Report 3: Metered fuel consumption

Including annex on high energy users

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Executive Summary

This report presents the results from an analysis of the median gas and electricity consumptions derived from the 2011 Energy Follow-Up Survey (EFUS). The 2011 EFUS consisted of a follow-up interview survey and associated monitoring of a sub-set of households first visited as part of the 2010/2011 English Housing Survey (EHS). Analysis is based on the meter reading sub-sample weighted to the national level, using a weighting factor specific to the meter reading sub-sample. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households.

- The meter reading data reveals a wide range in energy consumption across the household stock[1]. For gas, annualised consumption values ranged from a minimum of 300 kWh and a maximum of 76,500 kWh. For electricity, annualised consumption values ranged from a minimum of 400 kWh and a maximum of 35,100 kWh. For both fuels, the frequency distributions show considerable tailing towards the higher electricity consumption values, resulting in mean values that are considerably higher than the median values. In order to give a reasonable comparison across categories within typical dwelling and household groups, the report uses the median values throughout.

- The median annual mains gas consumption determined using the EFUS meter reading data is around 14,000 kWh, with a median value of around 3,700 kWh for electricity.

- 80% of households use between 5,900 to 28,000 kWh of gas per annum and between 1,800 and 8,800 kWh of electricity per annum.

- Significant differences are found in the average consumption levels for different categories of dwelling and household types. Gas use is closely linked to dwelling floor area as well as household size, with detached houses having a median gas consumption more than twice that found in flats. Electricity use appears to be related to the number of people in the household, with the data showing a median consumption of around 2,400 kWh for single people, compared with a figure of around 6,000 kWh where there are at least 5 people in the household.

- Households living in dwellings built between 1919 and 1944 show a significantly higher median gas consumption than those from other periods with a median of 17,100 kWh per year, a pattern that is also seen in the NEED report. These households also have a higher median electricity consumption than households living in dwellings built between 1965 and 1980.

- There is no statistically significant difference in the median gas consumption of households living in rural or urban areas. However, median electricity consumption is significantly higher in households in rural areas compared to urban areas, likely to be due to the large number of dwellings in these locations without a gas supply.

[1]These data are annualised to cover the period 15th November 2010 to 14th November 2011. This includes a very cold period in December 2010, which acts to raise consumption when compared to calendar year 2011 estimates.

- There are no significant differences in the median consumption of either gas or electricity between households living in dwellings with or without wall insulation, nor between households living in dwellings with differing levels of loft insulation. However, households living in dwellings that are fully double glazed have median gas consumptions that are lower than those households living in dwellings which are not fully double glazed. There is some evidence of lower median gas consumption with increasing levels of different insulation measures, although the only statistically significant difference can be seen between those households living in 'well insulated' dwellings (3 insulation measures) having both lower gas and electricity consumption than households living in 'poorly insulated' dwellings.

- On average, owner occupiers consume significantly more gas than any other tenure and more electricity than the private rented or local authority tenures. For both fuels, the private rented, local authority and RSL tenures show no significant differences in their median annual consumption rates.

- Median gas consumption is lower for households in the lowest income quintile compared to households in all other income quintiles with around 7,500 kWh separating the median gas consumption in the highest and lowest income quintiles. The median electricity consumption increases as the income quintiles increase, however the difference is only statistically significant between the first income quintile and the top three income quintiles. The trend of higher use of both gas and electricity and higher incomes is what might be expected when considering the larger size of dwelling that might typically be associated with high incomes and the ability to afford higher fuel bills and in fact, similar median values are found for all income groups when the consumption is normalised for floor area.

- There are no significant differences in the median consumption values of either gas or electricity between households in which someone is in during the day and households in which no-one is in during the day. In dwellings where the household is said to be under-occupying, the median gas consumption is significantly higher than where they are not under-occupying.

- There is no significant difference in the median consumption of either fuel for households in fuel poverty compared to those not in fuel poverty.

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1 Introduction

The main aim of the 2011 Energy Follow-Up Survey (EFUS) was to collect new data on domestic energy use, in order to update the current modelling assumptions about how energy is used in the home, and to inform energy efficiency policy. The 2011 EFUS consisted of a follow-up interview survey of a sub-set of households first visited as part of the 2010/2011 English Housing Survey (EHS). Additionally, sub-samples of these households were selected to have temperature loggers and electricity consumption monitors installed. A further stage of the EFUS was the compilation of gas and electricity consumption data from meter readings.

Gas use in dwellings is predominantly for space heating. For electricity consumption, apart from those households with electric main heating systems, usage is likely to be additionally influenced by the number of persons in the household (higher consumptions arising from larger household numbers) as electricity use is predominantly for lights and appliances.

This report focuses specifically on the analysis of the average (median) gas and electricity consumption values derived from meter readings taken primarily as part of the EHS 2010/11 survey and the 2011 EFUS. Analysis is based on the meter reading sub-sample weighted to the national level, using a weighting factor specific to the meter reading sub-sample. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households.

The outcomes of this analysis will be used to inform energy efficiency policy and the data will be used in a wider context in conjunction with other EFUS outputs.

Specific questions regarding metered energy use that this report will cover include:

- What are the typical measured gas and electricity consumptions per household in 2011?
- How is the average consumption influenced by different household demographics?
- What effect does household income have on average energy consumption?
- How do physical dwelling characteristics and location affect the average energy required by the household?
- Is there a clear association between the energy efficiency of a dwelling and the average amount of energy used by its occupants?

The annex to this report (Annex A) provides a focus on 'High Energy Users'. This combines the information obtained from the household interview survey and the temperature monitoring data in order to investigate if certain types of households are more likely to be high energy consumers.

A key component of this analysis process has been the linkage of the EFUS data to key dwelling and household descriptor variables collected in the interview and physical survey components of the 2010 English Housing Survey (EHS). In this report, and the majority of the companion reports in this EFUS series, simple bivariate comparisons between the variable under consideration and individual descriptor variables have been performed in order to provide preliminary results and identify

bivariate trends. It should be recognised, however, that subsequent investigations using more sophisticated statistical analysis may assist in the interpretation of results.

2 Methodology

A summary of the methodology of particular relevance to this report is provided below. Additional details, including the full interview questionnaire, can be found in the EFUS 2011 Methodology report.

The EFUS 2011 interview survey was undertaken by interviewers from GfK NOP between December 2010 and April 2011. A total of 2,616 interviews were completed, drawn from a sample of addresses provided from the first three quarters of the 2010/11 English Housing Survey (EHS). A further stage of the EFUS was the collection of consumption data from meter readings. For each household an initial meter reading (taken during the period April to September 2010) and a final meter reading (taken during the period February to November 2012) were obtained. Further detailed information on the EFUS 2011 methodology, and the production of meter reading data, can be found in the EFUS 2011 Methodology Report.

In order to obtain a final set of cases for reporting, a validation process was applied to the meter readings from all sources. Cases with a missing first or second reading were removed (1,162 cases) and the remaining data were inspected to decide on the validity of their consumption data, including day and night rates of electricity where applicable. Cases were dropped (109 cases) where the consumption was implausibly high or produced a negative figure, although in a number of cases the data could be consolidated and retained where there was clear evidence for the source of the discrepancy, e.g. a negative value resulting from a meter passing through 9999 during the consumption period. This process was assisted by comparison with the Meter Point (MPAN/MPRN) data held by DECC.

Following this validation, a complete set of initial and final electricity meter readings was obtained for 1,345 cases (51% of total EFUS sample). Of these, 1,197 cases had a mains gas supply and produced valid gas consumption values (89% of the meter reading sample, and 45% of the total EFUS sample).

This dataset covered a range of consumption periods from around 15 months to around 30 months, depending on the date of the original EHS survey and meter reading and the source of the second reading. The final dataset required annual consumption figures for each case in which seasonal differences in energy use were accounted for. For example, if two cases covering 15 months with a 12 month overlap returned the same consumption, but one had the additional three months in summer and the other the additional three months in winter, then a direct comparison would not be possible. A simple seasonal annualisation was achieved by calculating the cumulative number of degree days for the whole consumption period of each case and for a core 12 month period (15th November 2010 to 14th November 2011) covering all the cases, finding the ratio of the degree day totals and finally multiplying each consumption figure for the full period by this ratio[2]. This includes a very cold period in December 2010, which acts to raise consumption of the EFUS data when compared to other estimates which do not include this month (e.g. the Digest of UK Energy Statistics data for 2011). No weather correction of the data (i.e. to adjust to a 'typical year's weather') was

[2] Numerous alternatives to the degree day adjustment described are possible. However, testing of the effect of some alternatives suggests that the median consumptions of groups are not strongly influenced by the choice of approach.

carried out. See the EFUS Methodology Report for further details of the seasonal annualisation method.

2.1 Weighting factors

Weighting factors specific to the sample of 1,345 households that had valid initial and final electricity meter readings were derived using logistic regression based on the profile of respondents for the GOR, tenure, dwelling type and working status of household. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households. Although the objective of the weighting factor is to provide totals that can be interpreted at the national level, readers should be aware that there may remain some uncorrected bias in the data (e.g. if the households that had valid meter readings differ from the population in a way that is not visible to the weighting procedure).

3 Findings

Below are the key headline findings from the meter reading data recorded as part of the EFUS survey. Note that all average gas consumptions apply only to those dwellings with a gas meter (a sample of 1,197 cases) while average electricity consumption is calculated on the whole sample (1,345 cases).

3.1 Average consumption values

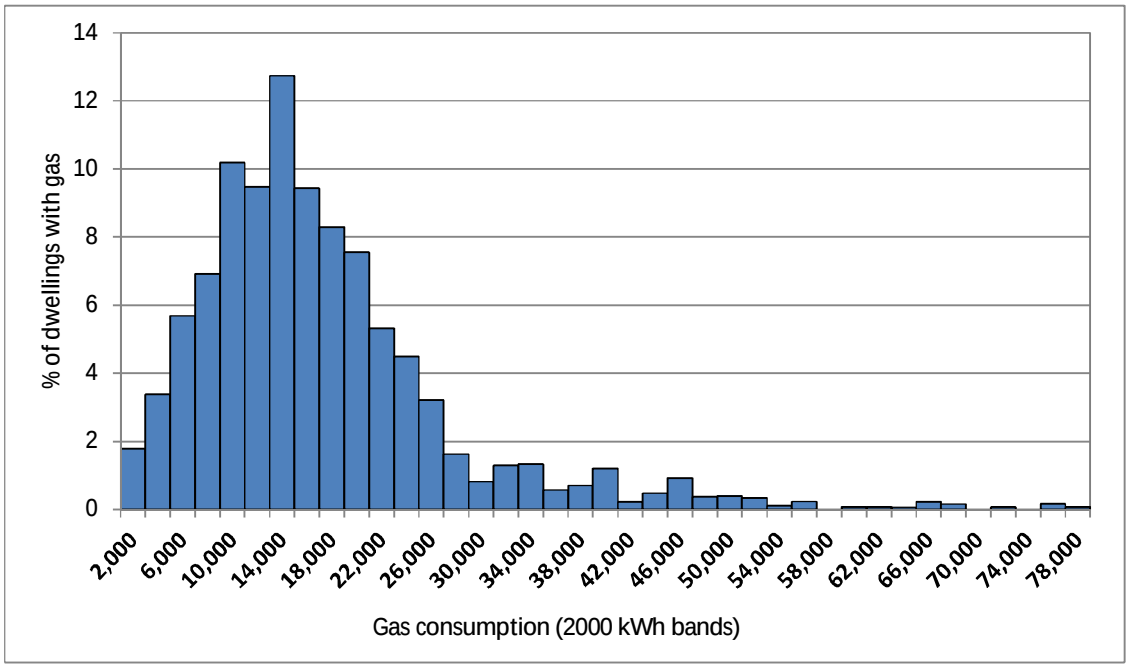
The meter reading data reveal a wide range in energy consumption across the household stock. For gas, consumption values range from a minimum of 300 kWh and a maximum of 76,500 kWh. As can be seen from the histogram in Figure 1, there is considerable tailing of values towards the higher consumption values which results in a mean annualised gas consumption for all households of 16,200 kWh[3] but a median value of 14,000 kWh. For the electricity consumption data, the consumption values range from a minimum of 400 kWh and a maximum of 35,100 kWh and, as is seen with the gas consumption, the frequency distribution (Figure 2) shows considerable tailing towards the higher electricity consumption values which results in a mean annualised electricity consumption for all households of 4,900 kWh but a median value of 3,700 kWh. In order to give a reasonable comparison across categories within typical dwelling and household groups, the report will use the median values throughout.

These headline figures compare well with DECC's National Energy Efficiency Data-Framework (NEED) 2009 and 2010 summary analysis[4] and Powering the Nation from EST[5], which focuses on electricity consumption. The NEED report quotes median values of 14,000 kWh for gas and 3,500 kWh for electricity, while Powering the Nation uses a mean, rather than a median, of 3,638 kWh, although the latter report excludes from its sample dwellings that use electricity for heating. The EFUS mean consumption, however, is higher than that reported by the Energy Consumption in the UK[6] for 2011. However, these differences can largely be explained through the different periods covered by these datasets, and in particular the inclusion of the cold December 2010 in the EFUS data.

If households using electricity as their main heating fuel (6% of households) are excluded from the EFUS analysis, the mean electricity consumption is 4,700 kWh (down from 4,900 kWh for all households) but the median consumption remains the same as for all households at 3,700 kWh. Some households also use electric heaters to provide secondary heating, either as an alternative to the main heating system (12% of all households) or supplementary to it (22% of all households) (see the EFUS 2011 Secondary Heating report). It should also be noted that there are a small percentage of dwellings (1.8%, sample size=21) with a mains gas supply that do not use it as the primary heating fuel. The analysis that follows was undertaken with the objective of giving an overview of household consumption values for the whole stock – further work is required to provide household consumption values split by the primary and secondary heating characteristics.

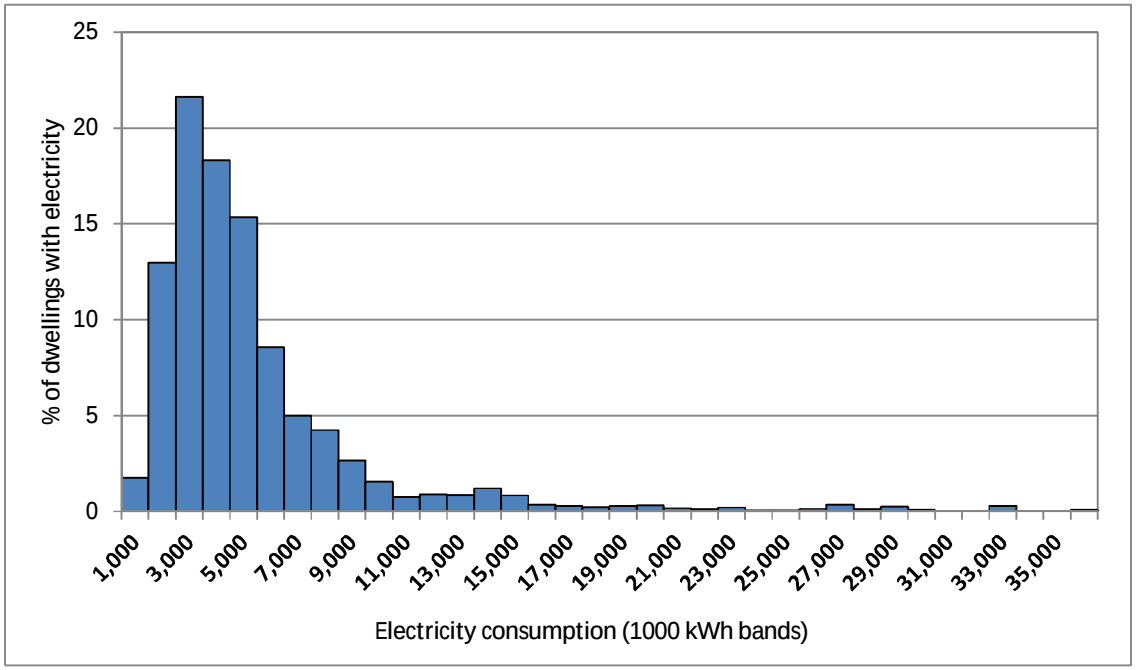
[3] All consumption estimates are rounded to the nearest 100 kWh.
[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65969/6861-need-report-nov-2012.pdf
[5] http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Powering-the-nation-household-electricity-using-habits-revealed
[6] https://www.gov.uk/government/collections/energy-consumption-in-the-uk

Figure 1: Distribution of annual gas consumption



Base: All dwellings with gas in EFUS 2011 meter reading sample (n=1197)

Figure 2: Distribution of annual electricity consumption



Base: All dwellings in EFUS 2011 meter reading sample (n=1345)

Table 1 shows the range of consumption values within each decile band[7] for gas and electricity. It can be seen that approximately 80% of households use between 5,900 to 28,000 kWh of gas per annum and between 1,800 and 8,800 kWh of electricity per annum.

Table 1: Range of gas consumption for each decile band

	Range of gas consumption in band (kWh)	Range of electricity consumption in band (kWh)
1st decile (lowest)	250 - 5,800	400-1,800
2nd decile	5,900 - 8,600	1,800-2,200
3rd decile	8,600 - 10,300	2,200-2,700
4th decile	10,300 - 12,500	2,700-3,200
5th decile	12,500 - 14,000	3,200-3,700
6th decile	14,000 - 16,100	3,700-4,300
7th decile	16,100 - 18,500	4,300-5,000
8th decile	18,500 - 21,500	5,000-6,200
9th decile	21,600 - 28,000	6,200-8,800
10th decile (highest)	28,000 - 76,500	8,800-35,100

Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.2 Variation in household consumption patterns by dwelling characteristics

It is of interest to energy efficiency policymakers to investigate whether energy consumption varies for different household and dwelling groups. Characteristics relating to the physical properties of the dwelling, (e.g. dwelling age and type, location and level of insulation,) have been examined and Table 2 shows the median gas and electricity consumptions and 95% confidence intervals[8] of the median consumption across a range of dwelling groups. The 95% confidence intervals show the significance of the differences across categories. Also shown are boxplots showing the median, the interquartile range (box) and the 10th and 90th percentile (extent of the whiskers). These boxplots provide an indication of the variability found within each category, although as per the objectives of this report, the discussion is limited to an analysis of the differences in median values. Detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary.

[7] the consumption values were divided into 10 bands with equal number of households. Raw sample sizes are 117 cases in the top 10% of gas consumers and 129 cases in the top 10% of electricity consumers.

[8] 95% confidence intervals around a median value have been calculated following the method described by McGill et al, 1978 using a Design Factor of 1.1. See the Methodology Report for further details.

Table 2: Median (and 95% confidence intervals) gas and electricity consumption across various dwelling groups

Dwelling characteristic	Characteristic category	Annual Gas consumption (kWh)			Annual Electricity consumption (kWh)		
		Sample size	Median	95% CI of the median	*Sample size*	Median	95% CI of the median
Dwelling type	End terrace	137	13,400	(12100, 14800)	146	3,800	(3300, 4200)
	Mid terrace	214	12,900	(11800, 14000)	223	3,400	(3100, 3700)
	Semi detached	363	15,500	(14600, 16300)	387	4,000	(3700, 4300)
	Detached	216	19,500	(18200, 20700)	255	4,600	(4300, 5000)
	Bungalow	117	13,100	(12000, 14200)	141	2,900	(2600, 3200)
	Flat	150	8,800	(7800, 9800)	193	2,800	(2500, 3100)
Dwelling type	House or bungalow	1047	14,900	(14400, 15500)	1152	3,900	(3700, 4000)
	Flat	150	8,800	(7800, 9800)	193	2,800	(2500, 3100)
Dwelling Age	Pre 1919	170	14,300	(12500, 16000)	206	4,000	(3600, 4500)
	1919-1944	223	17,100	(16000, 18300)	232	4,100	(3800, 4400)
	1945-1964	293	13,100	(12200, 14000)	326	3,600	(3300, 3900)
	1965-1974	181	14,200	(13100, 15300)	210	3,400	(3000, 3700)
	1975-1980	84	11,100	(9300, 12900)	92	3,200	(2800, 3700)
	1981-1990	90	13,700	(11900, 15600)	108	3,400	(2900, 3900)
	Post 1990	156	12,300	(10800, 13700)	171	4,000	(3700, 4400)
Useable floor area	< 50 m^2	95	8,700	(7700, 9700)	133	2,500	(2100, 2900)
	50 to 69 m^2	264	10,500	(9800, 11300)	292	2,900	(2700, 3200)
	70 to 89 m^2	372	13,600	(12900, 14300)	396	3,500	(3300, 3800)
	90 to 109 m^2	184	15,600	(14600, 16700)	199	4,000	(3700, 4300)
	110 to 139 m^2	138	19,300	(17700, 20800)	154	4,300	(4000, 4600)
	≥140 m^2	144	23,500	(21700, 25300)	171	5,500	(5000, 6000)
Region - EHS order	North East	91	15,500	(13800, 17100)	98	3,500	(2900, 4000)
	North West	209	15,200	(13900, 16600)	219	3,700	(3400, 4100)
	Yorkshire and the Humber	174	15,900	(14600, 17200)	183	3,600	(3300, 3900)
	East Midlands	81	15,000	(13100, 16900)	95	3,900	(3400, 4400)
	West Midlands	112	13,900	(12200, 15600)	128	4,200	(3700, 4700)
	East	130	13,300	(11800, 14800)	158	3,200	(2900, 3600)
	London	120	13,600	(11600, 15500)	134	3,500	(3000, 4000)
	South East	167	13,700	(12600, 14900)	183	4,000	(3600, 4400)
	South West	113	10,200	(8800, 11500)	147	3,800	(3300, 4300)
Urban or rural location?	Urban	1134	14,000	(13400, 14500)	1209	3,600	(3500, 3800)
	Rural	63	14,400	(12100, 16700)	136	4,800	(4200, 5300)
Type of heating system	Central Heating	1172	14,200	(13700, 14700)	1256	3,700	(3500, 3800)
	Non-Central Heating	25	3,900	(1900, 5900)	89	6,200	(5200, 7300)
Main fuel	Mains gas	1176	14,100	(13600, 14600)	1178	3,600	(3500, 3700)
	Electricity	14	3,500	(200, 6700)	78	6,700	(5600, 7700)
	Other (bott./bulk gas,solid,oil,comml)	7	2,500	(0, 6900)	89	4,500	(3800, 5200)
Are the walls of the dwelling insulated?	Insulated	594	13,500	(12800, 14200)	648	3,600	(3400, 3800)
	Not insulated	603	14,400	(13700, 15200)	697	3,800	(3600, 4000)
Loft insulation	<50mm	63	14,400	(11400, 17500)	75	3,700	(3100, 4300)
	50-149mm	467	15,300	(14500, 16200)	525	4,000	(3800, 4200)
	150+ mm	560	14,000	(13200, 14800)	611	3,700	(3500, 3900)
Is dwelling fully double glazed?	Yes	925	13,600	(13000, 14100)	1038	3,700	(3500, 3800)
	No	272	16,700	(15400, 18000)	307	4,000	(3700, 4300)
Dwelling insulation	All 3 insulation measures	234	12,300	(11300, 13300)	253	3,500	(3200, 3700)
	2 insulation meas.	363	14,700	(13900, 15500)	403	3,800	(3500, 4000)
	1 insulation meas.	371	15,300	(14300, 16300)	408	4,000	(3800, 4200)
	No insulation meas.	122	16,300	(14400, 18200)	147	4,200	(3700, 4700)

Energy efficiency (SAP09) rating	less than 30	15	*7,600	*(400, 14700)	35	*5,600	*(4100, 7100)
	30 to 50	236	16,300	(15100, 17500)	293	3,900	(3600, 4200)
	51 to 70	845	14,000	(13400, 14600)	902	3,800	(3600, 3900)
	more than 70	101	8,800	(7600, 10100)	115	2,700	(2300, 3100)

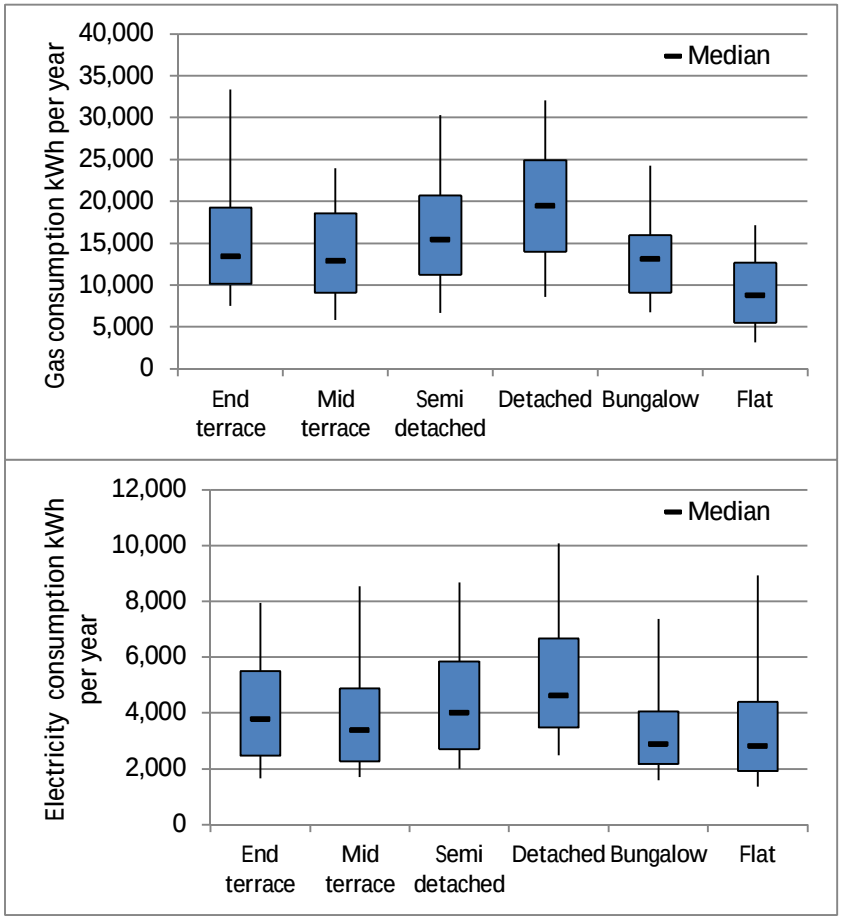
Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

**sample responses are very small and subject to large sampling errors*

3.2.1 Consumption by dwelling type

Table 2 and Figure 3 show the median consumption values for different types of dwellings. Households living in detached dwellings have significantly higher median consumption for both gas and electricity compared to any other dwelling type; conversely, households living in flats have significantly lower median consumption of both fuels compared to other dwelling types (with the exception of bungalows). Clearly, dwelling size is a key driver of the consumption pattern. Flats have a median consumption less than half that of detached houses (8,800 kWh and 19,500 kWh respectively). This pattern matches that reported in the NEED 2010 report, with a median of 19,300 kWh for detached houses and 8,100 kWh for flats. The median electricity consumption for flats is close to that of bungalows, despite flats being significantly smaller on average. One possible explanation for this is the high proportion of electric heating found particularly in purpose built flats, with around 22% of flats using electricity for space heating compared with 6% of bungalows.

Figure 3: Boxplots of household gas and electricity consumption values by dwelling type

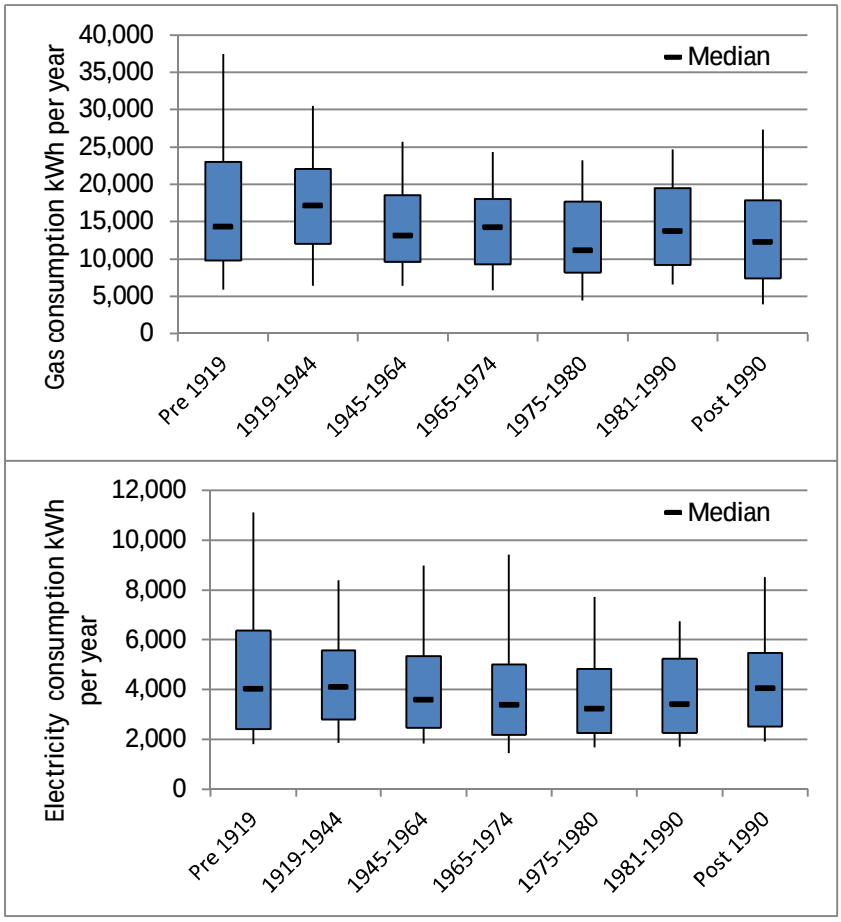


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.2.2 Consumption by dwelling age

It may be expected that fuel consumption would gradually decrease as the construction date of a dwelling becomes more recent due to improvements in energy efficiency standards, but Figure 4 shows a more complex picture. Households living in dwellings built between 1919 and 1944 show a significantly higher median gas consumption than those from other periods with a median of 17,100 kWh per year, a pattern that is also seen in the NEED 2010 report. These households also have a higher median electricity consumption than households living in dwellings built between 1965 and 1980.

Figure 4: Boxplots of household gas and electricity consumption values by dwelling construction date

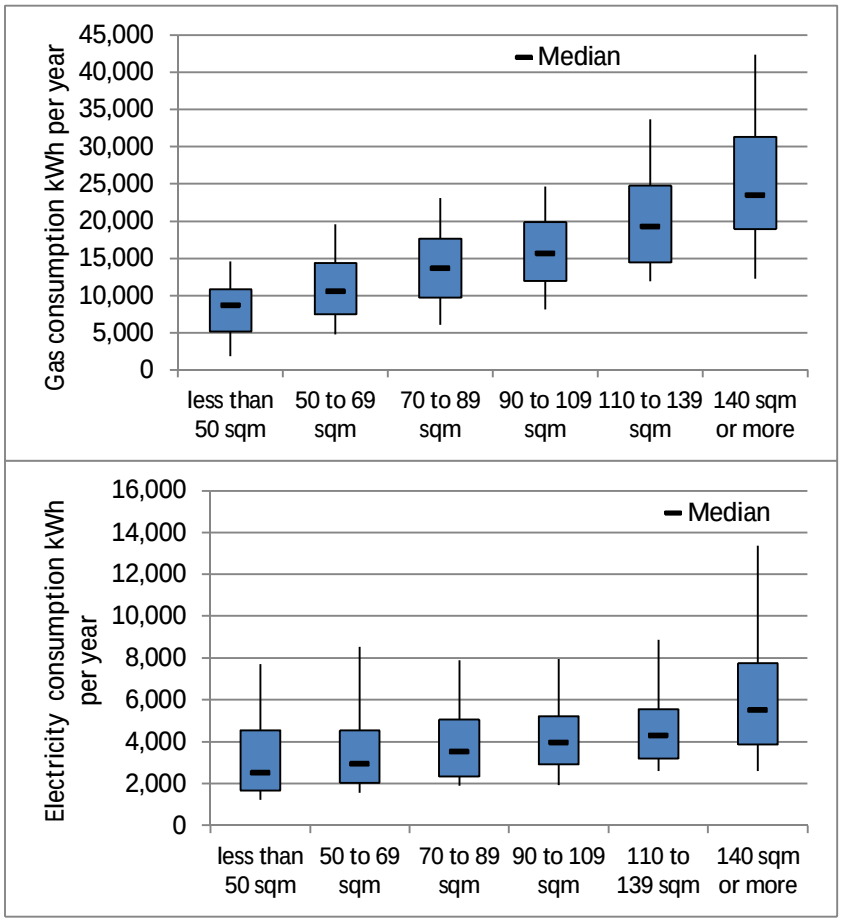


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.2.3 Consumption by floor area

Consumption of both fuels is strongly correlated with dwelling floor area (Figure 3). For gas, the median consumption for each successive floor area band is significantly higher than the previous band, whereas for electricity, the differences are not as distinct although the median consumption in dwellings greater than 140m^2 is significantly higher than all smaller dwellings and the median consumption in the smallest dwellings (<50m^2) is significantly lower than in dwellings larger than 70m$^{2.}$

Figure 5: Boxplots of household gas and electricity consumption values by floor area



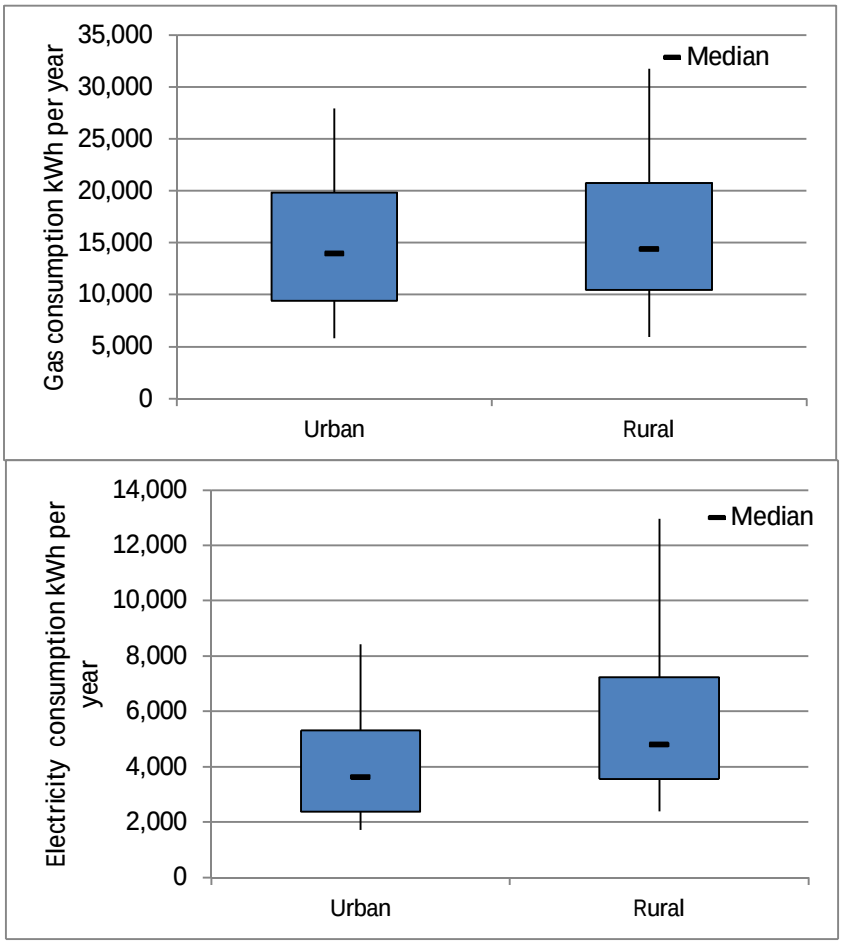
Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.2.4 Consumption by region and area type

Median gas consumption is lower in the South West compared to all other regions. This result was also seen in the NEED 2010 data where it was suggested that reasons may be due to warmer weather in the South-West or different types of properties. Further work to weather-correct the gas consumption values may be necessary before drawing any conclusions about the regional variations in gas consumption. Median electricity consumption is higher in the West Midlands compared to the Eastern region.

There is no statistically significant difference in the median gas consumption between rural and urban areas. However, median electricity consumption is significantly higher in rural areas compared to urban areas, likely to be due to the large number of dwellings here without a gas supply. In these properties, in addition to lights and appliances, electricity is likely to be used either the main heating fuel or as a secondary fuel to an oil or solid fuel supply.

Figure 6: Boxplots of household gas and electricity consumption values by area type



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.2.5 Consumption by energy performance

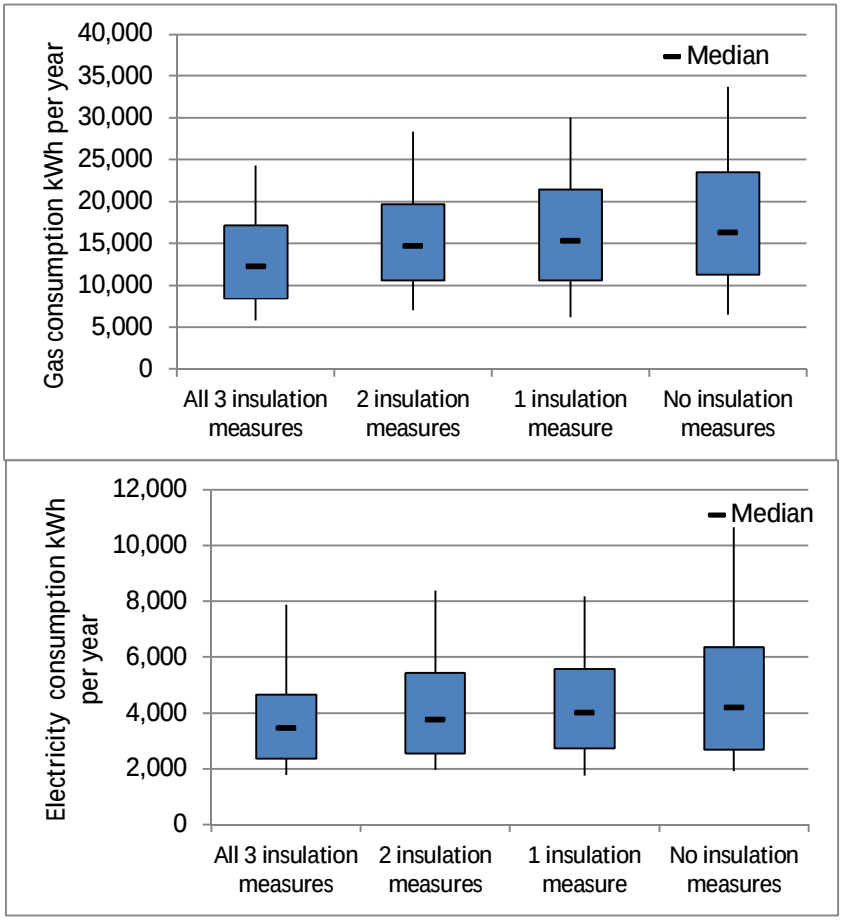
It may be expected that the measured fuel consumption is affected by the energy efficiency of the homes. Figure 7 presents an indicator of how energy consumption varies with levels of wall insulation, loft insulation and presence of double glazing the dwelling. The results are also presented in Table 2 above. Statistical uncertainty affects the conclusions that can be drawn from these results, with confidence intervals overlapping between estimates of consumption of different groups. There are no significant differences in the median consumption of either gas or electricity between dwellings with or without wall insulation, nor in dwellings with differing levels of loft insulation. However, dwellings that are fully double glazed have median gas consumptions that are lower than those dwellings which are not fully double glazed.

The data has also been analysed according to the number of these measures each dwelling has. There is some evidence of lower median gas consumption with increasing levels of different insulation measures, although the only statistically significant difference can be seen between those dwellings with all the insulation measures having both lower gas and electricity consumption than dwellings with no insulation measures.

In terms of gas consumption, the effect of the presence of good insulation on space heating is demonstrated by the 4,000 kWh difference between the medians for dwellings with none of the

measures and those with all three (although other occupancy and dwelling differences between all households will also have an effect in addition to insulation characteristics).

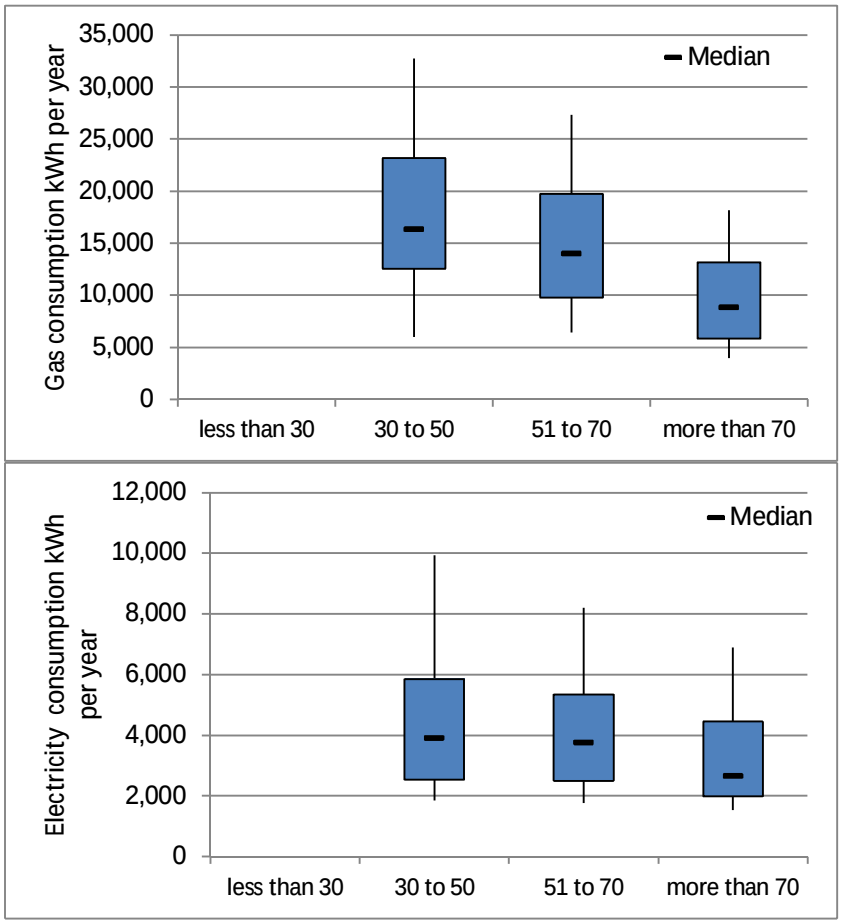
Figure 7: Boxplots of household gas and electricity consumption values for different levels of insulation



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

Energy efficiency can also be considered by examining the SAP rating of different households, shown in Figure 8 and also presented in Table 2 above, with dwellings with higher SAP ratings being more energy efficient. The dwellings with the lowest median gas consumption are in the most energy efficient SAP rating band (>70) with increasing levels of consumption in dwellings as SAP ratings decrease. While building fabric efficiency is a factor in reducing fuel use in higher SAP rated dwellings, the dwelling type also contributes, with 59% of dwellings in the highest SAP band being flats and only 7% being detached houses. Large heat losses from detached houses help to contribute to lower SAP ratings.

Figure 8 Boxplots of household gas and electricity consumption values by SAP rating



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)
**Sample responses for the <30 category are very small and subject to large sampling errors*

3.3 Household consumption patterns

Characteristics relating to the households living within the dwellings (e.g. pensioner present, household income level, tenure) have also been examined for differences in their median consumption levels. Table 3 shows the median (and 95% confidence intervals[7] of the median) consumption across a range of household groups. The 95% confidence intervals show the significance of the differences across categories. As in the previous section, boxplots are also shown to provide an indication of the variability found within each category and detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary.

Table 3: Median (and 95% confidence intervals) gas and electricity consumption across various household groups

Household characteristic	Characteristic category	Annual Gas consumption (kWh)			Annual Electricity consumption (kWh)		
		Sample size	Median	95% CI of the median	*Sample size*	Median	95% CI of the median
Tenure	Owner Occupied	784	15,700	(15100, 16400)	862	4,000	(3800, 4200)
	Private rented	112	11,000	(9200, 12700)	144	3,200	(2800, 3500)
	Local Authority	160	10,100	(9100, 11000)	176	3,100	(2800, 3400)
	RSL	141	11,300	(10200, 12500)	163	3,500	(3100, 4000)
Household size	1	298	10,500	(9700, 11200)	352	2,400	(2200, 2500)
	2	448	14,600	(13700, 15500)	514	3,600	(3400, 3800)
	3	212	15,600	(14300, 17000)	225	4,400	(4000, 4700)
	4	158	17,100	(15800, 18500)	167	4,700	(4300, 5100)
	5 or more	81	17,800	(15800, 19700)	87	6,000	(5300, 6600)
Pensioner Present?	At least one person of pensionable age	474	14,100	(13200, 15000)	553	3,200	(3000, 3400)
	No persons of pensionable age	723	13,900	(13200, 14500)	792	4,000	(3800, 4200)
Children Present?	At least one child	362	15,800	(14900, 16800)	387	4,500	(4200, 4800)
	No children	835	13,500	(12900, 14100)	958	3,300	(3200, 3500)
Age of HRP	16 - 34	132	11,800	(10600, 13100)	152	3,200	(2800, 3600)
	35 - 44	214	13,900	(12900, 15000)	234	4,200	(3800, 4500)
	45 - 54	238	15,300	(14000, 16600)	257	4,600	(4200, 5000)
	55 - 64	252	14,400	(13000, 15800)	280	3,800	(3500, 4100)
	65 - 74	226	14,300	(13000, 15600)	260	3,300	(3000, 3500)
	75 or more	135	13,400	(12000, 14800)	162	2,700	(2400, 3100)
Employment status of HRP and partner combined	1 or more work full time	581	14,700	(14000, 15400)	646	4,100	(3900, 4400)
	1 or more work part time	107	13,900	(12000, 15700)	116	3,700	(3200, 4100)
	none working, one or more retired	391	13,700	(12800, 14600)	448	2,900	(2700, 3100)
	none working and none retired	118	10,800	(9000, 12600)	135	3,600	(3100, 4100)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	241	10,200	(9100, 11200)	291	2,700	(2500, 3000)
	2nd quintile	260	13,400	(12500, 14300)	285	3,300	(3000, 3600)
	3rd quintile	229	12,700	(11600, 13800)	254	3,500	(3200, 3800)
	4th quintile	222	16,200	(15000, 17300)	250	4,200	(3900, 4500)
	5th quintile (highest)	245	17,800	(16600, 19000)	265	4,600	(4200, 4900)
Is anyone in the household at home during the day on a weekday?	No	466	13,800	(13000, 14600)	514	3,800	(3600, 4100)
	Yes	731	14,200	(13600, 14900)	831	3,700	(3500, 3800)
Under-occupying?	Not under-occupying	772	13,300	(12800, 13900)	867	3,800	(3600, 3900)
	Under-occupying	425	15,900	(14800, 17000)	478	3,700	(3400, 3900)
In Fuel Poverty? LIHC definition	Not in fuel poverty	1107	13,800	(13300, 14400)	1234	3,700	(3600, 3900)
	In fuel poverty	90	16,700	(14000, 19400)	111	3,800	(3000, 4600)

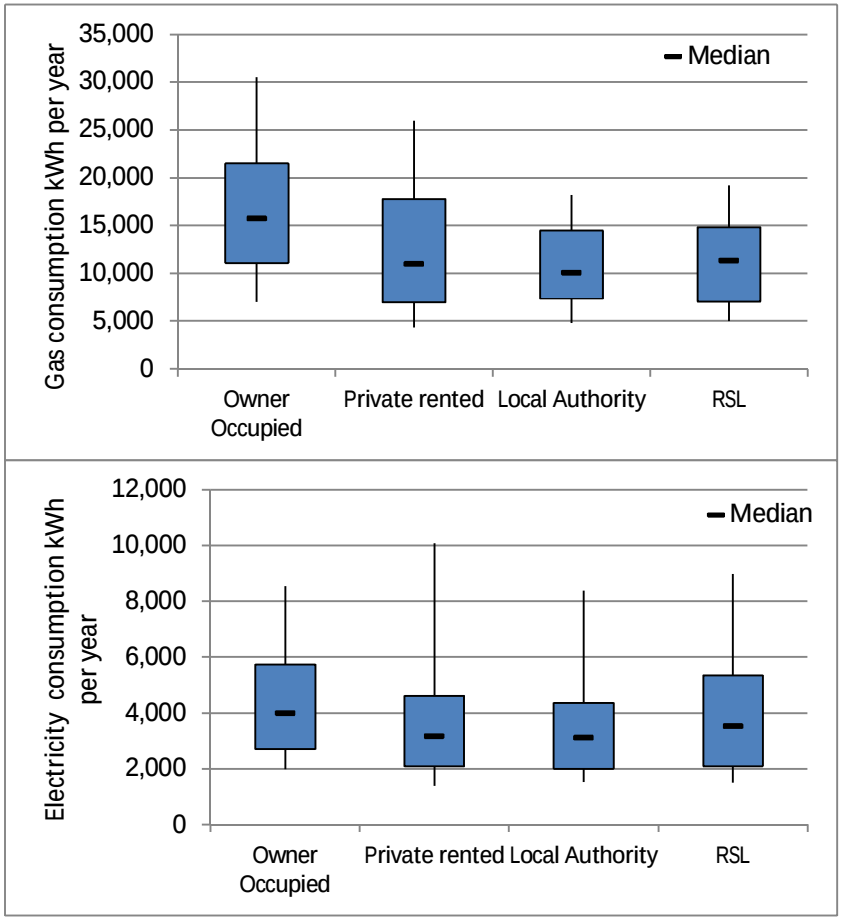
Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.3.1 Consumption by tenure

On average, owner occupiers consume significantly more gas than any other tenure and more electricity than the private rented or local authority tenures (see Figure 9). For both fuels, the

private rented, local authority and RSL tenures show no significant differences in their median annual consumption rates.

Figure 9: Boxplots of household gas and electricity consumption values by tenure

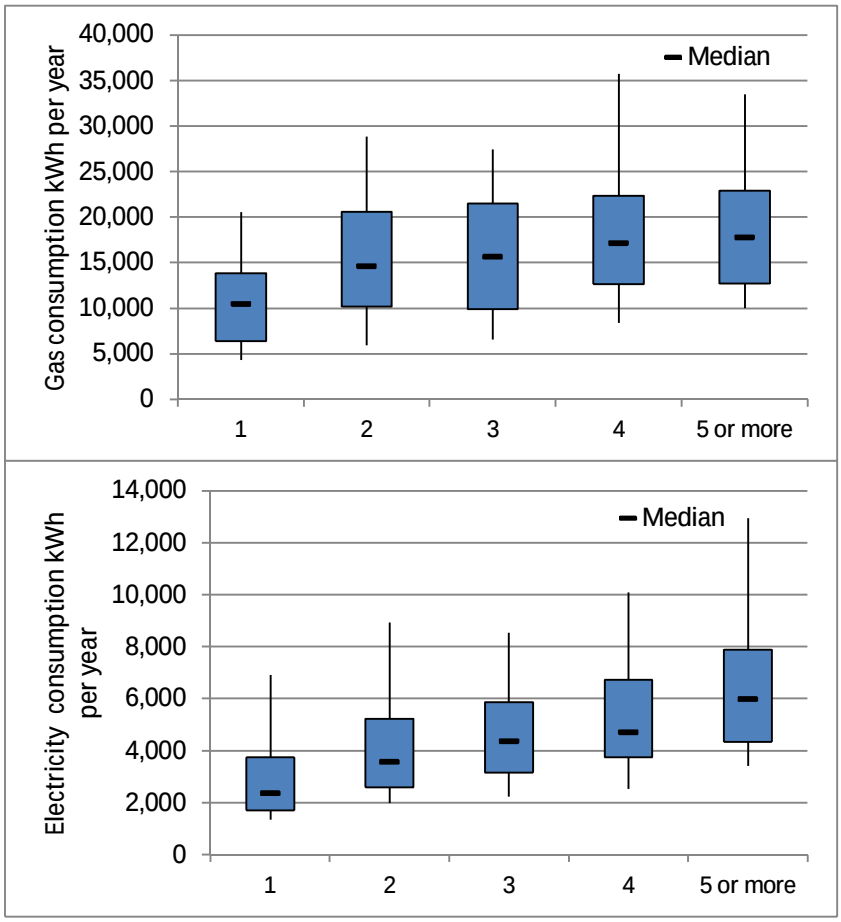


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.3.2 Consumption by household size

Household size has a strong influence on fuel consumption as suggested in Figure 10. Median consumption of both gas and electricity increases as the number of occupants grows, with median gas consumption ranging from 10,500 kWh in a one person household to 17,800 kWh in households where there are at least 5 people and median electricity consumption ranging from 2,400 kWh to 6,000 kWh in single person to 5+ persons households. However for both fuels, the difference in consumption between households with 3 or 4 persons is not statistically significant at the 95% level, nor, for gas consumption only, between households with 3, 4 or 5+ persons.

Figure 10: Boxplots of household gas and electricity consumption values by household size

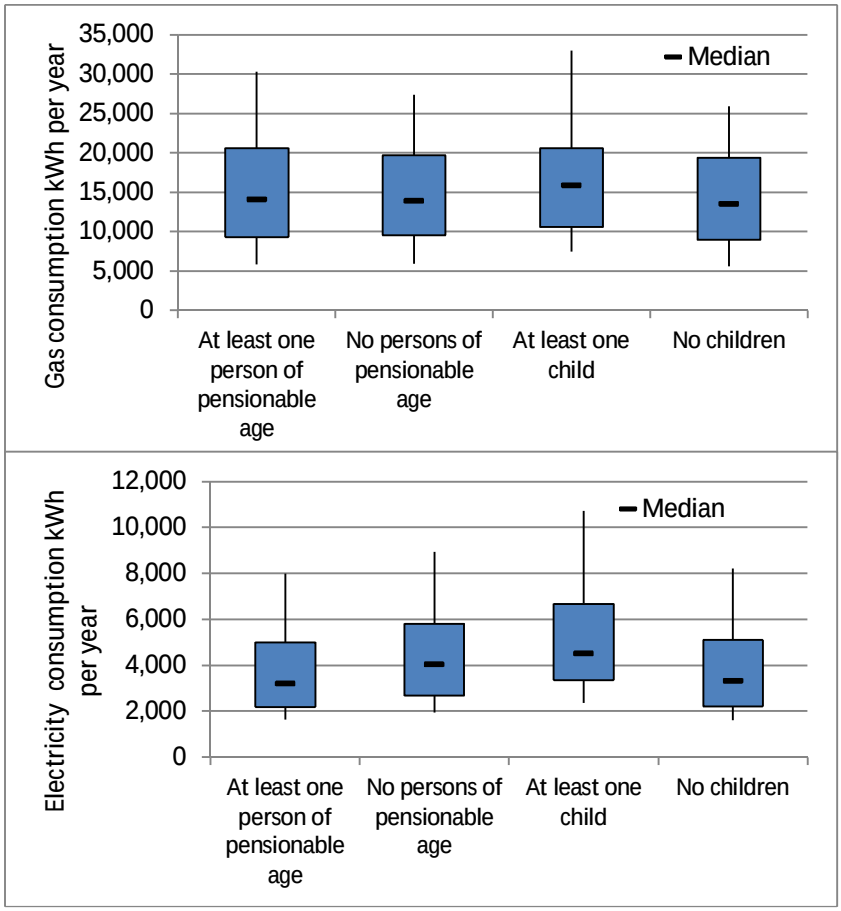


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.3.3 Consumption by household type

The median consumption values for mains gas and electricity for households with and without a pensioner present and households with and without a child present are shown in Figure 11. For gas, there is no significant difference in the median consumption of households with or without a pensioner present, however for electricity the median consumption is lower in households with at least one pensioner present compared to households with no pensioners present. For households with at least one child present, the median consumptions of both gas and electricity are higher than in households with at least one child present compared to households without any children.

Figure 11: Boxplots of household gas and electricity consumption values by pensioner present and children present

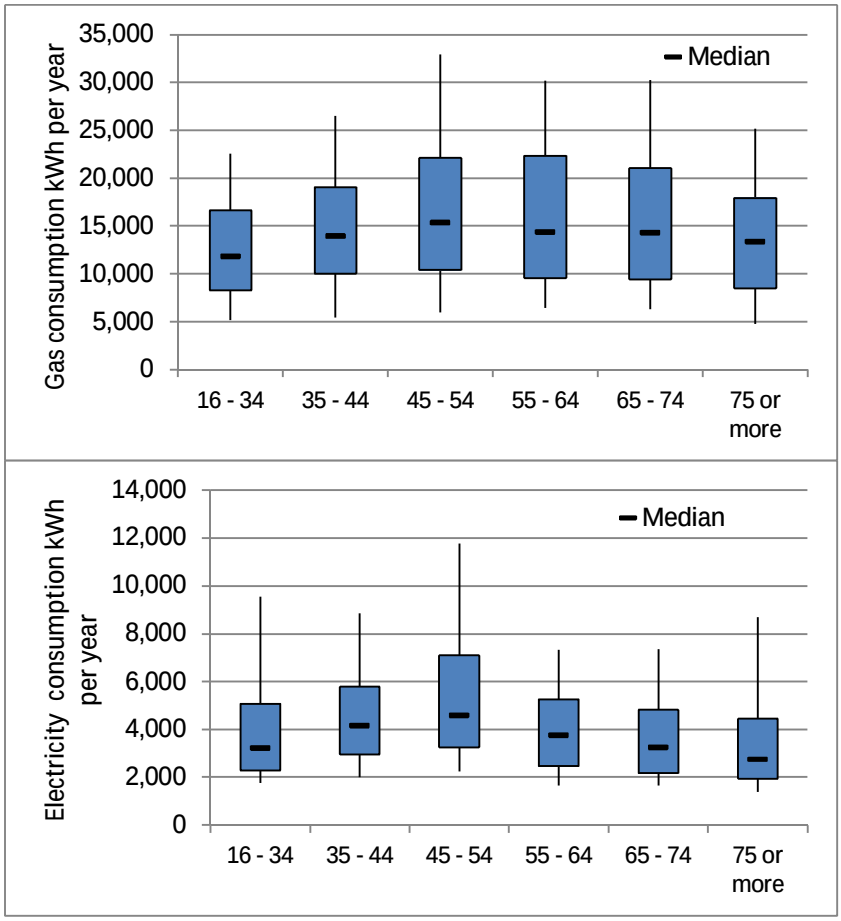


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.3.4 Consumption by age of household reference person (HRP)

Figure 12 shows the median consumption based on the age of the household reference person (HRP). Households in which the HRP is between 45-54 years old have a statistically significantly higher median gas consumption than households in which the HRP is between 16-34 years old; none of the differences between other age groups are statistically significant for median gas consumption. For electricity consumption, the median use by households in which the HRP is aged between 45-54 years old is higher than all other age groups except households in which the HRP is aged between 35-44 years old.

Figure 12: Boxplots of household gas and electricity consumption values by the age of the household reference person



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

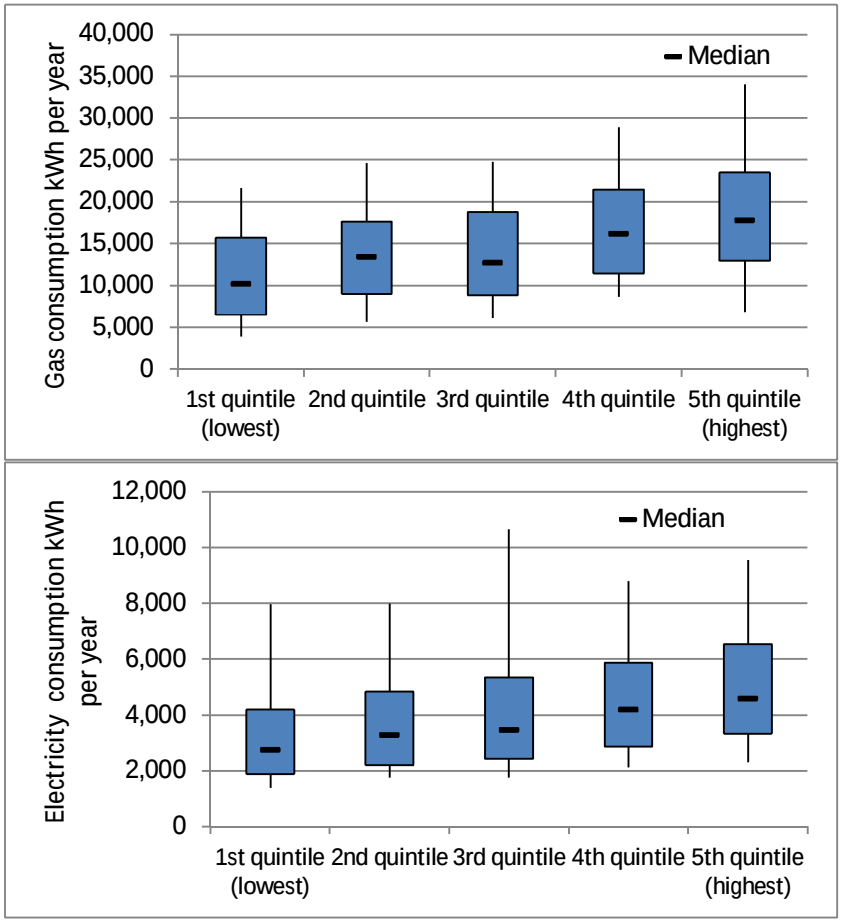
3.3.5 Consumption by household employment status and income

Median gas consumption is statistically significantly lower for households in which occupants are long-term sick and/or unemployed compared to households in which one or more persons are either working full time or are retired. Median electricity consumption is lower in households in which none of the occupants are working but one or more is retired compared to any of the other employment categories.

The consumption patterns by household income quintile are shown in Figure 13. Median gas consumption is lower for households in the lowest income quintile compared to households in all other income quintiles with around 7,500 kWh separating the median gas consumption in the highest and lowest income quintiles. Households with incomes in the top two income quintiles also have a statistically higher median gas consumption than households in the first three income quintiles however there are no significant differences between median gas consumptions in households in quintile two compared to three, and quintiles four compared to five. In fact, a discrepancy in the pattern is shown by a fall in median gas consumption values between the second and third quintiles. Initial analysis suggests that this may be due to the higher proportion of single person households in full time work in the third quintile compared to the second. These households typically occupy smaller dwellings and therefore have a lower gas consumption. Multivariate analysis would be required to investigate this further.

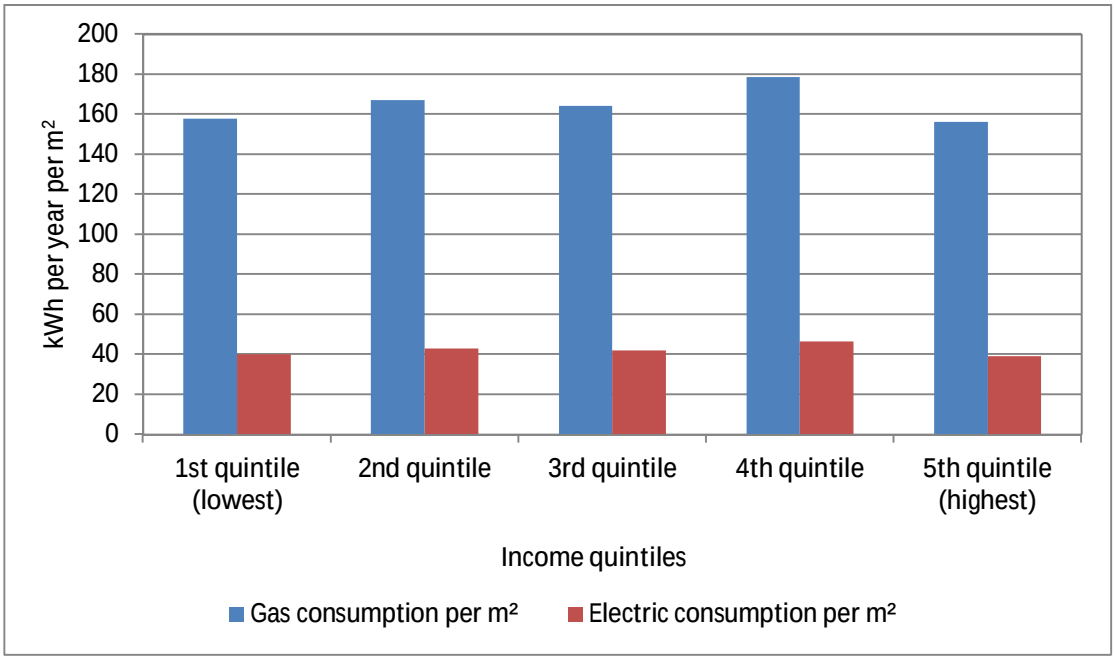
The median electricity consumption increases as the income quintiles increase, however the difference is only statistically significant between the first income quintile and the top three income quintiles. The trend of higher use of both gas and electricity and higher incomes is what might be expected when considering the larger size of dwelling that might typically be associated with high incomes and the ability to afford higher fuel bills. In fact, the consequence of high income households living in larger homes can be seen by comparing Figure 13 with Figure 14. Here consumption has been normalised to the floor area of each dwelling, resulting in a fairly uniform median annual consumption of both fuels across the income quintiles.

Figure 13: Boxplots of household gas and electricity consumption values by income quintiles



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

Figure 14: Median consumption values per m^2 of dwelling floor area by income quintiles

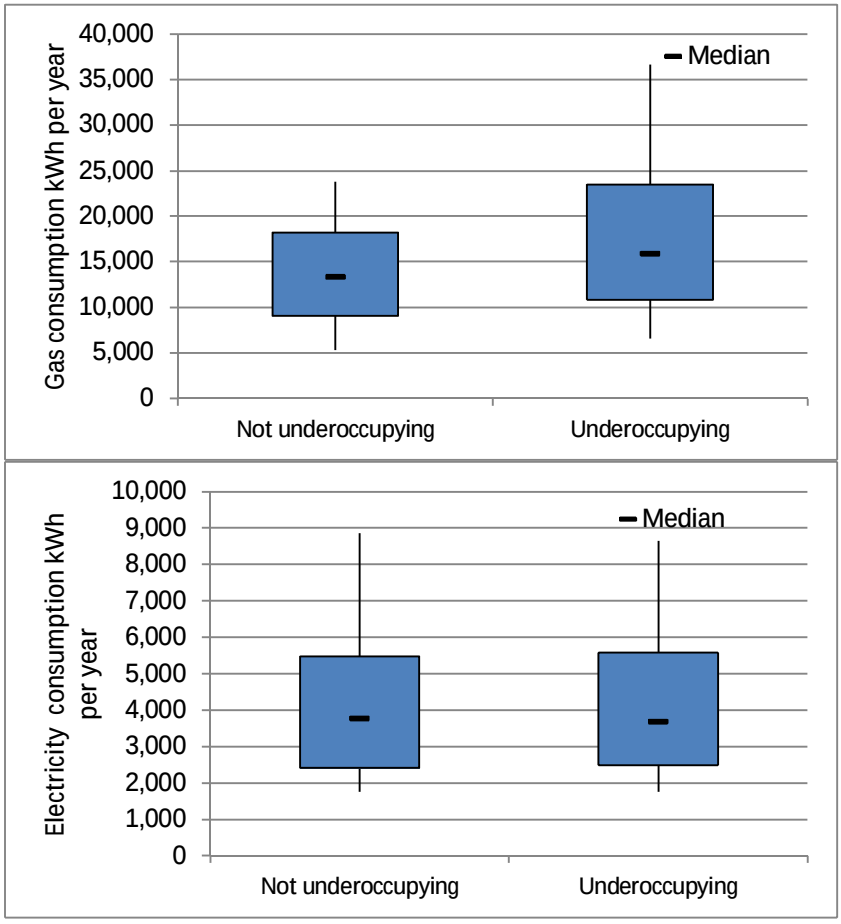


Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

3.3.6 Consumption by occupancy characteristics

Table 3 shows that there are no significant differences in the median consumption values of either gas or electricity between households in which someone is in during the day and households in which no-one is in during the day. There is, however a difference in the median gas consumption for households which are considered to be under-occupied compared to those not under-occupying, as shown in Figure 15. There is a difference of around 2,500 kWh for median gas consumption values. The higher figure for those under-occupying is indicative of the extra space heating used by these households in typically much larger dwellings. The mean floor area for an under-occupied dwelling is $127m^2$ compared with $76m^2$ for those not under-occupying. There is no significant difference in the median electricity consumption between households under-occupying or not.

Figure 15: Boxplots of household gas and electricity consumption values by under-occupation indicator



Base: All households in the metered consumption sub-sample (n=1197 for gas; n=1345 for electricity)

4 Conclusions

The results of the analysis of fuel consumption from a subset of 1,345 dwellings of the EFUS 2011 are presented in this report. The report presents analysis at the headline level, revealing key patterns in energy consumption across the stock.

The main findings of the analysis are:

- The meter reading data reveal a wide range in energy consumption across the household stock. For gas, annualised consumption values ranged from a minimum of 300 kWh and a maximum of 76,500 kWh. For electricity, annualised consumption values ranged from a minimum of 400 kWh and a maximum of 35,100 kWh. For both fuels, the frequency distributions show considerable tailing towards the higher electricity consumption values, resulting in mean values that are considerably higher than the median values.

- The median annual mains gas consumption determined using the EFUS meter reading data is around 14,000 kWh, with a median value of around 3,700 kWh for electricity.

- 80% of households use between 5,900 to 28,000 kWh of gas per annum and between 1,800 and 8,800 kWh of electricity per annum.

- Significant differences are found in the median consumption levels for different categories of dwelling and household types. Gas use is closely linked to dwelling floor area as well as household size, with detached houses having a median gas consumption more than twice that found in flats. Electricity use appears related to the number of people in the household, with the data showing a median consumption of around 2,400 kWh for single people, compared with a figure of around 6,000 kWh where there are at least five people in the household.

- Households living in dwellings built between 1919 and 1944 show a significantly higher median gas consumption than those from other periods with a median of 17,100 kWh per year, a pattern that is also seen in the NEED 2010 analysis. These households also have a higher median electricity consumption than households living in dwellings built betwen1965 and 1980.

- There is no statistically significant difference in the median gas consumption of households living in rural or urban areas. However, median electricity consumption is significantly higher in households in rural areas compared to urban areas, likely to be due to the large number of dwellings here without a gas supply. In these properties, in addition to lights and appliances, electricity is likely to be used either the main heating fuel or as a secondary fuel to an oil or solid fuel supply.

- There are no significant differences in the median consumption of either gas or electricity between households living in dwellings with or without wall insulation, nor between households living in dwellings with differing levels of loft insulation. However, households living in dwellings that are fully double glazed have median gas consumptions that are lower than those households living in dwellings which are not fully double glazed. There is some evidence of lower median gas consumption with increasing levels of different insulation measures, although the only statistically significant difference can be seen between those

households living in 'well insulated' dwellings (three insulation measures) having both lower gas and electricity consumption than households living in 'poorly insulated' dwellings.

- On average, owner occupiers consume significantly more gas than any other tenure and more electricity than the private rented or local authority tenures. For both fuels, the private rented, local authority and RSL tenures show no significant differences in their median annual consumption rates.

- Median gas consumption is lower for households in the lowest income quintile compared to households in all other income quintiles with around 7,500 kWh separating the median gas consumption in the highest and lowest income quintiles. The median electricity consumption increases as the income quintiles increase, however the difference is only statistically significant between the first income quintile and the top three income quintiles. The trend of higher use of both gas and electricity and higher incomes is what might be expected when considering the larger size of dwelling that might typically be associated with high incomes and the ability to afford higher fuel bills and in fact, similar median values are found for all income groups when the consumption is normalised for floor area.

- There are no significant differences in the median consumption values of either gas or electricity between households in which someone is in during the day and households in which no-one is in during the day. In dwellings where the household is said to be under-occupying, those that are excessive in size for the number of occupants, the median gas consumption is significantly higher than where they are not under-occupying.

This report has provided an overview of gas and electricity consumption across the housing stock. More specific analysis of high energy using households is presented in Annex A. Further analysis of how consumption varies by main heating system type and how households typically use them, and household underspending can be found in the EFUS 2011 Main Heating Systems and EFUS 2011 Household Underspend reports.

Annex A: Focus on High Energy Users

Executive Summary

This annex includes analysis which combines the information obtained from the household interview survey and the temperature monitoring data in order to investigate if certain types of households are more likely to be high energy consumers. For the purposes of this analysis, high gas consumers have been defined as those households with metered gas consumptions in the top 10% of weighted values obtained during the survey; the same has been done for high electricity consumers using the electricity consumption values. Analysis is based on the meter reading sub-sample weighted to the national level, using a weighting factor specific to the meter reading sub-sample. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households.

The results from the EFUS survey show that households in the top 10% of gas consumers are all in dwellings using mains gas as their primary heating fuel and therefore it is the factors influencing the energy required for space heating that are of primary interest for gas consumption. It has previously been reported that dwelling size appears to be the strongest driver of energy consumption (DECC, 2012). The EFUS data corroborates the trend that on average, higher gas consumptions were largely associated with larger dwelling floor areas whilst providing additional evidence to show that other factors must also play a role.

For electricity consumption, apart from those households with electric main heating systems, electricity use is predominantly for lights and appliances and therefore usage is additionally influenced by the number of persons in the household (higher consumptions arising from larger household numbers).

In order to try to understand any 'secondary' influences outside of these major drivers, this analysis by dwelling and household characteristics has considered high users in terms of those households in the top 10% of weighted values of total gas consumption and total electricity consumption, as well as those households in the top 10% of weighted values of gas consumption per m^2 and electricity consumption per person. The results show that the two approaches (total versus normalised) reveal variations in the percentage of high consumers within the dwelling and household categories and that it is the analysis by the gas per m^2 and electricity per person consumptions that are most helpful in assessing the potential determinants of high energy use.

In terms of gas consumption, the results suggest that the strongest determinants for households having the highest (total) gas consumptions are likely to be:

- Dwelling type, dwelling age, floor area, tenure, household size, age of HRP, household income quintiles and under-occupancy status.

However, the underlying influence of floor area for some of these characteristics is clearly the key driver as many of the differences in the percentage of high (total) gas consumers across the categories within these characteristics disappear when the analysis is carried out on the gas consumption/m^2.

From the analysis of gas consumption/m^2, it is seen that the strongest determinants for households being high consumers are likely to be:

- Dwelling age - households living in dwellings built 1919-1944 are more likely to be in the top 10% of gas consumers *per* m^2 than households living in dwellings built in 1975-1980 or post 1990.
- Floor area - households that live in the largest dwellings (>140m^2) are *less* likely to be in the top 10% of gas consumption *per* m^2 than those households in dwellings smaller than 90m^2.
- Under-occupancy - households under-occupying are *less* likely to be in top 10% of gas consumers than those not under-occupying

There appears to be little influence from the dwelling fabric efficiency (i.e. number of insulation measures) as to whether a household is more likely to be a high gas consumer.

This analysis has found that key driver of high electricity use is whether the household uses an electrically fuelled main heating system. Only a small proportion (~10%) of dwellings in England have an electrically fuelled main heating system so although this is a strong indicator that a household will have higher electricity consumption it is limited in its usefulness.

Excluding those households that use an electric main heating system, characteristics which show differences in the percentage of high (total) electricity consumption across categories are floor area, age of the Household Reference Person, the number of appliances in the household, the number of showers taken and the number of televisions. The underlying influence for many of these is likely to be the number of persons in the household.

When the electricity consumption is normalised to household size, significant differences across categories remain for the characteristics of:

- dwelling age - households living in dwellings built pre-1919 are more likely to be in the top 10% of *per person* electricity consumption than those living in dwellings built from 1975-1980.
- Region - households living in the South-East are more likely to be in the top 10% of *per person* electricity consumption than those living in Yorkshire and the Humber.
- Number of persons in the household - single occupants are significantly more likely to be in the top 10% of electricity *per person* consumers than households with four or more persons. This suggests that there is a baseline requirement of electricity use that the smallest households have but that further increases in electricity consumption due to larger household numbers are not linear.

These results provide an indication of the variables that could be considered as predictor variables for targeting high energy users.

A1 Introduction and Methodology

This analysis combines the information obtained from the household interview survey with meter reading data in order to investigate if certain types of households are more likely to be high energy consumers. For the purposes of this analysis, high gas consumers have been defined as those households with metered gas consumptions in the top 10% of weighted values obtained during the survey; the same has been done for high electricity consumers using the electricity consumption values. Analysis is based on the meter reading sub-sample weighted to the national level, using a weighting factor specific to the meter reading sub-sample. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households.

There were no specific modelling outcomes required from this work. Rather, the objective of this report was to show the potential the EFUS datasets offer in order to investigate a topic such as 'High energy users', and to provide a starting platform from which other users can explore further. The approach taken for this report has been to focus on each dwelling and household attribute (for example, tenure) and compare the proportions of high consuming households across each of the categories within that attribute (for example, are owner occupiers more likely to be high consuming households than private renters?).

A key component of this analysis process has been the linkage of the EFUS data to key dwelling and household descriptor variables collected in the interview and physical survey components of the 2010 English Housing Survey (EHS). In this analysis (as in the majority of the companion reports in this EFUS series) simple bivariate comparisons between the variable under consideration and individual descriptor variables have been performed in order to provide preliminary results and identify bivariate trends. It should be recognised, however, that subsequent investigations using more sophisticated statistical analysis may assist in the interpretation of results.

A total of 2,616 interviews were completed as part of the EFUS 2011 interview survey and just over half of these (1,345 cases) made up the subset of dwellings that had valid meter readings recorded (51% of total EFUS sample). Of these, 1197 cases had a mains gas supply and produced valid gas consumptions (89% of the meter reading sample). A detailed description of the methodology used to collect, process and validate the meter reading data can be found in the methodology section of the main EFUS 2011 Methodology report.

As described in the main body of the EFUS 2011 Metered Fuel Consumption report (to which this analysis forms an annex), the meter reading data produced a wide range of consumptions with some significant differences in the median household consumptions found for different categories of dwelling or household.

To investigate the high energy users, decile bands of the household consumption values were created[9] and households in the tenth (highest) decile band denoted as 'high consumers'. The highest 10% of gas consumers used between 28,000 and 76,500 kWh of gas and the highest 10% of electricity consumers used between 8,800 and 35,100 kWh of electricity. Households within the top 10% of gas and electricity consumption have been compared to the rest of the households (bottom

[9] the weighted household consumption values were divided into 10 bands with equal number of households. Raw sample sizes are 117 cases in the top 10% of gas consumers and 129 cases in the top 10% of electricity consumers.

90% of consumption) with regards to various dwelling and household characteristics to see if there are any underlying trends for these high consumptions.

However, as described in the main body of the EFUS Metered Fuel Consumption report, higher gas consumptions are largely associated with larger dwelling floor areas; the result of gas use being predominantly for space heating. For electricity consumption, apart from those households with electric main heating systems (6% of households), usage is likely to be additionally influenced by the number of persons in the household (higher consumptions arising from larger household numbers) as electricity use is predominantly for lights and appliances. In order to try to understand any 'secondary' influences outside of these major drivers, the analysis by dwelling and household characteristics was repeated by creating decile bands of the household gas consumption per m^2 and household electricity consumption per person and denoting the tenth (highest) decile band of each of these as 'high consumers'. The analysis for this report has therefore considered:

a) *total consumption* and the consumption *per m^2* for gas

b) *total consumption* and the consumption *per person* for electricity

It is essential to recognise that data on the highest 10% of energy users represents a small sub-sample of the EFUS – i.e. around 150 cases. As a result the sample errors are significantly higher with these data than other aspects of EFUS reporting. In this report differences between groups are only reported if they are significant at the 95% confidence level[10], and due to the small size of this sub-sample, readers are recommended to pay particular attention to confidence intervals presented in the tables.

A2 Findings

A2.1 High gas consumers

It was reported in Annex C of the National Energy Efficiency Data-Framework (NEED) Report[11] that property size appears to be the strongest individual driver of energy consumption. The strong influence of floor areas on gas consumption can also be seen in the EFUS data as the mean floor area for the top 10% of gas consumers is 143m^2 compared to 88m^2 for the rest of households (Table A1).

Table A1: Average floor area for the top 10% of gas consumers

	Top 10% of gas consumers	Bottom 90% of gas consumers
Mean Floor area (m^2)	143.0	88.4
95% confidence interval (m^2)	*(127.6, 158.2)*	*(86.0, 90.7)*

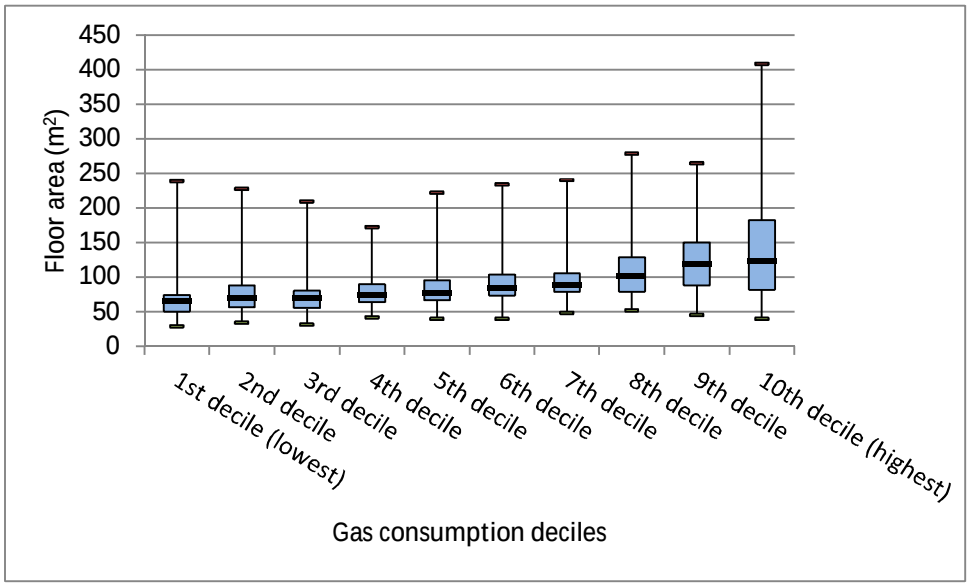
Base: All households with gas in EFUS 2011 meter reading sub-sample (n=1197)

[10] 95% confidence intervals around a mean value have been calculated using a design factor of 1.1. See Methodology report for more details.

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65972/6873-need-report-annex-c.pdf

However (as also found in the NEED analysis) there is a considerable range in gas consumption values within each floor area band. By using the EFUS data to look specifically at the highest consuming group, the floor areas of households within the top 10% of gas consumers range from 40m^2 to 408m^2. Figure A1 highlights not only the large variation in dwelling sizes within the highest 10% of gas consumers group, but also the large range of floor areas within the lower consumers as well, although the trend is clear that the largest dwellings will have the highest gas consumptions.

Figure A1: Boxplot of the distribution of floor areas within each decile group of gas consumption values



Base: All households with gas in EFUS 2011 meter reading sub-sample (n=1197)

It is clear that although large floor areas are likely to be the most significant determinant of households with the highest gas consumptions, a large component of the consumption is governed by other dwelling characteristics and household behaviours. The following sections look in turn at a number of dwelling (Section 2.1.1) and household (Section 2.1.2) characteristics to try to gain further insight into the potential drivers for the highest energy consumers. Detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary.

Only differences that are significant at the 95% confidence level have been reported on below, and readers are advised to note the confidence intervals which are considerably wider for the highest 10% of gas consumers due to the small sample size being examined.

A2.1.1 Analysis by dwelling characteristics

Characteristics relating to the physical properties of the dwelling, (e.g. dwelling age and type, location and level of insulation,) have been looked at and Table A2 shows the percentage of households in each category of the characteristic type that are high gas users, both in terms of total gas consumption and gas consumption per m^2. The 95% confidence intervals of the percentages show the significance of the differences across categories. Detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary.

Table A2: Proportion of dwelling type within the top decile band (and bottom 90% band) of total gas consumption and gas consumption per m^2

Dwelling characteristic	Characteristic category	*Sample size*	Proportion of category that is in the top 10% of gas consumers		Proportion of category that is in the bottom 90% of gas consumers		Proportion of category that is in the top 10% of gas consumption *per* m^2		Proportion of category that is in the bottom 90% of gas consumption *per* m^2	
			Row %	95% CI	Row %	95% CI	Row %	95% CI	Row %	95% CI
Dwelling type	End terrace	137	13	(7, 20)	87	(80, 93)	13	(7, 19)	87	(81, 93)
	Mid terrace	214	7	(3, 11)	93	(89, 97)	10	(6, 15)	90	(85, 94)
	Semi detached	363	11	(8, 15)	89	(85, 92)	11	(8, 15)	89	(85, 92)
	Detached	216	16	(10,	84	(79, 90)	5	(2, 9)	95	(91, 98)
	Bungalow	117	8	(3, 13)	92	(87, 97)	11	(5, 18)	89	(82, 95)
	Flat	150	2	(0, 5)	98	(95,	10	(5, 16)	90	(84, 95)
Dwelling type	House/	1047	11	(9, 13)	89	(87, 91)	10	(8, 12)	90	(88, 92)
	Flat	150	2	(0, 5)	98	(95,	10	(5, 16)	90	(84, 95)
Dwelling Age	Pre 1919	170	17	(11,	83	(76, 89)	9	(4, 14)	91	(86, 96)
	1919-1944	223	12	(7, 16)	88	(84, 93)	17	(12, 23)	83	(77, 88)
	1945-1964	293	8	(5, 12)	92	(88, 95)	11	(7, 14)	89	(86, 93)
	1965-1974	181	7	(3, 11)	93	(89, 97)	9	(4, 13)	91	(87, 96)
	1975-1980	84	5	(0, 10)	95	(90,	5	(0, 10)	95	(90, 100)
	1981-1990	90	7	(1, 12)	93	(88, 99)	8	(2, 14)	92	(86, 98)
	Post 1990	156	9	(4, 14)	91	(86, 96)	5	(1, 9)	95	(91, 99)
Useable floor area	< 50 m^2	95	4	(0, 9)	96	(91,	16	(8, 24)	84	(76, 92)
	50 to 69 m^2	264	4	(1, 6)	96	(94, 99)	16	(11, 20)	84	(80, 89)
	70 to 89 m^2	372	6	(3, 9)	94	(91, 97)	10	(6, 13)	90	(87, 94)
	90 to 109 m^2	184	7	(3, 11)	93	(89, 97)	8	(3, 12)	92	(88, 97)
	110 to 139 m^2	138	15	(9, 22)	85	(78, 91)	8	(3, 13)	92	(87, 97)
	≥140 m^2	144	34	(25,	66	(58, 75)	2	(0, 4)	98	(96, 101)
Region - EHS order	North East	91	12	(5, 19)	88	(81, 95)	17	(9, 26)	83	(74, 91)
	North West	209	14	(9, 20)	86	(80, 91)	11	(7, 16)	89	(84, 93)
	Yorkshire and the Humber	174	9	(4, 13)	91	(87, 96)	16	(10, 22)	84	(78, 90)
	East Midlands	81	12	(4, 19)	88	(81, 96)	11	(3, 18)	89	(82, 97)
	West Midlands	112	8	(2, 13)	92	(87, 98)	9	(3, 15)	91	(85, 97)
	East	130	9	(3, 14)	91	(86, 97)	9	(3, 14)	91	(86, 97)
	London	120	12	(5, 18)	88	(82, 95)	10	(4, 16)	90	(84, 96)
	South East	167	7	(3, 12)	93	(88, 97)	6	(2, 10)	94	(90, 98)
	South West	113	8	(2, 13)	92	(87, 98)	6	(1, 10)	94	(90, 99)
Urban or rural location?	Urban	1134	10	(8, 12)	90	(88, 92)	10	(8, 12)	90	(88, 92)
	Rural	63	11	(3, 20)	89	(80, 97)	6	(0, 12)	94	(88, 101)
Type of heating system	Central	1172	10	(8, 12)	90	(88, 92)	10	(8, 12)	90	(88, 92)
	Non-Central	25	2	(0, 8)	98	(92,	2	(0, 8)	98	(92, 104)
Main fuel	Mains gas	1176	10	(8, 12)	90	(88, 92)	10	(8, 12)	90	(88, 92)
	Electricity	14	0	(0, 0)	100	(100,	0	(0, 0)	100	(100,
	Other	7	0	(0, 0)	100	(100,	0	(0, 0)	100	(100,

Are the walls of the dwelling insulated?	Insulated	594	9	(6, 11)	91	(89, 94)	10	(7, 13)	90	(87, 93)
	Not insulated	603	11	(8, 14)	89	(86, 92)	10	(7, 13)	90	(87, 93)
Loft insulation	<50mm	63	16	(6, 26)	84	(74, 94)	8	(0, 15)	92	(85, 100)
	50-149mm	467	11	(8, 14)	89	(86, 92)	12	(9, 15)	88	(85, 91)
	150+ mm	560	9	(7, 12)	91	(88, 93)	9	(6, 11)	91	(89, 94)
Is dwelling fully double glazed?	Yes	925	8	(6, 10)	92	(90, 94)	10	(8, 13)	90	(87, 92)
	No	272	15	(10,	85	(81, 90)	9	(5, 12)	91	(88, 95)
Dwelling insulation	All 3 insulation	234	7	(4, 11)	93	(89, 96)	9	(5, 13)	91	(87, 95)
	2 insulation	363	10	(7, 14)	90	(86, 93)	12	(8, 15)	88	(85, 92)
	1 insulation	371	11	(8, 15)	89	(85, 92)	10	(7, 13)	90	(87, 93)
	No insulation	122	15	(8, 22)	85	(78, 92)	8	(3, 14)	92	(86, 97)
Energy efficiency (SAP09) rating	less than 30	15	18	(0, 39)	82	(61,	0	(0, 0)	100	(100,
	30 to 50	236	13	(8, 17)	87	(83, 92)	13	(8, 17)	87	(83, 92)
	51 to 70	845	10	(8, 12)	90	(88, 92)	10	(8, 12)	90	(88, 92)
	more than 70	101	4	(0, 8)	96	(92,	7	(1, 12)	93	(88, 99)

Base: All households with gas in EFUS Metered consumption sub-sample (n=1197).

Significant differences in the percentage of households that are high (total) gas consumers are seen within the dwelling type, dwelling age and dwelling floor area characteristics.

Households living in detached, semi-detached or end-terrace dwellings are more likely to be in the high (total) gas consuming group than those living in flats. However, when gas consumption is normalised to floor area, there are no significant differences in the percentage of households in the top 10% of gas consumption *per m*^{2}between different dwelling types.

In terms of dwelling age, those households living in pre-1919 dwellings are more likely to be in the top 10% of gas consuming households than households living in dwellings built 1975-1980. However, this changes when gas consumption is normalised to floor area as so that households living in dwellings built 1919-1944 are more likely to be in the top 10% of gas consumers *per m*^{2} than households living in dwellings built in 1975-1980 or post 1990.

The relationship between dwelling size and gas consumption has already been mentioned in this report and the results presented in Table A2 confirm that households in the largest dwellings (>140m^2) are more likely to be the top 10% of gas consumers than those living in anything smaller. However, looking at gas consumption *per m*^{2}, households that live in dwellings >140m^2 are actually *less* likely to be in the top 10% of gas consumption *per m*^{2} than those households in dwellings smaller than 90m^2.

A2.1.2 Analysis by household characteristics and heating patterns

This section describes the differences in the percentage of high gas consumers across the categories within various household and also uses variables derived (and reported in the 'Main Heating Systems' report in this series) from the householder responses to questions in the EFUS Interview survey about their heating patterns. Variables that have been investigated are the tenure of the household, the household size (number of occupants), whether there are children or pensioners present, the age of the Household Reference Person (HRP), the employment status and income of the household, two variables relating to occupancy (whether someone in the household is in during the day and whether the household is considered to be under-occupying) and the fuel poverty status

of the household. Detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary. In terms of heating patterns, the variables that have been examined are:

- how many months the household reported their heating to be on for,
- the number of hours the main heating is on for (daily and yearly),
- if the household reported that their main heating wasn't used at all,
- the mean room temperatures monitored in the living room and rest of dwelling during the heating season.

Table A3 shows the percentage of households in each category of the characteristic type that are high gas users, both in terms of total gas consumption and gas consumption per m^2. The 95% confidence intervals of the percentages show the significance of the differences across categories.

Table A3: Proportion of household type within the top decile band (and bottom 90% band) of total gas consumption and gas consumption per m^2

Household characteristic	Characteristic category	*Sample size*	Proportion of category that is		Proportion of category that is in		Proportion of category that is in		Proportion of category that is in	
			Row %	95% CI	Row %	95% CI	Row %	95% CI	Row %	95% CI
Tenure	Owner Occupied	784	12	(10, 15)	88	(85, 90)	9	(7, 12)	91	(88, 93)
	Private rented	112	9	(3, 14)	91	(86, 97)	10	(4, 16)	90	(84, 96)
	Local Authority	160	3	(0, 7)	97	(93, 100)	14	(8, 20)	86	(80, 92)
	RSL	141	2	(0, 4)	98	(96, 101)	10	(5, 16)	90	(84, 95)
Household size	1	298	4	(2, 7)	96	(93, 98)	8	(5, 12)	92	(88, 95)
	2	448	11	(8, 14)	89	(86, 92)	10	(7, 13)	90	(87, 93)
	3	212	10	(5, 14)	90	(86, 95)	12	(7, 17)	88	(83, 93)
	4	158	16	(10, 22)	84	(78, 90)	10	(5, 15)	90	(85, 95)
	5 or more	81	15	(7, 24)	85	(76, 93)	10	(3, 17)	90	(83, 97)
Pensioner Present?	At least one person of	474	11	(8, 14)	89	(86, 92)	11	(8, 14)	89	(86, 92)
	No persons of pensionable	723	10	(7, 12)	90	(88, 93)	10	(7, 12)	90	(88, 93)
Children Present?	At least one child	362	13	(9, 16)	87	(84, 91)	12	(9, 16)	88	(84, 91)
	No children	835	9	(7, 11)	91	(89, 93)	9	(7, 11)	91	(89, 93)
Age of HRP	16 - 34	132	4	(0, 8)	96	(92, 100)	9	(4, 14)	91	(86, 96)
	35 - 44	214	9	(4, 13)	91	(87, 96)	12	(7, 17)	88	(83, 93)
	45 - 54	238	14	(9, 18)	86	(82, 91)	10	(5, 14)	90	(86, 95)
	55 - 64	252	11	(7, 16)	89	(84, 93)	8	(4, 12)	92	(88, 96)
	65 - 74	226	11	(6, 15)	89	(85, 94)	12	(7, 17)	88	(83, 93)
	75 or more	135	8	(3, 14)	92	(86, 97)	9	(4, 15)	91	(85, 96)
Employment status of HRP and partner combined	1 or more work full time	581	11	(8, 14)	89	(86, 92)	9	(6, 11)	91	(89, 94)
	1 or more work part time	107	10	(3, 16)	90	(84, 97)	13	(6, 21)	87	(79, 94)
	none working, one or more	391	9	(6, 12)	91	(88, 94)	10	(7, 13)	90	(87, 93)
	none working and none	118	6	(1, 10)	94	(90, 99)	14	(7, 21)	86	(79, 93)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	241	6	(3, 9)	94	(91, 97)	13	(8, 18)	87	(82, 92)
	2nd quintile	260	7	(4, 11)	93	(89, 96)	13	(8, 17)	87	(83, 92)
	3rd quintile	229	7	(3, 11)	93	(89, 97)	7	(3, 10)	93	(90, 97)
	4th quintile	222	11	(7, 16)	89	(84, 93)	10	(6, 14)	90	(86, 94)

	5th quintile (highest)	245	17	(12, 22)	83	(78, 88)	8	(4, 12)	92	(88, 96)
Is anyone in the household at home during the day on a	No	466	10	(7, 13)	90	(87, 93)	9	(6, 12)	91	(88, 94)
	Yes	731	10	(7, 12)	90	(88, 93)	11	(8, 13)	89	(87, 92)
Under-occupying?	Not under-occupying	772	6	(4, 8)	94	(92, 96)	12	(10, 15)	88	(85, 90)
	Under-occupying	425	17	(13, 20)	83	(80, 87)	6	(3, 8)	94	(92, 97)
In Fuel Poverty? LIHC definition	Not in fuel poverty	1107	9	(7, 11)	91	(89, 93)	10	(8, 12)	90	(88, 92)
	In fuel poverty	90	19	(10, 28)	81	(72, 90)	15	(7, 23)	85	(77, 93)

Base: All households with gas in EFUS 2011 meter reading sub-sample (n=1197)

Significant differences in the percentage of households that are high (total) gas consumers are seen within the tenure, household size, age of HRP, household income quintiles and under-occupancy characteristics.

It can be seen from Table A3 that owner occupied households are more likely to be in the top 10% of gas consumers than households living in local authority or RSL dwellings. This is likely to be partly driven by the fact that owner occupied dwellings are typically larger than social sector dwellings, as becomes apparent when gas consumption is normalised to floor area which results in no significant differences between tenures in the likelihood of being a high gas consumer.

Single person households are less likely to be high gas consumers than households with two persons or four or more occupants when looking at the total gas consumption, however when gas consumption is normalised to floor area then there are no significant differences in the proportion of high gas consumers between households with different number of occupants. There are no significant differences in the proportion of high energy users between households with or without a pensioner present, nor between households with or without child(ren) present, both in terms of total gas consumption and in terms of gas consumption/m^2. Households where the HRP is aged between 45-54 years of age are also more likely to be in the top 10% of gas consumers than households where the HRP is aged between 16-34 years of age, but again, these differences do not exist when gas consumption is normalised to floor area.

Households in the top income quintile (highest income households) are more likely to be in the top 10% of gas consumers than households with incomes in quintiles in the bottom three quintiles. However, these differences do not exist when gas consumption is normalised to floor area.

Looking at the variables related to occupancy of the dwellings, it can be seen that households that are under-occupying are more likely to be in the top 10% of total gas consumers than those not under-occupying. However, this is predominantly due to the typically larger floor areas of dwellings in which occupants are under-occupying – looking at the gas consumption *per* m^2, households under-occupying are *less* likely to be in top 10% of gas consumers than those not under-occupying.

The analysis of variables related to how households use their heating systems (Table A4) shows that households in the top decile of gas consumers are likely to have higher mean daily hours of heating and higher mean yearly hours of heating than households in the bottom 90% of gas consumers.

However, looking at the gas consumption *per* m^2, the reverse conclusions can be drawn; the mean number of hours of heating are not different between high and not high gas consumers.

Table A4: Householder reported mean hours of heating for the top 10% of gas consumers

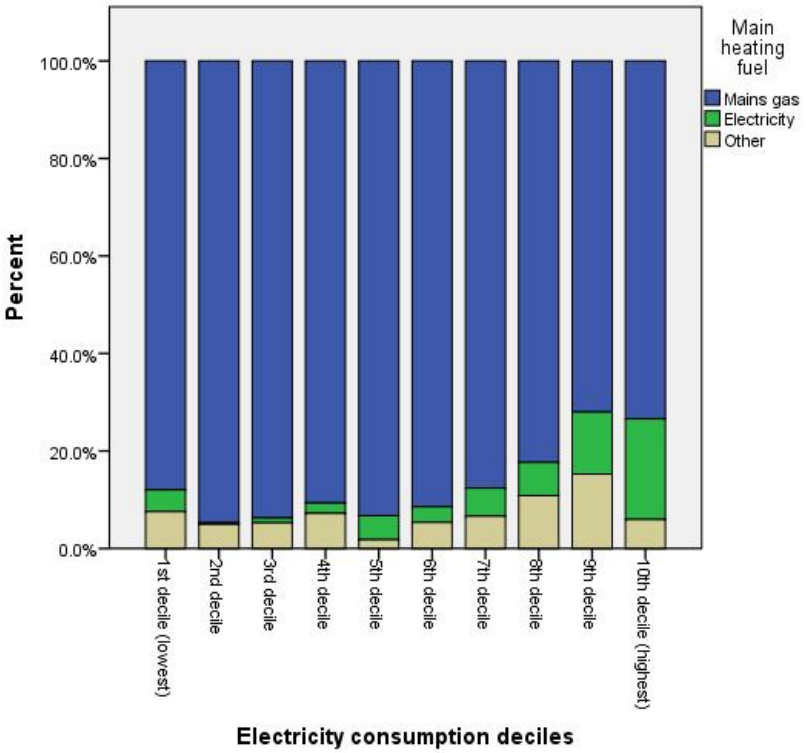
	Top 10% of gas consumers (n=117) Mean *(95% C.I.)*	Bottom 90% of gas consumers (n=1059) Mean *(95% C.I.)*	Top 10% of gas/m^2 consumers (n=117) Mean *(95% C.I.)*	Bottom 90% of gas/m^2 consumers (n=1059) Mean *(95% C.I.)*
Mean daily number of hours of heating	10.5 *(9.3,11.5)*	9.0 *(8.6,9.2)*	9.7 *(8.5,10.8)*	9.0 *(8.7,9.3)*
Mean yearly number of hours of heating	284.3 *(*243.7, 324.8*)*	219.7 *(*209.5, 229.8*)*	250.8 *(*216.2, 285.4*)*	224 *(*213.6, 234.5*)*

Base: All households with gas in EFUS 2011 meter reading sub-sample (n=1197)

A2.2 High electricity consumers

Households that are in the top 10% of electricity consumers are more likely to live in dwellings with non-central heating systems (i.e. storage heaters or room/portable heaters) than in dwellings with central heating and, as would be expected, are more likely to have heating systems fuelled by electricity than any other fuels. In fact, 20% of the highest 10% of consumers use electric storage heaters or room heaters as their main heating system. However, as Figure A2 shows, households in dwellings with electrically fuelled main heating systems can also be found in the lowest electricity consuming groups.

Figure A2: Proportion of each fuel type within each decile band of electricity consumption



Base: All dwellings in EFUS 2011 meter reading sample (n=1345)

In order to avoid the effect of high electricity consumption from electric space heating masking any potentially interesting secondary relationships, the analysis by key dwelling, household and electrical appliance use characteristics has been carried out only for those households using a main heating fuel other than electricity[12].

As with gas consumption, electricity consumption has been found to be strongly influenced by dwelling size. Analysis of the highest 10% of electricity consumers shows that the mean floor area of this group is significantly higher than the remaining 90% of households (see Table A5). It is also reported in the main body of the 'Metered Fuel Consumption' report that electricity use is strongly influenced by the number of people in a household and this analysis shows that the mean number of persons in a household is also statistically significantly higher for the top 10% of electricity

[12] Sample size = 1267.

consumers compared to all other households (Table A5). Electricity consumption, therefore, is analysed by consumption *per person* in addition to total electricity consumption.

Table A5: Average floor area and household size for the top 10% of electricity consumers

	Top 10% of electricity consumers	Bottom 90% of electricity consumers
Mean Floor area (m^2)	114.1	94.1
95% confidence interval (m^2)	*(100.0, 128.1)*	*(91.1,97.1)*
Mean household size (persons)	2.9	2.3
95% confidence interval (persons)	*(2.5, 3.1)*	*(2.2, 2.4)*

Base: all dwellings in EFUS 2011 Meter reading sample excluding those using electricity as their main heating fuel (n=1267)

A2.2.1 Analysis by dwelling characteristics

Table A6 shows the percentage of households in each category of the characteristic type that are high electricity users, both in terms of total electricity consumption and electricity consumption per person. The 95% confidence intervals of the percentages show the significance of the differences across categories.

The only significant difference in the percentage of households that are high (total) electricity consumers are seen for dwellings with the largest floor areas (>140m^2) being more likely to be high consumers than households living in dwellings with a floor area between 70-89m^2. This difference does not exist when electricity consumption is normalised to per capita.

In terms of electricity consumption per person, the only significant differences in the percentage of households that are high electricity per person consumers are seen for within the dwelling age and region characteristics. Households living in dwellings built pre-1919 are more likely to be in the top 10% of *per person* electricity consumption than those living in dwellings built from 1975-1980 and households living in the South-East are more likely to be in the top 10% of *per person* electricity consumption than those living in Yorkshire and the Humber.

Table A6: Proportion of dwelling type within the top decile band (and bottom 90% band) of total electricity consumption and electricity consumption per m^2

Dwelling characteristic	Characteristic category	*Sample size*	Proportion of category that is in the top 10% of electricity consumers		Proportion of category that is in the bottom 90% of electricity consumers		Proportion of category that is in the top 10% of electricity consumption *per person*		Proportion of category that is in the bottom 90% of electricity consumption *per person*	
			Row %	95% CI	Row %	95% CI	Row %	95% CI	Row %	95% CI
Dwelling type	End terrace	144	6	(2, 11)	94	(89, 98)	6	(2, 10)	94	(90, 98)
	Mid terrace	216	8	(4, 12)	92	(88, 96)	8	(4, 12)	92	(88, 96)
	Semi	374	9	(6, 12)	91	(88, 94)	6	(4, 9)	94	(91, 96)
	Detached	246	12	(7, 16)	88	(84, 93)	8	(4, 11)	92	(89, 96)
	Bungalow	131	5	(1, 9)	95	(91, 99)	5	(1, 10)	95	(90, 99)
	Flat	156	8	(3, 12)	92	(88, 97)	9	(4, 13)	91	(87, 96)
Dwelling type	House/	1111	9	(7, 10)	91	(90, 93)	7	(5, 9)	93	(91, 95)
	Flat	156	8	(3, 12)	92	(88, 97)	9	(4, 13)	91	(87, 96)
Dwelling Age	Pre 1919	194	12	(7, 17)	88	(83, 93)	12	(7, 17)	88	(83, 93)
	1919-1944	224	8	(4, 12)	92	(88, 96)	8	(4, 11)	92	(89, 96)
	1945-1964	312	8	(5, 12)	92	(88, 95)	8	(5, 12)	92	(88, 95)
	1965-1974	191	8	(3, 12)	92	(88, 97)	4	(1, 7)	96	(93, 99)
	1975-1980	89	6	(0, 11)	94	(89, 100)	2	(-1, 5)	98	(95, 101)
	1981-1990	96	5	(0, 10)	95	(90, 100)	5	(0, 10)	95	(90, 100)
	Post 1990	161	8	(4, 13)	92	(87, 96)	6	(2, 10)	94	(90, 98)
Useable floor area	< 50 m^2	102	6	(1, 11)	94	(89, 99)	9	(3, 15)	91	(85, 97)
	50 to 69 m^2	276	8	(4, 11)	92	(89, 96)	9	(6, 13)	91	(87, 94)
	70 to 89 m^2	379	6	(4, 9)	94	(91, 96)	5	(3, 8)	95	(92, 97)
	90 to 109 m^2	194	7	(3, 11)	93	(89, 97)	5	(2, 8)	95	(92, 98)
	110 to 139 m^2	149	9	(4, 14)	91	(86, 96)	6	(2, 10)	94	(90, 98)
	≥140 m^2	167	17	(11, 23)	83	(77, 89)	11	(6, 16)	89	(84, 94)
Region - EHS order	North East	95	9	(2, 15)	91	(85, 98)	10	(4, 17)	90	(83, 96)
	North West	210	10	(5, 14)	90	(86, 95)	6	(2, 9)	94	(91, 98)
	Yorkshire and the Humber	177	5	(1, 8)	95	(92, 99)	3	(0, 5)	97	(95, 100)
	East Midlands	91	8	(2, 14)	92	(86, 98)	6	(1, 11)	94	(89, 99)
	West Midlands	117	9	(3, 15)	91	(85, 97)	7	(2, 12)	93	(88, 98)
	East	147	4	(1, 8)	96	(92, 99)	4	(1, 7)	96	(93, 99)
	London	124	14	(7, 21)	86	(79, 93)	10	(4, 16)	90	(84, 96)
	South East	171	10	(5, 15)	90	(85, 95)	11	(6, 17)	89	(83, 94)
	South West	135	6	(2, 11)	94	(89, 98)	8	(3, 12)	92	(88, 97)
Urban or rural location?	Urban	1148	8	(6, 10)	92	(90, 94)	7	(5, 9)	93	(91, 95)
	Rural	119	13	(6, 19)	87	(81, 94)	10	(4, 16)	90	(84, 96)
Type of heating system	Central Heating	1251	9	(7, 10)	91	(90, 93)	7	(6, 9)	93	(91, 94)
	Non-Central Heating	16	5	(-7, 17)	95	(83, 107)	9	(-6, 24)	91	(76, 106)
Main fuel	Mains gas	1178	8	(7, 10)	92	(90, 93)	7	(6, 9)	93	(91, 94)
	Electricity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Other	89	8	(2, 15)	92	(85, 98)	8	(2, 15)	92	(85, 98)

Are the walls of the dwelling	Insulated	619	7	(5, 9)	93	(91, 95)	6	(4, 8)	94	(92, 96)
	Not insulated	648	10	(7, 12)	90	(88, 93)	8	(6, 10)	92	(90, 94)
Loft insulation	<50mm	69	8	(1, 14)	92	(86, 99)	8	(1, 16)	92	(84, 99)
	50-149mm	503	9	(6, 12)	91	(88, 94)	7	(5, 10)	93	(90, 95)
	150+ mm	583	8	(5, 10)	92	(90, 95)	7	(4, 9)	93	(91, 96)
Is dwelling fully double glazed?	Yes	974	8	(6, 10)	92	(90, 94)	6	(5, 8)	94	(92, 95)
	No	293	9	(6, 13)	91	(87, 94)	10	(6, 14)	90	(86, 94)
Dwelling insulation	All 3 insulation measures	241	7	(3, 10)	93	(90, 97)	7	(3, 10)	93	(90, 97)
	2 insulation measures	383	9	(6, 12)	91	(88, 94)	6	(3, 9)	94	(91, 97)
	1 insulation measure	395	8	(5, 11)	92	(89, 95)	6	(3, 8)	94	(92, 97)
	No insulation measures	136	12	(6, 17)	88	(83, 94)	13	(7, 19)	87	(81, 93)
Energy efficiency (SAP09) rating	less than 30	19	3	(-5, 12)	97	(88, 105)	9	(-5, 23)	91	(77, 105)
	30 to 50	265	9	(5, 13)	91	(87, 95)	10	(6, 14)	90	(86, 94)
	51 to 70	877	9	(7, 11)	91	(89, 93)	6	(5, 8)	94	(92, 95)
	more than 70	106	7	(2, 12)	93	(88, 98)	6	(1, 11)	94	(89, 99)

Base: all dwellings in EFUS 2011 Meter reading sample excluding those using electricity as their main heating fuel (n=1267)

A2.1.2 Analysis by household characteristics and appliance use

Table A7 shows the percentage of households in each category of the household characteristic type that are high electricity users, both in terms of total electricity consumption and electricity consumption per person. The 95% confidence intervals of the percentages show the significance of the differences across categories.

Table A7: Proportion of household type within the top decile band (and bottom 90% band) of total electricity consumption and electricity consumption per person

Household characteristic	Characteristic category	*Sample size*	Proportion of category that is in the top 10% of electricity consumers		Proportion of category that is in the bottom 90% of electricity consumers		Proportion of category that is in the top 10% of electricity consumption *per person*		Proportion of category that is in the bottom 90% of electricity consumption *per person*	
			Row %	95% CI	Row %	95% CI	Row %	95% CI	Row %	95% CI
Tenure	Owner Occupied	836	8	(6,10)	92	(90,94)	6	(5,8)	94	(92,95)
	Private rented	121	8	(3,13)	92	(87,97)	8	(3,14)	92	(86,97)
	Local Authority	168	9	(5,14)	91	(86,95)	9	(4,14)	91	(86,96)
	RSL	142	9	(4,14)	91	(86,96)	10	(5,15)	90	(85,95)
Household size	1	316	5	(2,8)	95	(92,98)	12	(8,15)	88	(85,92)
	2	486	8	(5,10)	92	(90,95)	8	(5,10)	92	(90,95)
	3	218	9	(5,13)	91	(87,95)	6	(2,9)	94	(91,98)
	4	161	12	(7,18)	88	(82,93)	3	(0,6)	97	(94,100)
	5 or more	86	18	(9,27)	82	(73,91)	0	(0,0)	100	(100,100)
Pensioner Present?	At least one person of pensionable age	514	7	(5,10)	93	(90,95)	9	(6,11)	91	(89,94)
	No persons of pensionable age	753	9	(7,12)	91	(88,93)	6	(4,8)	94	(92,96)
Children Present?	At least one child	375	12	(8,15)	88	(85,92)	5	(2,7)	95	(93,98)
	No children	892	7	(5,9)	93	(91,95)	8	(6,10)	92	(90,94)
Age of HRP	16 - 34	135	6	(1,10)	94	(90,99)	3	(0,6)	97	(94,100)
	35 - 44	225	11	(6,15)	89	(85,94)	7	(3,10)	93	(90,97)
	45 - 54	251	13	(9,18)	87	(82,91)	9	(5,13)	91	(87,95)
	55 - 64	269	5	(2,8)	95	(92,98)	6	(3,9)	94	(91,97)
	65 - 74	240	7	(3,10)	93	(90,97)	8	(4,11)	92	(89,96)
	75 or more	147	8	(3,12)	92	(88,97)	11	(6,17)	89	(83,94)
Employment status of HRP and partner combined	1 or more work full time	621	9	(7,12)	91	(88,93)	6	(4,8)	94	(92,96)
	1 or more work part time	112	10	(4,16)	90	(84,96)	11	(5,18)	89	(82,95)
	none working, one or more retired	414	6	(4,9)	94	(91,96)	8	(5,11)	92	(89,95)
	none working and none retired	120	10	(4,16)	90	(84,96)	11	(5,17)	89	(83,95)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	253	5	(2,8)	95	(92,98)	8	(5,12)	92	(88,95)
	2nd quintile	271	8	(4,11)	92	(89,96)	8	(4,12)	92	(88,96)
	3rd quintile	244	10	(6,14)	90	(86,94)	9	(5,14)	91	(86,95)
	4th quintile	237	8	(4,12)	92	(88,96)	4	(1,7)	96	(93,99)
	5th quintile (highest)	262	11	(7,15)	89	(85,93)	6	(3,9)	94	(91,97)

Is anyone in the household at home during the day on a weekday?	No	491	10	(7,13)	90	(87,93)	8	(6,11)	92	(89,94)
	Yes	776	8	(5,10)	92	(90,95)	6	(4,8)	94	(92,96)
Under-occupying?	Not under-occupying	809	8	(6,11)	92	(89,94)	6	(4,8)	94	(92,96)
	Under-occupying	458	9	(6,11)	91	(89,94)	10	(7,13)	90	(87,93)
In Fuel Poverty? LIHC definition	Not in fuel poverty	1170	8	(7,10)	92	(90,93)	7	(6,9)	93	(91,94)
	In fuel poverty	97	11	(4,18)	89	(82,96)	5	(0,9)	95	(91,100)

Base: all dwellings in EFUS 2011 Meter reading sample excluding those using electricity as their main heating fuel (n=1267)

The only significant difference in the percentage of households that are high (total) electricity consumers are seen for the number of persons in a household and the age of the HRP in a household. The largest households (5+ persons) are more likely to be in the top 10% of (total) electricity consumers than single occupancy households. However, when electricity consumption is normalised to *per person* then households of single occupancy are significantly more likely to be in the top 10% of electricity consumers than households with 4 or more persons. This suggests that there is a baseline requirement of electricity use that the smallest households have but that further increases in electricity consumption due to larger household numbers are not linear.

Households where the Household Reference Person (HRP) is between 45-54 years of age are more likely to be in the top 10% of electricity consumers than those where the HRP is 55-64 years of age. However, as with household size, this is not the case when electricity consumption is normalised to household size.

In the EFUS 2011 Interview Survey, householders were also asked about their availability and use of various types of appliances typically found in homes (see the 'Domestic Appliances, Cooking and Cooling Equipment' report in this EFUS 2011 series). This information has been used to derive additional variables with which to carry out further analysis of the high electricity consumers. These variables include:

- whether a household uses a high energy consuming appliance (includes heated swimming pools/jacuzzis/hot tubs, saunas, heavy workshop machinery and pottery kilns)
- the number of laundry, dishwashing and refrigeration appliances (includes washing machines, washer-driers, tumble driers, dishwashers, fridges, freezers and fridge-freezers)
- whether the washing machine is generally used on a hot wash (60° or more)
- if a dishwasher is used frequently (8 or more times per week)
- if the cooker is all electric or is an electric AGA
- if there is any fixed air conditioning
- TV ownership and use
- the number of baths/showers taken daily and how the water is heated for these.

Table A8 shows the percentage of households in each category of the appliance characteristic type that are high electricity users, both in terms of total electricity consumption and electricity consumption per person. The 95% confidence intervals of the percentages show the significance of the differences across categories.

The only significant difference in the percentage of households that are high (total) electricity consumers are seen for the number of appliances in a household, whether there are more than 3 televisions in a household and the number of showers taken daily. Households with 2 or 3 appliances are less likely to be in the top 10% of (total) electricity consumers than households with 6 or more appliances as are households with 3 or less televisions in their home compared to those with more than 3. Households taking more than 5 showers per day are more likely to be in the top 10% of (total) electricity consumers compared to households taking none or 1 per day.

However, there are no significant differences in any of the appliance use factors when the electricity consumption is normalised to household size, which is to be expected if it is considered that most of the appliance use variables will ultimately be governed by the number of persons in a household.

Table A8: Proportion of appliance characteristic type within the top decile band (and bottom 90% band) of total electricity consumption and electricity consumption per person

Appliance characteristic	Characteristic category	*Sample size*	Proportion of category that is in the top 10% of electricity consumers		Proportion of category that is in the bottom 90% of electricity consumers		Proportion of category that is in the top 10% of electricity consumption *per person*		Proportion of category that is in the bottom 90% of electricity consumption *per person*	
			Row %	95% CI	Row %	95% CI	Row %	95% CI	Row %	95% CI
Does household use a high energy appliance?	No	1216	8	(6,10)	92	(90,94)	7	(5,8)	93	(92,95)
	Yes	51	20	(8,32)	80	(68,92)	15	(4,26)	85	(74,96)
Number of appliances in household	None	**	**	**	**	**	**	**	**	**
	1	17	*6	(0,18)	*94	(82,10	*13	(0,31)	*87	(69,100)
	2	225	4	(1,7)	96	(93,99)	5	(2,9)	95	(91,98)
	3	368	5	(3,8)	95	(92,97)	6	(4,9)	94	(91,96)
	4	366	10	(7,14)	90	(86,93)	7	(4,10)	93	(90,96)
	5	242	12	(8,17)	88	(83,92)	9	(5,13)	91	(87,95)
	6 or more	49	22	(9,35)	78	(65,91)	10	(1,19)	90	(81,99)
Is washing machine generally used on a hot wash?	No	1217	9	(7,10)	91	(90,93)	7	(6,9)	93	(91,94)
	Yes	50	4	(0,9)	96	(91,10	8	(0,17)	92	(83,100)
Is the dishwasher used frequently?	No	1240	8	(6,10)	92	(90,94)	7	(6,9)	93	(91,94)
	Yes	27	*28	(10,47)	*72	(53,90)	*12	(0,25)	*88	(75,100)
Cooker all electric?	No	877	8	(6,11)	92	(89,94)	7	(5,9)	93	(91,95)
	Yes	390	8	(5,12)	92	(88,95)	8	(5,11)	92	(89,95)
Electric AGA?	No	1258	8	(7,10)	92	(90,93)	7	(6,9)	93	(91,94)
	Yes	9	*27	(0,59)	*73	(41,10	*27	(0,59)	*73	(41,100)
Any fixed air conditioning?	Yes	8	*10	(0,32)	*90	(68,11	*10	(0,32)	*90	(68,100)
	No	1259	8	(7,10)	92	(90,93)	7	(6,9)	93	(91,94)
More than 3 TVs in household?	No	1032	7	(5,9)	93	(91,95)	7	(5,9)	93	(91,95)
	Yes	235	15	(10,20)	85	(80,90)	9	(5,12)	91	(88,95)

Are TVs on for more than 8 hours daily?	No	475	6	(4,9)	94	(91,96)	7	(5,10)	93	(90,95)
	Yes	779	10	(8,13)	90	(87,92)	7	(5,9)	93	(91,95)
Number of baths taken daily	None	494	9	(6,12)	91	(88,94)	8	(5,10)	92	(90,95)
	1 a day	609	8	(6,10)	92	(90,94)	7	(5,10)	93	(90,95)
	Up to 3 a day	146	8	(3,13)	92	(87,97)	4	(0,7)	96	(93,100)
	3 or more a day	18	19	(0,39)	81	(61,100)	14	(0,32)	86	(68,100)
	Up to 4 a day	**	**	**	**	**	**	**	**	**
	Up to 5 a day	**	**	**	**	**	**	**	**	**
	More than 5 a day	**	**	**	**	**	**	**	**	**
Number of showers taken daily	None	192	5	(2,9)	95	(91,98)	7	(3,10)	93	(90,97)
	1 a day	451	7	(4,9)	93	(91,96)	8	(6,11)	92	(89,94)
	Up to 2 a day	389	9	(6,12)	91	(88,94)	8	(5,11)	92	(89,95)
	Up to 3 a day	150	9	(4,14)	91	(86,96)	5	(1,9)	95	(91,99)
	Up to 4 a day	54	18	(7,30)	82	(70,93)	3	(0,8)	97	(92,100)
	More than 5 a day	31	27	(10,44)	73	(56,90)	2	(0,8)	98	(92,100)
Electric shower?	No/NA	696	7	(5,9)	93	(91,95)	6	(4,8)	94	(92,96)
	Yes	571	10	(7,13)	90	(87,93)	8	(6,11)	92	(89,94)
Electric immersion heater used to heat water on a daily basis for some part of the year?	No	1198	8	(7,10)	92	(90,93)	7	(6,9)	93	(91,94)
	Yes	69	13	(4,22)	87	(78,96)	8	(1,14)	92	(86,99)

Base: all dwellings in EFUS 2011 Meter reading sample excluding those using electricity as their main heating fuel (n=1267)

* Sample responses are very small and subject to large sampling errors

A3 Conclusions

This analysis combines the information obtained from the household interview survey with meter reading data in order to investigate if certain types of households are more likely to be high energy consumers. High gas consumers have been defined as those households with metered consumptions in the top 10% of weighted values obtained during the survey.

It has previously been reported that dwelling size appears to be the strongest driver of energy consumption (DECC, 2012). The EFUS data corroborates the trend that on average, higher gas consumptions were largely associated with larger dwelling floor areas - the result of gas use being predominantly for space heating. However the EFUS data also show that some households in the largest dwellings have some of the lowest annual household gas consumption values. For electricity consumption, apart from those households with electric main heating systems, electricity use is predominantly for lights and appliances and therefore usage is additionally influenced by the number of persons in the household (higher consumptions arising from larger household numbers).

In order to try to understand any 'secondary' influences outside of these major drivers, this analysis by dwelling and household characteristics has considered high users in terms of those households in the top 10% of weighted values of total gas consumption and total electricity consumption, as well as those households in the top 10% of weighted values of gas consumption per m^2 and electricity consumption per person. The results show that the two approaches (total versus normalised) reveal variations in the percentage of high consumers within the dwelling and household categories and that it is the analysis by the gas per m^2 and electricity per person consumptions that are most helpful in assessing the potential determinants of high energy use.

In terms of gas consumption, the strongest determinants for households having the highest (total) gas consumptions are likely to be:

- Dwelling type, dwelling age, floor area, tenure, household size, age of HRP, household income quintiles and under-occupancy status.

However, the underlying influence of floor area for some of these characteristics appears to be the key driver as many of the differences in the percentage of high (total) gas consumers across the categories within these characteristics disappear when the analysis is carried out on the gas consumption/m^2.

From the analysis of gas consumption/m^2, it is seen that the strongest determinants for households being high consumers are:

- Dwelling age - households living in dwellings built 1919-1944 are more likely to be in the top 10% of gas consumers *per* m^2 than households living in dwellings built in 1975-1980 or post 1990.
- Floor area - households that live in the largest dwellings (>140m^2) are *less* likely to be in the top 10% of gas consumption *per* m^2 than those households in dwellings smaller than 90m^2.
- Under-occupancy - households under-occupying are *less* likely to be in top 10% of gas consumers than those not under-occupying

There appears to be little discernible influence from the dwelling fabric efficiency (i.e. number of insulation measures) as to whether a household is more likely to be a high gas consumer.

A key driver of high electricity use is whether the household uses an electrically fuelled main heating system. Only a small proportion (~10%) of dwellings in England have an electrically fuelled main heating system so although this is a strong indicator that a household will have higher electricity consumption it is limited in its usefulness.

Excluding those households that use an electric main heating system, characteristics which show differences in the percentage of high (total) electricity consumption across categories are floor area, age of the Household Reference Person, the number of appliances in the household, the number of showers taken and the number of televisions. The underlying influence for many of these is likely to be the number of persons in the household.

When the electricity consumption is normalised to household size, significant differences across categories remain for the characteristics of:

- dwelling age - households living in dwellings built pre-1919 are more likely to be in the top 10% of *per person* electricity consumption than those living in dwellings built from 1975-1980.
- Region - households living in the South-East are more likely to be in the top 10% of *per person* electricity consumption than those living in Yorkshire and the Humber.
- Number of persons in the household - single occupants are significantly more likely to be in the top 10% of electricity per person consumers than households with 4 or more persons. This suggests that there is a baseline requirement of electricity use that the smallest households have but that further increases in electricity consumption due to larger household numbers are not linear.

The results of this analysis give some insight into the variables that could be considered as predictor variables for targeting high energy users.

Glossary

Age of dwelling:	This is the date of construction of the oldest part of the dwelling. Recorded by surveyors in the EHS physical survey.
Age of HRP:	The Household Reference Person (HRP) is the person in whose name the dwelling is owned or rented or who is otherwise responsible for the accommodation. In the case of joint owners and tenants, the person with the highest income is taken as the HRP. Where incomes are equal, the older is taken as the HRP. This procedure increases the likelihood that the HRP better characterises the household's social and economic position. The age of the HRP is derived from householder responses to q167/168/169/170 in the EFUS 2011 Interview survey for new households and from variables obtained from the EHS Interview survey for households that had not changed since the earlier EHS interview.
Annual gross income of the HRP and partner weighted quintiles:	This is the annual income of the Household Reference Person and (any) partner. This includes income from private sources (regular employment, self-employment, government schemes, occupational pensions, private pensions and other private income), state benefits/allowances and tax credits, as collected on the EHS survey (this includes housing benefit/Local Housing Allowance but excludes council tax benefit and Support for Mortgage Interest) and interest from savings. It is a gross measure i.e. income before Income Tax or National Insurance deductions.
Children Present:	Anyone in the household who is 16 years old or younger. Derived from householder responses to q167/168/169/170 in the EFUS 2011 Interview survey for new households and from variables obtained from the EHS Interview survey for household that had not changed since the EHS interview.
Dwelling insulation:	The number of insulation measures where positive responses for 'Fully double glazed', 'Insulated walls' and having loft insulation greater than 200mm count as insulation measures.
Dwelling type:	Classification of dwelling on the basis of the surveyors' inspections during the EHS physical survey.
Employment status of HRP and Partner combined:	Information on employment status was not re-collected as part of the EFUS and is as reported in the EHS interview survey (and some households may have changed status in the period between the two interviews).
Fuel Poverty – LIHC definition:	Under the Low Income High Cost definition a household is considered to be fuel poor where: • They have required fuel costs that are above average (the national median level) • Were they to spend that amount, they would be left with a residual income below the official poverty line. Please refer to the following documents for more information. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66570/6406-fuel-poverty-changing-the-framework-for-

	measureme.pdf https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226988/fuel_poverty_stats_methodology_handbook_2013.pdf
Fully double glazed:	Derived from the 'dblglaz4' variable as measured by surveyors in the EHS physical survey. Fully double glazed is 'entire house double glazed'. Not fully double glazed is anything less than fully double glazed.
Household size:	Number of persons in the household, banded into 5 groups, derived from the 'hhsizex' variable from the EHS Interview survey.
In during the day:	See the EHS interview documentation for full details of occupancy questions asked as part of the EHS (question 'Hmwtht'). A household has been classified as being 'in during a weekday' if they indicate being generally in the house on weekdays during the winter, for any period between 9am and 5pm. It should be noted that this information was not re-collected as part of the EFUS, and some households occupancy patterns may have changed in the interval between the two interview surveys.
Insulated walls:	Derived from the 'wallinsx' variable as measured by surveyors in the EHS physical survey. 'Insulated' are 'cavity with insulation'; 'Not insulated' includes 'cavity without insulation' and 'other' wall types.
Loft insulation:	Banded variable of 'loftinsx', the level of loft insulation recorded by surveyors in the EHS physical survey.
Main fuel:	As determined by surveyors in the EHS physical survey. Grouped into 'mains gas', 'electricity' and 'other', which includes bottled gas, bulk gas, solid fuels, oil and community schemes.
Pensioner Present:	Anyone in the household who is 65 or over (male) or 60 or over (female). Derived from householder responses to q167/168/169/170 in the EFUS 2011 Interview survey for new households and from variables obtained from the EHS Interview survey for households that had not changed since the EHS interview.
Region:	Government Office Region that the dwelling is located in. Obtained from the EHS.
Rurality:	Is the dwelling in a rural (village or isolated hamlet) or urban (urban or town or fringe) location. Derived from the 'rumorph' variable in the EHS.
SAP rating:	The energy cost rating as determined by Government's Standard Assessment Procedure (SAP) and is used to monitor the energy efficiency of dwellings. It is an index based on calculated annual space and water heating costs for a standard heating regime and is expressed on a scale of 1 (highly inefficient) to 100 (highly efficient with 100 representing zero energy cost).
Tenure:	Derived from householder responses to q01 in the EFUS 2011 Interview

	survey.
Type of heating:	Central heating or non-central heating. Determined from householder responses to Q06 in EFUS 2011 interview survey. Non-central heating includes storage radiators, gas fires, electric heaters, coal/wood/ smokeless fuel fires or stoves and other.
Under-occupying:	A household is considered to be under-occupying if the dwelling is more than large enough for the number (and type) of occupants living there. For the full definition of under occupancy, see the fuel poverty methodology handbook, which is available at: http://www.decc.gov.uk/assets/decc/Statistics/fuelpoverty/614-fuel-poverty-methodologyhandbook.pdf
Useable floor area:	The total usable internal floor area of the dwelling as measured by the surveyor in the EHS physical survey, rounded to the nearest square metre. It excludes integral garages, balconies, stores accessed from the outside only and the area under partition walls. Grouped into 5 categories.

References

DECC, 2012. National Energy Efficiency Data-Framework (NEED) Report. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65969/6861-need-report-nov-2012.pdf