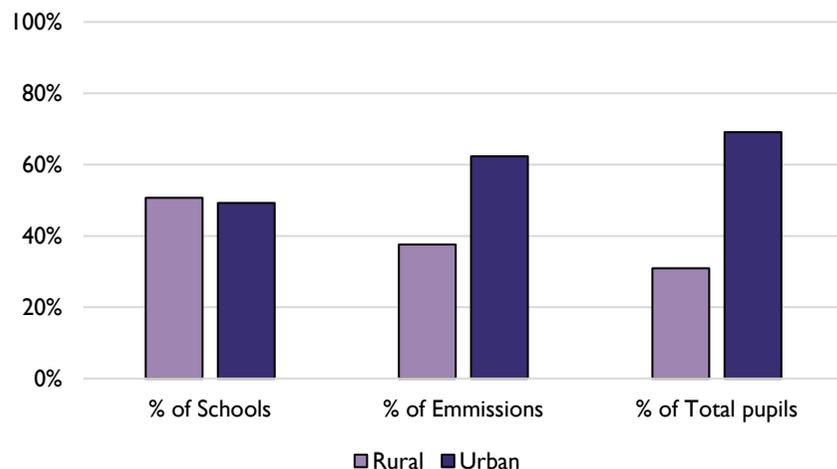
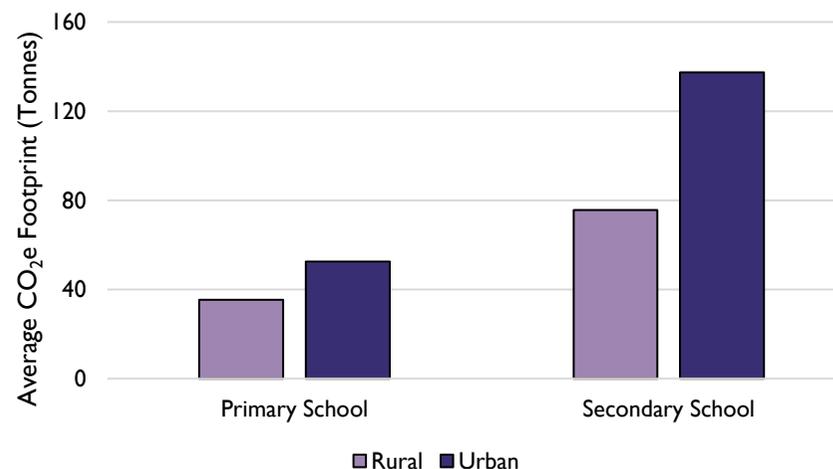


Figure 8. The average carbon footprint (tonnes CO<sub>2</sub>e) for schools in the Church of England by school type and whether it is in a rural or urban location (2021).



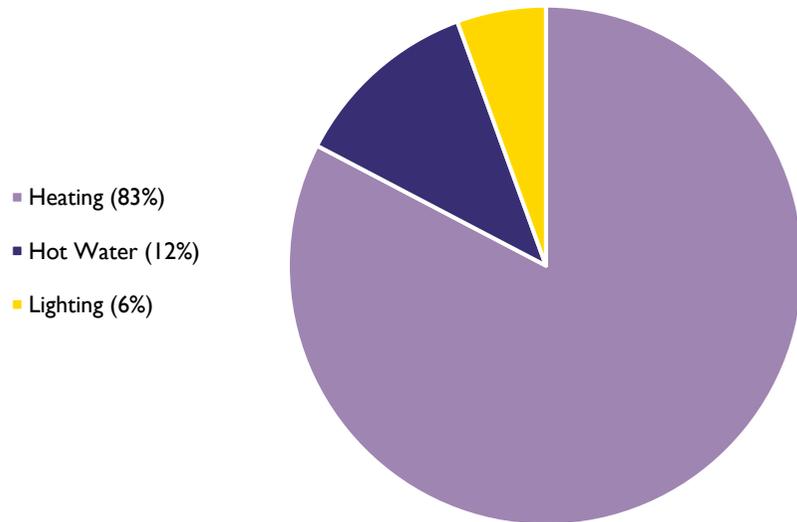
# Housing

## Emissions from Homes

It is estimated that there are around 9,500 homes owned by the Church of England<sup>9</sup>. The energy use of these homes is estimated to have emitted around 72,000 tonnes CO<sub>2</sub>e in 2020. This means that the average home has an annual in scope<sup>10</sup> gross carbon footprint of around 7.6 tonnes CO<sub>2</sub>e, not too different to that of an average church. Data suggests that the average UK home emits around 4 tonnes CO<sub>2</sub>e annually.<sup>11</sup>

The majority of emissions (83%) from homes came from heating, at an estimated 60,000 tonnes CO<sub>2</sub>e. It is estimated that hot water accounted for 12% of emissions, with 8,600 tonnes CO<sub>2</sub>e, and that lighting accounted for 6% of housing emissions (around 4,000 tonnes CO<sub>2</sub>e). The breakdown of these emissions can be viewed in Figure 9.

Figure 9. The contribution of energy uses to housing emissions.



<sup>9</sup> This figure is predominantly clergy housing, but in some cases may include homes owned by dioceses for other purposes. Note that this figure does not currently include homes owned by the Church of England’s pension board, for which data collection is still ongoing. These homes will be included in next year’s report.

<sup>10</sup> For the purposes of the Church of England’s net zero targets, “reasonable use” energy usage on heating, lighting and hot water as estimated on the EPC report are deemed in scope, while any additional energy used in the home for the occupants personal use (e.g. televisions, computers, cooking etc) are considered out of scope

<sup>11</sup> <https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/energyefficiencyofhousinginenglandandwales/2021>

## Heating Systems

The data provided from retrievable EPC records suggest that the vast majority of Church-owned homes (84%) have mains gas as their primary heating system, 14% use oil, 1% use electricity, and the remaining 1% use any other type of heating system, including bottled liquefied petroleum gas (LPG), community combined heat and power (CHP), heat pumps, or biomass fuel.

## EPC Ratings

EPC energy efficiency bands are applied to facilitate the understanding of the energy performance of a home. The bands range from 'A' (the most energy efficient) to 'G' (the least energy efficient). Most UK homes fall into a D banding.

Based on the Church-owned homes that have retrievable EPC records, the vast majority are D rated (50%). C and E rated homes both account for just over 20% each. 4% of homes were rated A and B while 3% of homes were rated F and G. The breakdown of all bands and those housing for which an EPC was not found, or a housing list was not provided, can be seen in Table 7.

The average annual footprint of a D rated home is around two and a half times larger than that of an A or B rated home and is just under half the average footprint of an F or G rated home.

The Minimum Energy Efficiency Standards (MEES) stop landlords from renewing or granting new tenancies if a property has a low EPC rating. As of 1<sup>st</sup> April 2020, F and G rated homes do not meet the domestic MEES and are not legally able to let to private tenants without a valid exemption. It is expected that from 2025 the domestic MEES will be raised to a legal minimum of band C for new tenancies. However, the MEES are unlikely to apply to clergy housing.

Table 7. The estimated number of homes in each EPC rating band, and their average annual emissions (in tonnes CO<sub>2</sub>e).

EPC Rating Band	% Church homes in this EPC Band	Number church homes in this EPC Band	Average Annual Emissions from Homes in this Band	% of housing-emissions
A	<1%	10	2.7	<1%
B	2%	150	2.9	1%
C	11%	1,000	5.4	8%
D	23%	2,190	7.1	22%
E	9%	860	11.0	13%
F	1%	100	16.0	2%
G	<1%	10	17.3	<1%
No EPC found	28%	2,600	7.6	27%
Homes in dioceses that did not provide a housing list (estimated)	27%	2,500	7.6	27%
<b>Grand Total</b>	<b>100%</b>	<b>9,500</b>	<b>7.6</b>	<b>100%</b>

## Other Buildings

### National Church Institutions (NCIs)

It is estimated that the major NCIs buildings (Church House Westminster, Lambeth Palace and Bishopthorpe Palace) emitted around 2,100 tonnes CO<sub>2</sub>e in 2021.

Data from the NCIs was received from Church House Westminster and Lambeth Palace. Emissions from Bishopthorpe Palace were estimated.

### Cathedrals

It is estimated that the 42 Cathedrals emitted around 8,600 tonnes CO<sub>2</sub>e in 2021.

This estimate is based on responses from 19% of Cathedrals, with the rest of the data estimated based on averages from those Cathedral who submitted data.

### Theological Education Institutions (TEIs)

Only one of the 20 TEIs submitted data in 2021, with a carbon footprint of 55 tonnes of CO<sub>2</sub>e. If we assume that the emissions from this TEI is representative of the average emissions of a TEI, then the total carbon footprint for TEIs would be around 1,100 tonnes of CO<sub>2</sub>e in 2021.

### Royal Peculiars

It is estimated that the 8 Royal Peculiars emitted around 340 tonnes CO<sub>2</sub>e in 2021.

No data were received from Royal Peculiars. Estimates for the emissions from Royal Peculiars were therefore based on averages taken from the cathedrals and churches datasets

It is expected that the footprints of other in-scope peculiars are collected in the *Church Buildings* section.

### Diocesan Offices

There were a total of 75 offices recorded on the lists supplied to the Data Services team by dioceses. It is estimated that these buildings emitted around 1,900 tonnes CO<sub>2</sub>e in 2021.

This estimate is based on responses from 23% of diocesan offices.

### Other Diocesan Property

It is estimated that other Diocesan Property emitted around 600 tonnes CO<sub>2</sub>e in 2021.

This list of buildings is supplied at the discretion of dioceses and may grow. The estimate is extrapolated from the 29% of buildings on these lists from which data was supplied.

## Work related travel

### Travel emissions from churches

2021 was the first year that data collection on emissions from work related travel was attempted. Additional questions were added to the Church EFT asking churches whether any work related travel claims had been made within the church (e.g. by the parish priest, or by volunteers acting on behalf of the church) and, if so, what was the total mileage claimed.

Of the 4,900 churches who submitted useable data to the EFT, 16% indicated that no work related mileage claims had been recorded, while 4,100 (84%) recorded some work related travel mileage. Collectively, a total of 615,000 work related miles of church car travel was recorded by these churches, contributing an estimated 210 tonnes of CO<sub>2</sub>e to the Church of England's carbon footprint

Scaling up from this sample to all churches, we estimate that the total work-related mileage from all Church of England Churches was an estimated 2,222,000 miles, equivalent to 770 tonnes of CO<sub>2</sub>e.

The average car mileage recorded by a church was 520 miles, which is equivalent to 0.18 tonnes of CO<sub>2</sub>e per year from work related car travel.

### Travel emissions from diocesan offices

This year, dioceses were additionally asked for the total reimbursable car mileage, their total reimbursable spend on rail and bus fares, and start and end location of any reimbursable flights. 8 (20%) of dioceses supplied data related to car mileage and total reimbursable spend on rail and bus fares, which were then used to estimate the dioceses bus and rail mileage and emissions, and two dioceses (5%) supplied details of work related reimbursable flights. Assuming that these diocesan offices were representative of the Church of England as a whole, the total CO<sub>2</sub>e emissions from diocesan work related travel is shown below in table 8.

Table 8. *Estimated work related travel emissions by vehicle type*

Emissions from car mileage (tonnes CO <sub>2</sub> e)	Emissions from rail travel (tonnes CO <sub>2</sub> e)	Emissions from bus travel (tonnes CO <sub>2</sub> e)	Emissions from flights (tonnes CO <sub>2</sub> e) <sup>12</sup>	Total (tonnes CO <sub>2</sub> e)
356	9	<1	3	369

### Travel emissions from schools

Travel emissions from schools (e.g. coach travel) has not been measured or estimated for this year. However it is intended that this will be incorporated into future iterations of the Energy Toolkit.

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<sup>12</sup> Due to the low number of dioceses submitting data related to work related flights, we have not attempted to use this data to estimate emissions from flights on behalf of the whole Church of England. We have however included these reported emissions in the final total.

## Diocesan Summary Tables

Table 9. Net carbon footprints for all Church of England building types (except for TElS and the NClS), by Diocese (in Tonnes CO<sub>2</sub>e) – 2021 and 2020<sup>13</sup>

Code	Diocese	Church Buildings (2021) <sup>14</sup>	Church Buildings (2020)	Schools (2021)	Schools (2020)	Housing (2021)	Housing (2020)	Other Buildings (2021) <sup>15</sup>	Other Buildings (2020)	Travel (2021)	Travel (2020)	Total (2021)	Total (2020)
1	Bath & Wells	3,300	3,400	4,100	3,600	2,100	2,000	280	350	40	n/a	9,900	9,300
2	Birmingham	2,600	2,500	3,200	4,100	1,200	1,100	300	200	20	n/a	7,300	7,900
3	Blackburn	2,900	3,100	8,000	7,700	1,400	1,400	230	150	30	n/a	12,600	12,400
5	Bristol	2,100	2,200	3,300	3,200	1,300	1,200	330	250	20	n/a	6,800	6,900
6	Canterbury	2,600	2,800	5,100	4,800	1,400	1,300	230	350	30	n/a	9,400	9,200
7	Carlisle	2,500	2,200	4,300	3,300	1,200	1,300	280	150	30	n/a	8,400	6,900
8	Chelmsford	4,500	5,100	4,500	4,500	3,500	3,300	580	350	30	n/a	13,100	13,300
9	Chester	3,500	3,800	5,500	5,700	1,900	1,800	280	250	30	n/a	11,100	11,500
10	Chichester	4,100	4,600	6,900	6,800	2,300	2,200	230	300	40	n/a	13,500	13,900
11	Coventry	1,800	2,100	5,000	3,800	1,200	1,100	260	300	20	n/a	8,300	7,300
12	Derby	2,400	2,600	4,500	4,300	1,200	1,200	280	150	20	n/a	8,500	8,200
13	Durham	2,500	2,700	3,400	3,900	1,300	1,300	340	300	20	n/a	7,600	8,200
14	Ely	2,500	2,300	4,100	4,000	1,200	1,200	410	400	30	n/a	8,200	7,900
15	Exeter	4,200	3,900	5,500	5,700	2,700	2,700	280	300	30	n/a	12,800	12,600
16	Gloucester	2,600	2,300	1,700	3,500	1,400	1,400	300	300	30	n/a	6,100	7,600
17	Guildford	2,400	2,800	3,900	4,000	2,100	1,500	300	300	20	n/a	8,700	8,700
18	Hereford	1,900	1,700	3,000	3,000	900	900	230	200	30	n/a	6,100	5,800
19	Leicester	2,200	2,500	4,900	4,600	1,200	1,200	230	150	20	n/a	8,600	8,400
20	Lichfield	4,700	5,100	6,200	5,900	3,200	3,000	570	250	30	n/a	14,700	14,300
21	Lincoln	3,800	3,300	4,600	4,500	1,600	1,600	820	400	30	n/a	10,800	9,800

<sup>13</sup> Some figures from 2020 may have been re-estimated

<sup>14</sup> Includes churches, church halls, and all other church buildings.

<sup>15</sup> Includes Cathedrals, Royal Peculiars, Diocesan Offices, TElS and all other Diocesan Property. Some of these buildings (e.g. Cathedrals, TElS) are situated geographically within the diocese rather than owned or managed by it

Code	Diocese	Church Buildings (2021) <sup>16</sup>	Church Buildings (2020)	Schools (2021)	Schools (2020)	Housing (2021)	Housing (2020)	Other Buildings (2021) <sup>17</sup>	Other Buildings (2020)	Travel (2021)	Travel (2020)	Total (2021)	Total (2020)
22	Liverpool	2,800	3,100	6,700	5,600	1,700	1,400	250	650	20	n/a	11,500	10,700
23	London	7,200	9,400	14,000	15,200	4,400	4,200	620	1,050	30	n/a	26,300	29,900
24	Manchester	3,500	4,400	12,600	12,900	1,900	1,800	330	650	30	n/a	18,400	19,800
25	Newcastle	1,900	2,100	4,500	3,100	1,300	1,200	230	200	20	n/a	7,900	6,600
26	Norwich	4,200	3,200	4,500	4,000	1,500	1,400	230	250	40	n/a	10,400	8,900
27	Oxford	5,800	6,400	6,500	5,800	3,200	3,300	570	600	60	n/a	16,200	16,100
28	Peterborough	2,500	2,600	2,600	2,600	1,400	1,300	250	450	30	n/a	6,700	7,000
29	Portsmouth	1,500	1,700	570	500	1,000	900	120	300	20	n/a	3,800	3,400
31	Rochester	2,500	3,400	2,100	2,300	1,700	1,600	280	250	20	n/a	6,600	7,600
32	St. Albans	3,700	4,200	7,100	6,800	2,200	2,100	240	350	30	n/a	13,300	13,400
33	St. Edms & Ipswich	2,800	2,400	1,500	3,400	1,200	1,200	230	200	30	n/a	5,800	7,200
34	Salisbury	3,600	3,500	2,800	2,000	1,700	1,600	280	350	40	n/a	8,500	7,400
35	Sheffield	2,000	2,400	2,700	2,000	1,100	1,100	220	250	20	n/a	6,000	5,700
36	Sodor & Man <sup>18</sup>	310	300	0	-	130	100	50	50	10	n/a	500	450
37	Southwark	4,600	6,300	7,400	6,400	2,900	2,800	260	200	20	n/a	15,200	15,700
38	Southwell & Notts	2,400	2,600	4,600	3,900	1,500	1,400	230	200	10	n/a	8,800	8,100
39	Truro	1,800	1,800	1,30	1,400	1,300	1,000	230	150	30	n/a	4,700	4,300
41	Winchester	2,700	3,200	3,700	4,000	1,500	1,400	280	350	30	n/a	8,200	8,900
42	Worcester	2,200	2,200	3,300	3,100	1,800	1,700	230	300	20	n/a	7,400	7,300
43	York	4,100	4,400	6,000	6,100	1,200	2,000	200	400	49	n/a	11,600	12,900
46	Leeds	5,300	6,300	8,900	13,500	3,300	3,100	740	450	40	n/a	18,300	23,400
<b>Nationally<sup>19</sup></b>		<b>126,000</b>	<b>137,000</b>	<b>196,000</b>	<b>195,000</b>	<b>72,000</b>	<b>69,000</b>	<b>12,800</b>	<b>13,000</b>	<b>1,100</b>	<b>n/a</b>	<b>410,000</b>	<b>415,000</b>

<sup>16</sup> Includes churches, church halls, and all other church buildings.

<sup>17</sup> Includes Cathedrals, Royal Peculiars, Diocesan Offices and all other Diocesan Property.

<sup>18</sup> There are no Church of England Schools in the Diocese of Sodor and Man

<sup>19</sup> Total includes figures from the NCIs which are not recorded under any individual diocese

Table 10. Data completeness rates for all Church of England building types by diocese from the Energy Toolkit in 2021<sup>20</sup>

Code	Diocese	Churches (2021)	Churches (2020)	Schools (2021)	Schools (2020)	Housing (2021)	Housing (2020)	Other Buildings (2021)	Other Buildings (2020)	Total (2021)	Total (2020)
1	Bath & Wells	32%	9%	52%	60%	0%	0%	50%	0%	25%	12%
2	Birmingham	62%	49%	98%	96%	20%	100%	25%	50%	49%	75%
3	Blackburn	39%	13%	24%	90%	0%	0%	50%	50%	24%	31%
5	Bristol	46%	36%	70%	69%	29%	29%	0%	20%	43%	38%
6	Canterbury	33%	13%	59%	82%	100%	0%	0%	50%	57%	20%
7	Carlisle	33%	40%	50%	44%	93%	75%	33%	50%	51%	50%
8	Chelmsford	31%	13%	75%	73%	88%	88%	0%	50%	56%	48%
9	Chester	16%	13%	37%	83%	0%	0%	33%	67%	14%	20%
10	Chichester	57%	46%	32%	86%	0%	0%	0%	0%	34%	38%
11	Coventry	57%	43%	82%	77%	22%	22%	50%	33%	49%	41%
12	Derby	28%	15%	32%	58%	58%	58%	50%	0%	38%	36%
13	Durham	30%	15%	42%	95%	74%	74%	0%	0%	47%	45%
14	Ely	19%	17%	52%	92%	63%	63%	0%	17%	35%	40%
15	Exeter	30%	9%	79%	65%	85%	85%	0%	0%	53%	39%
16	Gloucester	23%	22%	75%	75%	92%	92%	0%	33%	48%	47%
17	Guildford	71%	26%	94%	82%	66%	0%	100%	67%	72%	24%
18	Hereford	44%	43%	99%	66%	65%	65%	0%	50%	56%	50%
19	Leicester	12%	8%	71%	71%	0%	0%	0%	50%	18%	16%
20	Lichfield	12%	9%	74%	77%	26%	26%	33%	33%	24%	23%
21	Lincoln	23%	9%	98%	98%	67%	57%	31%	33%	41%	31%

<sup>20</sup> “Completeness” here means the percentage of buildings within each category that we obtained data for, whether from the church school or diocese themselves or from other sources such as scraped DECs. This is not the same as the “response rate” (which in this case would be the percentages of churches, schools or dioceses who completed the toolkit themselves).

Code	Diocese	Churches (2021)	Churches (2020)	Schools (2021)	Schools (2020)	Housing (2021)	Housing (2020)	Other Buildings (2021)	Other Buildings (2020)	Total (2021)	Total (2020)
22	Liverpool	20%	11%	72%	32%	66%	36%	0%	0%	37%	24%
23	London	42%	47%	82%	100%	28%	28%	0%	0%	40%	44%
24	Manchester	49%	29%	89%	55%	29%	29%	0%	50%	52%	36%
25	Newcastle	26%	30%	75%	94%	50%	50%	0%	50%	39%	44%
26	Norwich	8%	11%	79%	76%	68%	68%	0%	50%	28%	29%
27	Oxford	28%	42%	79%	82%	34%	34%	22%	11%	35%	43%
28	Peterborough	40%	14%	91%	90%	0%	0%	0%	0%	34%	18%
29	Portsmouth	17%	22%	62%	62%	55%	55%	67%	100%	35%	38%
31	Rochester	24%	14%	80%	0%	0%	0%	0%	0%	19%	7%
32	St. Albans	28%	15%	81%	72%	0%	0%	50%	0%	27%	19%
33	St. Edms & Ipswich	24%	20%	100%	76%	89%	89%	0%	0%	42%	41%
34	Salisbury	46%	13%	40%	36%	34%	34%	0%	0%	43%	20%
35	Sheffield	32%	15%	98%	97%	69%	69%	50%	0%	66%	44%
36	Sodor & Man <sup>21</sup>	68%	3%	N/A	N/A	N/A	N/A	0%	0%	46%	2%
37	Southwark	22%	28%	80%	54%	72%	72%	60%	25%	53%	52%
38	Southwell & Notts	49%	14%	88%	86%	71%	71%	0%	0%	62%	43%
39	Truro	50%	58%	100%	82%	98%	84%	100%	0%	68%	67%
41	Winchester	33%	58%	91%	90%	0%	0%	0%	33%	31%	44%
42	Worcester	24%	40%	86%	94%	22%	22%	0%	50%	32%	41%
43	York	30%	21%	72%	66%	78%	60%	50%	50%	48%	38%
46	Leeds	42%	50%	28%	17%	0%	0%	0%	33%	25%	27%
	<b>Nationally</b>	<b>32%</b>	<b>24%</b>	<b>68%</b>	<b>71%</b>	<b>42%</b>	<b>38%</b>	<b>23%</b>	<b>28%</b>	<b>40%</b>	<b>35%</b>

<sup>21</sup> There are no Church of England Schools in the Diocese of Sodor and Man. Additionally, Energy Performance Certificates are not available on the Isle of Man

Table 11. Completion and engagement rates for the Church Energy Footprint Toolkit in 2021

Code	Diocese	% Churches completed 2021	% Churches engaged 2021 <sup>22</sup>	% Churches engaged 2020
1	Bath & Wells	32%	39%	14%
2	Birmingham	62%	70%	57%
3	Blackburn	39%	49%	17%
5	Bristol	46%	56%	45%
6	Canterbury	33%	45%	23%
7	Carlisle	33%	38%	45%
8	Chelmsford	31%	36%	16%
9	Chester	16%	18%	19%
10	Chichester	57%	63%	55%
11	Coventry	57%	65%	51%
12	Derby	28%	34%	22%
13	Durham	30%	40%	23%
14	Ely	19%	26%	24%
15	Exeter	30%	36%	13%
16	Gloucester	23%	29%	29%
17	Guildford	71%	77%	31%
18	Hereford	44%	55%	49%
19	Leicester	12%	18%	13%
20	Lichfield	12%	17%	13%
21	Lincoln	23%	28%	13%
22	Liverpool	20%	24%	12%

Code	Diocese	% Churches completed 2021	% Churches engaged 2021	% Churches engaged 2020
23	London	42%	51%	59%
24	Manchester	49%	60%	37%
25	Newcastle	26%	28%	37%
26	Norwich	8%	13%	15%
27	Oxford	28%	37%	49%
28	Peterborough	40%	48%	21%
29	Portsmouth	17%	26%	35%
31	Rochester	24%	33%	23%
32	St. Albans	28%	33%	15%
33	St. Edms & Ipswich	24%	30%	25%
34	Salisbury	46%	52%	19%
35	Sheffield	32%	39%	20%
36	Sodor & Man	68%	70%	8%
37	Southwark	22%	36%	49%
38	Southwell & Notts	49%	58%	19%
39	Truro	50%	57%	59%
41	Winchester	33%	41%	58%
42	Worcester	24%	29%	47%
43	York	30%	36%	28%
46	Leeds	42%	50%	59%
	<b>Nationally</b>	<b>32%</b>	<b>39%</b>	<b>31%</b>

<sup>22</sup> The figures in this column are based on all churches who engaged with the toolkit (i.e. the total % who submitted useable and non-useable data)

## Methodology

The Energy Toolkit for all Church of England buildings was open for data collection relating to the year 2021 between April 2022 and July 2022.

### Estimating Emissions from Church Buildings

39% of churches used the Energy Footprint Tool, while 32% of churches submitted enough data to make their return useable. This was an increase from the previous year, where 31% used the tool and 25% submitted useable data.

Churches entered kWh and/or cost from their annual energy bills into the system, which were then weather-adjusted and converted into both gross and net CO<sub>2</sub>e emissions using 2021 carbon conversion factors<sup>23</sup>. To account for buildings that had not supplied data, their CO<sub>2</sub>e emissions were estimated. This estimation process was completed using multiple linear regression models based on the data that existed for each building type. The explanatory variables used were diocese, building size (floor area), whether the building is in a rural or urban parish, and any available utility bills and/or finance data. For “Church Halls and Other Church Buildings”, CO<sub>2</sub>e emissions were estimated for churches that had submitted data declaring that they had an “other building” but did not provide data for it. This was then scaled up to account for the churches that had not submitted any data to the Energy Footprint Tool.

### Estimating Emissions from Schools

Dioceses were given the option to supply data for each school from either a Display Energy Certificate (DEC), or from the school’s energy bills. To ensure that schools were included and engaged in the Church of England’s Net Zero targets, dioceses were encouraged to invite schools to complete the toolkit themselves. If a school was unable or unwilling to enter data, diocesan users were able to submit data on a school’s behalf.

Response rates to this data collection exercise varied between dioceses, ranging from 0% to 100%, with an overall 21% response rate at the time the toolkit was closed. In order to supplement these data, we used DEC records scraped from the Department for Levelling Up, Housing & Communities (DLUHC) API<sup>24</sup>. This exercise increased the response rate to 68%. Reasons to not retrieve records for schools could be due to there not being a record that exists, the existing record is out of date, or there were differences in the formatting of addresses between diocesan and DLUHC records.

For schools that submitted data, energy use in kWh from the school’s bills or DEC were weather-adjusted and converted into net CO<sub>2</sub>e emissions using 2021 conversion factors. For schools with missing data, figures were calculated via a multiple linear regression model based on the following variables: primary or secondary designation, urban or rural area, and number of pupils. This supporting information about schools was retrieved from the Get Information about Schools service<sup>25</sup>.

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<sup>23</sup> <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021>

<sup>24</sup> <https://epc.opendatacommunities.org/>

<sup>25</sup> <https://www.get-information-schools.service.gov.uk/>

## Estimating Emissions from Housing

30 dioceses (73%) supplied lists of the houses that they own to the Research and Statistics Team. For the remaining 11 dioceses (27%) who did not supply a list of their houses, their number of homes was estimated using a multiple linear regression model that included number of churches and number of clergy. It was estimated that the total number of homes owned by Church of England dioceses is around 9,500.<sup>26</sup>

The housing lists supplied by dioceses were used to gather EPC records using the DLUHC API. 59% of the homes recorded on the supplied lists had EPC records that could be retrieved via this method. The remaining 41% of homes did not have EPC records that could be retrieved via this method. Where no EPC record could be retrieved, it was assumed that no EPC record exists. It is however possible that there are a small number of homes where an EPC record exists, but it was not retrievable due to differences in the formatting of addresses between diocesan and DLUHC records. Once we factor in the estimated numbers of homes for dioceses who did not supply a list of properties, we estimate the overall completeness of this dataset to be 42%.

For each home with an EPC record, the lighting, heating, and hot water costs recorded were converted into a kWh energy use figure using the standard assessment procedure (SAP)<sup>27</sup>, which assumed unit costs of fuels that are applicable to the EPC inspection date. Assuming that these energy use figures would be unchanged since the date of the report, the kWh figures were converted into CO<sub>2</sub>e emissions figures using 2021 carbon conversion factors to give an estimate of emissions from each home in 2021 (rather than the emissions figure from the EPC report, which relates to the year that the EPC was commissioned). For homes that were missing an EPC report, it was assumed that they possessed the average emissions from a D rated home within the Church of England housing dataset.

## Estimating Emissions Other Buildings

NICs, Cathedrals, TElS, Royal Peculiars, Diocesan Offices, and all other buildings, could enter kWh and/or cost from their annual energy bills into the system, which were then weather-adjusted and converted into both gross and net CO<sub>2</sub>e emissions using 2021 carbon conversion factors.

For those buildings that had not supplied data, their CO<sub>2</sub>e emissions were estimated based on the average values from equivalent buildings (e.g. other offices, other cathedrals, large churches or other TElS).

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<sup>26</sup> Diocese in Europe has been excluded from this exercise.

<sup>27</sup> "RdSAP fuel prices from January 2022" retrieved from <https://www.bregroup.com/sap/standard-assessment-procedure-sap-2012/>

## Estimating emissions from travel

An additional section was added to the Church EFT, asking churches whether there were any work-related travel expenses claimed in this year, and if so, what was the total number of miles claimed for. This mileage was then converted to CO<sub>2</sub>e using the carbon conversion factors for an average car.

For churches who did not return data, we estimated mileage with a multiple linear regression model based on the 4,000 churches who did submit data on work related travel. The variables considered in the regression model were the same as those used to predict emissions for non-returning churches (diocese, building size (floor area), whether the building is in a rural or urban parish, and any available utility bills and/or finance data). Of these variables, only spend on church utility bills was found to be statistically significant, and so this was the only variable used to predict work-related mileage for churches, with all other variables excluded from the final model.

Travel emissions from central diocesan offices were also estimated. Car mileage emissions from dioceses were collected using the same method as for churches. Dioceses were additionally asked what their total reimbursable travel expenses were on rail and bus travel for the year, and for details of any work related flights that the diocese had funded (start and end points, and number of tickets purchased).

Emissions for rail travel were then estimated by converting the total spend on rail into an estimated rail mileage, which was done by using the dioceses total spend figure to find a fitted value of a regression model of train journey distance as a function of train fare spend. This model was built from a database of over 579,000 possible train routes and matching fares retrieved from the Rail Delivery Group<sup>28</sup>. Total spend on buses was similarly used to estimate bus mileage using estimates of localised average bus fares estimated from Department for Transport data.<sup>29</sup> Estimated rail and bus mileages were then converted into CO<sub>2</sub>e using the appropriate carbon conversion factors. For flights, the start and end airports of each journey were used to calculate a total journey distance. This was then converted into CO<sub>2</sub>e using the relevant carbon conversion factors.

Where a diocese did not enter any travel data, we assumed an average mileage for car, rail and bus travel based on those dioceses who did submit data. We did not do the same for flights, as only a small number of dioceses submitted this data and there was some uncertainty around how representative these two dioceses would be of the overall sample (given that a further six dioceses supplied other data on work related travel without flights, which we have taken to mean that these six dioceses did not have any work related flights to report).

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<sup>28</sup> <https://data.atoc.org/fares-data>

<sup>29</sup> <https://www.gov.uk/government/statistics/annual-bus-statistics-year-ending-march-2021>

## Glossary

- **DEC** – Display Energy Certificate; shows the energy performance of non-domestic buildings based on actual energy consumption.
- **DLUHC** - Department for Levelling Up, Housing & Communities
- **EPC** – Energy Performance Certificate; measures the energy efficiency of a property on a scale of A-G from estimated energy costs and summaries of a home's energy performance-related features.
- **Gross CO<sub>2</sub>e** – Total emissions garnered from energy use (kWh) within a building.
- **kWh** - Kilowatt hour; measure of energy use.
- **NCIs** – National Church Institutions; several national administrative bodies that work together to support the mission and ministries of the Church of England.
- **Net CO<sub>2</sub>e** – Gross Emissions minus the emissions that were created from fully renewable energy sources.
- **TEIs** – Theological Education Institutions.
- **Weather-Adjustment** – A weather-correction calculation that is applied to the emissions to take account of the weather experienced during that year. This is to allow for a more sensible comparison for absolute emissions year-on-year.