Department of Energy & Climate Change

National Energy Efficiency Data-Framework

Summary of Analysis using the National Energy Efficiency Data-Framework
Part I Domestic Energy Consumption

June 2013

Contents

1. Executive Summary

The National Energy Efficiency Data-Framework (NEED) was set up to provide a better understanding of energy use and energy efficiency in domestic and non-domestic buildings. This is the first of two NEED reports that will be published during 2013. The second report, Part II, summarising the impact of energy efficiency measures will be published in November 2013.

This report presents analysis of domestic gas and electricity consumption using data available in NEED. The report covers energy consumption in 2011 by property attributes, household characteristics, region and socio-demographic classifications. It also includes trends in energy consumption between 2005 and 2011. For the first time, information for Wales and consumption by number of adults in the property is also being published.

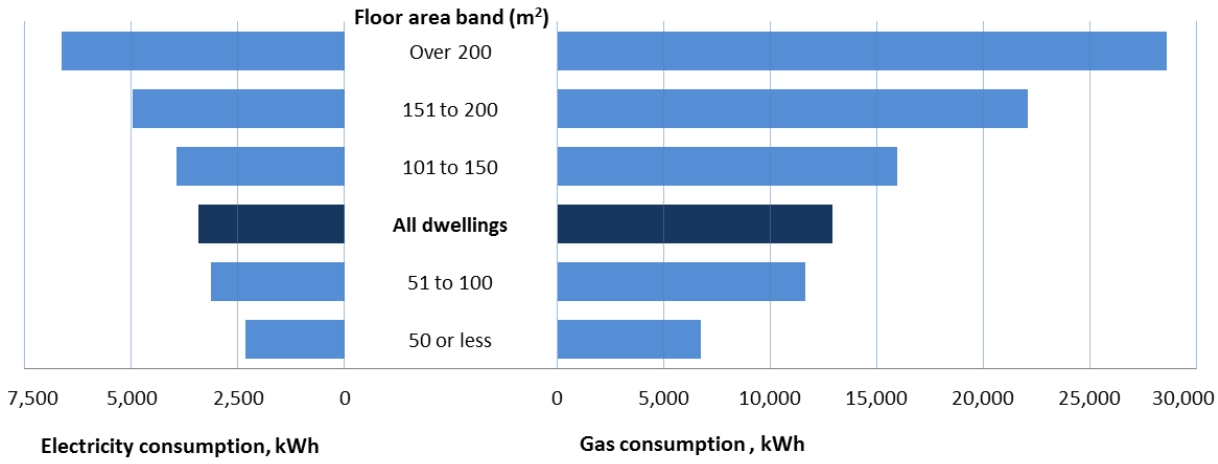
Results are based on a representative sample of data for England and Wales, with the exception of trends in consumption (Section 7) which covers only England between 2005 and 2010 and both England and Wales for 2011[1].

The relationship between energy use and any individual characteristic is complex, but there is a high correlation between certain characteristics and a household's energy use (for example, size of property or household income). This report provides insight into how each characteristic relates to energy use, but makes no attempt to control for other characteristics[2]. The results presented here are consistent with results for earlier years presented in previous reports.

Domestic energy consumption

Of the variables in NEED, property size has the greatest influence on households' gas and electricity consumption (see Figure 1.1), with a broadly linear relationship between fuel use and property size.

Figure 1.1: Median electricity and gas consumption in 2011, by floor area band, m^2

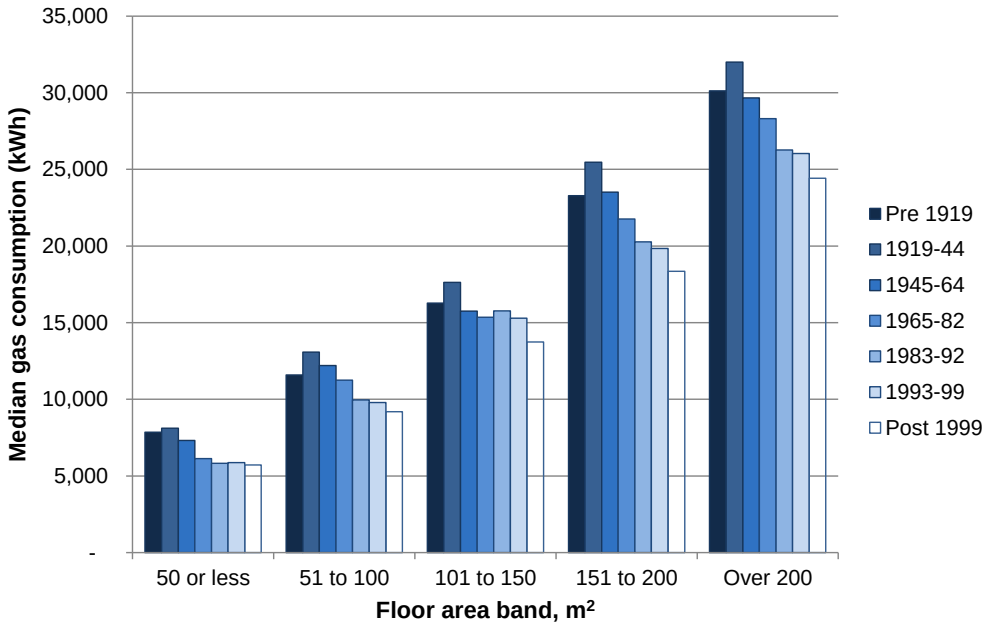


[1] Results for 2005 to 2011 presented in this report can be considered as a continuous trend. The sample used for England for 2005 to 2010 has very similar mean and median consumption values to the new sample for England and Wales used for 2011 analysis; the biggest difference in any year is less than 50 kWh. More information on the different samples is available in Annex B.

[2] This was explored in regression and econometric models of gas consumption presented in the November 2012 NEED report, Annexes E and F: https://www.gov.uk/government/publications/national-energy-efficiency-data-need-report-summary-of-analysis. Further work in this area is planned and will be published when available.

However, there is a significant amount of variation which is not explained by this single variable. Figure 1.2 shows the link between property age and consumption, once the effect of property size has been eliminated. The differences by property age reflect changes in construction methods and building regulations.

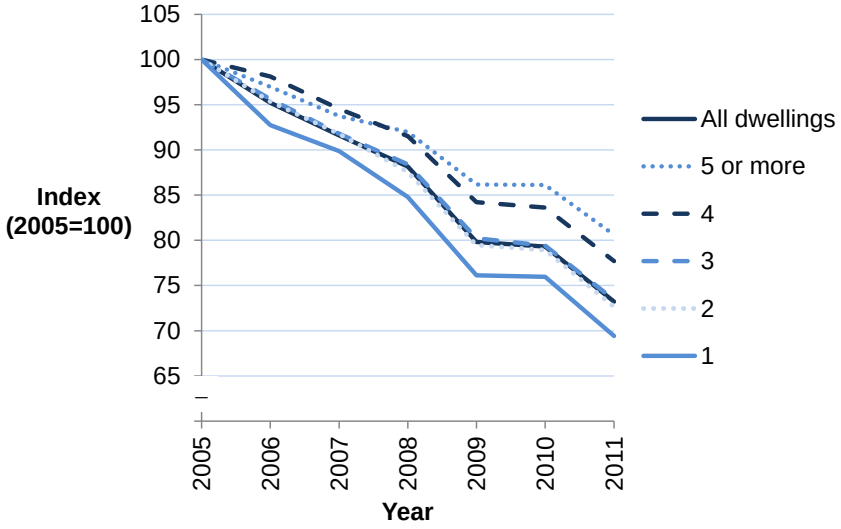
Figure 1.2: Median gas consumption in 2011, by floor area and property age



Trends in consumption

Median consumption has generally decreased over the period 2005 to 2011. While reductions have been seen for all property and household types, the scale of the reduction varies for different groups. This is demonstrated for properties grouped by number of bedrooms in Figure 1.3[3]. The median consumption for properties with fewer bedrooms showed a greater percentage decrease over the period than the median for properties with a higher number of bedrooms.

Figure 1.3: Change in median gas consumption by number of bedrooms, 2005 to 2011 (2005=100)



[3] The y axis for these charts does not start at zero in order to allow differences between groups to be seen more clearly.

The results from this work have provided important evidence to enable DECC and a range of other users to further develop its understanding of how energy is used in households. The results set out in this report along with models of gas consumption undertaken by and on behalf of DECC show that the majority of variation in gas consumption cannot be explained solely by variables available in NEED[4]. In addition, there is also variation resulting from differences in building construction, differences in performance of heating systems and appliances, and differences in the behaviours of the individuals within each household.

DECC will continue to work to understand more about these areas and expand the analysis undertaken using NEED; with results published as analysis is completed. The next publication will be Part II of this report in November 2013, summarising the impact of energy efficiency measures. Further work is also underway including, making data more accessible and producing an anonymised data set for wider use, and looking at the potential to produce meaningful analysis from NEED for the non-domestic sector.

[4] Regression and econometric models of gas consumption (presented in the November 2012 NEED report, Annexes E and F: https://www.gov.uk/government/publications/national-energy-efficiency-data-need-report-summary-of-analysis and DECC's local area gas model see the special feature 'Identifying local areas with higher than expected domestic gas use' in Energy Trends, March 2012 available at: http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-trends/4779-energy-trends-mar12.pdf) show that only approximately 30 to 40 per cent of the variation in gas consumption seen in different households can be explained using the variables available in NEED.

2. Introduction

The National Energy Efficiency Data-Framework (NEED) project was set up by DECC with support from the Energy Saving Trust (EST) and gas and electricity suppliers. Its purpose is to assist DECC in its business plan priority to "save energy with the Green Deal and support vulnerable consumers".

It is a key element of DECC's evidence base supporting DECC to:

- develop, monitor and evaluate key policies (including the Green Deal);
- identify energy efficiency potential which sits outside the current policy framework;
- develop a greater understanding of the drivers of energy consumption; and
- gain a deeper understanding of the impacts of energy efficiency measures for households and businesses.

The data framework provides the largest source of data available for analysis of consumption and the impacts of energy efficiency measures. The first results, published in June 2011, covered England and were a pilot to test that the framework approach worked. In November 2012, the results were updated and expanded to include results at local authority level as well as tables for gas and electricity consumption by multiple property attributes.

This report provides results which have been produced as part of a longer term plan to make best use of the potential of NEED. Results covered in this report are helping DECC reduce its dependence on survey data and small monitoring trials. It provides estimates based on observed energy use which can be used to help validate and improve theoretical estimates.

This report is the first of two NEED reports that will be published in 2013. It covers energy consumption for 2011, and for the first time includes information for Wales and consumption by number of adults in the property. A second report, covering the impact of energy efficiency measures installed in 2010 will be published in November, once final installations of measures through the Carbon Emissions Reduction Target (CERT) and the Community Energy Savings Programme (CESP) are available in NEED.

The report covers:

- Section 3: Headline consumption;
- Section 4: Energy consumption by property attributes;
- Section 5: Energy consumption by household characteristics;
- Section 6: Energy consumption by geography and area classification; and
- Section 7: Trends in domestic consumption.

Key findings and highlights are provided in this report, more detailed information on what NEED is (Annex A), the quality of the data used in the analysis (Annex B), as well as detailed data tables including more breakdowns and distributions (see Annex C for a list of all published tables) are available here: https://www.gov.uk/government /publications/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2013-part-1.

For any queries or feedback on this publication please email: EnergyEfficiency.Stats@decc.gsi.gov.uk.

The rest of this section provides a brief overview of how NEED was developed, the data it contains and how the dataset used for the analysis presented in this report was created. For a more detailed explanation see Annex A.

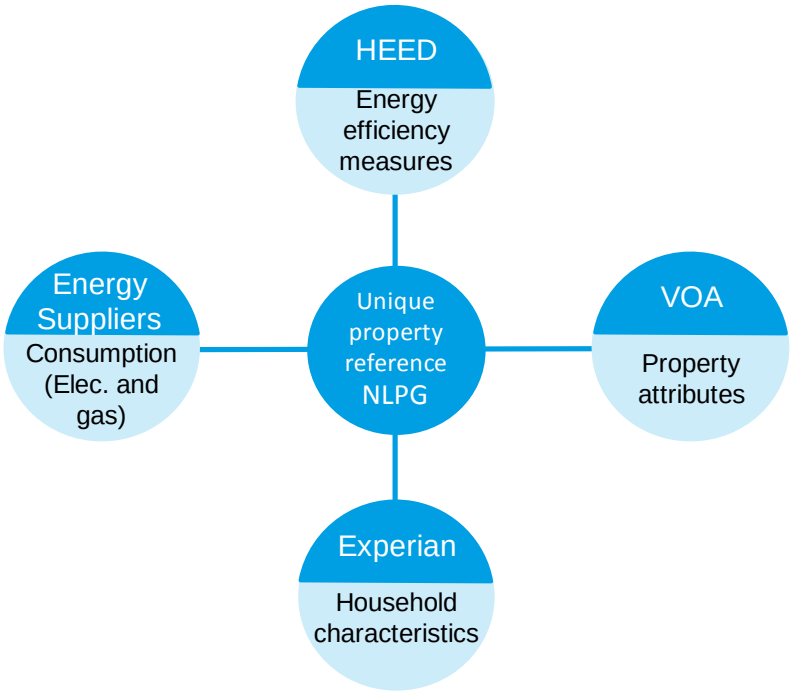
2.1 Development of the Framework

NEED is a framework for combining data from existing sources (administrative and commercial) to provide insights into how energy is used and what the impact of energy efficiency measures are on gas and electricity consumption, for different types of properties and households.

Overview

At the core of NEED is the National Land and Property Gazetteer (NLPG), the national standard for all buildings and addresses in England and Wales[5]. Datasets are combined within the framework using the NLPG unique property reference number (UPRN) as a spine. Address data from each of the datasets included in NEED are used to assign a UPRN to each record within that dataset. The UPRN is then used to link records from one dataset to the corresponding record in each of the other datasets. The diagram below (Figure 2.1) shows how this works for the core data used for domestic analysis, while Table 2.1 shows the scope of data in NEED. The principle is the same for both the domestic and non-domestic sectors, though different data are used.

Figure 2.1: Structure of domestic NEED



[5] The One Scotland Gazetteer is the equivalent in Scotland.

Table 2.1: Scope of NEED

In Scope	Out of Scope
Domestic and non-domestic properties	Very large consumers e.g. power stations
Great Britain[6]	Northern Ireland
Metered gas and electricity	Non-metered fuels e.g. oil, coal
Energy Efficiency Measures in HEED	DIY measures and others not recorded on HEED

While data in NEED cover the domestic and non-domestic sectors across the whole of Great Britain, the analysis presented in this report relates to domestic properties in England and Wales and the households occupying these properties (domestic NEED). The rest of this section provides further information on the data in domestic NEED.

2.2 Data in NEED

Data in NEED are gathered from a variety of sources including publically available data and data through commercial licences, voluntary agreements and service level agreements with dataset owners. Three key data sources have been used for the analysis of domestic consumption in this report: meter point gas and electricity consumption data; Valuation Office Agency (VOA) property attribute data; and Experian modelled data on household characteristics[7]. A brief description of each of these sources is provided below.

Gas and electricity consumption data

Gas and electricity meter consumption data used in NEED are provided by suppliers and cover 2004 to 2011. These data are provided in order to allow DECC to publish consumption data for small geographic areas[8]. Data are obtained from the billing information held on existing administrative systems of the energy companies. Data are annual with gas data covering the period from 1 October to 30 September and electricity data covering the year up to the end of January. The gas data are weather corrected. This should remove some of the variation between years which occurs due to cooler or warmer weather.

Although these are the same raw data used to produce DECC's published sub-national estimates of consumption, there are differences in the way they are analysed. NEED is based on a sample of properties in England and Wales and employs a different approach for cleansing and validating the data. The differences in the approaches are summarised in Table 2.2 below.

[6] Only England and Wales are included within the scope of analysis of the domestic sector in this report though data for all of Great Britain are available for a number of variables.

[7] Domestic NEED also makes use of information on energy efficiency measures from the Homes Energy Efficiency Database (HEED). HEED is used to provide information on energy efficiency measures installed in homes in order to understand the impact of installing these measures. It has not been used for the results presented in this report.

[8] More detailed information about how these data are collected and compiled for DECC's sub-national publication is available on the DECC website: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/175431/Sub-national_methodology_and_guidance_booklet.pdf.

Table 2.2: Differences in consumption data

NEED data	DECC's sub-national consumption estimates
• The property must be included as a domestic property on the Valuation Office Agency property attribute dataset to be included in domestic NEED analysis.	• Domestic properties classified based on consumption for gas (less than 73,200 kWh) and profile class for electricity (profiles 1 and 2 are domestic).
• Gas consumption between 100 kWh and 50,000 kWh.	• Gas consumption below 73,200 kWh.
• Electricity consumption between 100 kWh and 25,000 kWh.	• Electricity consumption below 100,000 kWh and profile class 1 or 2[9].
• Data matched to other sources via the NLPG UPRN at property level.	• Data assigned to Lower Level Super Output Area[10].
• Suspected estimated readings removed.	

These differences result in small differences in the mean consumption reported in the two sources. Additional information on the rationale for and impact of these differences, as well as further information on the quality of the data used in this analysis are included in Annex B.

Valuations Office Agency (VOA)

The VOA is responsible for allocating homes in England and Wales to the appropriate Council Tax band. In order to do this it maintains a property database covering all properties in England and Wales. It includes information on the age of dwelling, dwelling type, number of bedrooms and floor area. DECC does not have information on a property's council tax band.

Experian

Experian is a commercial organisation which produces modelled data for household characteristics at address level. Variables include income band, tenure and number of adults in the household. DECC leases these data for all domestic properties in the UK.

2.3 Creating the analytical dataset

In order to help increase processing speed, reduce cost and ensure that DECC is not processing more data than necessary, it was decided that a sample would be used for analysis. A random sample of approximately 3.7 million records was selected from the VOA data. To ensure the sample was representative of properties in England and Wales, the sample was stratified by local authority, number of bedrooms, property type and property age.

[9] Electricity consumption of between 50,000 and 100,000 kWh is reviewed and if it has a likely non-domestic address then it is also excluded from the sub-national domestic estimates.

[10] This means that for the sub-national consumption statistics some properties can be assigned accurately if the street is identified even if the exact property is not known.

Data matching statistics

Table 2.3 shows the match rates for England and Wales for each of the datasets used in this report. The match rates set out in the table are calculated based on the number of records for each relevant source, not the number of properties in England and Wales. For example, not all properties have a gas meter; the match rate shows how many of the properties with a gas meter could be matched to the National Land and Property Gazetteer (NLPG), not the number of properties on the NLPG which could be assigned a gas meter. Further information on the quality of data is available in Annex B.

Table 2.3: Matching statistics at building level (sub-building[11] match rates in brackets)

Data source	Match rate[12]
Electricity consumption	94% (87%)
Gas consumption	97% (93%)
Experian	94%
VOA property attribute data	100%

[11] A sub-building is a separate property within the same building, such as unit within a large shopping centre, or flat within a block of flats.

[12] Note that the match rates quoted for electricity and gas consumption include domestic and non-domestic properties. The match rate for VOA data is 100 per cent as only VOA records that could be matched to the NLPG were included.

3. Headline Consumption

All consumption figures presented in this report are based on valid domestic gas and electricity consumption[13] for properties in the NEED sample and are rounded to the nearest 100 kWh. All gas consumption data are presented on a weather corrected basis, this means that the consumption for each household has been adjusted to account for differences in temperature and wind in different years. This allows for a more consistent comparison of gas consumption over time, though the correction factor may not be fully mitigating the impact of extreme temperatures in any single year.

In 2011, the median[14] gas consumption was 12,900 kWh with median electricity consumption 3,400 kWh. However, within the distribution, there is a range of consumption. This is evident from the lower and upper quartiles[15] shown in Table 3.1. The table also shows that, mean consumption is larger than median consumption, by nine per cent for gas and 21 per cent for electricity[16].

Table 3.1: Annual consumption summary statistics, 2011, kWh

	Mean	Standard deviation	Lower quartile	Median	Upper quartile
Gas	14,100	7,800	8,800	12,900	18,000
Electricity	4,200	3,000	2,200	3,400	5,200

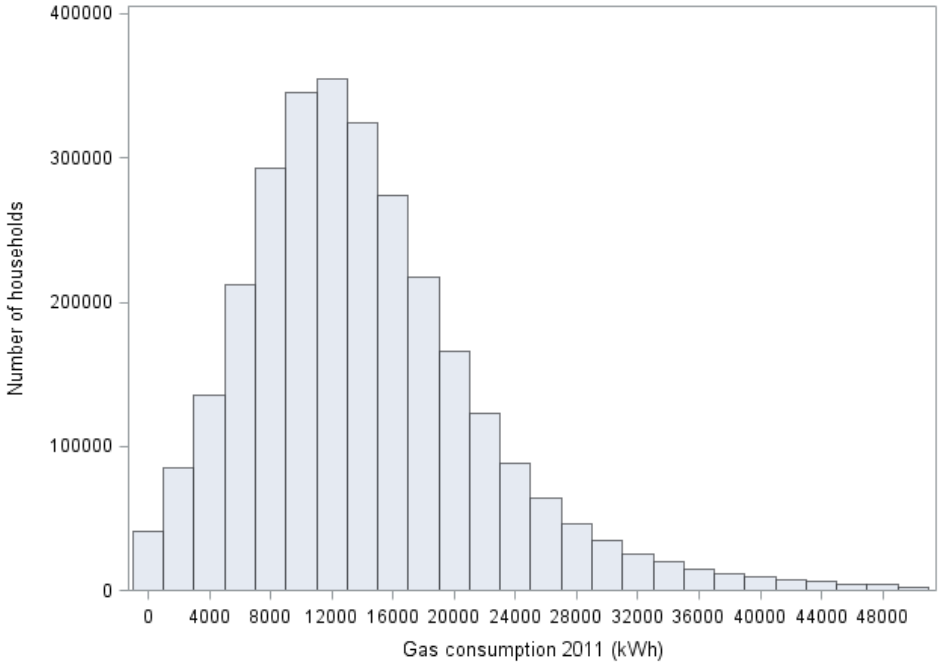
The table also shows that there is more variation in electricity consumption than gas consumption. The standard deviation is 55 per cent of the mean for gas and 73 per cent for electricity. This larger variability is likely to be due to the wider range of uses of electricity, including the variation between households that use electricity as the main heating fuel and those that do not as well as the use of electricity for secondary heating.

The distribution of gas and electricity consumption in 2011 is shown in more detail in Figure 3.1. The figure shows that the distribution is skewed towards lower consumption values for both gas and electricity, but that the skew is more pronounced for electricity.

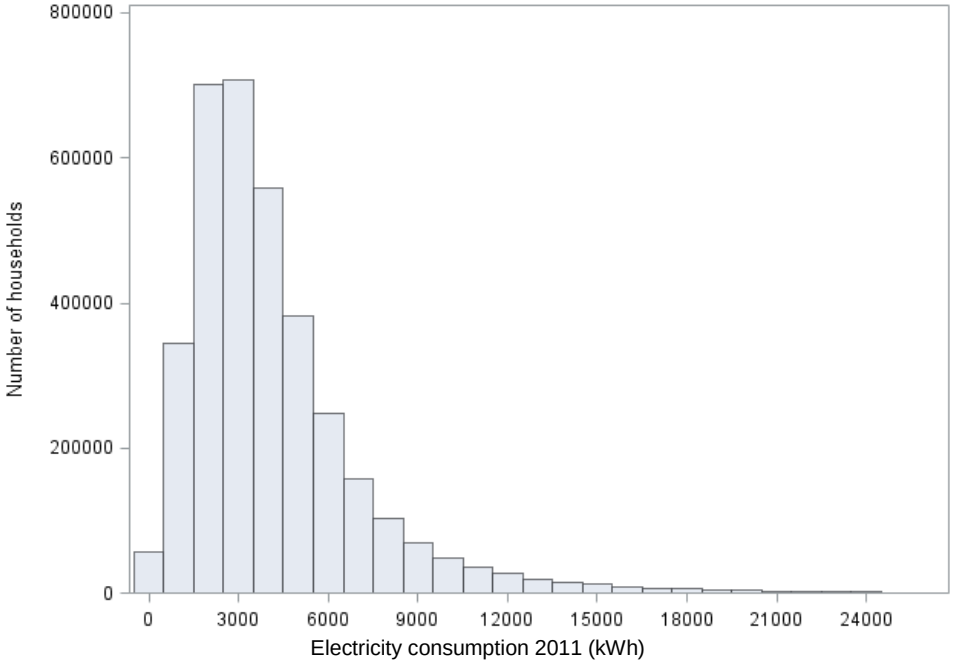
[13] Valid domestic gas consumption is taken to be values between 100kWh and 50,000 kWh. Domestic electricity consumption is considered valid in NEED if it is between 100 kWh and 25,000 kWh. Values which are suspected to be estimated readings are also excluded.
[14] The median is the middle value in the distribution, i.e. the consumption value where half of households have lower consumption and half have a higher one.
[15] Quartiles (including the median) divide the consumption values into four parts containing the same number of households. The lower quartile is the consumption value where 25 per cent of households have lower consumption and 75 per cent have a higher one. The upper quartile is the consumption value where 25 per cent of households have higher consumption and 75 per cent have a lower one.
[16] There are a relatively small number of higher consumers which are skewing the mean to make it higher than the median.

Figure 3.1: Distribution of consumption 2011

(a) Gas consumption



(b) Electricity consumption

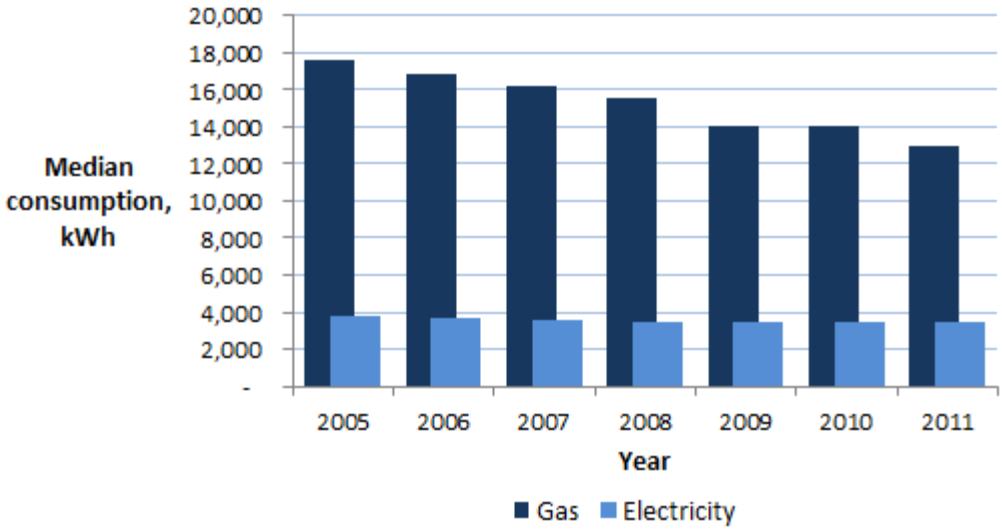


In the rest of this report, median consumption has been used to represent typical consumption. It is a more appropriate measure of typical consumption than the mean because the mean can be influenced by a relatively small number of high consuming households that are not typical of the rest of the population. Table 3.2 and Figure 3.2 show the median annual consumption for gas and electricity from 2005 to 2011. The gas data are weather corrected while the electricity data are not.

Table 3.2: Median gas and electricity consumption 2005 to 2011, kWh[17]

	2005	2006	2007	2008	2009	2010	2011
Gas	17,700	16,800	16,200	15,600	14,100	14,000	12,900
Electricity	3,800	3,700	3,600	3,500	3,400	3,500	3,400

Figure 3.2: Median gas and electricity consumption 2005 to 2011, kWh



The table and figure show that median gas and electricity consumption has been generally declining over the period. Median gas consumption reduced by just over a quarter (27 per cent) between 2005 and 2011. The largest drop was between 2008 and 2009, with a decrease in median annual consumption of nine per cent. Median electricity consumption decreased by nine per cent over the period 2005 to 2011. The reduction in consumption over time may be a result of a number of factors, for example; energy efficiency improvements in households[18], such as new boilers, insulation and more energy efficient appliances; higher bills and the recession; or changes in the building stock and household composition.

Detailed analysis on consumption by property and household characteristics is covered in sections 4 to 6. Historic trends in consumption by these characteristics are covered in section 7. More detailed results including distributional analysis of consumption are available in the supplementary data tables at: https://www.gov.uk/government/publications/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2013-part-1.

[17] Results for 2005 to 2011 presented in this report can be considered as a continuous trend. The sample used for England for 2005 to 2010 has very similar mean and median consumption values to the new sample for England and Wales used for 2011 analysis; the biggest difference in any year is less than 50 kWh. Trends in household income and number of adults are based on the new sample for all years. More information on the different samples is available in Annex B.

[18] The energy efficiency of the housing stock improved between 2005 and 2011, the average SAP rating of a dwelling increased by 7.7 points from 49.0 to 56.7. The SAP rating is a measure of the overall energy efficiency of the dwelling. Table 13: English Housing Survey Headline Report 2011-12: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/88370/EHS_Headline_Report_2011-2012.pdf.

4. Property Attributes

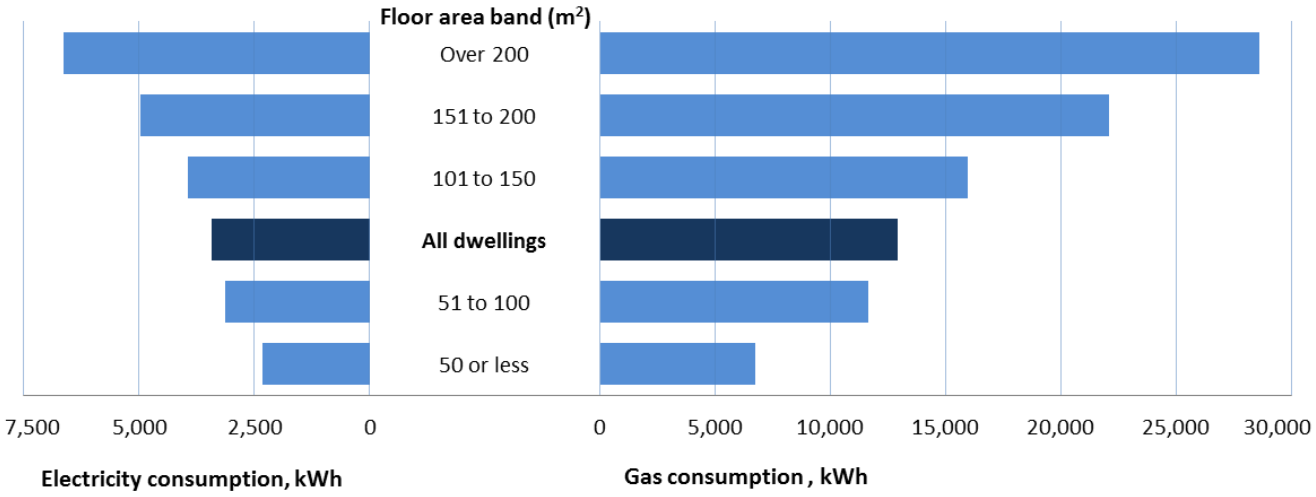
This section presents summary consumption statistics for 2011 by property attributes, covering; floor area, number of bedrooms, property type and property age. Property information analysed in this section is from the Valuation Office Agency (VOA) property attribute database.

The figures presented are observed figures and therefore reflect what is actually happening in households rather than theoretical consumption derived from physics based models. The differences in estimates derived from these two approaches can occur for a number of reasons, including differences in construction and performance of heating systems and appliances, and differences in how individuals use heating and other energy.

4.1 Floor area

The average useable floor area for properties in England is 91 square meters[19]. Around half of the properties in the NEED sample have a floor area between 51 and 100 square metres and about one third have a floor area between 101 and 200 square meters. Only three per cent have a floor area greater than 200 square metres. Figure 4.1 shows median gas and electricity consumption by floor area band[20,21].

Figure 4.1: Median electricity and gas consumption 2011, by floor area band, m^2



The figure shows that typical consumption for both gas and electricity is higher for properties with a greater floor area. For example, for gas consumption, the smallest properties (50 square meters or less) had median gas consumption about half the typical consumption for all properties in England and Wales. The largest properties on the other hand (with floor area

[19] Source: English Housing Survey Headline Report 2011-12: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/88370/EHS_Headline_Report_2011-2012.pdf.

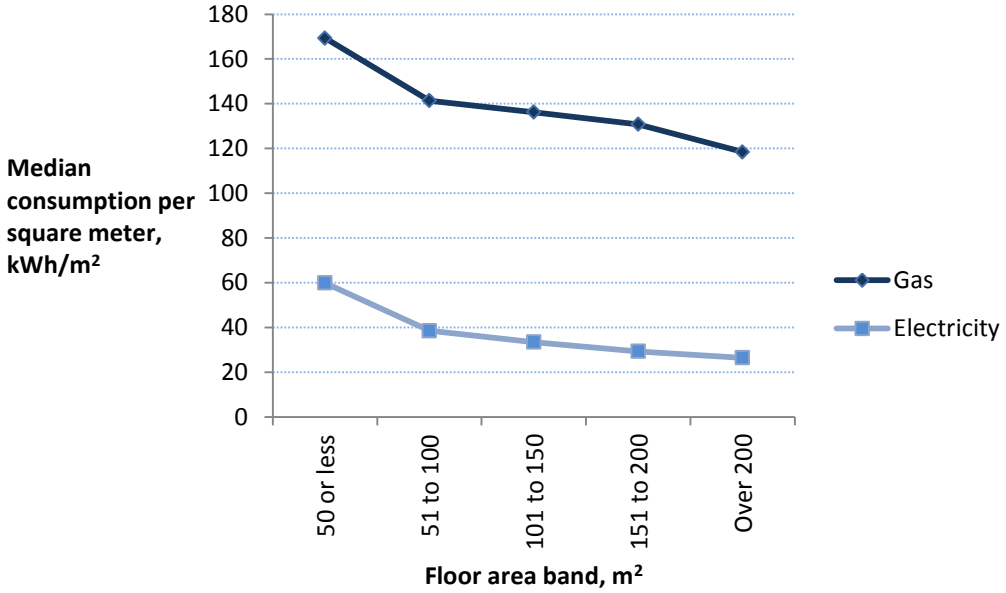
[20] Different scales are used for gas and electricity consumption in this and following charts in order to show the pattern in electricity consumption more clearly; electricity consumption is typically a lot lower than gas consumption (in kWh).

[21] The floor area variable available from VOA is defined differently for houses and flats. For houses the "Reduced Covered Area" is used while the "Effective Floor Area" is measured for flats. The floor area being captured for houses is measured externally and is effectively the building's footprint. For flats, it is the internal floor area excluding some internal spaces such as bathrooms/showers and WCs which are not excluded for houses.

greater than 200 square meters), had median gas consumption over twice the typical consumption for all properties.

The increased consumption for larger homes reflects the fact that in general, more energy is required to heat a larger property and that they are likely to have more appliances and occupants. However the consumption per square meter reduces for larger properties, for both gas and electricity. Figure 4.2 shows the median consumption per square meter of floor area for each floor area band.

Figure 4.2: Median gas and electricity consumption 2011 per square meter, by floor area band



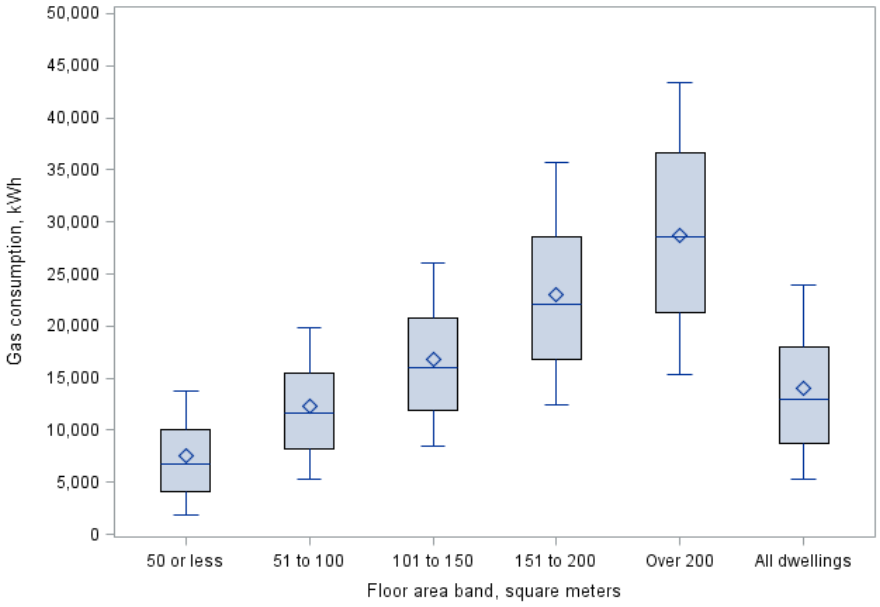
The figure shows that in general, the median consumption per square meter decreases as the size of the property increases. For both gas and electricity, the smallest properties with floor area of 50 square meters or less, have the highest consumption per square meter. The largest properties on the other hand have the lowest energy use per square meter. This suggests there is a minimum energy requirement, for example for refrigeration, cooking or heating main living areas, that does not depend on the size of the property. It is the consumption over and above this minimum that is more closely linked to the size of the property.

The range of consumption also varies more as the floor area increases. This is shown in the box plots[22] below (Figure 4.3). Properties with higher median gas consumption have a greater range in consumption. The range between the lower and upper quartiles for the group with the smallest floor area (50 or less) is 5,900 kWh while for the top group (over 200 square meters) it is 15,300 kWh. However, as a percentage of the median, the distribution is actually smaller for the group of households with the biggest floor area, the lower quartile is 75 per cent of the median and the upper quartile is 28 per cent above the median, while for the smallest properties these values are 60 and 48 respectively.

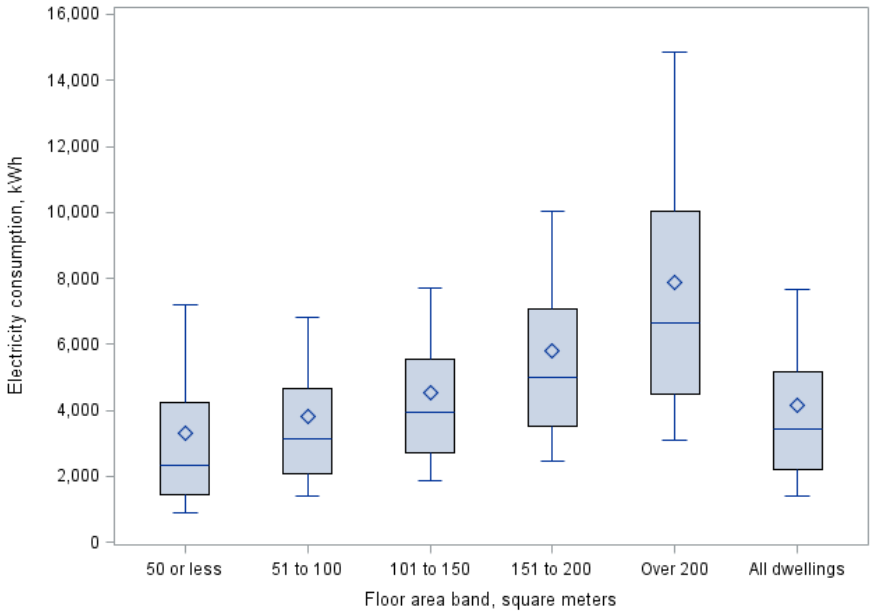
[22] Box plots aid in visualising the range and distribution of energy consumption in households. Consumption values are first arranged in increasing order of magnitude and then divided into four equal groups by 'quartiles'. The bottom of the box represents the lower quartile and the top of the box the upper quartile. The blue horizontal line within the box is the median. The diamond shape within the box represents the mean consumption. The lines extending from the bottom of each box show the range from the lower quartile to the 10th percentile. The lines extending from the top of each box show the range from the upper quartile to the 90th percentile.

Figure 4.3: Distribution of consumption in 2011, by floor area band, m^2

(a) Gas consumption



(b) Electricity consumption



The plots also show that a relatively small proportion of higher consuming households are influencing the distribution of consumption. This is demonstrated by the fact that the mean is higher than the median and the range between the upper quartile and median is larger than the range between the lower quartile and median. The effect is more pronounced for electricity than gas, and is likely to be due to the wider range of uses of electricity, including the variation between households that use electricity as the main heating fuel and those that do not, as well as the use of electricity for secondary heating and variation in the number of appliances households use.

4.2 Number of bedrooms

The number of bedrooms is also available in NEED[23]. This can also act as an indicator of property size, as there is a strong correlation between the number of bedrooms in a property and the floor area of the property.

About half of the properties (48 per cent) in the sample have three bedrooms. Median consumption for these properties was 13,700 kWh for gas and 3,600 kWh for electricity. This was only slightly higher than the median consumption for all properties in England and Wales (about 5 per cent for electricity and 6 per cent for gas) reflecting the fact that three bedroom houses make up the largest group of properties, with two bedroom houses being the next most common. Figure 4.4 shows the typical consumption by number of bedrooms. The pattern is similar to that demonstrated by floor area due to the high correlation between these two variables.

Figure 4.4: Median electricity and gas consumption 2011, by number of bedrooms

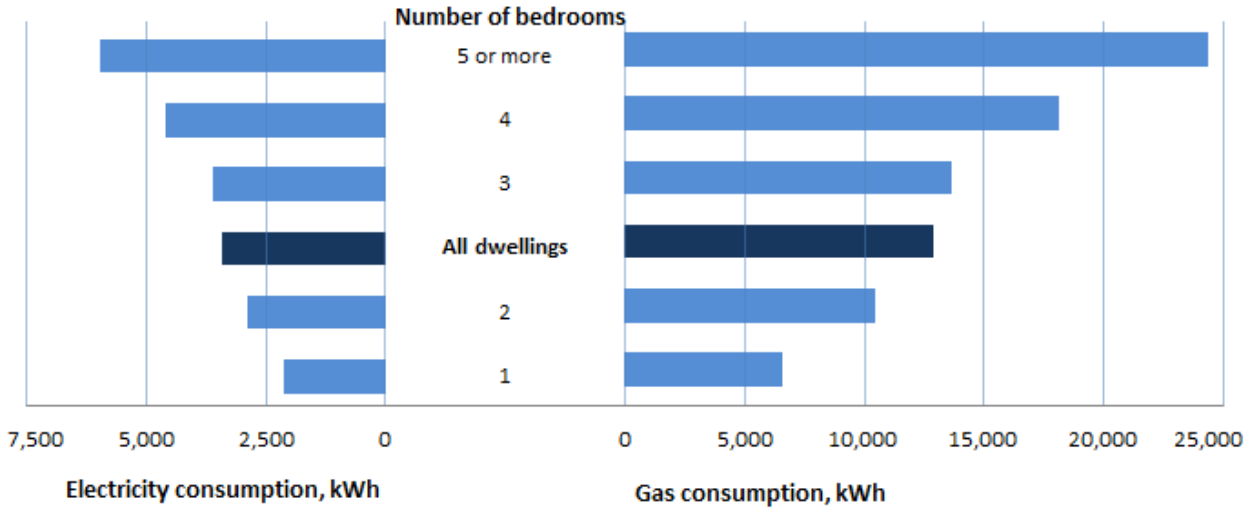
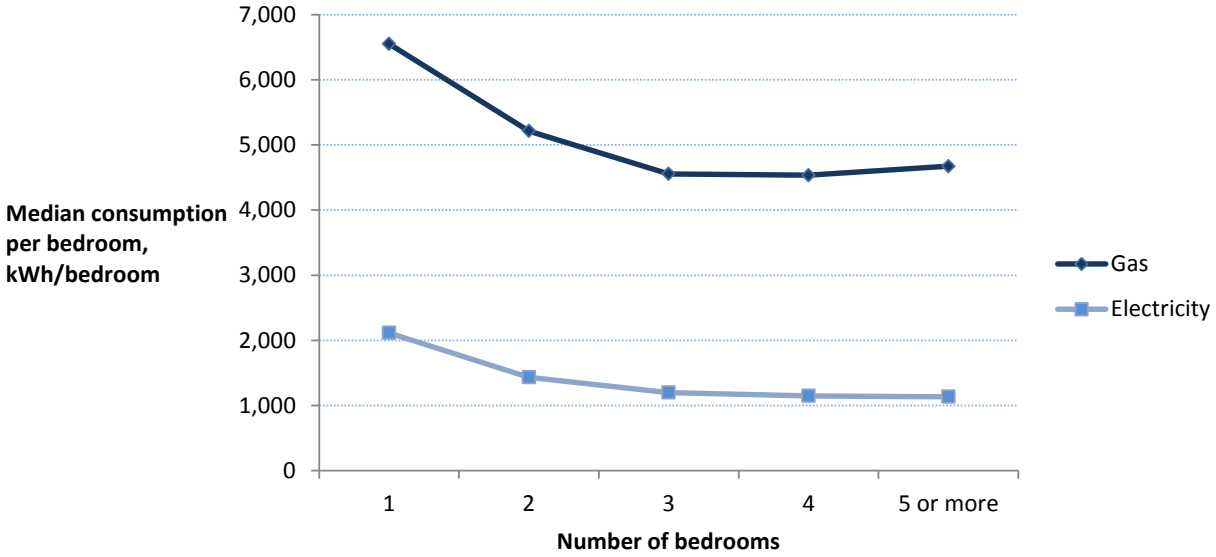


Figure 4.5 shows the median gas and electricity consumption per bedroom by number of bedrooms. It shows that the consumption per bedroom decreases between one and two bedrooms, but for three bedrooms or more, the consumption per bedroom remains fairly constant.

[23] The number of bedrooms includes rooms built as bedrooms even if they are not currently used as bedrooms, but excludes rooms incapable of comfortably holding a single bed.

Figure 4.5 Median gas and electricity consumption 2011 per bedroom, by number of bedrooms



From the results for consumption by floor area and number of bedrooms, it is clear larger properties typically have higher consumption. The typical consumption by other property attributes is set out in the remaining part of this section.

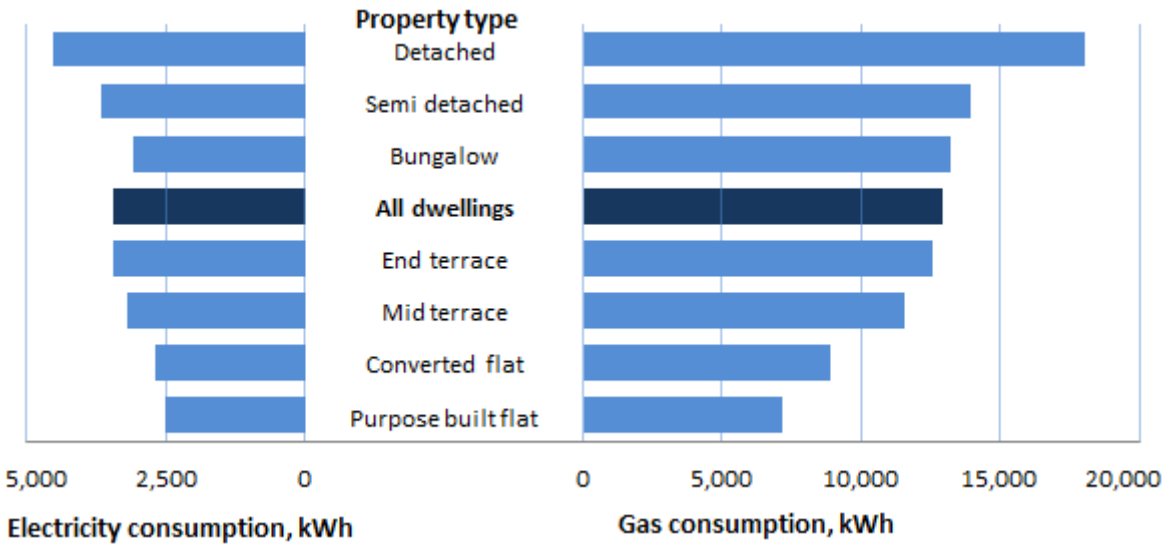
Unless stated, the results in the rest of this report do not control for the size of property. This means that where there are correlations between property size and other categories (which in many cases there are, such as property type) the size of property will be a factor in the observed typical consumption. For example, detached properties are generally larger than terraced properties. Previous work has been carried out on behalf of DECC to produce models of consumption which attempt to consider the influence of a number of factors on gas consumption[24]. The work shows that, of all the variables considered, property size has the greatest influence on gas consumption, but it only explains some of the observed differences. Other physical attributes and household characteristics (as set out in the rest of this report) help explain variation but there remains a significant amount of variation which has not been explained. This is a result of different physical attributes of properties and behaviours of occupants which cannot be measured using data in NEED.

4.3 Property type

About a quarter of the properties in the sample are semi-detached houses, a fifth are mid terrace and a further fifth are flats (converted or purpose built). Figure 4.6 shows median gas and electricity consumption for different property types.

[24] This work is available in annexes E and F of the November 2012 NEED report at https://www.gov.uk/government/publications/national-energy-efficiency-data-need-report-summary-of-analysis.

Figure 4.6: Median gas and electricity consumption 2011, by property type



Depending on the type of dwelling, median gas consumption ranges from 7,100 kWh to 18,000 kWh for gas and 2,500 KWh to 4,500 kWh for electricity. Detached properties have the highest typical gas and electricity consumption. They have typical consumption of about two and a half times more gas and 1.8 times more electricity than typical for purpose built flats, the group with the lowest typical consumption.

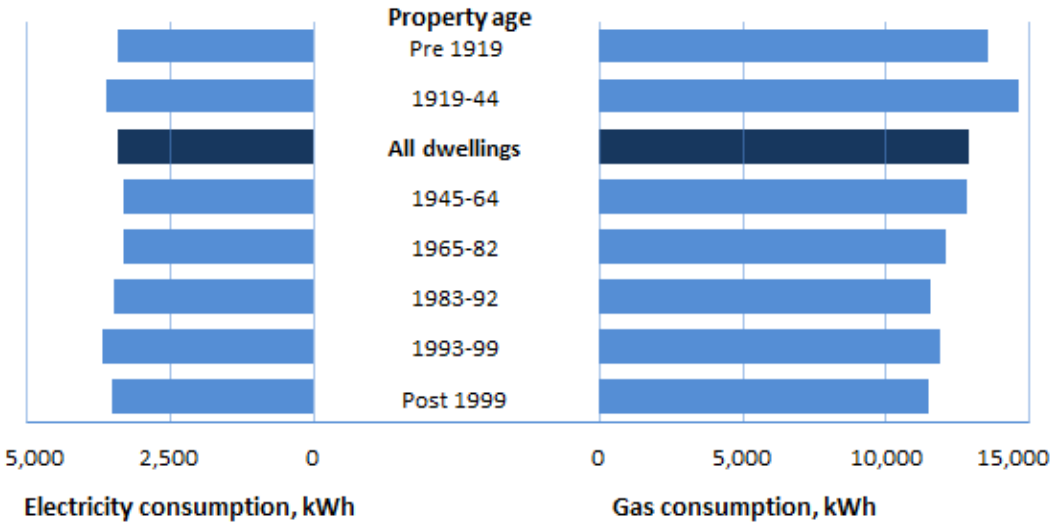
The figure also shows that in general, the pattern for median electricity consumption is similar to that for gas consumption, with one main exception. Median electricity consumption for bungalows is significantly lower than the median for all dwellings (11 per cent) but median gas consumption for bungalows is slightly higher than the median for all dwellings (by two per cent).

4.4 Property age

Approximately two in five properties in the NEED sample were built prior to the end of World War Two (pre-1945). A similar number were built in the 40 years following the end of the war (1945 to 1982) and approximately one in five houses have been built since the start of 1983. Figure 4.7 shows how typical gas and electricity consumption varies for different property age bands.

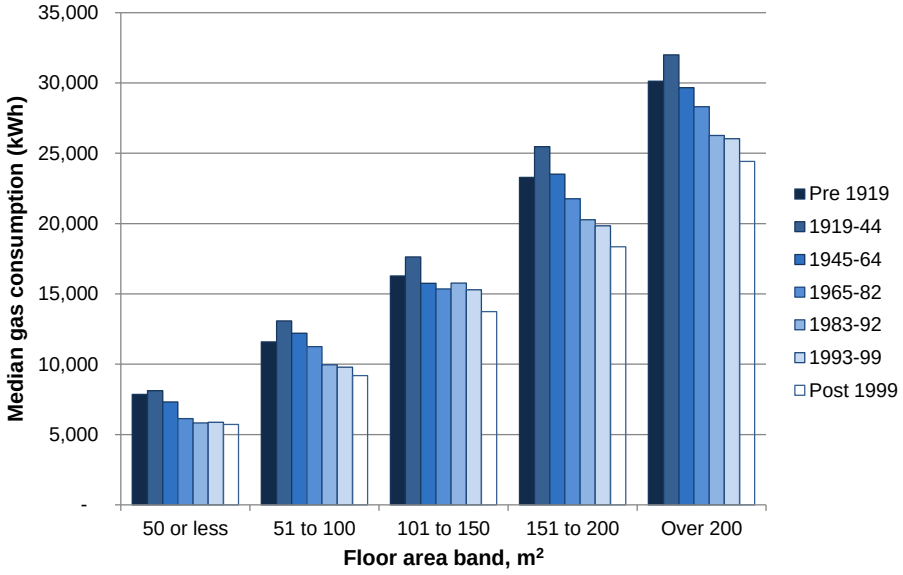
In general, older properties have higher typical gas consumption than newer ones. However, the relationship is not clear cut and the differences are smaller than those seen for other attributes.

Figure 4.7: Median electricity and gas consumption 2011, by property age



The general reduction in gas consumption seen in newer properties is likely to be due to the minimum performance standards regarding energy efficiency, which have become more stringent over time. For example, when the older (prior to 1962) properties were built there were no minimum energy efficiency standards requirements. Properties built in 1985 would have some requirements (typically needing 100mm of loft insulation and 40mm of cavity wall insulation to meet the requirements) and more recently built properties would have stronger requirements (properties built in 2006 typically needed 270mm of loft insulation, 150mm of cavity wall insulation and a minimum of a B-rated boiler)[25]. However, median gas consumption in properties built between 1993 and 1999 appears to be an exception to this trend. This is a result of the difference in the composition of the housing stock built during this period; the average floor area for properties built between 1993 and 1999 was higher than in the preceding period. Figure 4.8 shows median consumption by property age for each floor area band.

Figure 4.8: Median gas consumption in 2011, by floor area and by property age

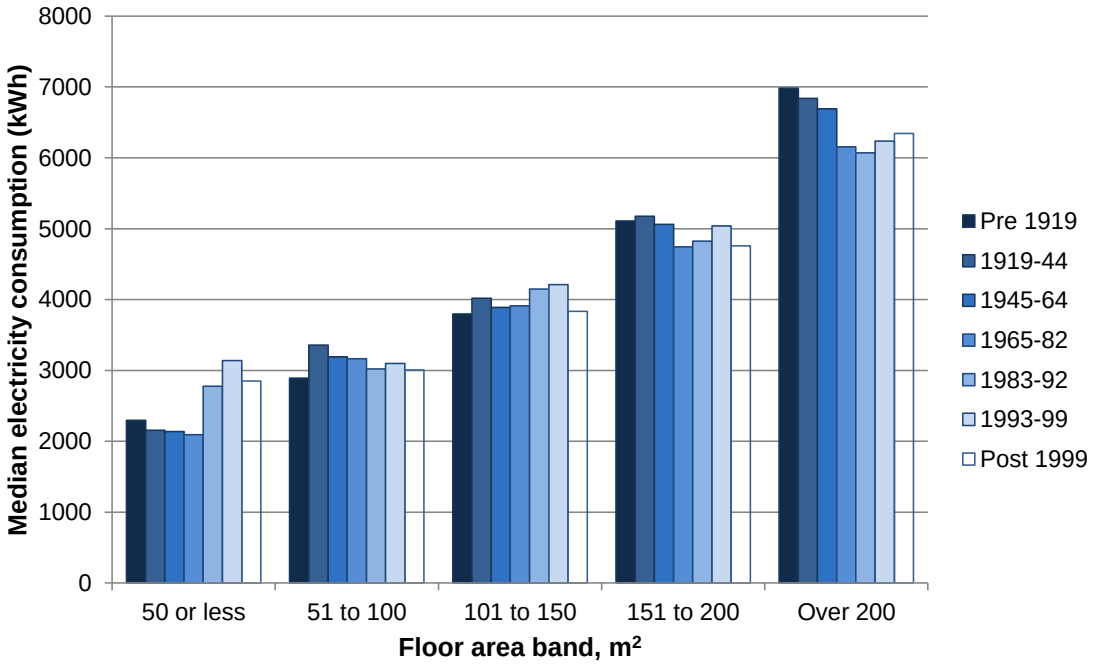


[25] Part L of the Building Regulations is a performance based requirement based on u-values (coefficient of thermal transmittance) rather than specific measures. The information above is indicative of how constructors would meet the requirements; see Annex G of November 2012 NEED report: https://www.gov.uk/government/publications/national-energy-efficiency-data-need-report-summary-of-analysis.

The figure shows that, within each floor area band, the median gas consumption for properties built between 1993 and 1999 is lower than or similar to median consumption for properties built between 1983 and 1992.

From Figure 4.9, the relationship between property age and median electricity consumption is not so clear. For example, the group with the highest median electricity consumption appears to be in relatively new properties built between 1993 and 1999. However, the median consumption for this group is only two per cent higher than that of older properties, built between 1919 and 1944. For all the remaining groups of properties median electricity consumption is within four per cent of the median for all properties. It is likely therefore that other factors are having a more significant impact on electricity consumption. Figure 4.9 shows median electricity consumption by property age for each floor area band.

Figure 4.9: Median electricity consumption in 2011, by floor area and by property age



Unlike median gas consumption, the link between electricity consumption and property age does not become any clearer when floor area is taken into account. Electricity consumption increases as property size increases, but the lack of a clear link with other physical attributes demonstrates that - unlike gas - electricity consumption is more closely linked to the behaviour and types of occupants rather than the physical attributes of a property. Section 5 provides more information on typical gas and electricity consumption for different types of occupants.

5. Household Characteristics

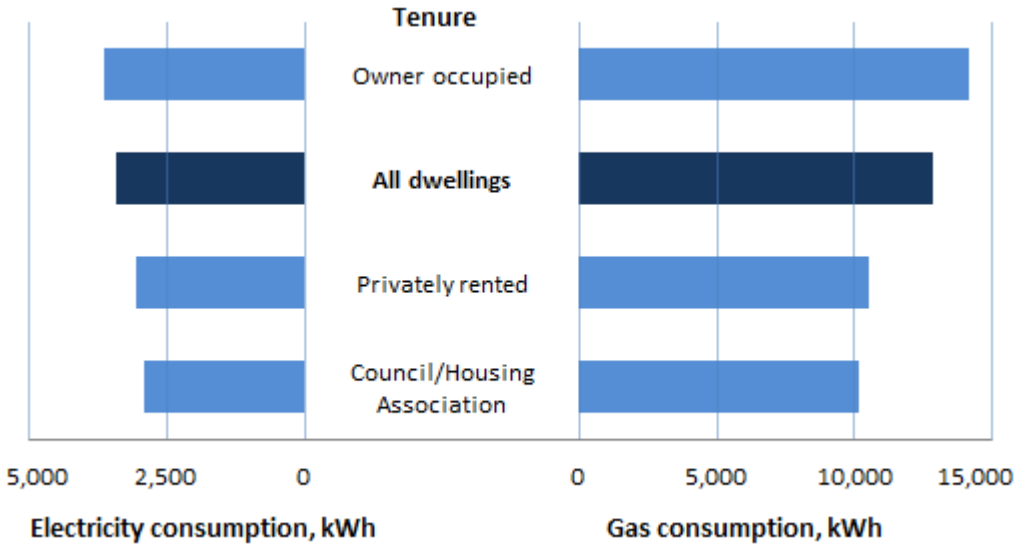
This section sets out summary consumption statistics for 2011 by household characteristics. Household information analysed in this section is obtained from modelled estimates leased from Experian. The household characteristics considered are household income, tenure and number of adult occupants.

As the data from Experian are modelled, estimates are indicative of characteristics of the household rather than actual data for the household and therefore results should be interpreted in this context. Annex B provides more details of quality including Experian's assessment of the accuracy of these data.

5.1 Tenure

The relationship between tenure and energy consumption is similar for gas and electricity, as Figure 5.1 shows.

Figure 5.1: Median electricity and gas consumption 2011, by tenure



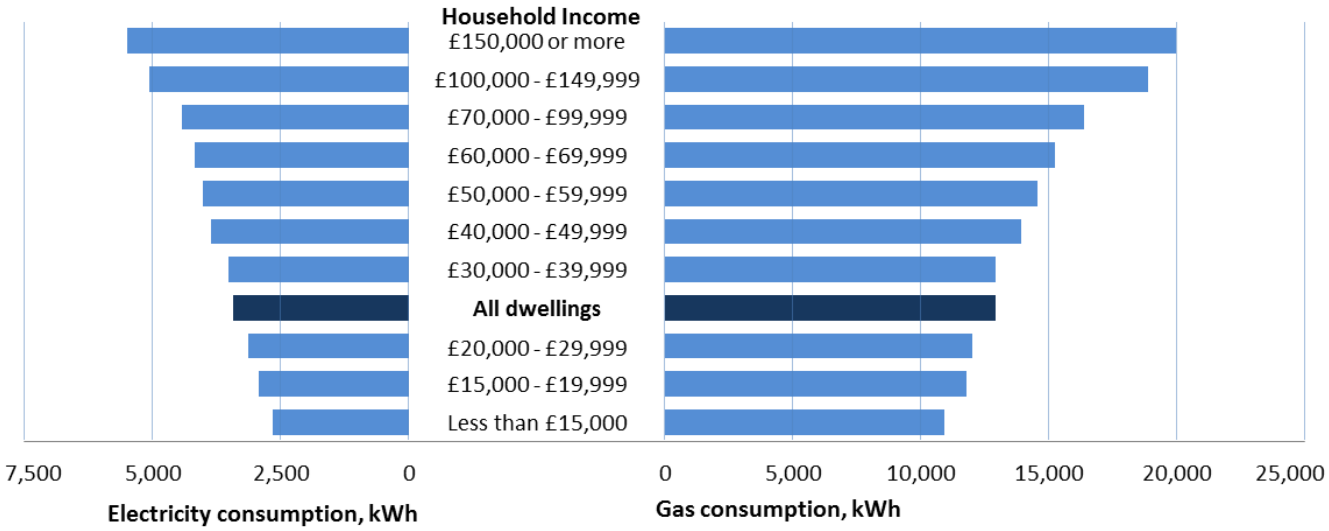
Owner occupiers have a higher typical gas and electricity consumption than households living in privately rented properties. Properties occupied by council/housing association tenants have the lowest median gas and electricity consumption. Some of this difference is likely to be explained by the physical attribute of properties each group live in. For example, properties occupied by council or housing association tenants are typically smaller and more energy efficient[26] than properties occupied by other groups. The lower gas consumption in rented properties compared with owner occupiers may also be related to the size of property, as privately rented properties are generally smaller than those of owner occupiers.

[26] The SAP rating is a measure of the overall energy efficiency of the dwelling. In 2011, the average SAP rating in the social sector was 62.9 compared with 55.4 in the private sector. Source: English Housing Survey Headline Report 2011-12 published by the Department of Communities and Local Government available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/88370/EHS_Headline_Report_2011-2012.pdf.

5.2 Household income

Figure 5.2 shows median gas and electricity consumption, with higher earners at the top and the lowest earners at the bottom. It shows that households in higher income bands have higher typical consumption for both gas and electricity. This may be the result of a number of factors, including the fact that higher income households tend to have larger and detached properties as well as being less sensitive to the cost of energy[27].

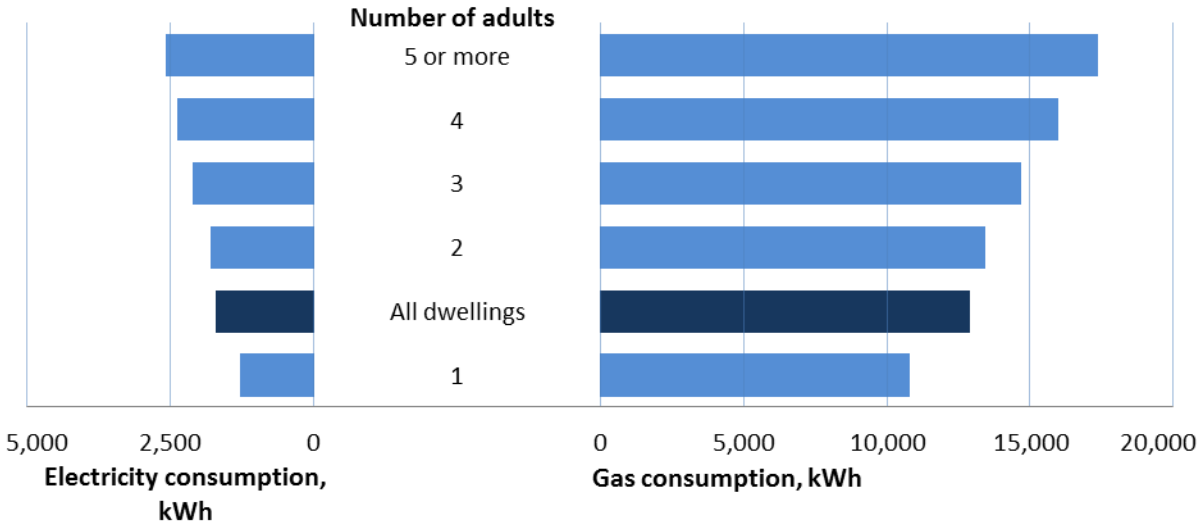
Figure 5.2: Median electricity and gas consumption 2011, by household income



5.3 Number of adults

This is the first time that information on energy consumption by the number of adults in the household has been analysed as part of NEED, see Figure 5.3. The figure shows that typical consumption increases as the number of adults increases; for both electricity and gas.

Figure 5.3: Median electricity and gas consumption 2011, by number of adults

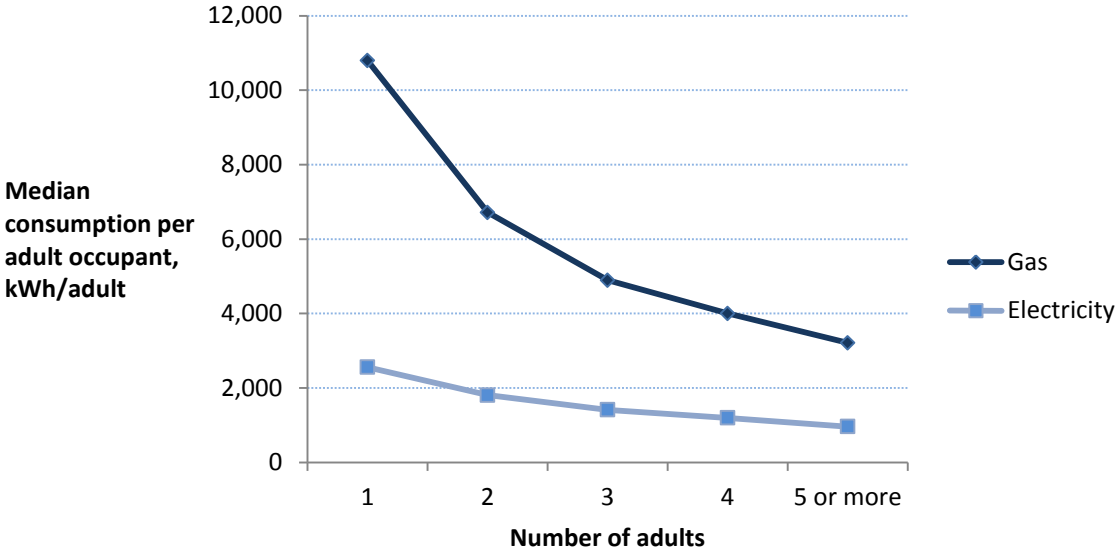


[27] For households in the top income decile, three per cent of all spend is on fuel (excluding petrol) the equivalent figure for households in the bottom income decile is eight per cent. Source: Living Cost and Food Survey.

For gas, the greatest increase is between one and two adults, an increase of 24 per cent (2,600kWh). Above two, there is an increase of around nine per cent for each additional adult. For electricity, there is a 42 per cent (1,100kWh) increase between one and two adults with much smaller increases for each additional adult beyond that (17 per cent for three adults and 13 per cent for four adults).

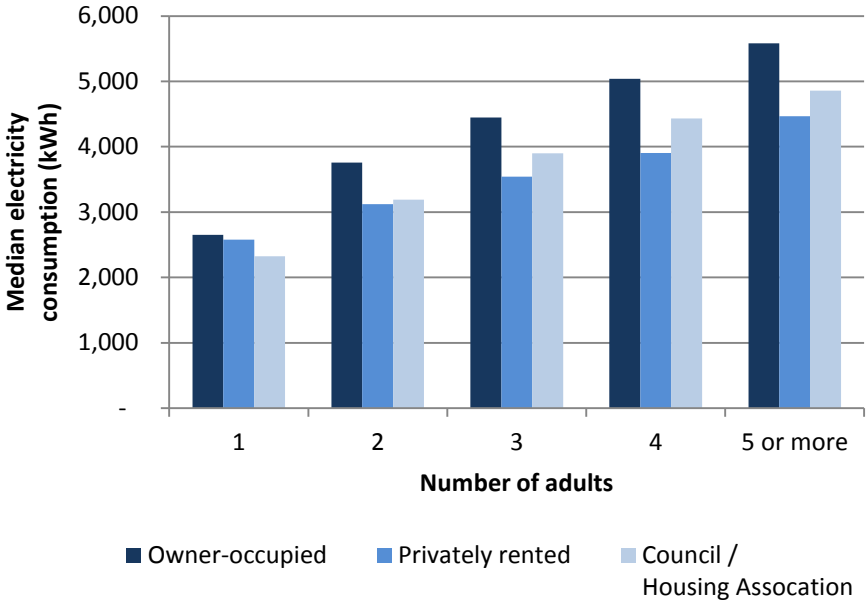
Properties containing more adults are generally larger, which will account for some of the observed differences. However, Figure 5.4 shows that the change is more marked for number of adults than for floor area. It shows typical gas consumption per adult is 61 per cent higher for one adult occupant than two. For electricity the equivalent figure is 41 per cent.

Figure 5.4: Median electricity and gas consumption per adult in household 2011, by number of adults



It is also interesting to see the variation in typical consumption by number of adults for different types of occupants. Figure 5.5 shows typical electricity consumption by number of adults and tenure.

Figure 5.5: Median electricity consumption 2011, by number of adults and tenure



For all categories of tenure (owner occupied, privately rented and council/housing association) the median consumption increases as the number of adult occupants increases. However, Figure 5.5 shows that the relative position of households privately renting and social sector tenants changes between one and three adults. While owner occupied properties have the highest typical consumption for any number of adults, privately rented households have higher typical consumption than social housing for properties with just one adult, very similar typical consumption for properties with two adults, and lower typical consumption for properties with three or more adults.

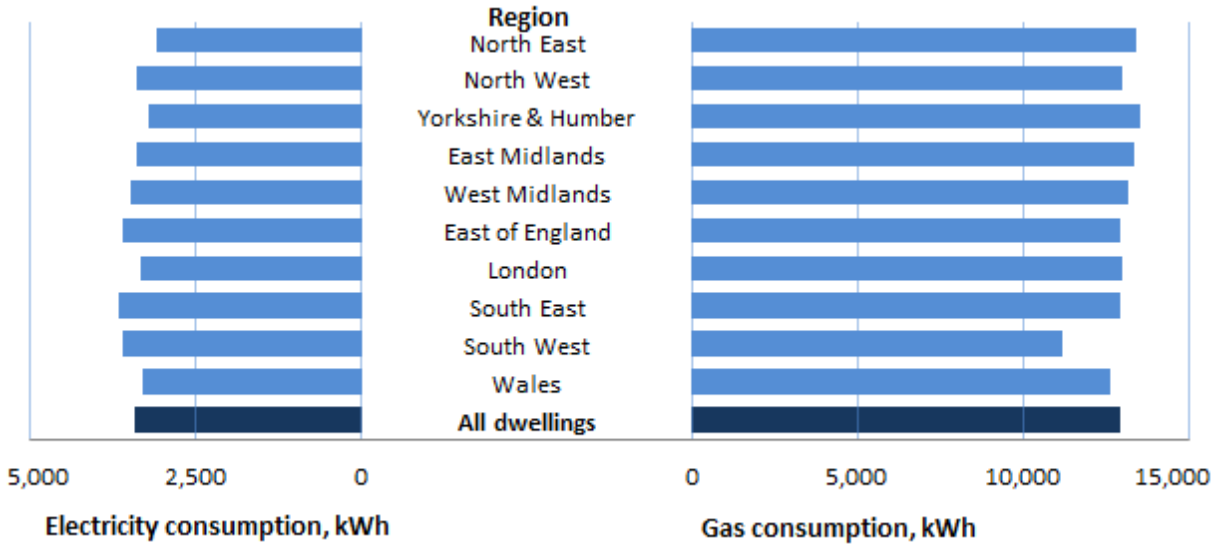
6. Geography and area classification

This section provides information about median gas and electricity consumption by region and output area classification, including information for Wales which is included for the first time. As referenced, these data are not consistent with the DECC Sub-national consumption statistics, which should be used as the main source for mean consumption by small areas.

6.1 Region

Figure 6.1 shows that there is little regional variation in median consumption. For gas, only the South West, Wales and the South East have median gas consumption lower than the median for all dwellings. In the South West it was 14 per cent lower, while for Wales it was only two per cent lower and the South East was less than one per cent lower. In all other regions median gas consumption was no more than five per cent higher than the overall median, with Yorkshire and the Humber having the highest median consumption.

Figure 6.1: Median gas and electricity consumption 2011, by region



The figure also shows that for electricity, median consumption is highest in the South East, six per cent more than the median for all properties. The lowest consumption is in the North East which is ten per cent lower than typical consumption for all dwellings.

It is not clear what is causing these differences. Part of the reason may be the prevalence of second homes; the South West has the highest proportion of people with a second home in the region, relative to the number of residence[28].

The lower median electricity consumption in the North East may be because of the higher prevalence of gas meters, less than one in ten households in the North East are not connected

[28] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-279998.

to the gas network[29] and therefore fewer households will use electricity as the main heating fuel.

Variation between regions may also be affected by the different make-up of the dwelling stock in each region and behaviour of occupants. Figure 6.2 shows the median gas consumption by property type for the regions with the two lowest and two highest overall median gas consumption values. It shows that the South West has the lowest or close to the lowest median consumption for each property type. However, in Wales, there is more variation with the median consumption above the median for all dwellings for mid terrace and end terrace properties. For the two regions which had the highest median consumptions, the North East and Yorkshire and the Humber, there is more variation in position relative to the typical consumption for all dwellings.

Figure 6.2: Median gas consumption in 2011, by selected regions and property type

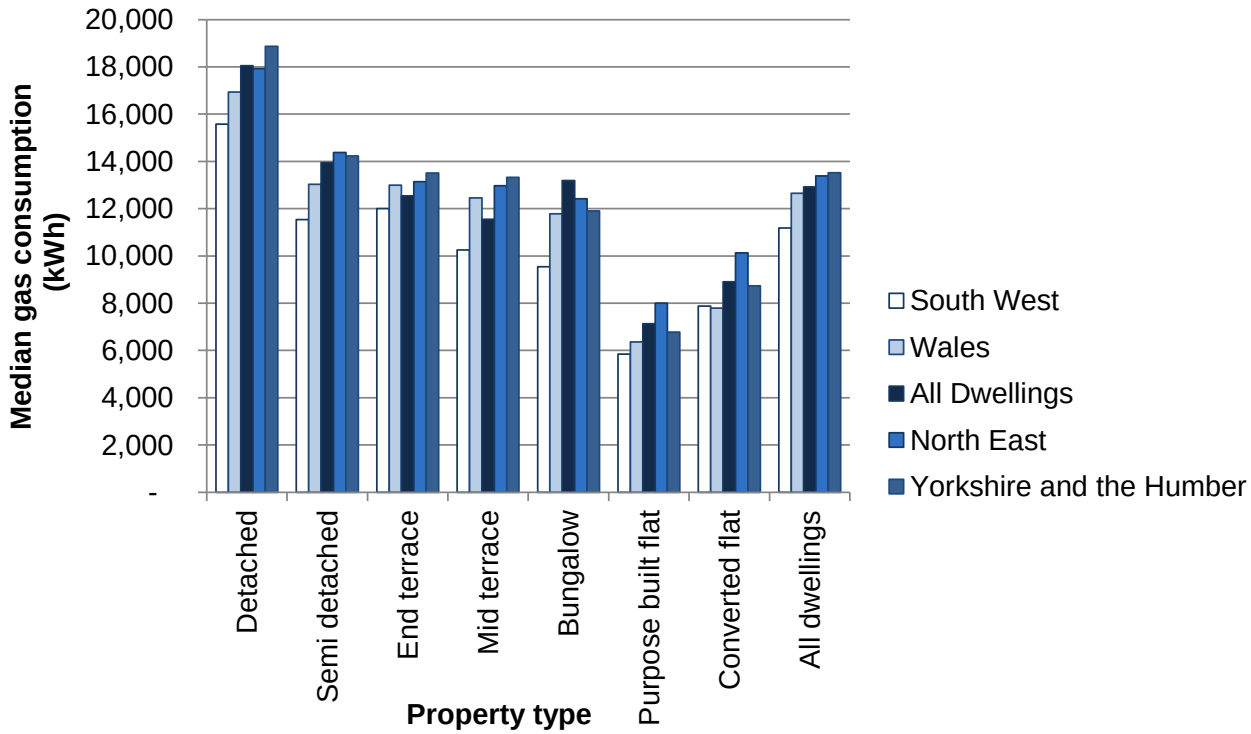
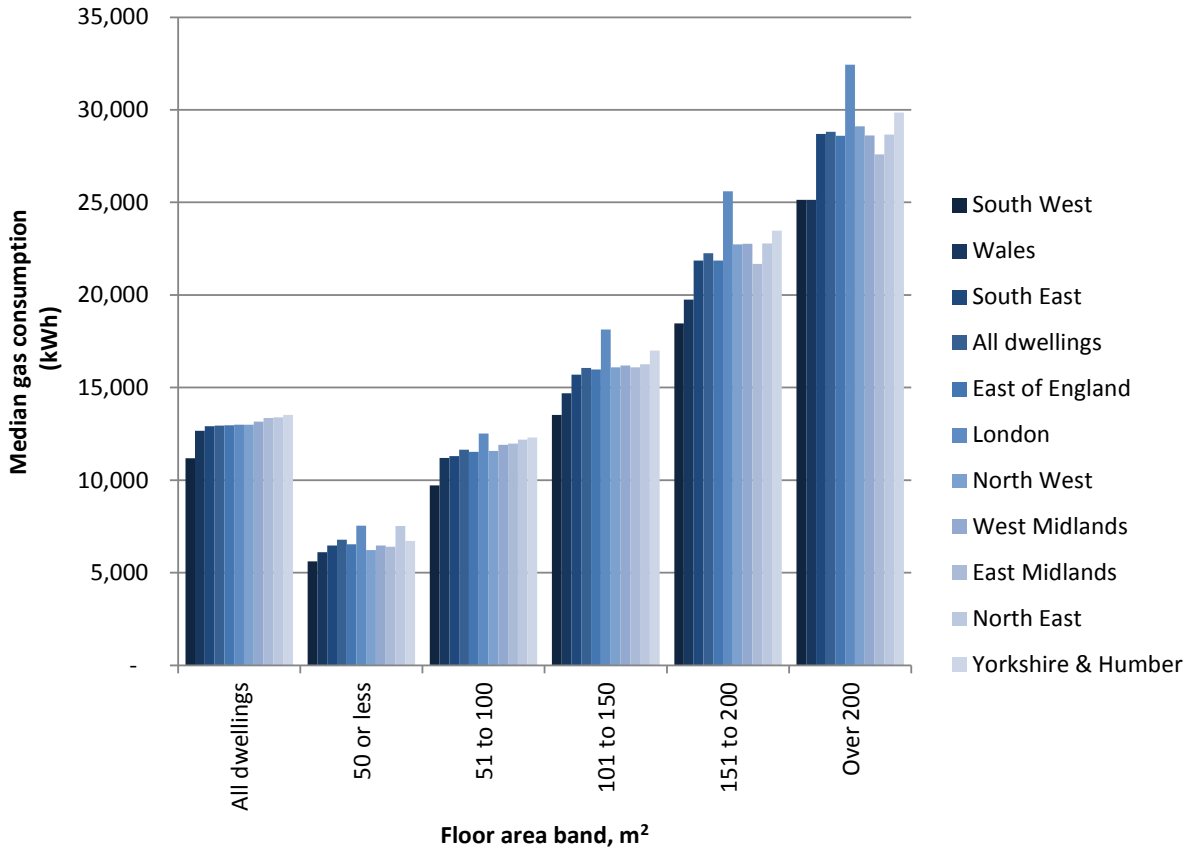


Figure 6.3 shows the median gas consumption by region and floor area band. It shows that again the South West has the lowest median consumption in all categories. However, it also shows that London has the highest median gas consumption in each category, despite having a median consumption very similar to the median for all dwellings (13,000 kWh for London and 12,900 kWh for all dwellings). This is a result of the different composition of the housing stock in London, the higher occurrence of flats and other smaller properties means that smaller properties have a greater influence on the median in London compared with other regions, despite the higher median consumption within each floor area band.

[29] See the sub-national gas consumption statistics factsheet for 2011 available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/175425/Gas_factsheet_2013.pdf.

Figure 6.3: Median gas consumption 2011, by region and floor area band, m²



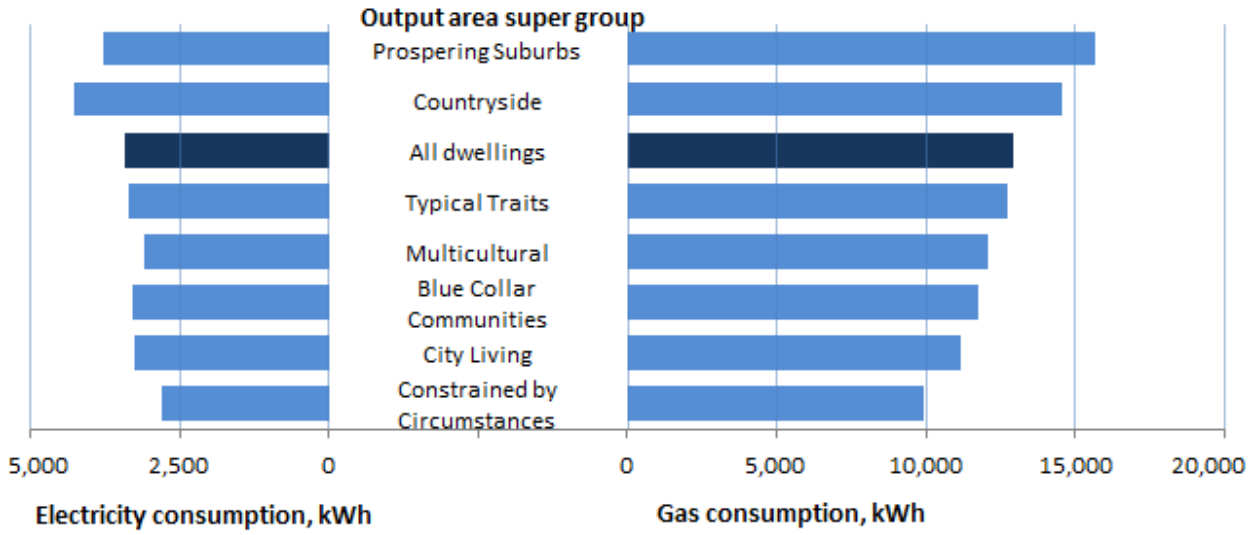
Local authority data provides further insights into the variations at local level. For headline consumption estimates for local authority level and below, DECC's published sub-national consumption statistics should be used. However, NEED can provide information for local authorities broken down by different types of properties and households. The detailed tables are available at: https://www.gov.uk/government/publications/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2013-part-1.

6.2 Output area classification

Output area classification is a neighbourhood classification from the Office for National Statistics based on socio-economic data from the 2001 Census. It can be used to make comparisons of energy consumption by type of neighbourhood. Figure 6.4 shows consumption for the seven super groups[30]. It shows that the super group with the highest median gas consumption is the more affluent 'prospering suburbs'. This group has a median gas consumption a fifth higher than typical consumption for all dwellings and close to three-fifths (58 per cent) more than the group with the lowest median, those 'constrained by circumstances'. Gas consumption is also low for city living communities. These differences will partly be due to the size and type of property common in such areas.

[30] Output Area Classifications split neighbourhoods into seven super groups and 21 groups. Summary statistics for all 21 groups are provided in the Additional Tables: Summary consumption statistics, Tables 17 and 18.

Figure 6.4: Median gas and electricity consumption 2011, by Output Area super group



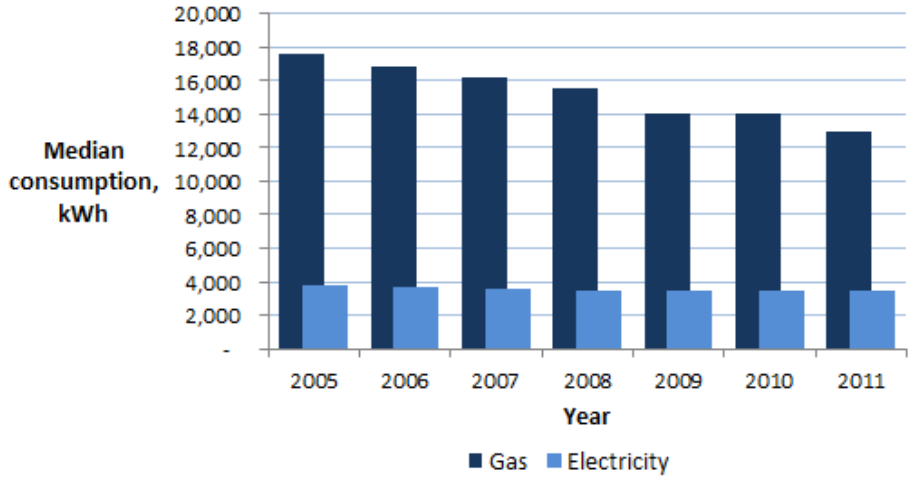
The link between electricity consumption and Output Area super group does not seem to follow the same pattern as that for gas. There are some similarities, such as communities constrained by circumstances, which have the lowest median consumption for both gas and electricity. Areas in the countryside have the highest median electricity consumption and the second highest median gas consumption; this is most likely to be because of the higher number of detached properties in rural areas as well as the higher proportion of properties with no gas connection which therefore rely more on electricity.

7. Trends in domestic consumption

This section provides highlights of the trends in median gas and electricity consumption between 2005 and 2011 for different property attributes and household characteristics. Accompanying tables with data for 2005 to 2011 for all the property characteristics and household attributes considered in this report are available at: https://www.gov.uk/government/publications/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2013-part-1.

For context, Figure 7.1 shows the median consumption for all households in the NEED sample with valid consumption in each year from 2005 to 2011. Data for 2005 to 2010 cover England only and are based on the previous NEED analysis sample. Data for 2011 are based on the new NEED sample and cover England and Wales. However, as Figure 6.1 shows, consumption in Wales is very similar to consumption in England and therefore results can be considered as a continuous time series[31].

Figure 7.1: Median gas and electricity consumption 2005 to 2011, kWh



The gas data used in NEED are weather corrected; the consumption for each household has been adjusted to account for differences in temperature in different years. This allows a more consistent comparison for analysis as it eliminates the fluctuation which would be observed as a result of warmer or cooler weather. Electricity consumption is not weather corrected. The figure shows that both gas and electricity consumption have been declining over the period.

Median gas consumption fell by just over a quarter (27 per cent) between 2005 and 2011. The largest drop was between 2008 and 2009, with a decrease in median annual consumption of nine per cent. There was an eight per cent decrease between 2010 and 2011. Median electricity consumption decreased by nine per cent over the period 2005 to 2011.

[31] The sample used for England for 2005 to 2010 has very similar mean and median consumption values to the new sample for England and Wales used for 2011 analysis; the biggest difference in any year is less than 50 kWh. More information on the different samples is available in Annex B.

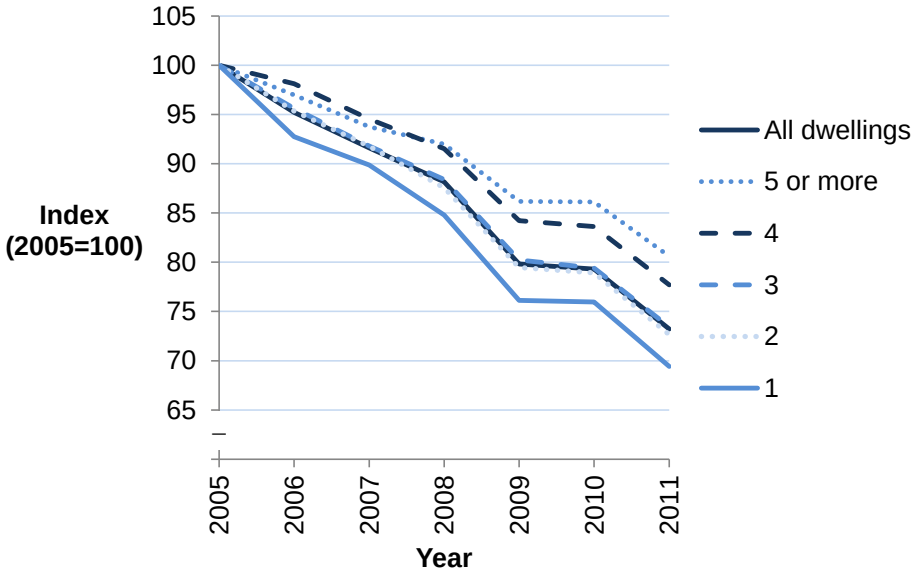
The reduction in consumption over time may be the result of a number of factors, for example; energy efficiency improvements in households[32], such as new boilers, insulation and more efficient appliances; higher bills and the recession; or changes in the building stock and household composition.

The reduction in median consumption for different types of properties and occupants follows a similar pattern to that for all dwellings. However, some types of households and properties will be more or less affected by the different factors described above.

7.1 Number of bedrooms

Figure 7.2 shows the trend in median gas consumption for properties by number of bedrooms. Changes in consumption are shown relative to a 2005 baseline (2005=100)[33].

Figure 7.2: Median gas consumption by number of bedrooms, 2005 to 2011 (2005=100)

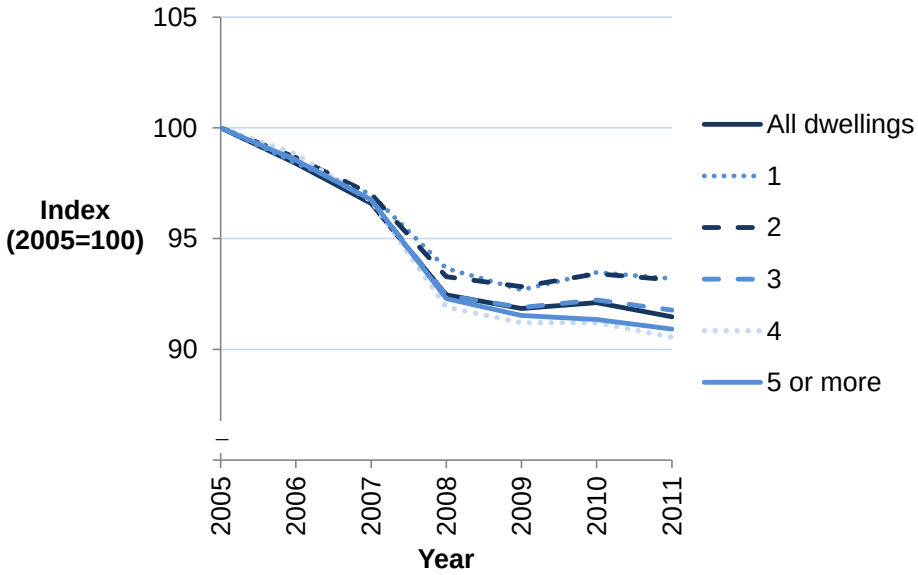


The figure shows that between 2005 and 2011 median gas consumption for all categories follows a similar trend to the change in typical consumption for all dwellings. However, generally, smaller properties showed a greater percentage decrease in median consumption over the period than larger ones. For example in 2011, typical gas consumption for properties with one bedroom was 31 per cent lower than in 2005, but for properties with five or more bedrooms it was only 19 per cent lower. Figure 7.3 shows the equivalent information for median electricity consumption.

[32] The energy efficiency of the housing stock improved between 2005 and 2011, the average SAP rating of a dwelling increased by 7.7 points from 49.0 to 56.7. The SAP rating is a measure of the overall energy efficiency of the dwelling. Table 13: English Housing Survey Headline Report 2011-12: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/88370/EHS_Headline_Report_2011-2012.pdf.

[33] Note that the y axis for these charts does not start at zero in order to allow differences between groups to be seen more clearly.

Figure 7.3: Median electricity consumption by number of bedrooms, 2005 to 2011 (2005=100)

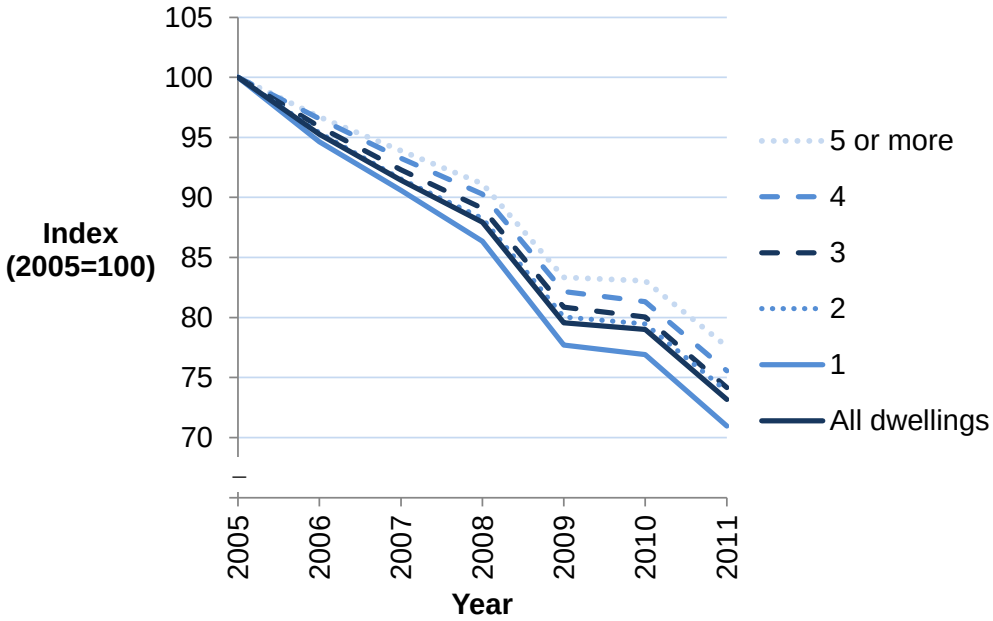


This demonstrates that there is less variation in the trend for electricity consumption. It also emphasises the smaller decrease in electricity consumption over the period compared to that of gas, as show in Figure 7.2. The difference between different groups of properties is less obvious than for gas. In contrast to gas, there is a slightly larger decrease over the period for properties with more bedrooms than for properties with fewer; one and two bedroom properties both had a decrease in typical consumption of seven per cent between 2005 and 2011 while four and five or more bedroom properties both decreased by around nine per cent.

7.2 Number of adult occupants

Figure 7.4 shows the trend in median gas consumption for households by number of adults in the household.

Figure 7.4: Median gas consumption by number of adults, 2005 to 2011 (2005=100)



The figure shows that the trend in median gas consumption by number of adult occupants is very similar to the trend for number of bedrooms. Properties with more occupants have a smaller decrease in median gas consumption over the period than properties with fewer occupants; five or more occupants has a decrease in median consumption of 22 per cent between 2005 and 2011 compared with 29 per cent for properties with only one adult occupant. This similarity between number of bedrooms and number of adult occupants is primarily due to the strong correlation between these two variables.

8. Conclusion

The results from this work have provided important evidence to enable DECC to further develop its understanding of how energy is used in households. It has built on the previous NEED reports and provides new data including longer time series, the first outputs for Wales and new information on consumption by number of adults in the household.

The value of the analysis is clear from the findings in this report and the many uses data have already been put to, within DECC and more widely. However, there are still a number of areas for further development. DECC will continue to work to expand the analysis undertaken using NEED and will publish results as analysis is completed.

The data accompanying this publication will be published as .CSV files for the first time to allow others to make more use of the data. Headline tables and distributions are being published on the same day as this publication, with Local Authority breakdowns being published on July 25. The update to the new NEED Table Creator[34] will be made available on the website on 15 August.

Over the coming year, there are also a number of areas where the framework will be developed. These include:

- Publication of NEED Analysis Part II on 7 November: This report will provide estimates of the impact of energy efficiency measures installed in 2010. It will also include updated estimates of the impact of installing a combination of measures at the same time and an updated estimate of the saving in gas consumption resulting from the installation of solid wall insulation. Measures installed through the Community Energy Saving Programme (CESP) will contribute to this analysis for the first time. It is also planned to include an update on non-domestic properties; subject to data quality.
- Conversion to use of AddressBase for the address spine: Work on matching address information using AddressBase is being undertaken within DECC. Initial results suggest this internal matching work will help with some of the harder to match properties, such as domestic flats and non-domestic properties, enabling more of these to be included in NEED in future.
- Working towards publishing an anonymised dataset: DECC continues to work towards making an anonymised domestic dataset available. The first stage of this includes producing an up to date Privacy Impact Assessment which will be published on the DECC website in July. Options for the anonymised dataset are being considered and users have had an initial opportunity to input views via a stakeholder event held in May 2013. Proposals for the final dataset will be made available via the NEED webpage prior to being finalised. The final dataset will balance the priorities of ensuring the dataset meets users' needs while maintaining data confidentiality.

[34] A tool based on data from NEED providing users with the ability to create bespoke cross tabulations on electricity and gas consumption by property attributes and household characteristics. Mean, median and number of observations are available for 2005 to 2010 at: https://www.gov.uk/government/statistical-data-sets/need-table-creator. Data for 2011 will be added on 15 August 2013.

- Inclusion of 2012 consumption data: Consumption data for 2012 will be available for use in NEED in early 2014. It will be used to produce analysis for an update to both Parts I and II of the NEED 2013 reports, planned for publication in June 2014.
- DECC policy evaluation: NEED is a core part of DECC's evidence base and will contribute to the evaluations of the Carbon Emissions Reduction Target (CERT), CESP and Warm Front over the coming 12 months. It will also contribute to the evaluations of a number of other policies including Green Deal and Smart Meter Implementation in the longer term.

Other developments for domestic NEED include assessing the potential to produce an in-house alternative to modelled Experian data, and further developing a model of domestic gas consumption; so far work on this has included identifying the most important variables for modelling.

Since the November 2012 publication, work has also been on-going on non-domestic NEED. A work programme has been established to improve the quality of the data framework for non-domestic buildings. Use of a VOA look up file for building sub-premises has led to improved matching rates so that over 90 per cent of rateable units are now captured in non-domestic NEED. The inclusion of 2012 Display Energy Certificates data has also increased the number of certificates available for analysis in NEED. Matching rates for consumption data are substantially lower, with about 30 per cent of non-domestic buildings matching to at least one electricity meter. A structured quality assurance programme has been designed and implemented and the results of this are being considered by DECC to prioritise next steps, including plans for publishing initial results and further development to improve the data-framework.

Finally, outputs for NEED are produced and published in line with the National Statistics Code of Practice and DECC will be seeking National Statistics accreditation for NEED at the next available opportunity.

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