Department for
Energy Security
& Net Zero

Non-Domestic Building Stock in England and Wales

Executive Summary

DESNZ research paper series number: 2024/005

March 2023

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Introduction

Meeting the UK's commitment to reduce its greenhouse gas emissions to net-zero by 2050 will require emissions from all buildings to be all but eliminated. Decarbonising energy use in non-domestic buildings is one of the most complex challenges facing the UK. Until now, the complexity and diversity of the non-domestic stock has limited attempts to develop comprehensive and detailed datasets to inform policy decisions. The Non-Domestic Building Stock project (NDBS) brings together existing and new data to develop a comprehensive and uniquely structured database 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. This summary provides a condensed description of the first phase of the NDBS.

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. NDBS integrates property tax, Energy Performance Certificate, geo-spatial, business and utilities data with other specialist data sets. Bringing together the wealth of data currently held separately by a range of government departments and agencies has resulted in unique insights into the non-domestic building stock for policy development.

This report presents the findings of the pilot phase of the project, in which a more detailed study was undertaken of the Hospitality sector to assess the potential to augment the database, with additional datasets and analysis. The method piloted for the Hospitality sector, has provided a full characterisation of the premises and their associated energy use for different activities. In particular, this method filled in important gaps in knowledge from existing data sets around floorspace, space heating and cooling equipment and their use.

This first phase has therefore demonstrated a method for developing a digital representation of the entire building stock which will be taken forward in the second phase of the project.

The data for the Hospitality sector were enhanced by remote and on-site surveys undertaken for a sample of premises. A supplementary analysis of large premises, not connected to the gas grid was also undertaken, which included remote and onsite verification surveys, as well as detailed zero-carbon audits (probe surveys).

Building on previous research

Data on floor area and business activities[1] at the premises level, collected by the Valuation Office Agency (VOA) for the majority of non-domestic types, have underpinned work over the last forty years on understanding energy use in the building stock of England and Wales. In

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[1] VOA data allows premises to be classified according to the activities which take place within them rather than the sector of the economy which they serve. For simplicity, these classes of activity are referred to as 'sectors' in this executive summary. In the report which follows, the term 'activity classes' is used.

this project, these core data sets have been supplemented with other data sources, models and surveys, both on-site and remote, to develop a more detailed snapshot of the stock.

Four main challenges have been faced in previous studies in the UK:

- There is no common base unit for data collection across the different data sets: VOA data are collected for individual premises. Some premises comprise multiple buildings (e.g. schools) while others share a building with other premises (often seen in traditional high streets). This makes it difficult to combine data that describe the built environment with data that describe ownership and activities.

- Gas and electricity metering arrangements in multi-user buildings are often complex, making it difficult to determine the relationships between gas and electricity consumption data and floor areas with precision and reliability.

- At a building level, the activity which takes place in a space has a greater bearing on its energy consumption than the sector of the economy it serves. Relating activities to buildings in a consistent manner is essential to allow comparison with previous studies and ensure that no activities are unaccounted for.

- Property taxation data from the VOA provides a very robust source of information about activities and the spaces in which they take place, but only for those activities which are assessed based on floor area. This has resulted in a large amount of missing floor space in some sectors such as hospitality, health and education.

Methodology

This study has focussed on data-driven methods to develop a more complete picture of the non-domestic building stock in England and Wales, addressing the challenges detailed above. Data sets such as the Inter-Departmental Business Register and Energy Performance Certificate (EPC) reports supplement the VOA records and allow a more granular analysis based on a near 100% sample.

The methods used in this pilot phase of the project are summarised in Figure 1. The initial step in this process was to classify all premises according to the activities they contain, following this, VOA data were linked with Ordnance Survey data to develop a spatial database of premises contained in the VOA data. This has allowed the complexity of the stock and its geographic distribution to be assessed, together with the distribution of age, building services types and rurality across the various sectors.

Additional data sets were linked to the spatial database to enable specific aspects of the stock to be explored. For example, listed buildings and conservation area data allowed the heritage status and potential impact of this on ease of decarbonisation to be investigated.

Figure 1 Overview of methodology
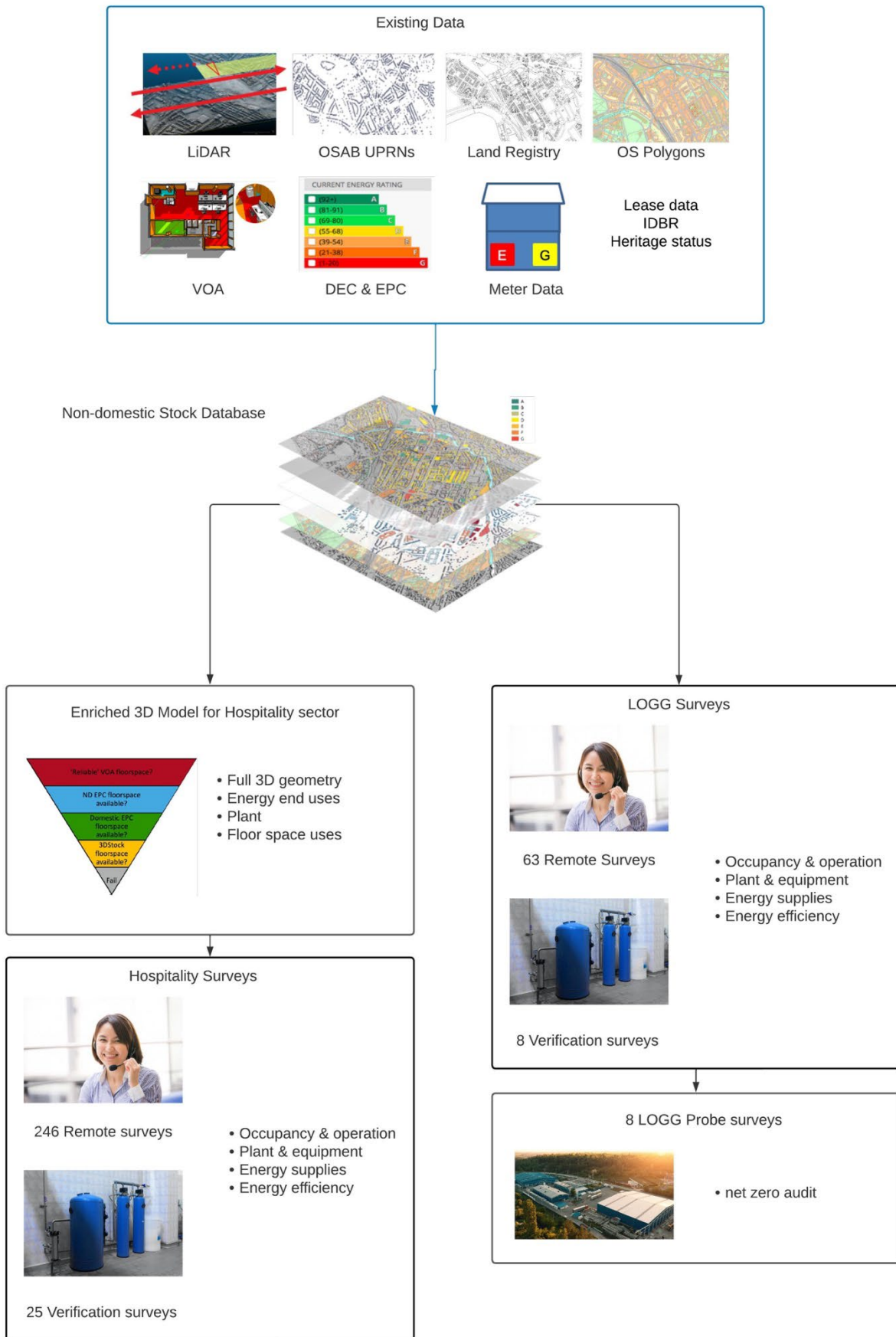
In this pilot phase a more detailed analysis was undertaken of the Hospitality sector to assess the potential to augment the methods detailed above with additional datasets and analysis and thus derive a more detailed model of the stock:

- A full three-dimensional model was developed, allowing floor areas to be derived even when they are not recorded by the VOA,

- Analysis of previously unreleased Energy Performance Certificate data enabled the space devoted to different activities within a premises to be explored.

- A survey methodology was designed to collect more detailed information on buildings and business characteristics to complement the database. The survey results form a supplementary dataset rather than being integrated into the database.

In phase 2, the methods piloted for the Hospitality sector will be extended to the non-domestic building stock as a whole.

Surveys were also undertaken for premises over 1000m^2 floor area, not connected to the gas grid (referred to as LOGG), to gain a deeper understanding of the specific challenges facing these premises. These surveys were supplemented with detailed energy audits for a small number of premises.

Key findings

This is the first analysis of the non-domestic building stock of England and Wales, based on an assessment of individual premises data with a near 100% sample. This coverage, coupled with the spatial analysis undertaken and access to previously unavailable data has resulted in a range of important new insights.

Composition of the building stock

The VOA records a total non-domestic floor area of 594 million m^2, although 94% of premises are smaller than 1000m^2. For the largest classes of Factory, Warehouse, Office and Shop the top 10% of premises size contains over 60% of all floorspace in their classification. Consideration needs to be given to the relative impact of policies targeted at owners and occupiers of different sizes of premises.

The age distribution of premises varies across the sectors. More than 30% of premises in the Health and Hospitality sectors have a construction date prior to 1900, while more than 20% of utilities premises were built in the last 25 years. The energy performance of premises is closely linked to their age.

Analysis of the building fabric codes contained in the VOA dataset suggests a complex mix of fabric and construction types across the non-domestic building stock with Ministry of Defence (MoD), Transport and Shops sectors having large proportions of premises with construction

types that are harder to retrofit. In rural areas, there was a general trend for less floor area in traditional brick constructions with slate and tile roofs, towards more lightweight construction techniques of portal frames and walls and roofs of sheet materials such as asbestos, profiled plastic and corrugated iron.

## Complexity of the non-domestic stock and interface with domestic stock

48% of all non-domestic premises share a building with other non-domestic premises, and a further 23% of non-domestic premises share a building with domestic premises. In Factory, Office, Transport and Warehouse sectors, the majority of premises occupy part of a building. This has important implications for implementation of any improvements to buildings and the premises they contain, suggesting that archetypal models in which buildings are typically assumed to contain a single occupier and activity are inadequate for characterising the complexity of the non-domestic building stock.

The demarcation between domestic and non-domestic premises varies across datasets. While VOA data class premises based on business activity, gas meter data are classified based on consumption, with commercial premises with lower consumption being treated as domestic and aggregated domestic supplies (for example in a large block of flats served by a single gas meter) treated as non-domestic. Within the EPC dataset, many self-catering premises, which are recorded as non-domestic in the VOA data and subject to commercial rates, are treated as domestic premises. This, combined with the number of domestic premises which share a building envelope with non-domestic premises, means it is not possible to treat domestic and non-domestic building stocks as discrete entities. The methods used in previous studies have not fully captured this complexity.

Heritage status

The distribution of heritage status varies across different sectors. In the Office and Hospitality and Shop classes, 50% of premises or more are either in a conservation area or in a building with listed status. Figure 2 shows the proportions of premises in each sector which are listed and/or in conservation areas. The additional hurdles associated with making improvements to heritage buildings are likely to be important barriers to reducing energy consumption in these classes. Survey responses in the hospitality sector confirmed that heritage status was an important limitation for businesses considering decarbonisation strategies.

Figure 2 Percentage distribution of premises by sector using the Listed building status and Conservation areas, combined to classify the premises, 2020
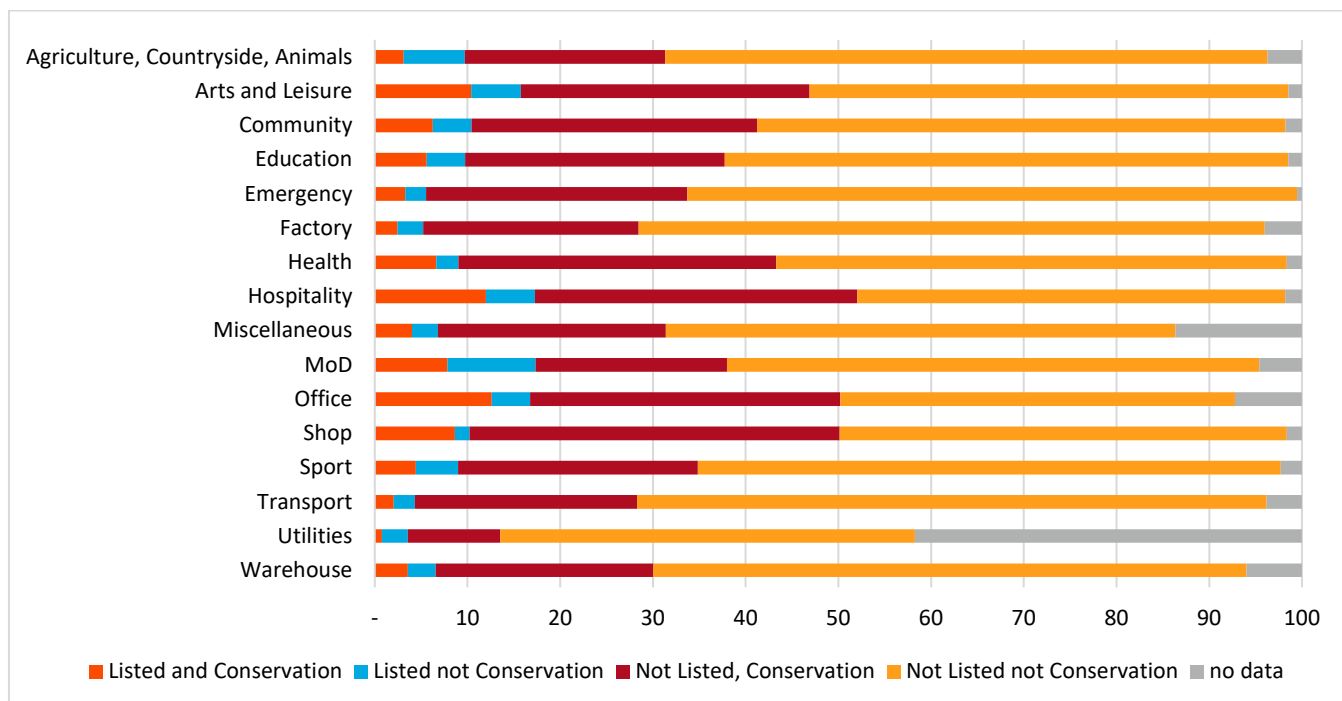
Energy Consumption

Six sectors (Factory, Shop, Hospitality, Education, Office, Warehouse) account for 85% of total non-domestic energy consumption. Electrical energy is dominant in several sectors including Agriculture, Transport, Office, Shop and Warehouse. The split is fairly even for 'Arts and Leisure', Hospitality, Sport and Emergency. Gas is the dominant fuel for Factory, Education, Community, MoD, Health and Utilities.

The highest median energy use intensities (EUI, kWh/m²/year) are found in the Utilities Hospitality and Emergency sectors. Analysis of EUI by floor area suggests that, on aggregate, premises in the 250 m² to 2,500 m² bandings are more efficient than those that are smaller or larger than these bandings.

Hospitality sector

The Hospitality sector contains a number of activities which are known to be valued using criteria other than floor area. Previous studies have either relied on VOA datasets for floor area for Hospitality (ND-NEED[2]), or inferred missing area based on measured surveys (BEES[3]).

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[2] ND-NEED is the UK Government Department for Energy Security and Net Zero's National Non-Domestic Energy Efficiency data framework which was set up to provide a better understanding of energy use and intensity in non-domestic buildings https://www.gov.uk/government/collections/non-domestic-national-energy-efficiency-data-framework-nd-need - history
[3] The Building Energy Efficiency Survey (BEES) 1014-2015 was commissioned by the UK Government Department for Business, Energy and Industrial Strategy. BEES set out to improve and update the evidence of

This study has undertaken the first mathematical estimation of missing floor area in the Hospitality class using a combination of EPC data and geometric models. The method has allowed floor area to be derived for 94% of Hospitality premises and results in a four-fold increase in floor area compared with VOA datasets, giving a total of 59.0 million m^2.

A minority of Hospitality premises are sole occupants of their buildings (44%), Figure 3 shows the proportion of premises in each part of the hospitality sector which occupy a whole building, share a building with other non-domestic (ND) premises or share a building with domestic premises (Dom). More than half of premises in the hospitality sector are subject to some form of heritage constraint. This is reflected in survey responses where it was identified as the most common barrier to implementing energy efficiency measures. Median EUI was found to be higher in urban than rural premises, across all sub-sector groups.

Figure 3 Mixed use counts of Hospitality premises (at the premises level) shown as a percentage of each sector
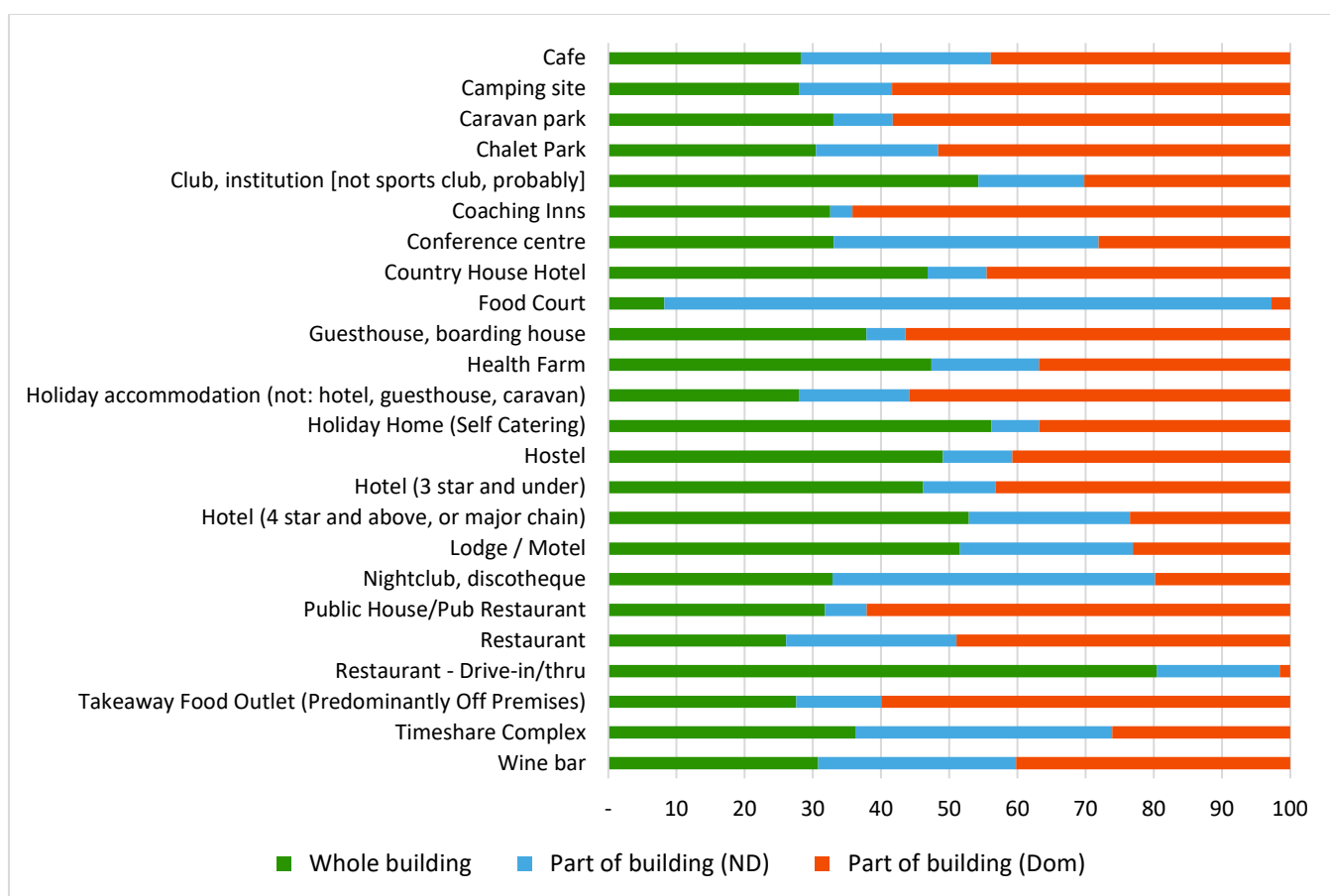
Surveys

Remote surveys, supplemented with on-site verification, were used to establish a more detailed understanding of premises and energy use for Hospitality and LOGG premises. A range of representative organisations were willing and interested in supporting efforts to collect

how energy is used, and to provide an assessment of the abatement opportunities for all non-domestic premises across England and Wales.

data from the Hospitality class. It was found that respondents were less likely to be able to answer more technical questions about the size of premises and there was variability in their ability to answer questions about numbers and types of equipment. They were able to provide detailed views on decarbonisation challenges facing their organisations. In subsequent phases of this project, survey design will follow detailed data analysis of the pilot study to facilitate more accurate and precise targeting of future surveys.

Matching business names and contact details to the database of premises was challenging and resulted in a bias in the survey sample. In particular, survey respondents were more likely to occupy a whole building than the population as a whole. The depth of analysis, which is possible based on the database, means that surveys are better used for qualitative exploration of specific issues in future phases than as a method of quantifying the stock as a whole.

Conclusions

The results of this study have demonstrated important progress in the understanding of the non-domestic building stock. In particular, the results highlight the complexity of the stock and numerous intersecting challenges facing businesses, which mean that understanding the characteristics of individual premises and how premises relate to each other is critical.

The method piloted for the Hospitality sector, has provided a full characterisation of the premises and their associated energy use for different activities. In particular, this method filled in important gaps in knowledge from existing data sets around floorspace, space heating and cooling equipment and their use. This method will provide new insights for other sectors in the next phase of this project.