Department for Energy Security & Net Zero

Non-Domestic Building Stock in England and Wales

Part 2: Energy Consumption

March 2023

Contents

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Notes on statistical conventions

1. All estimates for energy consumption and greenhouse gas emissions are presented on an annual basis.

2. All results presented relate to 2019/2020, although some datasets may not align precisely. Specifically, the data for the premises is derived from VOA data for 2020 and most other linked data has been aligned, whilst the most recent available energy consumption data was for the year of 2019.

3. All the data are derived from the available datasets. There are known limitations, meaning that these should be treated as estimates.

4. Rounding conventions:

   a. All energy values presented in this report are quoted in units of gigawatt-hours (GWh) per year rounded to the nearest integer;

   b. All electrical and non-electrical energy intensity values are quoted in units of kilowatt-hours per square metre Gross Internal Area (GIA) per year (kWh/m²), rounded to the nearest integer, unless stated otherwise;

   c. All figures for total floor areas across the activity class (CaRB3 class) are quoted in units of millions of square metres and rounded to 1 decimal place. For example, a floor area of 16,385,312 m² would be presented as 16.4 million m², unless stated otherwise;

   d. All percentage values are quoted to the nearest integer apart from tables where decimal percentages provide more insight. In those cases, values are rounded to one decimal place;

5. Table conventions:

   a. When there is no data, 'null values' are shown using a dash '-'

   b. All floor areas are reported as Gross Internal Area (GIA) unless otherwise stated. Where floor area is recorded as something other than GIA, conversion factors have been applied. GIA is the floor area of a building measured to the internal face of the perimeter walls at each floor level. Further information can be found in "Code of measuring practice: definitions for rating purposes", available at: https://www.gov.uk/government/publications/measuring-practice-for-voa-property-valuations/code-of-measuring-practice-definitions-for-rating-purposes

6. The 'Miscellaneous' CaRB3 class is included in most of the reporting where relevant, but it is excluded from commentary about the results apart from where relevant.

Purpose

This report forms part of the response to the Non-domestic Building Survey commissioned by the Department for Business, Energy and Industrial Strategy (BEIS). Part 1 of the response sets out a description of the Non-domestic Building Stock in England and Wales. This Part 2 focusses on the energy consumption characteristics of the stock. Part 3 reports a more detailed pilot study which was undertaken for the Hospitality class, which incorporates additional modelling and analysis, integration of new datasets and primary research in the form of remote surveys supplemented with a small number of verification surveys to address questions for which no reliable or comprehensive secondary data set could be found. The methods used in Part 3, for the Hospitality class, could be applied to each of the other activity classes, to enhance the description and understanding of all non-domestic building activity classes.

Another supplementary report provides a more detailed analysis of the stock of large premises (>1000 m²) not connected to the gas grid.

This document begins with a description of the methods used to link energy consumption data sets with the database of building stock characteristics described in Part 1. This linked dataset is used to develop a detailed analysis of energy consumption across the non-domestic building stock.

The initial analysis presented in this report is based on the bulk government datasets which cover all CaRB3 classes. However, for some premises in some CaRB3 classes these datasets do not include floor area; this is the case where the VOA unit of valuation is not directly dependent upon floor area, for example, the number of bedrooms in guest houses or the footfall in pubs. This means that while total energy consumption can be explored across the whole stock of non-domestic buildings in England and Wales using the existing bulk government datasets, Energy Use Intensity (EUI) cannot. Annual EUI, for this work, is quoted as kWh/m². The section "Understanding floor areas", in Part 1, explains the importance of floor area records and how they can affect the results of analyses.

In Part 3 of this report, we provide details of a supplementary algorithm which has been developed to produce alternative methods for measuring floor space. This alternative method can be used where VOA floorspace is either not recorded or considered inaccurate (e.g. the number of bedrooms scenario described above). Applying the supplementary algorithm to the Hospitality activity class allows an accurate assessment of EUI in the Hospitality class, for the first time. Hospitality is not the only activity class in which floor area is not recorded by the VOA, other examples include universities, schools, hospitals and cinemas. The algorithm developed in Part 3 is capable of being applied (with activity-specific refinements) to each of these activities. This work will be implemented in phase 2 of this project, at which point this initial assessment will be updated to reflect the more complete assessment of the energy consuming characteristics of the stock which will have then become possible.

Linking energy consumption datasets

Linking energy consumption

Electricity consumption data and gas consumption data was linked to Unique Property Reference Numbers (UPRNs) which are in turn linked to addresses within the Ordnance Survey AddressBase data. Table 1 shows some of the statistics for the linked consumption data; around 49% of non-domestic UPRNs matched to at least one electricity meter or one gas meter or more of these combinations. Matches to electricity meters were higher than for gas meters with 44% of non-domestic UPRNs matching to at least one electricity meter compared to 22% for gas meters.

It is important to note that matches are made to UPRNs rather than the premises. The relationship between UPRNs and VOA premises is occasionally complex: whilst there is a one-to-one relationship between most premises and UPRNs, there are cases where multiple premises can match to the same UPRN. In these cases it is important to share the consumption data for any matched energy meters amongst these premises. Sub-metering data is not available, so a statistical method for sharing the data has to be used. The logical approach might be to use floor area as a proxy for the share of the metered energy. However, as noted above, not all premises have floor areas recorded in the VOA data, but a rateable value *is* recorded for all premises, irrespective of floor area. For premises with floor area records, rateable value will normally increase as floor area increases (when rateable value is calculated per m²). Premises without floor area will nonetheless have their rateable value scaled according to the earning capacity of their activity, which is generally linked to non-area-based metrics such as footfall in pubs, or room rental rates in hotels. As a result, rateable value has been used to calculate the share of the energy consumption in cases where multiple premises are assigned to the same energy meter. These cases are rare and can be seen in Table 1. They amount to 2% of premises for electricity and 1% for gas. This situation is slightly more common in the Office class with 4% of Office premises sharing electricity consumption via their UPRN and 2% sharing gas consumption via their UPRN.

Table 1 Percentages of premises which match or share consumption data

CaRB3 class	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
Agriculture, Countryside, Animals	36%	34%	10%	1%	0%
Arts and Leisure	45%	38%	22%	2%	1%
Community	42%	34%	26%	2%	2%
Education	69%	60%	48%	2%	2%
Emergency	69%	58%	45%	2%	1%
Factory	41%	37%	14%	2%	1%
Health	71%	63%	51%	3%	3%
Hospitality	67%	61%	40%	1%	1%
Miscellaneous	47%	44%	34%	1%	1%
MoD	41%	29%	24%	1%	1%
Office	25%	22%	11%	4%	2%
Shop	70%	65%	29%	2%	1%
Sport	39%	33%	20%	2%	1%
Transport	35%	34%	6%	3%	1%
Utilities	11%	10%	2%	2%	1%
Warehouse	36%	32%	13%	3%	1%
All classes	**49%**	**44%**	**22%**	**2%**	**1%**

Some CaRB3 activities are inherently difficult to link energy consumption data with premises whilst others provide larger percentages of linked data. This can be seen in more detail in Table 9 in the Appendices where, for example, the CaRB3 activity 'Surgery / Clinic' of which there are around 25,000 premises has a 71% match rate to energy meters. In the Office class, the CaRB3 activity 'Office (Local Authority)' of which there are nearly 2,000 premises, has a 42% match rate to energy meters, whilst the 'Contractor Hut(s) and Compounds' premises of which there are 1,348 matches to 5% of energy meters.

All Activity Classes

Energy consumption by energy type and by activity class

The matches of premises to meter data can be aggregated to present energy consumption broken down into the 16 CaRB3 classes as is shown in Figure 1. Collectively, all of these classes consumed 117,103 GWh of delivered electrical energy and gas combined. Of this, 56,067 GWh (48%) was electrical consumption and 61,036 GWh (52%) was gas consumption. The six largest classes in terms of total energy consumption accounted for 85% of the total non-domestic energy consumption. These were:

- Factory (42,990GWh, 37%)

- Shop (17,427 GWh, 15%)

- Hospitality (13,026 GWh, 11%)

- Education (9,946 GWh, 8%)

- Office (8,330 GWh, 7%)

- Warehouse (7,996 GWh, 7%)

Figure 1 Total energy consumption by energy type and CaRB3 class, 2019
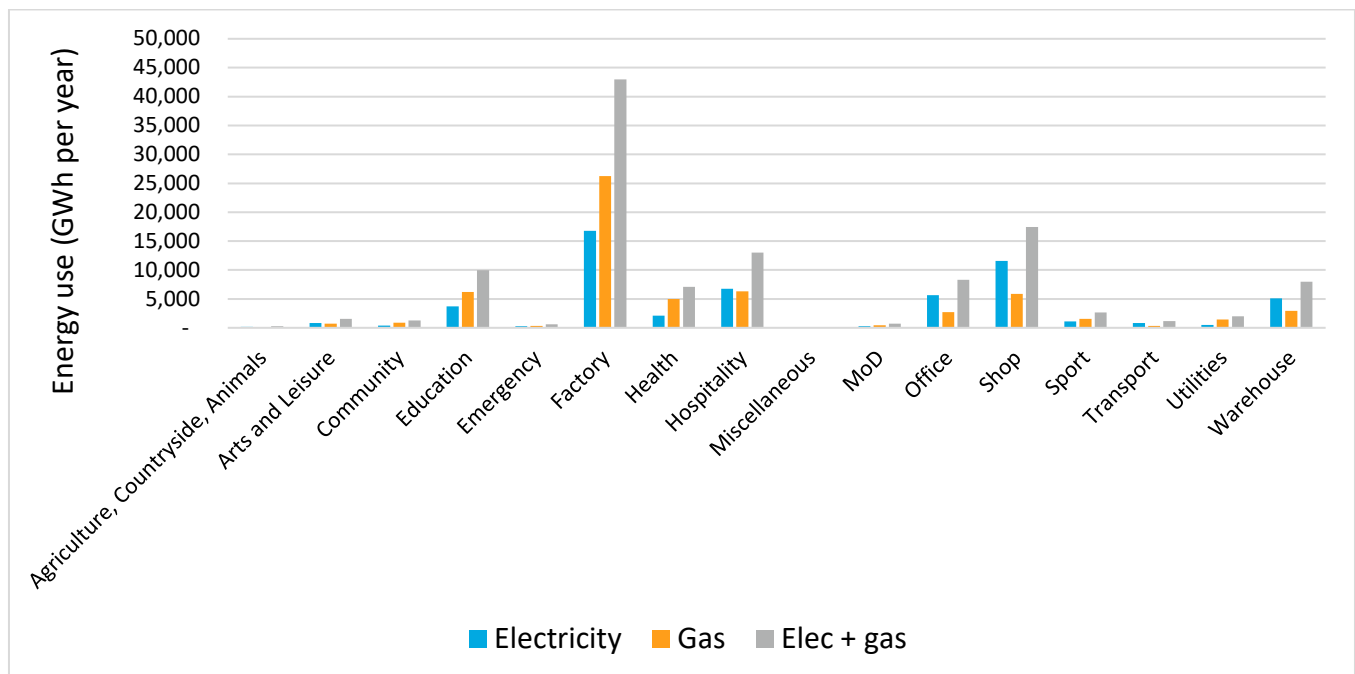
For the consumption of electrical energy, the same six CaRB3 classes account for 49,513 GWh of electrical energy (88%) with the highest to lowest consumption order being slightly different:

- Factory (16,755 GWh, 30%)
- Shop (11,564 GWh, 21%)
- Hospitality (6,736 GWh, 12%)
- Office (5,637 GWh, 10%)
- Warehouse (5,089 GWh, 9%)
- Education (3,732 GWh, 7%)

For the consumption of gas, the order of the six largest CaRB3 classes changes with Office dropping out of the list and Health moving in. This combination accounts for 50,200 GWh of gas consumption (82%[1]). The individual breakdown for gas is as follows:

- Factory (26,235 GWh, 43%)
- Hospitality (6,290 GWh, 10%)
- Education (6,213 GWh, 10%)
- Shop (5,863 GWh, 10%)
- Health (4,982 GWh, 8%)
- Warehouse (2,906 GWh, 5%)

Energy consumption distribution by fuel type and activity class

The electricity to gas split of consumption per CaRB3 class is shown in Figure 2. This shows that electrical energy is dominant in several classes including 'Agriculture, Countryside, Animals', Transport, Office, Shop and Warehouse. The split is fairly even for 'Arts and Leisure', Hospitality, Sport and Emergency. Gas is the dominant fuel for Factory, Education, Community, MoD, Health and Utilities.

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[1] The individual percentages for each CaRB3 class may not sum to the total due to rounding of the data

Figure 2 Energy consumption distribution by fuel type and CaRB3 class, 2019
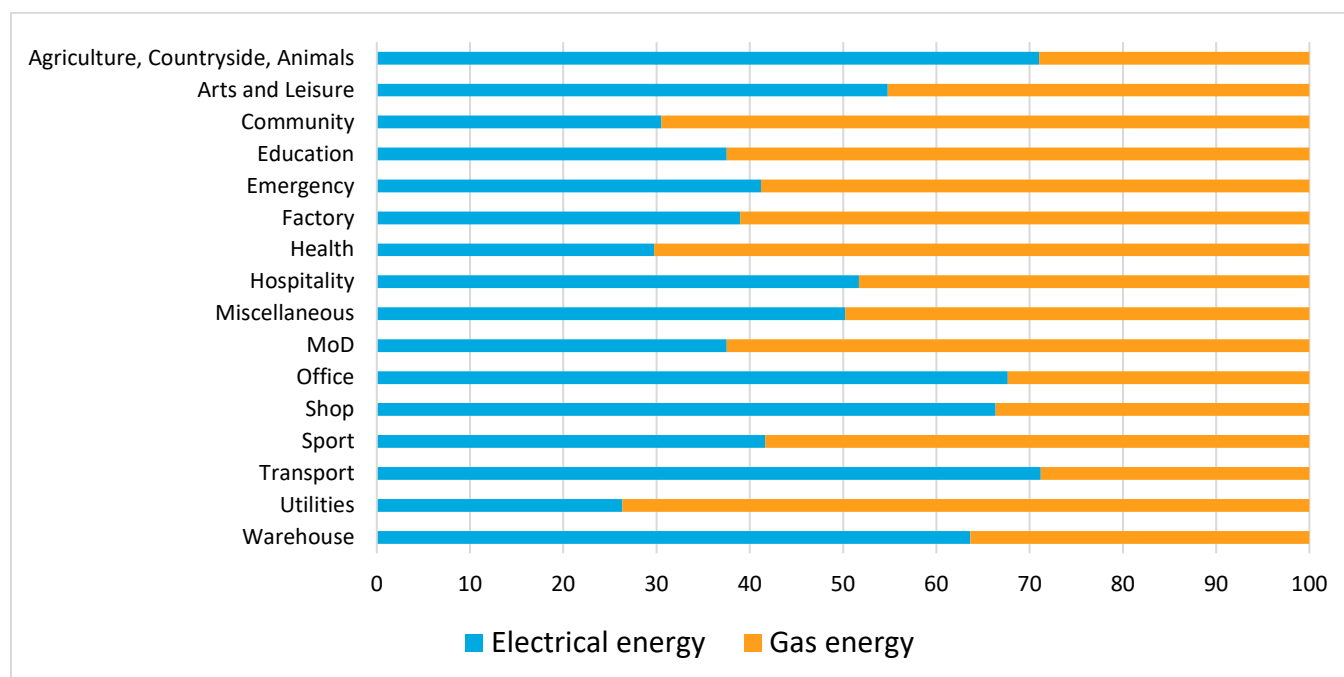
Greenhouse gas emissions by energy type and by activity class

The greenhouse gas emissions derived[2] from the energy consumption data are shown in Figure 3. These results show that the total greenhouse gas emissions from non-domestic premises was 26 MtCO2e per year. These were fairly evenly split between gas and electricity with 13 MtCO2e from electricity and 14 MtCO2e from gas. The largest class was Factory with 9 MtCO2e (electricity and gas) followed by Shop (4 MtCO2e), Hospitality (3 MtCO2e), Education (2 MtCO2e) and Warehouse (2 MtCO2e).

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[2] The Greenhouse gas emissions were derived by using the energy consumption data and the 'Greenhouse gas reporting: conversion factors' published by BEIS for the year 2020 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020 (updated 17/07/2020, accessed 10/01/2023).

Figure 3 Greenhouse gas emissions by energy type and by CaRB3 class, 2019
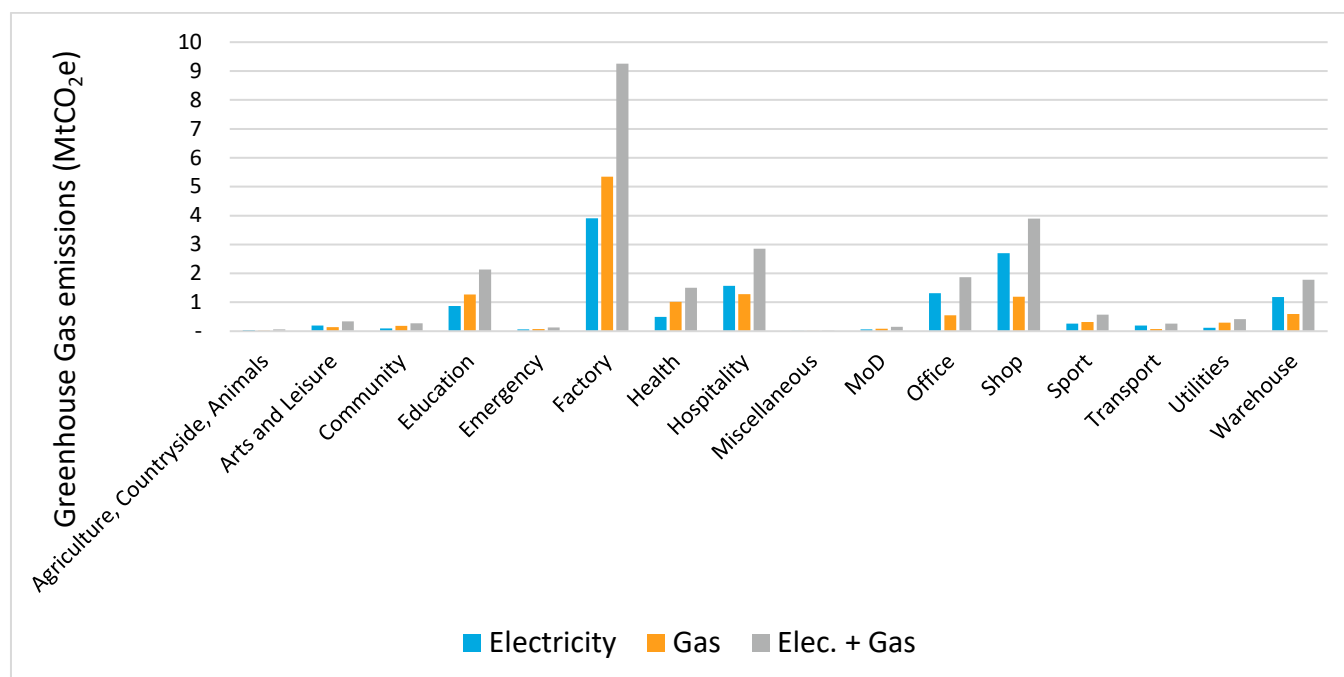
Distribution of total energy intensity by activity class

Energy use intensity (EUI) is commonly used alongside total energy consumption for a premises or activity class since by normalising consumption by floor area allows comparison between premises and activity classes, regardless of size. However, determining energy use intensity requires both total energy consumption and floor area to be known for a premises, and determining floor area is not straightforward for all premises. The VOA uses floor area for rating purposes for most but not all activities. For these latter activities, the floor area field is often used to record other metrics, which are likely to be activity specific (for example the field may be used to record the number of habitable rooms in self-catering accommodation), but this appears to be a customary practice rather than a formally defined one. As a result, assessment of EUI across the stock requires an activity-by-activity assessment of the usability of VOA floor area data in the specific context of this project. For a fuller explanation of the role and importance of understanding floor area data, in the calculation of EUIs, please see the section 'Understanding 'floor area' in Report 1.

Excluding floor area figures below a chosen threshold would remove some of the anomalous records but would also result in discarding genuine records, for example, in the case of a large hotel where the field may be used to record the number of bedrooms, the record may be a larger number than the total floor area of a small takeaway.

In Phase 1 of this project we have focussed on the Hospitality activity class to pilot methods for assessing floor area and have identified a four-fold under-reporting of floor area, as set out in Part 3 of this report. The degree of underreporting varies across the 24 different activities within the Hospitality activity class and detailed investigation is required for each individual

activity to determine the usability of the VOA floor area field for that specific activity. In Phase 2 of this project it will be possible to extend this analysis to the rest of the activity classes.

Consequently, while EUI may be justified as a metric for comparison within each CaRB3 activity, it should not be used for comparison within or across CaRB3 classes. Results for the Hospitality activity class, where activity-level analysis has been undertaken, are presented in Part 3 of this report. For the purposes of comparison with previous studies, a stock level analysis by floor area field is included in Annex 2 – Analysis by VOA floor area field.

Energy consumption by organisation size and energy type

By linking the Interdepartmental Business Register (IDBR) data to the non-domestic records it is possible to classify premises into organisation size[3]. The match rates between IDBR and the non-domestic premises records were low, so this section of reporting reflects this. Figure 4 shows that 5,072 GWh of total energy can be attributed to premises matched to 'Large' enterprises, which represents around 4% of total energy. SME premises account for 26,338 GWh, which represents 22% of total energy. The split between electrical energy and gas is fairly even for all of the categories. By far the largest amount of total energy is assigned to premises which were not linked to IDBR with 85,185 GWh (73%) of total energy falling into this category. A small category was assigned to records that did match to IDBR but through which it was not possible to resolve size of enterprise (due to missing data on both number of employees and turnover).

If the records that did not match to an IDBR record are excluded, then the split of energy assigned to Large premises is 16% and 84% to SME premises.

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[3] A company is an SME (small or medium-sized enterprise) if two of the following three characteristics are met: annual turnover less than €50m; number of employees less than 250; or annual balance sheet total less than €43m. Whilst it was not possible to assess the third characteristic using the IDBR data, it was possible to use the number of employees and for the records that matched to an 'Enterprises' record, turnover data were available in thousands of pounds sterling, which was converted to Euros at a rate of 1.11 Euros to the pound sterling. See FCO (2022) Small to medium sized enterprise (SME) action plan, FCO, published 27/01/2022: https://www.gov.uk/government/publications/fcdo-small-to-medium-sized-enterprise-sme-action-plan/small-to-medium-sized-enterprise-sme-action-plan#what-is-an-sme [accessed 23rd January 2023]

Figure 4 Energy consumption by organisation size and energy type, 2019
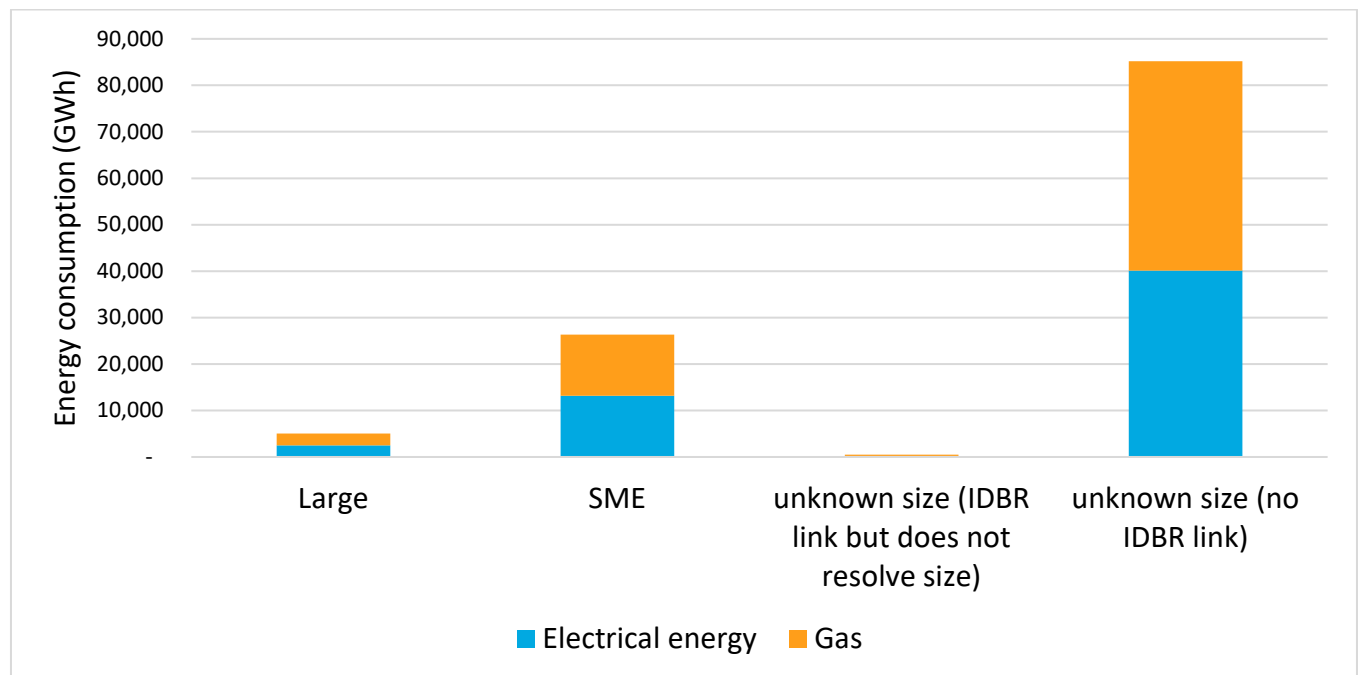
Energy consumption by organisation size by activity class

Table 2 shows total energy consumption aggregated by CaRB3 class and by organisation size, according to the links that have been made with IDBR data. Similar to Figure 4, many of the data failed to link to the IDBR dataset and this is reflected in the table. The activities with the highest proportion of energy consumption assigned to the 'Large' category include Transport, Emergency, Health and Community.

Table 2 Energy consumption by organisation size by activity class (CaRB3 class), 2019

CaRB3 class	Energy consumption by organisation size (GWh/year)				
	Large	SME	unknown via IDBR	no link to IDBR	Total
Agriculture, Countryside, Animals	3	32		228	**263**
Arts and Leisure	33	511	14	994	**1,552**
Community	114	276	4	888	**1,281**
Education	223	2,420	123	7,181	**9,946**
Emergency	61	191	2	352	**606**
Factory	2,188	7,648	167	32,987	**42,990**
Health	707	2,756	50	3,578	**7,091**
Hospitality	120	3,220	60	9,626	**13,026**
Miscellaneous		5		75	**79**
MoD		1		699	**701**
Office	441	2,133	38	5,717	**8,330**
Shop	685	4,765	7	11,969	**17,427**
Sport	14	702	9	1,947	**2,671**
Transport	265	295	16	590	**1,166**
Utilities	1	58	1	1,919	**1,978**
Warehouse	217	1,325	16	6,437	**7,996**
Total	**5,072**	**26,338**	**508**	**85,185**	**117,103**

Energy consumption by tenure

It is possible to classify non-domestic premises using His Majesty's Land Registry (HMLR) data into categories that describe the legal tenure of the estate[4]. The energy data have been

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[4] Using HMLR data, the concept of 'tenure' is more complex than a classification of 'owner occupier' vs 'tenant'. It might be that a premises is linked and flagged as 'leasehold' which actually represents a leasehold arrangement on the estate rather than an arrangement between the premises owner and the occupier. Likewise, an estate marked as 'freehold' might in fact be leased to an occupier. This could be via an HMLR registered (>7 year lease)

aggregated using these HMLR derived categories in Figure 5. Using this method, 66% of total energy is assigned to the category where there is no link to HMLR data, whilst 23% of total energy is assigned to some form of lease agreement and 7% of total energy is classified as being in freehold tenure.

Figure 5 Energy consumption by tenure, 2019
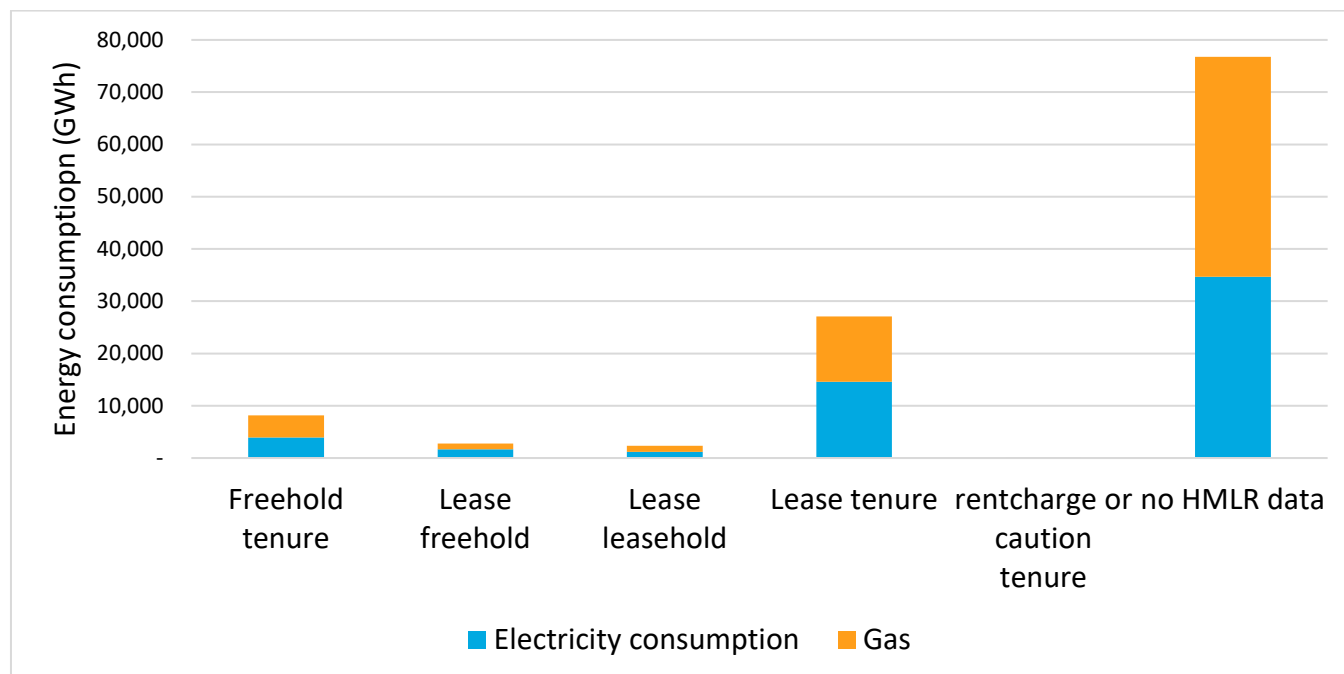
Energy consumption by tenure and activity class

Table 3 shows the split between the different HMLR estate tenancies by CaRB3 activity class. As with Figure 5, nearly two-thirds of total energy cannot be linked to HMLR data. This is particularly the case for Community, Emergency, Factory and MoD. 'Agriculture, Countryside, Animals' has the largest percentage of total energy (for the class) assigned to Freehold (81 GWh or 31%). If the various leasehold classifications are combined, this aggregation has the second highest share of total energy for each activity class (after the 'no HMLR data' column), which includes Shop, Sport, Hospitality and 'Arts and Leisure'.

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or via a non-HMLR arrangement. Nonetheless, the leases dataset includes any leases of more than 7 years and hence may reflect some risk to change in the future tenancy of the estate.

Table 3 Energy consumption by tenure by activity class (CaRB3 class), 2019

CaRB3 class	Energy consumption by tenure (GWh/year)						
	Freehold tenure	Lease freehold	Lease leasehold	Lease tenure	rentcharge or caution tenure	no HMLR data	Total
Agriculture, Countryside, Animals	81	34	4	4	0	140	**263**
Arts and Leisure	108	472	29	32	1	910	**1,552**
Community	107	149	10	15	0	1,001	**1,281**
Education	309	2,327	48	44	0	7,216	**9,946**
Emergency	72	41	4	4	0	486	**606**
Factory	2,682	6,135	423	632	3	33,116	**42,990**
Health	333	1,631	40	54	0	5,033	**7,091**
Hospitality	1,322	3,789	414	384	3	7,113	**13,026**
Miscellaneous	22	8	1	8	0	40	**79**
MoD	25	7	2	3		664	**701**
Office	770	2,302	340	168	5	4,745	**8,330**
Shop	1,631	6,243	1,001	731	4	7,815	**17,427**
Sport	75	1,014	32	34	0	1,516	**2,671**
Transport	24	282	6	6		848	**1,166**
Utilities	55	467	84	59		1,314	**1,978**
Warehouse	533	2,167	344	145	1	4,805	**7,996**
Total	**8,149**	**27,068**	**2,784**	**2,322**	**18**	**76,763**	**117,103**

Energy consumption by fuel type and by part of building and whole building premises

The spatial location of the address of the premises, combined with links to building polygons, HMLR boundaries and Ordnance Survey Sites were used to classify[5] premises according to whether they:

- occupy the whole building (single occupancy non-domestic)
- occupy part of a building with other non-domestic (multi occupancy non-domestic)
- occupy part of a building that includes dwellings (multi occupancy with domestic)
- occupy a site with multiple buildings (Campus single occupancy)

Figure 6 shows the energy consumption (electrical and gas) for each of these categories. Multi occupancy non-domestic is the largest category with 50,042 GWh of total energy assigned to this category (around 43% of total energy). Single occupancy non-domestic is the next largest category with 25,797 GWh (22%) of total energy followed closely by campuses with 24,487 GWh (21%). Multi occupancy buildings where non-domestic shares the building with domestic is the smallest group with 16,496 GWh (14%) of the total energy.

The split for each category between electrical energy and gas is similar, with electrical energy representing 53% (of total energy) for single occupancy non-domestic, 48% for both multi-occupancy non-domestic and multi-occupancy with domestic categories. Campuses use a slightly larger proportion of gas, compared to electricity, with electrical energy representing 41% of total energy and the remainder gas.

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[5] For the purpose of this analysis of the non-domestic premises records have been linked using several different data sources including Ordnance Survey AddressBase, His Majesty's Land Registry (HMLR) National Polygon dataset, Ordnance Survey 'Sites' and the links to Ordnance Survey Mastermap polygons. Mastermap polygons have been assumed to represent buildings for this national analysis. Furthermore, to carry out the analysis of premises consisting of a multi-building campus it was necessary to use a more generalised polygon dataset than Mastermap and so the Ordnance Survey OpenData 'Local Buildings' polygon dataset was used.

Figure 6 Energy consumption by part of building and whole building premises and tenure, 2019
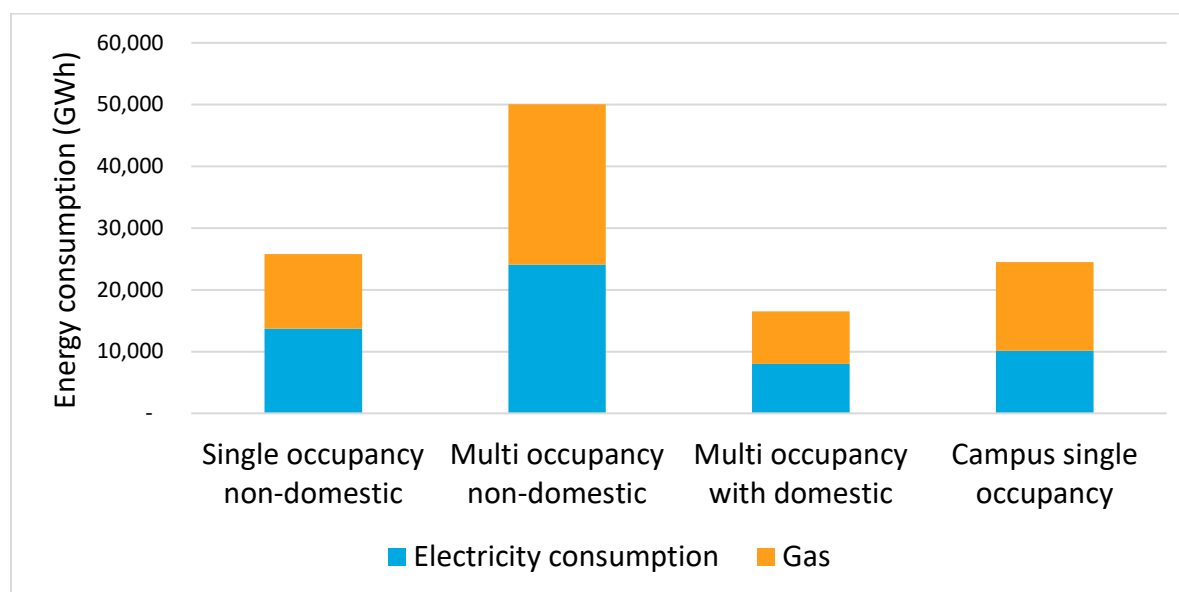
Table 4, below, provides total energy consumption in a manner similar to Figure 6, only this is electrical and gas consumption combined (to make total energy) and it is aggregated by CaRB3 class. Almost all CaRB3 activity classes have the largest share of total energy in the multi-occupancy non-domestic group, apart from 'Agriculture, Countryside, Animals', Community, Emergency and Hospitality. Health has the highest share of total energy in this multi-occupancy non-domestic group with 4,688 GWh (66% of total energy for Health) being used in this category of buildings.

'Agriculture, Countryside, Animals' with 130 GWh (49%), Community with 537 GWh (42%) and Hospitality 5,989 GWh (46%) all have the largest share of total energy in buildings that are shared with domestic premises. Emergency is the only activity class that uses more total energy in single non-domestic buildings than the other categories (300 GWh or 50%).

Campus based premises often (but not always) account for more total energy than buildings that are shared with domestic. In particular, Education with 3,503 GWh (35% of total energy), Factory with 16,102 GWh (37%), Sport with 393 GWh (15%) and Transport with 373 GWh (32%).

Table 4 Energy consumption by premises type by activity class (CaRB3 class), 2019

CaRB3 class	Energy consumption by Premises relationship to building(s) (GWh/year)					
	Single occupancy non-domestic	Multi occupancy non-domestic	Multi occupancy with domestic	Campus single occupancy	unknown occupancy	Total
Agriculture, Countryside, Animals	47	56	130	30	0	263
Arts and Leisure	602	741	126	82	2	1,554
Community	302	320	537	121	2	1,282
Education	1,134	4,355	917	3,503	40	9,949
Emergency	300	237	12	56	1	607
Factory	8,887	17,344	540	16,102	165	43,038
Health	693	4,688	1,348	358	6	7,094
Hospitality	3,340	3,175	5,989	508	25	13,037
Miscellaneous	27	29	12	10	2	80
MoD	15	430	223	32	0	701
Office	2,165	4,423	820	890	42	8,341
Shop	4,582	7,023	5,476	328	34	17,443
Sport	667	1,411	193	393	7	2,672
Transport	243	527	20	373	3	1,167
Utilities	480	1,173	18	308	0	1,978
Warehouse	2,314	4,108	134	1,394	58	8,007
Total	**25,797**	**50,042**	**16,496**	**24,487**	**389**	**117,211**

Energy consumption by part of building and whole building premises and tenure

For Table 5 the total energy has been classified via the premises relationship with building(s) as well as the HMLR categorisation of tenure. Since a large percentage of premises do not match to the HMLR tenure records, this table (like the other tenure related sections) is limited. This limitation is slightly less pronounced for multi occupancy with domestic where 9,292 GWh (56%) are assigned to records with no HMLR data and Single occupancy non-domestic where 14,968 GWh (58%) are assigned to records with no HMLR data.

'Lease freehold' is the next highest tenure grouping for total energy, followed by 'Freehold tenure'. The remaining groupings ('Lease leasehold', 'Lease tenure' and 'rentcharge or caution tenure') account for a much smaller percentage of total energy. The largest single grouping (ignoring the 'no HMLR data' group) is the 'multi occupancy non-domestic' combined with 'Lease freehold' tenure with 11,388 GWh of total energy.

Table 5 Energy consumption by part of building and whole building premises and tenure, 2019

Premises : Building	Energy consumption by tenure (GWh/year)						
	Freehold tenure	Lease freehold	Lease leasehold	Lease tenure	rentcharge or caution tenure	no HMLR data	Total
Single occupancy non-domestic	2,185	6,991	1,004	645	5	14,968	**25,797**
Multi occupancy non-domestic	2,449	11,388	977	656	8	34,563	**50,042**
Multi occupancy with domestic	2,063	3,996	639	503	4	9,292	**16,496**
Campus single occupancy	1,426	4,652	159	516	0	17,734	**24,487**
unknown occupancy	26	42	5	2	0	206	**281**
Total	**8,149**	**27,068**	**2,784**	**2,322**	**18**	**76,763**	**117,103**

Energy consumption by private and public sector, by energy source

There is no clear flag in the VOA data to enable the identification of all public sector premises. The CaRB3 activity classification system does however allow VOA descriptions to be combined with the classification system used within the Ordnance Survey AddressBase product (OSAB), which enables the estimation of the numbers of premises/addresses and floorspace (m² GIA) occupied by central government or local government bodies. The VOA data already contain an indication of local authority occupations (for some premises) or NHS hospitals, but OSAB sometimes also indicates where addresses contain 'Central Government Services' or a 'Job Centre' (via the OSAB classification). This can be appended to the CaRB3 activities derived from VOA records to extend the VOA-based classification.

In the section 'Public Sector Buildings' of Part 1 of this report, it is specifically noted that the premises identified as being part of the public sector are just those *identified* as being in the sector and that there are known to be many occupations of premises by public sector bodies (both central and local government) that are *not identified* as such, in the non-domestic stock data currently accessible and included in this current work. For this reason, this analysis cannot be taken as a definitive description of energy use in local/central government premises. However, access to data held by the Government Property Agency, on government occupations of premises would facilitate a more robust identification of these premises and their energy use.

Figure 7 shows the split of electrical energy and gas according to whether premises are private or public[6]. Public premises are dominated by 'Offices' (central government offices and local authority offices) followed by Education (state schools). When total energy is split between Private and Public sector, the Private sector dominates with 51,752 GWh of electrical energy (92%) and 51,725 GWh of gas (85%).

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[6] There is no clear flag in the VOA data to enable the identification of central government public sector premises, though some local authority occupations are identified. The CaRB3 activity classification system does, however, allow VOA descriptions to be combined with the classification system used within the Ordnance Survey AddressBase product (OSAB) to produce/enhance this distinction between public and private sector premises. For an explanation of what constitutes 'public' and 'private', please see the section entitled "Public Sector Buildings" in Report 1.

Figure 7 Energy consumption by private and public sector by energy source, 2019
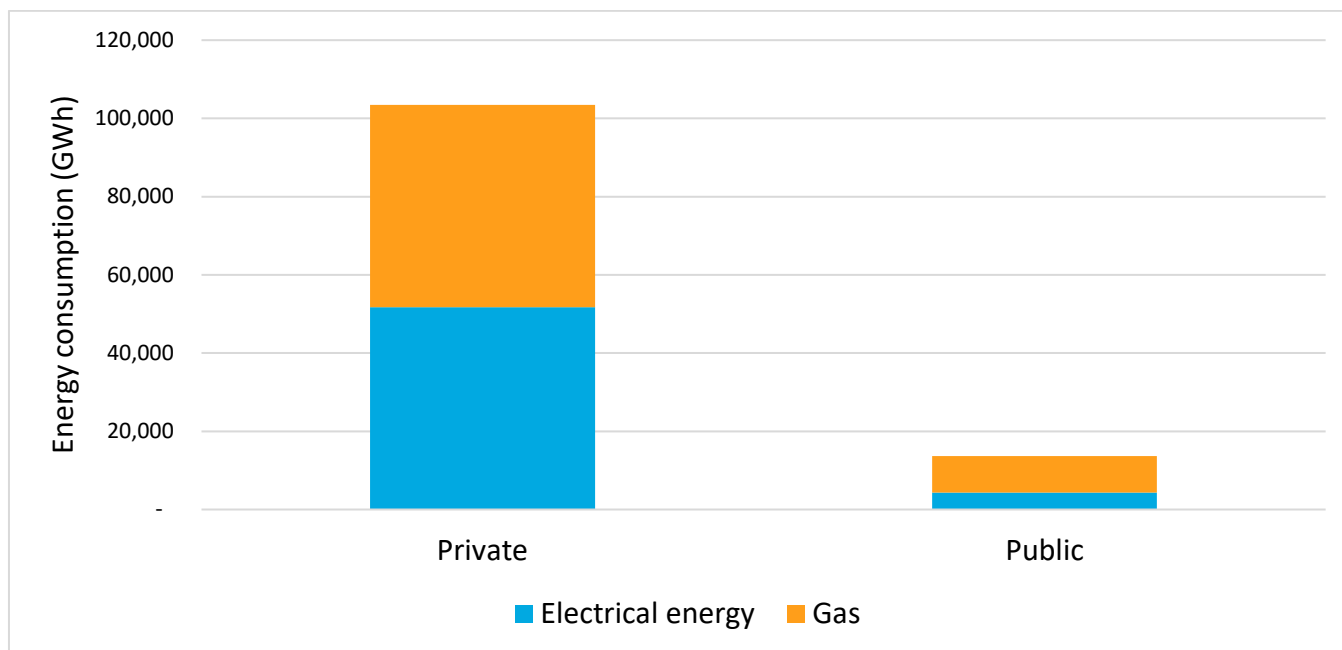
Energy consumption by activity class and by private or public sector

The split of total energy between public and private premises is shown in Table 6 with the breakdown by activity class (CaRB3 class). For most classifications, total energy use is close to 100% in the private sector with very little energy assigned to public sector premises. The exceptions here include Health where 5,547 GWh (78% of total energy for Health) is assigned to the public sector, Education where 6,375 GWh (64% of total energy for Education) is assigned to the public sector, Office where 448 GWh (5%) is assigned to public sector and Sport where 1,188 GWh (44%) is assigned to public sector premises. For the whole of the non-domestic stock the split is 13,626 GWh public sector (12%) to 103,477 GWh private sector (88%).

Table 6 Energy consumption by activity class (CaRB3 class) by private and public sector, 2019

CaRB3 class	Energy consumption (GWh/year)		
	Public	Private	Total
Agriculture, Countryside, Animals	0	263	**263**
Arts and Leisure	13	1,539	**1,552**
Community	19	1,262	**1,281**
Education	6,375	3,570	**9,946**
Emergency	0	606	**606**
Factory	17	42,973	**42,990**
Health	5,547	1,545	**7,091**

Hospitality	1	13,025	**13,026**
Miscellaneous		79	**79**
MoD	5	696	**701**
Office	448	7,882	**8,330**
Shop	2	17,424	**17,427**
Sport	1,188	1,483	**2,671**
Transport	0	1,166	**1,166**
Utilities	0	1,978	**1,978**
Warehouse	12	7,983	**7,996**
Total	**13,626**	**103,477**	**117,103**

Energy consumption by tenure and private or public sector

Table 7 shows total energy split by private and public sector premises aggregated by tenure, according to the HMLR records. Much like the previous tables that include tenure, the largest amount of total energy is assigned to the classification 'no HMLR data' where no link has been found to a tenure record. The next largest category is the 'Lease freehold' tenure. This accounts for 23,624 GWh (23% of total energy in the private sector category as a whole) and 3,444 GWh (25% of total energy in the public sector category as a whole).

The third largest tenure category is 'freehold tenure', which accounts for 7,843 GWh (or 8% of total energy in the private sector category as a whole). It seems that far less total energy is assigned to public sector 'Freehold tenure' premises with 306 GWh (2% of total energy in the public sector category as a whole).

Table 7 Energy consumption by tenure and private or public sector, 2019

Sector	Energy consumption by tenure (GWh/year)						
	Freehold tenure	Lease freehold	Lease leasehold	Lease tenure	rentcharge or caution tenure	no HMLR data	Total
Private	7,843	23,624	2,748	2,265	17	66,980	**103,477**
Public	306	3,444	36	57	0	9,784	**13,626**
Total	**8,149**	**27,068**	**2,784**	**2,322**	**18**	**76,763**	**117,103**

Annex 1 - Meter matching rates by individual activity

Table 8 Percentage match rates for all CaRB3 activities

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
Agriculture, Countryside, Animals	Agricultural showground	38%	35%	10%	6%	4%
	Animal Boarding	46%	43%	16%	1%	1%
	Bird Sanctuary	30%	29%	4%	1%	0%
	Cattle Breeding Centre	0%	0%	0%	0%	0%
	Fish Farm	53%	51%	15%	2%	0%
	Game Farm	34%	34%	0%	0%	0%
	Hatchery/Poultry Farm	36%	36%	18%	0%	0%
	Kennels and Catteries	42%	41%	12%	1%	0%
	Livestock market	31%	28%	9%	2%	1%
	Pack house [packing agricultural produce]	32%	32%	0%	0%	0%
	Racing Stable / Stud Farm	35%	34%	6%	2%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Specialist farming, horticulture, plant nurseries	50%	50%	9%	9%	5%
	Stables and Loose Boxes	24%	23%	4%	2%	0%
	Stables, riding	33%	32%	6%	1%	0%
	Veterinary Clinic / Animal Clinic	71%	64%	45%	2%	1%
	War Games Course/ Misc Agricultural Use	14%	14%	1%	2%	1%
Arts and Leisure	Amusement/theme Park, Tourist attraction	45%	43%	19%	4%	0%
	Aquarium	71%	68%	18%	7%	0%
	Arena	35%	35%	5%	0%	0%
	Arts and Leisure NEC	29%	25%	11%	2%	1%
	Bingo hall	66%	54%	40%	4%	2%
	Boathouse	19%	16%	6%	2%	0%
	Bowling Alley	56%	49%	24%	1%	0%
	Casino, gambling club	60%	45%	38%	2%	0%
	Cinema	63%	52%	37%	3%	2%
	Clubhouse	41%	34%	22%	3%	2%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Go Kart Rink	32%	31%	3%	4%	0%
	Heritage Railway	42%	39%	10%	2%	0%
	Library	66%	54%	41%	2%	2%
	Marina	42%	38%	11%	4%	0%
	Miniature Railway	13%	13%	0%	0%	0%
	Model Village	56%	56%	13%	6%	0%
	Museum, art gallery, arts centre	52%	45%	24%	2%	1%
	Pleasure Pier	51%	46%	37%	0%	0%
	Public Hall	50%	40%	34%	3%	2%
	Roller skating rink	32%	29%	11%	0%	0%
	Royal Palaces	46%	38%	15%	0%	0%
	Snooker Hall/Club	54%	44%	31%	6%	3%
	Stately Homes & Historic Houses	47%	43%	15%	3%	1%
	Theatre, concert hall	69%	57%	48%	2%	2%
	Tourist Attraction/Dark Ride	34%	31%	8%	2%	0%
	Village hall, Scout hut, Guide hut	40%	35%	18%	2%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Windmills	35%	35%	4%	0%	0%
	Zoo / Safari Park / Sea Life Centre	62%	57%	12%	0%	0%
Community	Cemetery / Burial ground	12%	11%	6%	1%	0%
	Community centre/Day centre	54%	43%	36%	3%	2%
	Community NEC	8%	5%	6%	0%	0%
	Crematorium	66%	58%	40%	2%	1%
	Law court	54%	42%	34%	2%	2%
	Mortuary	48%	42%	27%	6%	2%
	Municipal Occupation NEC	63%	54%	43%	2%	1%
	Nursing/Care Home	63%	54%	40%	1%	1%
	Prison/Young Offenders Institution/Detention Centre	69%	60%	43%	1%	1%
	Public Convenience	10%	9%	1%	1%	0%
	Undertaker, chapel of rest	70%	62%	44%	2%	1%
Education	Agricultural Research Centre	5%	5%	0%	0%	0%
	Archive	60%	43%	31%	0%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	College (6th form, FE, HE, etc.)	61%	51%	42%	3%	3%
	Dance School / Centre	43%	37%	23%	3%	1%
	Education NEC	45%	38%	25%	2%	2%
	Field Study, Activity and Adventure Centre	41%	37%	12%	2%	1%
	Nursery, Creche, Playschool, Childcare	55%	47%	36%	2%	2%
	Observatory/Telescope Site	7%	7%	1%	2%	0%
	Private School / College	74%	65%	49%	2%	2%
	Religious Retreat/Study Centre (Residential)	59%	54%	20%	1%	1%
	School	65%	50%	40%	5%	5%
	State school	82%	70%	60%	2%	2%
	Training Centre (Non residential)	53%	43%	34%	2%	2%
	Training Centre (Residential)	64%	55%	31%	2%	2%
	University	53%	42%	35%	3%	3%
	University Accommodation within Hospital	12%	8%	6%	4%	1%
	University Ancillary Land / Buildings NEC	41%	33%	22%	0%	2%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
Emergency	Ambulance station	65%	51%	47%	2%	1%
	Coastguard Station	38%	36%	8%	2%	0%
	Fire station	77%	66%	50%	2%	1%
	Lifeboat Station	30%	30%	1%	4%	0%
	Police station	67%	56%	46%	2%	1%
Factory	Abattoir / Slaughter House	46%	41%	13%	1%	1%
	Aggregate/Mineral Processing Plant / Depot	23%	23%	3%	3%	1%
	Aircraft works	25%	8%	17%	0%	0%
	Aluminium Smelting Works	0%	0%	0%	0%	0%
	Artificial Fibre Works	0%	0%	0%	0%	0%
	Asphalt Plant	27%	21%	12%	5%	3%
	Beet Sugar Factory	50%	50%	33%	0%	0%
	Brewery	40%	38%	18%	2%	1%
	Brickworks / clay tile/pipe works	48%	36%	33%	4%	5%
	Cement Tile Works	57%	57%	0%	0%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Cement Works	36%	29%	7%	0%	0%
	Chemical Works	35%	27%	22%	5%	5%
	Coking and Carbonising Plant	67%	67%	33%	0%	0%
	Concrete batching plant	24%	23%	3%	4%	1%
	Concrete Block Works	45%	39%	13%	2%	0%
	Concrete Product Works	45%	41%	12%	4%	1%
	Creamery	56%	53%	18%	3%	0%
	Distillery	38%	31%	15%	15%	8%
	Effluent Minewater Treatment Plant	2%	2%	0%	0%	0%
	Exhaust and tyre centre	54%	50%	14%	4%	1%
	Factory	56%	47%	30%	3%	2%
	Flour Mill	57%	49%	25%	7%	5%
	Food Processing Centre	45%	40%	21%	2%	0%
	Foundry	66%	53%	47%	2%	6%
	Industrial Minerals NEC	12%	12%	1%	2%	0%
	Industrial NEC	45%	38%	19%	3%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Iron and/or Steel Works	20%	13%	7%	3%	0%
	Laboratory	26%	22%	16%	2%	1%
	Large industrial (> 20,000 m2) NEC	42%	25%	25%	25%	8%
	Maltings - Non Trad	86%	79%	57%	0%	0%
	Maltings - Trad	60%	60%	60%	20%	20%
	Mill	20%	20%	0%	0%	0%
	Mineral Production - Brine	33%	33%	0%	0%	0%
	Mineral Production - Coal	17%	17%	0%	9%	0%
	Mineral Production - Gas	7%	7%	0%	0%	0%
	Mineral Production - Inert	15%	13%	2%	2%	2%
	Mineral Production - Oil	9%	9%	0%	0%	0%
	Mineral Production - Other Mineral Category	57%	14%	43%	14%	14%
	Mineral Production - Putrescible	32%	30%	2%	14%	2%
	Mineral Production - Rock, Sand, Clay etc.	23%	23%	2%	3%	0%
	Motor Vehicle Works	44%	17%	33%	6%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Newspaper print works	48%	45%	17%	0%	0%
	Oil refinery, gas processing etc	33%	33%	8%	4%	0%
	Paper Mill	69%	50%	50%	6%	8%
	Post Office Sorting Centre	71%	44%	55%	5%	4%
	Pottery	25%	17%	13%	4%	0%
	Provender Mill	56%	45%	18%	0%	0%
	Pumping Mines	0%	0%	0%	0%	0%
	Scrap Metal/Breakers Yard	30%	29%	5%	3%	1%
	Shipbuilding/ repair, boatyard	34%	32%	7%	4%	1%
	Tannery	33%	17%	33%	0%	0%
	Vehicle repair workshop / garage	43%	40%	13%	3%	1%
	Wafer Fabrication	71%	57%	43%	0%	0%
	Works	44%	41%	19%	0%	0%
	Workshop	39%	35%	12%	2%	1%
Health	Hospital	50%	50%	50%	0%	0%
	Hospitals and Clinics (NHS)	56%	46%	41%	6%	6%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Hospitals and Clinics (Private)	70%	60%	52%	2%	1%
	Surgery / Clinic / Health Centre	71%	64%	51%	3%	3%
Hospitality	Cafe	58%	52%	32%	2%	1%
	Camping site	27%	27%	4%	1%	0%
	Caravan park	48%	46%	7%	1%	0%
	Chalet Park	44%	40%	9%	3%	0%
	Club, institution [not sports club, probably]	69%	58%	51%	3%	2%
	Coaching Inns	92%	83%	56%	1%	2%
	Conference centre	37%	33%	14%	1%	1%
	Country House Hotel	77%	74%	31%	1%	1%
	Food Court	22%	21%	9%	1%	0%
	Guesthouse, boarding house	79%	73%	53%	1%	1%
	Health Farm	48%	43%	10%	10%	0%
	Holiday accommodation (not: hotel, guesthouse, caravan)	53%	45%	24%	1%	1%
	Holiday Home (Self Catering)	58%	56%	24%	1%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Hostel	53%	47%	27%	2%	1%
	Hotel (3 star and under)	83%	75%	60%	1%	0%
	Hotel (4 star and above, or major chain)	74%	64%	48%	1%	1%
	Lodge / Motel	46%	40%	18%	4%	2%
	Nightclub, discotheque	49%	42%	20%	4%	2%
	Public House/Pub Restaurant	84%	76%	57%	1%	1%
	Restaurant	68%	59%	48%	2%	1%
	Restaurant - Drive-in/thru	59%	49%	28%	1%	1%
	Takeaway Food Outlet (Predominantly Off Premises)	82%	73%	65%	1%	1%
	Timeshare Complex	44%	43%	19%	9%	3%
	Wine bar	64%	56%	37%	3%	3%
Miscellaneous	Airport Let Out NEC	1%	0%	1%	0%	0%
	Commercial NEC	24%	22%	10%	2%	1%
	Miscellaneous NEC	9%	8%	4%	0%	0%
	Showhouse	74%	69%	57%	1%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
MoD	Army Hereditament	27%	19%	17%	1%	1%
	Auxiliary Defence Establishment	51%	36%	31%	1%	1%
	Forces Careers Office	76%	72%	32%	4%	0%
	MoD NEC	32%	23%	14%	1%	1%
	Navy Hereditament	32%	27%	23%	2%	2%
	RAF Hereditament	27%	19%	17%	0%	0%
Office	Business Unit NEC	24%	22%	7%	1%	0%
	Computer centre	20%	16%	9%	1%	0%
	Contractor Hut(s) and Compounds	5%	5%	2%	1%	1%
	Film/ TV/ recording studio	35%	30%	18%	1%	1%
	Office	25%	22%	11%	4%	2%
	Office (HQ / Institutional)	37%	31%	20%	3%	3%
	Office (Inc Computer Centres) NEC	12%	10%	6%	2%	1%
	Office (Local Authority)	42%	35%	25%	4%	3%
	Sales office	24%	22%	14%	3%	2%
	Studio	27%	25%	10%	4%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
Shop	Amusement arcade	63%	59%	16%	3%	1%
	Auction Room(s)	39%	34%	16%	2%	1%
	Bank	0%	0%	0%	0%	0%
	Bank/ insurance/ building society branch	73%	66%	37%	2%	1%
	Betting Shop	69%	66%	17%	2%	1%
	Car Auction Building/Site	54%	51%	18%	1%	0%
	Car/Caravan Sales/Display/Hiring Site	31%	29%	6%	5%	2%
	Car Showroom / Sales Site	59%	50%	30%	3%	2%
	Car Supermarket	44%	36%	22%	0%	0%
	Department store	50%	0%	50%	0%	0%
	Factory shop	30%	29%	1%	1%	0%
	Farm shop	35%	33%	8%	2%	1%
	Food Store (shop)	60%	56%	18%	1%	1%
	Garden centre	55%	51%	18%	2%	1%
	Hairdressing/Beauty Salon	69%	65%	32%	2%	1%
	Hospital Let Out	2%	1%	1%	1%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Hypermarket/ superstore (over 2500 m2)	69%	57%	39%	3%	2%
	Information/Visitor Centre	34%	32%	10%	3%	1%
	Kiosk	11%	11%	2%	2%	1%
	Large Food Store (750 - 2500m2)	64%	56%	26%	2%	1%
	Large Shop (750 - 1850m2)	52%	47%	16%	3%	1%
	Large shop (over 1850 m2)	61%	54%	29%	2%	1%
	Launderette	84%	77%	67%	1%	1%
	Market (not livestock)	13%	11%	4%	2%	1%
	Motorway Service Area Let Out NEC	15%	11%	3%	3%	0%
	Pet Grooming Parlour	34%	32%	19%	1%	0%
	Pharmacy	53%	50%	19%	4%	3%
	Post Office (shop)	72%	65%	37%	2%	1%
	Retail warehouse	55%	47%	20%	3%	1%
	Shop NEC	73%	68%	30%	2%	1%
	Showroom	48%	42%	21%	3%	1%
	Station Let Out NEC	20%	18%	5%	2%	1%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
Sport	Bowling Centre (Indoor)	77%	62%	53%	4%	3%
	Bowling Green (Outdoor)	33%	28%	14%	2%	1%
	Cricket Centre	64%	36%	45%	0%	0%
	Cricket Ground	33%	28%	16%	2%	1%
	Football Ground	37%	30%	20%	3%	2%
	Football Stadium	81%	72%	54%	4%	4%
	Golf Course	73%	65%	37%	1%	1%
	Golf Driving Range	43%	41%	10%	6%	3%
	Gymnasium, fitness centre	37%	32%	16%	4%	2%
	Ice Rink	55%	48%	38%	3%	3%
	Leisure Centre	0%	0%	0%	0%	0%
	Leisure Centre within/part of Specialist Property	48%	38%	29%	2%	5%
	Leisure centre (without swimming)	45%	37%	24%	3%	2%
	Leisure centre (with swimming)	61%	49%	40%	2%	1%
	Motor Racetrack	18%	18%	3%	1%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Pavilion / Changing Room	16%	14%	3%	2%	1%
	Pitch and Putt/Putting Green	15%	14%	2%	2%	0%
	Point to point and eventing course	17%	17%	0%	0%	0%
	Polo Ground	18%	18%	6%	0%	0%
	Racecourse/ track (horses, dogs)	67%	56%	36%	1%	1%
	Rifle/ shooting range	20%	19%	5%	3%	1%
	Rugby Ground	55%	44%	32%	3%	3%
	Ski Centre	39%	33%	27%	3%	3%
	Speedway Racetrack	35%	35%	6%	0%	0%
	Sporting Right (premises used for sport) NEC	19%	19%	1%	1%	0%
	Sports Ground	26%	21%	14%	3%	2%
	Sports Stadium	48%	45%	29%	4%	2%
	Squash court(s)	52%	40%	38%	2%	2%
	Swimming pool	54%	44%	36%	3%	2%
	Tennis centre	70%	60%	48%	4%	3%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Tennis Court(s)/Club	34%	31%	13%	2%	1%
	Water Sport Facilities	31%	30%	5%	0%	0%
Transport	AA/RAC Service Centre / Box	0%	0%	0%	0%	0%
	Airport (minor)	32%	26%	15%	4%	0%
	Air Strip	19%	19%	3%	1%	0%
	Bus garage, bus depot	48%	39%	30%	3%	1%
	Bus station	20%	16%	7%	2%	2%
	Car wash	20%	19%	3%	4%	1%
	Civil Airport	28%	16%	16%	4%	4%
	Dock / Harbour / Wharf	19%	15%	8%	1%	0%
	Heliport	24%	24%	7%	3%	3%
	Lorry Park	26%	23%	7%	3%	1%
	Motorway and Major Road Service Area	36%	36%	9%	1%	0%
	Multi-storey car parks	11%	11%	2%	1%	1%
	Petrol filling station	52%	50%	6%	3%	1%
	Railway / Tramway (Non-Leisure)	11%	11%	4%	0%	0%

Non-Domestic Building Stock in England and Wales – Part 2: Energy consumption

CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Toll (Ferries, Roads And Bridges)	10%	10%	0%	0%	0%
	Truck Stop	40%	40%	10%	0%	0%
	Vehicle Testing Centre	44%	34%	18%	1%	2%
	Weighbridge	18%	14%	4%	2%	0%
Utilities	District Heating Networks	25%	14%	14%	0%	4%
	Domestic Fuel Installations	10%	10%	0%	0%	0%
	Power Generator	27%	19%	11%	1%	2%
	Refuse handling/disposal	26%	24%	4%	3%	1%
	Renewable Power Generator - Hydro	8%	8%	0%	2%	0%
	Renewable Power Generator - Other	10%	10%	0%	2%	0%
	Renewable Power Generator - Photovoltaic	8%	7%	3%	3%	2%
	Renewable Power Generator - Wind	6%	6%	0%	1%	0%
	Sewage works	8%	7%	1%	0%	0%
	Utilities, electricity	7%	7%	0%	0%	0%
	Utilities, gas	17%	15%	1%	8%	0%

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CaRB3 class	CaRB3 activity	Premises with elec or gas	Premises with elec	Premises with gas	Premises sharing elec	Premises sharing gas
	Utilities, nuclear	25%	8%	17%	0%	17%
	Utilities, telecoms	58%	58%	33%	0%	0%
	Utilities , water	16%	16%	2%	3%	0%
Warehouse	Bulk Cement Storage Depot	8%	8%	0%	0%	0%
	Bullion/Money Store	56%	48%	27%	5%	2%
	Cold store	41%	36%	15%	4%	1%
	Granary / Intervention Store	21%	21%	3%	0%	0%
	Large Distribution Warehouse	48%	38%	27%	2%	2%
	Liquid Bulk Storage (Incl Petrol & Oil)	25%	23%	6%	1%	0%
	Mineral Depot	28%	23%	11%	6%	8%
	Road Haulage Depot	50%	50%	0%	0%	0%
	Storage Depot	36%	31%	13%	2%	1%
	Store	20%	19%	5%	5%	1%
	Warehouse	47%	41%	19%	2%	1%
	Wholesale Warehouse	62%	49%	35%	3%	2%
All classes	**All activities**	**49%**	**44%**	**22%**	**2%**	**1%**

Annex 2 – Analysis by VOA floor area field

This annex presents an analysis of the stock by Valuation Office Agency (VOA) floor area for the purposes of comparison with previous work. Here it must be stressed that the contents of the VOA floor area field needs to be understood clearly, in terms of the analyses that are possible using the data in this 'floor area' field. As this is a crucial element of understanding, the following paragraphs are repeated from the section "Understanding 'floor areas'" in Part 1 of the report.

"Within the VOA data there are many instances of premises with activities that are not given a taxable value based on floor area. The principal CaRB3 classes in which this situation occurs are: Hospitality (mostly pubs, hotels and self-catering accommodation); Education (mostly state schools); Health (mostly NHS hospitals); Utilities; MoD. However, there are also many instances where premises that would normally be given a taxable value based on floor area are valued in some other way and these premises may be identified by a lack of floor area record. In summary, there are 269 different CaRB3 activities, spread through 16 CaRB3 classes, accounting for more than 177,000 premises where there is no record for a 'floor area'. However, there are also instances where the VOA uses the 'floor area' field to record metrics that are not necessarily directly related to floor area, such as the existence of a 'golf course' or the number of bedrooms in a guesthouse.

The 'missing' floor area records, and the 'non-area' records in the field allocated to floor area, are not necessarily anomalies so far as the VOA is concerned. However, the mixing of the record types causes problems when attempting to discover the actual floorspace in each CaRB3 activity and class population. The knock-on effect of this is felt in the calculation of energy use intensities, which rely on accurate and appropriate measurements of floor area in each premises. Thus, when based solely on VOA data, the sum of 'floor areas' in the Hospitality, Education, Health, Utilities and MoD CaRB3 classes are certainly an under-estimation. Similarly, this lack of floor area data reduces the sample size of calculated annual energy use intensities (EUI, kWh/m²) for these classes, in particular.

From the above, it is clear that the EUIs for these classes, when solely based on VOA 'floor area' data should be treated with a degree of caution. On the other hand, when the data are analysed according to the CaRB3 activity of premises (i.e. not aggregated to the class), the analyses are more robust, because the majority of premises, per CaRB3 activity, will be valued by the VOA using the same method. For example, no 'Hotel (4 star and above, or major chain)' premises have a floor area record, whilst almost all 'Cafes' have a floor area record, but both fall within the Hospitality CaRB3 class. This demonstrates problems that can arise when trying to simplify the data through aggregations."

The above means that only a very partial analysis of annual energy use intensities (EUI in kWh/m²) can be completed using only VOA data and **these results should not be considered a complete picture of energy use intensity in the non-domestic stock**.

The results for total (electricity and gas) energy use are shown in Figure 8. These results indicate that Utilities had the highest median EUI (403 kWh/m²), although it should be noted

that this is based upon fewer than 20 premises[7]. The list of the top six median EUIs is as follows:

- Utilities (403 kWh/m²)

- Hospitality (311 kWh/m²)

- Emergency (207 kWh/m²)

- Health (204 kWh/m²)
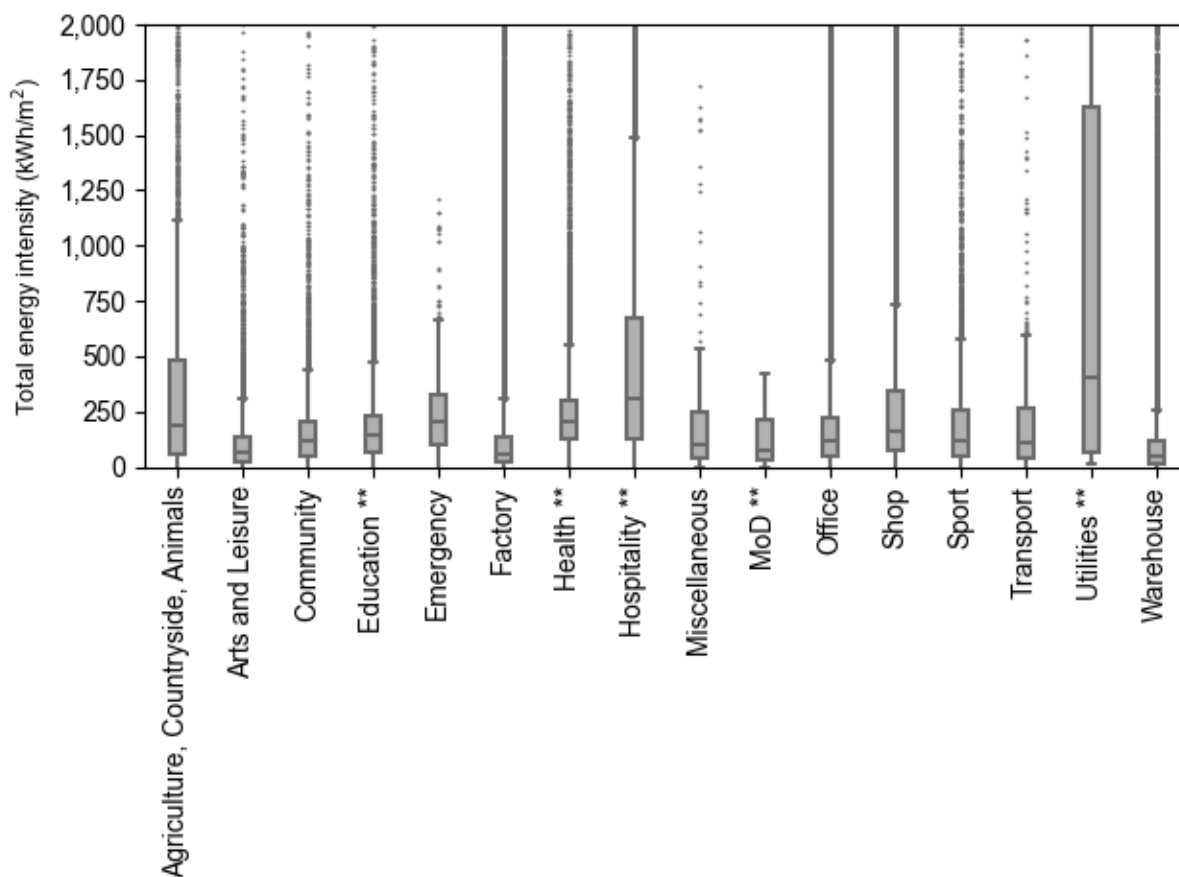
- Agriculture (191 kWh/m²)

- Shop (163 kWh/m²)

Whilst Factory, Warehouse and Office do not make it onto this list they have median EUIs of 56 kWh/m², 50 kWh/m² and 121 kWh/m² respectively.

The charts that follow are box and whisker plots[8].

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[7] Only 31 Utilities premises have floorspace > 5m² and of these only 15 have meter data matches (Table 1 shows the poor match rates). Further exploration is proposed for Phase 2 of this project to determine whether the values recorded as floorspace represent floorspace or some other metric.

[8] Note: In box and whisker plots, the 'box' columns, indicate the range of floor areas covered by the interquartile range of results (the middle 50 per cent of data points). The upper black bars extend to the 90th percentile, capturing a further 15 per cent of the total number of data points. The lower black bars span to the 10th percentile, also capturing 15 per cent of the total number of data points. Therefore, within each sector, 80 per cent of the total number of data points are displayed with outliers beyond this shown as individual dots. Classifications with a ** after them are cases where premises with VOA floorspace may not always be present or reliable.

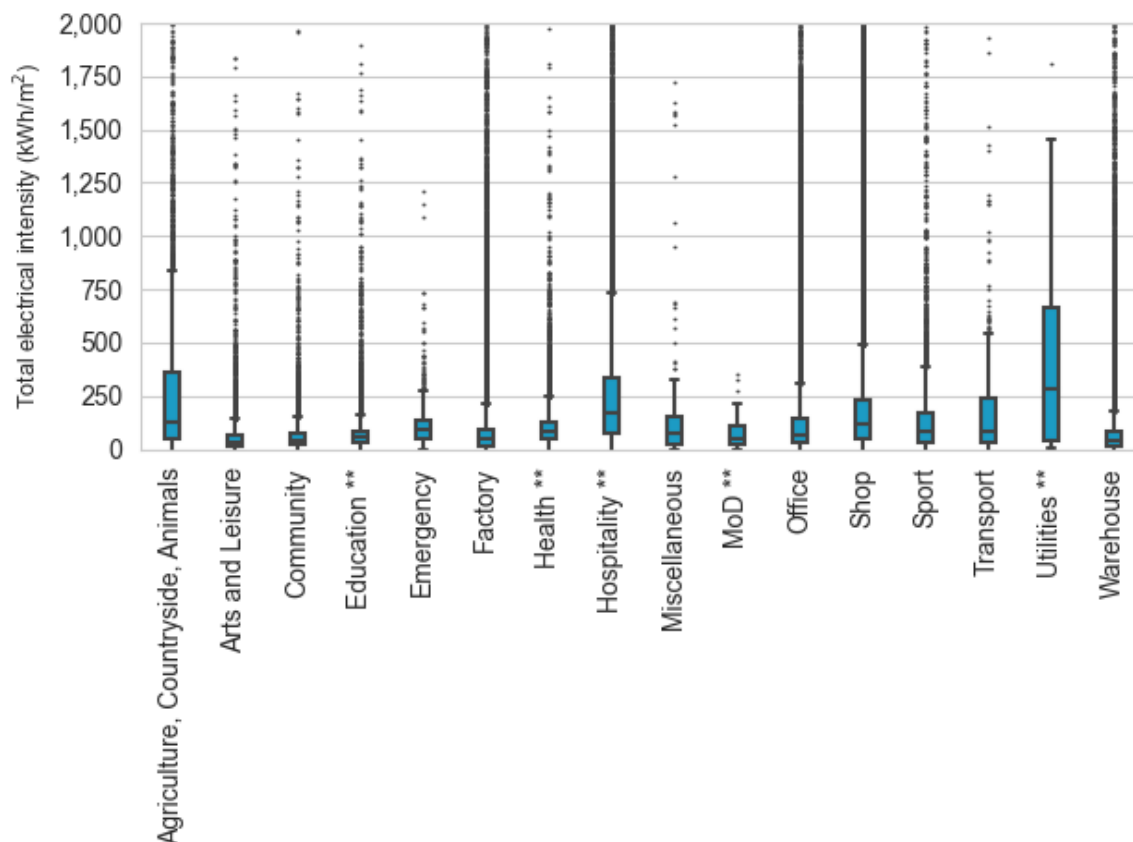**Figure 8 Distribution of total energy intensity (per year) by CaRB3 class, 2019**

Distribution of electrical energy intensity by activity class, (premises that have non-electrical end uses)

The electrical energy use intensity (EUI) is shown in Figure 9 for premises which also use non-electrical energy. This is determined by establishing whether they also have a connection to a gas meter, or if there is another fuel listed in the VOA data for the premises (other than electricity). The top six median EUI values are:

- Utilities (284 kWh/m²)
- Hospitality (171 kWh/m²)
- Agriculture, Countryside, Animals (128 kWh/m²)
- Shop (117 kWh/m²)
- Emergency (88 kWh/m²)
- Transport (87 kWh/m²)

Whilst Factory, Warehouse and Office do not make it onto this list they have median EUIs of 44 kWh/m², 39 kWh/m² and 67 kWh/m² respectively.

Figure 9 Distribution of electrical energy intensity (per year) by activity class, (premises that have non-electrical end uses), 2019

Distribution of electrical energy intensity by activity class, (all-electric premises only)

The data in Figure 10 are very similar to those shown in Figure 9, except the premises selected have no gas meter and no other fuel listed in the VOA data. This method is used to establish that they use electricity as their only fuel. The median electrical EUI is normally higher than the values calculated in Figure 9. For example, the electrical EUI for Hospitality with other fuels is 171 kWh/m² but for the cohort of premises that are all electric, this aggregate is 193 kWh/m² (11% higher). The electrical EUI of Offices with other fuels is 67 kWh/m², whilst in Figure 10 it is 92 kWh/m² (27% higher). This is expected, since the likelihood is that all-electric premises will have to use electricity for space heating. The median EUIs for the top six classes for EUI for the all-electric premises are:

- Utilities (599 kWh/m²)
- Hospitality (193 kWh/m²)
- Agriculture, Countryside, Animals (141 kWh/m²)
- Shop (121 kWh/m²)
- Health (115 kWh/m²)
- Emergency (105 kWh/m²)

For reference, whilst Factory, Warehouse and Office do not make it onto this list they have EUIs of 41 kWh/m², 37 kWh/m² and 92 kWh/m² respectively.

Figure 10 Distribution of electrical energy intensity (per year) by activity class, (all-electric premises only), 2019
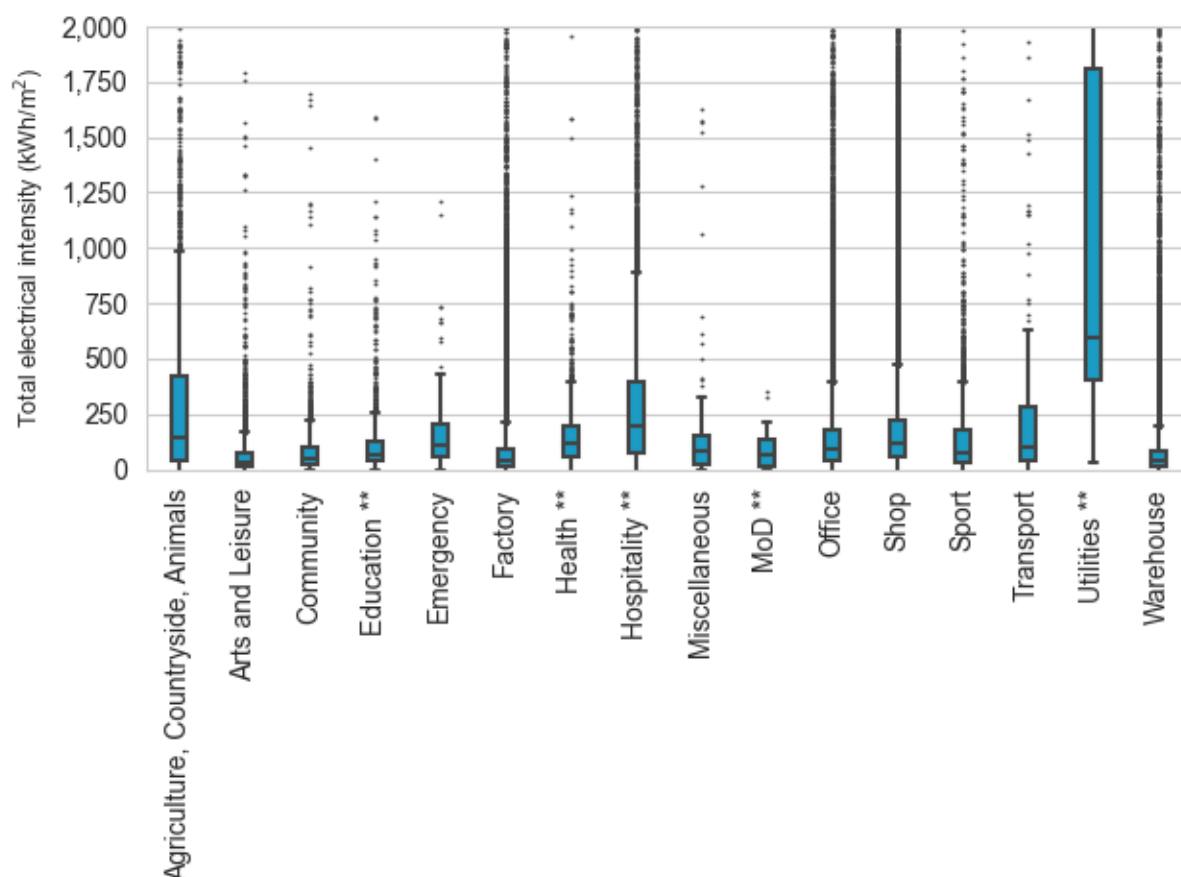
The full list of energy intensity for the CaRB3 classes is shown in Table 9 which also includes a column showing a comparison giving electric only as a percentage of total energy. This could be interpreted in a number of different ways. Electric only premises might be less energy intensive in terms of delivered energy, or it might indicate that other fuel sources are missing (including gas meters that have failed to match to the premises).

Table 9 Median annual energy intensity (EUI), by CaRB3 class, for total energy premises, electrical only premises and then electric only shown as a percentage of total energy

| CaRB3 class	Total energy EUI	Electric only EUI	Electric as % of total energy
Agriculture, Countryside, Animals	191	141	74
Arts and Leisure	68	32	47
Community	116	48	41
Education	141	65	46
Emergency	207	105	51
Factory	56	41	73
Health	204	115	56
Hospitality	311	193	62
Miscellaneous	104	86	83
MoD	73	62	85
Office	121	92	76
Shop	163	121	74
Sport	119	76	64
Transport	110	103	94
Utilities	403	599	149
Warehouse	50	37	74

Distribution of non-electrical energy intensity by activity class

Figure 11 shows the EUI of gas use across the CaRB3 activity classes. The median values tend to be larger than for the electrical energy EUIs already discussed. For example, the median gas EUI for Shop is 148 kWh/m² whilst in pure electric premises the electricity EUI is 121 kWh/m². The top six median gas EUI values are:

- Hospitality (231 kWh/m²)

- Agriculture, Countryside, Animals (199 kWh/m²)

- Emergency (189 kWh/m²)

- Health (158 kWh/m²)

- MoD (156 kWh/m²)

- Shop (148 kWh/m²)

Whilst Factory, Warehouse and Office do not make it onto this list they have median EUIs of 58 kWh/m², 44 kWh/m² and 117 kWh/m² respectively.

Figure 11 Distribution of non-electrical energy intensity (per year) by CaRB3 class, 2019
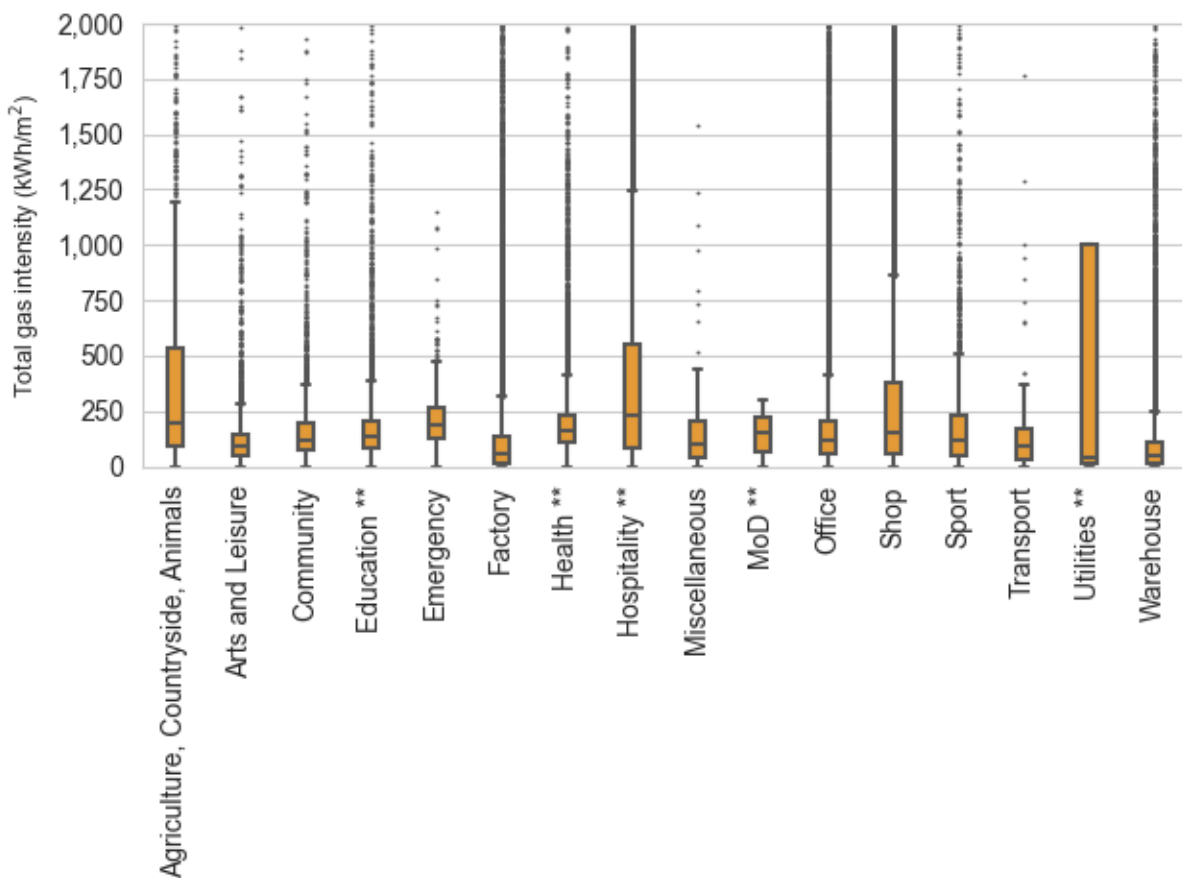
Energy consumption by premises floor area banding and energy type

Floor area was used to aggregate the data into bandings. The energy consumption is shown in Figure 12. As would be expected, energy consumption tends to be greater in premises with larger floor areas, with premises with a floor area greater than 1,000 m² being responsible for 26,586 GWh (23%) of all energy consumption. Premises with null floor area were also included and these account for the largest share with 35% (40,488 GWh) of all energy consumption. The bulk of these are premises in Hospitality, Education and Health, such as Public Houses, State schools, Surgery/Clinic/Health Centres, Petrol filling stations and Hotels (although there is a very large variety of premises in this group).

A smaller group of premises has recorded floor areas of zero. These account for only 1,214 GWh (1%) of all energy consumption, but they are dominated by Holiday Homes (Self Catering), Guesthouses, Hotels (3 star and under) and Hostels.

Figure 12 Energy consumption by premises floor area banding and energy type, 2018
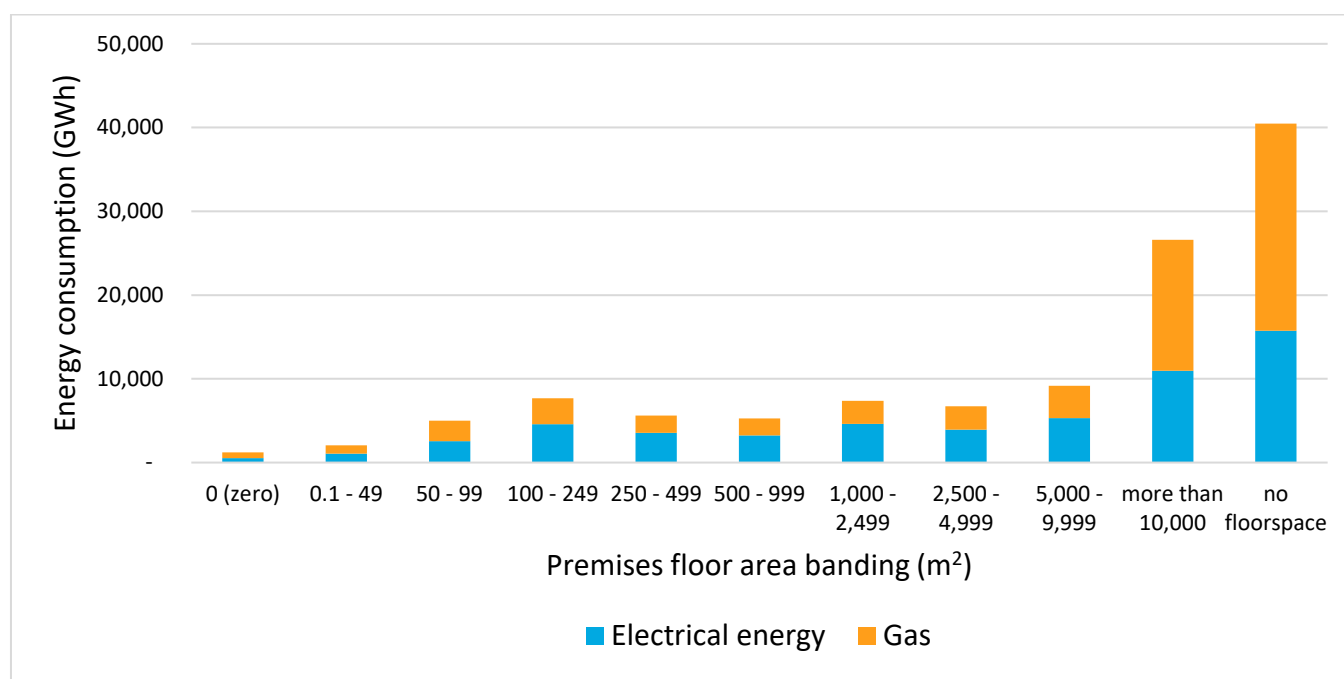
Total energy intensity by floor area banding

The floor area banding has been used to examine total energy use intensity (EUI) in Figure 13. The data here were handled slightly differently to Figure 8 because premises with no recorded floor area (either null or zero) had to be excluded from this query (in order to produce EUI values), in Phase 2 a detailed floor area model will be developed to allow EUI for these premises to be calculated. Using the median EUI values, the highest EUI (201 kWh/m²) is for the smallest premises (less than 50 m²). As the floorspace bandings increase from this point, the median EUI falls (164 kWh/m², 116 kWh/m², 87 kWh/m², 79 kWh/m²) until around the 500-999 m² banding. Following this, it rises again (81 kWh/m², 90 kWh/m², 121 kWh/m², 134 kWh/m²). This suggests that in terms of EUI, and on aggregate, premises in the 250 m² to 2,500 m² bandings are more efficient than those that are smaller or larger than these bandings.

Figure 13 Total energy intensity (per year) by floor area banding, 2019
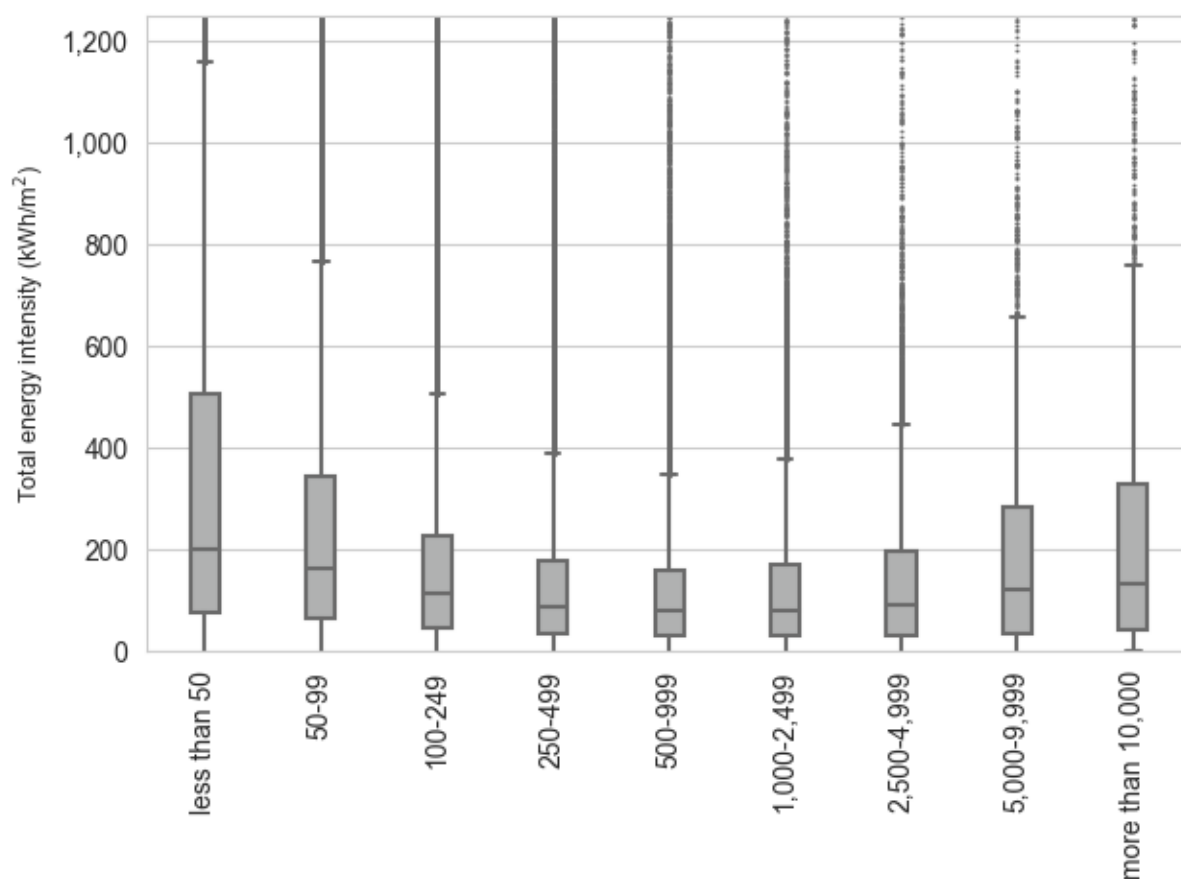
Percentage energy consumption by private and public sector by floor area banding

The percentage of energy consumption has been calculated for Table 10 by floor area bands and split into public sector, private sector and total (public and private combined) premises. It should be noted that many public sector premises are not valued by the VOA based upon floor area (such as schools and hospitals). The table shows that, for all the floor area bandings, the percentage of total energy assigned to public area premises is small (just 4% total) with the 'no floorspace' category containing the other 96% of total energy consumption for public sector premises. This will include much of the total energy in (public sector) state schools and health (NHS) previously seen in Table 6 (which will normally have no floor area recorded in the VOA).

The private sector column in Table 10 shows energy data are present for each of the floor area bands, and these percentages generally increase as the floor area band size increases. As with the public sector column, the largest percentage of total private energy consumption is the 'no floorspace' bracket (26%) which is actually joint largest with (also 26%) with the 'more than 10,000 m²' bracket. The principal information to be taken from this analysis is that there are many premises (i.e. 96%), identified as being operated in the public sector, for which there are no VOA floor area and age records, which makes the calculation of robust energy use intensities unlikely, when based solely on VOA data. Conversely, the private sector floor areas are represented much better, with only 26% of premises not having a floor area and age band in the VOA data. It should also be recalled, as discussed in the opening paragraphs of this annex, that it is known that many premises operated in the public sector cannot currently be identified as such, using the data made available for this method.

Table 10 Percentage of energy consumption by public and private sector, by floor area banding, 2019

Floor area (m²)	Percentage of energy consumption by sector		
	Public sector (%)	Private sector (%)	Total (%)
0 (zero)	0	1	**1**
0.1 - 49	0	2	**2**
50 - 99	0	5	**4**
100 - 249	0	7	**7**
250 - 499	0	5	**5**
500 - 999	1	5	**4**
1,000 - 2,499	1	7	**6**
2,500 - 4,999	1	6	**6**
5,000 - 9,999	1	9	**8**
more than 10,000	1	26	**23**
no floorspace*	96	26	**35**
Total	**100**	**100**	**100**

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