Department of Energy & Climate Change

DECC Non - domestic building energy use project phase I

Pilot study of the food and mixed retail sector

June 2013

Table of Contents

Foreword by DECC

Introduction

The Department of Energy and Climate Change (DECC) is working to improve the evidence available about energy use in non-domestic buildings. The last time a national survey was run was for the Non-Domestic Energy and Emissions Model (N-DEEM) in the mid-1990s. This work was based on around 800 site audits across premises within the sector.

While there are a number of lessons that can be taken from the previous work it is necessary to review the methodology used for this such that we can exploit the value of the administrative data now available, improve our understanding of current energy management and behaviours and develop a survey capable of provide robust evidence to understand the diverse nature of this sector.

This report reflects the work done by Databuild Research and Solutions Ltd who were commissioned by DECC to carry out a pilot study in the food and mixed retail sectors. The aim was to test effectiveness of different survey methods and review the accuracy of data and modelling from this. Following this pilot DECC will commission the full project to capture information on energy use for the whole non-domestic building sector over the next two years.

Findings from the pilot

Methodology

The comparison stage of this pilot tested a range of survey methods with a particular focus in determining the relative value of telephone based methods with site audits. While the site audits were valuable in collecting detailed information about the buildings and energy uses within them there were significant challenges around recruiting a robust sample for use in this pilot. The telephone based surveys achieved a much higher response rate of over 40% and also enabled better understanding of the approach to energy management taken by the businesses. For some of the types of information sought, the accuracy of data reported was good and we agree with Databuild's recommendation that a telephone based method should be the primary survey method. However, we note that important methodological refinements will be required to ensure a robust evidence base is generated. In addition, in the main study, the information gathered in the surveys will be supplemented by administrative data. It is noted that there are advantages of using on-line based material to support the telephone survey approach and in some sub-sectors this could be practical.

Energy estimates

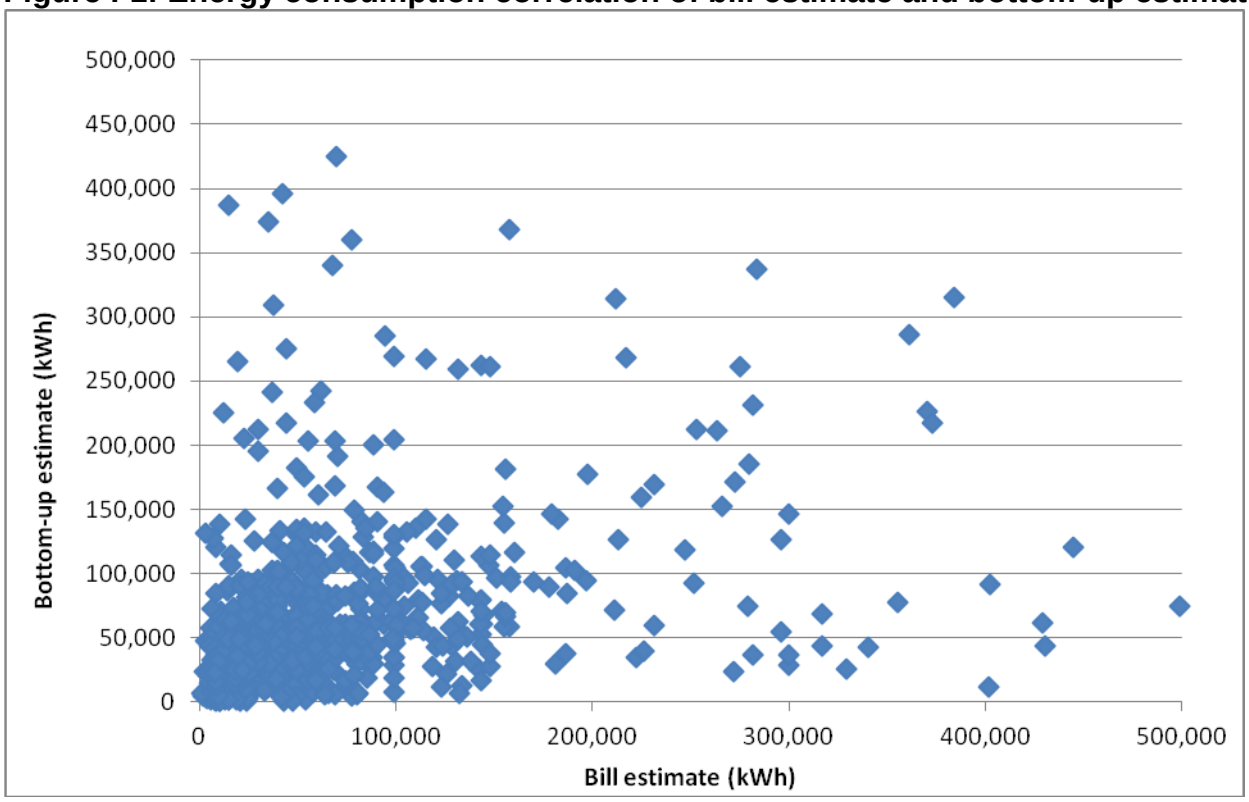
Subsequent to the Databuild research, DECC has carried out analysis comparing the bottom up estimates of energy end-use with energy consumption estimates / bills reported by the retailer and also with emerging data from the National Energy Efficiency Data-framework (NEED). NEED combines energy use at premises level with data about the property and occupying household/business to enable analysis of energy use within the building sector.[1]

The non-domestic sector NEED was still in its early stages at the time of the pilot study but work has now progressed such that it will be possible to draw a sample of records for the main project

[1] https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/national-energy-efficiency-data-need-framework

from data that have identified key premises information and the level of historic energy consumption for the premises. This will enable more robust validation of the survey estimates.

Figure F1: Energy consumption correlation of bill estimate and bottom-up estimate



An analysis of the accuracy and uncertainty of the bottom-up estimates has not been included in this report but it is acknowledged that the uncertainty is likely to be significant.

To assess the robustness of the bottom-up estimates, Figure F1 compares the energy estimate for the 862 cases in the pilot study estimates derived through a bottom-up model based on the survey data with bill estimates reported by the retailer. Some of these are based on actual bills, others are derived from what they thought they had spent on energy.

Overall the correlation between these two estimates is low but in aggregate terms the total energy use summed over all the cases is similar. DECC are therefore planning to make use of administrative data of premises energy consumption to constrain energy consumption at a site level in the main stage of the project.

Figure F2: Ratio of bottom up estimates to total consumption estimates

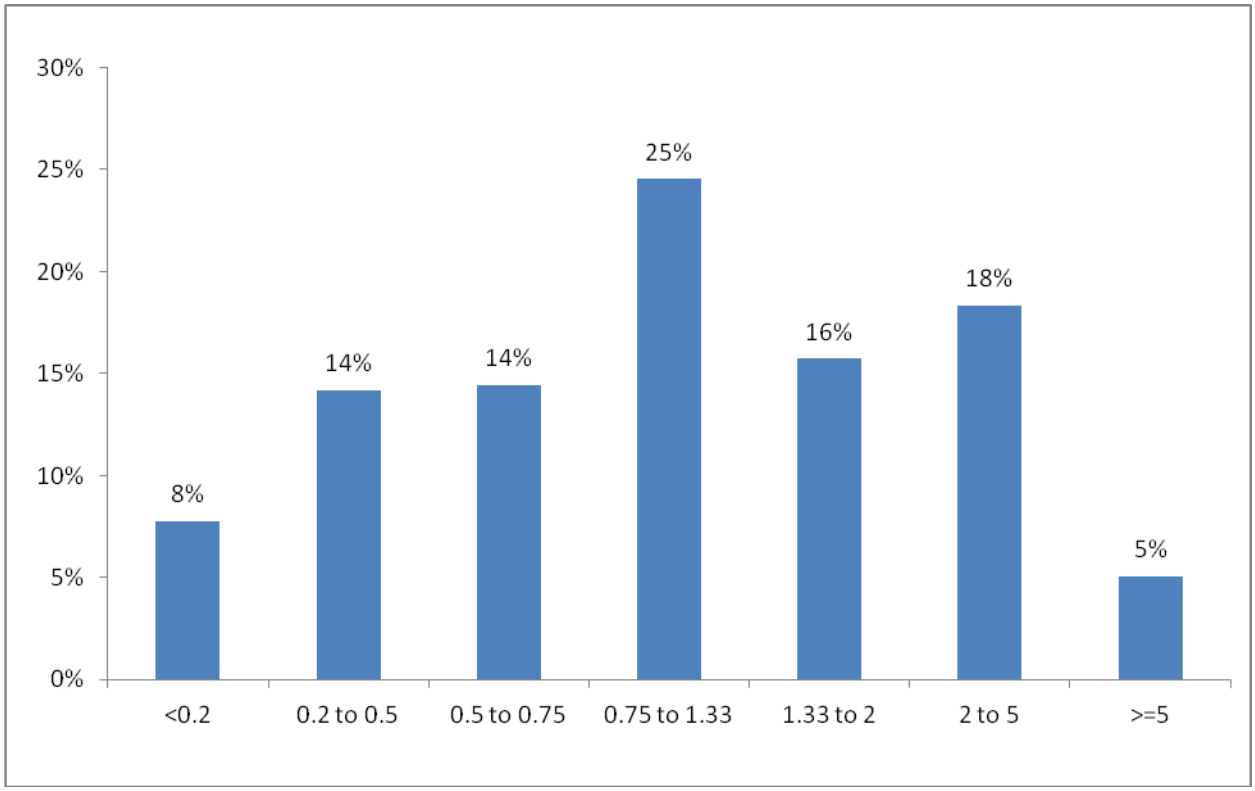


Figure F2 shows that in a quarter of cases the difference between the two estimates is less than 1/3 and in over half of cases is less than a factor of two. To enable reliable results to be used within the final model it will be necessary to identify outliers and consider removing these cases from the analysis, if these are considered to be the result of methodological limitations. In sub-sectors where a large proportion of estimates are not considered robust these can be targeted with a small number of site surveys.

It is noted that this is a comparison of two estimates and therefore it is not possible to identify if either is correct. We have therefore used data from NEED for about half the cases where it has been possible to match these addresses.

Figure F3: Energy consumption correlation of NEED estimate and bottom-up estimate

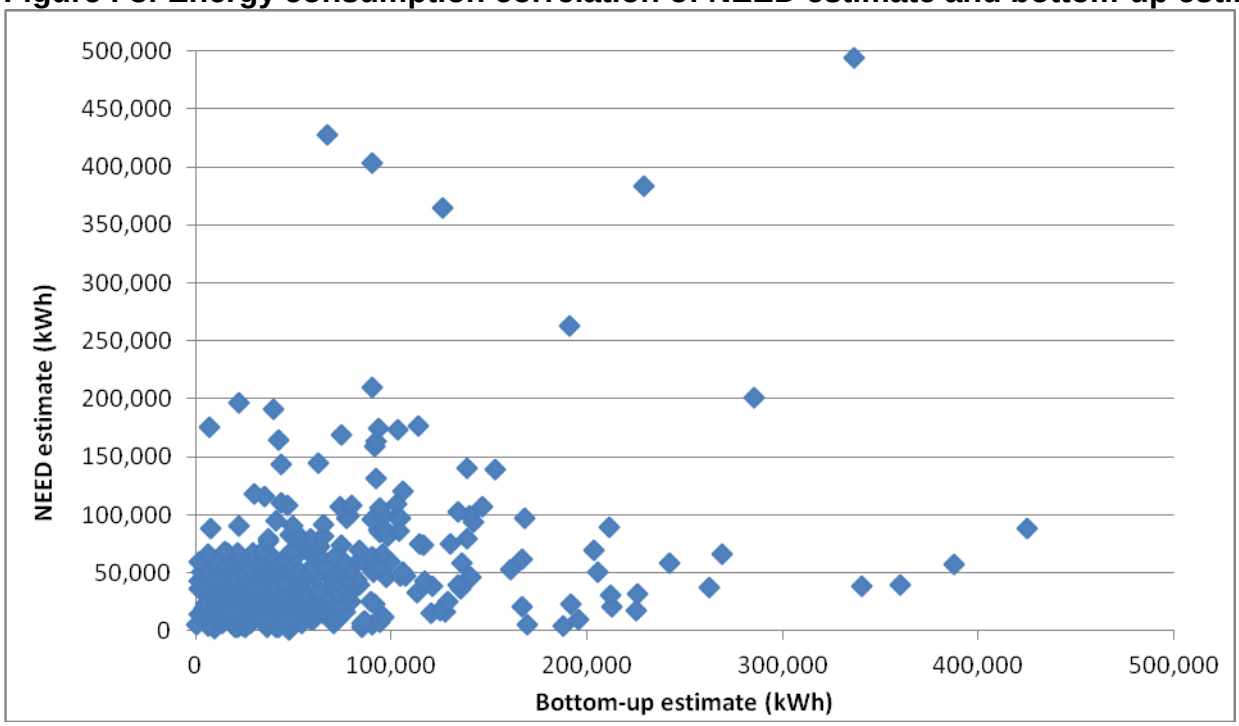
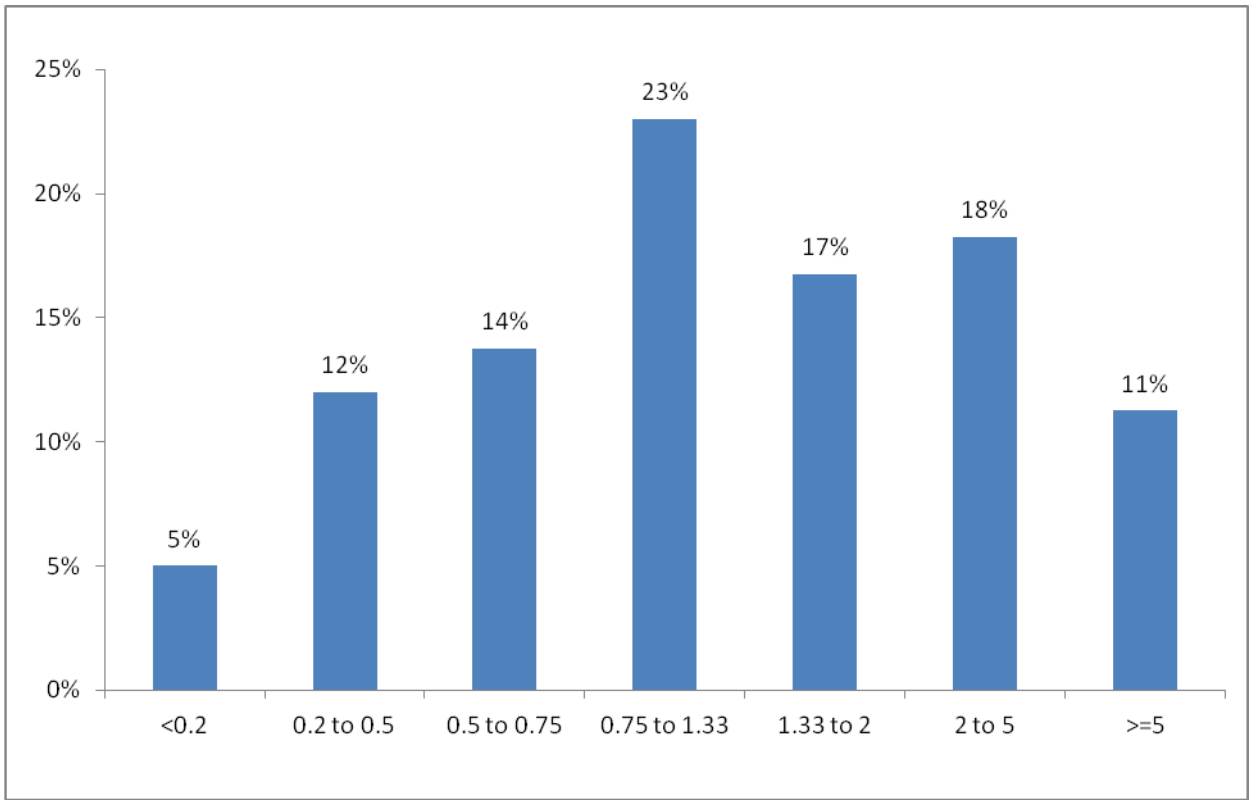


Figure F4: Ratio of bottom up estimates to NEED estimates for 2009

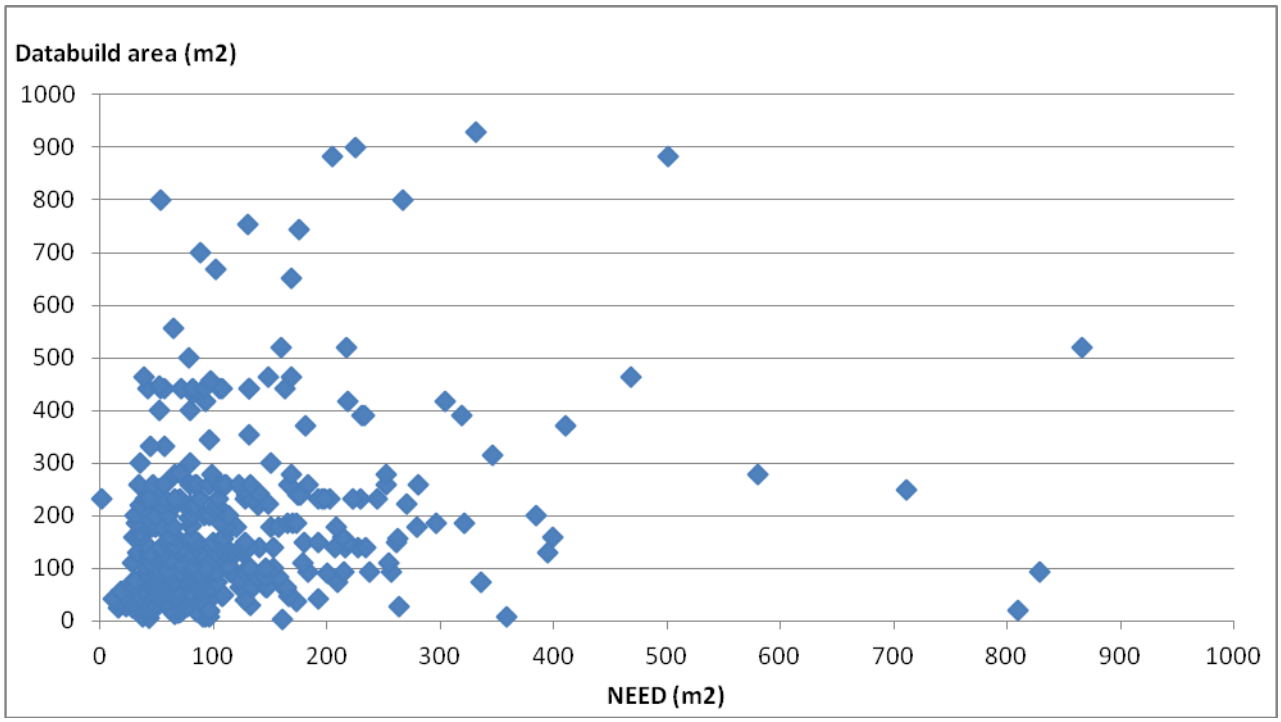


The NEED analysis in figure F3 shows a similar level of correlation to bottom-up estimates. It should be noted that full quality assurance of NEED consumption is still underway and is difficult to measure accurately where premises are occupied by multiple businesses. Analysis has also shown low correlation between NEED estimates and reported bill estimates.

Floor space estimates

A key input to the modelling for some end uses (e.g. lighting) is the measurement of the premises size. This is included in the Valuation Office Agency (VOA) Non-Domestic Ratings File (NDR) which is included in NEED and so it has been possible to compare this with the estimates provided by retailers.

Figure F5: Correlation of NEED and respondent estimated floor area



Again the correlation is low. Analysis of some case studies has shown that there are reliability issues in both data sources. For example, retailers reporting grossly inaccurate floor areas or possibly the wrong units. In other cases, NEED estimates referred to a larger space than the sampled unit (e.g. capturing a whole building or site when only part of this was occupied by the retailer sampled). Examples where this could occur will need to be carefully identified with the data to make robust calibration.

Next steps

While this analysis has revealed concerns with the accuracy of bottom-up estimates at the individual premises level we are confident that by changing the sample design to make better use of NEED data for floor area and energy consumption it will be possible for DECC to develop an error correction methodology to identify outliers in the results and constrain bottom-up estimates to realistic totals. In conjunction with refinements to the telephone survey and bottom-up calculation methodology is hoped that meaningful sector totals for energy end uses can be estimated. It is hoped that by removing those outliers which result from methodological limitations from the analysis, the data will be fit for modelling purposes to identify variation in

energy use between cases but further data is needed for a range of sectors before this can be fully determined.

As mentioned previously, another DECC project that is key to the success of this project is the development on non-domestic NEED to provide metered consumption and floor area for the sampled premises. We are working closely with DECC statisticians such that NEED data can be used with confidence in the early stage of the main project.

Future plans for the project

Following consideration of this pilot study and our analysis of the results DECC will commission the main project to collect energy use data and identify abatement opportunities for the full non-domestic buildings sector. We will run this as a modular project such that we can continue to learn lessons from the survey responses and continue to engage with stakeholders about the project whilst refining the methodology to constrain and gross data to be nationally representative.

There are a number of challenges to be tackled with the help of contractors and stakeholders to enable a robust data set such that it can be used to robustly underpin a wide range of analysis.

Further work is needed to produce better energy end-use estimates from the food and mixed retail sector and it is likely to be necessary to sample this sector again in the main project.

The full project is expected to conclude at the end of 2014 and we look forward to publishing the results in due course. We will continue to engage with a range of stakeholders as the project develops in particular to tap into sector knowledge of how best to obtain this information most effectively.

1 Executive summary

Introduction

Prior to this project, the UK government has relied upon data collected primarily in the 1990s for energy use statistics and assessment of abatement options in the non-domestic buildings sector. This data resides in the Non-domestic Building Stock (NDBS) database[2], and has been adapted along with other data collected over several years for use in the non-domestic energy and emissions (N-DEEM) model.

This project is phase I of a programme of work initiated by DECC to update the evidence base for the UK non-domestic buildings sector. The key overarching driver for updating the evidence base is that the Government needs reliable data about energy use and abatement opportunities in the non-domestic sector. Specifically these will give insight into:

- What energy using products are used and how they are used
- The options available to businesses to reduce energy consumption through:
    - Better use of existing equipment
    - Installation of energy efficiency measures
    - Long term drivers and trends in installation and usage
    - Organisational aspects that bear upon investment and activity trends.

Objectives

The overall objectives of this project are to:

- Evaluate alternative survey methodologies for gathering information on the use of energy and abatement opportunities in food and mixed retail premises. Food retailers predominantly sell food items, while mixed retailers sell a range of items, but a significant proportion (more than a minimum of 25%) of their activity involves the sale of food.
- Update and deepen DECC's insight by collecting data to enable examination of the way food and mixed retailers use energy and the abatement options open to them.
- Propose a survey methodology that can be scaled up and applied to the non-domestic building stock as a whole.

[2] As detailed in Harry Bruhns, Philip Steadman, Horace Herring (2000) A database for modelling energy use in the non-domestic building stock of England and Wales. Applied Energy 66 (2000) 277-297 and N.D. Mortimer, A. Ashley, M. Elsayed, M.D. Kelly, J.H.R. Rix (1998) Developing a database of energy use in the UK non-domestic building stock. Energy Policy 27 (8) 451-468

Research questions/data to be gathered

Key questions of interest to DECC at the time of commissioning this study are outlined in Table 1.1

Table 1.1: Research Questions/Data to be gathered:

Research question	Data required
Characteristics of the premises	Type, size, construction details e.g. insulation levels, age, presence of warehouse/ car park, etc. When refurbished/refit. Occupancy
Energy using equipment installed	Type and loadings of key equipment – lighting, refrigeration, pumps, motors, drives, heating. Is there a cold store, bakery, etc? Maintenance/replacement practices
How equipment is used	Hours of operation, controls
Energy used	Energy consumption data – in total, by area of site, for major items of plant, half-hourly, daily, weekly, monthly, annually. Energy management practices. Who manages – site, head office, contractor
Energy management options	Actions taken to reduce energy consumption. Test/consider other opportunities
Capital equipment options	Opportunities considered by site management. Other opportunities
Organisational factors	Ownership, tenure, if leasehold length of lease, environmental /energy policies, who pays the energy bill, who is responsible for which items of plant, who makes decisions on investment
Behaviour	Energy included in manager's performance assessment, staff campaigns/ incentives, actions taken in the past – why, actions considered but not implemented – why not
Attitudes	Return on investment required, CSR activity
Long term trends	Expected future activities/use of the site, expected trends

Methodology

The project was conducted in 2 stages:

1. **Comparison Stage:** This was used to explore the suitability of different survey mechanisms in terms of reliability and accuracy for the purpose of gathering the data of interest to DECC. The mechanisms tested were:

    a. A telephone survey

    b. Site audits

    c. Walkarounds[3]

    d. An intermediate approach comprising an online or paper-based survey supplemented with an in-depth telephone interview

   The results from this stage were used to develop a methodology for robust evaluation of the food and mixed retail sector.

2. **Main Stage**. This stage was used to:

    a. Implement the agreed approach for collecting the required data from a representative sample of sites in the food and mixed retail sector and updating DECC's evidence base by calculating key metrics, such as number of items of equipment, energy consumption and floor area of mixed food and retail sites.

    b. Consider and make recommendations for how other non-domestic premises could be evaluated, drawing on lessons learned in collecting data from the food and mixed retail sector.

862 interviews were conducted with independent and small chain (2-99 sites) food/mixed retailers, and 8 in-depth qualitative interviews were conducted with large food/mixed retailers (100+ sites)

[3] Walkarounds consisted of a member of the survey team walking around publically accessible areas of premises and visually assessing the equipment in use.

Comparison Stage

Independent / small chain food/mixed retailers

The **telephone survey** proved to be the most effective means of obtaining the data of interest to DECC from independent and small chain food/mixed retailers (fewer than 100 outlets):

- A higher response rate was achieved for the telephone survey (41%) than all other methods tested, except the walk around approach where permission was not obtained in advance.

- As expected, it was possible to obtain good data on behaviour and organisational factors affecting energy use using the telephone survey approach. It was also possible in most cases to obtain proxy data that could be used to inform an estimate of the profile of energy use for individual premises.

- It was more challenging to obtain detailed data where the number of types of end use (heating, lighting, refrigeration etc) exceeded four. It was also more difficult to obtain detailed data about individual items of equipment where respondents had more than five items in the same area of use (e.g. more than five chilled cabinets). Detailed data were obtained for the first five cabinets and additional information about the remaining cabinets was captured where offered.

- It was not possible through the telephone survey to obtain detailed data for lighting – specifically the number of bulbs – however, respondents were generally willing/able to provide an indication of the different types of lighting in their store as a proportion of their total lighting.

The **intermediate approach** (comprising an online/postal survey with telephone follow-up) proved to be the least effective means of gathering the data of interest to DECC from independent/small chain food/mixed retailers (fewer than 100 outlets):

- The response rate was the lowest of all approaches tested (7%).

- Many small food/mixed retailers approached to participate in the survey did not have access to the Internet/e-mail from their shop and said they were unable to complete the online survey for this reason. Where respondents were willing to participate in the survey, but did not have access to email/the Internet, a copy of the survey was sent to them in the post.

- For respondents agreeing to participate and being sent the survey, there were only two instances where this was completed without any kind of reminder. The deadline for completion was made obvious, but some respondents still did not complete the survey in the given timeframe.

- Where responses were received, they were not comprehensive. The limited information provided tended to be accurate when compared with the site audit response; however, the response was generally insufficient to estimate the profile of energy use in the shop.

- The approach was effective in obtaining a summary for respondent sites of whether or not the premises was using energy for each type of end use (refrigeration, heating, lighting etc), and some indication of the number of items and types of equipment, but responses to questions designed to obtain proxy data to inform an estimate of energy consumption for individual items of equipment were often incomplete.

- The online/postal survey did prove to be a practical means of obtaining other data of interest to DECC (e.g. behaviour and organisational factors) – however, the low response rate means that the premises for which responses are received using this approach are unlikely to be representative of the wider population.

The **site audits** provided the highest quality data about energy using equipment present in an individual premises; however, the site audits were subject to two significant limitations:

- Response rate – a number of businesses were unwilling to participate in the comparison stage due to the time commitment required for the audit. The response rate for the telephone interviews where we were seeking to organise a site audit was 23%. A few were also unwilling to participate because they had been approached by other people in the past that had offered to undertake a site audit and subsequently attempted to use this as the basis for a sales pitch for new equipment or services.

- High cost compared to other methods tested – site audits are expensive and time consuming compared to the other approaches tested.

Walk arounds were an effective means of exploring the energy using equipment used on the shop floor; however, they did not provide a means of exploring energy using equipment not visible from the shop floor. As the walk arounds were conducted on an ad hoc basis simply to test the approach, without the permission of the shop owners, no direct contact was made with anyone within the shop who would be able to provide information about behaviour and organisational factors.

Large retailers (100+ sites)

Head offices of large retailers with 100+ sites were contacted to explore how energy is managed and what data are captured to inform decision making. The interviews were conducted over the telephone on a qualitative basis, enabling the interviewer to pursue themes as they arose. Initial conversations with the largest retailers confirmed our hypothesis that detailed information about energy use is often captured and analysed at head office level and that this presented an opportunity for DECC to obtain detailed coverage of the sites owned/leased by the largest retailers.

The key limitation of the approach is that it took a significant amount of time to identify the correct respondent, determine what data they capture in relation to energy use and explore what information they would be able to provide. A number of retailers were quick to agree that they would be willing in principle to provide information to DECC for use in this study; however, a number requested that non-disclosure agreements be put in place to protect their information and these have proven time consuming to finalise. It was therefore not possible to include results for these retailers in the main results.

A number of retailers expressed interest in participating if they would get something in return; in particular, the retailers were keen to explore whether there would be any opportunity to feed into the policy making process if they were to supply data.

Incentives and alternative data collection strategies may be required in order to secure greater participation from large retailers in future phases of the work.

Main Stage

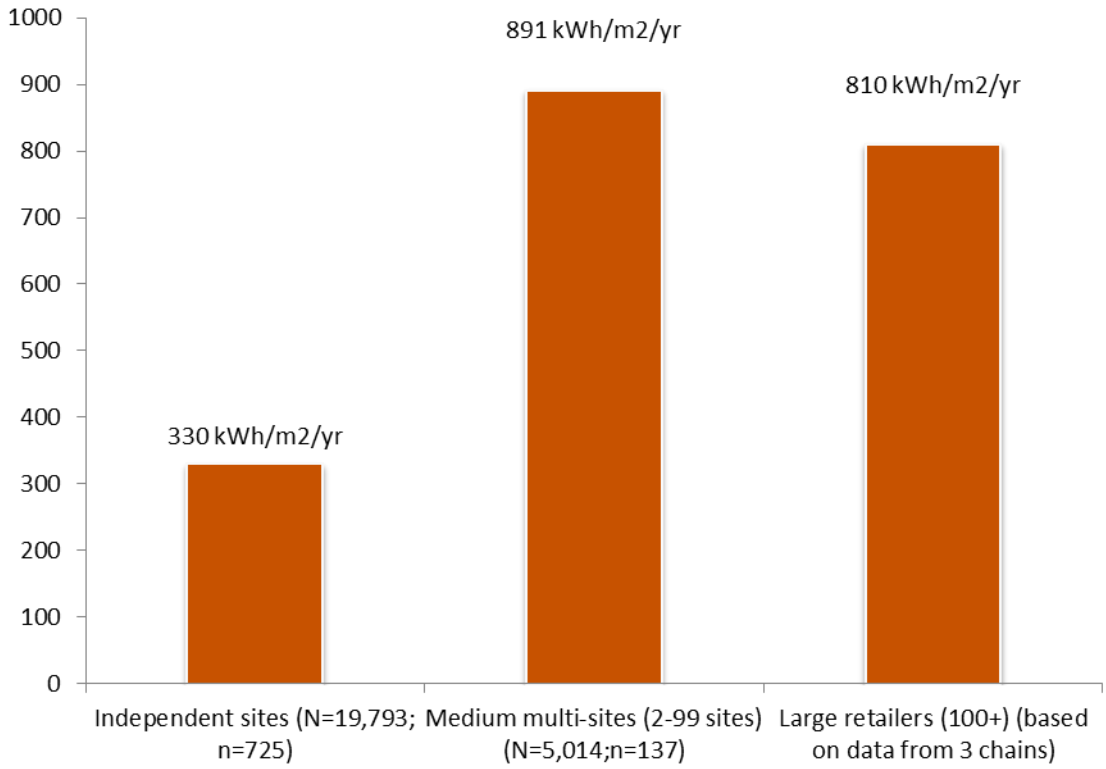
Energy Consumption

Energy consumption for independent and small chain organisations was calculated both from information provided by respondents regarding their energy bills and also through a bottom-up estimate whereby items of equipment and operational hours were converted to energy consumption using publically available factors.

We estimate that independent/small chain food/mixed retailers in the UK with fewer than 100 outlets consume approximately 2 TWh per annum.

Only a small number of large retailers were willing to share comprehensive energy use data; however based on those which did provided data average energy intensity per m^2 of retail space was calculated. This estimate is presented in Figure 1.1 below with a comparative figure for independent and small chain (labelled medium multi-site) organisations:

Figure 1.1: Average Energy Intensity of Mixed Food Retailers of Differing Organisational Size (independent and medium multi-sites are based on bill data).



For independent and medium-multi-site (or 'small') chains the most intensive sectors are supermarkets and bakers.

Data captured in the main stage telephone survey relating to the types of equipment in use and how these are used were analysed to produce a bottom-up estimate of the energy consumed in particular end-uses for **independent/small food/mixed retailers with fewer than 100 outlets:**

Table 1.2 reports the energy estimates for the main end-uses in this sector. The survey results have been grossed based on Experian data but these are raw figures and have not been validated or constrained to external sources in this pilot study.

Table 1.2: Bottom-Up Estimate of Energy Consumption in Different End Uses (Independent/Small Chain Food/Mixed Retailers)

Process	Annual GWh for process	% of total kWh	kWh/m^2/yr - gross floor area	kWh/m^2/yr - net floor area
Lighting	150	7%	34	35
Refrigeration	756	37%	173	175
Heating	40	2%	9	9
Cooling	51	3%	12	12
Hot Water	130	6%	30	30
Ovens	91	4%	21	21
Café	2	0%	0.4	0.64
Other end uses including specialist equipment (e.g. dough makers, mincers), small power (estimate based on difference between bill data and bottom-up figures)	831	40%	191	192
Total	**2,050**	**100%**	**471**	**475**

The large food/mixed retailers (100+ sites) that provided actual energy use data across the stock were supermarkets. All reported that electricity use accounted for the bulk of their energy use[4]; 75% of total energy use, with gas comprising the remaining 25%. Combining the profile information we were supplied gives an approximation for energy usage for a 'typical' large supermarket chain as follows:

[4] Based on energy supply broken down by source, from two supermarket retailers who provided this data.

Proportion of total energy consumption by end use[5]

- Refrigeration - 35%
- Lighting - 18.5%
- HVAC and hot water - 26.8%
- In store hot food production (bakery, cafe etc) - 10.3%
- Other uses (including small power - administration, computers, tills, conveyors) - 9.3%

Abatement

It was beyond the scope of the project to calculate accurate savings from abatement opportunities. However a number of examples are identified and potential savings estimated within this report. The main opportunities target refrigeration and lighting as these end-uses comprise the majority of energy use.

Given that comprehensive data was not provided for large retailers, abatement was only explored for independent and medium multi-site organisations (2-99 sites).

Recommendations for other sectors

We recommend that DECC adopt the following approach to gathering data from the other segments of the non-domestic sector:

1. **Survey of CRC participants / consultation**: Prior to undertaking work with other segments of the non-domestic sector, we recommend that DECC consults or surveys CRC participants to understand whether and how they collate and analyse data relating to their energy use, particularly data relating to type of end-use, whether they would be willing to share this with DECC[6] and the least burdensome way in which these data could be shared.

   This could take the form of a consultation with all CRC participants, inviting them to complete a short questionnaire to understand how they manage energy consumption in the buildings they own or occupy, the degree and coverage of sub-metering and what data they already collate for the purpose of internal or other reporting, detailing the profile of their energy use by type of end use (heating, lighting etc). This could be followed by a series of qualitative interviews with representatives from each activity group of interest to DECC to understand under what circumstances they would be prepared to provide information to DECC.

2. **Work to update the evidence base for other segments of the non-domestic sector:** We recommend that DECC adopt a modular phased approach to gathering data from other segments of the non-domestic sector:

[5] Weighted figures based on data supplied by three supermarket chains who supplied total annual consumption and individual energy profile.

[6] A number of large retailers in the food/mixed retail sector approached in this study were willing to share data with DECC in principle, but wanted something in return for supplying this information.

1. **Preparatory phase:** In the preparatory phase for each activity group we recommend that DECC identify and engage relevant stakeholders to build a detailed understanding of the segment and to test the hypotheses underpinning the envisaged approach within segments. This effort has proven helpful in Australia for the purpose of engaging with the largest organisations in the sector, encouraging participation and making the best use of energy data that have already been collated for other purposes.

   It cannot be assumed that the approaches that have proven to work for the food/mixed retail sector will work in other sectors and stakeholder engagement also provides an opportunity to review the planned approach to collecting the data of interest to DECC from businesses within each activity group.

2. **Methodology development and pilot phase:** We recommend that the precise approach for each business activity group is developed following the completion of the stakeholder engagement exercise and that a pilot phase is undertaken for the planned approach and questionnaire for each sub-segment within each group. This would provide an opportunity to:

   - Test the final sampling approaches for each activity group and the quality of the databases.
   - Ensure the target respondent will participate in the research and that it will be possible to achieve a good response rate.
   - Check that respondents understand the purpose of the research and the questions being asked.
   - Ensure respondents are able to give meaningful responses that would provide enough information to answer the research questions.
   - Ensure the survey structure works i.e. the questions are in an order that makes the conversation easy.
   - Test the length of the questionnaire.

3. **Main phase:** Following piloting, the planned approach and survey instruments should be reviewed to ensure they are fit for purpose and changes made in light of the findings from the pilot to maximise the insight obtained with the resources available. The precise approach would need to be tailored for each business activity sector and sub-segments within each sector in order to achieve full coverage of the non-domestic sector. We recommend that each activity group be stratified (e.g. by business activity) to ensure good representation within the sample of premises with high energy intensity (kWh/m^2), as indicated by analysis of NEED data.

   Section 5 of the report provides an outline of the approach we recommend be adopted in exploring energy use and abatement opportunities for each activity group. Each section discusses possible sample structures and approaches for the purpose of the survey work[7],

[7] We recommend that the approaches proposed in this report are carefully reviewed and piloted before fieldwork is undertaken to gather data from each activity group. We recommend that NEED data relating to the energy use and intensity of particular activity sectors are reviewed to ensure that the final sampling approach for each activity provides good representation of premises with particularly high energy intensities (kWh/m^2) within each activity group.

but does not specify sample sizes as we would expect this to be led by DECC's needs in terms of accuracy and the resources available for updating the evidence base.

Prior to commissioning work to update the evidence base for other segments of the non-domestic sector we recommend that DECC take steps to decide:

- **The specific sub-segments of the non-domestic sector about which DECC would like to draw robust conclusions**

  This will be required in order to ensure that these sub-segments are sufficiently represented in the eventual sample to enable robust conclusions to be drawn.

- **The priority data points within each of these sub-segments and desired level of accuracy for these data points**

  This will be necessary to inform decisions about sample size for each of the sub-segments of interest. For example, if DECC require a specific level of accuracy for the proportion of premises within a particular activity using particular types of equipment, the sample size could be designed to ensure that a specific confidence interval is achieved.

- **The way in which the data collected from the survey will be analysed and integrated with any future model, and explanatory power for the purpose of statistical tests**

  The sampling approach can be specifically designed to achieve a particular level of statistical explanatory power; this may be useful; for example, in drawing conclusions about whether the behaviour of one segment is significantly different to another.

2 Introduction

Background

Prior to this project, the UK government has relied upon data collected primarily in the 1990s for assessment of abatement options in the non-domestic buildings sector. This data resides in the Non-domestic Building Stock (NDBS) database[8], and has been adapted along with other data collected over several years for use in the non-domestic energy and emissions (N-DEEM) model.

This is the pilot project for a programme of work initiated by DECC to update the evidence base for the UK non-domestic buildings sector. The key overarching driver for updating the evidence base is that the Government needs reliable data about energy use and abatement opportunities in the non-domestic sector. Specifically these will give insight into:

- What energy using products are used and how they are used
- The options available to businesses to reduce energy consumption through:
    - Better use of existing equipment
    - Installation of energy efficiency measures
    - Long term drivers and trends in installation and usage
    - Organisational aspects that bear upon investment and activity trends.

Whilst the knowledge in the current N-DEEM evidence-base is still valuable, it requires updating because:

- The energy uses in buildings have changed – for example, there have been significant technical changes in lighting and refrigeration that will have a major impact on energy consumption in the retail sector
- The way that buildings are used has also changed – for example, in the 1990s very few retail premises were open 24 hours; now the 24 hour supermarket is commonplace
- Organisations' priorities have changed and this influences the way they manage their buildings and their energy use; unit energy costs are greater and there are reputational and regulatory drivers to reduce carbon emissions.

[8] As detailed in Harry Bruhns, Philip Steadman, Horace Herring (2000) A database for modelling energy use in the non-domestic building stock of England and Wales. Applied Energy 66 (2000) 277-297 and N.D. Mortimer, A. Ashley, M. Elsayed, M.D. Kelly, J.H.R. Rix (1998) Developing a database of energy use in the UK non-domestic building stock. Energy Policy 27 (8) 451-468

The key data collected in this project are similar to those covered in the original NDBS data set, but the scope has been widened to consider organisational behaviour, and other data necessary to build an effective micro-simulation model of possible adoption and use of measures. Therefore, in addition to capturing the physical characteristics of the building stock and energy end-uses, this project and subsequent phases also sought to investigate the institutional environment and attitudes towards energy saving in the sector.

Objectives

The overall objectives of this project are to:

- Evaluate alternative survey methodologies for gathering information on the use of energy and abatement opportunities in food and mixed retail premises. Food retailers predominantly sell food items, while mixed retailers sell a range of items, but a significant proportion (at least 25%) of their activity involves the sale of food.

- Update and deepen DECC's insight by collecting data to enable detailed analysis of the way food and mixed retailers use energy and the abatement options open to them.

- Propose a survey methodology that can be scaled up and applied to the non-domestic building stock as a whole.

It is not within the scope of this project to use the collected data to build a model for DECC to examine energy consumption and abatement options in the food and mixed retail sector. The design and building of such a model will be undertaken at a subsequent stage in DECC's programme of work to update the non-domestic buildings evidence base. Therefore, whilst we provide some examples of abatement opportunities in this report to illustrate how the data collected in this study can be used for this purpose, we have not sought to undertake a comprehensive analysis to estimate the total abatement potential in the food/mixed retail sector.

Research questions

Key questions of interest to DECC at the time of commissioning this study are outlined below

Table 2.1: Research Questions/Data to be gathered:

Research question	Data required
Characteristics of the premises	Type, size, construction details e.g. insulation levels, age, presence of warehouse/ car park, etc. When refurbished/refit. Occupancy
Energy using equipment installed	Type and loadings of key equipment – lighting, refrigeration, pumps, motors, drives, heating. Is there a cold store, bakery, etc? Maintenance/replacement practices
How equipment is used	Hours of operation, controls
Energy used	Energy consumption data – in total, by area of site, for major items of plant, half-hourly, daily, weekly, monthly, annually. Energy management practices. Who manages – site, head office, contractor
Energy management options	Actions taken to reduce energy consumption. Test/consider other opportunities
Capital equipment options	Opportunities considered by site management. Other opportunities
Organisational factors	Ownership, tenure, if leasehold length of lease, environmental /energy policies, who pays the energy bill, who is responsible for which items of plant, who makes decisions on investment
Behaviour	Energy included in manager's performance assessment, staff campaigns/ incentives, actions taken in the past – why, actions considered but not implemented – why not
Attitudes	Return on investment required, CSR activity
Long term trends	Expected future activities/use of the site, expected trends

Priority areas were discussed and agreed with DECC prior to undertaking fieldwork, with particular emphasis given to gathering data to inform an estimate of the profile of energy consumption by end use, details about how equipment is controlled and used, organisational and behavioural factors affecting energy use and the degree to which action had been considered/taken over the last three years to replace or improve the efficiency of specific energy using equipment.

Methodology

The project was delivered in two stages:

1. **Comparison stage**; to determine the relative suitability of different survey mechanisms for collecting the data of interest to DECC, both in terms of their reliability and accuracy. More specifically this stage was used to:

    a. Identify who can provide the information DECC requires and the best way to obtain these data; this included an assessment of the relative reliability and suitability of three methods of collecting the data that DECC require from the food and mixed retail sector:

        i. A telephone survey

        ii. Site audits; and

        iii. An intermediate approach comprising an online survey supplemented with an in-depth telephone interview

    b. Develop a methodology for robust evaluation of the food and mixed retail sector, drawing on the findings from the comparison of survey methodologies.

2. **Main stage.** This was used to:

    a. Implement the agreed approach for collecting the required data from a representative sample of sites in the food and mixed retail sector, updating DECC's evidence base.

    b. Consider and make recommendations for how other non-domestic premises could be evaluated, drawing on lessons learned in collecting data from the food and mixed retail sector.

3 Comparison Stage

Introduction

This section summarises the work undertaken in the comparison stage whereby different survey techniques for collecting the data of interest to DECC were explored.

The purpose of the comparison stage was to:

1. Identify who could provide the information DECC required and the best way to obtain these data; this included an assessment of the relative reliability and suitability of three methods of collecting the data that DECC required from the food and mixed retail sector:

- A telephone survey
- An intermediate approach comprising an online survey supplemented with an in-depth telephone interview
- Site audits

2. Subsequently use this information to develop a cost-effective methodology for robust evaluation of the food/mixed retail sector in the main data collection stage.

The questionnaires and topic guides used in the comparison stage of the project can be found in the methodology appendix (Annex 5).

Outline of Survey Techniques Tested

Table 3.1 summarises the methodologies tested in the comparison stage.

Table 3.1: Overview of data capture methodologies tested in this study

Methodology	Description
Telephone survey	Telephone survey conducted by experienced project-trained researcher. Survey length typically 15-20 minutes, dependent on number of energy end uses present at the target business. If respondent unable or unavailable to complete the survey on first call, an appointment was made to call them back. Where no one answered the phone at the premises, records were called a further five times at different times of day and on different days in an attempt to identify when the premises was occupied. Once contact had been made at the business in question (with either the respondent or other individual) a further five attempts were made to contact the respondent and complete the survey. Where no respondent could be identified on the first call, a further two follow up calls were made.
Online / postal survey[9]	Link to survey emailed or paper copy of survey posted to respondents, for them to complete at their own convenience. Respondent recruited and agreed to participate before survey

Methodology	Description
	dispatched. Trained researcher on hand via telephone for any queries regarding the content of the survey and how to complete it. Where receipt of completed survey was delayed, respondents were called (if postal) or emailed (if email) a further three times in 3-4 day intervals to remind them about the survey and completion deadline.
Site audit	Expert auditor visiting the business premises to collect detailed first-hand information on the building and equipment in place. Visits typically took 1-2 hours depending on the size of the premises. Prior consent obtained from the proprietor and a convenient date and time confirmed. Audit process designed to limit time impact on the respondent; most of the data was able to be collected unaccompanied, with just questions on behaviour, billing and specific queries regarding energy using equipment needing their time. These took approximately 15 minutes with the respondent at the end of the visit.
Walk around	Project-trained researcher visiting the premises and walking around public areas, observing information about the building and energy using equipment visible. Proprietor not informed the exercise was taking place as the purpose of the walk around was to explore how much information could be gathered by looking at the building and energy using equipment inside, without the use of questioning the respondent. Visits took 10-15 minutes to accurately observe everything that was visible in areas that were accessible.

In addition to testing the effectiveness of the telephone survey, site audits and the intermediate approach, a further four site audits were conducted targeting large chain retailers. It was more time consuming to get a response from large chain retailers, relative to small and medium-sized chains, and this could not be completed within the timescale available for the comparison stage.

In addition, a further seven premises were selected to test the effectiveness of a 'walk around' technique, whereby a project-trained researcher visited the premises and walked around the public areas, observing the building and visible energy-using equipment.

[9] It was originally proposed to test a specially adapted version of the survey questionnaire for online completion by respondents. However, once recruitment for these surveys had commenced it emerged that a significant proportion of respondents either didn't have access to email at all, or didn't have access to email/the internet at the site. Therefore, the technique was adapted to allow for a version to be printed off and posted.

Methodology

The comparison stage comprised an evaluation of the energy using equipment and behaviour of twenty food/mixed retail premises in Cheshire, consisting of:

- Fourteen sites participating in a telephone survey, followed by a site audit
- Six sites participating in an online or postal survey, followed by a telephone interview and site audit

A summary of the work undertaken during the comparison stage is given in Annex 1: Table 1.

The primary purpose of the comparison stage was to test the relative suitability of the agreed survey mechanisms for collecting the data of interest to DECC, in terms of their reliability and accuracy.

The sample for this was deliberately structured to ensure that we attempted to obtain the required data from retailers across the spectrum of premises, in terms of their expected ability to be able to provide the data. We ensured that the following were covered:

- Premises in a variety of locations – food and mixed retail premises in town centres, secondary locations and shopping centres.[10]
- Premises from both independent retailers and those with multiple trading sites.
- A range of business activities within food and mixed retail, including a mixture of energy intensive[11] and non-energy intensive activities.

The following criteria were used to determine whether a business premises is likely to be energy intensive:

A business premises will be considered energy intensive if a significant proportion of their floor space involves:

- *Specific business activities with a high energy demand; Dry cleaning, Baking, Café*
- *Use of particular equipment with a significant energy demand (e.g. refrigeration and/or cold storage)*

[10] It was intended that we would also speak to single-site, small and medium chain businesses based in retail parks; on commencing data collection however no food retailers emerged in the sample, as sites associated with these locations were always large chains, with whom we were unable to secure engagement within the timeframe of the comparison stage

[11] In terms of their energy use (kWh) per unit floor area (m^2)

The logistics of carrying out the audits; Cheshire was a convenient location for the auditors as AEA have offices in Warrington. It offered a good mixture of town centre, shopping centres and secondary locations across which a range of different types of non-domestic building could be included in the study. The proximity to AEA offices also ensured that it was feasible to complete sufficient site audits within the timescale for the comparison stage.

Familiarity with the area; AEA are familiar with the retail market in Cheshire and this helped to ensure that a good range of types of premises were included within our sample for the comparison stage.

Fieldwork was conducted in January and February 2012.

Following the completion of the comparison stage, the findings were analysed/reviewed and used to inform the approach for the main stage. A summary of the key findings from the comparison stage and the conclusions/implications for the approach adopted in the main stage can be found in Appendix B of the methodology appendix (Annex 5) produced to accompany this report.

Results from Comparison Stage

This section summarises the key results from the comparison stage, including:

1. An analysis of the effectiveness of each survey mechanism in terms of response rate/respondent engagement, comprehensiveness of information gathered and accuracy.

2. An overview of the key findings from the comparison stage; these findings were used to inform the methodology for the main phase.

3. An outline of the challenges encountered in collecting the data of interest to DECC from the food/mixed retail sector that should be considered in future stages of the programme of work to update the evidence base.

The reader should note that the results are deliberately reported on a primarily qualitative (rather than quantitative) basis due to the relatively small sample size (n=20)[12].

[12] It was anticipated that a total of 36 interviews would be completed during the comparison stage, but due to difficulties engaging large chain retailers and to a lesser extent small and medium chain retailers, this target was not reached within the timeframe we were working to. The difficulty was due to delays in navigating head offices to identify individuals and then securing agreement to participate, which in some instances required board approval.

Analysis of Effectiveness of Survey Mechanisms

Independents, and Small/Medium-Sized Chains

While the telephone survey and site audit was set out as one approach in the methodology section above, and the intermediate approach and site audit was also set out as an approach, the effectiveness of the telephone survey, intermediate approach and site audit will each be evaluated separately in the following section.

Telephone Survey

The telephone survey proved to be the most effective means of obtaining the data of interest to DECC.

A higher response rate was achieved for the telephone survey than all other methods tested, except the walk around approach where permission was not obtained in advance. The response rate for the telephone survey in the main phase was 41% (compared to a response rate of 23% for the comparison stage where there was a requirement for the site to complete an audit in addition to the telephone survey). It was more time consuming to engage with multi-site retailers with fewer than 100 sites, but the level of response was similar when the interviewer had identified the correct person.

As expected, it was possible to obtain good data on behaviour and organisational factors affecting energy use using the telephone survey approach. It was also possible, in most cases, to obtain proxy data that could be used to inform an estimate of the profile of energy use for individual premises. It was more challenging to obtain detailed data where the number of types of end use (heating, lighting, refrigeration etc.) exceeded four. It was also more difficult to obtain detailed data about individual items of equipment where respondents had more than five items in the same area of use (e.g. more than five chilled cabinets). Detailed data were obtained for the first five cabinets and additional information about the remaining cabinets was captured where offered.

It was not possible through the telephone survey to obtain detailed data for lighting – specifically the number of bulbs; however, respondents were generally able to provide an indication of the different types of lighting in their store as a proportion of their total lighting.

The key strengths and weaknesses of the telephone survey approach are summarised in the table below:

Table 3.2: Strengths and Weaknesses of the Telephone Survey Approach

Strengths	Weaknesses
High response rate compared to other methods	Relevant individuals hard to reach, or only able to speak when they are busy; more difficult to secure response where there are few quiet periods (e.g. bakery)
Cost effective means of obtaining representative UK wide coverage	Not practical within 15-20 minute survey to gather comprehensive data for large sites with a lot of energy using equipment
Faster to administer than other methods	Respondent not always able/willing to look closely at equipment
Low time commitment for respondent compared to audit / intermediate approaches	Relying on descriptive/technical abilities of respondent to relay information
Opportunity to probe and clarify responses, and tailor survey questions using routing (unlike postal)	Respondents unable to provide accurate information for number of items for non-bulky equipment e.g. number of lights, but generally able to provide proxy data
Good for sites with small number of end uses, and capturing data about obvious bulky end using equipment	Some proxy data difficult for respondent to provide accurately (e.g. dimensions of chiller cabinets), but data provided sufficiently accurate to get an idea of internal volume and likely consumption given hours of use

Intermediate Approach

The intermediate approach (comprising an online/postal survey with telephone follow-up) proved to be the least effective means of gathering the data of interest to DECC for this sector.

The response rate was the lowest of all approaches tested (7%). Many small food/mixed retailers approached to participate in the survey did not have access to the Internet/email from their shop and said they were unable to complete the online survey for this reason. Where respondents were willing to participate in the survey, but did not have access to email/the Internet, a copy of the survey was sent to them in the post.

For respondents agreeing to participate and being sent the survey, there were only two instances where this was completed without any kind of reminder. Despite reminders, some respondents did not complete the survey in the given timeframe.

Where responses were received, they were not comprehensive. The limited information provided was considered to be reasonably accurate when compared with the site audit response; however, the response was generally insufficient to estimate the profile of energy use in the shop.

The approach was effective in obtaining a summary for respondent sites of whether or not the premises was using energy for each type of end use (refrigeration, heating, lighting etc.), and some indication of the number of items of some types of equipment, but responses to questions designed to obtain proxy data to inform an estimate of energy consumption for individual items of equipment were often incomplete.

The online/postal survey did prove to be a practical means of obtaining other data of interest to DECC (e.g. behaviour and organisational factors); however, the low response rate meant that the premises for which responses were received using this approach were unlikely to be representative of the wider population.

The key strengths and weaknesses of the email/postal survey approach are summarised in Table 3.3 below:

Table 3.3: Strengths and weakness of the email/postal survey approach

Strengths	Weaknesses
Read questions and complete survey at their own pace and convenience – good for owner/managers with no time to complete survey during working day	Low response rate; no guarantee that person agreeing on the phone to complete the survey will actually do so
Respondents have more time to gather specific information (e.g. makes and models)	Time consuming to deliver in general, further time-lag for postal
Can provide visual cues (e.g. photos of particular types of equipment) to assist the respondent	Do not always have access to e-mail / Internet to complete online
Opportunity to validate the work (e.g. letter from DECC)	No opportunity for probing at time of response
Possible to introduce routing of questions to tailor survey based on earlier responses [if online]	Respondents miss out the 'hard' bits, don't provide full information for the parts they do answer
	No routing for postal – unnecessary questions, whole survey overwhelming

Site Audits

The site audits provided the highest quality data about energy using equipment present in an individual premises; however, the site audits were subject to two significant limitations:

1. Response rate: A number of businesses were unwilling to participate in the comparison stage due to the time commitment required for the audit. A few were also unwilling to participate because they had been approached by other people in the past that had offered to undertake a site audit and subsequently attempted to use this as the basis for a sales pitch for new equipment or services

2. High cost compared to other methods tested: Site audits are expensive and time consuming compared to the other approaches tested.

The key strengths and weaknesses of the site audit approach are summarised in Table 3.4 below:

Table 3.4: Strengths and Weaknesses of the Site Audit Approach

Strengths	Weaknesses
Expert gathering data rather than relying on respondent response	Lower response rate compared to telephone survey due to time commitment
Possible to examine equipment in person rather than relying solely on description	Comparatively expensive and difficult to achieve UK wide coverage
Opportunity to discuss behaviour in person with probing	Time consuming for the respondent
Respondent likely to complete 'interview' once engaged	More difficult to arrange a convenient time due to time commitment required by respondent / availability of auditor in location
Good for large premises and those with lots of energy using equipment	A degree of respondent mistrust of purpose – fear that the audit is a ploy to sell them something
	No better than alternative approaches in some instances (e.g. not able to obtain kW rating where equipment is purpose built, not accessible)

Walk Around

Although not part of the original research plan, walk arounds were an effective means of exploring the energy using equipment used on the shop floor; however, they did not provide a means of exploring energy using equipment not visible from the shop floor. As the walk arounds were conducted on an ad hoc basis simply to test the approach, without the permission of the shop owners, no direct contact was made with anyone within the shop who would be able to provide information about behaviour and organisational factors.

The key strengths and weaknesses of the walk around approach are summarised in Table 3.5 below:

Table 3.5: Strengths and Weaknesses of the Walk-Around Approach

Strengths	Weaknesses
Opportunity to include hard to reach groups and can be conducted relatively easily in any shop	Only possible to access publicly accessible parts of the premises – can't cover every data item of interest
Carried out by trained individual – not relying on the respondent to relay information	Larger sites can be time consuming
Short in duration for most sites	Limited behavioural information unless permission obtained
Can count equipment easily and can gather information about makes and models to inform assessment of energy consumption	Can't get exact data, will never reach maximum accuracy as cannot access all areas of the premises
Can make strong assumptions based on what we can see	No opportunity to probe respondents

Large Chains

Head offices of large retailers with 100+ sites were contacted to explore how energy is managed and what data have been collected and analysed to inform decision making. The interviews were conducted over the telephone on a qualitative basis, enabling the interviewer to pursue themes as they arose. Initial conversations with the largest retailers confirmed our hypothesis that detailed information about energy use is captured and analysed at head office level and that this presented an opportunity for DECC to obtain detailed coverage of the sites owned/leased by the largest retailers.

The key limitation of the approach is that it took a significant amount of time to identify the correct respondent, identify the data they capture in relation to energy use and explore what information they would be able to provide. A number of retailers were quick to agree that they would be willing, in principle, to provide information to DECC for use in this study; however, a number requested that non-disclosure agreements be put in place to protect their information and these have proven time consuming to finalise.

A number of retailers expressed interest in participating if they would get something in return; in particular, the retailers were keen to explore whether there would be any opportunity to feed into the policy making process if they were to supply data.

The key strengths and weaknesses of the head office engagement approach are summarised in Table 3.6 below:

Table 3.6: Strengths and Weaknesses of Large Retailer Head Office Engagement

Strengths	Weaknesses
Possible to gather robust insight into large number of premises through single engagement	High risk – no guarantee of participation. Risk that those willing to engage will not be representative
Provides insight into energy management behaviour in the largest organisations and the data they capture about their energy use/format (whether they agree to supply quantitative data relating to energy use or not)	Time consuming to secure agreement to participate; subsequent time delay to supply information
Opportunity for DECC to engage with key players in the sector	Data each is willing/able to supply will vary. Difficult to obtain granular level data e.g. on precise profile of equipment, management at local level where discretion

Summary of key findings

Table 3.7 summarises the relative effectiveness of the survey methods tested with respect to the criteria set out

Table 3.7: Relative Effectiveness of Survey Methods Tested in the Comparison Stage

Audience	Attribute	Telephone (n=11)	Online/postal (n=6)	Walkaround (n=7)	Site audit (n=20[13])
Independents (n=16)	Response rate	GOOD	MEDIUM	GOOD	POOR
	Comprehensiveness of response for respondent premises	GOOD	POOR	MEDIUM	GOOD
	Accuracy of data obtained	MEDIUM	MEDIUM	GOOD	GOOD
Small to medium chains (n=4)	Response rate	MEDIUM	MEDIUM	GOOD	POOR
	Comprehensiveness of response for respondent premises	MEDIUM	POOR	MEDIUM	GOOD
	Accuracy of data obtained	MEDIUM	MEDIUM	GOOD	GOOD
Large retailers (based on HO engagement – after site level referred us to HO)	Response rate	MEDIUM		GOOD	POOR
	Comprehensiveness of response for respondent premises	MEDIUM		MEDIUM	GOOD
	Accuracy of data obtained	GOOD		MEDIUM	GOOD

[13] Site audits higher than the total number of telephone and intermediate surveys due to three respondents promising completed intermediate surveys that weren't received.

Tables 2 and 3 in Annex 1 show detailed comparisons of the data obtained from the site audit with the data that were obtained via the telephone or intermediate approach, respectively. These comparisons are based on the assumption that site audit data are always 100% accurate; however, it should be noted that in a few cases, items were described in some detail over the telephone but seem to have been missed during the audit.

Due to the small sample sizes, the results should be considered indicative only. Observations from the analysis conducted during this stage of the study included:

1. For the telephone survey, we observed a slight tendency for respondents to overestimate the number of refrigeration and heating / cooling items at the premises compared to the site audit. This tendency was also observed for the intermediate survey with refrigeration, but heating and cooling data matched the audits completely; however the sample size was small and one intermediate respondent had heating equipment but stated that he did not want to count them.

2. For the telephone and intermediate surveys, there was a tendency for respondents to underestimate the types of lights they have (markedly more so for intermediate), and underestimate the number of bulbs they had dramatically. The latter fact heavily influenced the decision to ask for proportions rather than individual bulbs in the main stage.

3. Respondents always gave accurate information for hot water equipment, where most respondents just had 1-2 items for this end use.

4. Some respondents overestimated and some underestimated the floor area of their premises, with the quantity and amounts almost cancelling each other out when looking at overall tendency.

A number of factors influenced the discrepancies in results. These included:

1. How well the respondent understood the question and their skill and ability in collecting information and answering it.

2. Some respondents were unable to provide any estimates for floor area, having to rely on prompting from the researcher, which included asking for the size relative to a tennis court (where they felt they had a reasonable idea of the size of this).

3. How well respondents understood the equipment they possess and their premises. Examples -

- Respondents particularly struggled to distinguish between bulbs and light fittings, where fittings could contain a number of bulbs.
- Respondents struggled to locate and identify their air conditioning equipment, in one case not even being sure how many units they had.
- Some respondents did not understand the breakdown by area that we were looking for after explanation by the interviewer, and seemed to miss areas of their premises, which they then mentioned later in the interview.

- Site audits sometimes returned fewer items than were captured by the other techniques, suggesting that either the audit missed certain items or that items the auditor identified to be one single item were believed to be more than one item by respondents; the latter is plausible perhaps where dealing with rows of open refrigerated cabinets.

These findings directly influenced the delivery of the telephone survey in the main stage, identifying particular areas where respondents struggle to provide data, and tailoring the training given to the telephone researchers prior to the project. The fact that the floor areas and heating / cooling data given in the intermediate survey varied by less than the telephone survey suggested that respondents benefit from preparation time to capture this information correctly, and influenced the decision to supply willing respondents with the questions in the main stage prior to telephone interview.

None of the approaches tested were able to obtain comprehensive data on the kW rating of energy using equipment in the food/mixed retail sector. Even in the site audits, which were conducted by expert auditors from AEA, there were several instances where energy using equipment either had no kW plate rating (e.g. custom built display cabinets) or the kW rating was not visible / accessible at the time of the audit. Therefore, in the majority of cases, the best available data to inform an estimate of energy consumption for individual items of equipment was the make and model of the equipment where possible, and the approximate size of the equipment and details about operation where the make/model was not visible/available.

Table 3.8 summarises the effectiveness of each approach in terms of how often it was possible to obtain accurate data by survey method and type of information.

Table 3.8: Effectiveness of Approaches in Gathering Accurate Data for Particular Data Points

Data section	Sub section	Telephone	Online/ postal	Walk-around	Site-audit
Profile	Respondent, type of store, location etc	All	All	Most	All
Building Information	Age	Most	Most	Most	All
	Construction	Most	Some	Most	All
	Floor Area	Some	Rarely	Some	All
	Space Use	Some	Rarely	Rarely	All
Behaviour and Attitudes to Energy Use	Staff Training and Management	All	Most	Never	Most
	Actions taken to reduce energy use	All	Some	Never	Most
	Formalised objectives, policies	All	Most	Never	Most
Energy Information	Type and Consumption	Most	Most	Rarely	Most
	Metering	All	Most	Rarely	All
Lighting Equipment	Type of lighting	Some	Some	Most	All
	Behaviour (operating hours, control methods)	All	Most	Rarely	Most

Data section	Sub section	Telephone	Online/ postal	Walk-around	Site-audit
Fridges, Freezers and Cold Stores	Equipment (dimensions, age, make model)	Most	Most	Most	Most
	Behaviour (temp, op. hours, control methods)	Some	Some	Rarely	Most
Heating, Hot Water and Cooling	Equipment (dimensions, age, make model)	Some	Some	Rarely	Most
	Behaviour (temp., op. hours, control)	Some	Some	Rarely	Most
Ovens and Catering Equipment	Equipment (dimensions, age, make model)	Most	Some	Some	All
	Behaviour (temp., op. hours, control methods)	Most	Most	Rarely	Most

Key:

All or almost all of the time

Most of the time

Some of the time

Rarely

Never

As expected, the site audits were the most effective in obtaining accurate data, followed by the telephone survey approach. The data supplied in the online/postal survey and walk arounds were generally less comprehensive than the data obtained in the telephone survey.

It proved helpful in the main stage to provide a summary in advance of the interview of the key questions to be covered in the telephone survey; this helped to address the limitations of the approach in instances where the respondent site had a large number of items of energy using equipment in their shop. However, respondents could not be relied upon to complete the survey autonomously. It is also worth noting that this technique would require additional finance to roll out on a larger scale.

Challenges encountered in recruitment

Challenges are now assessed for the 2 approaches set out in the methodology section i.e. the telephone survey + site audit approach and the intermediate approach + site audit.

In total, 317 individual food and mixed retail businesses were contacted during the comparison stage; 143 for the telephone survey with site audit and 174 for the intermediate survey and site audit. Of these, only 20 provided responses, which were included in the study, as outlined above.

The outcomes of calls are broken down in Table 4 in Annex 1. The most common response to the telephone survey (in 27% of cases) was that the respondent was spoken to at least once (but no more than five times) but it was not possible to explain the project to the respondent and secure their participation and / or complete survey at time of call. The most common response to the intermediate approach was an unusable sample i.e. the respondent was no longer in business or in the target sector, or the telephone number did not work.

The number of refusals for both the telephone survey with site audit and intermediate survey with site audit were both very similar. The primary reasons that people gave when refusing to participate in the project are summarised in Table 5 in Annex 1. The main reason given for not participating in both the telephone survey and intermediate approach was that they viewed participation as too much of a time commitment.

Reasons given by head offices of large chains when refusing to participate in the project are summarised in Table 6 in Annex 1. The main reason given when refusing to participate in the telephone survey was that participation was viewed as too much of a time commitment for themselves/store staff. The three principal reasons given when refusing to participate in the intermediate approach were that head office viewed participation as too much of a time commitment for themselves/store staff; they wanted financial remuneration or another incentive to participate; and that the interviewer had contacted an additional site for a company where head office had already refused.

From analysing the call outcomes from the comparison stage[14] we identified a number of challenges common to all methodologies tested in collecting the data of interest to DECC.

1. Respondents who worked alone were less likely to be able to speak over the phone to discuss participation than those employing staff, who could cover the respondent's duties

[14] And relevant issues that were identified during the comparison stage but became more of an issue during the main stage of data collection

while they were speaking. When respondents working alone began the interview, they were frequently interrupted.

2. Some shops were simply busier than others. This was assumed to be because of location and the frequency of customers coming in (for example, being close to transport hubs), or that they had very busy days, or very busy times of day. Where busier premises were contacted, it was more difficult to speak to and complete an interview with the required respondent.

3. Where the relevant person worked at the premises, or was at least present at some points during the week, it was markedly easier to engage them in the study. When they were permanently off-site (typically an owner rather than a manager), usually the only way to contact them was via post or email, with no guarantee they would respond (and at additional cost). A significant proportion of gatekeepers at retail premises were unwilling to give out mobile or other contact numbers for the relevant person where they were not based on site. Sometimes the relevant individuals never worked at the business premises at all, and researchers were frequently told the only means of contact was via post, with no guarantee that the individual would participate.

4. Respondents who worked with and were familiar with weights and measurements (out of all of the businesses we contacted, this was particularly the case for butchers) seemed better able to understand the work, and not be put off by the prospect of covering the detailed questions we needed to ask them about their energy using equipment. Where respondents did not have this background or indeed much of a working knowledge of mathematics, it was noticeably more difficult for them to describe the dimensions of their equipment, and any figures given were more likely guesswork than an informed estimate.

5. When relevant respondents contacted via mobile telephone were actually at the site and / or had the information of interest to DECC to hand, they were more likely to complete the interview rather than put it off or refuse.

6. When the respondent's business was part of a chain, it slowed down engagement because head offices needed to be contacted to gain permission to speak to a respondent at site level. Some chains however did not have this kind of prescriptive centralised control function, which made it more likely we could speak to somebody at the site without needing any additional permission.

7. For single site retailers, it was often only a matter of biding time to eventually speak to the relevant person when they were at the store and available. Where owners operated more than one store and thus had additional premises to take care of, it became harder to reach them. These types of respondents frequently moved from store to store; they were typically busier, and it was harder to pin them down at one location. It was more demanding for researchers having to negotiate gatekeepers at more than one location, who sometimes provided conflicting information as to a respondent's whereabouts.

8. Although not as great an issue during the comparison stage, language factors were a significant difficulty during the main stage of data collection. These were encountered when speaking to a number of store types, but markedly more so in supermarkets, corner shops and general stores. It was frequently difficult for some respondents to understand why we were contacting them, and what the work was for. In total, researchers cited 170 separate businesses contacted in the main stage where a lack of spoken English either severely

hindered the interview or rendered it impossible to identify the correct respondent and/or explain the survey and the project's aims to the correct respondent. In addition, a further 35 respondents who completed telephone interviews were cited by researchers as struggling with all or part of the interview due to a lack of spoken English, thus hampering the accuracy of data that it was possible to collect. The language barrier was a greater issue in cities and towns than it was in villages and rural locations.

9. Negative attitudes toward the Government were encountered when speaking to some respondents, and they were unwilling to participate as a result. Some bakeries and other hot food outlets were unwilling to participate and mentioned the planned addition of VAT to their products during the main stage. Other companies had a negative view of Government due to the perceived burden of regulations they face.

10. Businesses that weren't subject to a high frequency of sales and research calls were more likely to engage. Those who mentioned good experiences of participating in research in the past seemed also more likely to engage. We often heard people saying that they are constantly being called by companies trying to advertise new products and sell things, and encouraging these respondents to participate was more difficult.

11. Respondents frequently cited that unless there was an identifiable benefit to their business for participation then they wouldn't complete the work. Financial remuneration was frequently requested for the time they were spending on the phone to researchers.

We expect that similar challenges will be encountered in collecting data from other segments of the non-domestic sector and recommend that DECC develops strategies for minimising the non-response bias that may occur as a result. Table 7 in Annex 1 outlines possible strategies for minimising bias / addressing the limitations of each of the above survey methodologies in collecting data from other non-domestic sectors. For all methods, it is suggested that the consultants:

- Review the methodology to reduce the questionnaire length and burden
- Consider giving incentives to participate
- Give the opportunity to complete the survey in a language other than English
- Give formal notification e.g. a letter from the Minister endorsing the work and stressing the importance of participating

4 Main Stage

Introduction

This section summarises the work undertaken during the main stage, to collect data from a representative sample of food/mixed retail premises.

The questionnaires and topic guides used in the main stage of the project can be found in the methodology appendix (Annex 5) produced to accompany this report.

Methodology

The findings from the comparison stage indicated that the ability of food/mixed retailers to provide the data of interest to DECC varied most significantly by the size of the retailer in terms of the number of premises they occupy. Therefore, we split the remainder of the project into two streams of work.

Findings for independents and small/medium chains (less than 100 premises) are provided below. Section 5 presents the findings of engagement with a few large retailers (100+ premises).

Profile

The pilot study drew a sample of food/mixed retailers from the Experian pH dataset[15]. The Experian file was used to determine the population of sites in these sectors and the sample results have been grossed to this total. The grossing weights the sample cases based on the number of shops in particular classification and size band relative to the total number of such shops in the Experian dataset.

Based on the work undertaken in this study we estimate that approximately 24,800 premises are owned or leased by independent and small- and medium-sized chain retailers (fewer than 100 sites) in the food/mixed retail sector. They occupy a total of approximately 4.36 million m^2 (gross floor area). The average reported gross floor area for all premises is 119 m^2 (see Table 1 in Annex 3) – this is approximately 20m^2 smaller than the average *"One Stop"* (~140m^2). Further information on the profile of independents and small- and medium-sized chains is given in Annex 2.

Survey Approach

The sample of independents was structured by **activity sector**, as a purely random sample would have resulted in relatively few interviews with retail premises with particularly energy intensive activities (e.g. butchers, bakers, frozen food stores (freezer centres)).

For the small- and medium-sized chain we started by speaking to head office to determine what data are available centrally and to request permission to speak to a typical site.

The questionnaire used in the comparison stage appeared to be effective in gathering the majority of the data of interest to DECC. However, the following changes were made to the questionnaire for the main stage in light of the findings of the comparison stage; we

[15] http://www.experian.co.uk/phgroup/how-we-do-it/the-ph-megafile.html

1. **Removed all questions asking for kW plate ratings**: The comparison stage demonstrated that in almost all instances food/mixed retailers are unable to provide kW plate ratings for the equipment they use in their shop. Therefore, we proposed to gather proxy data to enable the kW rating and/or energy consumption to be estimated in the analysis stage.

2. **Included proxy questions for each item of equipment described by the respondent**: Respondent retailers were generally willing to describe each item of equipment in their shop in turn, even where we asked them for an indication of the average, for example, size etc. of their equipment. Therefore, we made amendments to the questionnaire structure to enable these data to be captured in a form that can be analysed more easily than capturing the verbatim descriptions.

3. **Amended the lighting section of the survey to reflect inability of respondents to provide accurate information about the number of lights in their store:** As the site audits clearly demonstrated that estimates provided by retailers of the number of lights in their store were inaccurate, we amended the questionnaire to solely ask respondents about the type of lighting they use in their store and approximate the proportion of their lights that are of each type. These data could then be used in the analysis stage to inform an estimate of total energy consumption arising from lighting demand.

As the telephone survey approach was found to be challenging to implement in the comparison stage where four or more types of end use (heating, lighting etc.) needed to be covered, we decided to check the number of end uses in booking appointments, providing willing respondents with a copy of the questions in advance of the telephone call to enable them to prepare for the discussion.

Table 1 in Annex 2 outlines the number of interviews completed with each group covered in the telephone survey. This ranged from 2 interviews for independent newsagents, 2 for small and medium-sized chains of freezer centres and 2 for small and medium-sized chains of newsagents, to 208 for independent butchers.

On completion of the telephone survey the data were weighted according to the population from which they were drawn in order to adjust for under / over representation of particular groups within our sample compared to the population. We then extrapolated the results to draw conclusions about all independent and small retailers with less than 100 premises. Table 2 in Annex 2 summarises the number of interviews completed with premises in each category according to the desired stratification of the population[16], based on the Experian pH data supplied to Databuild for the purpose of the survey and the weighting factor.

Since the achieved sample is not fully representative of the population the effective sample size is reduced to approximately one-third of the total sample.

[16] Interviews were continued where the respondent's business activity or size was different to the database criteria and the results reported throughout this report are based on the actual business activity as described by the respondent in the interview; however, the interview responses were weighted according to the database criteria to reflect the population from which the respondent premises had been drawn.

Challenges and Limitations

This section discusses the challenges associated with drawing a representative sample of food/mixed retailers for the purpose of this study and the limitations of the extrapolated results presented in this report. This includes consideration of:

1. The challenges involved in identifying the precise size of the population of food/mixed retail establishments in the UK and drawing a representative sample of food/mixed retailers

2. The limitations of key data collected in the survey, including data relating to floor area, energy consumption, and estimates arising from the bottom-up estimates of energy consumption prepared following the completion of data collection.

Challenges Associated with Identifying the Size of the Population and Proposed Approach to Defining Population

For the purpose of this project DECC is specifically interested in retailers that:

- Predominantly sell food items – food retailers

- Sell a range of items, but a significant proportion (more than a minimum of 25%) of their activity involves the sale of food – mixed retailers

A number of classification systems are available that enable examination of the number of retailers that fit this definition of food and mixed retail. However, the Standard Industrial Classification (SIC) and Thomson Directory classifications are the primary identifiers used within NEED and with which the data collected in this project need to be aligned.

The Valuation Office Agency (VOA) database is regarded as the most comprehensive available database of premises in the non-domestic sector. According to 2010 data (the most recent available in the public domain), there are approximately 548,000 retail hereditaments, defined as a unit to which business rates are applied, in England and Wales, with a total floor space of just over 106 million m^2. Based on analysis conducted in the mid-nineties of the VOA's Valuation Support Application (VSA), we estimate that approximately 16% of retail premises in the UK are involved in the sale of food (see Table 3 in Annex 2).

This figure is significantly higher than the population of local units/premises in the retail SIC codes (SIC45 and SIC47) obtained from analysis of data published by the Office of National Statistics and Experian modelled business sector data. A comparison of the population data available from ONS, Experian and VOA are given in Table 4 of Annex 2.

Unfortunately, a significant proportion of the records in the retail category of the VOA database are simply categorised as "shop", rather than specifying the precise business activity; therefore, it is difficult to determine the precise nature and potential sources of the discrepancy from the VOA data available in the public domain.

Historic analysis of the VOA data from the mid-nineties indicated that some hereditaments recorded as "shops" would fall into non-retail SIC categories (e.g. personal services such as hairdressers). However, this did not account for the entirety of the observed discrepancy

between the VOA population data and equivalent figures from alternative sources, suggesting that some retail hereditaments may not be covered in the ONS statistics / present in databases available from commercial database providers like Experian.

A further challenge to be faced in identifying a sample of food/mixed retailers is that the SIC retail categories are broad; for example, 'retail sale in non-specialised stores with food, beverages or tobacco predominating' (for further examples, see Table 5 of Annex 2) and do not offer sufficient granularity to identify specific business types, such as freezer centres.

Proposed Approach to Defining the Population

Analysis undertaken by DECC prior to this project suggested that Thomson Directory classifications provided a more accurate reflection of the precise nature of the business activity on the premises than SIC codes. Therefore, the decision was made to use Thomson Directory classifications as the basis for defining the food/mixed retail sector. The specific Thomson Directory classifications used to define the food/mixed retail sector for the purpose of the main stage of this project are summarised in Table 6 of Annex 2.

In parallel with this project DECC have been undertaking work to match data available from the commercial database provider Experian to the records in the VOA database to enable more detailed analysis to be undertaken of the profile of the population. However, this work was on-going at the time the study was conducted and therefore we were required to use modelled business Experian pH data as the basis for drawing our sample and determining the population of the food/mixed retail sector.

We recommend further analysis is undertaken when DECC has successfully matched Experian pH data to the VOA database, as it is envisaged that this will inform a more accurate estimate of the population for the non-domestic sector.

The Experian pH data obtained by DECC to provide profile information for premises within NEED was used to draw a sample of food/mixed retailers for the purpose of the study. This source was chosen as:

1. The results of this study are intended to be integrated with NEED data in developing a model to examine energy use and abatement potential in the non-domestic sector.

2. The Experian pH data provided all of the information necessary to implement the proposed sampling strategy; it:

- Provided Thomson codes to enable sites with specific business activities to be identified
- Included a company identifier which enables multi-site retailers to be identified, along with the number of sites they own/lease
- Was possible for Experian to append telephone numbers to the majority of records they had supplied to DECC

Following the completion of data collection, the Experian pH data was used as the basis for estimating the population for the purpose of extrapolating the survey results.

Based on analysis of the Experian pH data supplied to us for the purpose of this study, we estimate that there are approximately 43,000 food/mixed retail premises in the UK that devote more than 25% of their net floor area to food retail. Approximately 42% of these premises are owned/leased by large retailers with more than 100 premises in total.

The population from the Experian pH data was adjusted to remove all premises found to be outside the scope of the study – those not selling food or where less than 25% of their retail floor space was devoted to food retail, and those found to be no longer in business. Table 7 in Annex 2 summarises the total number of individual premises owned/leased by food/mixed retailers, based on analysis of the Experian pH data and adjusted to reflect the outcomes of primary research undertaken in this study.

Table 8, in Annex 2, summarises the outcomes of our analysis of the Experian pH data supplied by DECC for the purpose of the survey; the population of individual premises (sites) in each category prior to fieldwork; and the population following adjustments made to reflect the outcomes of fieldwork / analysis.

The adjusted populations were used to gross up the results of the telephone survey of independents/small chain retailers (less than 100 sites); each record was given a weight based on the population from which it was drawn (N/n).

As some responses indicated the precise nature of the activity undertaken at the premises differed from that indicated in the database, whilst the weighting has been based on the database categorisation (to avoid introducing bias), all results relating to the population, profile and behaviour of particular activity sector segments are based on the responses given by the respondent.

Challenges Associated with the Key Data Collected in the Survey

Floor Area Estimates

Floor area was collected to enable the energy intensity of premises to be calculated. The key limitation surrounding estimates of floor area was the ability of respondents to provide accurate figures for the size of their premises. The survey was designed to mitigate this limitation as follows:

1. Respondents were given freedom to provide an estimate in both imperial and metric measurement systems.

2. Where respondents could not give an estimate based on conventional measurement systems, alternative scales were devised, for example, the proportion of a tennis court they felt their premises would fill or the number of parked cars which would fit into the space.

Using this means of collating data enabled 799 respondents (93%) to estimate their floor area. In the 63 cases where respondents were not able to provide an estimate, values were replaced by the average floor area for their activity sector and size (number of sites). No significant differences were observed between ability to provide floor area estimates and activity sector, size (number of sites) or equipment in use.

The proportion of floor area devoted to retail was derived by asking respondents what proportion of their floor area was devoted to uses other than selling to customers. This was broken down specifically into storage rooms/warehouses, staff rooms, office space, flats/apartments above the premises and other uses. Where these uses were cited, gross floor area was adjusted accordingly to calculate net floor area. A potential limitation is the definition of non-retail uses respondents choose to categorise as other. For example, some respondents mentioned food preparation space when given the option to describe other uses but it is not entirely clear whether all respondents would consider this to be non-retail space. However, the research team did ensure that non-retail space was described during the interview as any space not devoted to selling.

The categorisation of space into uses other than serving customers was utilised to estimate net retail floor space which approximates the VOA metric of net floor area. The proportion devoted to uses such as toilets, car parks and stairwells were therefore removed from this estimate. However, the ability of respondents to quantify spaces such as stairwells was limited and respondents were not probed on space devoted to heating, tanks and cooling. Net retail floor space may therefore be an over-estimate in comparison to net internal area.

Overall Energy Consumption Estimates Based on Reported kWh / Spend (£)

The overall estimate of energy consumption is based on respondent data about their energy bills. To increase the opportunity to capture these data, energy use for both gas and electricity were captured in four ways:

- Annual consumption in kWh
- Annual consumption in terms of £ expenditure
- Quarterly consumption in terms of £ expenditure
- Monthly consumption in terms of £ expenditure

Providing respondents the opportunity to provide data in these varied ways enabled 689 (80%) to provide an estimation of energy use. Monetary values were then converted to annual kWh using factors published by DECC[17]. The conversion factor used was based on premises with very small energy consumption. This assumption was based on the sample of respondents that were able to give a kWh estimate, however the sample size was low (<50). The estimate may therefore carry a degree of inaccuracy, resulting from variation in energy prices both as a consequence of heterogeneity of energy providers and inaccurate estimation of the magnitude of estimation consumption.

The following process was then used to estimate the total energy consumption for independents and small chains in the food/mixed retail sector:

[17] DECC (Edition: 29 March 2012) Prices of fuels purchased by non-domestic consumers in the United Kingdom excluding/including CCL: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx

All data relating to energy spend (£) were converted into a cost per annum; whereby those provided on a monthly basis were scaled up to 12 months of the year and quarterly estimates were multiplied by 4.

This was converted into kWh using data published by DECC relating to the average price that establishments with very small energy use paid per kWh in 2011.[18]

The results were combined with data provided in the 250 instances where the respondent was able to provide kWh and divided by the gross floor area on a case by case basis to calculate the kWh per annum per m^2 for each activity sector.

Where respondents were unable to provide their energy use or energy spend data (173 cases), the floor area of the shop was used in combination with the median kWh per annum per m^2 factors for their sector to estimate energy consumption.

Based on this approach, we estimate that independent and small chain food/mixed retailers use 2 TWh per annum – this equates to approximately 471 kWh per m^2 based on gross floor space and approximately 475 kWh per m^2 based on net retail floor space. Results by activity sector are provided in Table 4.1 below.

[18] The 'very small' assumption was chosen based on the magnitude of energy use reported by respondents that were able to provide a kWh estimate. Source: Prices of fuels purchased by non-domestic consumers in the United Kingdom: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx

Table 4.1: Estimated Energy Consumption and Energy Intensity for Independents and Small Chains (fewer than 100 outlets)

Activity sector	n	N	GWh per annum [95% confidence interval][19]	kWh per m2 – gross floorspace	kWh per m2 – net floorspace
Butchers	241	3,016	205 [179-229]	366	369
Bakers	198	2,862	428 [376-480]	702	705
Supermarkets	176	1,948	360 [324-397]	792	795
Freezer centres	5	29	3 [2-4]	193	193
Newsagents	29	5,444	238 [224-250]	316	323
Other mixed food retail	213	11,507	816 [712-920]	415	418
Total	862	24,807	2,050 [1,819-2,282]	471	475

Table 4.1 reports the energy estimates for the main end-uses in this sector. The survey results have been grossed based on Experian data but these are raw figures and have not been validated or constrained to external sources in this pilot study.

Bakeries and supermarkets appear to be the most energy intensive activities in terms of kWh per m^2, with newsagents proving, as one might expect to be the least energy intensive of the activity sectors covered in the study.

In order to impute missing cases, consumption data captured was first applied to floor area to derive kWh/m^2. In total, 634 cases had provided both some estimate of energy consumption and floor area estimate enabling this conversion. Examination of the resultant data revealed a number of extreme values within the dataset, although many appeared to be the result of larger premises or activity rather than inaccuracy. To alleviate the effect this may have when imputing

[19] The confidence intervals calculated consider the design effect of weighting the dataset. Calculations have included cases for which energy use was imputed; however removing these cases narrows the confidence interval and the confidence intervals presented therefore represent a conservative estimate. Due to small sample size the lower bound for freezer centres was negative. The figure presented in the table has therefore been calculated using the un-weighted sum of those respondents interviewed divided by the total population.

consumption for missing cases, the median kWh was calculated for each sector to replace missing values. Final consumption was then based on the kWh/m^2 multiplied by the floor area.

Bottom-Up Estimate of Energy Consumption

The data relating to specific energy using equipment collected in the survey of independents and small/medium chain retailers (those with fewer than 100 sites) was used to produce a bottom-up estimate of energy consumption to enable consideration of the overall profile of energy by end use (refrigeration, heating, lighting etc.). The bottom-up estimates have two primary limitations:

1. The nature of data respondents are able to provide:

    - The comparison stage confirmed that telephone survey respondents would be unable to provide detailed kW ratings for equipment on their premises. This led to the collection of proxy data (e.g. size, make and model) for the types of equipment respondents owned

    - Respondents were often able to give proxy data regarding dimensions; however the make and model proved more difficult to capture.

2. The availability of data in the public domain enabling accurate weighting of survey data to a national estimate of energy consumption:

    - The absence of make and model data for most equipment hindered the ability to use secondary research to provide accurate kW ratings.

    - Information available in the public domain regarding energy consumption was often limited and the conversion factors employed do not always make use of the proxy data provided by the respondent.

The conversion factors used in producing the bottom-up estimate of energy consumption based on reported data fall into four broad categories:

1. Conversion factors based on technical reports produced by organisations concerned with energy or equipment specifications e.g. The Market Transformation Programme, The Food Services Technology Centre and The International Energy Agency.

2. Conversion factors based on work conducted by the Resources Research Unit of Sheffield Hallam University for DEFRA during the 1990s.

3. Conversion factors based on a make or model reported by respondents.

4. Conversion factors based on a qualitative desk research to determine rating factors for products available on the market

In order to mitigate the limitations of conversion factors used, the final bottom-up energy estimates have been reviewed, compared to bill data consumption estimates, and sense checked. Where appropriate, conversion factors have been reviewed and replaced with

alternative sources to obtain more realistic estimates of energy consumption for the size of business/nature of business activity.

In producing the bottom-up estimates of energy consumption, we were also required to make assumptions in the following areas:

- **Operating hours** – The average hours of operation used to calculate the bottom-up estimates of energy use were derived from interview responses. However, a larger than anticipated proportion of respondents could not give an estimate of the number of hours during which equipment was used intermittently, as opposed to continually. These end uses included hot water, heating and cooling. To avoid over-estimation of average operational hours through exclusion of respondents using systems intermittently, an estimate of intermittent use of hot water, heating and cooling systems was derived from qualitative information provided by respondents. This estimate was combined with hours of operation provided by respondents who could estimate usage in deriving average operational hours.[20] Although care was taken to draw on qualitative evidence in deriving assumptions for intermittent use, the factors used would benefit from additional research for validation.

- **Dimensions** – For refrigeration equipment (e.g. chillers and freezers), the factor used to convert this equipment to an estimate of energy consumption relies on internal dimensions (e.g. volume, display area). Although external dimensions were captured, it was not possible to derive internal dimensions from respondents. The study therefore employed a scaling factor to adjust volume and display area. These factors were based on review of some common products available through online searches and could therefore benefit from additional research for validation.

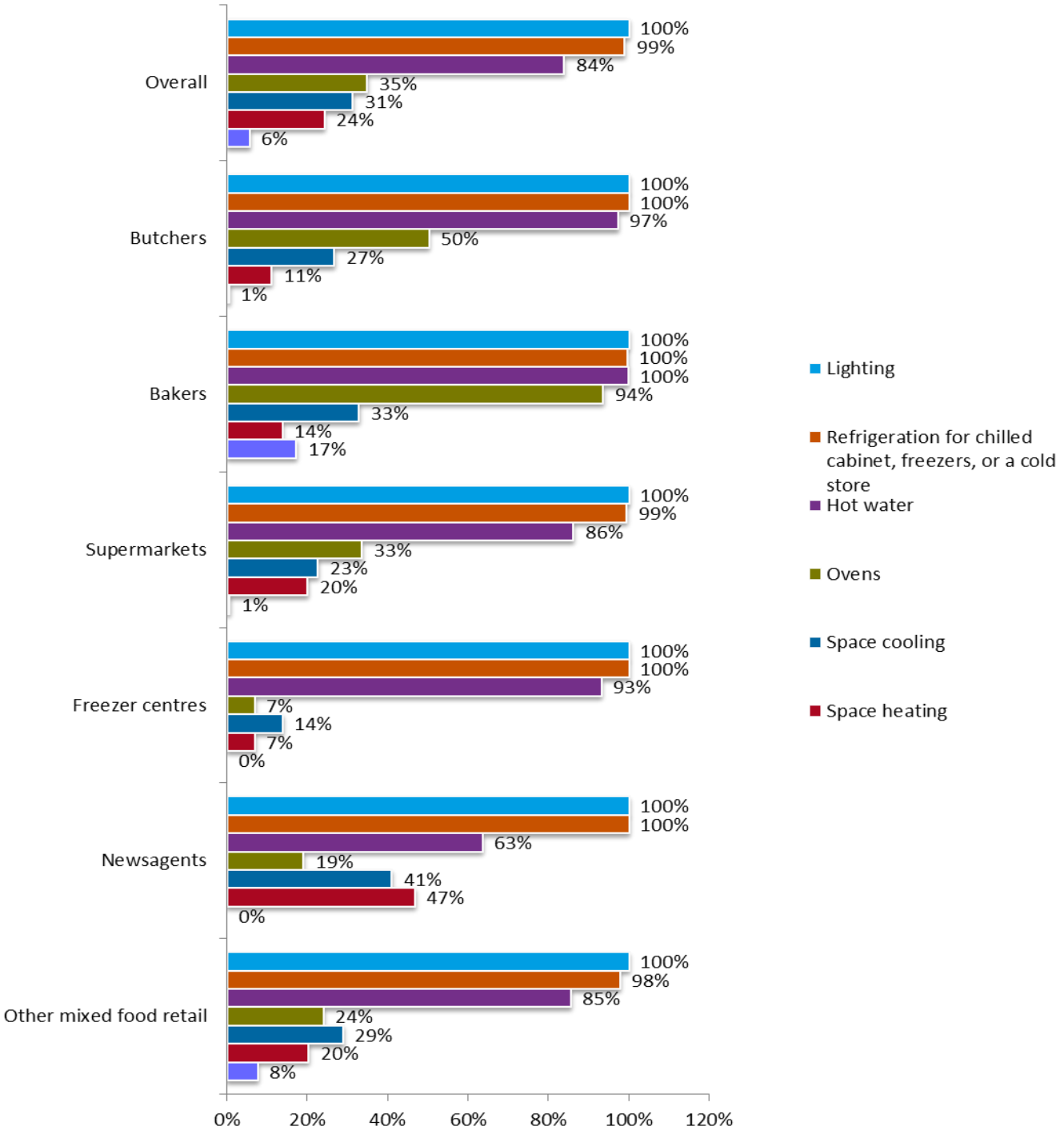
Databuild have provided DECC with a spreadsheet to accompany this report with full details of conversion factors used. All assumptions can be edited, enabling sensitivity analysis to be undertaken and the resulting impact on the bottom-up estimate to be observed.

[20] For hot water systems, such as local tap heaters, use was also assumed to be related to the number of individuals using hot water. The average number of employees from Experian based on activity type was therefore extracted to enable annual use/employee/yr assumptions to be employed.

Energy Consuming Equipment in Use in the Food and Mixed Retail Sector

Each respondent to the telephone survey was asked to indicate whether they used energy for lighting, refrigeration for chilled cabinets, freezers or cold stores, hot water, ovens, space cooling, space heating, cafés / catering equipment. The results are summarised in Figure 4.1 below:

Figure 4.1: Area of End Use by Activity Sector (Independents and Small/medium Chains – fewer than 100 outlets: N=24,807, n=862)



The key findings were as follows:

- All premises reported that they use energy for lighting and the majority (99%) had some form of refrigeration.

- The majority of premises use energy for hot water (84%); although newsagents were significantly less likely to have hot water on the premises (63%) and almost all butchers and bakers use energy for hot water.

- Approximately a third (35%) of all premises use ovens; although newsagents were significantly less likely to use energy for ovens (19%) compared to butchers (50%) and bakers (94%).

- Energy is used for space cooling in less than a third of all premises (31%) and for space heating in less than a quarter of all premises (25%).

Each respondent was subsequently asked a series of questions to determine the number of items of key energy using equipment within their store. Their responses enabled an estimate to be made of the total number of items of particular equipment. Table 9 in Annex 2 summarises the estimated number of each type of equipment covered in the telephone survey, while Figures 4.2 and 4.3 below summarise the percentage of items that can be found in each activity sector, to illustrate how the data can be used to understand where effort may need to be targeted for particular policy interventions. Figure 5 shows the age profile of equipment in use.

Figure 4.2: Specific Refrigeration, Heating and Cooling Equipment in use by Sector - Expressed as a Percentage of all Items in each Sector for Independents and Small/medium Chains (fewer than 100 outlets)

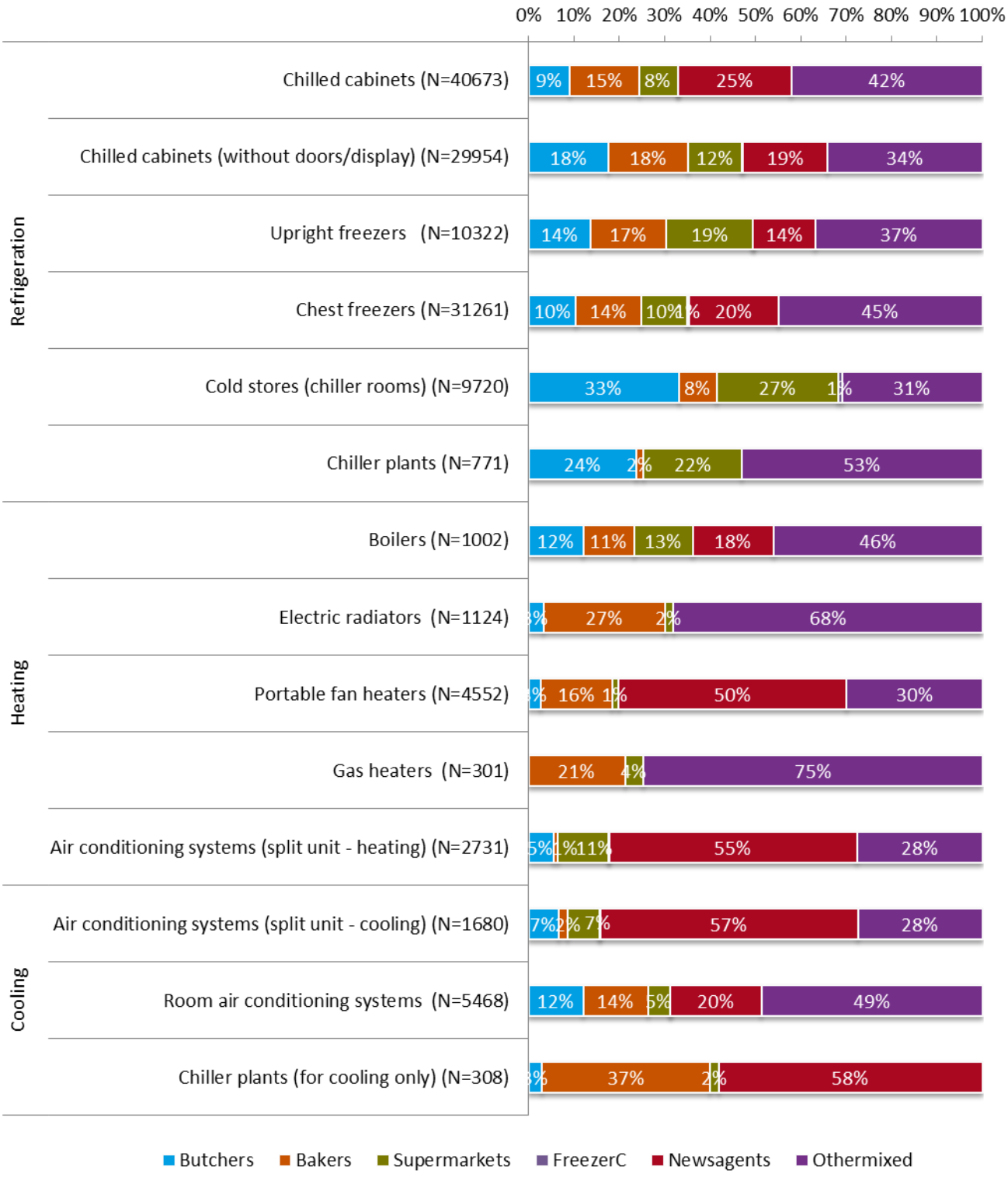


Figure 4.3: Specific Café, Oven and Hot Water Equipment in Use by Sector - Expressed as a Percentage of all Items in Each Sector for Independents and Small/medium Chains (fewer than 100 outlets)

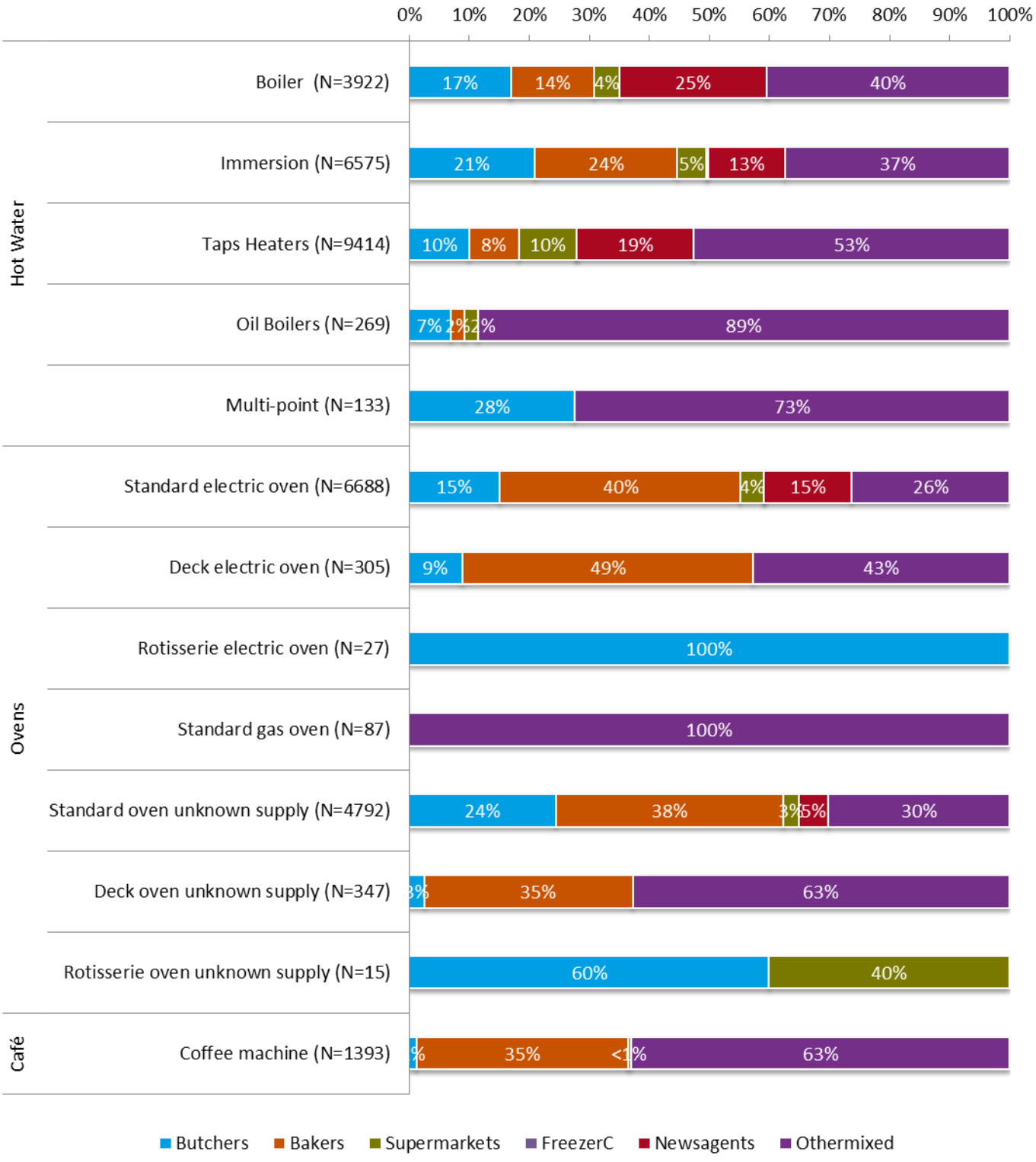
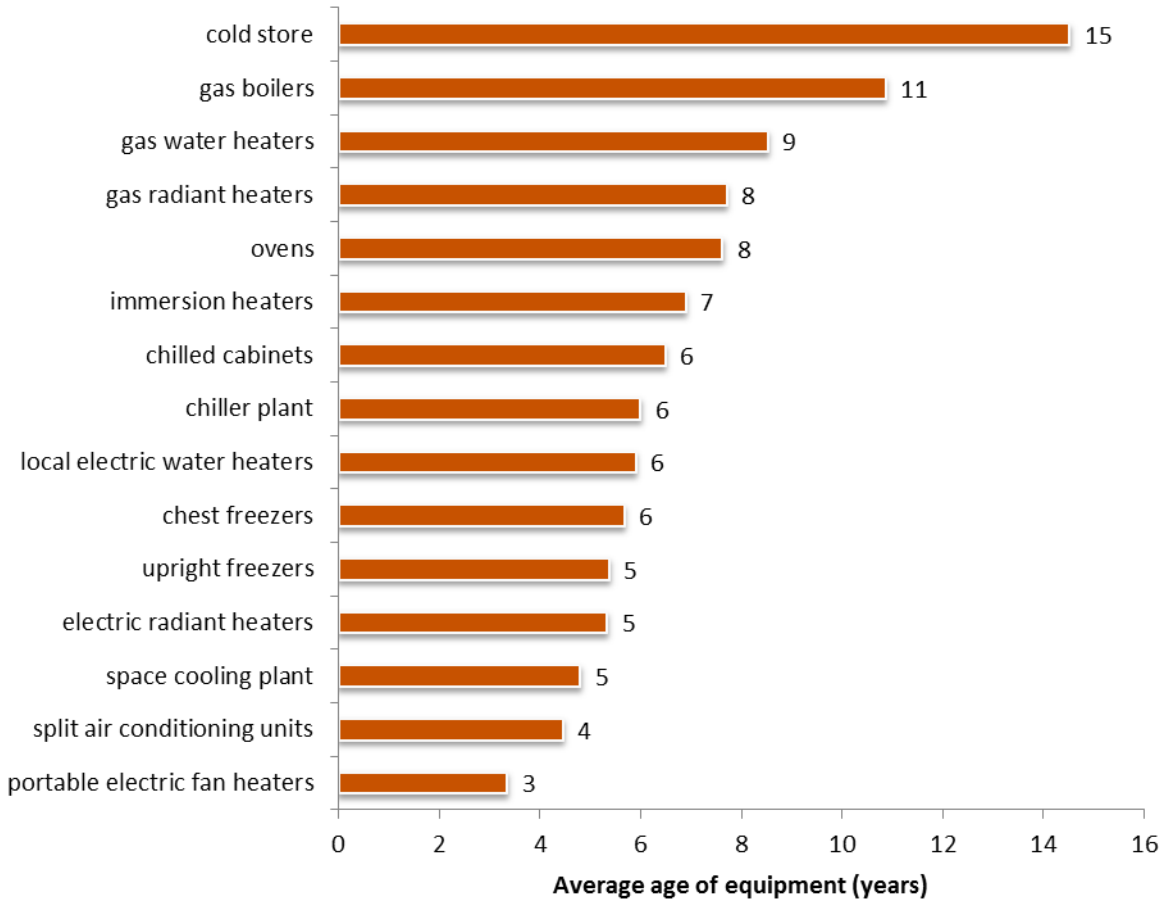


Figure 4.4: Average Age (mean) of Particular Types of Equipment Owned by Independents and Small/medium Chains (fewer than 100 outlets)



Again, the results suggest there is a significant degree of variation by activity sector, in particular:

- Of the key energy using equipment asked about in the survey, the most common items were chilled cabinets (41k) and chilled cabinets (without doors/display) (30k)
- Cold stores used by butchers (19 years old) and freezer centres (20 years old) are significantly older than those used by supermarkets (7 years old) and bakers (8 years old)
- Gas boilers used by newsagents (30 years old) and bakers (11 years old) are significantly older than those used by butchers (5 years old) and supermarkets (6 years old)
- Ovens used by bakers (11 years old) tend to be older than ovens used by butchers (9 years old) and significantly older than ovens used in supermarkets (6 years old) and newsagents (4 years old)
- Upright freezers tended to be older in butchers (8 years old) and bakers (7 years old) compared to supermarkets and newsagents (5 years old)

The age of chest freezers and chiller cabinets is similar across all activity sectors covered in the survey.

Bottom Up Estimate of Energy Consumption based on Types of Equipment Installed

The data collected in the telephone survey has been used to produce a bottom-up estimate of energy consumption by end use. Full details of the approach described in the methodology annex. Table 10 in Annex 2 illustrate the results of our initial analysis of energy consumption. The full analysis can be found in the spreadsheet produced to accompany this report. We have included an estimate of energy use for:

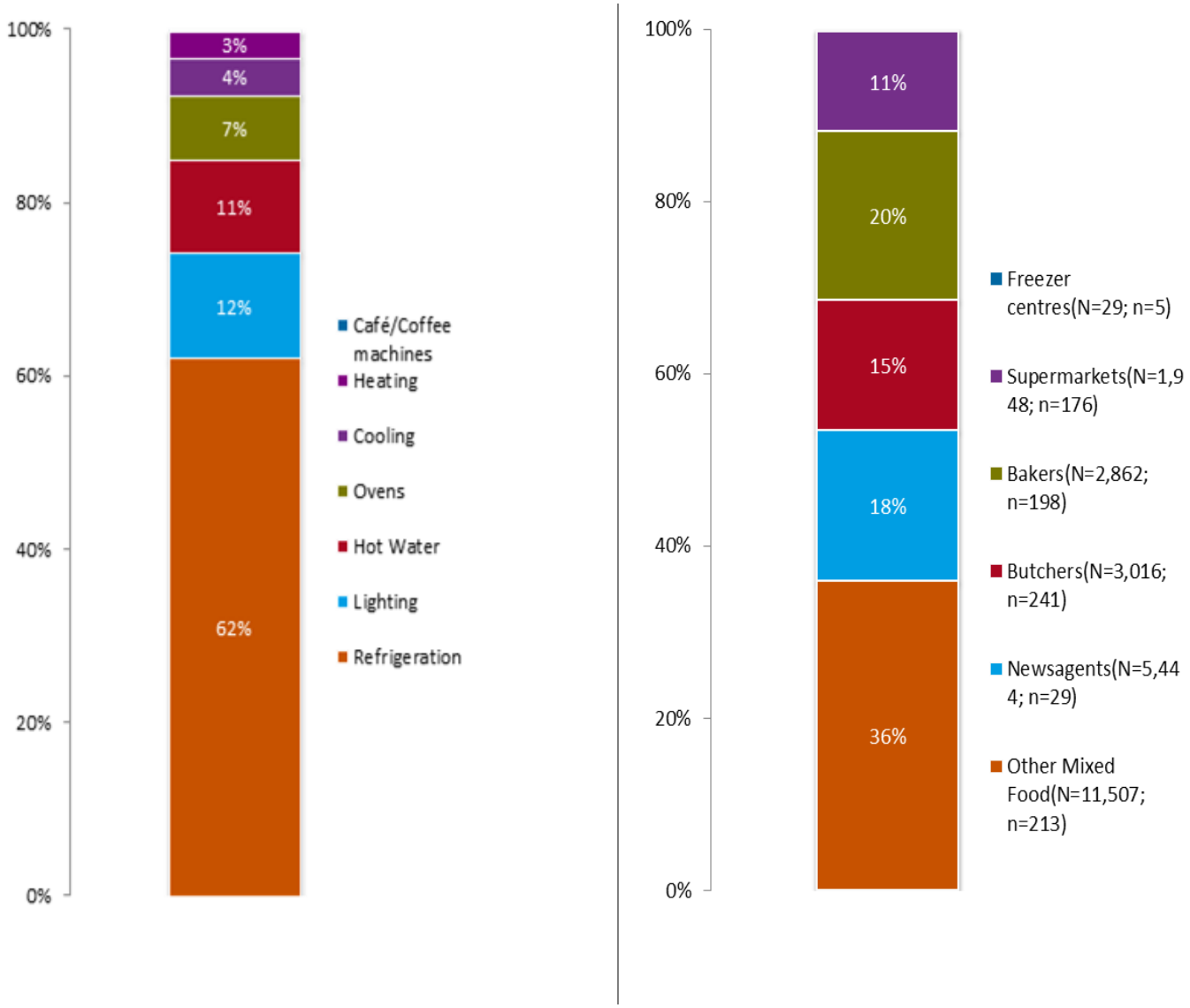
- Gross floor area – based on respondent estimate of the floor space for their entire premises

- Net floor area – gross floor area adjusted to remove space devoted to toilets, parking and domestic living space[21]

The energy consumption (excluding other end uses such as specialist equipment) is broken down by end use and also by sector in Figure 4.5 below. Refrigeration and lighting comprise nearly three quarters of the sector's energy consumption.

[21] This estimate is more closely aligned with the VOA definition of Net Internal Area (NIA). However, respondents were often unable to give details of area devoted to stair wells and were not probed on the space devoted to permanent air conditioning, heating and cooling apparatus and the resultant floor area estimate may over-estimate NIA.

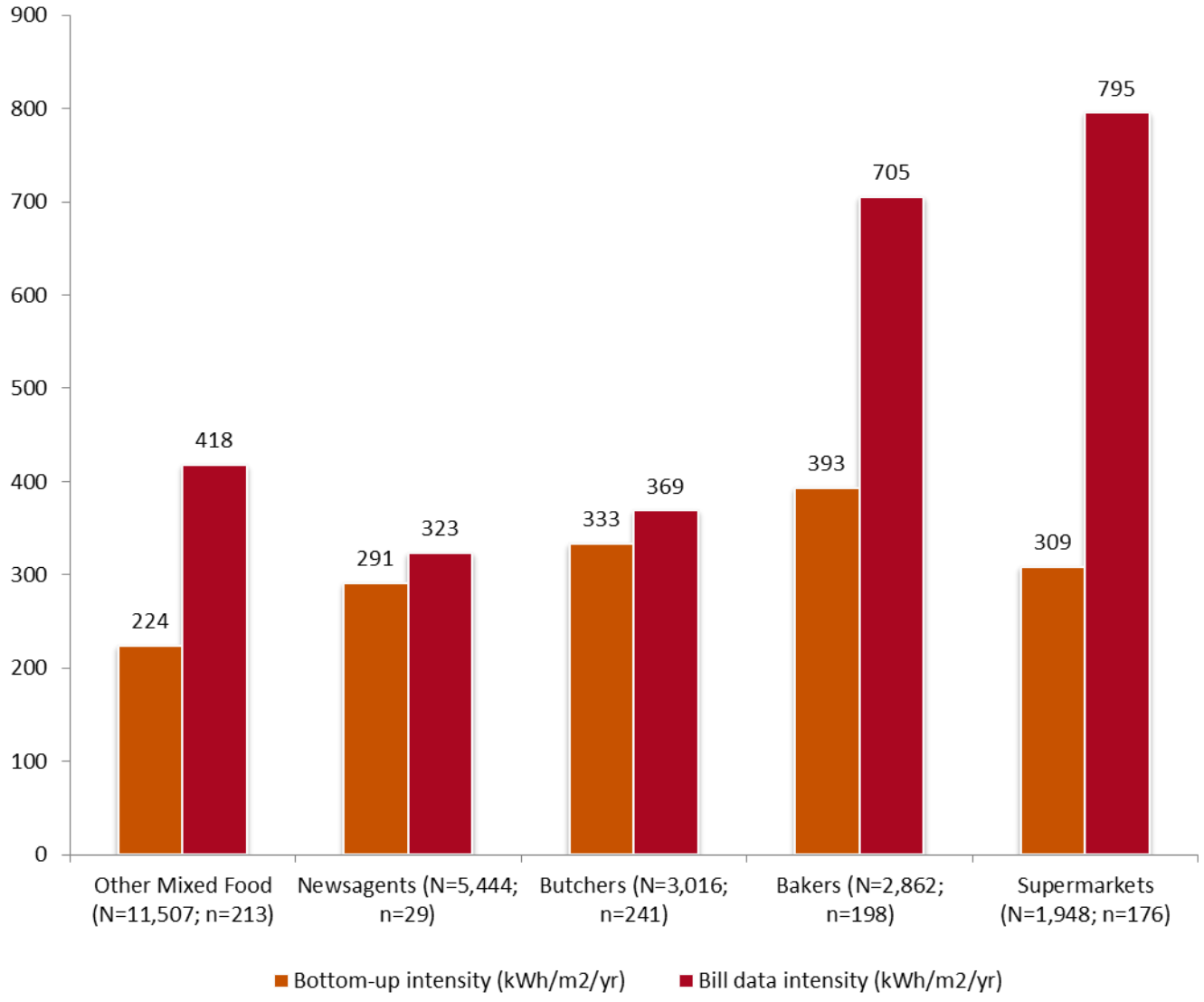
Figure 4.5: Bottom-Up Energy Consumption Broken Down by End Use and Sector for Independents and Small/medium Chains (fewer than 100 outlets)



Energy Intensity – Comparison of Bottom Up and Reported Estimate

Figure 4.6 below illustrates the energy intensity (kWh/m^2) calculated for each sector. Due to the small sample of freezer centres included within the survey they are excluded from the chart. Considering energy intensity based on bill data supplied by respondents; supermarkets and bakers have the highest energy intensity.

Figure 4.6: Energy Intensity kWh/m^2/annum based on Energy Bill Data Provided by Respondents and the Bottom-Up Estimate of Energy Use broken down by Sector for Independents and Small Chains (fewer than 100 outlets)



Comparisons to existing studies reveal that energy intensities derived through this study are within a similar order of magnitude. For example, the Sheffield Hallam surveys[22] report the following average energy intensities for specific shop types:

- Corner Food shops – green grocers and delicatessen ~250 kWh/m^2/annum
- Corner Food shops - butchers ~450 kWh/m^2/annum
- Supermarket ~650 kWh/m^2/annum

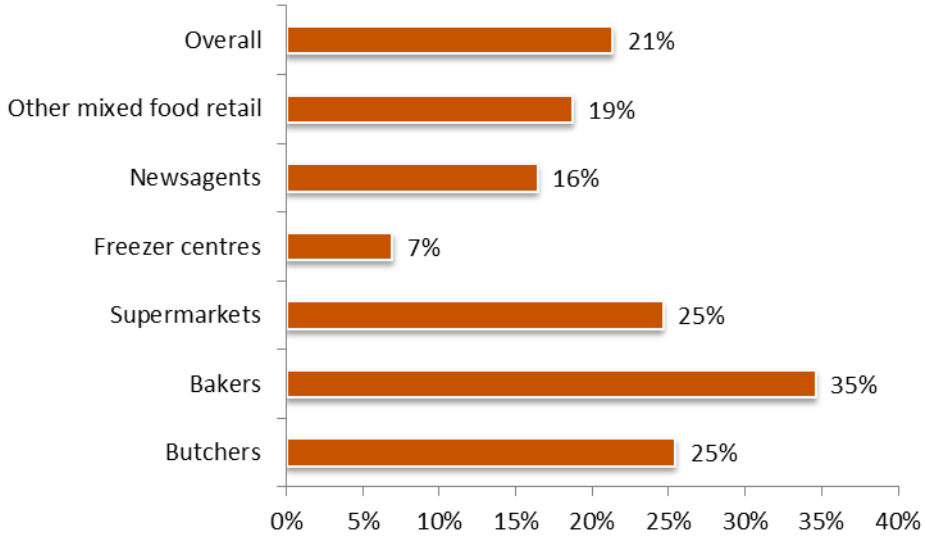
[22] Elsayed MA, Grant JF & Mortimer ND (2002) Energy use in the United Kingdom non-domestic building stock: 2002 catalogue of results Resources Research Unit, School of Environment and Development, Sheffield Hallam University

Considering size of shop; energy intensity of independents averages at ~330 kWh/m2/yr (N=19,793; n=725) and medium sized multi-sites average at 891 kWh/m2/yr (N=5,014; n=137).

Organisational behaviour and attitudes[23]

Just over a fifth of all independent/small chain food/mixed retailers indicated that they their business aims to reduce energy consumption or carbon emissions (21%). Bakers were claimed to be the most likely to have reduction in energy consumption as one of their objectives to reduce energy consumption, with more than a third (35%) indicating that this was the case, compared to 16% of Newsagents and 7% of freezer centres, as illustrated in Figure 4.7 below:

Figure 4.7: Percentage of Premises with Objectives to Reduce Energy Consumption, Split by Sector (independents and small/medium chains – fewer than 100 outlets: N=24,807, n=862)



Consistent with this, bakers were found to be the most likely to have an environmental policy (19%) followed closely by butchers (18%); bakers were also the most likely to have Corporate Social Responsibility objectives (9%). For comparison, the findings indicate that 15% of all independent/small chain food/mixed retailers have an environmental policy and 4% have corporate social responsibility objectives.

Less than 3% of all independent/small chain food/mixed retailers reported being certified to ISO14001[24], with supermarkets (8%) and newsagents (7%) being the most likely to report certification to the standard.

Overall, 16% of food/mixed retail premises record information about energy use in a way that enables them to look at their energy use over time. Bakers (23%) and Butchers (20%) are the

[23] The responses presented in this section are based on self-reported behaviour that has not been verified. The results should therefore be treated with due caution.

[24] ISO14001 is the Environmental Management standard and requires organisations to identify and assess aspects of their business which may impact the environment and take necessary control to reduce them.

most likely to do so; freezer centres (7%) and supermarkets (8%) are the least, as shown in Figure 4.8 below:

Figure 4.8: Percentage of Premises that Record Energy Consumption in a Way that Enables them to Monitor their Use over Time (independents and small/medium chains – fewer than 100 outlets: N=24,807, n=862)

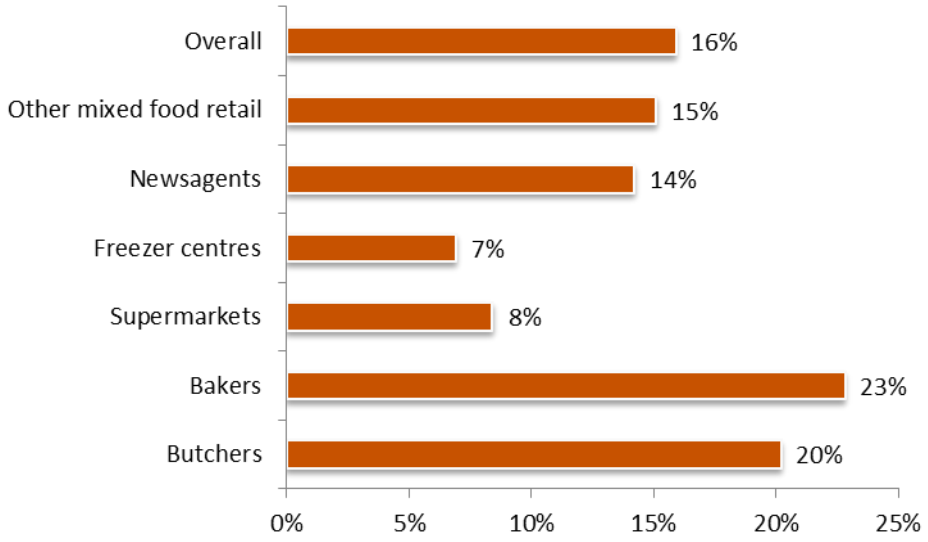
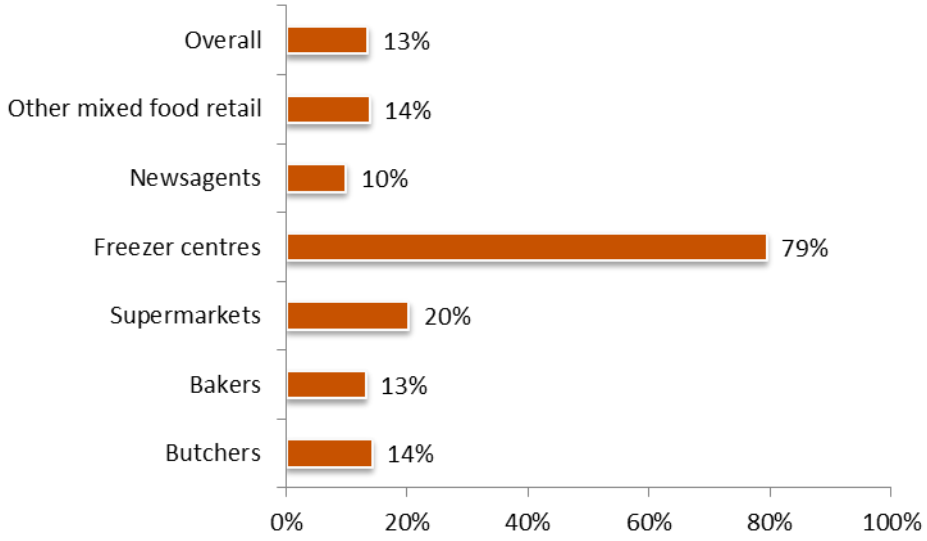


Table 11 in Annex 2 compares the energy intensity (kWh per m^2 net internal floor area) for those with objectives to reduce energy consumption or carbon emissions and environmental policies to those that do not. The results suggest that businesses with higher energy consumption in general are more likely to have taken action to have set targets for reducing energy consumption, put an environmental policy in place or set up a system to monitor energy use over time.

Just under 17% of all independent/small chain food/mixed retailers said their organisation encourages and supports staff in reducing energy consumption through training. Supermarkets were the most likely to encourage and support staff in this way (27%), with freezer centres (7%) and newsagents (13%) being the least likely. Less than 2% of all independent food/mixed retailers claimed they had set targets for staff to reduce energy consumption; the level of target setting was generally low across all activity sectors.

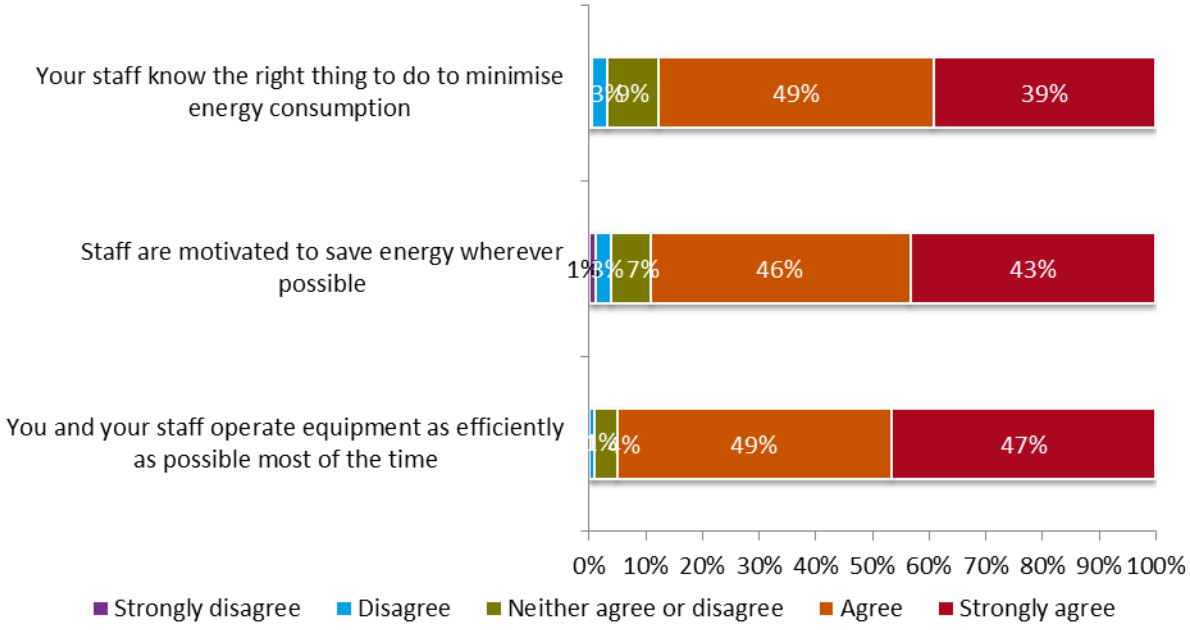
Approximately 13% of independent/small chain retailers in the food/mixed sector have undertaken an energy audit/review; however, supermarkets (20%) were found to be the most likely to have done so, as illustrated in Figure 4.9 below. Please note although freezer centres appear to be the most likely to have carried out an energy audit/review; the results are based on a small sample size.

Figure 4.9: Percentage of Premises that have Undertaken an Energy Audit/Review (independents and small/medium chains – fewer than 100 outlets: N=24,807, n=862)



The majority of independent/small chain food/mixed retailers agreed that they and their staff operate equipment as efficiently as possible most of the time (96%) and that staff are motivated to save energy wherever possible. They also generally agreed that staff know the right thing to do to minimise energy consumption, as shown in Figure 4.10 below:

Figure 4.10: Energy Efficiency Behaviour (independents and small/medium chains – fewer than 100 outlets: N=24,807, n=862)



Action to improve energy efficiency

For each area of end use covered in the survey (heating, lighting, refrigeration etc) we asked all respondents whether they had considered or taken any action in the last three years to:

- To replace equipment
- Improve its efficiency

The results are summarised in Figure 4.11 below:

Figure 4.11: Proportion of all Independent and Small/medium Chain Food/Mixed Retail Premises (where end use is relevant) that have Taken or Considered Action to Replace Equipment or Improve Energy Efficiency in the Last Three Years (independents and small chains – fewer than 100 outlets: N=24,807, n=862)

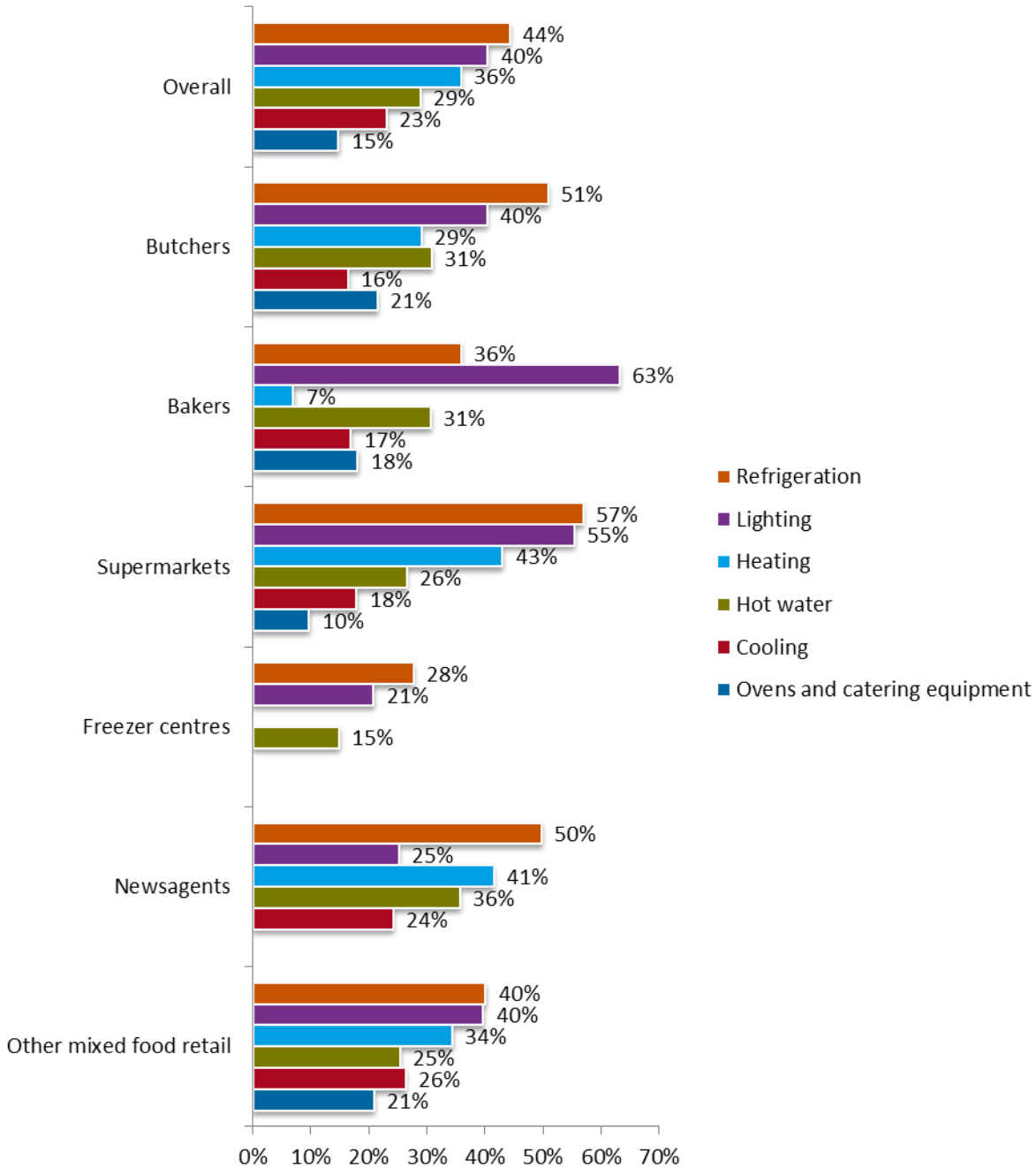


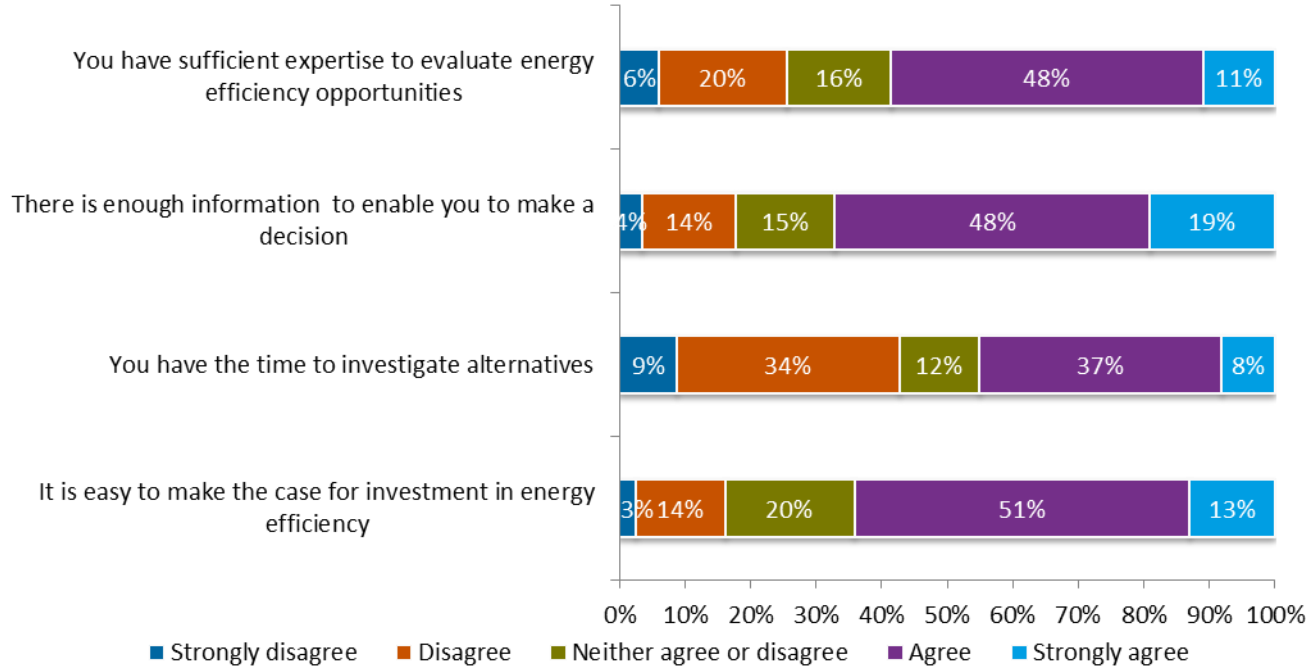
Table 12 in Annex 2 summarises the key findings relating to actions taken/considered and observations from the analysis. Limited evidence was found of planned replacement cycles amongst independent/small chain food/mixed retailers; planned replacement cycles was generally cited by less than one in ten of those considering or taking action in each area. It was much more common that action would be considered/taken in response to breakdowns and/or high running costs.

All organisations that had considered or taken action in the last three years in any of the areas covered in the survey (63%) were asked whether they agreed or disagreed with the following statements:

- You have sufficient expertise to evaluate energy efficiency opportunities
- There is enough information to enable you to make a decision
- You have the time to investigate alternatives
- It is easy to make the case for investment in energy efficiency.

The results are summarised in Figure 4.12 below:

Figure 4.12: Factors Affecting Energy Efficiency Behaviour and Investment (independents and small/medium chains – fewer than 100 outlets: N=24,807, n=862)



Supermarkets were the most likely to agree that they have sufficient expertise to evaluate energy efficiency opportunities (69%) followed by other mixed food retailers (62%). Freezer centres (50%) and Bakers (31%) were the most likely to disagree with the statement.

Freezer centres were the most likely to agree that there is sufficient information available to them to make decisions (75%), followed closely by other mixed food retail (74%). Supermarkets were the most likely to disagree that there was sufficient information available to inform decisions (34%), followed by freezer centres (25%) and newsagents (24%).

Supermarkets were the most likely to agree that they have time to investigate alternatives (59%). Freezer centres (75%) and newsagents (51%) were the most likely to disagree.

Bakers were the most likely to agree that it was easy to make the business case for investment in energy efficiency (80%), followed by supermarkets (72%). Freezer centres (25%) and butchers (21%) were the most likely to disagree with the statement.

Control systems of equipment installed

Heating

Respondents with space heating were asked about the controls they used for their heating. Approximately half (52%) of all respondents said their heating was controlled by thermostats; however, in more than two fifths of cases (44%), the respondent indicated that heating was switched on and off manually as required. In 18% of cases, respondents reported controlling heating through the use of timers, either in conjunction with thermostats or without.

Butchers (75%) and freezer centres (100%) with heating most frequently reported that they used timers to control their heating (either in conjunction with thermostats or otherwise). However, bakers were found to be more likely to solely use thermostats. 85% of bakers indicated that their heating is controlled using thermostats and 10% indicated that timers were used. Newsagents most frequently reported manually controlling their heating as required (59%).

Where thermostats are in use the thermostat is typically set between 18 and 21 degrees Celsius. There is some variation by activity sector; however, the sample size is too small for statistically significant results to be observed for small differences in reported temperature settings.

Lighting

Lighting in independent/small chain food/mixed retailers is almost exclusively controlled manually through the use of switches, for both the shop floor and storage areas

- Less than 1% of all premises used timers to control lighting on the shop floor
- 2% indicated that lighting outside the main shop floor was controlled with occupancy sensors, and 3% indicated use of timers

Cooling

Where cooling was present, it tended to be controlled by thermostats (65%) or a mixture of thermostats and timers (27%). 8% indicated that their cooling was solely controlled through the use of timers.

Butchers and bakers are more likely than other activity sectors to employ the sole use of thermostats where they have space cooling (75% and 79% respectively); supermarkets are the least likely to solely control their cooling using thermostats (48%). Supermarkets and other mixed food retailers were the most likely to employ a mixture of thermostats and timers (30% and 31% respectively) where they had cooling.

Where thermostats are employed to control space cooling, they are typically set to between 18 and 20 degrees Celsius.

Operating hours

Table 13 in Annex 2 summarises the typical hours of operation for particular types of equipment covered in the survey, indicating how this estimate was calculated from the data collected.

We observed significant variation in hours of operation by activity sector; for example:

- Lighting is in use for a significantly longer hours in supermarkets and newsagents (approximately 4,500 hours per annum) compared to butchers and bakers (typically 3,000 hours) due to longer opening hours

- Hot water boilers tend to be in use for significantly longer hours in multi-site bakeries (7,500 hours per annum) compared to multi-site retailers in the 'other food/mixed category – 2,500 hours per annum (approx.)

- Hours of operation for ovens is significantly greater for bakers (2,280 hours per annum for multi-site, 1,560 hours per annum for single site) than supermarkets (624 hours per annum for multi-site, 468 hours for single site)

Illustration of Abatement Opportunities

It is beyond the scope of this study to use the data collected in the telephone survey to provide a comprehensive analysis of the abatement potential in the food/mixed retail sector. However, this section provides examples to illustrate how the data collected in the telephone survey can be used in conjunction with other data available in the public domain to estimate the abatement potential among independent and small chain food/mixed retailers for particular capital equipment replacement/refurbishment actions and optimising energy usage patterns. A full list of abatement opportunities considered and their feasibility both in terms of the data collated and practicality is provided in section 6.

In this section, we consider and quantify the potential impact among independent/small chain food/mixed retailers of those opportunities considered to be the most feasible options. These opportunities include:

- Capital replacement actions
- Retrofit/refurbishment actions
- Behavioural actions

Where possible we have estimated the cost of taking these actions in addition to the resultant energy savings. Please note – the figures presented in this section are for illustration and are indicative only.

For the purposes of this report we have considered the benefits which may arise from capital replacement of the following equipment:

- Lighting – replacement of all halogen lighting with LED systems
- Refrigeration - replacement of appliances greater than 10 years old with best available technology

Lighting- Halogen Replacement with LED

Based on the bottom-up analysis of energy consumption, we estimate that the lumen requirement for independent and chains of 2-99 premises in the food/mixed retail sector served by halogen bulbs is 585 gigalumens; this equates to an estimated annual energy consumption of 34.5 GWh.

The typical effectiveness of halogen lighting is 17 lumens per watt, compared to at least 50 lumens per watt for LED lights[25]. Therefore, if all halogen lights were to be replaced by LED lighting, we estimate that total energy consumption could be reduced by 66%, equating to a saving of 22.7 GWh and reducing CO_2e[26] emissions by approximately 11,900 tonnes per annum.

The total cost of replacing halogen bulbs with LEDs and value for money in terms of the cost per tonne of carbon saved over a period of 10 years is outlined in Table 14 in Annex 2[27].

Refrigeration

We estimate that refrigeration accounts for approximately 62% of energy consumption by independent/small chain food/mixed retailers ~ 756 GWh.

Potential energy savings for capital replacement of refrigeration equipment are based on replacing equipment greater than 10 years old. To estimate the scale of the abatement opportunity, the standard factors for appliances from DEFRA's Market Transformation Programme (MTP) used to derive bottom-up energy consumption are replaced with the 'MTP Best Available Technology Scenario' factor. Table 15 in Annex 2 outlines the number of appliances which could be replaced and the resultant savings. In total, approximately 20 tonnes of CO_2e could be saved per annum.

It should be noted that a number of retailers may operate with refrigeration units which are supplier or manufacturer controlled. Additional research would therefore need to be conducted to determine if retailers or suppliers would be the most appropriate audience to target with any future abatement policies. Additionally, this section has not quantified the cost of this capital replacement action as prices of refrigeration units vary considerably depending on specification and size.

Retrofit/refurbishment actions

The retrofit and refurbishment of equipment also provides significant abatement opportunity. We have calculated potential savings from the following actions:

- Refurbished of chiller rooms/cold stores greater than 10 years old to maintain air tightness and seal leaks
- Fit display cabinets with transparent doors

[25] http://efficient-products.defra.gov.uk/cms/assets/Uploads/MTP-Draft-Comments-on-ELC-CELMA-Comments.pdf

[26] Based on reduction in use of grid electricity, 0.5246 $kgCO_2e$ per kWh: http://www.carbontrust.com/media/18223/ctl153_conversion_factors.pdf

[27] Note that this excludes cost savings associated with the need to replace halogen bulbs more frequently than LED lights (due to significantly longer lifespan of LED lights)

Refurbishment of Chiller Rooms/Cold Stores

Information published by the Carbon Trust estimate a 12% energy saving from refurbishment and repair of cold stores/rooms (see Table 16 in Annex 2).

Fitting Transparent Doors to Display Cabinets

According to information published by the Carbon Trust, fitting transparent doors to open fronted chilled display cases can reduce energy consumption by 30%[28].

The estimated energy consumption from our initial bottom-up analysis of the data provided in the telephone survey indicates that the total energy consumption per annum of display cabinets without doors is 234.8 GWh per annum.

If transparent doors were fitted to all display cabinets in use by independent/small chain food/mixed retailers, total consumption would be reduced to around 170.7 GWh per annum, saving 73.1 GWh and reducing CO_2e emissions by approximately 38,400 tonnes per year. The total cost of undertaking this measure and value for money in terms of the cost per tonne of carbon saved per annum is outlined in Table 17 in Annex 2.

Behavioural Actions

The findings suggest there are significant opportunities for independent and small chain food/mixed retailers to reduce energy consumption through improved management and control (e.g. optimisation of control for key energy using equipment, introducing a system to monitor energy consumption, providing training for staff and setting targets).

If independent/small chain food/mixed retailers could be encouraged/enabled to take action to reduce their total consumption by an average of 5% per year, this would result in an estimated saving of 96GWh per annum, reducing yearly CO_2e emissions by approximately 50,000 tonnes. Examples of how savings through behavioural changes can be achieved are outlined below:

- The average air conditioning thermostat setting for the sector is 19°C; increasing AC temperatures by 1 degree can cut energy use by 5%[29] equating to approximately 2.23 GWh per annum
- The 'Close the door campaign' suggests closing shops doors can cut heating energy use by 50%.[30] Potential savings are calculated by reducing the energy consumption of heating equipment by those sites with an open door policy by 50% (see Table 18 in Annex 2)

[28] http://www.carbontrust.com/media/51754/ctg808-energy-savings-retail-interactive.pdf

[29] Air conditioning savings factor based on a retail site for air conditioning and would therefore benefit from further review: http://www.airwell.com/LearnaboutAC/13energysavingtips.aspx

[30] Close the Door Campaign: http://www.closethedoor.org.uk/content/view/42/48/

5. Results for Large Retail Chains

Despite the challenges, we were able to complete qualitative interviews with seven large retailers (100+ premises). We received additional quantitative energy management data on specific stores from two of these seven retailers;[31] and high level summary data from one other.

Profile

Based on analysis of the Experian pH data supplied to us for the purpose of this study approximately 42% of food and mixed retail premises in the UK are owned / leased by large retailers with more than 100 premises in total. See Annex 4 for further details on the profile of large chains.

The conversations held with large retailers during the comparison stage confirmed that a significant amount of data relating to the energy use of the largest retailers is collated centrally.

Large retailers manage their energy differently to the rest of the market in the food and mixed retail sector, typically displaying greater centralised control of store operation and energy behaviour than is present in smaller chains. Therefore we used a tailored approach to engage large retailers to understand how they operate with regards to managing energy use, collecting energy use data and exploring opportunities for abatement.

Therefore, we proposed to approach the head offices of all chains with 100+ sites to explore whether they would be willing to provide the data they hold centrally about energy use (by type where possible (e.g. sub-metering) or inventory data))

We adopted the following approach for each large retailer:

1. Identify the person responsible for energy management at head office level.

2. Discuss the project with them and whether they hold the data of interest to DECC.

3. Explore whether they would be willing to participate and establish whether any conditions would need to be met in order to proceed (e.g. non-disclosure agreements, direct correspondence from DECC).

4. Obtain the data they are willing to provide for as many of their trading premises as possible. The preferred format for these data was specified, but we allowed retailers to provide the data in the format that was most convenient for them if it ensured participation.

5. Review the data supplied to understand the overall profile of their stores and energy use, and the data items that are not available at head office.

6. Have a follow-up discussion with them to:

    - Raise any queries about the data supplied

[31] Albeit only one of these was able to provide internal floor areas for their estate

- Arrange to speak to a sample of sites (where we are permitted) to fill in any knowledge gaps (e.g. site level behaviour)

21 large retailers were approached in total and in-depth interviews were conducted with appropriate representatives from eight of these retailers.

Given the sensitivity of quantitative data held by large retailers, we also endeavoured to conduct site audits to provide supporting evidence of energy intensity. Four site audits of stores operated by large retailers were completed in total.

In total we made contact with a sample of 18 food large retail chains including supermarkets, convenience stores and street food retailers such as sandwich outlets and bakery chains. With all retailers we contacted, we firstly aimed to understand what information was held centrally and what was held at store level, and whether or not any outside energy or maintenance contractors were involved with energy management. We took even greater care with retailers that operate both their own stores and franchised premises because energy management was expected to vary depending on which type they were. It was crucial to identify the internal management structure of retailers to ensure that we approached the individuals that could supply the information of interest to DECC, and identify whether it was just one or more than one person we would need to engage with to collect all of this information.

Where respondents agreed to participate in the project, we undertook in-depth qualitative interviews with the relevant person(s) within the retailers. We identified that in all cases we would initially need to collect information at the head office level by speaking to individuals such as energy and maintenance managers, unless they specifically delegated engagement to outside contractors. Specific, detailed questionnaires were not used because the approach to energy management was expected to be variable; therefore we used a set of topic questions and experienced members of the team to explore broad areas with the relevant individuals we were able to engage.

We also sent out pro formas designed to capture energy management data from retailers within the sample, for either all of their retail stores or a selection for which they could provide information. In addition, we attended the Retail Energy Forum (REF) meeting with DECC to discuss the project with retailers attending the meeting and secure their input.

Management Structure

All participating large retailers had an energy management function within the organisation, set up to manage energy use across the stock which included retail stores and other warehouse buildings in their locality. It also typically included distribution centres and central offices. Stores are the main energy users and therefore the focus of attention of managers.

The internal approach to managing energy varied depending on the retailer. Some stores had distinct teams to manage energy and property, meaning that energy use as a result of energy using products (e.g. refrigeration, lighting) would be managed by a different team from energy use influenced by property fabric, such as insulation levels. Both teams were often managed in the same part of the overall organisation (e.g. the operations department) and had good relationships.

In other cases, one team would deal with all energy matters and would provide input into energy management, store design and maintenance. Where retailers had a centralised head office function, the energy teams tended to be small, with a few individuals managing large portfolios of stock.

Where the retailer had a more disparate head office function, there was no one team responsible for energy matters. Instead, there would be several individuals in different areas of the business or different subsidiary companies, all responsible for energy issues. In some cases, the whole function would be outsourced to one or more outside contractors.

Approach to Energy Management

Managing energy use is seen as an important issue within large retailers, as energy is a significant cost. In all cases, the main driving force behind energy management is to save money. As a result, large retailers make significant efforts to manage energy use within their portfolio using a number of key approaches, detailed below.

Metering

All supermarket and most other food and mixed retailer organisations that we contacted had a central energy management system (EMS) in place.

Every organisations contacted had a method in place for metering their energy consumption. All supermarket and most other food and mixed retail respondents typically utilised smart metering to feed information from a particular retail site back to the retailer either directly, or via an outside data collection company or energy supplier. Typically, data are captured at 30 minute intervals at all times (including when the store is closed and overnight) and transmitted for the previous 24 hour period each morning. This allows retailers to view data from the previous day but not live. While all retailers had some kind of smart metering for electricity, not all stores had gas consumption metered in this way.

Most retailers have undertaken planned deployment of smart metering to comply with part L of the building regulations 2010. All retailers stated that where suitable, energy monitoring equipment would now be installed in a new store as standard and during refurbishment of existing stock if equipment wasn't installed during a planned roll out.

Installing smart metering across a retail estate sometimes presents problems for retailers. For example, one retailer did not have 100% of their stores with electricity smart metering in place because of a technological hurdle they had encountered. For a proportion of their stock they need their smart meters to be located in the basements of stores (due to the way existing building metering is set up) and as a result there were issues with the units relaying data wirelessly; signal interference means data can only be sent intermittently (thus meaning delays in getting complete data for a given time period) or not sent at all. The same retailer reported this same issue within enclosed building spaces such as shopping centres – there is too much interference to transmit data from the smart meter. They are currently exploring ways around this, including wired solutions.

Sub metering

Sub metering allows precise details of energy use in energy using products of a certain type or in certain areas of a building to be captured. For a food retailer, in combination with smart

metering, this can allow them to collect half hourly data outputs and observe how consumption varies over a given time period.

All supermarket respondents made some use of energy sub-metering. These large retailers identified it as an important tool in understanding energy use within a store, identifying areas to reduce consumption and monitor unexpected outputs, particularly for larger stores. Other large food and mixed retailers typically did not have sub metering in place, but at least two of these planned to explore its installation in the future[32].

For supermarkets, specific store areas or end uses that retailers sub meter include (where present)

- Refrigeration (sometimes split into chilled cabinets and freezers separately for faster identification of problems when they arise)
- Lighting
- Heating
- Cooling
- Bakery and other hot food production
- Cafe / restaurant
- Warehouse and storage areas – sometimes split again into individual energy end uses
- Petrol station
- Administrative areas and offices

Respondents with sub metering noted data gaps across their stock, where less sub-metering had been undertaken either for cost or other practical reasons. Where sub-metering on site was not present, overall energy use of the store was still recorded where practical[33]. Reasons for total absence or incomplete coverage of energy sub metering included:

- **Low energy use and / or smaller store size**: Where energy use overall is lower and therefore not deemed cost effective to sub-meter by different appliance types (e.g. refrigeration, lighting etc.). Retailers also often struggle to justify the benefits of sub metering for smaller stores.

- **Cost effectiveness and benefits**: One retailer reported that although they hoped to eventually install sub-metering across their entire stock, this was difficult to get approval internally because of it being a low priority for management, who believe there are more cost effective ways to target and reduce energy consumption – such as changes to energy using appliances and technologies.

- **Leased premises**: Premises on high streets (e.g. express type convenience stores) or in shopping centres tend to be leased, which impacts on the extent to which the retailer is prepared to invest in sub-metering. Changes to the building and / or energy setup also usually require permission from a landlord.

[32] Demonstrating the recognition that smart metering is a useful tool for reducing energy consumption, something that wasn't found in any significant prevalence with small and medium chain retailers

[33] In some rare cases, in a store on a lease agreement, energy consumption could be paid by the landlord. In these cases, the store would still seek to monitor energy use to monitor for equipment failures.

Respondents with stores of a similar size and similar equipment types had applied a blanket programme of sub-metering across their stock in recent years. One supermarket respondent stated that it would now be standard practice to install sub metering in new stores over a certain size.

Inventory / Asset Information

We also explored whether retailers held an inventory of the energy using equipment in their retail stores. Some retailers didn't have this type of inventory in place centrally at all, and it was understood that this information may only be obtainable by speaking to individual sites. Where retailers did have central inventory data, these data typically were not held by energy teams. Individuals or teams handling maintenance and property were most likely to hold this information if it did exist.

Handling of Meter Outputs and Energy Management Systems (EMS)

Different retailers handle the outputs from the meters within their individual stores in different ways; all will have access to the data at some point during the process, but it may go to other organisations en route. Typically data will either be sent to the retailer / their designated energy management company directly for access through EMS software or it will be sent to an external data collection company. Where an external data collection company is used, they collate and compile the data before sending it onwards to the retailer or their designated energy management company. In some instances, data may also be passed via the retailers' energy supply company for billing purposes. It is worth noting that the route data takes will be down to factors including

- The type of energy software retailers are using (and whether it can accept raw data without processing)
- Relationships / contracts with organisations supplying metering technologies
- Relationships / contracts with energy supply companies and other external energy contractors

Once the retailer or their designated energy management company receive the energy consumption data, it is stored within the energy management system (EMS). Where inventory information and floor plans are also stored centrally they can be incorporated within the EMS to allow easy access to the data in one place. Respondents used a few providers supplying tailored energy management services to retailers in the UK[34].

One respondent provided restricted access to their energy management system to allow viewing of data and outputs for five selected stores. This showed that outputs were provided for both electricity and gas use, with a priority on electricity use.

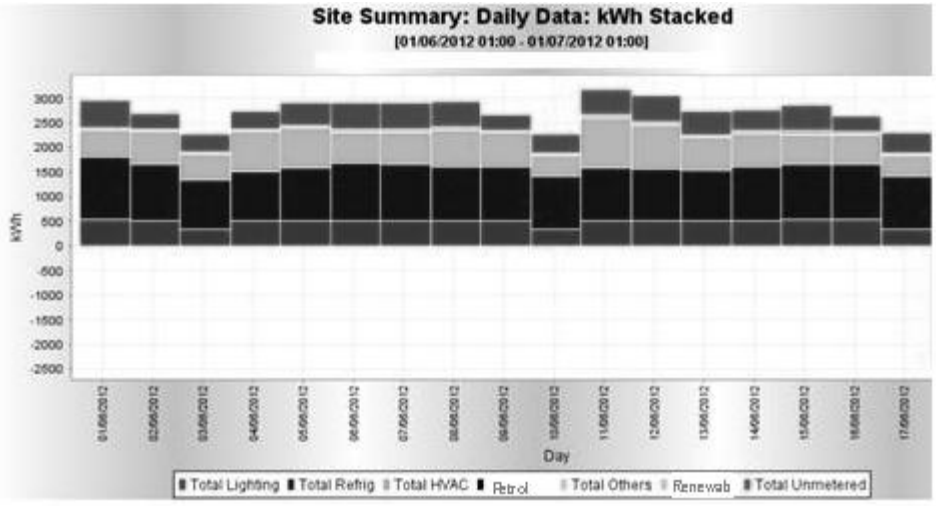
- Central outputs: This particular system provides data on each store including:
- Store details – location, description, internal floor area
- Store gas use – half hourly, daily, weekly, monthly use reports
- Store electricity use - half hourly, daily, weekly, monthly and year on year performance
- Sub meters – equipment sub-metered, installation notes, half hourly, daily, weekly, monthly and year on year performance
- Energy dashboard – store level energy use outputs

[34] These included providers such as Energy ICT and Ista-UK.

- Water use data
- Works data – logging when improvements have been installed

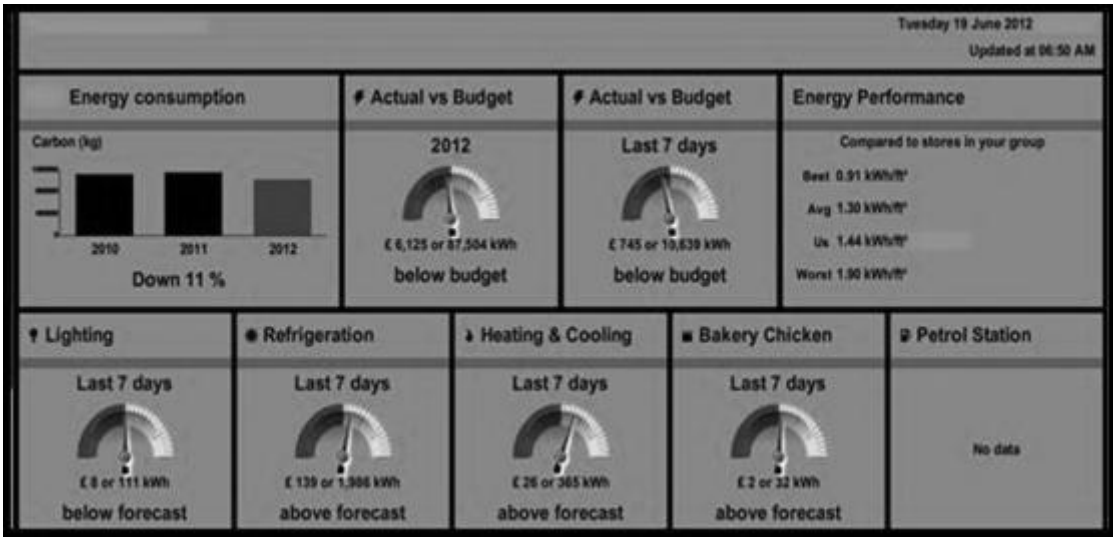
Figure 5.1 below shows an example output of daily sub-metering outputs at the store level.

Figure 5.1: Example EMS Output of Store Level Electricity Sub Metering from a Large Retailer (100+ outlets)



At the store level, outputs are tailored to provide relevant information to store managers, which can be communicated to staff within the store. Outputs include daily, weekly, monthly and year to date energy consumption. An energy budgeting system is used to provide a view on how the store is performing according to forecast. An example of a store view output is provided in Figure 5.2 below:

Figure 5.2: Example Store-Level EMS Energy Use Output from a Large Retailer (100+ outlets)



Another retailer provided some sample outputs from different software to demonstrate how data can be displayed. Figure 5.3 shows single store energy consumption for one site over the previous 7 years. The observed peaks in the summer months result from increased work demand from refrigeration. The baseline drop of around 25% in approximately October 2007 resulted from a store-wide change to refrigeration equipment, starkly demonstrating the impact upgrading to more energy efficient technology can make.

Figure 5.3: Example Store Level Consumption over Several Years from a Large Retailer (100+ outlets)

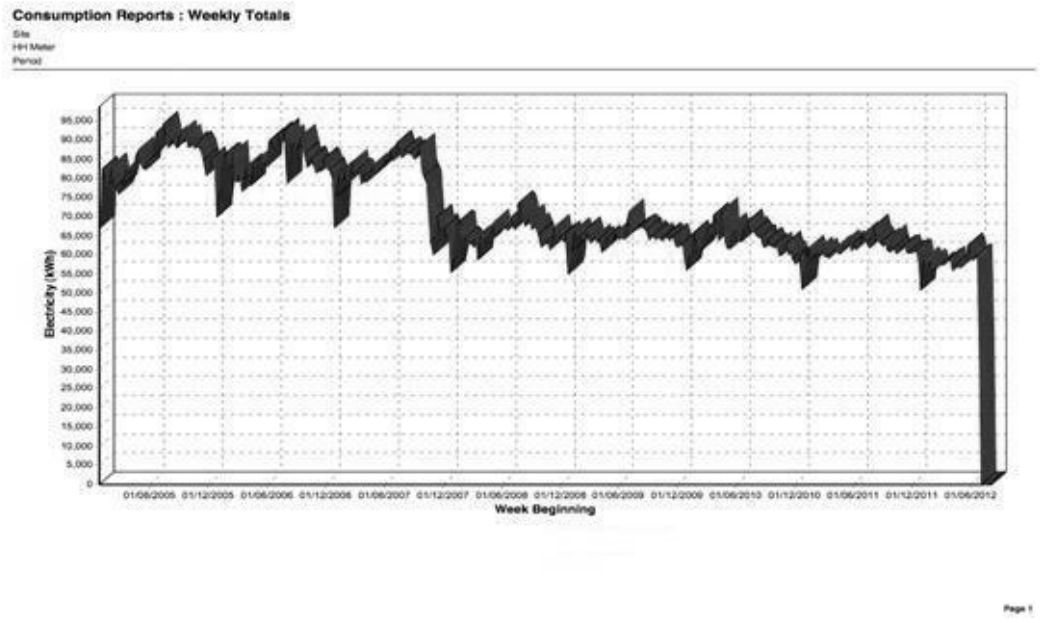
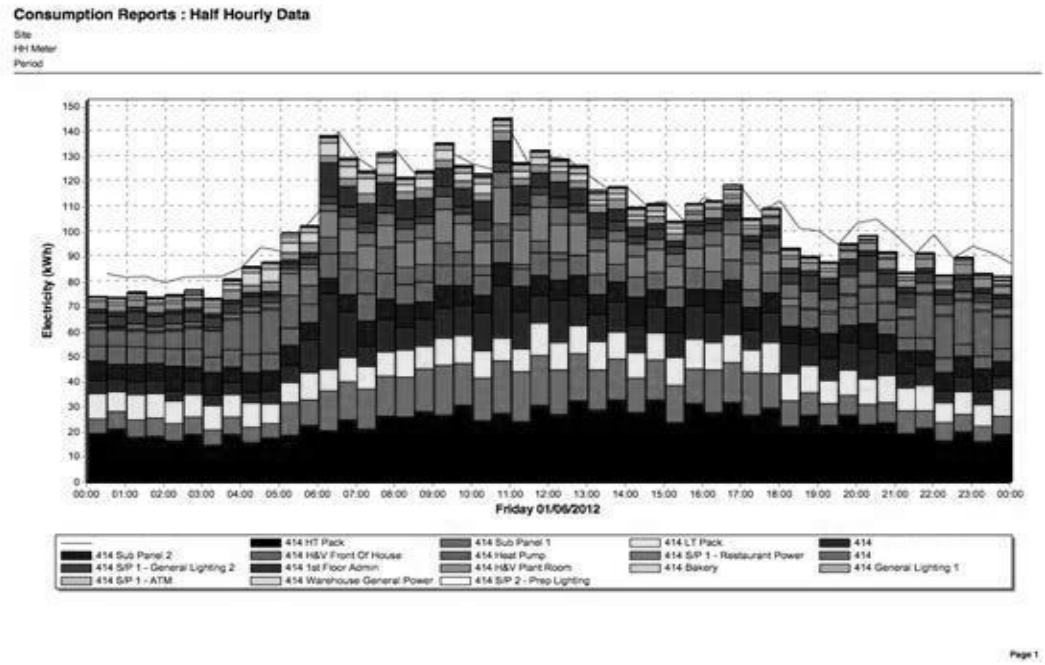


Figure 5.4 shows a more detailed output from a supermarket with a very high degree of sub-metering. The chart covers a 24 hour period and it is possible to identify when particular end uses are consuming most power, and how this varies over the day.

Figure 5.4: Detailed Sub Metering for Supermarket over 24 Hour Period[35] from a Large Retailer (100+ outlets)



Use of Energy Management Data for Management Purposes

Typically, daily, weekly and monthly energy use reports are being used by energy managers to monitor and manage energy use across their stock. In addition to standard reports by store and equipment type, managers would typically know how to design their own reports within the system. For example, if a particular issue was identified with a particular make or model of equipment in store, the manager would be able to set up reports of the energy use of that equipment where it was installed in any sub-metered store within the stock to check for failures elsewhere.

Energy Baseline: All retailers we spoke to expressed the need to compare meter outputs to a known baseline, both for the entire store and for specific end uses. Most retailers already had baseline references in place for much of their estate, with those that did not were in the process of using the energy management to produce the baselines needed. For effective comparisons between stores, baselines need to be in place for stores of similar functions and similar size[36]. Where energy baselines weren't solidly established, retailers found it more difficult to effectively identify stores and / or particular energy end uses that were using more energy than they should have been.

Energy targets: Establishing baselines can allow a retailer to understand how much energy a particular store should be using at a particular time. Once this is known, it is possible to set energy consumption targets for individual store managers to meet. While not all retailers do have

[35] This figure highlights some of the difficulties that are faced when attempting to sub meter specific types of equipment or areas of the store; there can be overlap between specific end uses that are run from the same electricity distribution panel (a panel keeping the electrical devices, power points or store areas separate from other panels in the store). Certain panels also cover a very wide range of energy uses with no further split or way to see exactly what is attached to the panel. This issue presents itself more markedly for older stores where the electricity panels are set up in different ways and the main consideration at the time was functionality (ensuring when fuses blow they don't affect the whole store) rather than being able to observe energy use in the future.

[36] It is also especially to factor in fuel sources in addition to electricity, so comparisons can be made effectively – for example between stores that use gas for certain functions and those that don't

energy targets in place, all those that we spoke to expressed a desire to have these in the future. Targets are passed on to store managers using the energy management system.

Respondents took slightly differing approaches to targeting and had experimented with different models of targeting across different regions of stores and across stores of a similar type/age. Two included a system where league tables had been set up of stores of a similar type in the same region, which meant that store managers had targets set relevant to comparable stores (as discussed with baselines) in order to instil some competition and relevance to energy management. One of these retailers said that they offered a prize to the staff at the store that consumed the lowest percentage of their expected baseline in a particular region; typically some finances towards the store's social fund. None of the retailers we spoke to had any formal penalties when targets are not met, but area / regional managers would explore factors resulting in the failure on their next visit to the store. One retailer in particular said that it was really a reputational thing; "nobody wants to be the worst performing store".

Day to day management: Energy managers have daily or weekly reports, which would highlight specific failures of equipment, which they could then have investigated and if necessary arrange for repairs or replacement to be carried out.

Store managers are typically sent reports on a weekly basis so that they can see:

- How their use changes over time; compared to previous weeks or the same weekly period from the previous year
- How their energy use compares to other stores of similar size both in their own region and wider

These outputs can help store managers control energy use at store level with training and guidance from the central energy management team.

Building management systems: Some of the retailers we spoke to used building management systems, typically where the contractors who deal with their energy offer these services. These systems are in place to optimise both environmental conditions and energy consumption. The system makes sure equipment is turned on and off at the correct times when the store is open, specifically handling the heating & cooling, lighting and sometimes refrigeration[37]. The system makes sure that the stores are at the correct temperature for the time of year and that the timed lights come on and go off at the correct time, in relation to the amount of daylight. For this system to operate effectively, the contractor will need full access to the energy management system but can equally add benefit by identifying where equipment is malfunctioning and feeding this back to the retailer.

Longer term energy management: The energy management team have company-wide energy use targets to meet across the portfolio. These targets were either set on an energy use/floor area or at a total level. Store level targets are an important way for a company to ensure they meet these overall targets, and understanding store level targets through energy management can show how realistic overall targets will be.

[37] Refrigeration units will work harder when heating is on and / or doors are being opened more frequently. Building management can adjust the amount of work all fridges and freezers are doing to keep food at the same temperature based on the temperature of the building

Engagement and Targeting of Store Staff

Respondents discussed training they had put in place for staff and new starters to ensure they are aware of how to manage energy using equipment properly and to encourage energy efficiency through behavioural change. One particular retailer was currently in the process of producing new training material for store managers to train staff. Another retailer had undertaken a partnership with an energy supplier to train a sizeable proportion of its store staff in ways to be energy efficient, both at work and at home.

Some retailers had specifically trained one particular staff member at each store to be the store 'energy champion'. The energy champion tended to be someone within the management structure, typically the assistant manager. These staff members were given responsibility for communicating energy use at the store level and ensuring good practice of other staff (e.g. encouraging lights to be turned off in back rooms when not used).

Some respondents were also undertaking their own internal research with store staff to help understand attitudes and awareness of energy use, exploring ways in which to improve energy related behaviours amongst them. Examples included focus groups with store staff to monitor awareness and response to specific campaigns (such as energy use information and reduction targets) provided to stores by head office energy teams. Some others were undertaking specific projects on select stores to explore energy using behaviour of staff in more detail to understand opportunities for abatement through equipment use.

One retailer had chosen a proportion (approximately 15%) of their retail stores to trial supplying them with a greater quantity of energy information. In addition to weekly energy reports, stores were given more detailed outputs and staff encouraged to look at these. If participants of this scheme report a benefit through increased efficiency savings from having extra information available then the retailer may make this standard across the rest of their estate.

It was noted by one respondent that staff behaviour was seen as a relatively small opportunity to achieve energy savings as in most cases energy use had been automated (e.g. motion sensitive lighting, heating).

Store Refurbishment / Creation and Energy Efficiency

Depending on the internal management structure discussed earlier, store refurbishment or creation of new stores (purpose built or in existing property) was typically led by the property and refurbishment team, with input from energy managers. Respondents stated that while there is always a desire to put the most energy efficient equipment in place, there is a set budget controlled by the property/refurbishment teams, which can be a limiting factor.

When retailers are moving into existing premises rather than building a new premises, additional issues can present themselves. Particularly in high street locations, one retailer stated that whilst they would like to explore the use of centralised refrigeration technologies they are unable to pursue this because a lot of landlords don't like alterations being made to the floors, walls and exterior of their properties. Space is usually at a premium in high street locations and to fix equipment externally to a building can be impossible for practical reasons and because of cost. Retailers[38] often already need to site air conditioning equipment externally and this reduces the space to explore other technologies.

[38] This problem was expressed by large retailers but it can be assumed is an issue for any food and mixed retailers operating in high street locations where space is at a premium

Refurbishment is seen as a significant opportunity to put in place additional sub-metering and upgrading old high energy using equipment such as refrigeration and lighting.

Trigger points for store refurbishment include

- Age of stores, on a refurbishment cycle
- Competition – for example, if a competitor store has opened up in the local area, this can trigger a refurbishment or 'refresh' of a store

Large retailers vary in the fine details of their approach to repairing and replacing equipment, but all will look to refit and repair appliances before replacing them outright. Most retailers did have planned schedules of replacement sometimes many years in advance, so a store will know when they are due to have some or all of a particular technology replaced. These cycles are based on the age of equipment and sometimes timed to coincide with refurbishment schedules. Individual breakdown or suspected breakdown of units (highlighted by the energy management system or store managers) will be handled by maintenance teams as and when the need arises. Retailers varied on the speed of their response to maintenance issues based on the type of technology and the severity of the problem, with some retailers showing less concern for certain problems.

One retailer in particular identified that about 20% of their stores were using very old oven equipment and have since targeted a campaign to replace these ahead of existing planned schedules.

In general it appeared that fabric improvements such as insulation were a lower priority than for other sectors which may be due to central team structures (as fabric refurbishment can be managed outside of the energy team) and the relative lower proportion of energy use for space heating in this sector.

Energy supply

Respondents had large energy supply contracts with energy suppliers, which were negotiated periodically. In one case, the large retailer had a different arm of the business involved in energy supply, which led to a pseudo-internal marketplace where one part of the business would negotiate deals with the energy supply arm in order to pay for energy. Retailers did not report much input from energy suppliers with regards to how they are using energy, but in one case a retailer recently partnered with an energy supply company to deliver a staff training campaign.

Key Areas of Energy Use and Energy Profile

The main areas of energy use cited by all respondents included lighting, refrigeration, heating ventilation and air conditioning (HVAC) accounting for a large proportion of overall energy use. The interaction of heating, heat producing appliances (ovens, heated bain-maries, hot plates), cooling and refrigeration technologies was of particular concern to the large retailers we spoke to. Where ovens are in use as part of retail operations, they can be responsible for a significant part of overall energy use.

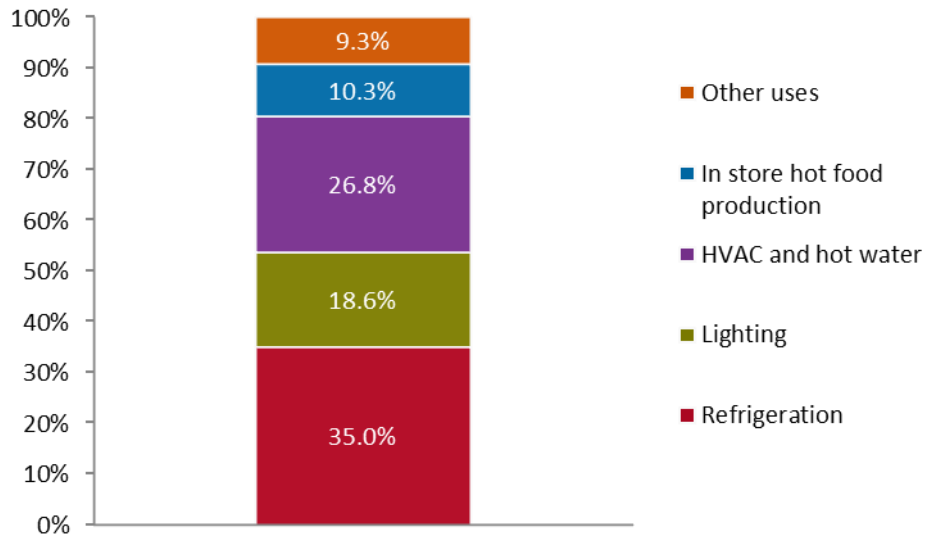
The respondents that provided actual energy use data across the stock (supermarket retailers) reported that electricity use accounted for the bulk of their use[39]; 75% of total energy use, with gas comprising the remaining 25%.

Combining the profile information we were supplied gives an approximation for energy usage for a 'typical' supermarket as follows:

Proportion of total energy consumption by end use[40]

- Refrigeration - 35%
- Lighting - 18.5%
- HVAC and hot water - 26.8%
- In store hot food production (bakery, cafe etc) - 10.3%
- Other uses (including small power - administration, computers, tills, conveyors) - 9.3%

Figure 5.5: Large Chain (100+ outlets) Supermarket Total Energy Use by End Use



The consumption data we were provided along with up to date retail floor area allowed us to estimate large food/mixed retailer energy intensity to be 810 kWh/m^2 in 2011[41], for the retailers that supplied this data.

Where gas supply is installed in supermarkets it is used primarily for heating and hot water; the profile for electricity consumption alone is as follows.

[39] Based on energy supply broken down by source, from two supermarket retailers who provided this data.

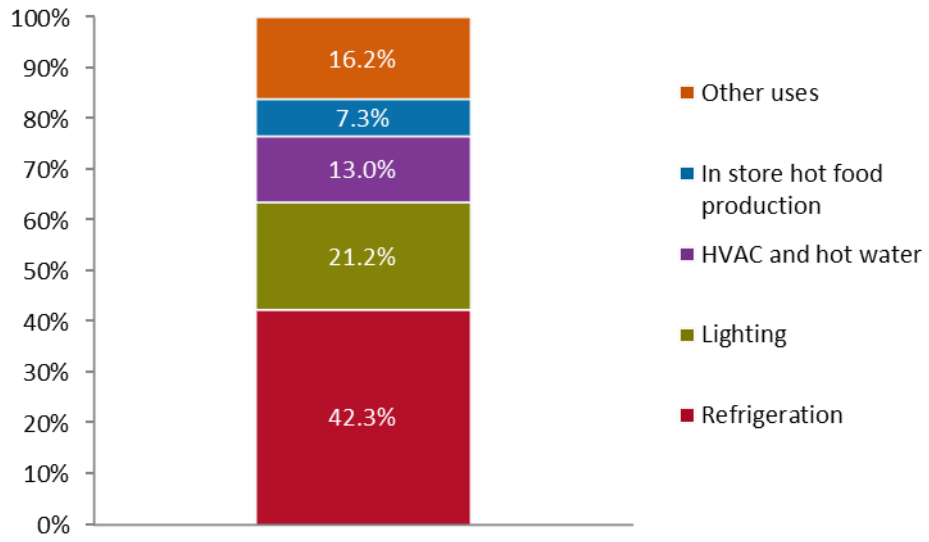
[40] Weighted figures based on data supplied by three supermarket chains who supplied total annual consumption and individual energy profile.

[41] One retailer was able to provide gross internal area. To convert this to net internal area, guidance from the Homes & Communities Agency / Office of Project and Programme Advice and Training was used (online at www.homesandcommunities.co.uk/download-doc/6155/10397). This suggested that to convert to NIA, remove 15-20% of the value; the 20% figure was used, to account for the quantity of other space uses in supermarket retail.

Proportion of electricity consumption by end use[42]:

- Refrigeration – 42.3%
- Lighting – 21.2%
- HVAC and hot water - 13%
- In store hot food production (bakery, cafe etc) - 7.3%
- Other uses (including small power -administration, computers, tills, conveyors) - 16.2%

Figure 5.6: Large Chain (100+ outlets) Supermarket Electricity Use by End Use



These profile figures and the energy intensity would have a higher degree of accuracy had more data been received, but due to the low variation we saw between the chains that did supply data we can be relatively confident that these will be representative of the sector as a whole[43].

No actual consumption data was received from organisations other than supermarkets, but qualitative discussions suggested that many face challenges in ensuring their store is at the optimum temperature e.g. due to the use of equipment that produces a significant amount of heat (ovens, latent heat from refrigeration). As a result many indicated that HVAC is one of their primary considerations, followed by lighting and refrigeration. We expect that because their retail premises tend to be smaller, the quantity and types of equipment installed in premises and activity would be similar to independent retailers and smaller chains.

To demonstrate how the intensity figure calculated for large chain supermarkets compares to the independent and small / medium chain retailers, see Table 19 in Annex 2.

[42] Weighted based on electricity consumption data separated from gas consumption supplied by two supermarket retailers.

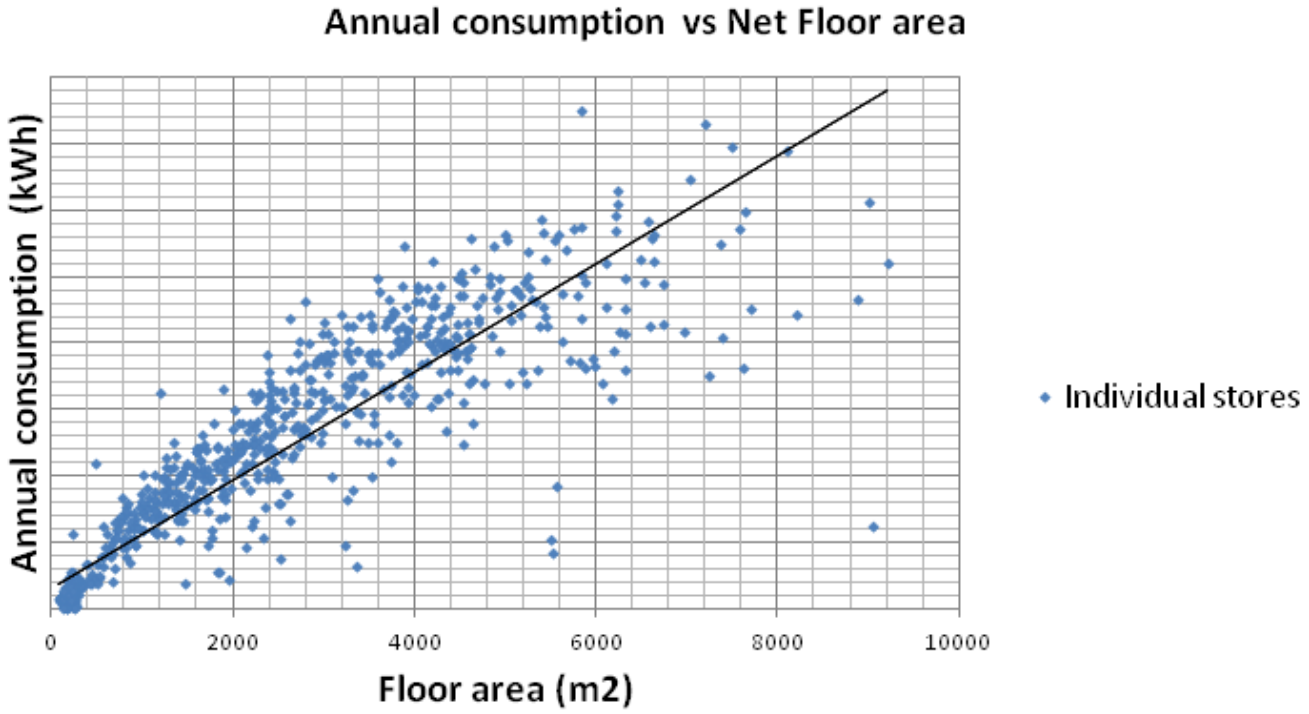
[43] Data provided cover 53% of the individual premises operated by the 5 supermarkets with the largest market shares in 2011

Energy use intensity

Only one large supermarket retailer provided a breakdown of total estate by floor area of individual premises, so it was not possible to accurately compare stores of similar sizes between retailers. Data we received for total retail estates also unfortunately do not allow us to quantitatively compare supermarkets that; for example, focus on one type of good (e.g. frozen food) with those that do not, or compare supermarkets in different price brackets e.g. budget vs. upmarket.

However, we are able to display the data from the aforementioned retailer to demonstrate how increasing floor area corresponds to energy use.

Figure 5.6: Annual Consumption Plotted against Net Floor Area for One Supermarket (large retailer with 100+ outlets)



For this particular retailer, the following were calculated[44]:

- Lower first quartile 1: 878 kWh/m^2
- Upper third quartile 3: 1268 kWh/m^2
- Median: 1061 kWh/m^2
- Average: 976 kWh/m^2

50% of stores for this particular retailer fall between an intensity of 878 and 1,268 kWh/m2. The analysis was carried out on a sample of approximately 1,000 stores for which data were supplied.

[44] The population size is not reported here to maintain the anonymity of the retailer who supplied this data

Figure shows a strong correlation between increasing store size and increasing energy consumption. The equation for the linear regression line illustrated above is y = 815.2x + 399,678 (where y = kWh and x = m^2); with an R^2 value of 0.846 (equating to a correlation coefficient of 0.92). Bearing in mind that this is based on data from just one large supermarket retailer, if data for individual stores can be collected from other large retailers then the equation can be made more robust and could subsequently used to estimate energy consumption for a known floor area in the absence of complete data being provided by large retailers.

We recommend that DECC use CRC data to obtain data about overall energy use for each large retailer. The profile of energy use for each large retailer could then be estimated using VOA/NEED data (which provides floor area for individual stores) in combination with data that can be gathered from large retailers to produce an overall estimate of the profile of total energy consumption.

Existing initiatives

Many retailers already reported they had made or were exploring changes to their stores and / or the equipment they were using by replacing older technologies or refitting existing ones. Some of the technology initiatives retailers reported undertaking included:

- Targeting and replacing very old refrigeration equipment ahead of planned replacement
- Upgrading to more efficient light bulbs, typically changing to more efficient light bulbs
- Changing less energy efficient bulbs to LED lighting in appropriate areas
- Installing PIR lighting controls in areas such as staff rooms, toilets, connecting areas and warehouses so lighting is only on as necessary
- Installing doors / blinds on open fridges with doors, and avoiding using open fridge and freezer technologies

Some retailers had conducted site audits in order to identify some of these areas where they could save money and increase energy efficiency. Through this approach, specific issues with particular equipment types had been identified, resulting in support and encouragement for site managers to rectify them and if necessary a more widespread approach to the particular issue.

Challenges Specific to Large Chains

We experienced significant difficulties in engaging large retailers within the project, largely due to a lack of willingness to participate, particularly those engaged with the Retail Energy Forum. The main reason cited by large chains for reticence to participate was due to negative experience of participating in the Carbon Reduction Commitment (CRC) and the experience of engaging with a previous Carbon Trust led project, where little feedback was provided to the group in return for their efforts.

Other factors that hampered engagement include:

- **Delay in decisions to participate, because of gaining permission or other reasons**: Delays were encountered with a number of companies who stated that participation in a project of this type would require sign off from a number of individuals internally. These would typically be one or more of the company's board of directors, and waiting for board meetings

to take place meant progress was slow, with no guarantee of a positive outcome after directors had convened to discuss the project.

- **Policy and attitudes toward market research**: Some retailers operate blanket policies to not participate in market research of any kind, even when the significance of this particular project was explained and confirmation of the project was provided from DECC.

- **Internal time constraints**: Almost all respondents said that finding time to participate with the project would be difficult due to other internal commitments; there were instances where we were able to collect partial information via telephone but it was made clear to us that they wouldn't have the resource to complete a pro forma at all / within the timeframe of the project

- **Organisational structure and relevant individuals**: Some retailers that we contacted had more disparate head office structures than others; for example, one convenience store retailer explained that their stock was actually split and managed by several distinct companies, each having their own individual or team responsible for energy and as a result practices could vary across the whole estate. This meant we would typically need to engage with a number of people simply to collect information and made this information patchy, as no single person could provide the entire picture for the company. In addition, the organisations with the least complex head office structures actually struggled to even identify who we would need to speak to and even if someone existed in a relevant role.

Overall, large retailers did not view engagement with this project as a high priority, and those that did engage with the survey often missed deadlines for providing information (some by several months) due to other commitments.

Abatement Opportunities for Large Retailers (100+ Premises)

Overall, large retailers have proven to be much more conscious of the energy their stores are using, and thus the opportunities for abatement will be lower than with independent stores and smaller chains; large retailers have typically already taken significant and noticeable steps to limit their energy use and improve the behaviour of staff in their stores.

From qualitative discussions, the main interests in future abatement initiatives cited include:

- Refrigeration upgrades, several noting the action taken in France whereby a voluntary agreement has been implemented encouraging doors on cabinets across all stores[45]

- Improving lighting controls, incorporate motion or daylight sensors in relevant areas, in combination with timers in other areas

[45] Convention Efficacite Energetique: http://www.developpement-durable.gouv.fr/IMG/pdf/Convention_efficacite_energetique_120118_MEDDTL_Intermarche_meubles_frigorifiques.pdf

- Lighting changes - respondents were interested in opportunities to replace existing bulbs with more energy efficient ones, such as LED bulbs

- Using centralised refrigeration cooling technologies instead of individual compressors

- Further behavioural initiatives, such as training staff to not overfill fridges, and ensuring that ovens are used only when needed

A desire for building fabric improvements was also noted, but appeared to be less of a priority for retailers than energy using equipment on site.

As previously discussed, where not using or not using across the whole estate several of the retailers we spoke to are keen to explore the use of other tools to help reduce their energy:

- installation of sub-metering
- use of building management systems
- establishment of energy baselines for effective store energy budgets and targets

Improving Engagement with Large Retailers

As discussed above, engagement with large retailers was a time consuming process, with limited quantitative data being supplied within the timeframe of the project.

To secure greater engagement with large retailers in future based on our experiences and comments they made to us during the process it may be logical to explore certain incentives and changes to the data collection methodology.

Providing incentives or opportunities to engage with DECC on policy issues: Without DECC making engagement mandatory, the single biggest factor that respondents mentioned would affect their decision to engage was the offering of an incentive to supply data. Many said they didn't have the internal resource to engage and for those that did the project was low down on their priority list. Several retailers explained that they would be more inclined to engage and would provide information more readily if there was some benefit to themselves; for example technology subsidies or financial incentives.

Other respondents expressed an interest in developing a continued dialogue between DECC and their internal public affairs team to feed in at the early stages of policy making.

It has also been identified that with or without an incentive, more time needs to be allowed for engagement with large retailers - establishing what data they have and what they are willing to provide, providing more time for them to collate and submit information and give opportunity for review.

One approach that has proven to be successful in Australia involves engaging significant stakeholders within the sector to assist in the development of the approach for collecting data from particular activity groups (e.g. offices). The benefit of involving these organisations in the development of the approach is that they can then assist in endorsing the work and encouraging participation amongst their members. We recommend that DECC considers whether it would be

possible to engage relevant associations to invite them to be part of the steering group for collecting data from other segments of the non-domestic sector.

Engaging senior management: The large retailers may have been more willing to co-operate with this exercise if they believed the results would make a beneficial difference to policy making. Direct communication from DECC's Permanent Secretary or Minister to CEOs of the retailers may have helped encourage engagement. In the one case where DECC had a pre-existing relationship with a senior staff member in one of the retailers, we were more successful in gaining cooperation from the energy management team.

Approach to collecting hard data: Most retailers we conducted qualitative interviews with failed to follow up with the further information requested by completing the pro forma, and for the additional information we did receive there were large delays. Where respondent organisations have sub metering and better energy management systems in place they found it easier to extract, collate and supply additional data compared to those with no sub metering and less effective software. Larger chains were also more willing and able to supply data than smaller ones. We recommend a more tailored approach to capturing data based on the size of the large chain and how / where data is stored.

As a point of process, we recommend DECC could explore whether face-to-face interviewing allows large retailers to feel greater engagement with the project and a greater understanding of what information needs to be supplied subsequent to the interview.

Taking a bottom up approach, where central data is not available: Where it was not possible to collect real data from a central source, an alternative option to consider is to undertake surveys or audits at a sample of sites to understand energy use of stores considered to be 'typical' of a retailers store type and then grossing these up to the total stock. Permission from head office would almost certainly be required for this, but we found that in some cases this suggestion was less sensitive than providing data from their EMS, which some considered to be their 'crown jewels' in terms of data (which they were therefore unwilling to share).

Care would need to be taken here to ensure that the stores selected for the bottom up study were representative of the population. For example, where a retailer has a number of store types (e.g. 'metro' or 'local' stores as well as supermarkets), stores in each category would need to be included. Outputs from these reviews could subsequently be discussed with head office to sense check the outputs and whether the results are in the right ball park for the total stock.

Allowing time to respond: Some large retailers were contacted in March and agreed to participate with the project and we are still waiting for or have only recently received information, so we recommend a time window be allowed to engage and receive data alongside resources to chase up responses. The time requirement however is likely to be less important than providing a better reason to engage, such as opportunities to engage in policy influencing activities.

6 Summary of abatement opportunities considered

The following opportunities were considered when exploring abatement options. This list was submitted to DECC for approval. Comments received from DECC on the practicality of measures suggested and data availability were considered to assess feasibility. Most of these have been presented at the end of chapter 4.

Abatement Opportunity	Factors utilised	Feasibility
Capital replacement of refrigeration units 10+ years old	Upgrading to MTP best available technology scenario	Feasible; survey data provides the number of refrigeration units and their age profile. Presented.
Capital replacement of ovens 15+ years old	Upgrading to an energy star rated oven	Feasible; survey data provides the number of ovens and their age profile. However, type of oven (i.e. deck, conventional etc.) has not always been captured. This led to a number of ovens categorised as standard by default. Given the uncertainty behind oven type this abatement opportunity has not therefore been presented.
Upgrading halogen lighting to LED	Based on US Department of Energy factors for lumens provided by each lighting type	Feasible; survey data provides the proportion of all lighting that is halogen based. Presented.
Fit transparent doors to chilled cabinets without doors	Carbon Trust estimates a saving of 30% can be made through this action	Feasible; survey data provides and estimate of number of units with and without doors. Presented.
Fit night blinds/curtains to chilled cabinets	Carbon Trust estimates a saving of 6% can be made through	Feasible to apply however the generic factor may not be appropriate to apply as savings would be greatly affected by opening hours. This opportunity has not therefore been presented

Abatement Opportunity	Factors utilised	Feasibility
	this action	
Chiller/cold rooms repair to maintain air tightness and seal leaks. Applied to rooms 10+ years old	Carbon Trust estimates a saving of 12% can be made through this action	Feasible; survey provides the number chiller rooms and an estimate of the age profile for these items. Presented.
Boilers – insulate boilers and pipe work	Carbon Trust indicate this can return a 10% saving	Feasible, but considered to a be disruptive measure for those targeted. This opportunity has not therefore been presented as an example.
Fit transparent doors to chilled cabinets without doors	Carbon Trust estimates a saving of 30% can be made through this action	Feasible; survey data provides and estimate of number of units with and without doors. Presented.
Fit night blinds/curtains to chilled cabinets	Carbon Trust estimates a saving of 6% can be made through this action	Feasible to apply however the generic factor may not be appropriate to apply as savings would be greatly affected by opening hours. This opportunity has not therefore been presented as an example.
Boilers – insulate boilers and pipe work	Carbon Trust indicate this can return a 10% saving	Feasible, but considered to a be disruptive measure for those targeted. This opportunity has not therefore been presented as an example.
Turning air conditioning units down by 1	Based on the air conditioning manufacturer estimate of 5% savings associated with a	Feasible; survey data provides the number of air conditioning units. However, not possible to know whether a shop is ‘over-cooled’ (i.e. thermostats may be set low to offset heat producing appliances). Presented.

Abatement Opportunity	Factors utilised	Feasibility
	1 degree change	
Closing doors in shops with open door policies.	'Close the door campaign' suggests closing shops doors can cut heating energy by 50%.	Feasible; survey data provides number of heating appliances in premises with open door policies. However, heating does make a small proportion of total energy use (3%). Presented.
Correctly stock refrigeration units	Carbon Trust estimates a 5% saving can be made from not overstocking	Not feasible; survey did not capture the degree to which units were under or over stocked.
Capital replacement of refrigeration units 10+ years old	Upgrading to MTP best available technology scenario	Feasible; survey data provides the number of refrigeration units and their age profile.

Glossary

N-DEEM – the non-domestic energy and emissions (N-DEEM) model is a bottom-up model of energy use in the UK non-domestic building stock. This model is predominantly based on data collected in the 1990s and makes use of detailed energy use data, covering a range of different building types and national level data on the building stock. Prior to this project, it has been used as the primary tool for the assessment of abatement options in the non-domestic buildings sector.

NEED – the National Energy Efficiency Data Framework (NEED); a project set up by DECC to develop its understanding of energy use and the impact of energy efficiency measures. It brings together energy consumption data at property level and matches this with data relating to the profile of the property from Valuation Office Agency (VOA) data. In the case of the non-domestic component of NEED, data from Experian are also integrated within the framework to obtain further information relating to the business activity undertaken at the premises.

Standard Industrial Classification (SIC) codes – an industry recognised standard for the classification of business activities; see http://www.companieshouse.gov.uk/infoAndGuide/sic/sic2007.shtml

Thomson codes – codes used by the Thomson directory to describe business activity. These codes are different from those used in the SIC system of classification and in some areas, including retail, provide a more accurate reflection of the precise nature of activity being undertaken at an individual premises.

List of Annexes

Department of Energy & Climate Change
3 Whitehall Place
SW1A 2AW
www.decc.gov.uk
URN 13D/142