



Department for
Energy Security
& Net Zero

Non-Domestic Building Stock in England and Wales

Part 1: Stock Description

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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 2020, although some datasets may not align precisely.
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 meter Gross Internal Area (GIA) per year (kWh/m²), rounded to the nearest integer;
 - c. All figures for total floor areas across the activity 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;
 - 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;
 - e. Values that round to 0% are shown as less than the next highest value. For example, 0.2% would be shown as <0.5%;
5. Table conventions:
 - a. When there are no data, 'null values', or the numbers are so low that the data are at risk of being disclosive, values are replaced and 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.

Acronyms

Acronym / abbreviation	Full title / explanation
AUC	(VOA) Accommodation Use Code
CaRB	Carbon Reduction in Buildings
DEC	Display Energy Certificate
Dom	Domestic (residential)
DWP	Department for Work and Pensions
EPC	Energy Performance Certificate
GIA	Gross Internal Area
GPA	Government Property Agency
HMLR	His Majesty's Land Registry
HMRC	His Majesty's Revenue and Customs
IDBR	Inter-departmental Business Register
kWh	kilowatt hour
MoD	Ministry of Defence
MPAN	[Electricity] Meter Point Administration Number
MPRN	[Gas] Meter Point Reference Number
ND	Non-domestic
NDBS	Non-domestic Building Stock
NDR	Non-domestic Rating List
NULL	Indicates no data
NUTS	Nomenclature of territorial units for statistics
ONS	Office for National Statistics
OS	Ordnance Survey

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Acronym / abbreviation	Full title / explanation
OSAB	Ordnance Survey AddressBase
PD	(VOA) Primary Description
SCAT	(VOA) Special Category
SCU	Self-contained Unit
SIC	Standard Industrial Classification
SME	Small or medium-sized enterprise
UPRN	Unique Property Reference Number
VOA	Valuation Office Agency

Introduction

The Non-Domestic Building Stock project (NDBS) brings together existing, previously used and new data to develop a comprehensive and uniquely structured model in which every non-domestic building is represented in detail: its energy use and energy efficiency, its geometry and materials and the activities of the occupants.

NDBS integrates real data at a building-by-building level to create a complete characterisation of the non-domestic building stock in England and Wales. Bringing together the wealth of data, currently held separately by a range of government departments and agencies, has resulted in a range of unique insights into the non-domestic building stock for policy development. Access to data that have not previously been made available to research has also enhanced the ongoing development of innovative data manipulation and analysis techniques.

This report presents the findings of the pilot phase of the project. NDBS integrates property tax, Energy Performance Certificate, geo-spatial, business and utilities data with other specialist data sets. The model for the Hospitality class, and large (>1000 m²) premises not connected to the gas grid, has been validated and enhanced by remote and on-site surveys undertaken for a sample of premises, in addition to detailed zero-carbon audits (probe surveys) undertaken for a small number of large off-gas grid premises.

The report is structured as follows:

Part 1 – Stock Description

Part 1 combines a variety of datasets at the individual premises level to create a description of the non-domestic building stock of England and Wales, which is based on the entire population rather than a sampling approach. Part 1 sets out the overall methodology for the project and reports the results of statistical analysis of the stock. The datasets which underpin this report have been collected for a range of different purposes and have varying levels of completeness. The implications these constraints have for the findings, presented in each section, are described in the text.

Part 2 – Energy Consumption

Part 2 links electricity and gas consumption data with the model of the non-domestic building stock to explore the energy consumption characteristics of different classes of activity.

Part 3 – Hospitality Sector (CaRB3 activity class)

The Hospitality class was selected for a more detailed analysis in this pilot phase. Part 3 reports the results of geospatial analysis to construct the geometrical properties of individual premises, and links data from Energy Performance Certificates, to create a more detailed description of the stock, which is intended to test the methods to be applied to other activity classes in later phases of the project. The results of remote (telephone) surveys and verification surveys (on-site) are reported.

Part 4 – Large Off Gas Grid Buildings

Part 4 presents an analysis of large (>1000 m²) premises which are not connected to the gas grid (LOGG). The characteristics of LOGG premises are described, together with a comparison against their on-grid peers. The results of remote (telephone) surveys, verification surveys (on-site) and detailed zero-carbon audits (probe surveys) on a sample of premises are reported.

Objectives

The main objectives of this report are to draw together digital datasets in a database that can describe the non-domestic building stock (NDBS), with as much detail and accuracy as the datasets will allow, in order to provide an updated evidence base for BEIS' understanding of the space use, building fabric and energy use in non-domestic buildings. A key aim is to pull these datasets together and to match them geometrically so that all premises, and their relationship to the buildings that contain them, can be automatically represented geospatially. In other words, the location of the premises can be displayed on a digital map, and the relationship to any buildings on that map can be derived.

Each premises should be assigned a classification to allow characterisation and quantification of the activities and activity classes, which make up the non-domestic building stock. The classification should ensure that no activities are excluded and be capable of adapting to accommodate the potential for shifts in classification in the future (to include previously excluded, or new activities).

NDBS was designed to meet the following research objectives:

- Account for all non-domestic premises within buildings where possible (the population rather than a sample);
- Collect and aggregate new and existing data on the non-domestic building stock and in particular, data related to the fabric and HVAC systems;
- Update the understanding of how premises and buildings are used, in particular with reference to energy use;
- Explore the spatial relationships between premises, buildings,
- Where possible explore relationships between premises, estates and tenure.
- Whilst energy abatement is not part of this work, the overall objective is to assist BEIS in understanding the barriers to and facilitators of energy abatement.

This report sets out how these objectives have been tackled and presents the findings from this work.

Non-Domestic Building Stock in England and Wales

Extent of a non-domestic unit

Defining the extent of a non-domestic unit is not simple and care is required to avoid including elements that are not contained within buildings or non-domestic activity that does not require a building (like an 'Amazon delivery locker' or a 'Quarry' or a 'Beach Hut' or a market stall pitch). The Valuation Office Agency (VOA) is one of the most reliable sources of non-domestic activity for England and Wales. The VOA is a division of His Majesty's Revenue and Customs (HMRC), responsible for the assignment of a theoretical annual rental value to all non-domestic premises, upon which business rates are then based. The VOA actually deals with 'hereditaments'¹ and for this work, we substitute the more user-friendly word 'premises' for this (NB: the word premises is both singular and plural). Not all premises, such as places of worship², incur business rates and so these non-rateable premises do not appear in VOA data.

Whilst the records described in the VOA data (largely) represent space *within* buildings, they do also include space *external* to buildings (e.g. land used for storage) and units of valuation that are not area-dependent, such as a 'golf course', or the number of bedrooms in guest houses. The 'external' spaces are excluded from the non-domestic unit calculation within this work, which focuses on activity within buildings. Some 'premises' listed in the VOA are entirely external to buildings such as telecommunication masts and advertising hoardings (although some of these may be attached to a building). These are not included as non-domestic units.

It should also be noted that not all premises have records that include data describing physical characteristics of those premises. Whilst shops, offices, factories and warehouses will almost always have data on floor space, floor level(s) or storeys, etc. some important classifications such as pubs, hotels, hospitals, schools and universities, will not have these data on physical characteristics. This situation has an effect upon subsequent analyses of floorspace, storey counts etc. in this work.

A common misconception is that premises equate to buildings. This is not always the case and the relationship can be complex. This means that the extent of a non-domestic building might include just one premises, or it might include many premises, as is the case with an office block with multiple tenants, or it may be that a single premises occupies many buildings, as is the case with some schools, hospitals and other activities that take place across a site or campus. A premises can also extend through several adjoining buildings as might be found, for instance, when a retail unit expands from one building to occupy the ground floor of an adjacent building. Added to this, domestic premises may or may not be present within a

¹ The Valuation Office Agency uses the term 'hereditament' (a piece of heritable property) to describe a premises.

² Whilst these and other 'un-rated' premises are excluded from the analysis in this report, these premises can be included in this model using the methods outlined below. More detail is available in the section on Classification of activities.

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building that also contains non-domestic activity. This could be flats above a shop through to purpose-built blocks that contain a mixture of domestic and non-domestic units.

As a result, buildings are not ideally suited as units for modelling the stock. (Indeed, in many situations it is not easy to define where one building stops and another adjoining building starts.) Non-domestic premises as mentioned can correspond to parts of buildings, whole buildings or groups of buildings on common sites. The activity, floorspace and energy consumption normally relate to the premises, which may or may not be the same as the building. Instead of using 'building' the preferred method is to use the 'SCU' or Self-contained Unit. This concept was devised by Taylor et al. (2014 ³) and then adopted by Evans et al. (2017 ⁴).

A SCU can be generated by plotting the geospatial locations of VOA premises and then aggregating those that fall within a geometric polygon representing the building footprint. Where possible, the different premises are correctly allocated to the floor(s) that they are located on which builds up a three-dimensional stack of activity within each building polygon. When activities span multiple building footprints, such as when a premises is located across multiple (historic) addresses, such as '7 -9 The High Street' then the SCU boundary expands from a single building footprint to encompass the neighbouring building footprints as required. An example is shown in Figure 1. The final SCU boundary does not divide the premises but instead it wraps a polygon around the addresses, map polygon (building footprint) and premises and treats this as a single unit. The self-contained unit provides a well-defined unit for analysis.

³ Taylor, S., Fan, D., & Rylatt, M. (2014). Enabling urban-scale energy modelling: A new spatial approach. *Building Research & Information*, 42, 4–16. DOI: <https://doi.org/10.1080/09613218.2013.813169>

⁴ Evans, S., Liddiard, R., & Steadman, P. (2017). Modelling a whole building stock: Domestic, non-domestic and mixed use. *Building Research & Information*, 47, 156–172. DOI: <https://doi.org/10.1080/09613218.2017.1410424>

Figure 1 The assignment of a self-contained unit (SCU) around a ground floor shop that spans two buildings (e.g. 7 – 9 The High Street) with domestic flats above. The SCU is designed so that it does not divide any premises and treats the enclosed objects as a single unit.



It is too computationally intensive (in terms of computer processing and storage space) to produce a full SCU-based model of England and Wales within the constraints of this pilot study. Instead, a georeferenced model has been built based on the matching of premises to building footprints (and vice versa for multi-building premises), to provide a pilot model that is geospatial, but does not include the detailed 3D models of each SCU. The results that follow in this report are based upon this georeferenced model and show how the VOA data can be analysed both directly and through linkages to other datasets to describe the non-domestic building stock.

Classification of activities

For this model of the non-domestic building stock the CaRB3 (Carbon Reduction in Buildings, version 3) has been used. This system is a set of descriptions of the activities that occur within premises which can range from 'Abattoirs' through to 'Zoo / Safari Park / Sea Life Centre'. The classification is not for describing the physical characteristics of premises or the buildings associated with them, such as 'detached', 'terraced', 'tall', 'short', etc. However, there may be correlations of CaRB3 with the perception of the physical attributes often associated with activities, but these are generally coincidental and should not be relied upon. For example, there may be a perception of what a 'factory' looks like, but the activity of 'factory' can take place in many different building types.

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Like the precursors to CaRB3 (CaRB2⁵ and CaRB⁶), these CaRB3 activity classifications are heavily based upon the classification system employed by the Valuation Office Agency (VOA). As of 2017, there are 409 classifications in the VOA's special category (SCAT⁷) codes. Some of these SCATs are very precise, such as 'Bowling Alley' or 'Cement Tile Works', whilst others are very broad, such as code '096' for 'Factories, Workshops and Warehouses (Incl Bakeries and Dairies)'. The VOA also uses one of the 106 'Primary Description' (PD) codes to specify the activity in premises. An example code would be 'IF3' indicating 'Workshop', which would commonly be found in combination with SCAT '096' (see above), thus identifying the derived activity as being a workshop. However, we cannot tell what sort of workshop. In many instances, the code combinations can be quite specific such as SCAT '249' and PD 'CS5', indicating a 'Shop' that is a 'Laundrette'.

The CaRB3 activity classification system uses the combination of the VOA SCAT and PD, for each premises, to match to activities that are more aligned with known profiles of energy use. The general concept is to retain as much information in the classification as possible, but to also condense the classifications. Although largely based on VOA data inputs, CaRB3 can also be applied to activity codes in Ordnance Survey AddressBase (OSAB), to which most VOA premises have been matched. Where there is a non-domestic address with no matched VOA premises, CaRB3 can be applied to the OSAB classification. This also allows the model to pull in addresses that are not subject to non-domestic business rates, such as care homes and places of worship. Thus, the CaRB3 class system can be used for the whole building stock with nothing excluded, subject to the datasets used.

For this 2020 non-domestic model, the CaRB3 system condenses 1,180 combinations of VOA codes into 315 activities, grouped into 17 classes. Added to this are two further classes to deal with OSAB classifications (Commercial and Domestic). This gives the nineteen classes summarised in Table 1. Note the degree of complexity in the 'Factory' class (with 61 activities), due to the multitude of industrial processes covered. The detail within the 'Office' classification is shown in

⁵ Evans, S., et al. (2017). "Modelling a whole building stock: domestic, non-domestic and mixed use." *Building Research and Information* 47(2): 156-172. <https://doi.org/10.1080/09613218.2017.1410424>

⁶ Bruhns, H., et al. (2006). *A Preliminary Model of Non-Domestic Energy Use for England and Wales*. COBRA 2006: The construction and building research conference of the Royal Institution of Chartered Surveyors. University College London.

⁷ VOA (2017). "Non-domestic rating stock of properties 2022 metadata." from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1104283/NDR_Stock_of_Properties_including_Business_Floorspace_Metadata.zip. [accessed 14/12/2022]

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Table 2 with the 11 CaRB3 activities shown in detail. The full list of CaRB3 classes and CaRB3 activities is provided in Table 28.

The 'Excluded' class is predominantly non-buildings, such as land, phone masts and cash machines etc. and as such it is not included in most of the analysis that follows. 'Commercial' is an OSAB-derived classification that only applies where no more precise VOA classification can be applied to the non-domestic (commercial) address. The addition of the OSAB coding system increases the number of CaRB3 activities to 401, for the 2020 NDBS data.

Table 1 The CaRB3 classes and the number of activities in each classification

CaRB3 class	number of CaRB3 activities in the classification
Agriculture, Countryside, Animals	19
Arts and Leisure	31
Commercial	2
Community	16
Domestic	10
Education	20
Emergency	8
Excluded	33
Factory	61
Health	8
Hospitality	28
Miscellaneous	5
MoD	6
Office	11
Shop	34
Sport	41
Transport	33
Utilities	18
Warehouse	17

Table 2 The 11 CaRB3 activities for the Office CaRB3 class. Note that whilst almost all of these are derived from the VOA it is only possible to identify Office (Central Government) by linking also to Ordnance Survey AddressBase (OSAB) to refine this activity.

CaRB3 class	CaRB3 activity	Source for CaRB3 activity
Office	Business Unit NEC	VOA
Office	Computer centre	VOA
Office	Contractor Hut(s) and Compounds	VOA
Office	Film/ TV/ recording studio	VOA
Office	Office	VOA
Office	Office (Central Government)	OSAB
Office	Office (HQ / Institutional)	VOA
Office	Office (Inc Computer Centres) NEC	VOA
Office	Office (Local Authority)	VOA
Office	Sales office	VOA
Office	Studio	VOA

Understanding ‘floor areas’

Within the VOA data there are many instances of premises with activities that are not given a taxable value based on floor area. In terms of the counts of premises, the most significant CaRB3 classes in which this situation occurs are: Hospitality (mostly pubs, hotels and self-catering accommodation); Education (mostly state schools); Utilities; Office; Health (mostly NHS hospitals); ‘Arts and Leisure’ (Table 3). 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 counts and percentages of premises with and without VOA ‘floor area’ records are shown in

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Table 3. This demonstrates that some CaRB3 classes have high percentages of premises without floor area records, but that these can account for relatively small numbers of premises, such as the MoD and Emergency classes.

Table 3 Counts and percentages of premises, with and without a VOA 'floor area' record, per CaRB3 class.

CaRB3 class	with a 'floor area' record		without a 'floor area' record	
	count of premises	percentage	count of premises	percentage
Agriculture, Countryside, Animals	18,181	95	842	5
Arts and Leisure	34,060	73	9,186	27
Community	19,947	63	7,474	37
Education	43,905	36	27,975	64
Emergency	4,086	38	2,528	62
Factory	276,465	98	5,834	2
Health	27,786	60	11,034	40
Hospitality	195,593	70	59,145	30
Miscellaneous	6,297	34	4,157	66
MoD	958	12	844	88
Office	445,680	97	11,962	3
Shop	524,034	99	4,186	1
Sport	23,680	84	3,764	16
Transport	11,646	44	6,481	56
Utilities	19,161	0	19,130	100
Warehouse	225,049	99	2,584	1

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

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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.

Using the CaRB3 class it is possible to report the numbers of premises and the total floor area recorded in the VOA Rating List for these 16 CaRB3 classes in

Table 4. Note the dominant CaRB3 classes of Factory, Office, Shop and Warehouse, which together make up 78% of all VOA non-domestic premises and 92% of all non-domestic floorspace recorded by the VOA. A full table of CaRB3 class and CaRB3 activity is in Table 28 and Treemaps of these activities can be seen for premises counts in Figure 36 and for floor area in Figure 37.

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Table 4 Premises counts and total floor area for the 16 CaRB3 classes, shown as values and percentages of the non-domestic stock.

CaRB3 class	Premises counts	Floor area of all VOA premises	Percent of all premises counts	Percentage of floor area of all VOA premises
Agriculture, Countryside, Animals	18,181	3.1	1%	1%
Arts and Leisure	34,060	7.1	2%	1%
Community	19,947	4.9	1%	1%
Education	43,905	5.3	2%	1%
Emergency	4,086	1.7	<0.5%	<0.5%
Factory	276,465	167.14	15%	28%
Health	27,786	2.8	1%	<0.5%
Hospitality	195,593	14.9	10%	3%
Miscellaneous	6,297	0.4	<0.5%	<0.5%
MoD	958	0.1	<0.5%	<0.5%
Office	445,680	100.0	24%	17%
Shop	524,034	122.6	28%	21%
Sport	23,680	4.8	1%	1%
Transport	11,646	1.4	1%	<0.5%
Utilities	19,161	0.1	1%	<0.5%
Warehouse	225,049	157.3	12%	26%
SUM	1,876,528	593.6	100%	100%

Premises and Buildings

The relationship between premises and buildings is not always a simple one-to-one relationship. A non-domestic premises is an extent of contiguous or neighbouring floor space occupied by an institution, organisation or business, but they do not always exist in a single building. For the purpose of this report a building footprint is considered to represent a building. For a full model then the self-contained unit (SCU) would be used in the place of building footprint.

This sometimes complex relationship between premises and building footprints can be simplified into four main categories of premises-to-building relationships:

- One-to-One where the premises occupies exactly one (entire) building, as can be observed in many different situations.
- Many-to-One (non-domestic) where the premises can be a part of one building with other non-domestic premises, as, for example, an office suite in a multi-tenant office building.
- Many-to-One (non-domestic and domestic) where the premises is part of one building with other occupants, including some domestic (dwellings), as is the case with flats above a shop.
- One-to-Many where the premises is spread across several buildings on a shared site, as in a hospital, large factory or secondary school. In this last type of ‘campus’ situation, it is necessary to know the boundary of the site in order to collect all the buildings on that site into the premises in question.

Working out the relationship between premises and buildings is not a simple process. For the purpose of this analysis of 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. A fully national model including Mastermap for all buildings would allow a more refined estimate of these values. Nonetheless, the method is robust and provides a good initial estimate of the relationship of the different premises-to-building categories. Planned construction of the full three-dimensional geometric model (3DStock) will enable a more detailed investigation of floor areas in premises and their buildings, where these do not have floor areas in the VOA data, such as pubs, hotels, hospitals, schools etc. Part 3 of the work, on the Hospitality class, implements these additional methods, but the work has also highlighted where further developments may also be possible.

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Table 5 The relationship between premises and building polygons within the model. For this analysis polygons are assumed to equate with buildings.

Premises relation to building	Whole building	Part of building (Shared with non-domestic)	Part of building (Shared with domestic)	Multiple buildings	Not possible to resolve
Count of all VOA premises	22%	48%	23%	2%	4%
Floor area of all VOA premises	26%	51%	8%	11%	4%

As is shown in Table 5, across all of the non-domestic stock, the model currently indicates that 22% of all premises and 26% of the recorded floorspace can be assigned to a single building polygon. Nearly half of all premises and floorspace are assigned to part of a building that also contains other non-domestic premises (48% of premises and 51% of floorspace). Multiple premises in a single building within the same activity class are counted individually rather than as one building. For example, in the case of an office building, a single premises in a single building will count as just a single 'value', whereas a purpose-built office block with 20 offices will count as 20 premises (and the combined associated floor area). Twenty-three percent of premises and 8% of floorspace are flagged as sharing a building polygon with at least one domestic premises.

Details in Table 7 show that many of these 'share the building with domestic' fall into the Shops CaRB3 class (13% of all premises) with nearly 5% of all premises being in the Hospitality category. Table 8 shows that this category appears to represent less floorspace per premises which suggests that these may be smaller businesses. However, large businesses with many small premises – such as coffee shop chains – would likely also fall within this premises size category.

Where multiple buildings form a single premises, this creates a many-to-one relationship of buildings to premises, which can be described as being a 'campus' premises.

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Table 5 shows that these represent 2% of all premises and 11% of all VOA floorspace. Closer inspection of the floor area in Table 8 shows that this group is dominated by Factory and Warehouse premises which tend to have larger than average floor areas per premises.

The numbers in Table 5 relate to premises and the floorspace of those premises. Some readers may find these percentages higher than they might have expected. Whilst it is not possible to give detailed statistics on the numbers of buildings involved it is possible to make some calculations at the overall stock level. In **Error! Reference source not found.** Table 6 these show that 40% of all building polygons with non-domestic activity are occupied by a single premises whilst only 9% of these are occupied by multiple premises. 20% of these building polygons are a mixture of non-domestic and domestic, but if we count all the extra buildings that fall within a campus type arrangement this accounts for 31% of all non-domestic buildings.

Table 6 The number of building polygons (as a percentage of all non-domestic building polygons)

Premises relation to building	Whole building	Part of building (Shared with non-domestic)	Part of building (Shared with domestic)	Multiple buildings
Percentage of non-domestic building polygons on Ordnance Survey data	40%	9%	20%	31%

It is possible to explore the relationship between the activities (CaRB3 class) and the numbers of premises and the floorspace in the VOA records through Table 7, Table 8, Table 9 and Table 10 as a percentage of all of the non-domestic stock (Table 7 and Table 8) or as a percentage of each CaRB3 class (Table 9 and Table 10). Cases where it was not possible to establish the relationship between buildings and premises (for example because no UPRN was matched meaning there is no spatial location) are in the 'Not possible' category.

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Table 7 Premises per CaRB3 class as a percentage of all VOA non-domestic premises

CaRB3 class	Whole building	Part of building (ND)	Part of building (Dom)	Campus	Not possible
Agriculture, Countryside, Animals	0.10%	0.30%	0.30%	0.10%	<0.1%
Arts and Leisure	1.00%	0.50%	0.20%	0.10%	<0.1%
Community	0.50%	0.30%	0.10%	0.10%	<0.1%
Education	0.60%	0.80%	0.20%	0.70%	<0.1%
Emergency	0.10%	0.10%	<0.1%	<0.1%	<0.1%
Factory	3.90%	9.00%	1.00%	0.20%	0.60%
Health	0.60%	0.50%	0.30%	<0.1%	<0.1%
Hospitality	2.70%	2.60%	4.70%	0.20%	0.20%
Miscellaneous	0.10%	0.10%	0.10%	<0.1%	<0.1%
MoD	<0.1%	<0.1%	-	-	<0.1%
Office	2.00%	17.20%	2.70%	0.10%	1.70%
Shop	7.20%	7.30%	12.90%	0.10%	0.50%
Sport	0.40%	0.50%	0.10%	0.20%	<0.1%
Transport	0.20%	0.40%	<0.1%	<0.1%	<0.1%
Utilities	0.30%	0.20%	-	0.10%	0.40%
Warehouse	2.40%	8.00%	0.70%	0.10%	0.70%
All Classes	22%	48%	23%	2%	4%

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Table 8 Floorspace per CaRB3 class as a percentage of all VOA non-domestic floorspace

CaRB3 class	Whole building	Part of building (ND)	Part of building (Dom)	Campus	Not possible
Agriculture, Countryside, Animals	0.1%	0.2%	0.2%	0.1%	<0.1%
Arts and Leisure	0.6%	0.4%	0.1%	0.1%	<0.1%
Community	0.4%	0.3%	0.1%	<0.1%	<0.1%
Education	0.4%	0.3%	0.1%	0.1%	<0.1%
Emergency	0.1%	0.1%	<0.1%	<0.1%	<0.1%
Factory	7.9%	13.6%	0.7%	4.8%	1.1%
Health	0.2%	0.1%	0.1%	<0.1%	<0.1%
Hospitality	0.8%	0.8%	0.8%	<0.1%	0.1%
Miscellaneous	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
MoD	<0.1%	<0.1%	-	-	<0.1%
Office	2.8%	11.2%	1.1%	0.6%	1.3%
Shop	6.1%	9.5%	4.2%	0.6%	0.4%
Sport	0.2%	0.3%	0.1%	0.1%	<0.1%
Transport	0.1%	0.1%	<0.1%	<0.1%	<0.1%
Utilities	<0.1%	<0.1%	-	<0.1%	<0.1%
Warehouse	6.5%	13.9%	0.5%	4.1%	1.4%
All Classes	26%	51%	8%	11%	4%

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Table 9 Premises per CaRB3 class as a percentage of all premises within that CaRB3 class (each row adds up to 100%)

CaRB3 class	Whole building	Part of building (ND)	Part of building (Dom)	Campus	Not possible
Agriculture, Countryside, Animals	15%	34%	36%	11%	4%
Arts and Leisure	55%	30%	9%	5%	1%
Community	51%	28%	12%	7%	2%
Education	27%	34%	9%	29%	1%
Emergency	67%	25%	4%	3%	1%
Factory	26%	61%	7%	2%	4%
Health	43%	33%	21%	2%	2%
Hospitality	26%	25%	45%	2%	2%
Miscellaneous	38%	23%	16%	9%	14%
MoD	28%	29%	25%	14%	5%
Office	8%	72%	12%	<0.5%	7%
Shop	26%	26%	46%	<0.5%	2%
Sport	33%	40%	10%	15%	2%
Transport	29%	59%	5%	3%	4%
Utilities	27%	18%	3%	10%	42%
Warehouse	20%	67%	6%	1%	6%
All Classes	22%	48%	23%	2%	4%

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Table 10 Floorspace per CaRB3 class as a percentage of all floorspace within that CaRB3 class (each row adds up to 100%)

CaRB3 class	Whole building	Part of building (ND)	Part of building (Dom)	Campus	Not possible
Agriculture, Countryside, Animals	14%	36%	34%	14%	2%
Arts and Leisure	52%	34%	8%	5%	2%
Community	46%	36%	11%	5%	3%
Education	45%	34%	11%	7%	3%
Emergency	46%	38%	4%	11%	1%
Factory	28%	48%	3%	17%	4%
Health	51%	26%	21%	1%	2%
Hospitality	31%	32%	33%	1%	2%
Miscellaneous	21%	52%	7%	12%	7%
MoD	33%	50%	-	-	17%
Office	16%	66%	6%	4%	7%
Shop	29%	46%	20%	3%	2%
Sport	21%	43%	17%	17%	2%
Transport	29%	46%	4%	19%	2%
Utilities	25%	38%	-	25%	13%
Warehouse	24%	53%	2%	16%	5%
All Classes	26%	51%	8%	11%	4%

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It is possible to make aggregations of the relationship between premises and building polygons to investigate the geographical distribution of these categories around England and Wales. For this analysis the NUTS 1 regions were used.

Table 11 and Table 12 show that in all regions both the counts of premises and the floorspace suggest that the dominant category is premises that share a building polygon with other non-domestic premises.

Table 11 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by NUTS 1 regions.

Region	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
East Midlands (England)	2%	4%	1%	<0.5%	<0.5%	8%
East of England	2%	5%	2%	<0.5%	<0.5%	10%
London	2%	7%	5%	<0.5%	1%	15%
North East (England)	1%	2%	1%	<0.5%	<0.5%	4%
North West (England)	3%	6%	3%	<0.5%	1%	13%
South East (England)	3%	7%	3%	<0.5%	<0.5%	14%
South West (England)	3%	5%	3%	<0.5%	<0.5%	11%
Wales	2%	3%	1%	<0.5%	<0.5%	6%
West Midlands (England)	2%	5%	2%	<0.5%	1%	9%
Yorkshire and The Humber	2%	5%	2%	<0.5%	<0.5%	10%
unknown	-	<0.5%	<0.5%	-	<0.5%	<0.5%
All categories	22%	48%	23%	2%	4%	100%

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Table 12 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by NUTS 1 regions.

Region	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
East Midlands (England)	3%	5%	1%	2%	<0.5%	10%
East of England	3%	5%	1%	1%	<0.5%	10%
London	2%	7%	2%	<0.5%	1%	12%
North East (England)	1%	2%	<0.5%	1%	<0.5%	5%
North West (England)	4%	7%	1%	2%	1%	14%
South East (England)	3%	7%	1%	1%	<0.5%	13%
South West (England)	2%	4%	1%	1%	<0.5%	9%
Wales	2%	3%	<0.5%	1%	<0.5%	5%
West Midlands (England)	3%	6%	1%	1%	1%	12%
Yorkshire and The Humber	3%	6%	1%	1%	<0.5%	11%
unknown	-	-	-	-	<0.5%	<0.5%
All categories	26%	51%	8%	11%	4%	100%

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Building Age

Within the non-domestic data supplied by the VOA there is a field for building age (age_code) which provides a category for ages before 1971 and then provides an exact year for 1971 onwards. Using this it was possible to make the aggregations set out in Table 13 and Table 14 **Error! Reference source not found.** The term 'Null' is used to indicate that no data were recorded for premises. Whilst the age bands are not identical in size, they do show some patterns for the relationship between premises and buildings. Very few multiple building (campus) relationships to premises exist in the older part of the stock (there are some but they all register below 0.5% of the total number of premises in Table 13 and so appear as <0.5% whilst as a percentage of total floorspace they are apparent in Table 14). Whilst these numbers are small, the floorspace does increase slightly as age decreases suggesting that campus like arrangements became more common in the post 1964 premises. Cases where premises share a building with domestic appears to be dominated by the pre-1900 age bracket with 8% of all premises but only 3% of all floorspace in this category. Table 7 and Table 8 have already shown that as a proportion of the whole of the non-domestic stock, Shops and Hospitality are the activity classifications which have most premises and floorspace in these situations. Given that many shops are in older buildings situated on traditional 'High Street' locations, with flats above the shop, this may explain this statistic.

Cases where non-domestic premises share the building polygon with other non-domestic premises appear to increase from 1900 onwards. This suggests that the newer buildings that contain non-domestic premises may have been to be designed to accommodate multiple non-domestic premises. However, there are also plenty of cases where non-domestic premises share the building polygon with other non-domestic premises in pre-1900 buildings. Whether this is by design or due to more recent conversions of the building is not known.

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Table 13 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by VOA building age.

Age code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Pre 1900	5%	9%	8%	<0.5%	1%	23%
1900 – 1918	1%	2%	2%	<0.5%	<0.5%	6%
1919 – 1939	1%	3%	2%	<0.5%	<0.5%	7%
1940 – 1954	1%	2%	1%	<0.5%	<0.5%	4%
1955 – 1964	1%	3%	1%	<0.5%	<0.5%	6%
1965 – 1970	1%	3%	1%	<0.5%	<0.5%	6%
1971 – 1980	2%	3%	1%	<0.5%	<0.5%	6%
1981 – 1990	2%	6%	1%	<0.5%	<0.5%	9%
1991 – 2000	1%	4%	<0.5%	<0.5%	<0.5%	6%
2001 – 2010	1%	5%	1%	<0.5%	<0.5%	7%
2011 – 2020	1%	3%	1%	<0.5%	<0.5%	4%
Null	4%	4%	4%	1%	1%	15%
All categories	22%	48%	23%	2%	4%	100%

Table 14 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by VOA building age.

Age code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Pre 1900	3%	5%	3%	<0.5%	<0.5%	11%
1900 – 1918	1%	2%	1%	<0.5%	<0.5%	4%
1919 – 1939	1%	2%	1%	<0.5%	<0.5%	5%
1940 – 1954	1%	2%	<0.5%	<0.5%	<0.5%	4%
1955 – 1964	2%	4%	1%	1%	<0.5%	7%
1965 – 1970	2%	4%	<0.5%	1%	<0.5%	8%
1971 – 1980	3%	6%	<0.5%	1%	1%	11%
1981 – 1990	4%	8%	<0.5%	1%	1%	14%
1991 – 2000	3%	7%	<0.5%	2%	<0.5%	13%
2001 – 2010	3%	8%	<0.5%	2%	1%	14%
2011 – 2020	2%	4%	<0.5%	1%	<0.5%	7%
Null	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%	1%
All categories	26%	51%	8%	11%	4%	100%

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It is clear from this analysis that a large proportion of non-domestic premises occupy older buildings - nearly 30% of floorspace and 15% of premises pre-date 1918. Indeed, 67% of premises, accounting for 64% of total floorspace, were constructed prior to the decade 1991-2000 when energy performance became a significant factor in building regulations for non-domestic buildings.

Building Height

The non-domestic data supplied by the VOA includes a field called 'storey height' which provides the number of storeys of the premises. This field has been used to aggregate premises into three categories. This field is 'null' for around 20% of premises and these largely coincide with premises which have no SMV data and as such may introduce bias into the statistics shown. Table 15 and Table 16 indicate that the largest percentages of premises and floorspace are in the 2-6 storey bracket. Almost all the floorspace and premises that are listed as 7 storeys and above occur in buildings shared with other non-domestic premises. The largest single category for this analysis is for premises listed as being in a 2-6 storey category that shares with other non-domestic premises. Premises that share their building polygon with domestic premises also occur mostly in the 2-6 storey category. The multiple building (campus) category is almost non-existent for the 7 storeys and higher category, with only 13 premises occurring in this grouping. However, this is very likely an under-estimation of the number of 'campus' premises that contain buildings of more than seven storeys. Principal amongst such premises would be education and healthcare, where taller buildings occur quite frequently, such as in universities and hospitals, but no storey (or floorspace) data are recorded for these by the VOA.

Table 15 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by VOA storey count groupings.

building height	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
1 - 2 storeys	7%	15%	3%	<0.5%	1%	26%
2 - 6 storeys	10%	24%	14%	<0.5%	2%	51%
7 storeys and up	<0.5%	2%	<0.5%	<0.5%	<0.5%	3%
unknown	5%	7%	6%	1%	1%	21%
All categories	22%	48%	23%	2%	4%	100%

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Table 16 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by VOA storey count groupings.

building height	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
1 - 2 storeys	8%	16%	1%	3%	1%	30%
2 - 6 storeys	16%	28%	5%	6%	2%	58%
7 storeys and up	<0.5%	3%	<0.5%	<0.5%	<0.5%	4%
unknown	2%	4%	1%	1%	<0.5%	8%
All categories	26%	51%	8%	11%	4%	100%

Are Premises Off the Gas Grid?

Table 17 and Table 18 show the percentages of premises and total floorspace that can be attributed to the different relationships to building polygons within the model. 82% of the non-domestic stock is in a postcode that has gas grid connections and only 18% is not. Within those that are in an off-gas postcode it is those premises which form part of a non-domestic building that represent the largest share of both premises and floorspace.

Table 17 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by whether the premises is within a postcode classified as ‘off the gas grid’.

Premises is in an off-gas postcode	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Yes	4%	11%	3%	1%	-	18%
No	19%	37%	21%	1%	4%	82%
All categories	22%	48%	23%	2%	4%	100%

Table 18 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by whether the premises is within a postcode classified as ‘off the gas grid’.

Premises is in an off-gas postcode	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Yes	4%	11%	1%	2%	-	18%
No	23%	40%	7%	8%	4%	82%
All categories	26%	51%	8%	11%	4%	100%

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Presence of Air Conditioning

Table 19 and Table 20 show the percentages of premises and total floorspace that can be assigned to an air conditioning code according to the VOA field. These statistics suggest that more than two thirds of the non-domestic stock has no air conditioning (71% of premises and 67% of floorspace) whilst around 13% of premises making up 30% of floorspace have either full or partial air conditioning in place. The premises-to-building relationship that makes up the largest percentage of this are multi occupancy non-domestic buildings followed by single occupant 'Whole buildings'. 'Null' indicates that no air conditioning data were recorded for premises.

Table 19 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by VOA code for the presence of air conditioning.

Air Conditioning code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Full	1%	6%	1%	<0.5%	1%	8%
None	16%	35%	17%	1%	3%	71%
Partial	1%	2%	1%	<0.5%	<0.5%	5%
Null	5%	5%	4%	1%	1%	16%
All categories	22%	48%	23%	2%	4%	100%

Table 20 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by VOA code for the presence of air conditioning.

Air Conditioning code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Full	2%	10%	1%	1%	1%	14%
None	19%	33%	6%	6%	3%	67%
Partial	4%	8%	1%	3%	1%	16%
Null	1%	1%	<0.5%	<0.5%	<0.5%	3%
All categories	26%	51%	8%	11%	4%	100%

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Heating Systems

The VOA records a field for the central heating code in the Rating List. The values in this are either 'F', 'N' or 'P' which are assumed to represent 'Full', 'None' and 'Partial'. Table 21 and Table 22 show that the largest percentage of cases have full central heating. Around a quarter to a third have no central heating. 'Null' indicates that no heating data were recorded for premises.

Table 21 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by VOA code for central heating.

Central Heating Code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
F	8%	24%	8%	<0.5%	2%	42%
N	8%	17%	10%	<0.5%	1%	36%
P	2%	3%	1%	<0.5%	<0.5%	5%
null	4%	5%	5%	1%	1%	16%
All categories	22%	48%	23%	2%	4%	100%

Table 22 The percentage of all VOA floorspace classified into their relationship to building polygons, aggregated by VOA code for central heating.

Central Heating Code	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
F	14%	29%	4%	5%	2%	54%
N	6%	12%	3%	1%	1%	24%
P	6%	9%	1%	4%	1%	20%
null	1%	1%	<0.5%	<0.5%	<0.5%	2%
All categories	26%	51%	8%	11%	4%	100%

Table 23 and Table 24 show the VOA fuel used code, indicating the main fuel(s) used for the premises. This is assumed to be for heating, although that may not be the case for all premises. The source data behind these codes are either one or two letters and the letters can be in different orders. For example, some premises are labelled 'GE' which stands for Gas and Electricity whilst others are labelled 'EG' which is Electricity and Gas. There are many different combinations. For the sake of simplicity, the first letter has been used for these tables. These tables show that this field is rarely recorded by the VOA with fewer than 35% of all premises, representing 50% of all floorspace, having a value recorded in this field. For those cases where a value is recorded, gas is the dominant fuel used with 20% of all premises and 34% of all floorspace. Electricity is the next most common fuel used with 9% of all premises and 9% of all

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

floorspace. However, this field is null (no data) for 65% of all premises and 50% of all floorspace which means that this data field may not be suitable for further analysis. Null represents cases where no fuel used code was recorded by the VOA.

Table 23 The percentage of all VOA premises classified into their relationship to building polygons, aggregated by VOA main fuel code (first letter).

Fuel Used Description (first letter)	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Coal / Coke	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Electricity	2%	5%	2%	<0.5%	<0.5%	9%
Gas	4%	12%	3%	<0.5%	1%	20%
Mixture of Two or More Others	<0.5%	1%	<0.5%	<0.5%	<0.5%	2%
None	<0.5%	1%	1%	<0.5%	<0.5%	3%
Not Otherwise Classified	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Oil	<0.5%	1%	<0.5%	<0.5%	<0.5%	1%
Null	15%	28%	18%	2%	3%	65%
All categories	22%	48%	23%	2%	4%	100%

Table 24 The percentage of all VOA floor area classified into their relationship to building polygons, aggregated by VOA main fuel code (first letter).

Fuel Used Description (first letter)	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings	Not possible	SUM
Coal / Coke	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Electricity	2%	5%	1%	1%	<0.5%	9%
Gas	9%	17%	2%	4%	1%	34%
Mixture of Two or More Others	1%	1%	<0.5%	<0.5%	<0.5%	2%
None	<0.5%	1%	<0.5%	<0.5%	<0.5%	2%
Not Otherwise Classified	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%	1%
Oil	1%	1%	<0.5%	<0.5%	<0.5%	2%
Null	13%	25%	5%	5%	2%	50%
All categories	26%	51%	8%	11%	4%	100%

Non Domestic Building Stock in England and Wales – Part 1: Stock Description Floorspace

There are differences in median floorspace when the VOA records are aggregated by CaRB3 class and the premises-to-building relationship, as is shown in **Error! Reference source not found.**Table 25. Note that this method excludes any premises that have VOA floorspace of zero. This means that this table is based upon 1.61 million premises (86% of the full 1.876 million premises listed above).

These median floorspace values show that for most CaRB3 classes the floorspace of premises that share a building with other non-domestic premises tend to be smaller than for those occupying a whole building. There are exceptions to this situation (for example Arts & Leisure, MoD, Sport or Utilities). But, for the dominant CaRB3 classes of Factory, Office, Shop and Warehouse this holds true.

Non-domestic premises that share a building with domestic premises tend to have less floorspace than equivalent premises sharing a building with other non-domestic premises. Again, there are exceptions (for example MoD, Sport or Transport), but for the dominant CaRB3 classes of Factory, Office, Shop and Warehouse this holds true.

The median floorspace of campus premises is much larger than the equivalent for a single premises occupying a whole building. These differences are moderate for cases like Hospitality and Offices. They are more notable for Emergency, Factory, Shop, Transport and Warehouses. In the case of Warehouse, Factory and Shop the difference between single premises occupying a whole building and the multiple buildings campus cases is 10 times or more.

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

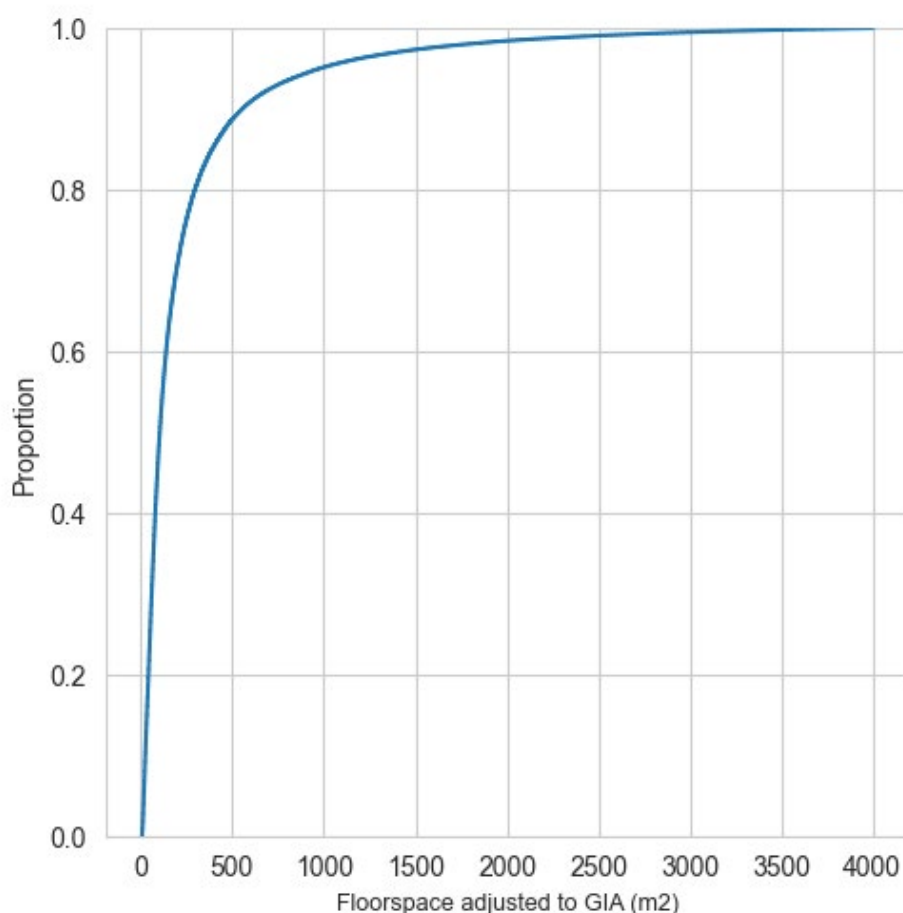
Table 25 Median VOA floorspace areas for the CaRB3 classes grouped by their relationship to building polygons (units: m²)

CaRB3 class	Whole building	Part of building (ND)	Part of building (Dom)	Multiple buildings
Agriculture, Countryside, Animals	84	67	62	65
Arts and Leisure	189	227	195	185
Community	285	302	164	240
Education	248	211	188	379
Emergency	350	492	159	4,431
Factory	247	144	106	3,276
Health	147	124	80	216
Hospitality	203	185	121	244
Miscellaneous	226	76	51	268
MoD	137	249	304	123
Office	183	57	56	225
Shop	112	109	71	1,179
Sport	107	203	361	181
Transport	105	71	96	1,399
Utilities	874	2,240	-	3,814
Warehouse	332	147	74	3,915
All	170	102	74	390

General Characteristics of the Non-domestic Stock

The data in this section relate to the 1.876 million premises that are included in the non-domestic stock covered by the database, or when the reporting requires floorspace, then this is limited to 1.610 million premises with floor area recorded by the VOA. The total floor area recorded is 594 million m². (The split of these premises and their floor area can be seen in Treemaps shown in Figure 36 and Figure 37). As shown in Figure 2, small premises are the most common in terms of frequency, as 94% of premises were smaller than 1,000 m². Overall average floorspace is 369 m² whilst the median floorspace is 103 m², suggesting that the distribution of the data is positively skewed towards smaller areas.

Figure 2 Plot of cumulative premises frequency against premises floor area, 2020

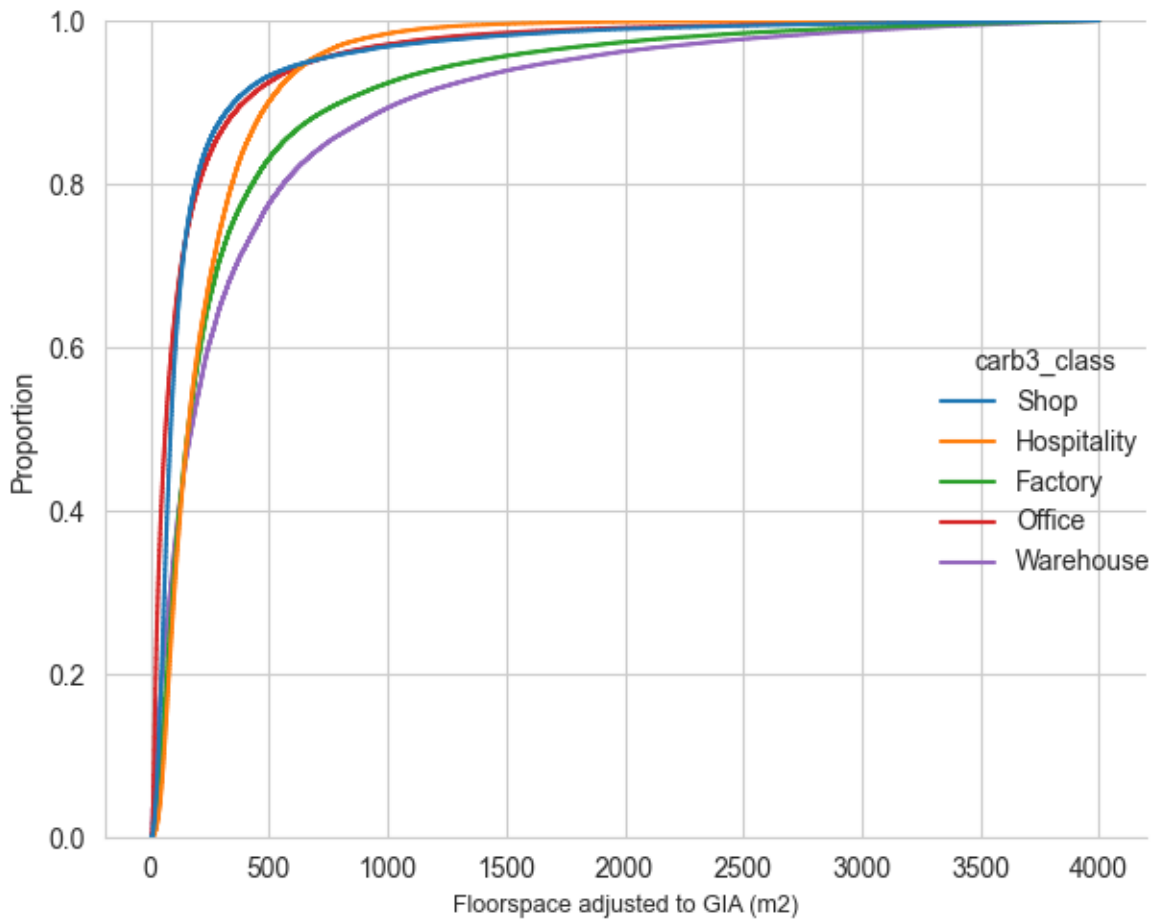


As would be expected, different CaRB3 classes produce different floorspace aggregates. This can be seen in

Figure 3 Plot of cumulative premises frequency against premises floor area, 2020 for Shops, Hospitality, Offices, Factory and Warehouses.

which shows the same data as Figure 2 but for some of the individual CaRB3 classes (Shops, Offices, Hospitality, Factory and Warehouse). This indicates that around 10% of Warehouses and Factories are larger than 1,000 m² and around 10% of Hospitality premises are larger than 500 m².

Figure 3 Plot of cumulative premises frequency against premises floor area, 2020 for Shops, Hospitality, Offices, Factory and Warehouses.

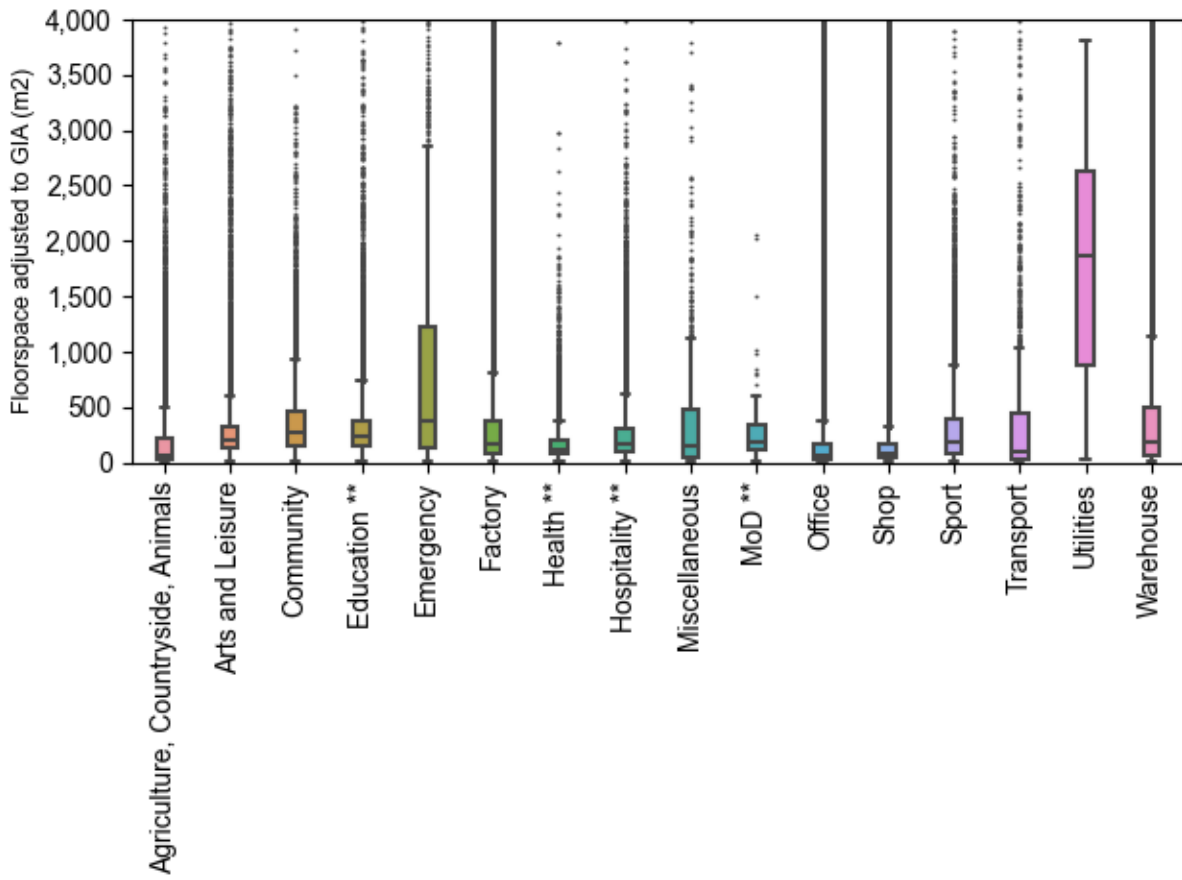


Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Figure 4 shows the distribution of floorspace for premises in each CaRB3 class. The y axis of the chart has been limited to 4,000 m² to make the chart legible. Hospitality, Offices and Shops tend to be smaller, with median floor areas of 157 m², 63 m² and 86 m² respectively. Factory and Warehouse have median floor areas of 164 m² and 169 m² respectively. Utilities have the largest median floor area of 1,871 m². Education, Health and MoD are all likely to be under-represented here due to the manner in which the VOA calculates the rateable value of some of these premises (often using a method that does not require floorspace). Making *reliable* estimates of this 'missing' floorspace is not *currently* possible, for all activity classes in the non-domestic, but such estimates have been completed for the Hospitality CaRB3 class in Part 3 of this report. Emergency and Utilities have the largest interquartile range of premises sizes of 1,092 m² and 1,749 m² respectively whilst Health, Office and Shop have the smallest interquartile range of premises sizes of 122 m², 137 m² and 107 m² respectively.

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Figure 4 Premises floor area size, by CaRB3 class, 2020.



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Examining Table 26 along with Figure 2 and Figure 3 shows that even though there are generally far greater numbers of smaller premises, when a CaRB3 class is used to group all floor area, the proportion of the floor area that can be placed into the smaller premises is relatively small. In all 16 of the CaRB3 classes used here, the largest percentage of total floor area is within the 90-100 percentile. For the largest classes of Factory, Office, Shop and Warehouse this top 10% of premises size contains 69%, 66%, 62% and 69% of all floorspace in their classification respectively. To summarise, there is a lot of floorspace in a relatively small number of premises.

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Table 26 Proportion of total activity class floor area covered by each quartile of the population (with the top quartile being split into two parts: 75-90 and 90-100 percentiles), 2020.

CaRB3 class	0 - 24%	25 - 49%	50 - 74%	75 - 89%	90 - 100%
Agriculture, Countryside, Animals	1%	4%	13%	24%	58%
Arts and Leisure	7%	14%	21%	21%	37%
Community	6%	13%	23%	22%	36%
Education	7%	14%	22%	21%	37%
Emergency	2%	5%	16%	27%	50%
Factory	2%	5%	10%	14%	69%
Health	7%	15%	23%	22%	33%
Hospitality	6%	13%	23%	24%	33%
Miscellaneous	<0.5%	3%	12%	23%	62%
MoD	5%	7%	13%	13%	63%
Office	2%	5%	11%	17%	66%
Shop	4%	7%	12%	15%	62%
Sport	3%	10%	22%	26%	40%
Transport	<0.5%	2%	6%	17%	75%
Utilities	5%	13%	20%	22%	40%
Warehouse	1%	4%	10%	16%	69%
SUM all classes	2%	6%	12%	16%	65%

Summary Statistics for the Non-domestic Stock (Breakdown by activity class, size, age, geography, heritage status, gas connection)

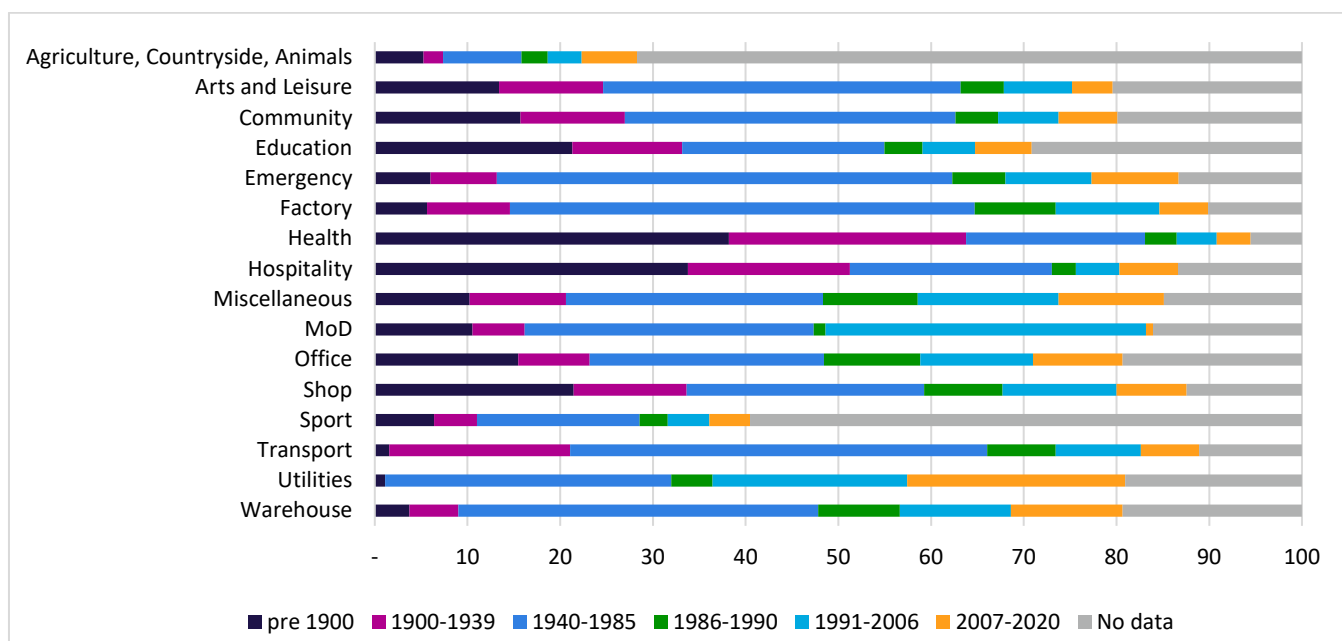
Age

Figure 5 shows the percentage distribution of premises floor areas by premises age (for each CaRB3 class). This shows that Utilities, MoD and Warehouse have the largest proportion of premises that date from after 1991 with 45%, 35% and 24% respectively. Health and Sport by contrast have the smallest proportion of premises floor area dating from after 1991 (8% and 9% respectively, although it should be noted that for Sport, 60% of the floor area has no age data assigned to it, meaning that this 9% might be an under-estimate).

Health and Hospitality have the largest proportion of older (pre-1940) premises with 64% and 51% respectively. For the activities that dominate the non-domestic stock (Factory, Office, Shop, Warehouse) the ratios vary. Factory is fairly even with 15% of floorspace being pre-1940 and 16% being post-1991. Office likewise (23%, 22%). Shops tend to have more older premises than newer (34%, 20%). Warehouse has less floorspace in older (pre-1940) premises (9%) compared to 24% in post-1991 premises.

For many premises, the VOA has not recorded age (it is left blank). Floorspace per CaRB3 class, per age band is shown in Figure 5 where 'Agriculture, Countryside, Animals' is the classification in which 72% of the total floorspace has no VOA age recorded. Sport is the second highest (60%) The average for the other classes is around 16% with the most complete classification being Health where only 6% of the VOA floorspace has no age recorded.

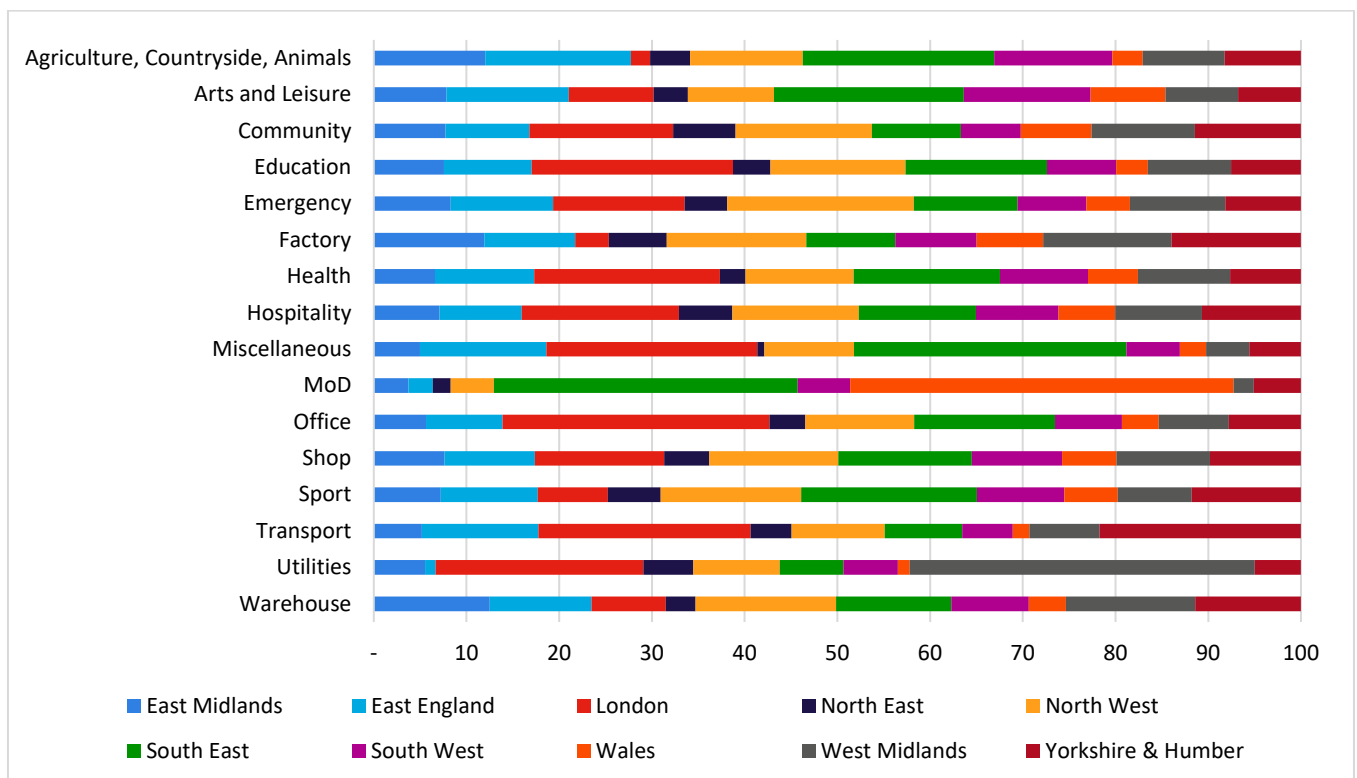
Figure 5 Percentage distribution of floor area by activity class and premises age, 2020



Non Domestic Building Stock in England and Wales – Part 1: Stock Description Region

Figure 6 shows non-domestic floorspace for the CaRB3 classes allocated to the geographical NUTS level 1 region in which the premises are located within. The regions with the least floorspace tend to be North East England and Wales. The exception here is for MoD where 41% occurs in Wales. London tends to have the largest amount of floorspace overall. This is particularly notable for office floorspace where London has 29% of all office floorspace. Factory floorspace in London is lowest (4%) compared to North West, West Midlands and Yorkshire & Humber which are 15%, 14% and 14% respectively.

Figure 6 Percentage distribution of floor area by CaRB3 class and NUTS1 region, 2020



Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Off-gas

It is possible to link the VOA records to a range of data that indicates whether a mains gas supply is not present. This includes a list of postcodes which are known to have no gas connections, the VOA fuel used code and the absence of a gas meter (MPRN) linked to the premises. Using this method, it is possible to get some indication of the numbers of premises that might be 'off-gas' due to infrastructure limitations. This is in contrast to premises inside an 'on-gas' postcode that are not connected to the gas network but which could establish a connection to the gas grid if they wanted to.

Figure 7 Percentage distribution of floor area by CaRB3 class and whether the premises is inside an 'off-gas' postcode region, 2020.

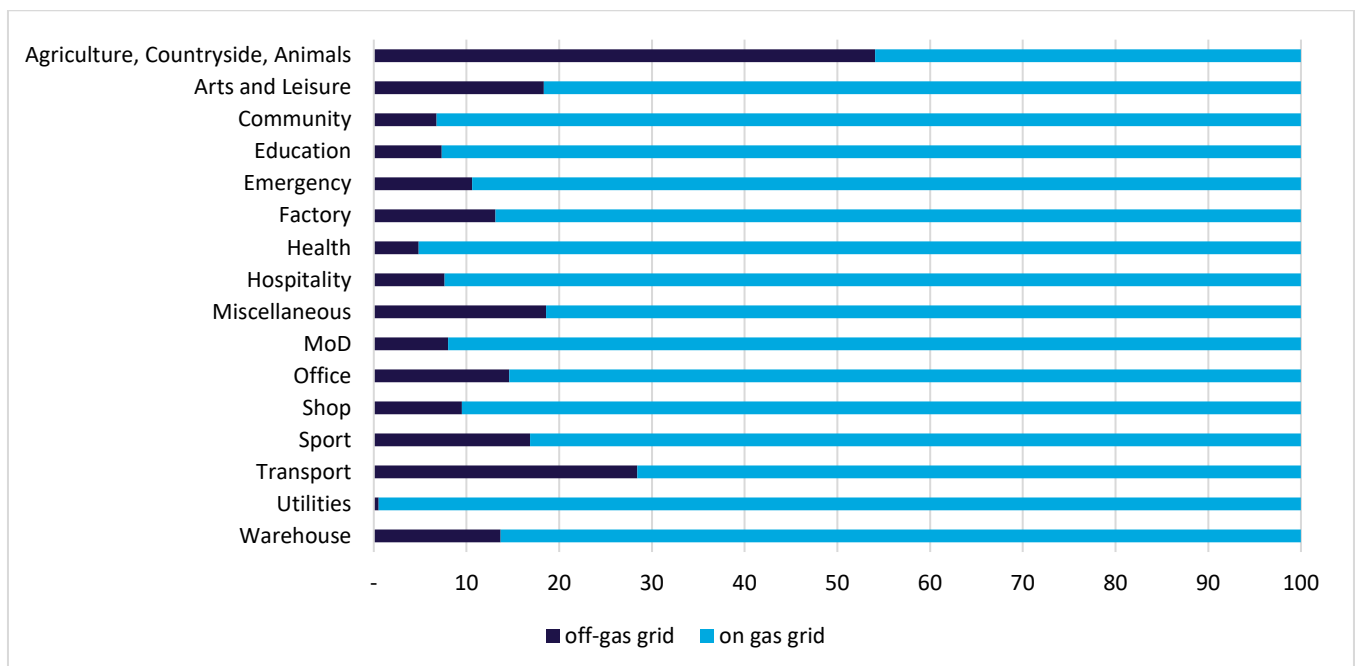


Figure 7 shows the proportions of floorspace for each CaRB3 class inside an off-gas postcode (and with no gas meter or VOA flag indicating the use of gas) compared with those inside an 'on gas' postcode. Most of the CaRB3 class floorspace is either connected to the gas grid or could be if they choose to. Agriculture is the exception here with 54% of the floorspace occurring off the gas grid. Transport is the next largest case with 28% of floorspace being off the gas-grid.

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Heating Systems

Within the VOA data there is a field for 'central heating code' which has values of 'F', 'P' and 'N' which are assumed to represent 'Full', 'Partial' and 'None' respectively. This field is not always completed, so there are also cases left blank (null). Using these data, it is possible to estimate the floor areas by CaRB3 class for these codes. However, this has the potential to be misleading in some cases, in particular Warehouse and Factory, since the differences between the treated floorspace and the untreated floorspace may be very large. For example, a large warehouse might only have 'partial' central heating to heat its office space, leaving the rest of the storage floorspace untreated.

Figure 8 Percentage distribution of floor area by CaRB3 class, using the Central Heating Code within the VOA data, 2020.

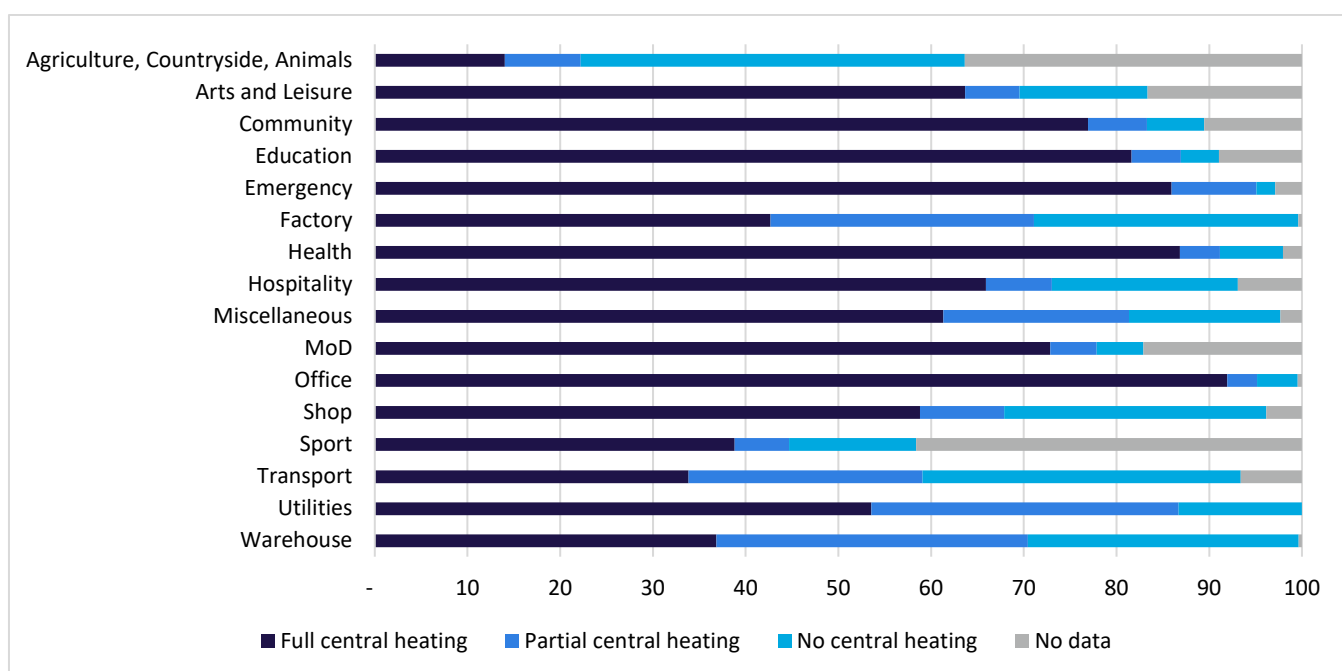


Figure 8 shows that full central heating is the dominant classification for the non-domestic stock as a whole. The CaRB3 classes where this is lowest are 'Agriculture, Countryside, Animals', Transport and Warehouse. Offices have the highest proportion of floorspace with full central heating at 92% along with Health, Emergency and Education at 87%, 86% and 82% respectively. Partial central heating is a relatively large proportion in Warehouse, Utilities, Factory and Transport at 34%, 33%, 28% and 25% respectively. The classifications where no central heating is recorded as being a significant proportion of the class is 'Agriculture, Countryside, Animals', Transport, Warehouse, Shop and Factory at 41%, 34%, 29%, 28% and 28% respectively. Sport and 'Agriculture, Countryside, Animals' are the two classifications with the largest number of 'null' cases (no central heating code recorded whatsoever).

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Fuel Used

The VOA data records a field for fuel used as well as a lookup table to decipher these codes, for example 'E' means 'electricity' and 'G' means 'gas'. In many cases two letters are used. For example, 'GE' whilst other times it might be 'EG'. There are currently 37 different combinations. For the sake of simplicity, this analysis has been carried out using the first letter in the field on the assumption that this is likely to indicate the primary fuel used at the premises. A separate code ('M') is used by the VOA for 'Mixture of Two or More Others' which has been abbreviated to 'Mixture of fuels' in the charts. No attempt has been made to (re) classify cases where the fuel used code is a combination of letters into 'Mixture of fuels'.

Figure 9 Percentage distribution of floor area by CaRB3 class, using the fuel used code within the VOA data, 2020

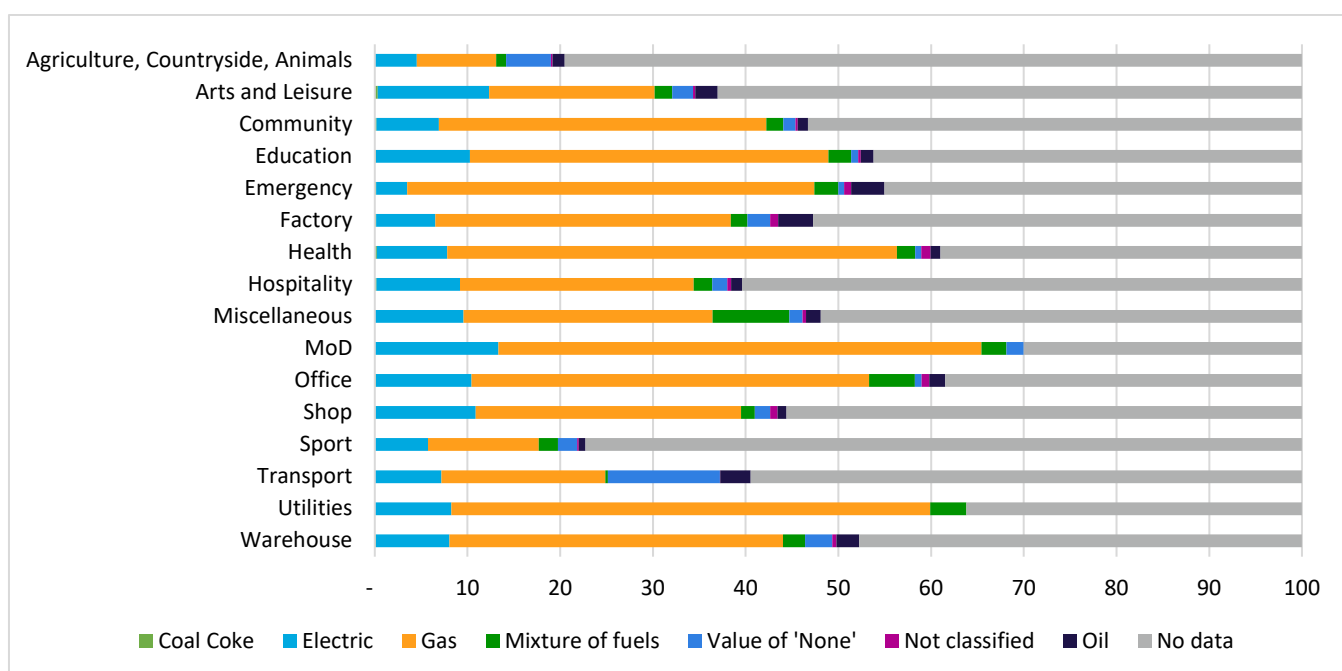


Figure 9 shows that the field is regularly left blank in the VOA data and that this is often the case for around half of the total floorspace in a CaRB3 class. This lack of data is most significant in 'Agriculture, Countryside, Animals (80%)', Sport (77%), Arts and Leisure (63%), Hospitality (60%). Gas is then the dominant coding for those premises that do have a fuel used code recorded. These percentages are largest in MoD (52%), Utilities (52%), Health (49%), Emergency (44%) and Office (43%). Electricity use is generally around 10% or less of a class's total floorspace and this is highest in MoD, Arts and Leisure and Shop (13%, 12% and 11% respectively). The use of Coal/Coke is still present, but in relatively few premises (less than 1% so this is not visible in Figure 9). The use of Oil is generally low (below 5%) and is highest in Factory (4%), Emergency (4%), and Transport (3%).

Air Conditioning Code

The VOA data holds information on the presence of air conditioning as a series of letters with the values of 'F', 'P' and 'N' which are assumed to represent 'Full', 'Partial' and 'None' respectively. This field is not always completed and so there are also cases where records are

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

left blank (null). Using these data, it is possible to estimate the floor areas per CaRB3 class for these codes, which can be seen in Figure 10.

Figure 10 Percentage distribution of floor area by CaRB3 class, using the Air conditioning code within the VOA data, 2020

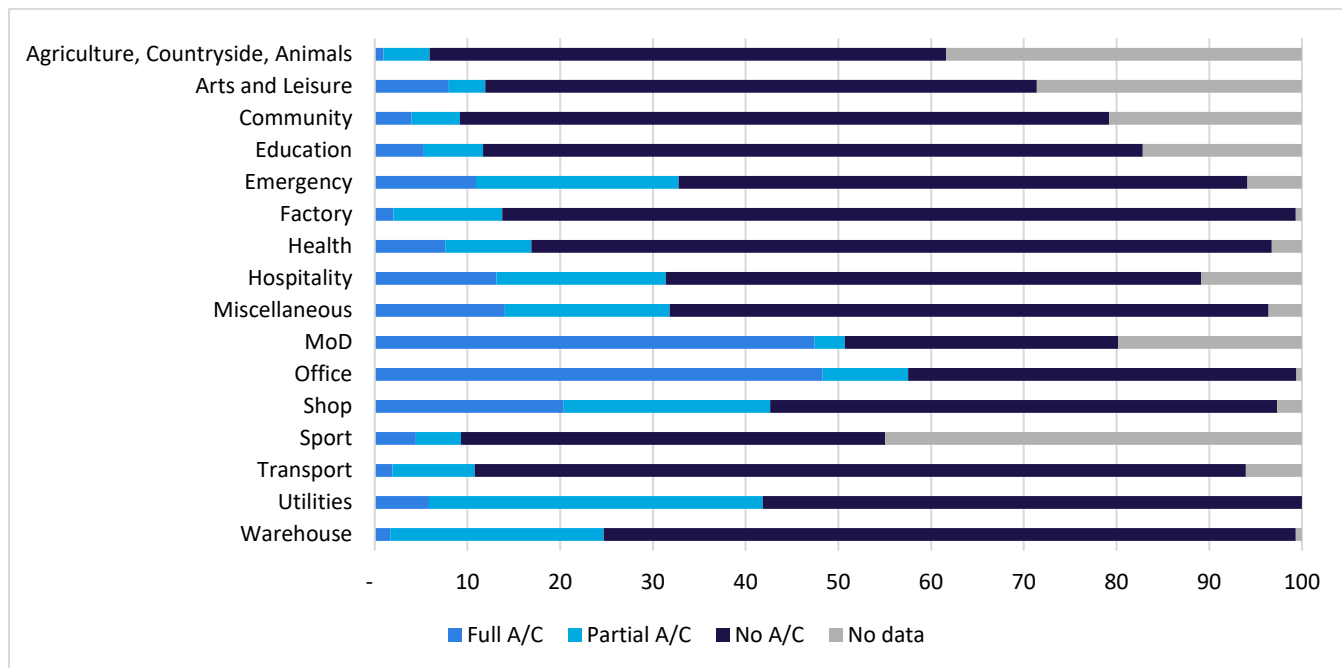


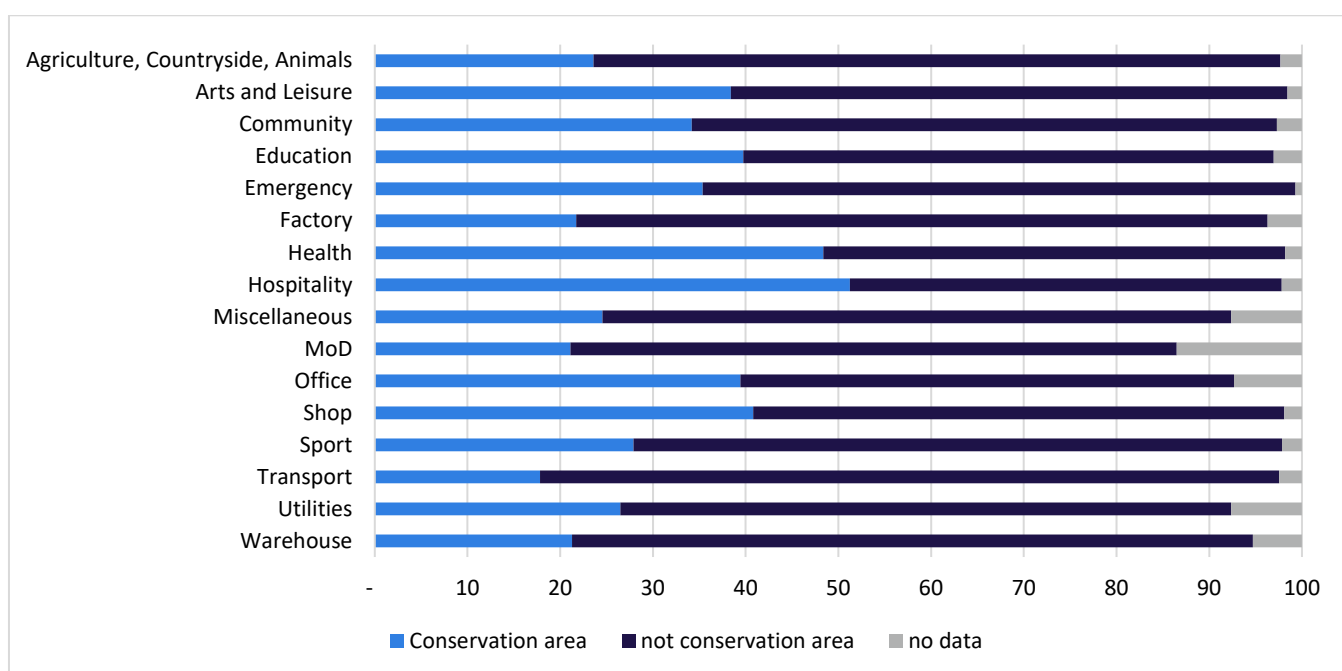
Figure 10 indicates that most premises have no air conditioning according to the data held by the VOA. The CaRB3 classes with the highest proportion of total floor area classified as having no air conditioning are Factory (86%), Transport (83%), Health (80%) and Warehouse (75%). Full air conditioning is most prevalent in the floorspace for Office (48%), MoD (47%) and Shop (20%). Partial air conditioning is highest in Utilities (36%), Warehouse (23%), Emergency (22%) and Shop (22%). The data field is most likely to be null for floorspace in Sport (45%), 'Agriculture, Countryside, Animals' (38%), 'Arts and Leisure' (29%) and Community (21%).

Non Domestic Building Stock in England and Wales – Part 1: Stock Description Heritage Status

Conservation areas

A dataset of Conservation Areas for both England and Wales was combined so that the location of premises within conservation areas could be identified. The results are displayed in Figure 11. The proportions of floorspace within conservation areas is highest for Hospitality (51%) followed by Health (48%), Shop (41%) and Education (40%). The CaRB3 class that have the largest proportions of floorspace outside of conservation areas are Transport (80%), Factory (75%), 'Agriculture, Countryside, Animals' (74%) and Warehouse (73%).

Figure 11 Percentage distribution of floor area by CaRB3 class, using the Conservation areas (both England and Wales) to classify the premises, 2020



Listed Buildings

Listed buildings for both England and Wales were combined to form a single dataset. It was then possible to link these data to HMLR boundaries containing a non-domestic premises. The grading, in order of importance is as follows:

- Grade I: buildings of exceptional interest.
- Grade II*: particularly important buildings of more than special interest.
- Grade II: buildings that are of special interest

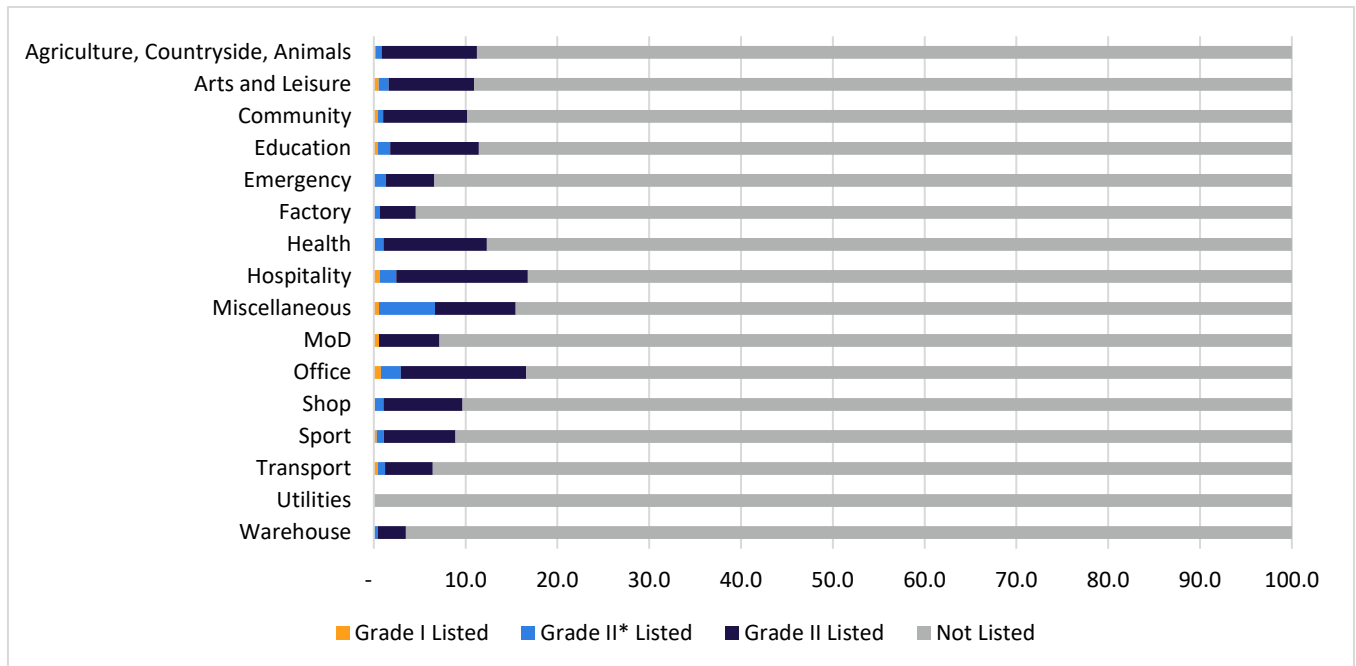
Using these data, it was possible to flag those non-domestic premises that are likely to be in a building which is Listed. Figure 12 gives the results. Unsurprisingly, very little floorspace is assigned to the highest 'Grade I' listed status with Office and Hospitality making up 0.8 and 0.7% of their total CaRB3 class floorspace respectively. Likewise, in the 'Grade II*' listed status it is Office and Hospitality which represent a small amount of the total floor area (2% each).

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

'Grade II' listing is more widespread. Again, it is Office and Hospitality which feature most strongly with 14% of total floorspace being assigned to each of these CaRB3 classes. Health (11%), Education (10%) and 'Agriculture, Countryside, Animals' (10%) are also noteworthy.

Utilities stand out as having no floorspace that has been assigned a listing. Warehouse (97%), Factory (95%) and Transport (94%) are dominated by floorspace that is not listed at all.

Figure 12 Percentage distribution of floor area by CaRB3 class, using the Listed building status (both England and Wales) to classify the premises, 2020



Non Domestic Building Stock in England and Wales – Part 1: Stock Description Rural or Urban Locations

The ONS rural and urban classification of Output Areas has been incorporated into the model to enable the location of premises to be analysed according to this classification. Data on the location of the premises were linked to the output areas to achieve this and the results are shown in Figure 13.

Figure 13 Percentage distribution of floor area by CaRB3 class, using the Rural Urban classification to categorise the premises, 2020

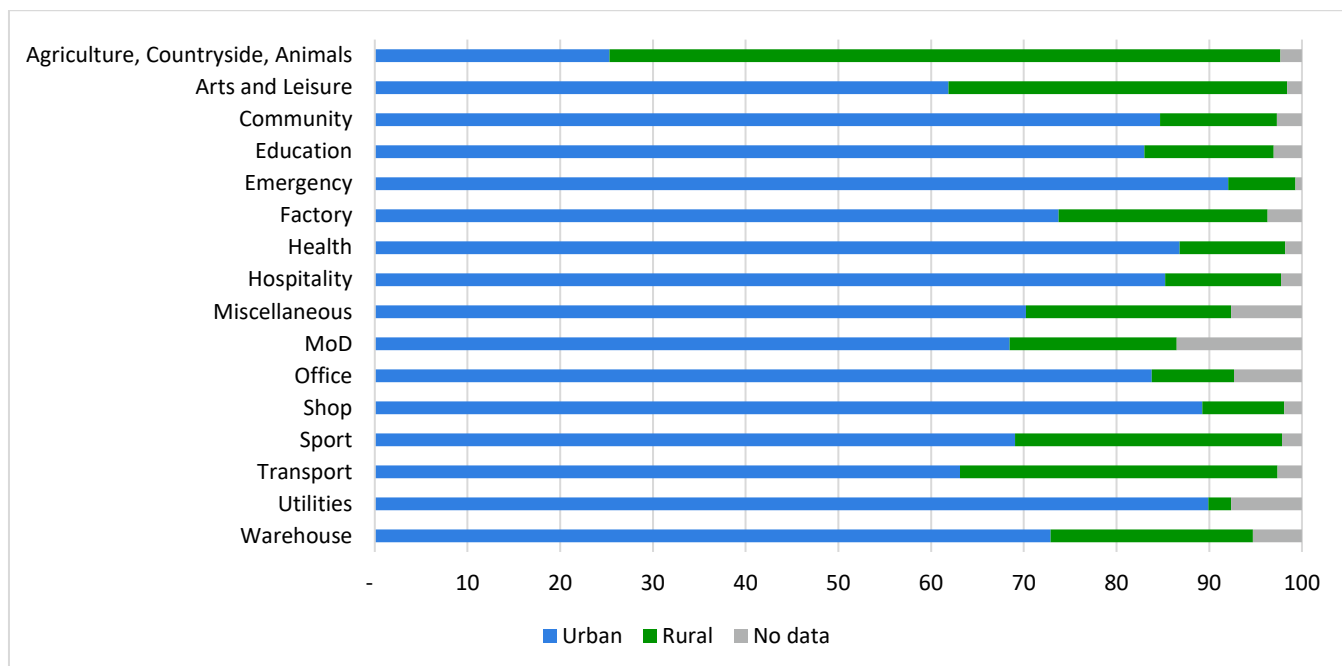


Figure 13 indicates that for all CaRB3 classes apart from 'Agriculture, Countryside, Animals', more than 50% of floor area is within an urban area. This is highest for Emergency (92%), Utilities (90%), Shop (89%) and Health (87%). For Rural areas 'Agriculture, Countryside, Animals' stands out with 72% of all this CaRB3 class being assigned to a rural area. Arts & Leisure (37%), Transport (34%) and Sport (29%) and Factory (23%) are the next highest classes.

IDBR Linked Data

Data were integrated from the Inter Departmental Business Register (IDBR), which is managed by the Office for National Statistics (ONS). Data were extracted from M03_Y2020 (March 2020). The data supplied included tabular data on around 9.3 million 'Enterprises' and around 4 million 'Local Units', along with around 5.4 million Company Record Numbers (CRNs). There are links between all of these tables. These records have 'birthdate' and 'deathdate' assigned to them, although for current records, the 'deathdate' is null.

Address matching was attempted for IDBR records that either had a null (empty) 'deathdate' or where the 'deathdate' was recent (in this case April 2018 was set as a cut off). The requirement of the address matching was to make strong matches between the premises and the IDBR record and for this reason a strong match was stipulated for the business name. Matches were run for both 'Enterprises' and 'Local Units'. In total 3.3 million 'Enterprise' addresses were run, returning a 6% match rate. 1.3 million 'Local Units' were run, returning a 13% match rate. Whilst these match rates could be improved, if the constraints requiring the business name to return a near perfect match were slackened, this will (almost certainly) introduce false positives in the matching. It should also be noted that some matches will never be possible within this system since it is likely that they do not relate to premises within buildings. For example, there are many records that are 'EXECUTOR OF THE LATE...' or 'TRUSTEES OF [name of person redacted] DECEASED'.

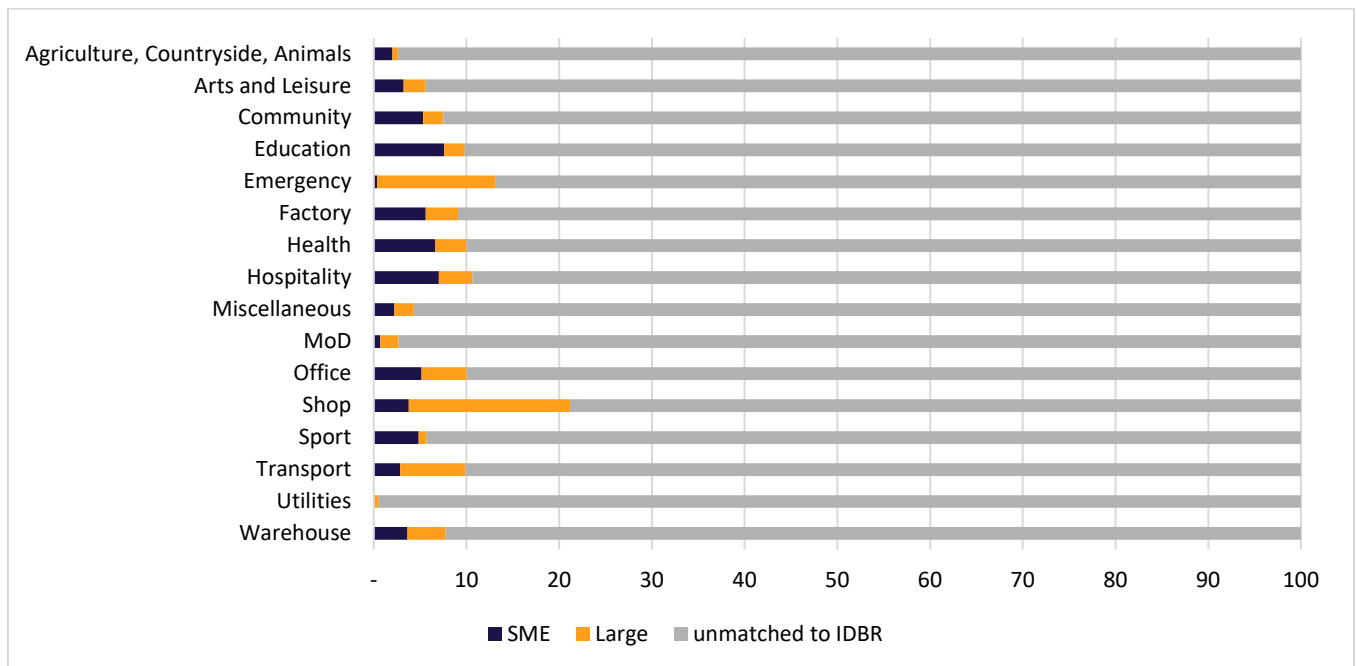
Proportion of SMEs

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 €43m⁸. 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. The results are shown for the CaRB3 classes, using floorspace as a percentage of total CaRB3 class floorspace, in Figure 14. Figure 14 indicates that the majority of floorspace for each CaRB3 class does not match to an IDBR record. If the non-matched floorspace is ignored and the ratios between SME and Large Enterprise floor areas are considered, then Emergency and Utilities show the largest proportion of Large Enterprise floorspace to *total matched floorspace* (97% and 100%) respectively. For the four bulk classes Factory (38%), Office (49%), Shop (82%) and Warehouse (53%) shows that the ratios between Large Enterprises and all matched IDBR records varies considerably between the CaRB3 classes. The lowest ratio of Large Enterprise floorspace to total matched IDBR floorspace is for Sport (15%), Education (22%) and 'Agriculture, Countryside, Animals' (23%). However, these ratios may be biased by the low match rates to IDBR records.

⁸ 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]

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Figure 14 Percentage distribution of floor area by CaRB3 class, using an SME / large enterprise split from IDBR data to classify the premises, 2020

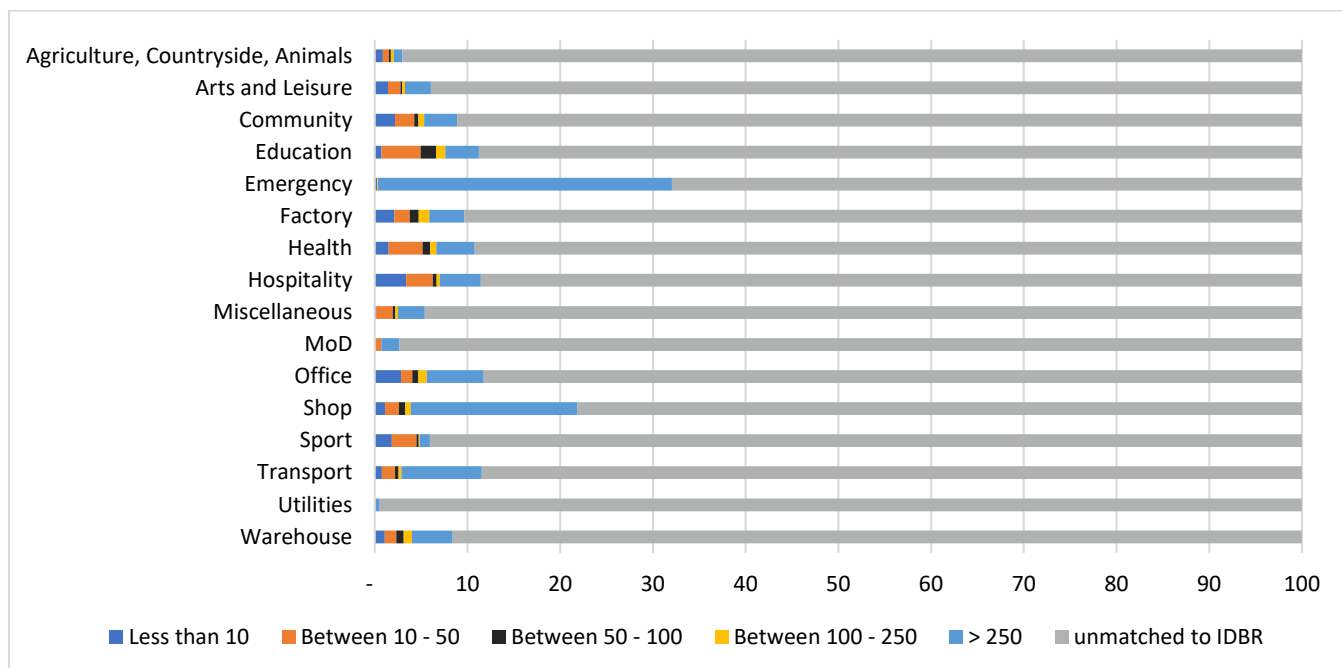


Numbers of Employees

The IDBR dataset includes counts of employees. Whilst many IDBR records failed to match to premises, for those that did, it is possible to classify these counts of employees into groupings, as shown in Figure 15, indicates that all CaRB3 classes have the largest amount of floorspace allocated to the 'unmatched to IDBR' grouping. Next, it is the 'greater than 250 employees' group that has the largest percentage of floorspace in almost all cases apart from Sport. Emergency and Shop stand out as the two CaRB3 classes with the largest amount of floorspace assigned to businesses with greater than 250 employees. These results should be treated with caution due to the (poor) IDBR matching rates.

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Figure 15 Percentage distribution of floor area per CaRB3 class, using number of employees from IDBR data to classify the premises, 2020



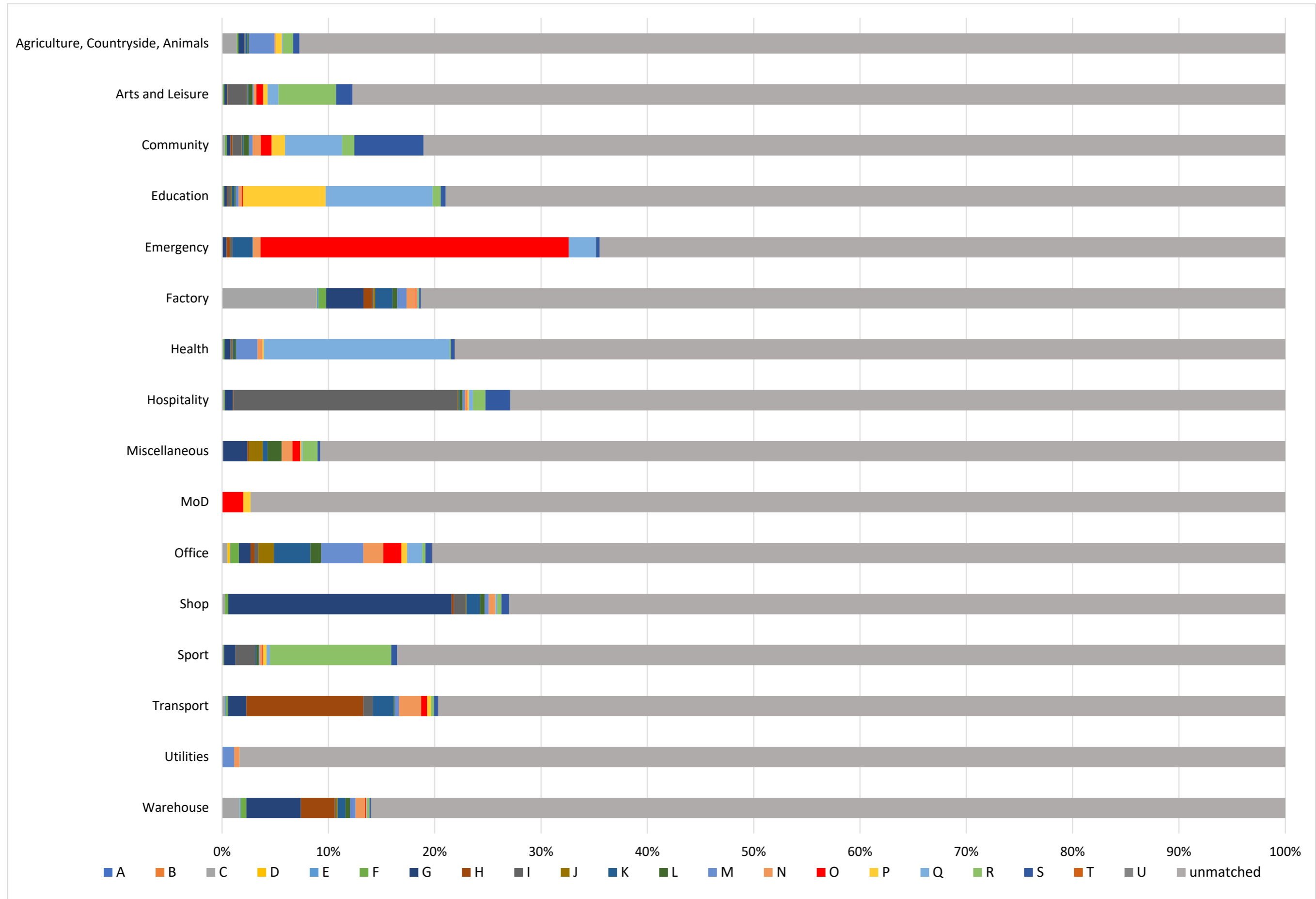
Standard Industrial Classification (SIC)

Using the IDBR data it is possible to map onto the matched premises the Standard Industrial Code (SIC) for that IDBR match. In turn, it is possible to allocate this SIC to the premises floorspace and hence produce aggregates of what percentage of floorspace, per CaRB3 class is allocated to each SIC 'Section' descriptor.

Although SIC is commonly used within government for quantification of economic activity, it is not necessarily aligned with the actual activity within specific premises. For example, take a company falling within the SIC detail category of 'hose and pipe fittings made of plastic (manufacture)'. This company may operate two factory premises, a warehouse and a head office premises, thus the SIC is actually split across multiple premises (CaRB3) activity types and vice versa. This means that allocating 'economic activity' to premises is problematic.

The mapping of CaRB3 classes to SICs is not a perfect one-to-one match. The CaRB3 class of Factory for example, might equally map to SIC section 'C' (Manufacturing) and to SIC section 'G' (Wholesale and Retail Trade; Repair of Motor vehicles and motorcycles). The results of this matching process are shown in Figure 16 (and the letter codes are shown in Table 27).

Figure 16 Percentage distribution of floor area per CaRB3 class, using SIC section from IDBR data to classify the premises, 2020



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Table 27 IDBR SIC section letters and descriptions (to assist in deciphering Figure 16)

SIC section	SIC Section Description
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

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Figure 16, (when read along with Table 27) confirms that for each CaRB3 class there can be multiple SIC sections assigned to the matched floorspace. Whilst this appears complex in some classifications (for example Office, which has C, F, G, J, K, L, M, N, O, P, Q and S more or less evenly assigned to matches) other classifications are more straightforward (for example Shop which has 21% of total floorspace assigned to 'G'). Likewise, Hospitality is 21% assigned to 'I'.

Public Sector Buildings

There is no clear flag in the VOA data to enable the identification of 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 us to estimate 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.

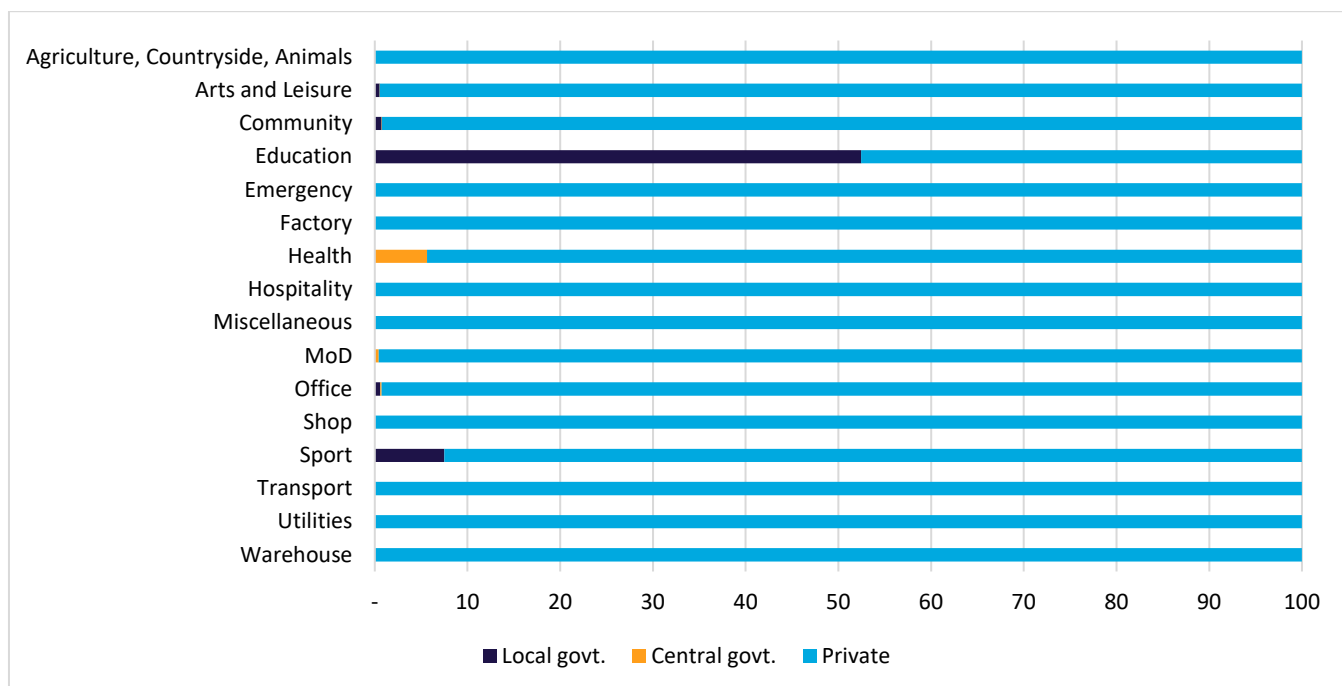
Although 'Central Government Services', where identified, are spread across nine CaRB3 classes, almost 90% of the premises count and 95% of the floorspace is in Offices. A further 4% is classified as 'Factory' floorspace, whilst the second most common premises type, by count, is 'Shop' (5%).

The OSAB classifications for 'Job Centre' operated by the Department for Work and Pensions (DWP) have been sampled randomly and found not to be particularly reliable. In light of this, only premises identified as having the word 'Job' in the VOA premises address have been included in the above analysis. However, the numbers of 'Job Centres' falls far below the number actually operated by the DWP.

Figure 17 shows the premises counts as a percentage of CaRB3 class. Education has the largest percentage of premises assigned to local or central government (52% local government) which will be state schools. This is followed by Sport premises (8%). If the same chart were produced using floor area then the significance of Education and Sport would be reduced because these (local authority managed) premises will normally not have floor space recorded by the VOA.

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Figure 17 Percentage distribution of premises by CaRB3 class, using Local government, Central government and Private splits (both England and Wales) to classify the premises, 2020



A comparison of the total Central Government floorspace in the above analysis has been made with the general literature published by the Government Property Agency (GPA, page 20)⁹ which estimates the government’s property occupations as approximately three million square metres of floorspace, as at 2020. This suggests that there is a very considerable amount of central government-occupied floorspace that is not easily identifiable from the datasets that currently make up the NDBS.

The identified Local Authority occupations are larger than those for Central Government, both in total (4.1 million m² versus 0.81 million m²) and average (1,380 m² versus 1,175 m²), respectively. The identification of Local Authority occupations is vastly better than for Central Government, primarily due to Local Authority occupations sometimes being recorded in the VOA data, whilst Central Government occupations are not. ‘Sometimes’ is used here because it is known, from previous research, that local authorities will frequently lease/rent premises that are not being recorded as ‘Local Authority occupations’ in the VOA data.

As with Central Government, office floorspace dominates in the Local Authority premises (89%), with the remainder split mostly between Community and Warehouse uses (~4% each). However, in terms of the number of premises, Local Authorities have the most occupations, due to schools, with the CaRB3 education class accounting for 22,600 premises (82%), albeit mostly without floor area records. It is also known, from previous research using data not available from the VOA, that there can be Local Authority occupations that appear not to be

⁹Government Property Agency: GPA Strategy 2020-2030. 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/988168/GPA_Strategy_2020-2030.pdf Accessed 28/11/2022

logged as such in the VOA's own central database. It is very likely that this is also the case for Central Government occupations.

Ownership and Tenure

His Majesty's Land Registry (HMLR) data on ownership and tenure

The HMLR data includes four datasets:

- National polygon dataset (polygons showing the extent of the property boundary). Each polygon has a 'Title number'. According to HMLR¹⁰: *This dataset shows the indicative shape and position of each boundary of a registered title for land and property in England and Wales. Every freehold or leasehold title has at least one index polygon. This dataset has more than 25 million titles and 28 million polygons. HM Land Registry index polygons are mapped against MasterMap, Ordnance Survey's large scale map.*
- Title number and UPRN lookup dataset (UPRNs which link to OSAB UPRNs). Each UPRN has a 'Title number' which can be used to link to the National polygon dataset and the Tenure dataset. According to HMLR¹¹: *This dataset contains HM Land Registry title numbers and Unique Property Reference Numbers (UPRN) for freehold and leasehold land and property registered in England and Wales.*
- Title Descriptor dataset (or 'Tenure' dataset). This includes 'Title number', estate interest, class of title, registered status and record status. The class of title translates into whether the legal interest is Freehold or Leasehold). According to HMLR¹²: *This dataset describes legal interests that are recorded against freehold and leasehold estates registered in England and Wales. (An estate is property and/or land.) An estate is given a unique title number when it is registered. This means you can get data from individual records.*
- Leases dataset (UPRNs, tenure, date of lease, length of lease). According to HMLR¹³: *A lease is a contract which gives the right to exclusive possession of land to a tenant for a specific amount of time. Leasehold is one of two ways of owning land (the other is freehold). The owner of a freehold or leasehold interest may grant a lease. The "landlord" (or "lessor") is the person who grants the lease. The landlord's title is the "superior" or "reversionary" title. The "tenant" or "lessee" is the person who takes the lease. The tenant's title is the "inferior title". If the lease is granted for more than 7 years, it must be registered with HM Land Registry.*

Whilst it is possible to classify non-domestic premises using these data, the concept of 'tenure' is more complex than a classification of 'owner occupier' vs 'tenant'. Using these data, 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

¹⁰ <https://use-land-property-data.service.gov.uk/datasets/nps> Accessed 12/12/2022

¹¹ <https://use-land-property-data.service.gov.uk/datasets/nps> Accessed 12/12/2022

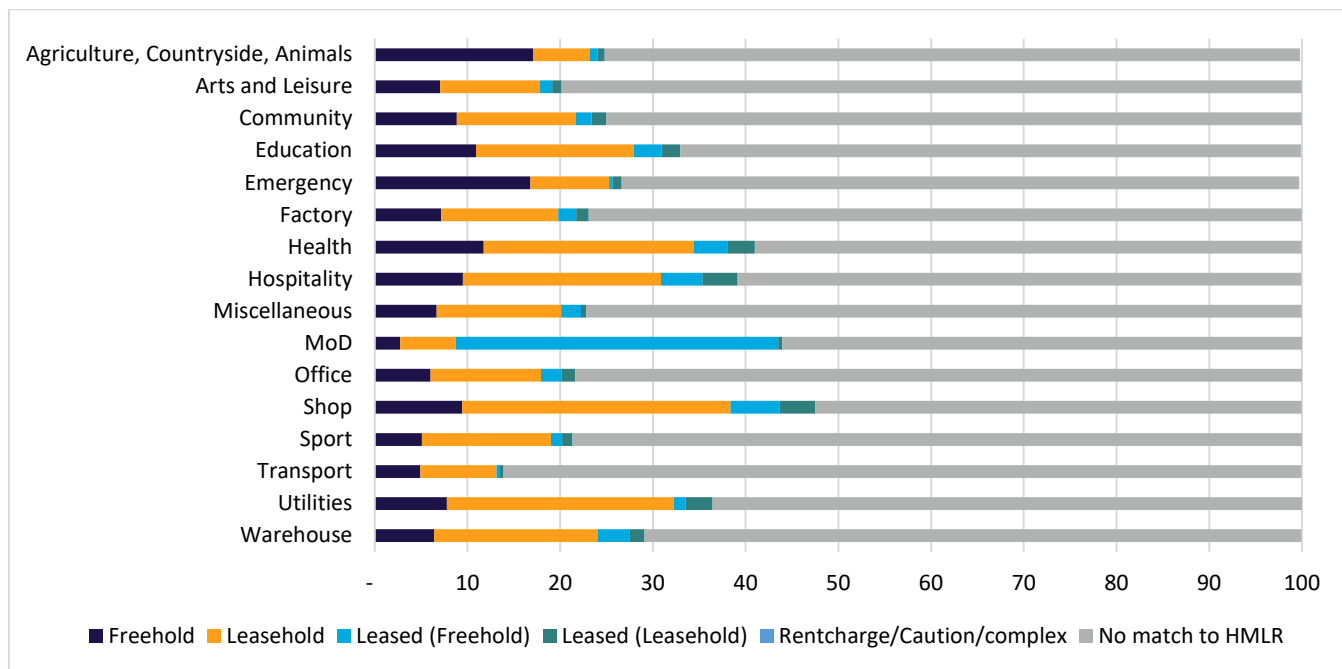
¹² <https://use-land-property-data.service.gov.uk/datasets/nps> Accessed 12/12/2022

¹³ <https://use-land-property-data.service.gov.uk/datasets/leases/tech-spec> Accessed 12/12/2022

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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) 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.

Figure 18 Percentage distribution of floor area by CaRB3 class, using the HMLR ‘Title Descriptor’ and HMLR ‘Leases’ data to produce a combined classification of premises, 2020



The data from HMLR were linked to the VOA premises and some broad classifications of the HMLR data were made as shown in Figure 18. The CaRB3 classes with the largest percentage of floorspace assigned ‘Freehold’, without any lease arrangements, are ‘Agriculture, Countryside, Animals’ (17%), Emergency (17%), Health (12%) and Education (11%). Leaseholder arrangements (in estate ownership) are largest in Shop (29%), Utilities (24%), Health (23%) and Hospitality (21%). Arrangements where an estate is Freehold but has a (>7 year) lease associated with it make up around 3% of the total VOA floorspace. This is most notable for MoD where 35% of the CaRB3 class floorspace fits this arrangement. This is followed by Shop (5%), Hospitality (4%), Health (4%), Warehouse and Education (both 3%). Very little floorspace is assigned to Leasehold estates which also have a (>7 year) lease associated with them making up only about 2% of the total VOA floorspace. This sort of arrangement can be seen for Shop and Hospitality (both 4%), Health and Utilities (both 3%). A fifth category is for a small number of premises that have more obscure estate arrangements such as ‘Rentcharge’ or ‘Caution’ associated with them.

This leaves 70% of VOA floorspace that is not associated with any HMLR data using the linking methods outlined above. Transport (86%), Arts and Leisure (80%), Sport (79%) and Office (78%) are the largest percentages in this classification. None of the CaRB3 classes dip below 50% for this category, with the lowest percentages being Shop (52%), MoD (56%), Health (59%) and Hospitality (61%).

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Where leases exist, it is possible to derive the length of the lease and the start date, but whilst date of lease is a 'date' that can be queried, the length of lease (the 'term') is a free text field that would need significant cleaning before it could be used to run queries such as 'What is the length of the tenancy'

EPC Data and Tenure

Whilst the domestic EPC dataset has a field called 'tenure' this field is absent from the non-domestic EPC records. Non-domestic EPCs do however have a field called 'transaction_type' which represents the reason that triggered the EPC. Some examples of the values in this field include "Mandatory issue (Marketed sale)" or "Mandatory issue (Property to let)" or "Mandatory issue (Property on construction)". This field does not directly represent tenure and it could be mis-interpreted. For example, an EPC might be triggered by a marketed sale, but the new owner might then lease the property soon after the sale has gone through. Likewise, an EPC triggered by 'Property to let' might not result in the property being let. Also, premises may change ownership, but the 'sitting tenant' could remain in occupation. Nonetheless it is useful to link this data to the VOA premises to get an overall idea of the trends that might link to tenure.

When this dataset is linked to premises, around 75% of all VOA non-domestic floorspace does not match to a non-domestic EPC. Those that do match to a premises, represent around 69% of the available EPCs which have been successfully matched to a UPRN. When multiple EPCs match to the same premises, the most recent EPC is selected and any older EPCs are set aside. Marketed sale is the largest reason for an EPC transaction with around 10% of all floorspace being classified in this way. Property to let is the second largest (8% of all floorspace).

Figure 19 Percentage distribution of floor area by CaRB3 class, using the non-domestic EPC 'transaction_type' field to classify records. Where DEC matches the premises these are identified, but no 'Transaction' is listed. 2020



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Figure 19 shows that for the largest percentage of VOA floorspace per CaRB3 class it is not possible to match an EPC. For the matches that can be made, when the transaction type triggering an EPC is 'Marketed sale' the percentage of CaRB3 floorspace is highest in Shop (17%), Health (16%) and Hospitality (13%). When the transaction type is 'Property to let' this is highest in Shop (12%) Hospitality (9%), Health (9%) and Warehouse (8%). Whilst these transaction types can be used as a proxy for 'tenure' this sort of association should be made with care and caution.

Challenges and Policies

Costing Retrofits

Calculating accurate estimates of the costs to retrofit the non-domestic building stock is beyond the scope of this report. It is possible to estimate the numbers of premises and the amount of floorspace that might incur higher than average retrofit costs due to their location, age or existing materials.

Some initial analyses of the VOA data for 'structure construction', 'wall construction' and 'roof construction' indicate huge diversity in the combinations of codes across the stock; namely 7,131 combinations of standard structure, wall and roof codes, when paired with CaRB3 class. In addition, there can be multiple combinations of codes within premises, probably associated with different building elements (for example extensions), ages and sub-activities. Further detailed analysis, beyond the scope of this report, is likely to elicit further detail and insights into this diversity and how it is likely to affect the complexity, and thus cost, of building retrofits.

The building of a full 3DStock-based model would also provide estimations of surface areas of buildings to be retrofitted. As noted previously, a very large proportion of the stock's floor area is within a relatively small number of premises. However, amongst these will be campus-type premises that may be more complex to retrofit, due to the number of buildings involved. At the simpler end of the scale, there are the premises that occupy a single building polygon and these account for 22% of premises and 26% of floor area of the stock (

Table 5).

Heritage Status

Figure 11 indicates premises within Conservation Areas and variation according to the different CaRB3 classes. Overall, 40% of all premises, occupying 30% of the total non-domestic floorspace are within Conservation areas.

Figure 12 shows that some premises have a Listed building status and that this can vary according to the different CaRB3 classes. Overall, 11% of all premises, occupying 8% of the total non-domestic floorspace are in buildings with some form of Listed building status applied. The vast majority of these are Grade II Listed buildings.

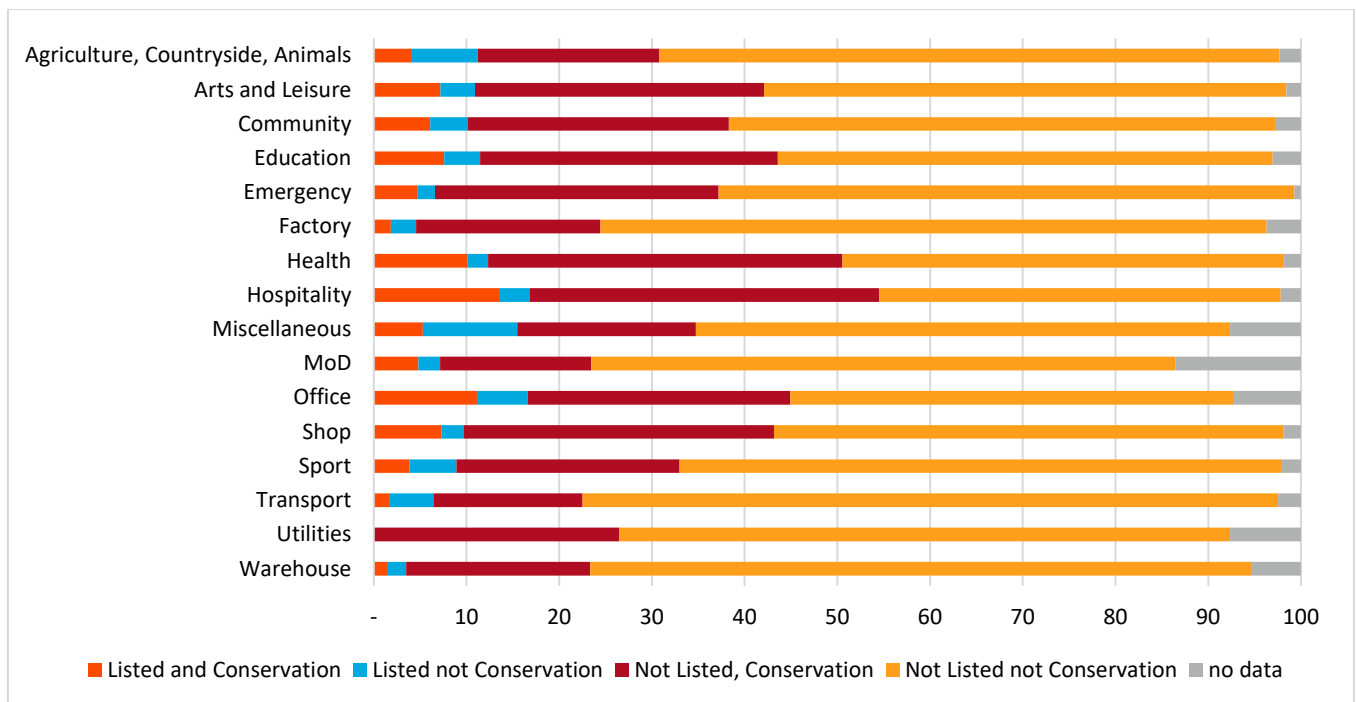
In reality, Listed buildings can occur inside Conservation areas. Figure 20 shows the distribution of floor area per CaRB3 class when both the Listing and the Conservation areas are taken into account together. For simplicity the listing has been reduced to a flag of 'Listed' or not listed. This chart shows that for activity classes such as Hospitality, 55% of the floor area of the class is either Listed and in a Conservation area, Listed but not in a Conservation area, or not Listed but in a Conservation area. For Health, Office, Education and Shop these values are 51%, 45%, 44% and 43% respectively. Factory (24%), Warehouse (23%) and Transport (23%) are considerably lower.

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Figure 21 is similar to Figure 20 except it shows the percentage of premises per CaRB3 class (rather than floorspace) when both the Listing and the Conservation areas are taken into account together. Like Figure 20 it shows that Hospitality has the largest percentage of premises (52%) that have some combination of Listing and or Conservation area applied to them. Shop, Office and Arts and Leisure are next with 50%, 50%, and 47% respectively. Twenty to thirty percent of each of the Factory, Warehouse and Transport premises have some sort of planning restriction.

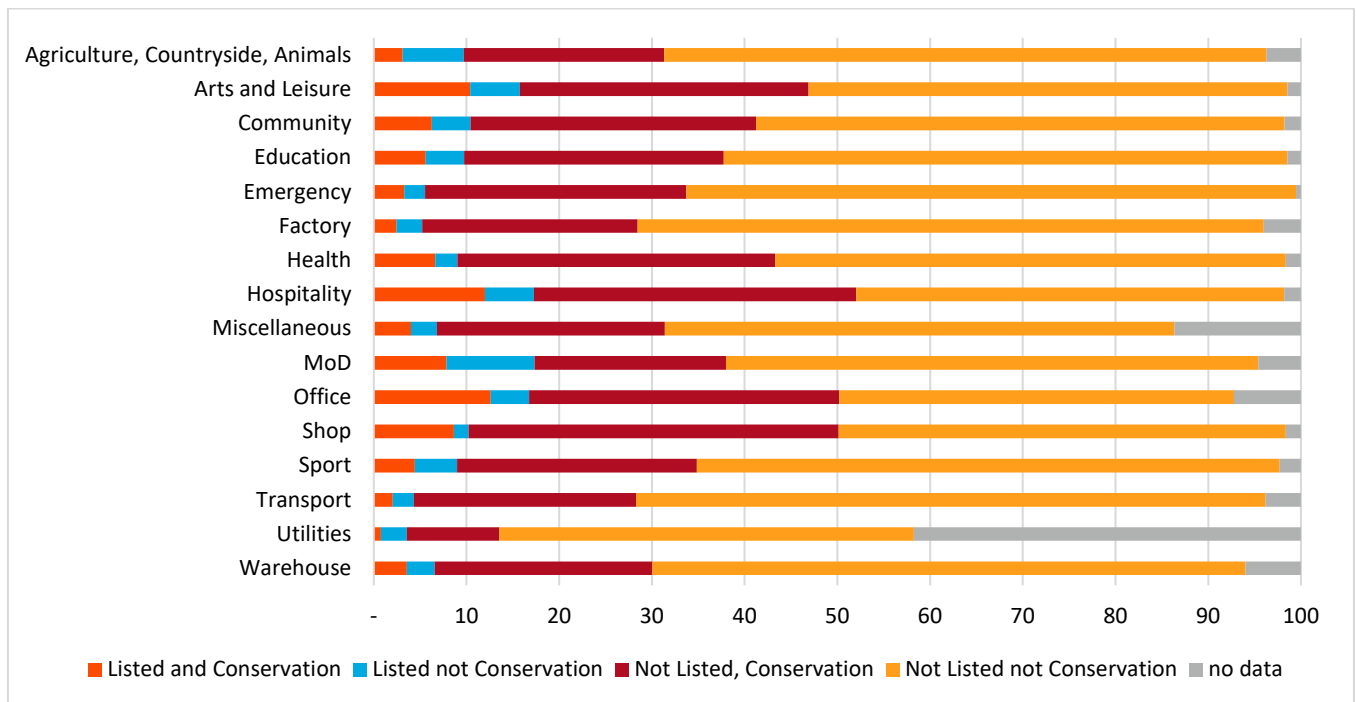
This suggests that between 25% and 50% of the activity class-specific floorspace of the bulk of the non-domestic sector may be subject to more complex retrofits that require non-standard methods. These may result in higher than average costs and/or lower than average emissions reductions compared to other non-domestic buildings outside of these restricted areas.

Figure 20 Percentage distribution of floor area by CaRB3 class, using the Listed building status and Conservation areas, combined to classify the premises, 2020



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Figure 21 Percentage distribution of premises by CaRB3 class, using the Listed building status and Conservation areas, combined to classify the premises, 2020



When considered in combination with the number of premises in shared buildings (Table 7), it might be surmised that Factories, Hospitality, Offices and Shops are likely to not only be in conservation areas but also be in shared buildings. This is further complicated for Hospitality and Shops, which can frequently be found sharing with domestic properties, which in turn are likely to require different energy consumption mitigation strategies to the non-domestic premises. This multi-layered complexity is indicated by Figure 22.

Figure 22 Percentage distribution of total VOA non-domestic floor area by CaRB3 class, using the Listed building status and Conservation areas, combined to classify the premises, 2020 (all bars assembled add up to 100%)

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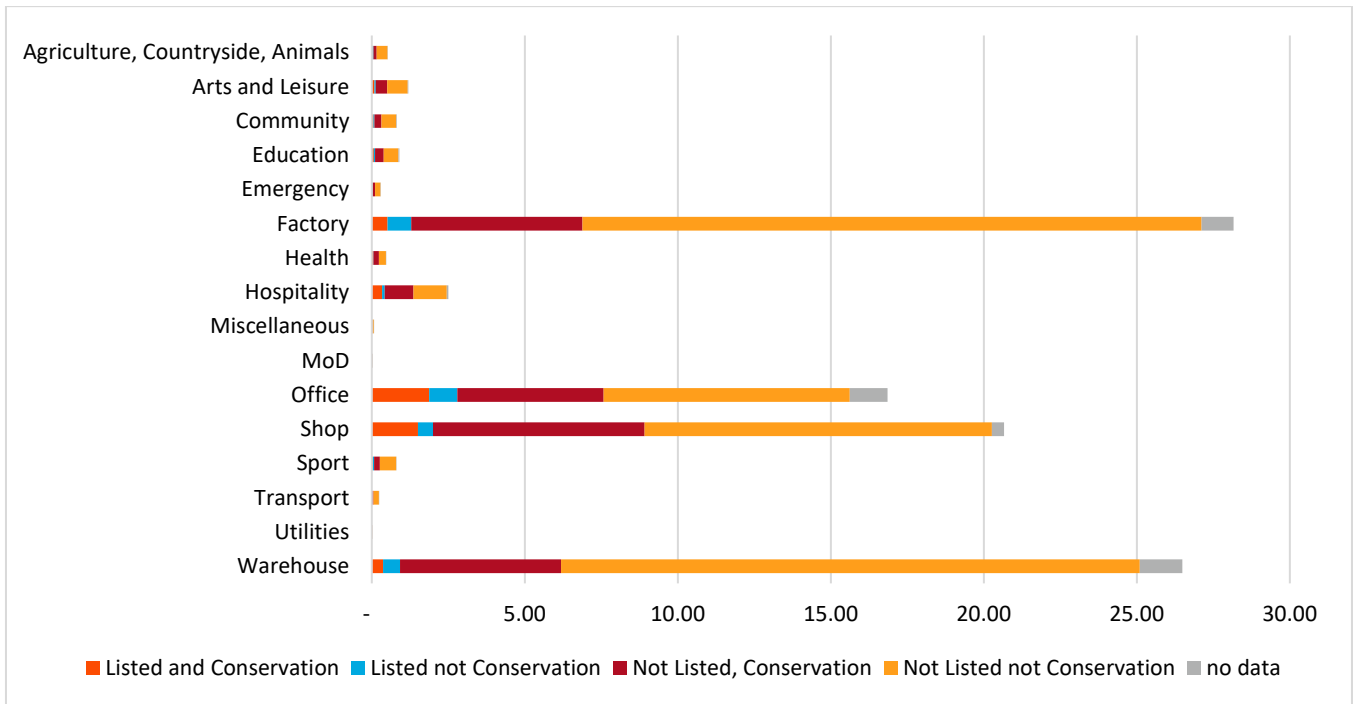


Figure 22 presents a similar set of data to Figure 20 and

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Figure 21, but this time shows the floor areas as a percentage of the total non-domestic floor area recorded by the VOA. This indicates that 30% of the total floorspace is made up of premises inside a building or an area with some sort of planning restriction, with Shop (9%) being the largest percentage of total non-domestic floorspace, followed by Office (8%), Factory (7%) and then Warehouse (6%).

Age

The age of non-domestic buildings will influence the retrofit costs. Retrofits of older buildings tends to be more expensive. The data on premises age by CaRB3 class has already been shown in

Figure 5 Percentage distribution of floor area by activity class and premises age, 2020

. Assessing how much floorspace might be liable for costly retrofits based upon age could be done by simply looking at the amount of floorspace that falls into the older age brackets. Using

Figure 5 Percentage distribution of floor area by activity class and premises age, 2020

, just for illustrative purposes, if 1985 is taken as the cut off with premises that pre-date this being considered more costly to retrofit then Health and Hospitality may incur significant costs for retrofits, with 83% and 73% of floorspace in their activity class being within this category. Transport and Factory are the next with 66% and 65% respectively. Sport (29%) and Utilities (32%) have the lowest percentage of floorspace in this pre-1985 category.

If the buildings in the 1940-1985 bracket are considered to be less costly and the cut off for 'costly older retrofits' is moved to pre-1940, then it is again Health and Hospitality that stand out as having the most floorspace in this category (64% and 51% respectively). Shop is the next largest class with 34% of floorspace being pre-1940 followed by Education (33%), Community (27%) and Arts and Leisure (25%). Utilities has the lowest amount of pre-1940 floorspace (1%) followed by 'Agriculture, Countryside, Animals' (7%) and Warehouse (9%). Note that 'Agriculture, Countryside, Animals' should be treated with caution since 72% of the floorspace in this category has no age recorded.

If the non-domestic stock is treated as a whole, then the picture is slightly different as indicated by

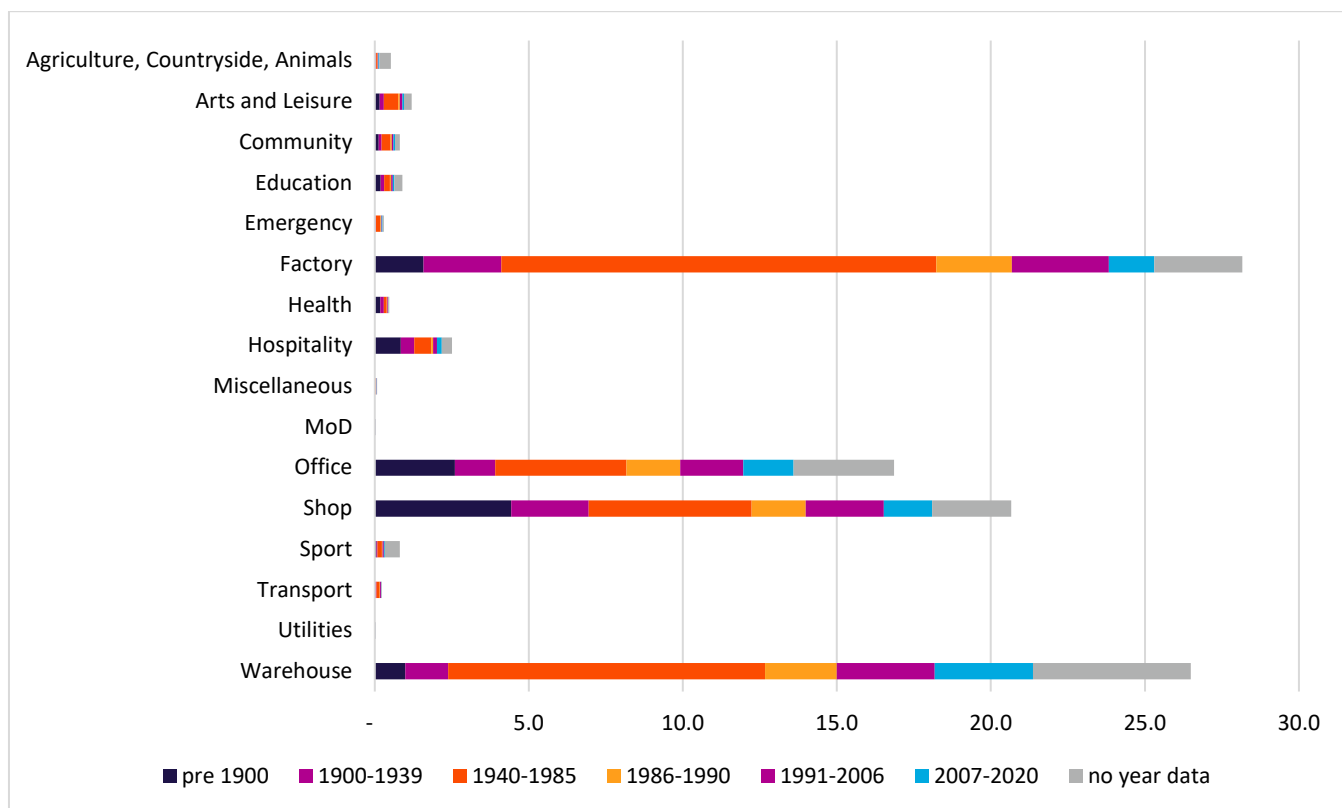
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Figure 23. If premises pre-1985 are considered to be costly to retrofit the Factory class in this category represents 18% of all non-domestic floorspace according to the VOA data.

Warehouses are next (13%) followed by Shop (12%) and Office (8%). If a pre-1940 period is considered as the cut-off then Shop represents the largest percentage of total non-domestic floorspace (7%) followed by Office (4%) and Factory (4%)

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Figure 23 Percentage distribution of total non-domestic floor area by CaRB3 class, using VOA age to classify the premises, 2020 (all bars when assembled add up to 100% of non-domestic floor area).



Materials and Construction

Within the VOA data there are fields relating to the walls, roof and structure materials/systems. These are not always filled and the coding can be complex to decipher. For the sake of simplicity, a basic classification was carried out to assign a retrofit 'complexity' to these on the scale of 1 to 3. For example, the material 'Stone' was assigned a complexity of 3 to indicate that working with this material (for example in order to reduce heat loss) would be more complex than say for 'Brick' which was assigned a complexity value of 2. These complexity scores were then assembled for the premises to give a very basic score from C1 to C9 (the sum of the scores for structure, walls and roof) as to how complex upgrading this material/system combination might prove to be, with 9 being the most complex. Some of the data lacked values or it was not possible to provide a score and so these are left as no data or unsure data. The classifications are detailed in Annex 4 – Valuation Office Agency construction codes and possible effects on retrofits, in Table 30. The results are shown in Figure 24 and Figure 25.

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Figure 24 Percentage distribution of floorspace by CaRB3 class, using the complexity of retrofitting the wall, roof and structure materials to classify the premises, 2020. C9 is the highest complexity with C1 the lowest complexity.

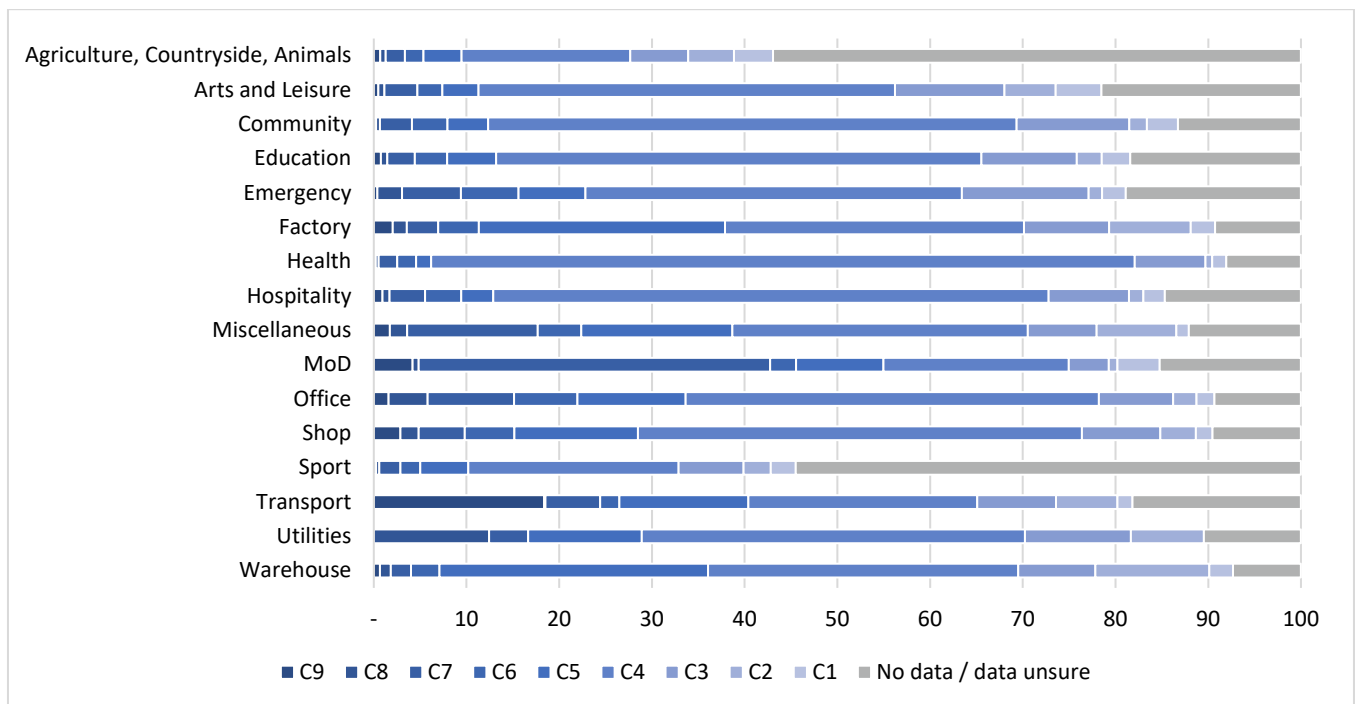
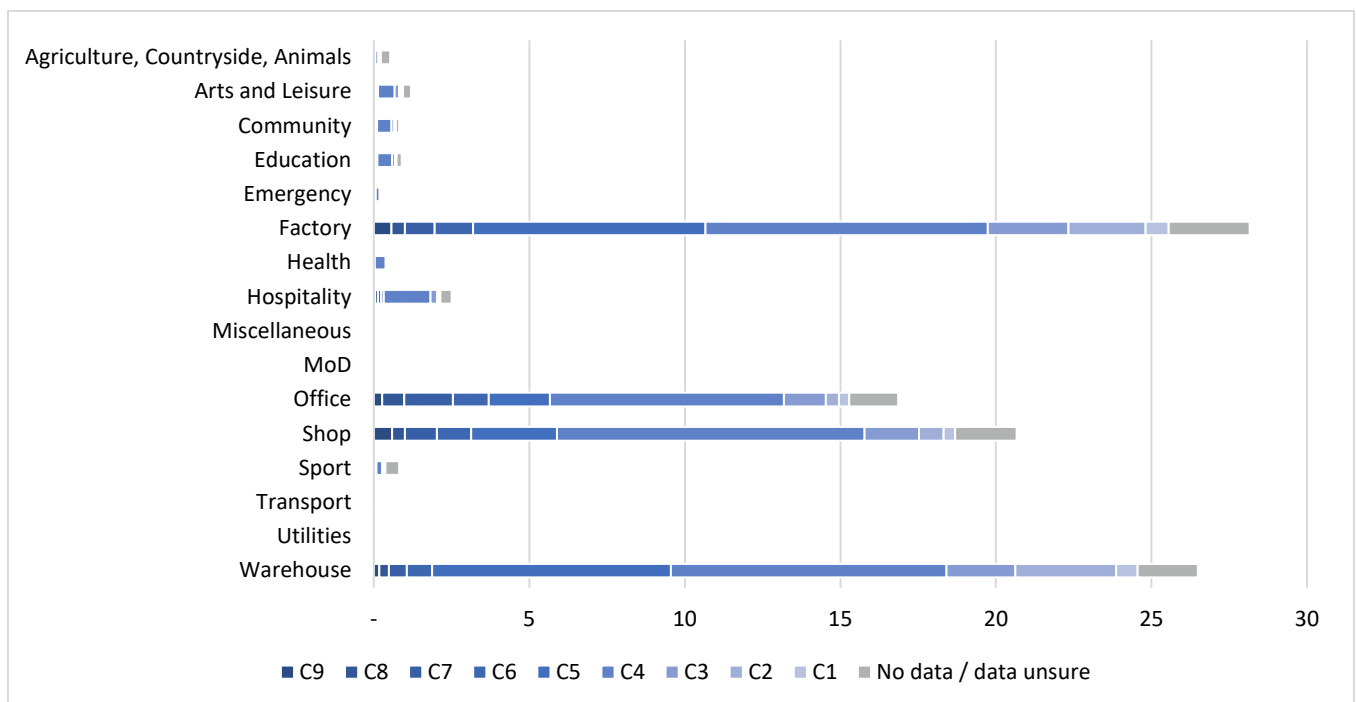


Figure 25 Percentage distribution of total non-domestic floor area by CaRB3 class, using the complexity of retrofitting the wall, roof and structure materials to classify the premises, 2020 (all bars when assembled add up to 100% of non-domestic floor area). C9 is the highest complexity with C1 the lowest complexity.



Whilst the results shown in **Error! Reference source not found.** and

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Figure 25 should not be considered anything more than crude estimates, there are some patterns that can be observed. ‘Agriculture, Countryside, Animals’ and Sport are both lacking data for more than 50% of their floorspace and as a result these classes need more data before further analysis. For most of the other CaRB3 classes the largest share of the floorspace falls into the C4 category. The exception is the MoD class where the largest floorspace percentage is in the C7 bracket. When the floorspace is treated as a percentage of all non-domestic floorspace (

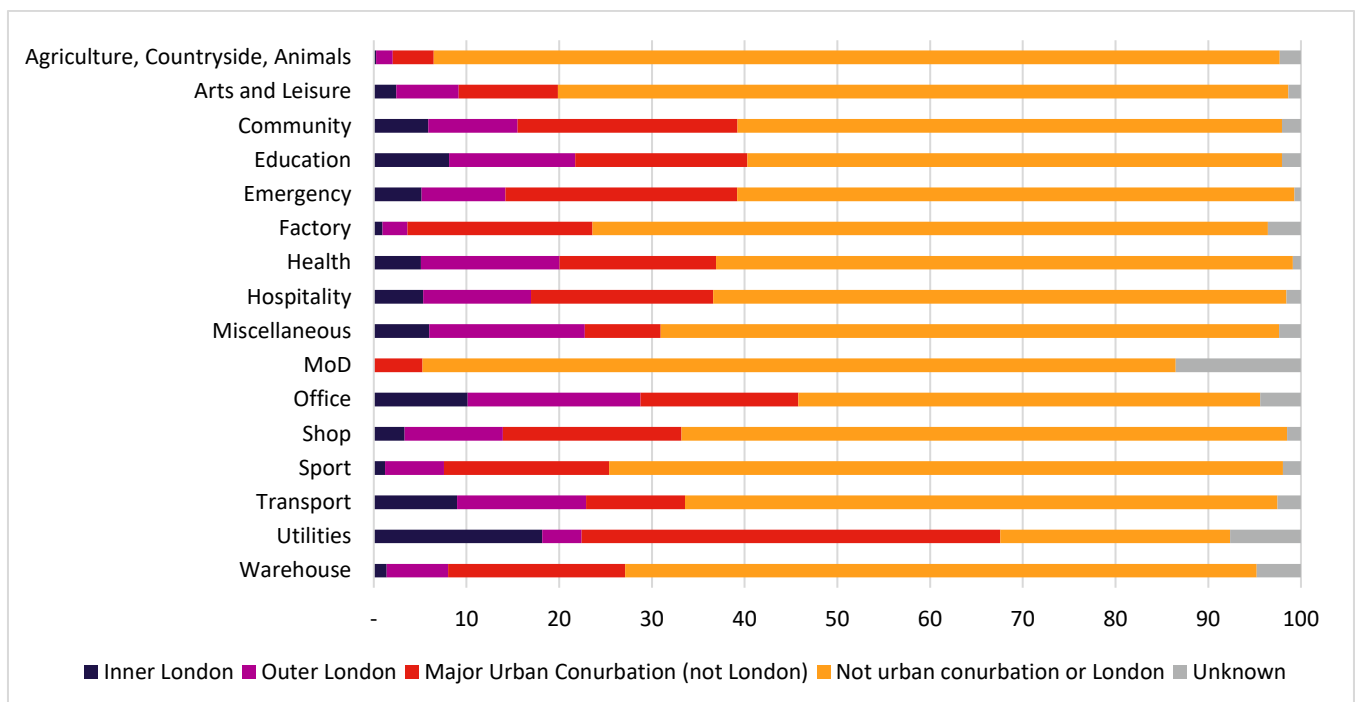
Figure 25), Shop, Office Factory, Warehouse and Hospitality all have the largest percentages of total floorspace in the C4 and C5 brackets.

Inner Urban

Retrofit work in inner urban areas can result in higher than average costs due to restricted access to buildings. On the other hand, denser urban areas may be more suitable to alternative heating solutions such as district heating.

In Figure 26 the geographic locations of the premises have been aggregated by whether they are within Inner London, Outer London, a non-London major urban conurbation or none of these. The results show that Utilities has its largest percentage of floor area occurring in Inner London (18%) followed by Office (10%) Transport (9%) and Education (8%). When Inner London, Outer London and other (non-London) major urban conurbations are combined then the ranking is very similar, with Utilities (68%), Office (46%), Education (40%) and Community (39%) being the CaRB3 classes with the largest amount of VOA floorspace in these urban areas.

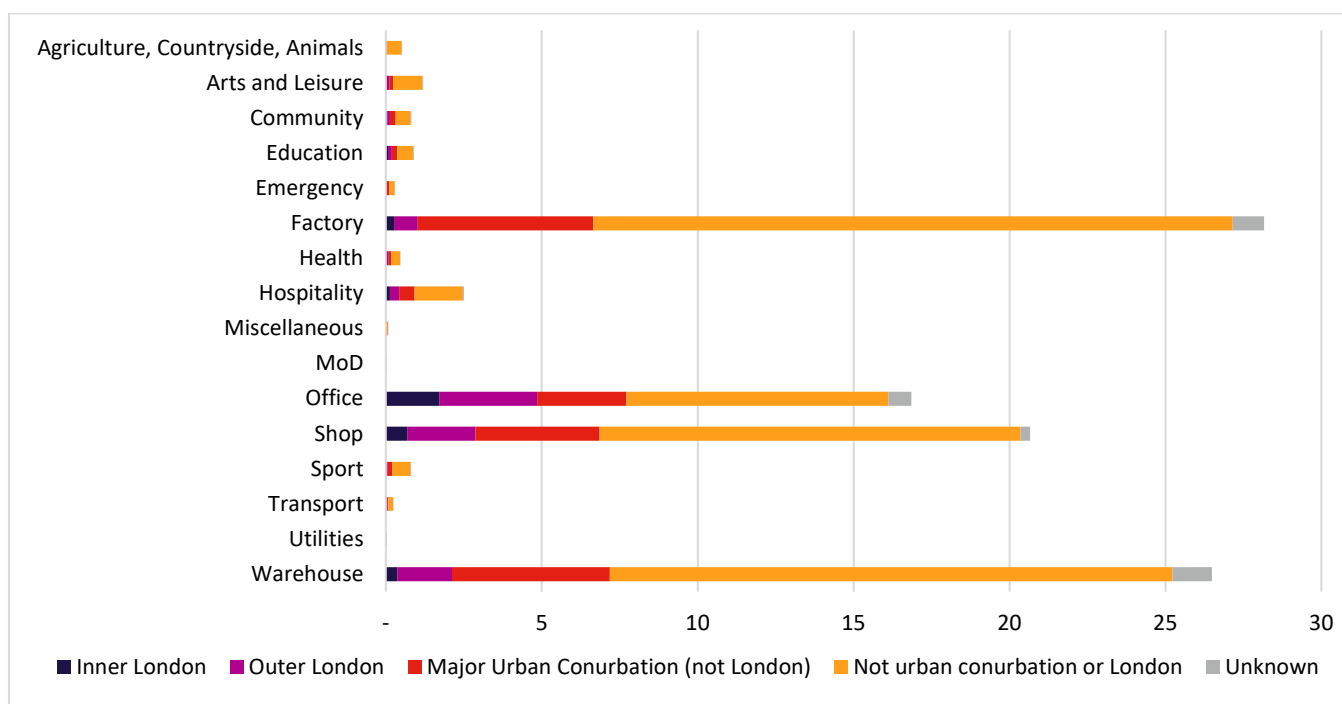
Figure 26 Percentage distribution of VOA floorspace by CaRB3 class, using London and major urban conurbations to classify the premises, 2020



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The same data as Figure 26 are also analysed in Figure 27, but this time the floorspace is shown as a percentage of all VOA non-domestic floorspace. The four 'bulk' classes of non-domestic activity stand out here. Within Inner London Office represents 2% of all VOA floorspace, followed by Shop (1%). When Inner London, Outer London and other (non-London) major urban conurbations are aggregated then the top classifications are Office (8%) followed by Warehouse (7%), Shop (7%) and Factory (7%).

Figure 27 Percentage distribution of total VOA non-domestic floor area by CaRB3 class, using the London and major urban conurbations to classify the premises, 2020 (all bars assembled add up to 100%)



Connection to the Natural Gas Grid

The lack of connection to the gas grid for non-domestic premises is reported in **Error! Reference source not found.** Using this approach, it is possible to extend the analysis by identifying premises that are in an 'off-gas grid' postcode and have no gas meter or listing of gas within the VOA fuel used codes. Thirteen percent of the total VOA floor area has been identified as being 'off-gas' using this method and this is largest in Factory (4%), Warehouse (4%) Shop (2%) and Office (2%).

The question, "Can 'off-gas' premises be connected to the gas grid?" is more complex than the analysis possible using this dataset. It may be that premises in a dense urban environment, which are close to an existing gas grid are more expensive to connect (due to road closures etc) than premises in rural areas. Nonetheless a measure of distance has been used to indicate the 'difficulty' of connecting off-gas premises to the gas grid.

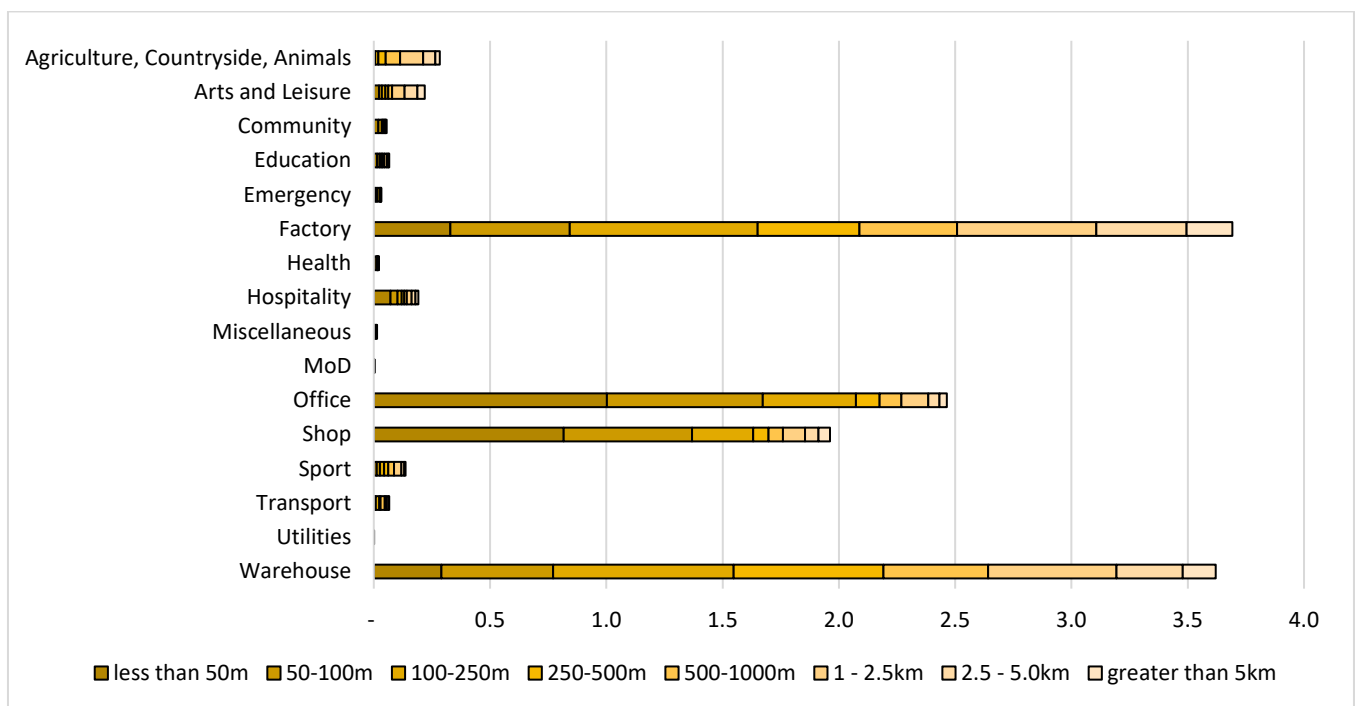
Data on existing gas network routes was not available (to calculate distance from the gas network), so instead the location of these off-gas premises was then matched to the nearest

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'on-gas address' (domestic or non-domestic) with a matching gas meter (MPRN) and the distance between the two was calculated. The results are shown in Figure 28 indicating the percentage of all non-domestic floor area assigned to off-gas premises aggregated by CaRB3 class and groups of the distance to the nearest on-gas address. This chart suggests that 10% (of the total 13% of off-gas VOA floor area) is within 1km of the nearest address connected to a gas meter. Most of the off-gas Office and Shop floorspace is within premises that are within 500m of an address with gas (2% and 1.7% respectively). In terms of the cost of digging trenches and laying gas main, these distances are not insignificant.

For all CaRB3 classes combined the remaining 3% of the total floorspace is occupied by off-gas premises more than 1km from the nearest address that does have gas. This 3% is largely dominated by Factory (1%) and Warehouse (1%).

Figure 28 Percentage distribution of total VOA non-domestic floor area by CaRB3 class, for 'off-gas' premises shaded by distance to nearest address which does have a gas meter 2020 (on-gas premises are excluded hence the floorspace percentages are low relative to the whole non-domestic stock)



Colocation with Industrial Processes

Quantifying industrial process and waste heat potential

Identifying premises with industrial processes or waste heat is not straightforward. There is no single value that can be used to identify this. One approach is to use a proxy for this by trying to identify floorspace within premises might contain machinery or equipment used for industrial processes or which generates significant waste-heat. The accommodation use codes (sub-divisions of premises), from the VOA can be employed here to make an estimation of the amount of floorspace that might be used in this way. For example, a Warehouse might have significant – but not all – floorspace assigned to the accommodation use 'Chill Store' where large refrigeration units will generate waste heat (through the cooling process). Whilst this

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waste heat is probably not currently captured and re-purposed (for example directed to another part of the premises or a neighbouring premises that could use low grade heat for space heating), this approach can be thought of as an attempt to identify the 'potential' (for waste heat generation) within each premises.

The probability that any given accommodation use might be a source of waste heat is, for the current state of the research a simple 'probably available' ('1') or 'may be available' flag ('2'), or a null for where there is thought to be no prospect of waste heat, such as outdoor areas. As process energy can be a source of waste heat, there is a significant overlap, such that it may be expected that some types of process heat would degrade to a level making it unsuitable for further process use but still useful to capture as waste heat for re-purposing; for example, from hot processes in factories, repurposed to space heating. In addition to the current simplistic probability categorisation of its existence, there is also an estimation of whether the source of waste heat is likely to be seasonal, such as in an air-conditioned office that may be heated in the winter but provide the potential to capture waste heat dumped from chillers in the summer. Again, this is a simple categorisation of 'likely not seasonal' ('1'), 'probably seasonal' ('2') and 'probably highly seasonal' ('3'), or null where no waste heat is thought to be available. Given the opportunity for further research, this field could have an actual probability value attributed to each premises sub-division (accommodation use code).

The codes are detailed in Table 29 in the Annex 3 – Accommodation Use Codes (sub-divisions within premises) and the basis of these estimates of the availability of waste heat is previous research into the characteristics of electrical appliances (non-heating and non-cooling) found in premises' sub-activity spaces¹⁴. That research indicated areas of premises containing equipment used for 'process' had high electrical energy use intensities (kWh/m²/year). Also, unsurprisingly, the 'process' energy use had high correlations with 'process' activity spaces, i.e. there was a lot of process energy being used in the process areas of premises. The method applied in this current work, to quantify sources of waste heat, is based on the sub-divisions of premises' floor areas (the accommodation uses) that may have high levels of incidental internal heat gains from energy-using equipment, not the overall floor area of the premises. Thus, office premises with a large server room may be a useful source of waste heat, whilst offices without server rooms might not be.

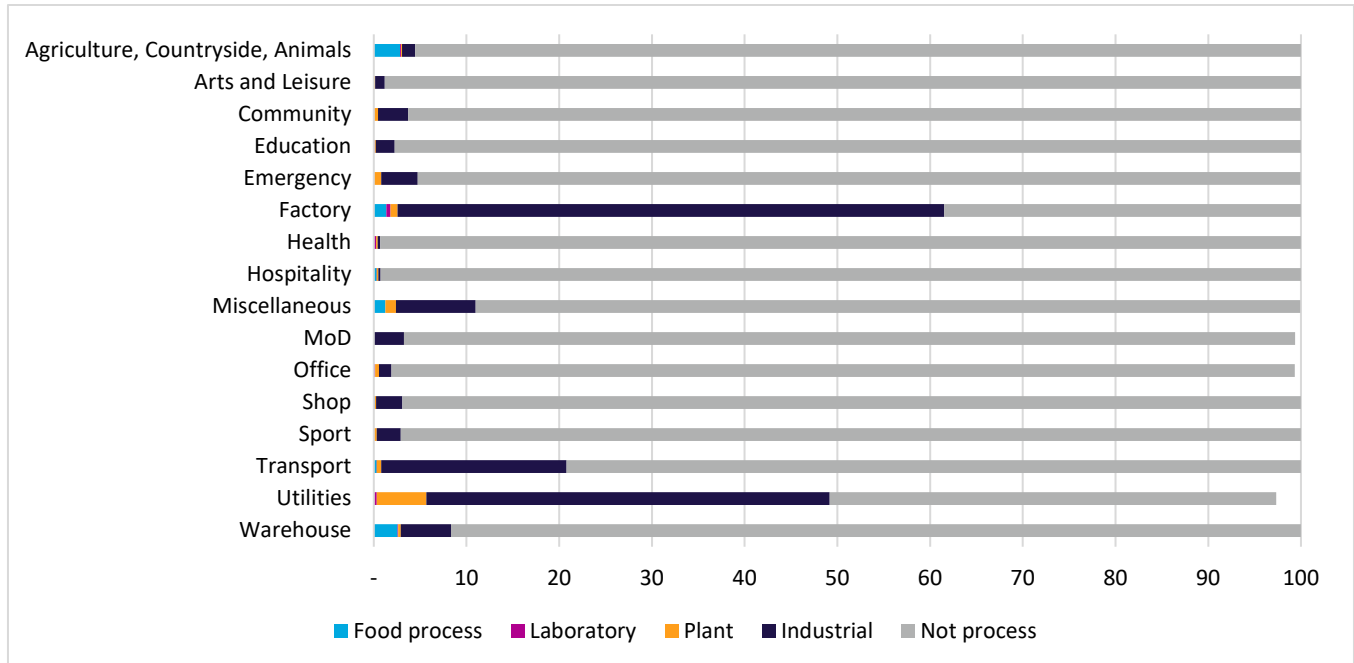
Using this approach, it is possible to run queries across the whole of the VOA floorspace to identify some of these accommodation use codes that are categorised in this way (as 'process/waste-heat'). Compared to the total floorspace in the VOA around 79% is considered to be 'not industrial process' using this method and 19% is classified as 'Industrial' (which includes the 'Production area' and 'Workshop' floorspace in the accommodation use codes). Around 1% of the total floor area is classified as 'Food processing' which includes the accommodation uses codes of 'Food processing areas', 'Chill Store' and 'Cold Store'. Using this method very small percentages (less than 1%) of total floor area are attributed to

¹⁴ Characterising Space Use and Electricity Consumption in Non-domestic Buildings: <https://www.tandfonline.com/doi/full/10.1080/09613218.2013.817112> and <https://dora.dmu.ac.uk/handle/2086/6105>

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'Laboratory' or 'Plant' accommodation use code activity, both of which are considered 'process/waste-heat' spaces.

Figure 29 Percentage distribution of VOA floorspace by CaRb3 class, using VOA accommodation use code floorspace aggregated into potential waste heat groupings to classify the premises, 2020



When distribution of this potential waste heat floorspace is calculated as a percentage of the total floor area per CaRB3 class, this results in Figure 29. Factory is the only classification that has more than half of all floor area assigned to some sort of process/waste heat activity (59% 'Industrial', 1% 'Food processing' and 1% 'Plant'). This is followed by Utilities (44% 'Industrial', 5% 'Plant'), Transport (20% 'Industrial') and then Warehouse (5% 'Industrial' and 3% 'Food processing').

The CaRB3 classes with the lowest percentages of floor area that might be considered useful for process energy/waste heat capture are Hospitality, Health, Arts and Leisure, Community, Office and Sport. However, there will be some premises that could be a useful source of waste heat, which are effectively hidden in the aggregated data. For example, office premises with substantial server rooms ('Computing' in the accommodation uses), despite 'computing' not generally being seen as a 'process' energy use.

Industrial Process, Waste Heat and Co-location with Other Non-domestic Premises

Identifying cases where process/waste-heat is co-located with other premises could be carried out in a number of different ways (depending upon the interpretation of 'co-located'). For this report, HMLR polygons were used to cluster premises. These HMLR property polygons were combined with the method outlined in the previous section to identify 'sites' with 'process or waste-heat' floorspace. A threshold of at least 25% of the premises' floorspace being assigned to this 'process or waste-heat' was set, thus excluding premises with smaller proportions of

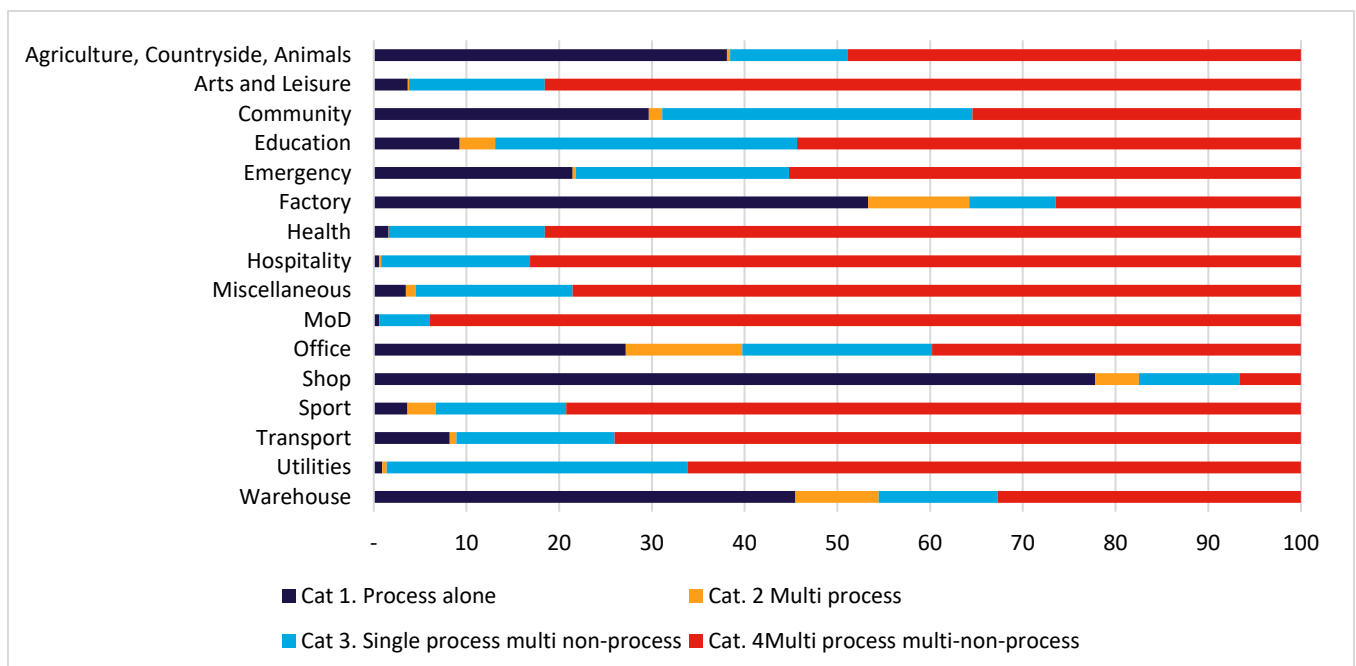
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such floorspace. There are a number of different potential relationships between the premises and the HMLR polygon. These premises might exist alone within an HMLR polygon or there can be other VOA premises sharing the HMLR polygon. When there are other premises these may also have ‘process or waste-heat’ floorspace whilst others might not. The data for all premises within each of these sites were gathered and the premises were then classified into one of four relationships categories:

1. a single premises with at least 25% of its floor area is identified as ‘process or waste-heat’
2. multiple premises *each* with at least 25% of floor area (of each premises) identified as ‘process or waste-heat’
3. a single premises (with at least 25% of its floor area identified as ‘process or waste-heat’) sharing the site with *one or more other premises with no ‘process or waste-heat’*
4. multiple premises *each* with at least 25% of floor area (of each premises) identified as ‘process or waste-heat’, sharing the site with *one or more other premises with no ‘process or waste-heat’*

The results of these calculations are shown in Figure 30. This indicates that for the total ‘process or waste-heat’ floor area in each CaRB3 class, category 4, above, is the most common, apart from for Community, Factory, Office, Shop and Warehouse. Seventy-eight percent of all process or waste-heat floorspace for Shop is associated with premises that are *not* co-located with other premises (within the HMLR boundary) category 1 above. Also in category 1, Factory is the next largest with 53% of all process or waste-heat floorspace being allocated to premises that are *not* co-located with other premises, followed by Warehouse (46%). There are other methods to test ‘co-location’ that could be employed depending on the intention of the research question.

Figure 30 Percentage of ‘process / waste-heat’ floorspace aggregated into groupings where HMLR boundaries contain or eliminate other non-domestic premises.



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There can be a range of sites that fit into the four categories, outlined above and shown in Figure 30. Note that this analysis might involve a premises with 'process / waste heat' floorspace but existing without any other premises within the boundary. It can involve multiple premises with 'process / waste heat' floorspace but no other premises that do not include 'process / waste heat' floorspace. Or it can include combinations of premises with 'process / waste heat' floorspace and premises with zero 'process / waste heat' floorspace (who might be willing third party recipients of waste heat) within the HMLR boundary.

The above classifications have been visualised in Figure 31, which shows some of the sites identified with 'process/waste-heat' floorspace along the Lea Valley, near Tottenham in Greater London. The map shows all non-domestic premises as coloured points. Added to this are the sites with potential 'process/waste-heat' floorspace identified by the red shading 'Heat map'. The more intense red colouring is associated with larger 'process/waste-heat' floor areas. The polygons outlined in black are HMLR boundaries.

Figure 31 Heat map showing the density of VOA floorspace assigned to process/waste heat on HMLR sites co-located with VOA activity, along the Lea Valley, Tottenham, Greater London, 2020. The stronger the red colour, the larger the 'process/waste-heat' floor area that has been identified.

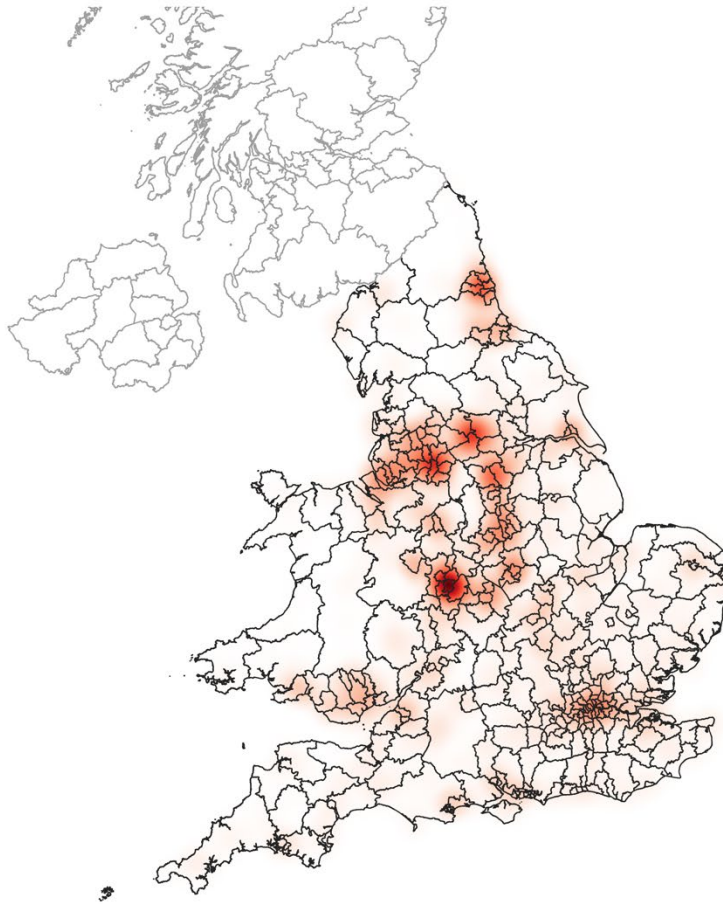


Figure 32 presents the same process/waste-heat 'heatmap' data as Figure 31 but at a smaller cartographic scale and with the VOA premises and HMLR data removed (for the sake of clarity). The colouring of the heatmap shows, at a much more general level, the parts of England and Wales that have premises which meet the criteria set out in this section. This

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suggests that whilst south Wales, Greater London and parts of the Midlands offer potential for the use of process/waste-heat, it is in particular Birmingham, Leeds, Manchester, Stockport, Newcastle upon Tyne and Sunderland that have the more intense concentrations of this 'process/waste-heat' potential.

Figure 32 Heat map showing the density of VOA floorspace assigned to process/waste heat on HMLR sites co-located with VOA activity, England and Wales only, 2020



Occupier Churn

The frequency with which the occupiers of premises change (churn) is difficult to establish using the available data. Within the VOA data it would be possible to look for changes over time if previous or subsequent years of VOA data were available (rather than a snapshot of the data around March 2020). However, this approach would be reliant on clear and obvious changes to the premises data. There is no flag known to us within the VOA data that indicates a change of occupant. This is because the VOA is only responsible for the valuation process, not the collection of business rates, as this falls to each local authority, which will usually have a good indication of the name of the occupier. Furthermore, the property name is often simply listed as, for example, 'OFFICE & PREMISES' or 'UNIT 1' rather than a business name. This means that the owner or tenant could change, but the VOA data could remain unchanged. Equally, a business might adapt their trading name without it indicating a change to the

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occupant of the premises. Instead, other linked datasets are required to answer this question of turnover of occupants of premises.

Turnover and IDBR data

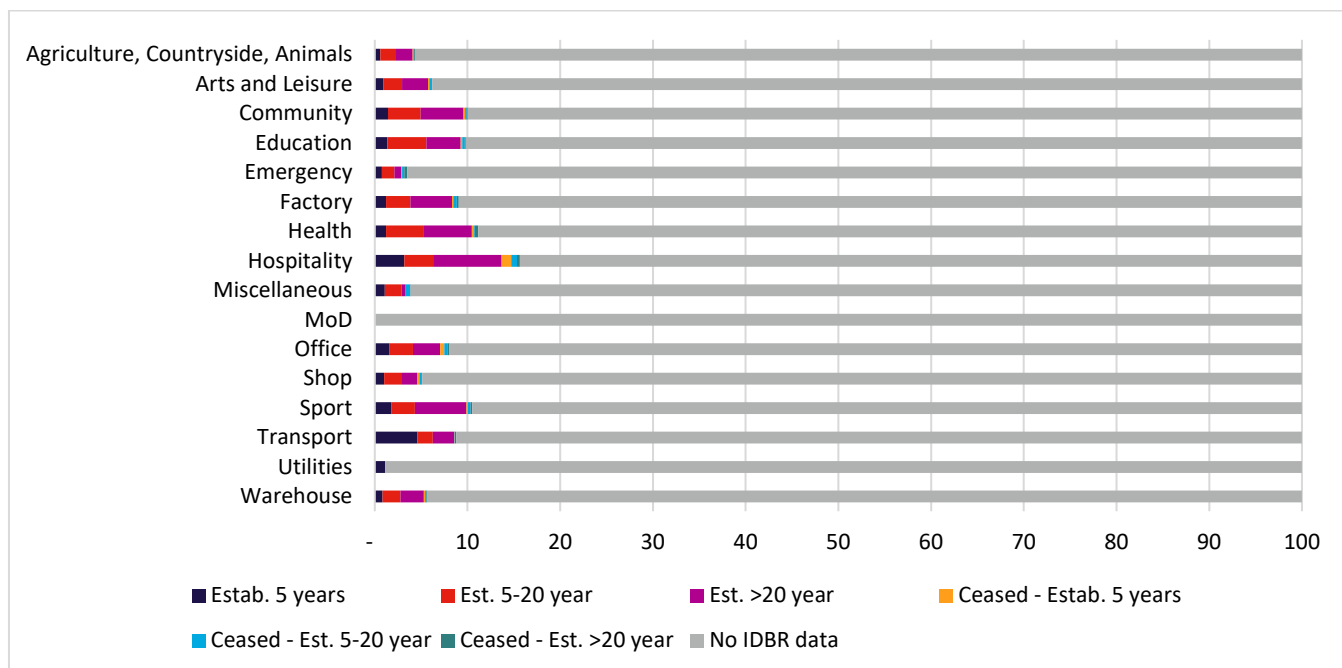
The IDBR data offers the opportunity to check 'birthdate' and 'deathdate' of a business which can be an indication of turnover. However, the matching rates between IDBR data and NDBS have been extremely low, meaning that any analysis using the IDBR is based upon a much smaller sample of non-domestic premises and one which may be biased due to the nature of the success or failure of the address matching weighted by the business name. For the records that do make a match it was possible to use 'birthdate' and 'deathdate' to establish some basic classifications of:

- 'Established < 5 years',
- 'Established 5 - 20 years',
- 'Established > 20 years',
- 'Ceased. (Business was established < 5 years)',
- 'Ceased. (Business was established 5 - 20 years)',
- 'Ceased. (Business was established > 20 years)',

Using these categories, the percentage of floorspace per CaRB3 class can be seen in Figure 33. Whilst 93% of the VOA floorspace does not currently match to IDBR business addresses the 7% of floorspace that does match is dominated by the 'Established > 20 years' category (3%). Around 0.5% of floorspace has ceased trading in the two years prior to the model date (i.e. between April 2018 and April 2020). Most of this is in the four bulk classes of Factory, Office, Shop and Warehouse followed by Hospitality. For these premises that have ceased trading according to the IDBR data, it is not known if these premises are now occupied by new businesses that have not yet appeared in the IDBR data or whether some of these premises are now vacant but the VOA records have not yet been fully updated.

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Figure 33 Percentage distribution of VOA floorspace by CaRB3 class, using IDBR ‘birthdate’ and ‘deathdate’ to produce classifications 2020



Within the individual CaRB3 classes shown in Figure 33, the largest percentages of floorspace per class are for premises that were established over 20 years ago. Hospitality, Sport, Health and Community have the largest values here (with 7%, 6%, 5% and 5% respectively).

Transport and Hospitality have the highest values of floorspace that are occupied by businesses established less than 5 years ago (5% and 3% respectively). Hospitality is the activity class with the largest percentage of floorspace that has ceased trading with businesses less than 5 years old (1%) and businesses 5 to 20 years old (1%).

If the ceased trading IDBR records are calculated as a proportion of all the IDBR matches per CaRB3 class then Community, MoD, Utilities, Transport and ‘Agriculture, Countryside, Animals’ show the lowest proportion of floorspace attributable to businesses ceasing to trade.

Turnover and HMLR Data

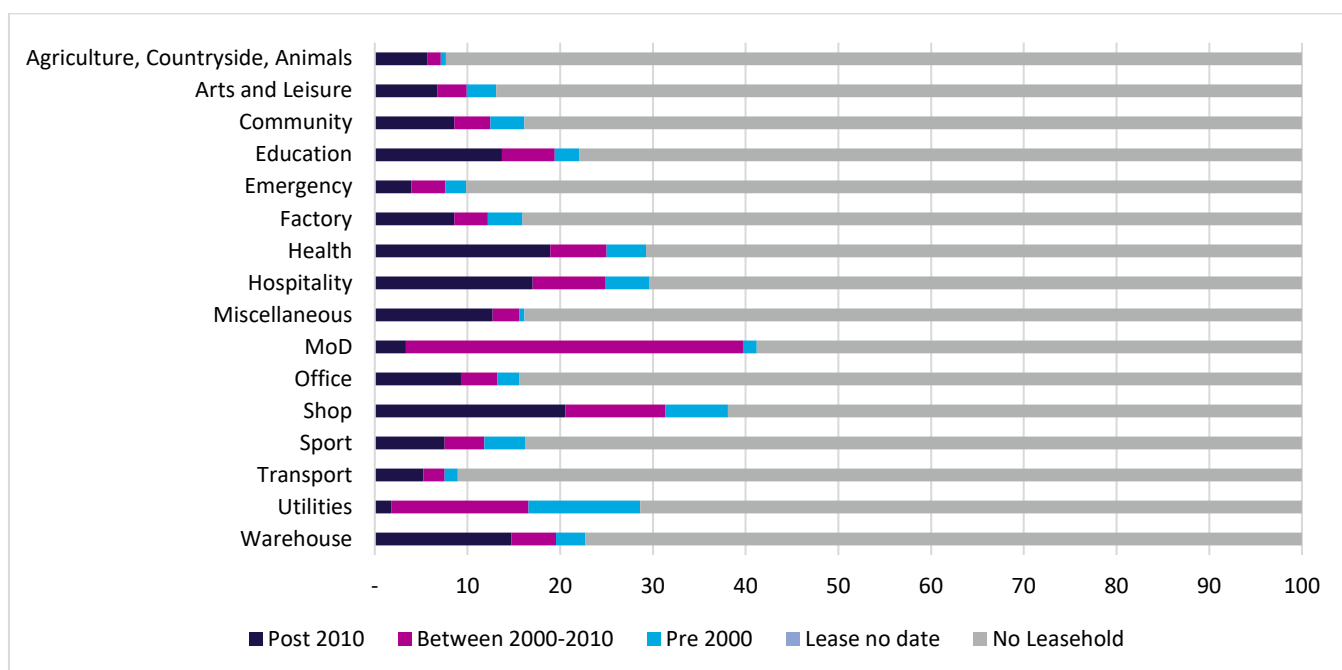
The HMLR publishes lease data which includes any leases over 7 years’ duration. Whilst these data should not be interpreted as leases between a premises owner and an occupier, the data are useful to identify leases that are relatively recent compared to older leases. Figure 34 shows this analysis. Around 77% of all floorspace is not linked to an HMLR lease. This does not mean that the property does not have a lease (it could have a lease of less than 7 years). Alternatively, it might be a freehold ownership not requiring a lease. For the premises that do have a link to a lease, 13% of all VOA floorspace has a lease established since 2010 with 6% having a lease between 2000 and 2010 and 4% having a pre- 2000 lease agreement. The length of each leases is recorded, but due to the fact that this is free text it is not simple to make calculations from this field.

Within Figure 34 the percentages of floorspace per CaRB3 class is shown. Shop (21%), Health (19%), Hospitality (17%) and Warehouse (15%) have the largest proportion of floorspace

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assigned to a post-2010 lease whilst Utilities (2%), MoD (3%) and Emergency (4%) have the lowest. MoD has the largest amount of floorspace assigned a lease between 2000 and 2010 (36%) with Utilities (15%) and Shop (11%) following on. Pre-2000 leases tend to be assigned to less floorspace per CaRB3 class, with Utilities (12%), Shop (7%) and Hospitality (5%) being the largest. The CaRB3 classes with the largest percentage of floorspace that does not link to an HMLR lease are 'Agriculture, Countryside, Animals' (92%), Transport (91%), Emergency (90%) followed by Sport, Office, Factory and Community (84% each).

Figure 34 Percentage distribution of VOA floorspace by CaRB3 class, using HMLR lease data split by date of lease to classify the premises, 2020



Turnover and EPC Data

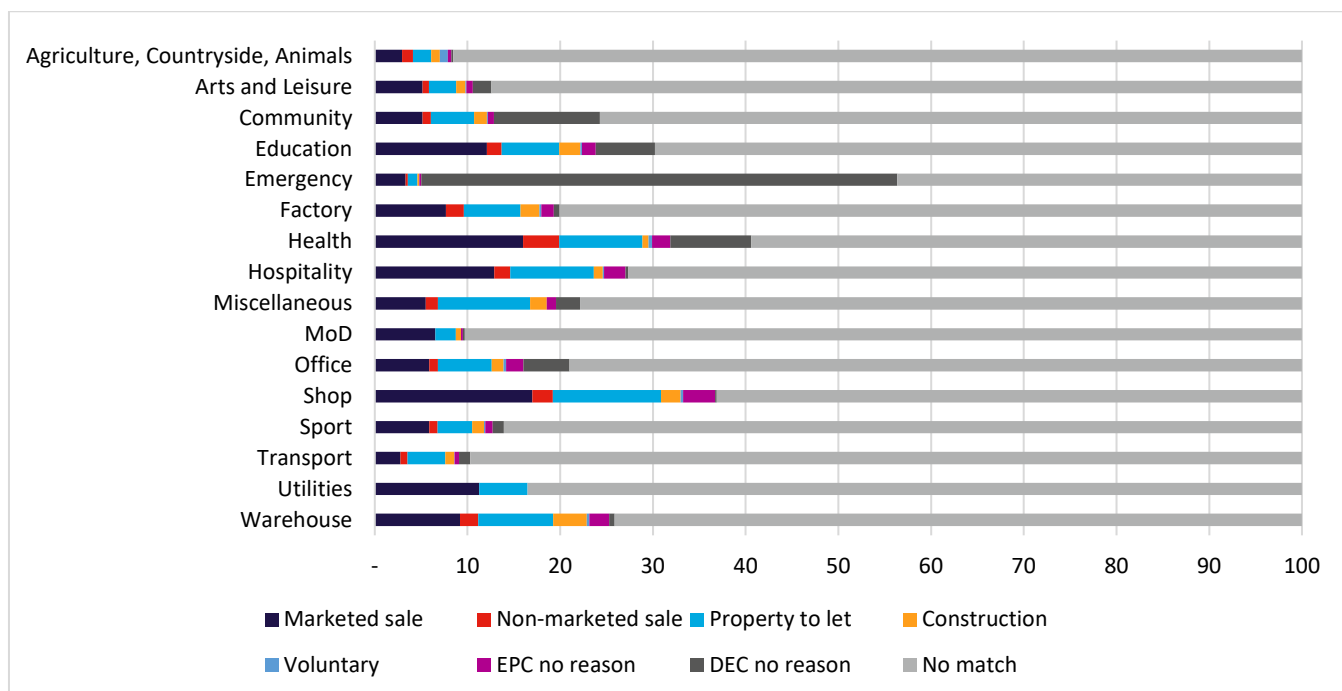
Within the EPC data there is a field for 'Transaction type' for which there are a range of options including:

- 'Mandatory issue (Marketed sale)',
- 'Mandatory issue (Non-marketed sale)',
- 'Mandatory issue (Property to let)',
- 'Mandatory issue (Property on construction)',
- 'Voluntary (No legal requirement for an EPC)',
- 'Voluntary re-issue (A valid EPC is already lodged)',
- No value (transaction type not recorded)

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Linking the EPC data to the non-domestic premises and then using this field to classify the most recent EPC or DEC shows that whilst 75% of all non-domestic floorspace has no EPC or DEC certificate associated with it, for the remaining 25% it is possible to identify the CaRB3 classes allocated to these ‘Transaction types’, as shown in Figure 35.

Figure 35 Percentage distribution of VOA floorspace by CaRB3 class, using links to the most recent EPC for the Transaction type field to classify the premises, 2020



Overall, for the 25% of total floorspace associated with premises that do make a match to an EPC or a DEC, 10% are ‘Marketed sale’ and 8% are recorded as ‘Property to let’ for the transaction type in the EPC. ‘Construction’ amounts to around 2% of floorspace whilst another 4% are through EPCs with no transaction type reason (2%) or DEC which do not have a transaction type field (2%).

Figure 35 indicates the percentages of floorspace per CaRB3 class. Emergency, Community, Health and Education all have the largest percentages of floorspace assigned to a DEC (51%, 11%, 9% and 6% respectively). For EPCs triggered by ‘Marketed sale’ Shop (17%), Health (16%), Hospitality (13%) and Education (12%) have the largest proportions of class floorspace. For EPCs triggered by ‘Property to let’, Shop (12%), Hospitality (10%), Health (9%) and Warehouse (9%) have been identified. Warehouse is the classification which shows the largest percentage of floorspace through ‘Construction’ triggering the EPC (4%) followed by Education (2%) Shop (2%) and Factory (2%). However, there are several classifications where the amount of floorspace assigned to premises with no EPC or DEC matched is significant with ‘Agriculture, Countryside, Animals’ (92%), Transport (90%), Arts and Leisure (87%) and Sport (86%) being the largest. This may be an indicator that turnover of occupants is low in these CaRB3 classes.

Annex 1 – CaRB3 activities and classes

Table 28, below, gives a full list of CaRB3 classes, activities and CaRB3 codes (for use with Figure 36 and Figure 37), together with counts of premises and summed floor areas, where these are present. Floor areas given as ‘0.00’ indicate that the summed floor areas amount to less than 10,000 m², whilst ‘–’ indicates that no floor area data appear for that CaRB3 activity, or that the inclusion of the data would be disclosive. Note that Table 28 is ordered by CaRB3 close, which means that some CaRB3 Classes appear more than once in the list (e.g. Miscellaneous), but there is only one instance of each CaRB3 code and CaRB3 activity.

It is reiterated, here, that some Valuation Office Agency – and thus CaRB3 – categories do not generally have any recorded floor areas, but there may be a small number of premises that have, for some reason, had a floor area recorded, such as ‘State School’ (code ED01) with nearly 23,000 premises but barely 10,000 m² of total recorded area. Therefore, simple calculations, based on total area divided by the count of premises, will in some cases not produce an average floor area for the CaRB3 activity.

Table 28 All CaRB3 classes and CaRB3 activities along with count of premises and total floorspace according to the VOA 2020.

Note that whilst floorspace is reported, some activities (e.g. State schools) will have unfeasibly low floor areas due to the methods used by the VOA to produce rateable value¹⁵.

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
Agriculture, Countryside, Animals	Stables and Loose Boxes	AG01	5,732	0.59
	Kennels and Catteries	AG02	4,243	0.20
	Stables, riding	AG03	4,257	1.27
	Veterinary Clinic / Animal Clinic	AG04	1,617	0.42
	Racing Stable / Stud Farm	AG05	1,282	0.36
	War Games Course/ Misc Agricultural Use	AG06	361	0.01

¹⁵ It should also be noted that not all premises have records that include data describing physical characteristics of those premises. Whilst shops, offices, factories and warehouses will almost always have data on floor space, floor level(s) or storeys, etc. some important classifications such as pubs, hotels, hospitals, schools and universities, will not have these data on physical characteristics. This situation has an effect on subsequent analyses of floorspace.

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CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Livestock market	AG07	134	
	Animal Boarding	AG08	174	0.05
	Game Farm	AG09	118	0.01
	Bird Sanctuary	AG10	103	0.00
	Agricultural showground	AG12	52	0.00
	Fish Farm	AG13	53	0.01
	Pack house [packing agricultural produce]	AG14	19	0.16
	Specialist farming, horticulture, plant nurseries	AG15	24	0.01
	Hatchery/Poultry Farm	AG16	11	0.02
	Cattle Breeding Centre	AG17	1	
Arts and Leisure	Village hall, Scout hut, Guide hut	AR02	17,428	3.91
	Clubhouse	AR03	4,824	1.26
	Library	AR04	2,841	0.12
	Museum, art gallery, arts centre	AR05	1,754	0.05
	Snooker Hall/Club	AR06	716	0.39
	Tourist Attraction/Dark Ride	AR07	755	0.01
	Theatre, concert hall	AR08	808	0.00
	Stately Homes & Historic Houses	AR09	662	0.00
	Cinema	AR10	611	0.00
	Marina	AR11	434	0.00
	Bingo hall	AR12	374	0.00
	Boathouse	AR13	418	0.04

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CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Public Hall	AR14	357	0.13
	Bowling Alley	AR15	224	0.51
	Go Kart Rink	AR17	116	0.12
	Casino, gambling club	AR18	137	0.25
	Heritage Railway	AR20	101	
	Amusement/theme Park, Tourist attraction	AR21	84	0.00
	Zoo / Safari Park / Sea Life Centre	AR22	67	
	Windmills	AR23	51	0.00
	Miniature Railway	AR24	49	0.00
	Pleasure Pier	AR25	35	
	Roller skating rink	AR26	31	0.01
	Aquarium	AR27	29	0.00
	Arena	AR28	21	0.00
	Model Village	AR30	16	0.00
	Royal Palaces	AR31	16	
	Arts and Leisure NEC	AR99	1,101	0.28
Miscellaneous	Commercial NEC	CL99	1,299	0.31
Community	Community centre/Day centre	CO01	10,448	3.92
	Public Convenience	CO03	3,992	0.00
	Cemetery / Burial ground	CO04	2,502	0.00
	Undertaker, chapel of rest	CO05	1,817	0.46
	Law court	CO06	383	0.10
	Crematorium	CO07	301	0.00

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CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Municipal Occupation NEC	CO08	122	0.18
	Nursing/Care Home	CO09	110	0.01
	Prison/Young Offenders Institution/Detention Centre	CO10	144	
	Mortuary	CO11	48	0.01
	Community NEC	CO99	80	0.18
Education	State school	ED01	22,971	0.01
	Nursery, Creche, Playschool, Childcare	ED02	12,364	3.18
	Private School / College	ED03	2,737	0.81
	College (6th form, FE, HE, etc.)	ED04	1,386	0.20
	University	ED05	1,010	0.07
	School	ED06	20	0.03
	Training Centre (Non residential)	ED07	703	0.46
	Dance School / Centre	ED08	967	0.26
	Field Study, Activity and Adventure Centre	ED09	716	0.18
	Observatory/Telescope Site	ED10	182	0.00
	Training Centre (Residential)	ED11	183	0.01
	Religious Retreat/Study Centre (Residential)	ED12	137	0.01
	University Accommodation within Hospital	ED13	83	
	University Ancillary Land / Buildings NEC	ED14	54	0.01
	Agricultural Research Centre	ED15	64	0.01

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CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Archive	ED16	35	0.00
	Education NEC	ED99	293	0.09
Emergency	Police station	EM01	1,559	1.63
	Fire station	EM02	1,609	0.00
	Ambulance station	EM03	704	0.08
	Lifeboat Station	EM04	163	0.00
	Coastguard Station	EM05	51	0.00
Factory	Workshop	FA01	210,030	62.23
	Factory	FA02	30,656	87.44
	Vehicle repair workshop / garage	FA03	25,571	6.63
	Exhaust and tyre centre	FA04	2,399	1.06
	Concrete batching plant	FA06	837	0.00
	Scrap Metal/Breakers Yard	FA07	818	0.22
	Mineral Production - Rock, Sand, Clay etc.	FA08	984	
	Laboratory	FA09	554	1.14
	Post Office Sorting Centre	FA10	489	0.86
	Shipbuilding/ repair, boatyard	FA11	352	0.25
	Aggregate/Mineral Processing Plant / Depot	FA12	407	
	Food Processing Centre	FA13	215	0.73
	Brewery	FA14	225	0.21
	Chemical Works	FA15	146	0.25
	Abattoir / Slaughter House	FA16	208	0.66

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CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Mineral Production - Putrescible	FA17	176	
	Mineral Production - Inert	FA18	131	
	Concrete Product Works	FA19	121	0.00
	Industrial Minerals NEC	FA20	160	0.00
	Asphalt Plant	FA21	138	
	Works	FA22	28	0.46
	Provender Mill	FA23	98	0.09
	Brickworks / clay tile/pipe works	FA24	77	
	Concrete Block Works	FA25	66	
	Iron and/or Steel Works	FA27	33	0.03
	Flour Mill	FA28	62	0.02
	Foundry	FA30	55	0.43
	Pottery	FA31	48	0.37
	Newspaper print works	FA33	31	0.48
	Paper Mill	FA34	36	1.19
	Creamery	FA35	34	0.41
	Mineral Production - Oil	FA36	50	
	Mineral Production - Coal	FA37	27	
	Effluent Minewater Treatment Plant	FA38	50	
	Aircraft works	FA39	12	0.01
	Motor Vehicle Works	FA40	20	0.01
	Mill	FA41	10	0.04
	Oil refinery, gas processing etc	FA42	24	0.00

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Mineral Production - Gas	FA44	16	
	Cement Works	FA45	14	
	Pumping Mines	FA46	9	
	Maltings - Non Trad	FA47	14	
	Aluminium Smelting Works	FA48	5	0.01
	Cement Tile Works	FA49	9	
	Distillery	FA50	15	0.03
	Mineral Production - Other Mineral Category	FA51	8	
	Tannery	FA52	6	0.05
	Wafer Fabrication	FA53	7	0.08
	Maltings - Trad	FA54	6	0.03
	Large industrial (> 20,000 m2) NEC	FA55	12	0.34
	Beet Sugar Factory	FA56	7	0.00
	Mineral Production - Brine	FA57	3	
	Artificial Fibre Works	FA58	1	
	Coking and Carbonising Plant	FA59	4	
	Industrial NEC	FA99	951	1.37
Health	Surgery / Clinic / Health Centre	HE01	25,509	2.75
	Hospitals and Clinics (NHS)	HE03	1,607	0.01
	Hospitals and Clinics (Private)	HE04	668	0.01
	Hospital	HE06	2	0.00
Hospitality	Holiday Home (Self Catering)	HO01	64,206	0.02
	Public House/Pub Restaurant	HO02	42,035	0.05

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Restaurant	HO03	28,878	6.75
	Cafe	HO04	15,984	1.79
	Club, institution [not sports club, probably]	HO05	9,394	4.34
	Guesthouse, boarding house	HO06	7,820	0.02
	Camping site	HO07	3,066	0.00
	Caravan park	HO08	3,838	0.00
	Hotel (3 star and under)	HO09	4,112	0.01
	Takeaway Food Outlet (Predominantly Off Premises)	HO10	4,750	0.39
	Hotel (4 star and above, or major chain)	HO11	3,449	0.00
	Restaurant - Drive-in/thru	HO12	2,413	0.77
	Nightclub, discotheque	HO13	1,328	0.53
	Hostel	HO14	1,545	0.03
	Wine bar	HO15	1,060	0.10
	Conference centre	HO16	708	0.07
	Chalet Park	HO18	226	0.00
	Lodge / Motel	HO19	218	0.00
	Country House Hotel	HO20	178	0.00
	Coaching Inns	HO21	126	
	Holiday accommodation (not: hotel, guesthouse, caravan)	HO22	77	0.00
	Food Court	HO23	90	0.01
	Timeshare Complex	HO24	71	

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Health Farm	HO25	21	0.00
Miscellaneous	Showhouse	MI01	3,306	0.00
	Airport Let Out NEC	MI02	353	0.05
	Miscellaneous NEC	MI99	1,339	0.05
MoD	Auxiliary Defence Establishment	MO01	427	0.01
	MoD NEC	MO02	137	0.00
	Army Hereditament	MO03	184	0.00
	RAF Hereditament	MO04	84	0.00
	Navy Hereditament	MO05	48	
	Forces Careers Office	MO06	26	0.01
	MoD NEC	MO99	52	0.03
Office	Office (Inc Computer Centres) NEC	OF01	867	0.17
	Business Unit NEC	OF02	10,166	0.97
	Contractor Hut(s) and Compounds	OF03	1,348	0.26
	Office	OF04	427,732	91.48
	Sales office	OF05	628	0.04
	Studio	OF06	1,359	0.15
	Office (Local Authority)	OF07	1,985	2.66
	Office (HQ / Institutional)	OF09	758	2.35
	Film/ TV/ recording studio	OF10	494	0.53
	Computer centre	OF11	343	1.43
	Shop	Shop NEC	SH01	425,679
Hairdressing/Beauty Salon		SH02	21,512	1.42

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Retail warehouse	SH03	9,898	15.89
	Showroom	SH04	8,042	3.48
	Bank/ insurance/ building society branch	SH05	9,430	3.02
	Car Showroom / Sales Site	SH06	5,703	6.53
	Kiosk	SH07	5,763	0.10
	Betting Shop	SH08	4,568	0.57
	Car/Caravan Sales/Display/Hiring Site	SH09	3,618	0.26
	Hypermarket/ superstore (over 2500 m ²)	SH10	2,235	13.94
	Large Food Store (750 - 2500m ²)	SH11	2,754	4.01
	Post Office (shop)	SH12	2,378	0.51
	Pharmacy	SH13	3,160	0.41
	Garden centre	SH14	2,396	2.62
	Large shop (over 1850 m ²)	SH15	2,330	11.83
	Factory shop	SH16	1,687	0.39
	Food Store (shop)	SH17	6,309	2.18
	Farm shop	SH18	1,425	0.27
	Market (not livestock)	SH19	995	0.01
	Launderette	SH20	1,316	0.11
	Amusement arcade	SH21	740	0.35
	Large Shop (750 - 1850m ²)	SH22	457	0.57
	Pet Grooming Parlour	SH23	523	0.01

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Station Let Out NEC	SH24	376	0.01
	Information/Visitor Centre	SH25	244	0.04
	Department store	SH26	2	0.00
	Auction Room(s)	SH27	140	0.12
	Motorway Service Area Let Out NEC	SH28	154	0.02
	Car Auction Building/Site	SH29	70	0.25
	Hospital Let Out	SH30	90	0.01
	Car Supermarket	SH31	37	0.25
	Bank	SH32	3	0.00
Sport	Gymnasium, fitness centre	SP01	4,020	v1.26
	Sports Ground	SP02	3,879	0.77
	Golf Course	SP03	1,879	1.33
	Bowling Green (Outdoor)	SP04	1,950	0.14
	Cricket Ground	SP05	1,917	0.26
	Leisure centre (with swimming)	SP06	1,503	0.12
	Leisure centre (without swimming)	SP07	1,580	0.16
	Tennis Court(s)/Club	SP08	1,302	0.08
	Football Ground	SP09	1,044	0.21
	Pavilion / Changing Room	SP10	1,199	0.14
	Swimming pool	SP11	589	0.00
	Rifle/ shooting range	SP12	534	0.07
	Rugby Ground	SP14	500	0.17
	Golf Driving Range	SP15	230	0.00

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Water Sport Facilities	SP16	278	0.01
	Bowling Centre (Indoor)	SP17	239	0.00
	Squash court(s)	SP18	146	0.03
	Football Stadium	SP19	114	0.00
	Pitch and Putt/Putting Green	SP20	108	0.00
	Motor Racetrack	SP21	81	0.00
	Racecourse/ track (horses, dogs)	SP22	90	
	Tennis centre	SP23	69	0.00
	Point to point and eventing course	SP24	52	0.00
	Sports Stadium	SP25	56	
	Leisure Centre within/part of Specialist Property	SP26	58	0.01
	Polo Ground	SP27	49	0.02
	Ice Rink	SP28	30	
	Ski Centre	SP29	34	
	Speedway Racetrack	SP30	17	
	Cricket Centre	SP32	11	0.00
	Leisure Centre	SP35	1	
	Sporting Right (premises used for sport) NEC	SP40	121	0.00
Transport	Petrol filling station	TR02	5,192	0.01
	Car wash	TR03	2,739	0.05
	Multi-storey car parks	TR04	1,331	0.02
	Dock / Harbour / Wharf	TR06	264	0.34

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Lorry Park	TR07	736	0.36
	Bus station	TR08	371	0.00
	Bus garage, bus depot	TR09	359	0.43
	Air Strip	TR10	232	0.05
	Motorway and Major Road Service Area	TR11	90	
	Airport (minor)	TR12	58	0.02
	Civil Airport	TR13	27	
	Heliport	TR14	30	0.00
	Vehicle Testing Centre	TR15	110	0.08
	Railway / Tramway (Non-Leisure)	TR16	31	0.04
	AA/RAC Service Centre / Box	TR17	5	0.00
	Weighbridge	TR18	51	0.00
	Toll (Ferries, Roads And Bridges)	TR20	10	
	Truck Stop	TR24	10	0.00
Utilities	Sewage works	UT01	5,374	
	Utilities, electricity	UT02	6,508	0.00
	Refuse handling/disposal	UT03	1,836	0.04
	Utilities, gas	UT04	1,170	
	District Heating Networks	UT05	64	
	Utilities , water	UT06	68	
	Domestic Fuel Installations	UT07	20	0.00
	Utilities, telecoms	UT08	14	0.03
	Utilities, nuclear	UT09	12	

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

CaRB3 Class	CaRB3 Activity	CaRB3 Code	Premises counts	Floor area of all VOA premises (millions m ²)
	Power Generator	UT10	205	0.00
	Renewable Power Generator - Hydro	UT11	264	
	Renewable Power Generator - Other	UT12	243	
	Renewable Power Generator - Photovoltaic	UT13	2,256	
	Renewable Power Generator - Wind	UT14	1,127	
Warehouse	Warehouse	WA01	127,322	105.81
	Store	WA02	93,308	10.45
	Storage Depot	WA04	1,833	2.13
	Large Distribution Warehouse	WA05	1,362	34.56
	Wholesale Warehouse	WA06	476	1.90
	Cold store	WA07	284	2.03
	Liquid Bulk Storage (Incl Petrol & Oil)	WA08	263	0.02
	Mineral Depot	WA09	57	
	Bullion/Money Store	WA10	63	0.12
	Granary / Intervention Store	WA11	39	0.22
	Bulk Cement Storage Depot	WA12	40	
	Road Haulage Depot	WA14	2	0.00

Annex 2 – Treemaps of CaRB3 classes and activities, by counts and total area of premises

Figure 36 and Figure 37, below, provide a simplified graphical representation of Table 28. In these figures, each CaRB3 class is indicated by a colour field and each activity is represented by the CaRB3 code listed in Table 28. However, to aid readability, all CaRB3 activities with a summed floorspace of less than one million square metres have been aggregated to 'OTHER', for each CaRB3 class. For example, 'SH03' indicates 'Retail warehouse' whilst 'SH OTHER' indicates all the CaRB3 activities that each have less than one million square metres recorded in the data within the 'Shop' CaRB3 class. The same floorspace threshold is applied in both Figure 36 and Figure 37.

Figure 36 Treemap of the CaRB3 classes and CaRB3 activities by count of premises, 2020

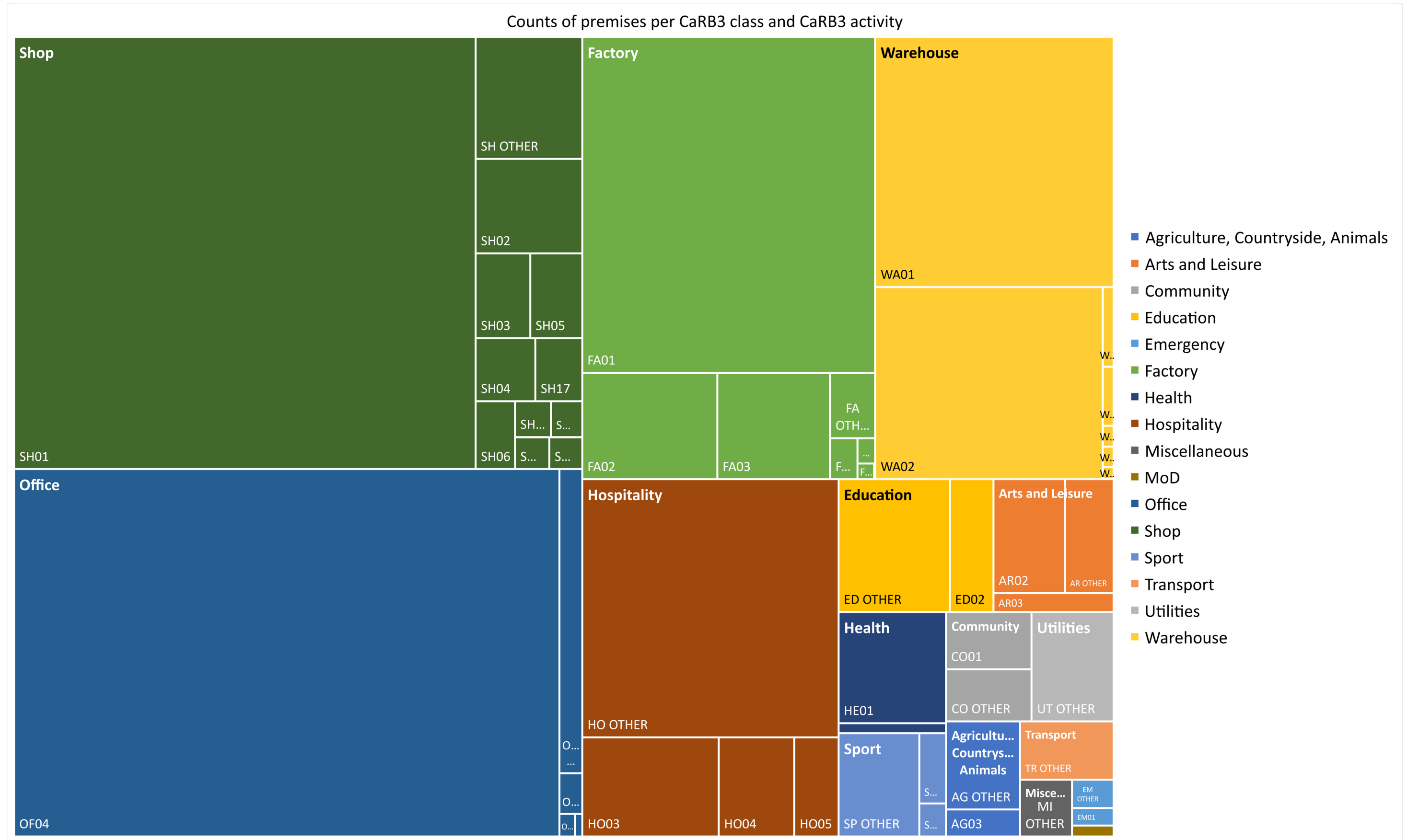
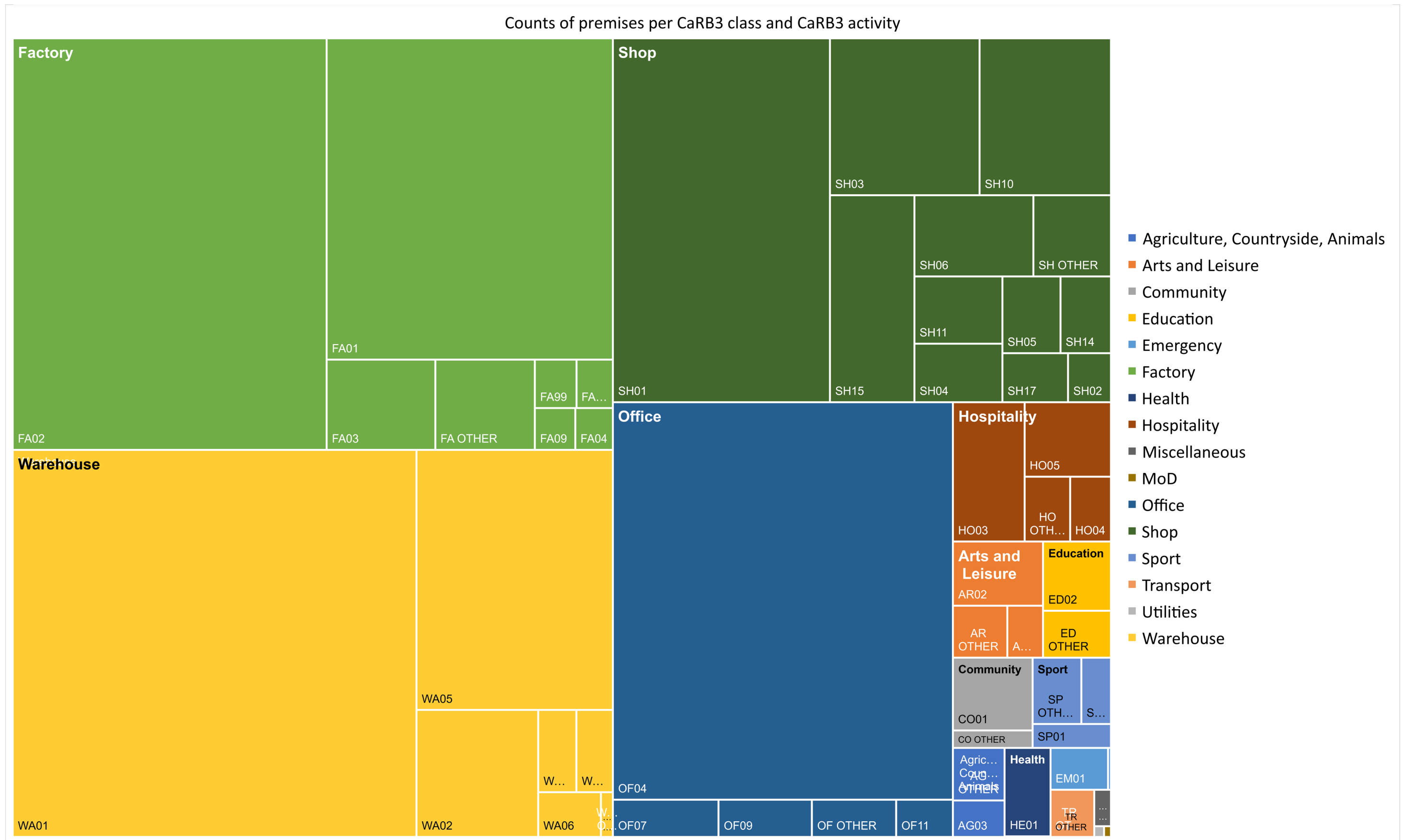


Figure 37 Treemap of the CaRB3 classes and CaRB3 activities by VOA floor area, 2020



Annex 3 – Accommodation Use Codes (sub-divisions within premises)

Below, Table 29 provides a list of the Valuation Office Agency (VOA) codes and descriptions for sub-divisions of premises. The 'auc location' has been added to the VOA classification system to indicate whether the area described in the line entry of the VOA data is internal (1), external (2), possibly internal or external (3), or unknown/excluded (4), in relation to a building. For example, an 'Ancillary Office' is most likely to be internal and is given the code '1', whilst a 'Stall' could be inside or outside of a building, so is given code '3'. This 'location' code may be used as an indicator of whether the space is being heated or cooled.

The 'auc building' code indicates whether the space is a building, or part of a building: 1 = probably part of a building; 2 = probably not part of a building; 3 = could be/not be part of a building; 4 excluded from building analyses. The 'auc activity' is a rationalised description, based on the original VOA description, to allow more effective analysis. Similarly, the 'auc class' is an aggregation of 'auc activity' for analysis purposes, principally with energy use profiles in mind.

Finally, the 'auc waste heat' field indicates the estimated probability of the auc to be a source of waste heat for repurposing, together with the 'auc wh seasonal' field which indicates whether the source of waste heat is likely to be year-round (1), seasonal (2), or highly seasonal (3). Nulls indicate that it is thought no waste heat would be available.

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

Table 29 VOA Accommodation Use Codes (AUC), with activity description, location code, building code, grouping and waste heat codes.

auc	auc_description	auc_located	auc_building	auc_activity	auc_class
04S	4 Sheet Advertising Display	3	2	advertising	advertising
06S	6 Sheet Advertising Display	3	2	advertising	advertising
08S	8 Sheet Advertising Display	3	2	advertising	advertising
12S	12 Sheet Advertising Display	3	2	advertising	advertising
144	144 Sheet Advertising Display	3	2	advertising	advertising
16S	16 Sheet Advertising Display	3	2	advertising	advertising
192	192 Sheet Advertising Display	3	2	advertising	advertising
32S	32 Sheet Advertising Display	3	2	advertising	advertising
48S	48 Sheet Advertising Display	3	2	advertising	advertising
64S	64 Sheet Advertising Display	3	2	advertising	advertising
96S	96 Sheet Advertising Display	3	2	advertising	advertising
ADA	Area (m ²) for of Advertising Display	3	2	advertising	advertising
ADS	Advertising Display	3	2	advertising	advertising
AMA	Amusement Arcade (where not zoned)	1	1	arts and leisure indoor	arts and leisure
ANO	Ancillary Office	1	1	office work	office work
ASG	Grass Airstrip	2	2	airstrip	airstrip
ASH	Surfaced Airstrip	2	2	airstrip	airstrip
ASI	Ancillary Store(s) (inside)	1	1	storage general	storage
ASO	Ancillary Store(s) (outside)	1	1	storage general	storage
ATM	Atm	3	1	atm	sales

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

auc	auc_description			auc_activity	auc_class
		auc_located	auc_building		
ATR	Atrium	1	1	circulation	circulation
AUS	Area Under Supported Floor	1	1	area under supported floor	indeterminate
BAR	Bar	1	1	bar	catering
BAY	Loading Bay	1	1	goods handling	process
BHA	Area (m ²) of Beach Hut	4	4	unclassified	unclassified
BHI	Beach Hut(s)	4	4	unclassified	unclassified
BHS	Boathouse	1	1	boathouse	storage
BIN	Bingo Hall	1	1	arts and leisure indoor	arts and leisure
BKH	Banking Hall	1	1	sales indoor	sales
BRD	Boardroom	1	1	meetings	meetings
BWG	Bowling Green	2	2	arts and leisure outdoor	arts and leisure
CAN	Canteen	1	1	canteen	catering
CAT	Cattery	1	1	animals	animals
CDS	Crown Double Advertising Display	3	2	advertising	advertising
CED	Drinks Cellar	1	1	drinks cellar	storage, temp controlled
CEL	Cells	1	1	cells	accommodation
CHA	Changing Rooms	1	1	locker/cloak/changing room	locker/cloak/changing room
CHL	Chill Store	1	1	storage chilled	storage, temp controlled
CLB	Clubhouse	1	1	arts and leisure indoor	arts and leisure
CLD	Cold Store	1	1	storage cold	storage, temp controlled
CLS	Classroom	1	1	education/training	education/training
CMC	Community Centre	1	1	community centre	community

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auc	auc_description	auc_located	auc_building	auc_activity	auc_class
CMM	Committee Room	1	1	meetings	meetings
CNP	Canopy	2	1	canopy	canopy
COM	Computer Room	1	1	computing	computing
COV	Covered Area	2	1	outdoor area covered	outdoor
CQS	Crown Quad Advertising Display	3	2	advertising	advertising
CWS	Car Wash	2	3	vehicle repair/maintenance	process
DBU	Double Bedroom - En Suite	1	1	bedroom	accommodation
DDS	Double Demy Advertising Display	3	2	advertising	advertising
DIS	Sales Display Area	2	2	sales outdoor	sales
DNC	Dance Floor	1	1	arts and leisure indoor	arts and leisure
DOG	Kennel	1	1	animals	animals
DOR	Dormitory	1	1	bedroom	accommodation
DRG	Driving Range	2	2	arts and leisure outdoor	arts and leisure
DRS	Double Royal Advertising Display	3	2	advertising	advertising
DSF	Double Or Twin Room - Shared Facilities	1	1	bedroom	accommodation
DUT	Dutch Barn	2	1	storage open	storage
FIT	Fitness Room	1	1	sport indoor	sport
FOD	Foodcourt Kiosk	1	1	sales indoor	sales
FOL	Foaling Box	1	1	animals	animals
FPA	Food Processing Areas	1	1	food production	process
FSF	Family/Multiple Room - Shared Facilities	1	1	bedroom	accommodation
FSS	Petrol Filling Station Shop	1	1	sales indoor	sales

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auc	auc_description	auc_located	auc_building	auc_activity	auc_class
GAR	Garage	1	1	vehicle repair/maintenance	process
GHS	Glasshouse	1	1	horticulture	horticulture
GIA	GIA/NIA Difference	1	1	GIA/NIA Difference	measurement
GLF	Golf Course	2	2	arts and leisure outdoor	arts and leisure
GTH	Gatehouse	1	1	office work	office work
GYM	Gymnasium	1	1	sport indoor	sport
HAL	Hall	1	1	hall	hall
HIT	Hi-tech (dedicated area)	1	1	hi tech area	hi tech area
HNG	Hangar	1	1	hangar	storage
HTH	Health Centre	1	1	health	health
KTN	Kitchen	1	1	catering	catering
LAA	Actual Living Accommodation (Valued At 0)	1	1	living accommodation	accommodation
LAB	Laboratory	1	1	laboratory/clean room	process
LAN	Notional Living Accommodation (Valued At 0)	1	1	living accommodation	accommodation
LBI	Indoor Loosebox	1	1	animals	animals
LBO	Outdoor Loosebox	2	3	animals	animals
LCS	Land Used For Car Sales	2	2	sales outdoor	sales
LFG	Land Used for Storage - Fenced, Hard Gravelled	2	2	land	land
LFH	Land Used for Storage - Fenced, Hard Surfaced	2	2	land	land
LFT	Lift Shaft	1	1	plant	plant
LFU	Land Used for Storage - Fenced, Unsurfaced	2	2	land	land
LNG	Lounge	1	1	hospitality	hospitality

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

auc	auc_description	auc_located	auc_building	auc_activity	auc_class
LOG	Land Used for Storage - Open, Gravelled	2	2	land	land
LOH	Land Used for Storage - Open, Hard Surfaced	2	2	land	land
LOK	Locker Room	1	1	locker/cloak/changing room	locker/cloak/changing room
LOU	Land Used for Storage - Open, Unsurfaced	2	2	land	land
LRH	Lairage (Abattoirs)	3	3	animals	animals
MBU	Multiple Bedroom - En Suite	1	1	bedroom	accommodation
MOR	Mooring	2	2	outdoor area	outdoor
MSR	Mess / Staff Room	1	1	staff room	staff room
NUR	Nursery	1	1	childcare	childcare
OFF	Office	1	1	office work	office work
OUT	Outdoor Seating / Display	2	2	outdoor area	outdoor
OWK	Works Office	1	1	office work	office work
PAV	Pavilion	1	1	arts and leisure indoor	arts and leisure
PEN	Pen	3	3	animals	animals
PIG	Pitch	2	2	sport outdoor	sport
PIH	Hard Surface Pitch	2	2	sport outdoor	sport
PIW	All Weather Pitch	2	2	sport outdoor	sport
PKB	Bicycle Parking Space	2	3	vehicle parking	vehicle parking
PKC	Coach Parking Space	2	2	vehicle parking	vehicle parking
PKD	Disabled Parking Space	2	3	vehicle parking	vehicle parking
PKG	Area (m ²) for Parking	2	3	vehicle parking	vehicle parking
PKL	Lorry / Truck Parking Space	2	2	vehicle parking	vehicle parking

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auc	auc_description			auc_activity	auc_class
		auc_located	auc_building		
PKM	Motorbike Parking Space	2	3	vehicle parking	vehicle parking
PKN	Portakabin	5	5	portable building	portable building
PKS	Parking Space	2	3	vehicle parking	vehicle parking
PLT	Plant Room	1	1	plant	plant
PLY	Playing Field	2	2	sport outdoor	sport
PON	Pond	2	2	outdoor area	outdoor
PRD	Production Area	1	1	process	process
PRO	Pro Shop	1	1	sales indoor	sales
QDS	Quad Demy Advertising Display	3	2	advertising	advertising
RAO	Retail Area (not otherwise classified)	1	1	sales indoor	sales
REC	Reception / Entrance Area	1	1	reception	office work
RES	Restaurant	1	1	dining	catering
SAL	Sales Pitch	3	3	sales outdoor	sales
SAM	Site Of Automatic Machine	3	3	auto machine site	sales
SBS	Single Bed Space	1	1	bedroom	accommodation
SBU	Single Bedroom - En Suite	1	1	bedroom	accommodation
SCN	Storage container	3	2	storage container	storage
SGY	Surgery	1	1	health	health
SHD	Shed	1	3	shed	shed
SHO	Showers	1	1	washing people	washing
SOC	Indoor Soccerdome	1	1	sport indoor	sport
SOV	Sales (valued on overall basis)	1	1	sales indoor	sales

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

auc	auc_description	auc_located	auc_building	auc_activity	auc_class
SPU	Store (Primary Use)	1	1	storage general	storage
SQC	Squash Court	1	1	sport indoor	sport
SRI	Indoor Shooting Range	1	1	arts and leisure indoor	arts and leisure
SRM	Showroom	1	1	sales indoor	sales
SRO	Outdoor Shooting Range	2	3	arts and leisure outdoor	arts and leisure
SSF	Single Room - Shared Facilities	1	1	bedroom	accommodation
STL	Stall	3	3	sales indoor/outdoor	sales
STR	Strongroom	1	1	storage secure	storage
SUI	Suite - Ensuite	1	1	bedroom	accommodation
SZA	Sales Area (Zone A)	1	1	sales indoor	sales
SZB	Sales Area (Zone B)	1	1	sales indoor	sales
SZC	Sales Area (Zone C)	1	1	sales indoor	sales
SZD	Sales Area (Zone D)	1	1	sales indoor	sales
SZE	Sales Area (Zone E)	1	1	sales indoor	sales
SZF	Sales Area (Zone F)	1	1	sales indoor	sales
SZR	Sales Area (Zone Remainder)	1	1	sales indoor	sales
TAC	Tack Room	1	1	storage general	storage
TCG	Grass Tennis Court	2	2	sport outdoor	sport
TCH	Hard Surface Tennis Court	2	2	sport outdoor	sport
TCW	All Weather Tennis Court	2	2	sport outdoor	sport
TEL	Telephone Kiosk	3	3	phone kiosk	communications
TEN	Indoor Tennis Hall	1	1	sport indoor	sport

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

auc	auc_description	auc_located	auc_building	auc_activity	auc_class
TFA	GIA All Main Areas	1	1	main areas (usually retail sales)	main areas PD dependent
TFD	Total Floor Area - Dry (Leisure Clubs)	1	1	sport indoor (dry)	sport
TFW	Total Floor Area - Wet (Leisure Clubs)	1	1	sport indoor (wet)	sport
TOW	Control Tower	1	1	office work	office work
VS1	Vehicle display spaces	2	2	Vehicle display spaces	sales outdoor
VS2	Vehicle display spaces	2	2	Vehicle display spaces	sales outdoor
VS3	Vehicle display spaces	2	2	Vehicle display spaces	sales outdoor
VS4	Vehicle display spaces	2	2	Vehicle display spaces	sales outdoor
VS5	Vehicle display spaces	2	2	Vehicle display spaces	sales outdoor
VS6	Vehicle spaces	3	3	vehicle space indoor/outdoor	vehicle space indoor/outdoor
VS7	Vehicle spaces	3	3	vehicle space indoor/outdoor	vehicle space indoor/outdoor
VS8	Vehicle spaces	3	3	vehicle space indoor/outdoor	vehicle space indoor/outdoor
VS9	Vehicle spaces	3	3	vehicle space indoor/outdoor	vehicle space indoor/outdoor
WCE	Toilets (public)	1	1	wc public	wc
WCS	Toilets (staff)	1	1	wc	wc
WHS	Warehouse	1	1	warehouse	warehouse
WIN	Windmill	1	1	windmill	windmill
WKS	Workshop	1	1	workshop	process
XNC	Not Otherwise Classified	3	3	unclassified (VOA)	unclassified (VOA)

Annex 4 – Valuation Office Agency construction codes and possible effects on retrofits

Table 30, below, shows the Valuation Office Agency construction codes and how the degree of difficulty for retrofits has been estimated. Access to information on the realities of retrofitting these building elements would allow improvements to be made to this initial estimation of difficulty.

Table 30 Matrix of construction codes and potential ease/difficulty of retrofit.

		1 = straightforward; 2 = not straightforward; 3 = more complex; empty cell = not appropriate, or not possible to evaluate		
construction code	description	roof construction	structure construction	wall construction
A	Asbestos	1		2
B	Brick	3	1	1
C	Concrete	2	3	2
D	Part of a larger Complex	3	3	3
E	Steel	1	2	2
F	Felt	2		2
G	Glass	3		3
H	Half Timbered	2	2	2
I	Corrugated Iron	2		3
J	Open			
K	Block		1	1
L	Aluminium	2		2
M	PPM	2		2
N	Stone	3	2	2
O	Portal	2	2	2
P	Portacabin / Terrapin			
R	Traditional	1	1	1
S	Slate	1		3
T	Tile	1		3
V	Varied (mix)	3	3	3
W	Wood	1	2	2

Non Domestic Building Stock in England and Wales – Part 1: Stock Description

X	Not Otherwise Classified	3	3	3
Y	Systems	3	3	2

This publication is available from: www.gov.uk/government/publications/national-buildings-database-phase-1-non-domestic-building-stock-in-england-and-wales

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