Report 9: Domestic appliances, cooking & cooling equipment

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Executive summary

Electrical appliances and cooking are major end uses of energy in the home. It is important for energy efficiency policy, and the development of energy modelling methodologies, to understand how many appliances are in the stock, and how they are being used. The Energy Follow-Up Survey (EFUS) has collected ownership and use patterns for key appliances across England through interviews with 2,616 households. Analysis is based on the interview sample weighted to the national level, using a weighting factor specific to the interview sample. The results on ownership and use patterns presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households. In addition to this, results from the detailed monitoring of electricity demand among a small subsample of around 80 homes are reported on. Due to the small sample size of the electricity monitoring sub-sample (80 households), these results have not been weighted to be representative of the English housing stock.

Laundry appliances

Approximately, 97% of households own a washing machine, and 62% of households own a tumble dryer. Owner occupiers are more likely to own washing machines and tumble dryers compared to the other tenures. Single person households, households without any children, households in which the HRP is 75 years old or more, households in which none of the occupants are working, households with incomes in the lowest income quintile and households that are not under-occupying are all less likely than their counterpart groups to own a washing machine or tumble dryer.

A large number of older laundry appliances are present in the stock, which may present an opportunity for energy savings. The survey suggests that over 2.1 million washing machines, and 2.6 million tumble dryers, are more than 10 years old.

The median number of washing loads per week is 4 and the median number of drying loads per week is 3 in the winter. Approximately 59% of households report typically running their washing machine at 40°C; 27% report typically washing at 30°C, and 8% report using temperatures hotter than 40°C.

The majority of households with tumble dryers tend not to use them in the summer. Households that own a tumble dryer do, on average, one more load of washing per week compared to households that do not own a tumble dryer.

As to be expected, there is a pattern of more frequent washing machine use among large households, particularly those with children. The median number of loads per week also increases as household income increases. However, households with at least one pensioner present, and households that are considered to be under-occupying use their washing machines less than their counterpart groups.

Refrigeration appliances

Ownership of refrigerators and freezers is almost universal. 99% of households own a refrigerator (either as a separate unit or combined with a freezer) and 93% of households own some kind of freezer.

There are no apparent differences in fridge ownership across the different household groups suggesting that this appliance is considered a necessity. Freezer ownership across the different household groups is more variable with similar differences in the patterns of ownership as those seen for the laundry appliances.

A large number of refrigeration appliances are more than 10 years old, including around 24% of standalone fridges and 24% of standalone freezers (equivalent to around 2.5 million of each of these types of appliance) which may represent a significant potential for energy saving. In general, the oldest fridges are more likely to be found in owner occupied households than in private rented households, in households containing an older occupant, in households without any children and in households under-occupying compared to their counterpart groups. There is no apparent relationship between income and the ownership of an older fridge.

Dishwashers

Dishwashers are present in less than half of all homes (41%). Dishwasher ownership across the different household groups shows similar differences in the patterns of ownership as those seen for the laundry appliances. There is a particularly strong relationship to income, suggesting that dishwasher ownership is perhaps considered as a 'luxury' rather than a necessity. Almost 70% of dishwashers are less than 6 years old. The median number of times households typically use their dishwashers is 4 times per week and half of all households use them between 2 and 7 times per week.

Cooking appliances

Ownership of ovens and hobs is almost universal, although only approximately 80% of households have a grill. Approximately 80% of households have a microwave. Ownership of a standard cooking appliance (oven plus hob plus grill) and/or a microwave is fairly uniform across different type of households.

Electricity is the dominant fuel used in ovens (almost 70% of households with ovens have electric ovens and just under 30% have gas ovens). For hobs, the prevalence of fuels is reversed with gas being the dominant fuel (38% of households have electric hobs, whereas 61% have gas hobs).

A significant number of older ovens are present in the stock. Approximately 22% of ovens are over 10 years old (equivalent to around 4.5 million ovens).

Households use their hobs and microwaves more frequently than their ovens or grills. The average use of hobs and microwaves is higher for households where someone is in during the day and households with children present, compared to their counterpart groups.

Televisions

The number of televisions in homes ranged from 0 to 9, with a median number of 2. Just under 2% of households report that they do not have a television. Owner occupiers typically have a higher mean number of televisions than any of the other tenures. Additionally, the mean number of televisions in a household increases as household size increases. Households in the lowest income quintiles report having fewer televisions on average than households in any of the four high income quintiles and households with children present and households where no pensioners are present also report a higher mean number of televisions compared to their counterpart groups.

The main (most used) television in the home is much more likely to be a flat screen type. Almost 10% of households use a flat screen plasma television as their main television and just over 10% have a LED-LCD flat screen as their main television. Owner occupied households are more likely to have a flat screen television than a standard CRT type as the most used television compared to households in the social rented sector whereas households in the lowest income quintile are less likely to have a flat screen model as the television used the most compared to households with higher incomes. Additionally, single person households are also less likely to have a flat screen television as the most used television compared to larger households.

The television used most often in the house is reported to be used for approximately 5 to 6 hours per day. The average number of hours is greater for households that are in the social rented sector compared to owner occupiers or private renters, and is likely to be higher for households with children, containing someone of pensionable age, where someone in during the day and households that are not under-occupying.

Cooling equipment

43% of all households (equivalent to 9.5 million households) use portable fans. Other fixed fans are in use by around 9% of households (2 million households). Air conditioning use is very rare with less than 3% of households using fixed or portable air conditioning units during the summer months.

The use of electrical cooling equipment will have an impact on energy usage levels. This data provides useful baseline information on the number of households with electrical cooling equipment and the frequency of use. Around 17% of households use portable fans on a daily basis during the summer months. Just under 40% of households with portable fans use them more than once per week but not every day, and a further 39% of households use them less than once a week.

Electricity demand

Data on electricity demand was collected for a specific subsample of properties, excluding those with any reported space heating or water heating load.

The median base load for these homes is 90 Watts. Base load has been defined at the power demand of the household for the level of electrical power consumption in Watts exceeded for 90% of the monitoring period (when assessed using high-frequency data).

The lowest average hourly power demand is 121 Watts while the highest is around twenty times more at 2,438 Watts.

The maximum power demand for all the households ranges from 483 watts to over 13kW while the minimum ranges from effectively zero (power outage situation) to 632 Watts. Across all the properties, the median power demand is 447 Watts.

Seasonal analysis shows that monthly demand is lower in the summer and higher in the winter. This is likely to be due mainly to the increased use of lighting over the longer nights, alongside possible increases in appliance use (e.g. tumble dryers).

Time of day analysis shows that electricity demand starts to increase earlier on weekdays compared to weekends and that demand increases throughout the middle part of the day at weekends. The evening peak appears to occur slightly earlier at the weekend, but the peak power demand is approximately the same for all days.

Analysing the data to produce a power frequency curve shows that for 90% of the time, electrical demand is less than 1,000 Watts and that it is between 100 to 1000 Watts for about 75% of the time.

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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.

The range of data collected on cooking and appliances as part of the EFUS is necessarily restricted by the time available for the survey, and the EFUS concentrates on a limited number of large appliances (laundry appliances, refrigeration appliances, dishwashers, cooking appliances, televisions and cooling equipment). Furthermore, complementary surveys, in particular the UK Government's Household Electricity Use Survey[1] (HEUS) has recently collected detailed monitored data from appliances. The extent of the EFUS data collected on appliances was therefore restricted in preference to other aspects of energy use not covered by this survey (in particular the use of heating systems). The HEUS survey is based on a much smaller and restricted sample (250 households, exclusively in the owner occupied sector) which has not been weighted or adjusted. Because of this, differences between the surveys are therefore to be expected, and direct comparisons between results presented here and those of that survey are not made.

In this report on appliance use, analysis of the data collected during the household interview on the use of various types of appliances typically found in homes is presented, along with an analysis of the results obtained from the subset of dwellings with electricity monitors. It should be noted that throughout this report the word 'ownership' is used to describe the availability of appliances in the home. Whilst it is realised that in some instances appliances may not 'be owned' by the householder (in furnished rented properties for example), the questions were asked for '*all appliances you use, and for which you are responsible for paying the bill'* and the therefore 'ownership' should be taken in this context. The results on ownership and use patterns presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households. Due to the small sample size of the electricity monitoring sub-sample (80 households), these results have not been weighted to be representative of the English housing stock.

The results of this analysis will be used to inform energy efficiency policy, and to inform and update the assumptions in the key energy modelling methodologies in use in the UK: the BRE Domestic Energy Model (BREDEM) and its derivative the UK Standard Assessment Procedure (SAP). These methodologies are extensively used to predict the annual energy consumption in dwellings; BREDEM includes estimates for space and water heating, lighting, electrical appliances and cooking energy use; whereas SAP only includes space and water heating and lighting energy use. CO_2 emissions can be deduced directly from energy use, and the prediction of housing-related CO_2 emissions through

[1] Powering the Nation: Household Electricity Using Habits Revealed. Owen,P. EST, 2012; Household Electricity Survey: A study of domestic electrical product usage. Zimmerman et al, Intertek, 2012.

to 2050 will continue to rely heavily on the SAP and BREDEM methodologies. Specific questions of interest to the SAP and BREDEM development teams are:

- What are the ownership levels of key appliances in the home? How often are they used?
- Do different types of household use their appliances in different ways?
- How energy efficient are these appliances?
- What is the split of fuels used for cooking appliances?
- What proportion of households use powered cooling equipment such as fans and air-conditioning and how frequently is this cooling equipment used?
- What is the typical base electricity load for lights and appliances?
- How does electricity demand for non-heating space and water heating use vary on different months of the year?
- How does electricity demand for non-space and water heating use vary throughout the day?

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). These data were then weighted and grossed to account for survey non-response, and allow estimates at the national level to be produced. When weighted, this resulted in a population of 21.9 million households. Further detailed information on the EFUS 2011 methodology can be found in the EFUS 2011 Methodology report.

The householder reported results presented in this report have been produced using data collected from the 'Cooking and appliances ' and 'Overheating and cooling' sections of the EFUS Interview survey[2]. This includes questions on the 'white goods' appliances, cooking appliances, electrical cooling equipment, televisions and other leisure equipment in the home along with questions to ascertain the typical usage patterns. Full details of the exact questions asked can be found in the EFUS questionnaire which forms part of the EFUS 2011 methodology report.

Householders were asked about all appliances in the home, for which they were responsible for paying the bill. This included any appliances kept in garages and storage rooms. Appliances not working were asked not to be included.

The age of appliances was also asked, and householders were asked to estimate the age of appliances if they did not know exactly. Use of appliances was asked as typical weekly usage for laundry appliances, dishwashers and cooking appliances, and cooling equipment, and for daily usage for the three most used televisions in the home. Specific questions were also asked about the type and size of televisions, and the typical temperature of washing loads.

It should be remembered that the analysis presented from householders in section 4 of this report is based on householders' *responses* to questions put to them during the interview, rather than on information recorded in diaries or monitored directly.

A small, and very specific, subsample of the EFUS (79 houses) did, however, have their total electricity power demand directly monitored. This was done to provide an indication of electrical lights, appliance use and cooking use in houses – including data on electrical base load and time of day usage. Data were recorded using battery powered data loggers connected to current transmitters fixed around the each dwellings 'live' meter tail. Electricity usage in the whole house was recorded onto a 'memory card' at 10 second intervals. Monitors were installed over a five month period from March 2011, and recorded data until January 2012. The sample was chosen to be those houses (no flats) that reported no use of electric space or water heating systems[3] on the EFUS

[2] See EFUS 2011 Methodology Report. The results in this report relate to responses given to questions q82 to q111.

[3] For safety reasons those with potentially unsafe electrical systems were also excluded.

interview survey. Thus these data are able to provide some indication of the range of domestic lights, appliance and cooking load in houses.

2.1 Weighting factors

The EFUS data have been scaled up to represent the national population (and to correct for non-response) using weighting factors. The results presented in this report are therefore representative of the English housing stock, with a population of 21.9 million households. See the EFUS 2011 Methodology report for further details of the weighting process.

3 Ownership and use of domestic appliances

In the EFUS interview survey householders were asked questions about the ownership and use of washing machines, tumble dryers, dishwashers, refrigerators, freezers, cookers, microwaves, televisions and any other large leisure appliances.

3.1 Laundry appliances

Table 1 shows the level of ownership of laundry appliances. It can be seen that the vast majority (97%) of households own a washing machine and that 62% of households own a tumble dryer.

Table 1: Ownership of washing machines and tumble-dryers

Appliance	Sample size	Number of Households (000s)	Percentage of households	
			(%)	95% C.I.
Separate automatic washing machine	2196	18,238	83.3	(81.7,84.9)
Separate tumble dryer	1288	10,786	49.3	(47.2,51.4)
Other type of washing machine	20	*167	*0.8	(0.4,1.1)
Combined washer-dryer	327	2,982	13.6	(12.2,15.1)
Any type of washing machines(including washer-dryer)	2512	21,123	96.5	(95.7,97.3)
Any tumble dryers (including washer-dryer)	1587	13,492	61.6	(59.6,63.7)

Base: all households in the EFUS Interview Survey (n=2616)

There are however, differences in ownership levels across certain household groups. Table 2 shows the percentage of each group that owns a washing machine (together with the 95% confidence intervals of that percentage) for the household characteristics that show significant differences between the categories. Results are also presented for tumble dryer ownership. Detailed descriptions of the variables used or derived from the EHS and EFUS data can be found in the Glossary.

Analysis shows that owner occupiers are more likely (at the 95% confidence level) to own washing machines and tumble dryers compared to the other tenures. Single person households, households without any children, households in which the HRP is 75 years old or more, households in which none of the occupants are working, households with incomes in the lowest income quintile and households that are not under-occupying are all less likely than their counterpart groups to own a washing machine or tumble dryer.

Table 2: Ownership of laundry appliances across household groups

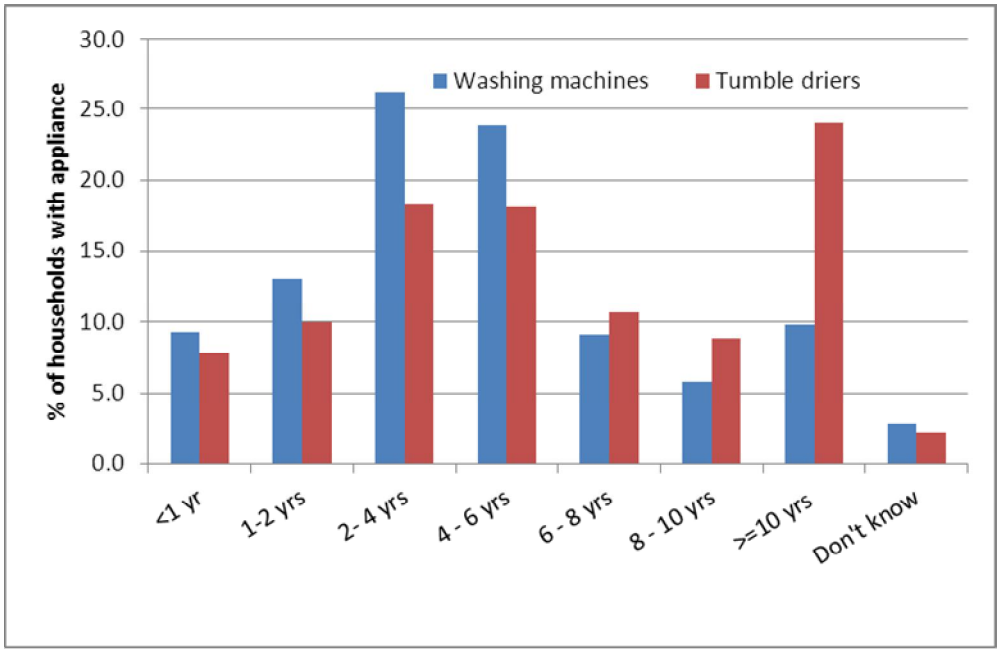
Household characteristic	Characteristic category	Sample size	% of group with a washing machine	95% C.I.	% of group with a tumble dryer	95% C.I.
Tenure	Owner Occupied	1486	98	(97.6, 99.1)	68	(65.3, 70.5)
	Private rented	385	96	(93.3, 97.8)	49	(43.5, 54.5)
	Local Authority	405	92	(89.5, 95.2)	48	(43.1, 53.8)
	RSL	340	89	(85.4, 92.7)	53	(47, 58.6)
Number of persons in household	1	734	89	(87, 91.9)	49	(45.1, 53.1)
	2	907	99	(98.2, 99.7)	65	(61.9, 68.7)
	3	424	99	(98.1, 100.1)	66	(60.9, 70.9)
	4	365	99	(98.4, 100.3)	70	(65.2, 75.5)
	5 or more	186	100	(98.8, 100.6)	65	(57, 72.1)
Pensioner Present	At least one person of	942	95	(93, 96.2)	60	(56.9, 63.8)
	No persons of	1674	97	(96.6, 98.3)	62	(59.7, 64.8)
Any children present?	At least one child	807	99	(98.8, 100)	66	(62.6, 69.7)
	No children	1809	95	(94.1, 96.3)	60	(57.2, 62.1)
Age of HRP	16 - 34	395	98	(95.9, 99.2)	57	(51.2, 61.9)
	35 - 44	477	98	(96.9, 99.5)	62	(57.5, 67)
	45 - 54	524	98	(96.7, 99.3)	66	(61.5, 70.5)
	55 - 64	494	97	(95.1, 98.5)	66	(61.8, 71)
	65 - 74	426	95	(92.6, 97.2)	60	(55.1, 65.3)
	75 or more	300	91	(86.9, 94.2)	53	(46.6, 59)
Employment status of HRP and partner combined	1 or more work full	1267	98	(97.6, 99.1)	65	(62.5, 68.2)
	1 or more work part	229	98	(96.4, 100.1)	63	(56, 69.8)
	none working, one or	774	93	(90.6, 94.7)	55	(51.2, 58.9)
	none working and	346	94	(90.8, 96.5)	55	(48.9, 60.4)
Income quintile	1st quintile (lowest)	611	90	(87.1, 92.4)	52	(47.3, 56)
	2nd quintile	578	96	(94.7, 98)	54	(49.4, 58.4)
	3rd quintile	499	98	(96.6, 99.3)	62	(57, 66.4)
	4th quintile	471	99	(98.1, 100)	68	(63.1, 72.4)
	5th quintile (highest)	457	99	(98.4, 100.1)	73	(68.7, 77.7)
Is anyone in the household at home	No	1012	97	(96.3, 98.5)	62	(59.2, 65.7)
	Yes	1604	96	(94.7, 96.9)	61	(58.4, 63.6)
Household is under-occupying?	Not under-occupying	1806	96	(94.7, 96.8)	60	(58, 62.9)
	Under-occupying	810	98	(96.9, 99)	64	(60.4, 67.7)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2351	96	(95, 96.8)	61	(58.5, 62.8)
	In fuel poverty	265	97	(95.2, 99.5)	61	(54.3, 67.2)

Base: all households in the EFUS Interview survey (n=2616)

Figure 1 shows distribution of ages of washing machines and tumble dryers in households that have those appliances. It can be seen that the greatest proportion of tumble dryers are more than 10 years old whereas the greatest proportion of washing machines are between 2 to 4 years old. The age of an appliance can act as a proxy for its energy efficiency and the EFUS 2011 data show us that there are a significant number of laundry appliances that are 10 or more years old within the

housing stock (approximately 2.1 million washing machines and 2.6 million tumble dryers), which are likely to be less energy efficient than more modern models.

Figure 1: Age of laundry appliances



Base: all households in the EFUS Interview survey, with those appliances (washing machine n=2512; tumble drier n=1587)

Questions were also asked about the frequency of use of washing machines and separate tumble dryers (for tumble dryers this was asked for use in both the summer and winter). The median number of loads (rather than the mean) is used here to provide a more accurate representation of the typical use because for both laundry appliances there are a small number of households with a particularly high level of use that act to skew the mean. As can be seen from Table 3, the median number of washing loads per week is 4 and the median number of drying loads per week is 3 in the winter and 0 in the summer. The results also show that 75% of households with tumble dryers use them once per week or not at all during the summer. Further analysis (Table 4) also shows that households that own a tumble dryer do, on average, one more load of washing per week compared to households that do not own a tumble dryer.

Table 3: Number of times the laundry appliances are used in a typical week.

	Median	25th Percentile	75th Percentile
Number of times per week the washing machine is typically used	4	2.00	6.00
Number of times per week in winter the tumble dryer is typically used	3	1.00	5.00
Number of times per week in summer the tumble dryer is typically used	0	0.00	1.00

Base: all households in the EFUS 2011 Interview Survey owning each appliance (washing machine n=2512; tumble drier n=1587).

Table 4: Median number of times a washing machine is used per week by households with and without a tumble dryer

Any type of tumble dryer (including washer-dryer)	Number of times per week the washing machine is typically used	
	Median	95% C.I.
No	3.0	(2.8, 3.2)
Yes	4.0	(3.8, 4.2)

Base: all households in the EFUS Interview survey (n=2616)

For washing machines, an additional question was asked about the temperature that most washes are made at. It can be seen from Table 5 that nearly 60% of washes are reported to take place at 40°C, and that only a small proportion of households use their washing machine at temperatures hotter than 40°C.

Table 5: Temperature that household typically runs the washing machine.

	30 degrees or less	40 degrees	Higher than 40 degrees	Don't know
Percentage of households with washing machine (%)	27.5	59.3	8.1	5.1

Base: all households in the EFUS 2011 Interview Survey with washing machines (n=2512)

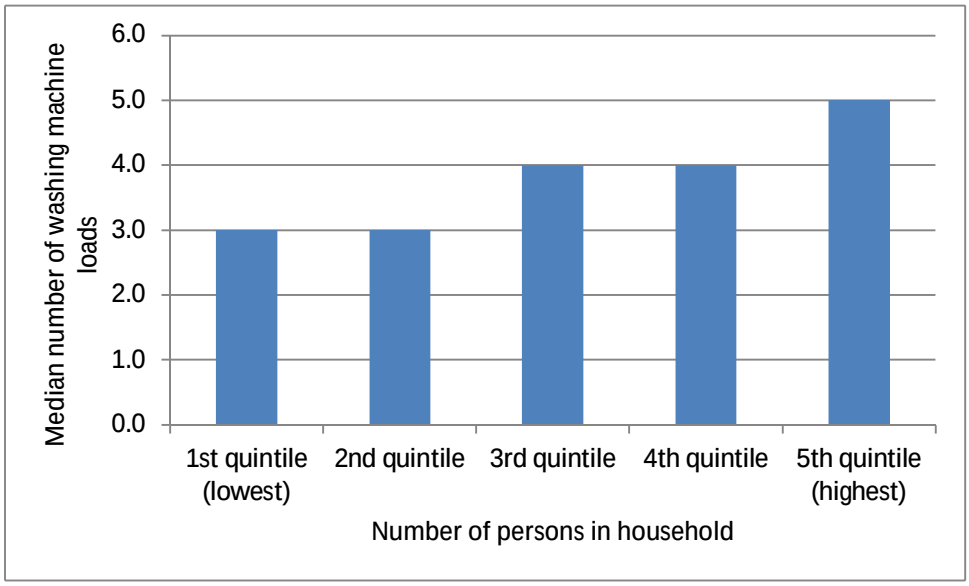
As to be expected, there is a pattern of more frequent washing machine use among large households, particularly those with children (Table 6). It can be seen that the median number of washing machine loads per week increases from 2.0 for single person households to 7.0 for households containing 5 or more persons (Figure 2). The median number of loads per week also increases as household income increases; households in the lowest income quintile report an average of 3.0 loads of washing per week compared to 5 loads in households in the highest income quintile. Additionally, households with at least one pensioner present, and households that are considered to be under-occupying use their washing machines less than their counterpart groups.

Table 6: Median number of washes per week across different household groups

Household characteristic	Characteristic category	Sample size	Number of washes per week	
			Median	95% CI
Tenure	Owner Occupied	1465	4.0	(3.8, 4.2)
	Private rented	368	4.0	(3.6, 4.4)
	Local Authority	378	4.0	(3.6, 4.4)
	RSL	301	4.0	(3.5, 4.5)
Household size	1	649	2.0	(1.9, 2.1)
	2	895	4.0	(3.9, 4.1)
	3	420	5.0	(4.7, 5.3)
	4	363	7.0	(6.5, 7.5)
	5 or more	185	7.0	(6, 8)
Pensioner Present?	At least one person of pensionable age	886	3.0	(2.9, 3.1)
	No persons of pensionable age	1626	4.0	(3.8, 4.2)
Children Present?	At least one child	801	7.0	(6.7, 7.3)
	No children	1711	3.0	(2.9, 3.1)
Age of HRP	16 - 34	386	4.0	(3.6, 4.4)
	35 - 44	467	5.0	(4.6, 5.4)
	45 - 54	513	5.0	(4.7, 5.3)
	55 - 64	474	4.0	(3.8, 4.2)
	65 - 74	401	3.0	(2.8, 3.2)
	75 or more	271	2.0	(1.9, 2.1)
Employment status of HRP and partner combined	1 or more work full time	1246	4.0	(3.8, 4.2)
	1 or more work part time	225	4.0	(3.5, 4.5)
	none working, one or more retired	717	3.0	(2.9, 3.1)
	none working and none retired	324	4.0	(3.5, 4.5)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	552	3.0	(2.9, 3.1)
	2nd quintile	551	3.0	(2.7, 3.3)
	3rd quintile	488	4.0	(3.7, 4.3)
	4th quintile	466	4.0	(3.7, 4.3)
	5th quintile (highest)	455	5.0	(4.7, 5.3)
Is anyone in the household at home during the day on a weekday?	No	979	4.0	(3.8, 4.2)
	Yes	1533	4.0	(3.8, 4.2)
Under-occupying?	Not under-occupying	1718	4.0	(3.8, 4.2)
	Under-occupying	794	3.0	(2.8, 3.2)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2254	4.0	(3.9, 4.1)
	In fuel poverty	258	4.0	(3.5, 4.5)

Base: all households in the EFUS 2011 Interview Survey with washing machines (n=2512)

Figure 2: Average (mean) number of washing machine loads by household size.



Base: all households in the EFUS 2011 Interview Survey with washing machines (n=2512)

3.2 Refrigeration

It can be seen that ownership of refrigerators and freezers is almost universal. 99% of households own a refrigerator (either as a separate unit or combined with a freezer) and 93% of households own some kind of freezer[4].

Table 7: Ownership of fridges and freezers

Appliance	Sample size	Number of Households (000s)	Percentage of households	
			(%)	95% C.I.
Fridge-freezer	1718	14,219	64.9	(62.9,67)
Separate fridge with small ice-box freezer	485	4,121	18.8	(17.2,20.5)
Separate fridge without small ice-box freezer	711	6,141	28.1	(26.2,29.9)
Separate freezer	1203	10,095	46.1	(44,48.2)
Any type of fridge(separate or combined with freezer)	2584	21,614	98.7	(98.2,99.2)
Any type of freezer (separate or combined with freezer, not including 'ice boxes')	2457	20,449	93.4	(92.4,94.4)

Base: all households in the EFUS Interview Survey (n=2616)

Analysis of fridge and freezer ownership across the different household groups shows no differences in the percentages for fridges (including fridge-freezer), suggesting that ownership of a fridge is

[4] This does not include households with only an 'ice-box' as part of their fridge. 1.2 million households own a fridge with an 'ice-box', but no other freezer.

considered a necessity. Freezer ownership (including fridge-freezer) is, however, more variable (Table 8) with similar differences in the patterns of ownership as those seen for the laundry appliances. Owner occupiers are more likely to own a freezer compared to the other tenures, whereas single person households, households with no children and households that are not under-occupying are all less likely than their counterpart groups to own a freezer. Households in the lowest income quintile are less likely to own a freezer than households in the fourth or fifth income quintiles.

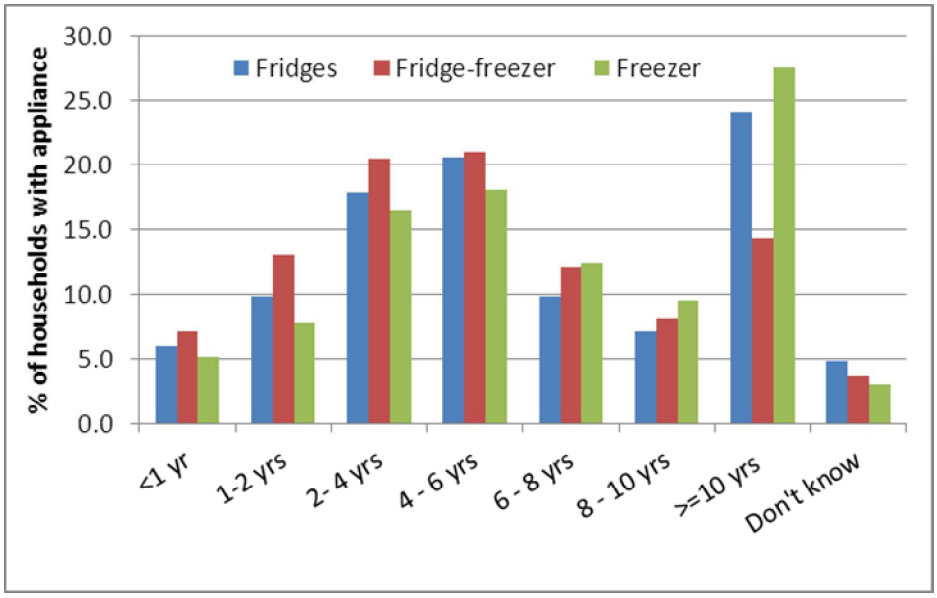
Table 8: Ownership of freezers across different household groups

Household characteristic	Characteristic category	Sample size	% of group with a freezer (of any type)	95% C.I.
Tenure	Owner Occupied	1486	96	(95, 97.2)
	Private rented	385	86	(82, 89.7)
	Local Authority	405	91	(88.3, 94.4)
	RSL	340	89	(85.9, 93)
Number of persons in household	1	734	88	(85.4, 90.6)
	2	907	94	(92.7, 96)
	3	424	96	(93.5, 97.8)
	4	365	98	(96, 99.4)
	5 or more	186	96	(92.7, 99)
Pensioner Present	At least one person of pensionable age	942	94	(92.4, 95.7)
	No persons of pensionable age	1674	93	(91.7, 94.4)
Any children present?	At least one child	807	96	(94.1, 97.2)
	No children	1809	92	(91.1, 93.8)
Age of HRP	16 - 34	395	89	(85.6, 92.4)
	35 - 44	477	95	(92.7, 97.1)
	45 - 54	524	95	(92.4, 96.7)
	55 - 64	494	94	(92, 96.5)
	65 - 74	426	96	(93.6, 97.8)
	75 or more	300	90	(86.5, 93.9)
Employment status of HRP and partner combined	1 or more work full time	1267	94	(92.6, 95.5)
	1 or more work part time	229	94	(90.9, 97.6)
	none working, one or more retired	774	93	(91, 95)
	none working and none retired	346	91	(87.3, 94.1)
Income quintile	1st quintile (lowest)	611	89	(86.5, 91.9)
	2nd quintile	578	93	(91.1, 95.6)
	3rd quintile	499	93	(90.8, 95.6)
	4th quintile	471	96	(94.5, 98.2)
	5th quintile (highest)	457	95	(92.7, 97.1)
Is anyone in the household at home	No	1012	93	(90.7, 94.3)
	Yes	1604	94	(92.8, 95.4)
Household is under-occupying?	Not under-occupying	1806	92	(90.5, 93.2)
	Under-occupying	810	97	(95.2, 97.9)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2351	93	(92.2, 94.4)
	In fuel poverty	265	94	(91, 97.2)

Base: all households in the EFUS Interview Survey (n=2616)

Households with standalone fridges and freezers typically have older appliances than households with a combined fridge-freezer. The age of appliances were collected as banded amounts. Just over 27% of separate freezers are more than 10 years old whereas the majority of fridge-freezers (21%) are in the 4 to 6 years old age band.

Figure 3: Age of refrigeration appliances



Base: all households in the EFUS 2011 Interview Survey with these appliances (fridge with or without ice box n=1196, freezer n=2457, fridge-freezer n=1718)

To investigate whether there is any trend in age of appliance by household characteristics, the ownership of 'new' versus 'old' fridges is looked at (it was shown earlier that ownership of fridges is fairly ubiquitous throughout the stock) (Table 9). In general, the oldest appliances are more likely to be found in owner occupied households than in private rented households, in households containing an older occupant, in households without any children and in households under-occupying compared to their counterpart groups. There is no apparent relationship between income and the ownership of an older fridge.

Table 9: Percentage of households with an older fridge across various household groups

Household characteristic	Characteristic category	Sample size of group	% of group with a fridge 4 or more years old	95% C.I.
Tenure	Owner Occupied	1445	62	(59.4, 64.9)
	Private rented	327	51	(45, 56.9)
	Local Authority	386	60	(54.3, 65)
	RSL	326	54	(48.5, 60.4)
Household size	1	692	65	(61.5, 69.3)
	2	869	61	(57, 64.2)
	3	396	54	(48.2, 59)
	4	347	57	(51.2, 62.7)
	5 or more	180	51	(43.1, 59.1)

Pensioner Present	At least one person of pensionable age	919	66	(63, 69.7)
	No persons of pensionable age	1565	56	(53.3, 58.7)
Children Present?	At least one child	761	52	(48.3, 56.1)
	No children	1723	63	(60.3, 65.3)
Age of HRP	16 - 34	340	45	(39.5, 51.1)
	35 - 44	456	54	(49.3, 59.3)
	45 - 54	503	61	(56.1, 65.5)
	55 - 64	477	64	(59, 68.5)
	65 - 74	416	63	(58, 68.2)
	75 or more	292	73	(66.9, 78.2)
Employment status of HRP and partner combined	1 or more work full time	1202	58	(54.4, 60.6)
	1 or more work part time	217	56	(49.2, 63.7)
	none working, one or more retired	752	67	(63.7, 71)
	none working and none retired	313	52	(46.2, 58.3)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	570	61	(57, 65.8)
	2nd quintile	544	60	(55.5, 64.6)
	3rd quintile	474	57	(52, 61.8)
	4th quintile	452	61	(55.9, 65.8)
	5th quintile (highest)	444	59	(53.8, 63.9)
Is anyone in the household at home during the day on a weekday?	No	944	57	(53.9, 60.9)
	Yes	1540	61	(58.5, 63.9)
Underoccupying?	Not under-occupying	1694	57	(54, 59.2)
	Under-occupying	790	65	(61.8, 69.1)
Fuel Poverty Low Income High Cost indicator (LIHC)	Not in fuel poverty - LIHC	2241	60	(57.4, 61.9)
	In fuel poverty - LIHC	243	59	(52.4, 66)

Base: all households in the EFUS 2011 Interview Survey with a fridge for which householder knows/can estimate age (n=2484)

3.3 Dishwashers

Dishwashers are present in less than half of all homes (41%) as shown in Table 10.

Table 10: Ownership of dishwashers in the stock

Appliance	Sample size	Number of Households (000s)	Percentage of households	
			(%)	95% C.I.
Dishwasher	977	8,893	40.6	(38.5,42.7)

Base: all households in the EFUS Interview Survey (n=2616)

As was seen for the laundry appliances, there are differences in the ownership of a dishwasher between certain household groups. Table 11 shows that owner occupiers are much more likely to own a dishwasher compared to the other tenures and that households in the local authority sector have particularly low rates of dishwasher ownership. Similarly to laundry appliances, dishwasher ownership is less than in their respective counterpart groups in single person households, households without children, households in which the HRP is 75 years old or more, or aged 16-34

years, households with incomes in the lowest income quintile, households that are not under-occupying and households considered to be in fuel poverty. Dishwasher ownership shows a particularly strong relationship to income, suggesting that dishwasher ownership is perhaps considered as a 'luxury' rather than a necessity.

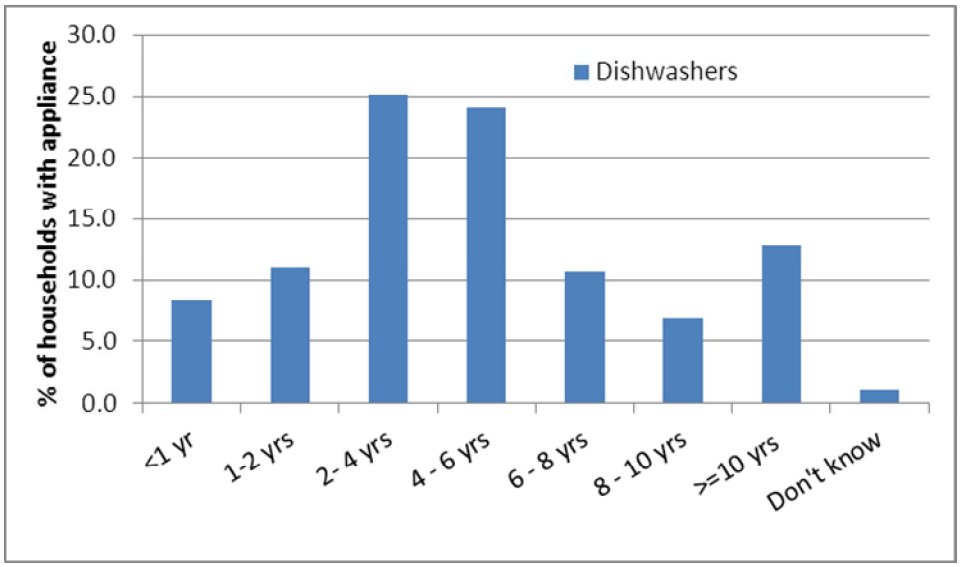
Table 11: Ownership of dishwashers across household groups

Household characteristic	Characteristic category	Sample size of group	% of group with a dishwasher	95% C.I.
Tenure	Owner Occupied	1486	54	(51.4, 57)
	Private rented	385	19	(14.3, 22.9)
	Local Authority	405	9	(6.3, 12.6)
	RSL	340	15	(10.8, 19.2)
Household size	1	734	19	(16.3, 22.6)
	2	907	45	(41.4, 48.5)
	3	424	47	(42, 52.4)
	4	365	60	(54.2, 65.2)
	5 or more	186	48	(39.7, 55.5)
Pensioner Present	At least one person of pensionable age	942	38	(35, 41.8)
	No persons of pensionable age	1674	42	(39.1, 44.3)
Children Present?	At least one child	807	50	(45.8, 53.4)
	No children	1809	37	(34.3, 39.2)
Age of HRP	16 - 34	395	24	(19.2, 28.4)
	35 - 44	477	42	(36.7, 46.4)
	45 - 54	524	53	(48.2, 57.6)
	55 - 64	494	49	(44, 53.7)
	65 - 74	426	37	(32.2, 42.3)
	75 or more	300	30	(23.9, 35.2)
Employment status of HRP and partner combined	1 or more work full time	1267	48	(45.4, 51.5)
	1 or more work part time	229	39	(32.2, 46.1)
	none working, one or more retired	774	34	(30.2, 37.6)
	none working and none retired	346	19	(14.6, 23.8)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	611	18	(14.3, 20.9)
	2nd quintile	578	26	(21.8, 29.6)
	3rd quintile	499	38	(33, 42.3)
	4th quintile	471	49	(44, 53.9)
	5th quintile (highest)	457	73	(68.7, 77.6)
Is anyone in the household at home during the day on a weekday?	No	1012	43	(40.1, 46.8)
	Yes	1604	38	(35.8, 41.1)
Underoccupying?	Not under-occupying	1806	34	(31.1, 35.9)
	Under-occupying	810	55	(51.4, 58.9)
Fuel Poverty Low Income High Cost indicator (LIHC)	Not in fuel poverty - LIHC	2351	42	(39.4, 43.8)
	In fuel poverty - LIHC	265	32	(25.8, 38.1)

Base: all households in the EFUS 2011 Interview Survey with a dishwasher (n=977)

Dishwashers tend to be relatively new appliances, almost 70% of dishwashers are less than 6 years old (Figure 4).

Figure 4: Age of dishwashers



Base: all households in the EFUS 2011 Interview Survey with a dishwasher (n=977)

The median number of times households typically use their dishwashers is approximately 4 times per week. Around 50% of all households use them between 2 and 7 times per week (Table 12).

Table 12: Number of times per week that dishwashers are used

	Median	25th Percentile	75th Percentile
Number of times per week the dishwasher is typically used	4.0	2.0	7.0

Base: all households in the EFUS 2011 Interview Survey with a dishwasher (n=977)

3.4 Cooking

Ownership and use questions for major cooking appliances (ovens, hobs, grills, range cookers and microwaves) were asked to all households. The results for ownership of each type of cooking appliance are shown in Table 13. It can be seen that almost all households own ovens and hobs (95% and 93% of households respectively); approximately 80% of households *without* an oven have an Aga / Rayburn style range cooker. Ownership of microwaves is also high, with over 80% of households owning one of these appliances.

Table 13: Ownership of cooking appliances

Appliance	Sample size	Number of Households (000s)	Percentage of households	
			(%)	95% C.I.
Oven (not part of an Aga / Rayburn style range cooker)	2503	20,896	95.4	(94.6,96.3)
Hob (not part of an Aga / Rayburn style range cooker)	2448	20,427	93.3	(92.2,94.4)
Grill	2195	18,241	83.3	(81.7,84.9)
Aga / Rayburn style range cooker	95	870	4.0	(3.2,4.8)
Microwave	2160	18,074	82.6	(81,84.2)

Base: all households in the EFUS 2011 Interview Survey (n=2616)

Ownership of the most common cooking combination (oven plus hob plus grill) and microwaves is fairly uniform across different type of households. Some differences exist with regards to the ownership of range-style cookers. Aga/ Rayburn type cookers are more likely to be found in owner-occupied households compared to any other tenure, households in which the HRP is aged between 55-64 years compared to households in which the HRP is aged between 16-34 years, households in rural locations compared to those in urban locations and households with incomes in the highest income quintile compared to those in the lowest income quintile (Table 14).

Table 14: Ownership of range style cookers and microwaves across household groups

Household characteristic	Characteristic category	Sample size	Percentage of group with an Aga/Rayburn style range cooker		Percentage of group with a microwave	
			%	95% C.I.	%	95% C.I.
Tenure	Owner Occupied	1486	5	(3.9, 6.4)	83	(80.9, 85.1)
	Private rented	385	2	(0.3, 3.1)	79	(74.9, 83.8)
	Local Authority	405	2	(0.4, 3.4)	86	(82.4, 89.8)
	RSL	340	2	(0.2, 3.1)	81	(76.1, 85.3)
Number of persons in household	1	734	2	(0.8, 3)	80	(77, 83.3)
	2	907	5	(3, 6)	83	(80, 85.4)
	3	424	4	(2.1, 6.3)	85	(81.2, 88.7)
	4	365	5	(2.5, 7.3)	82	(77.7, 86.4)
	5 or more	186	7	(3, 11.1)	87	(81.3, 92.1)
Pensioner Present	At least one person of pensionable age	942	4	(2.7, 5.5)	82	(79.5, 84.9)
	No persons of pensionable age	1674	4	(2.9, 4.9)	83	(80.7, 84.7)
Any children present?	At least one child	807	4	(2.4, 5.3)	83	(80.5, 86.2)
	No children	1809	4	(3, 5)	82	(80.3, 84.1)
Age of HRP	16 - 34	395	2	(0.5, 3.5)	82	(77.9, 86.3)
	35 - 44	477	5	(2.7, 6.9)	83	(78.9, 86.4)
	45 - 54	524	4	(1.9, 5.5)	83	(79, 86.1)
	55 - 64	494	6	(3.7, 8.3)	86	(82.9, 89.6)
	65 - 74	426	2	(0.8, 4)	83	(79.5, 87.2)
	75 or more	300	5	(2, 7.3)	75	(69.8, 80.6)

Employment status of HRP and partner combined	1 or more work full time	1267	5	(3.3, 5.8)	84	(81.4, 85.9)
	1 or more work part time	229	4	(1.2, 6.8)	82	(77, 87.9)
	none working, one or more retired	774	3	(1.9, 4.6)	81	(78.1, 84.2)
	none working and none retired	346	3	(1, 5)	81	(76, 85.2)
Income quintile	1st quintile (lowest)	611	2	(0.9, 3.5)	80	(76.9, 83.8)
	2nd quintile	578	3	(1.7, 4.9)	82	(78.4, 85.3)
	3rd quintile	499	3	(1.5, 5)	81	(77.5, 85)
	4th quintile	471	4	(2, 5.9)	86	(82.7, 89.6)
	5th quintile (highest)	457	7	(4.6, 9.8)	83	(79.4, 86.9)
Is anyone in the household at home	No	1012	4	(2.6, 5.3)	83	(80.4, 85.5)
	Yes	1604	4	(2.9, 5)	82	(80.2, 84.3)
Household is under-occupying?	Not under-occupying	1806	3	(2, 3.7)	82	(80, 83.9)
	Under-occupying	810	6	(4.4, 8.1)	84	(81, 86.6)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2356	3	(2.2, 3.7)	83	(81.1, 84.5)
	In fuel poverty	260	13	(8.9, 18)	80	(75.1, 85.7)

Base: all households in the EFUS 2011 Interview Survey (n=2616)

The fuel used by different cooking appliances was also examined. The proportion of gas and electric ovens, hobs and grills in the housing stock is shown in Table 15. Electricity is the dominant fuel used in ovens (almost 70% of households with ovens have electric ovens and just under 30% have gas ovens). For hobs, the prevalence of fuels is reversed with gas being the dominant fuel (38% of households have electric hobs, whereas 61% have gas hobs). The fuel used for grills appears to be the same as that used for the oven and this is supported by the results in Table 16 showing the interaction between the fuels used for the oven, hob and grill. For those with a gas oven, the combination of this with a gas grill and gas hob is more likely than any other mix of fuels (95% of gas ovens have this combination). For those households with an electric oven, the most common combination is either to have an all-electric cooker (i.e. with an electric grill and electric hob) (55%) or to have an electric grill but a gas hob (44%).

Table 15: Percentage of cooking appliances using different fuel types (n.b. a small number of cases are dual fuel – i.e. they can use more than one fuel - so percentages do not sum to exactly 100%).

Appliance	Sample size	% of households with this appliance using electricity	% of households with this appliance using mains gas	% of households with appliance using other fuel or dual-fuel
Oven (not part of an Aga / Rayburn style range cooker)	2503	68.7	29.3	2.0
Hob (not part of an Aga / Rayburn style range cooker)	2448	37.9	61.2	0.8
Grill	2195	69.7	29.9	0.5
Aga/Rayburn type range cooker	95	17.2	47.3	35.5

Base: all households in the EFUS 2011 Interview Survey with these appliances (n=2616)

Table 16: Relationship between fuels used for oven, hob and grill.

Hob fuel	Grill fuel	Mains gas oven	Electric oven
Mains gas	Mains gas	95.2%	*1.2%
	Electricity	*3.3%	43.5%
	Other fuel	**0.0%	**0.0%
Electricity	Mains gas	*.8%	*0.0%
	Electricity	*.5%	54.8%
	Other fuel	**0.0%	*.1%
Other fuels	Mains gas	**0.0%	**0.0%
	Electricity	*.2%	*.4%
	Other fuel	**0.0%	**0.0%
	TOTAL	100.0%	100.0%

Base: all households in the EFUS 2011 Interview Survey with an oven plus hob plus grill (n=2145)

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

*** within the sample there were no responses for this combination but this is not necessarily true for the population. The probability of this combination occurring in the population is likely to be <0.5%*

Householders also provided estimates of the age of ovens and the distribution of these is shown in Figure 5. A large number of ovens are reported by households to be greater than 10 years old (22% - equivalent to around 4.5 million ovens). These may represent a potential for replacement by more energy efficiency models. Analysis of these data by key household characteristics shows similar appliance age distributions to non-cooking appliances in that owner occupiers, households with a pensioner present and households under-occupying tend to have older ovens (Table 17).

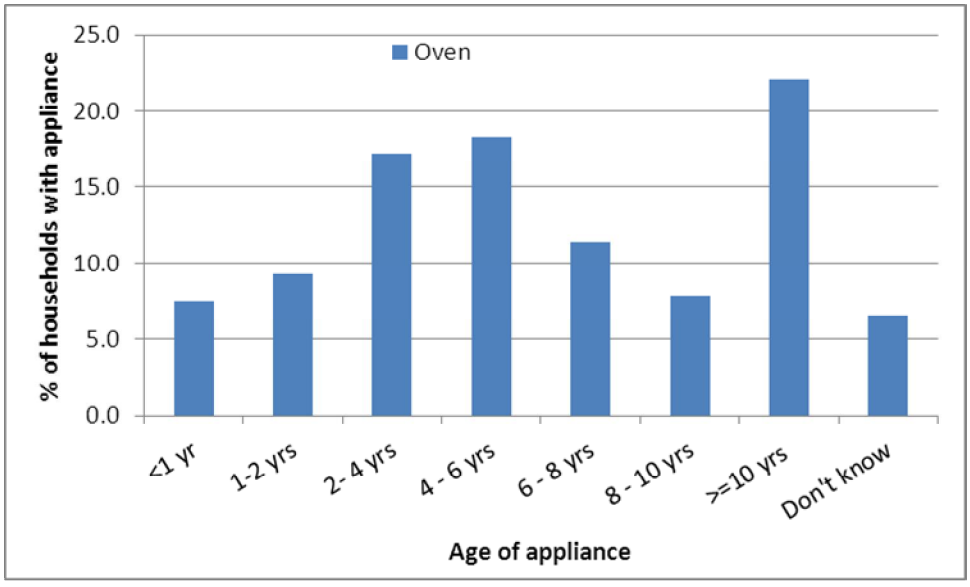
Table 17: Percentage of households with an older oven across various household groups

Household characteristic	Characteristic category	Sample size of group	% of group with an oven 4 or more years old	95% C.I.
Tenure	Owner Occupied	1373	67	(64.4, 69.8)
	Private rented	291	53	(47.2, 59.8)
	Local Authority	369	58	(52.2, 63.3)
	RSL	314	60	(54, 65.9)
Household size	1	660	68	(64.2, 72.1)
	2	830	66	(62.1, 69.2)
	3	372	61	(55, 66)
	4	328	60	(53.8, 65.5)
	5 or more	157	50	(41.5, 58.7)
Pensioner Present	At least one person of pensionable age	877	69	(65.9, 72.7)
	No persons of pensionable age	1470	61	(57.9, 63.4)
Children Present?	At least one child	711	59	(55.3, 63.2)
	No children	1636	66	(63, 68.1)

Age of HRP	16 - 34	315	54	(47.6, 59.7)
	35 - 44	413	58	(53, 63.4)
	45 - 54	485	64	(59.6, 69)
	55 - 64	456	67	(61.9, 71.4)
	65 - 74	399	70	(64.7, 74.6)
	75 or more	279	70	(64.5, 76.2)
Employment status of HRP and partner combined	1 or more work full time	1118	62	(59.3, 65.5)
	1 or more work part time	206	62	(54.4, 69)
	none working, one or more retired	725	69	(65.8, 73.2)
	none working and none retired	298	56	(49.7, 62.1)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	546	62	(58, 66.9)
	2nd quintile	510	66	(61.2, 70.2)
	3rd quintile	452	63	(58, 67.8)
	4th quintile	432	66	(61.4, 71.2)
	5th quintile (highest)	407	61	(55.8, 66.2)
Is anyone in the household at home during the day on a weekday?	No	894	64	(60.8, 67.7)
	Yes	1453	63	(60.5, 66)
Underoccupying?	Not under-occupying	1604	61	(58.1, 63.4)
	Under-occupying	743	69	(65.7, 73)
Fuel Poverty Low Income High Cost indicator (LIHC)	Not in fuel poverty - LIHC	2118	63	(61.1, 65.6)
	In fuel poverty - LIHC	229	67	(60, 73.4)

Base: all households in the EFUS 2011 Interview Survey with an oven of known or estimated age (n=2347)

Figure 5: National distribution of oven ages



Base: all households in the EFUS 2011 Interview Survey with an oven (n=2503)

The typical use of different cooking appliances, as reported by householders, is shown in Table 18 and Figure 6. Hobs, microwaves and range cookers are typically used more frequently than ovens

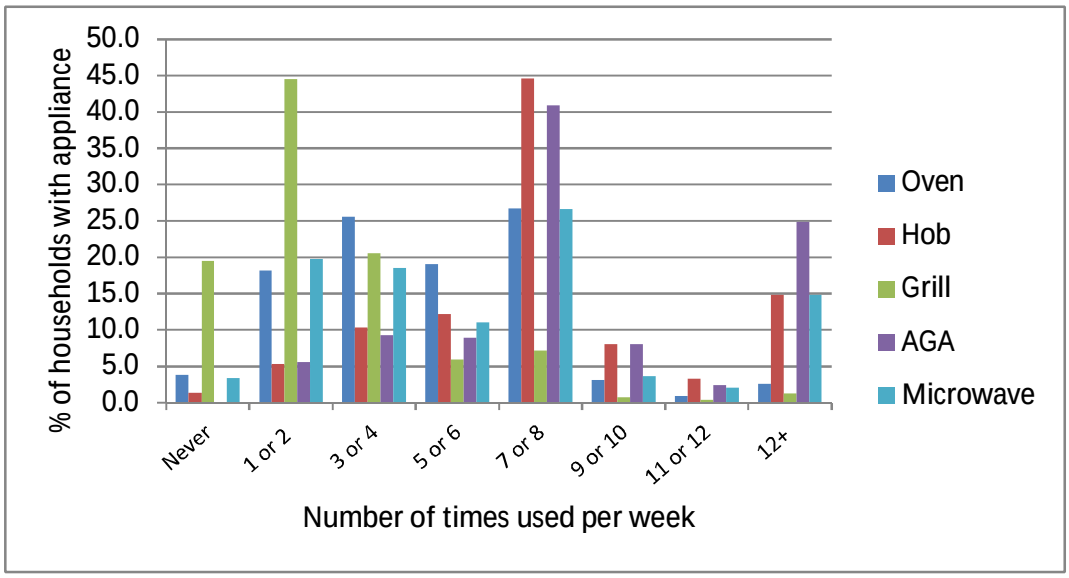
and grills. Approximately 70% of hobs and 50% of microwaves are used 7 or more times during the week. This compares to 33% of ovens, and 10% of grills. Very frequent use (more than 12 times per week) is also more commonly reported for hobs, AGAs and microwaves than for grills or ovens. A relatively high proportion of households with grills (approximately 20%) report that they are never used.

Table 18: Typical use of cooking appliances per week

	Sample size	Median	25th Percentile	75th Percentile
Oven use per week	2503	5.5	3.5	7.5
Hob use per week	2448	7.5	5.5	9.5
Grill use per week	2195	1.5	1.5	3.5
AGA use per week	95	7.5	7.5	11.5
Microwave use per week	2160	5.5	3.5	7.5

Base: all households in the EFUS 2011 Interview Survey owning each appliance (n=2616).

Figure 6: Typical number of times cooking appliances are used per week



Base: all households in the EFUS 2011 Interview Survey owning each appliance (n=2616)

Analysis by household characteristics (Table 19) shows use of an oven is linked to household size, age of the household reference person, if children are present and whether the household is under-occupying. The mean use of an oven increases as the household size increases from 1 to 3 persons although larger households do not show statistically different levels of oven use. Older households, households with children present and households not under-occupying typically have a higher average use of ovens compared to their counterparts. For hobs and microwaves, average use is higher for households where someone is in during the day and households with children present, compared to their counterpart groups.

Table 19: Mean usage of ovens, hobs and microwaves across difference household groups

Household characteristic	Characteristic category	Sample size	Oven use per week		Hob use per week		Microwave use per week	
			Mean	95% CI	Mean	95% CI	Mean	95% CI
Tenure	Owner Occupied	1486	5.0	(4.8, 5.1)	7.9	(7.6, 8)	6.3	(6, 6.5)
	Private rented	385	5.1	(4.6, 5.4)	8.1	(7.6, 8.5)	6.5	(5.9, 7)
	Local Authority	405	5.1	(4.6, 5.4)	7.5	(7, 7.8)	6.7	(6.2, 7.2)
	RSL	340	5.0	(4.6, 5.3)	7.6	(7, 8)	5.8	(5.3, 6.3)
Household size	1	734	3.6	(3.4, 3.8)	6.2	(5.9, 6.4)	5.5	(5.1, 5.7)
	2	907	5.0	(4.8, 5.1)	7.8	(7.5, 8)	5.9	(5.6, 6.2)
	3	424	5.9	(5.5, 6.1)	8.4	(8, 8.7)	6.9	(6.4, 7.4)
	4	365	6.1	(5.7, 6.3)	9.2	(8.7, 9.6)	7.5	(6.9, 8)
	5 or more	186	6.4	(5.8, 7)	10.2	(9.5, 10.7)	8.4	(7.5, 9.1)
Pensioner Present?	At least one person of pensionable age	942	4.4	(4.1, 4.5)	7.7	(7.4, 7.9)	6.4	(6, 6.6)
	No persons of pensionable age	1674	5.3	(5.1, 5.4)	7.9	(7.7, 8)	6.4	(6.1, 6.5)
Children Present?	At least one child	807	6.0	(5.7, 6.2)	8.8	(8.5, 9)	7.4	(7, 7.7)
	No children	1809	4.6	(4.4, 4.7)	7.4	(7.2, 7.5)	5.9	(5.7, 6.1)
Age of HRP	16 - 34	395	5.6	(5.2, 6)	7.9	(7.4, 8.2)	6.3	(5.8, 6.8)
	35 - 44	477	5.6	(5.2, 5.8)	8.1	(7.6, 8.4)	6.7	(6.2, 7.1)
	45 - 54	524	5.3	(4.9, 5.5)	7.9	(7.5, 8.2)	6.4	(5.9, 6.8)
	55 - 64	494	4.7	(4.4, 4.9)	7.7	(7.3, 8)	5.7	(5.3, 6.1)
	65 - 74	426	4.4	(4.1, 4.7)	8.0	(7.5, 8.3)	6.5	(6, 6.9)
	75 or more	300	4.0	(3.6, 4.2)	7.2	(6.7, 7.7)	6.7	(6.1, 7.2)
Employment status of HRP and partner combined	1 or more work full time	1267	5.3	(55.4)	7.8	(7.6, 8)	6.3	(5.9, 6.5)
	1 or more work part time	229	5.0	(4.55.4)	8.2	(7.6, 8.6)	6.6	(5.9, 7.1)
	none working, one or more retired	774	4.3	(4.14.5)	7.7	(7.3, 7.9)	6.4	(6, 6.7)
	none working and none retired	346	5.4	(4.95.8)	7.9	(7.4, 8.4)	6.6	(6, 7.1)
Annual gross income of the HRP and partner weighted quintiles	1st quintile	611	4.5	(4.2, 4.8)	7.4	(7.1, 7.7)	6.1	(5.7, 6.4)
	2nd quintile	578	4.7	(4.4, 5)	7.6	(7.2, 7.9)	6.6	(6.2, 7)
	3rd quintile	499	5.0	(4.7, 5.3)	7.9	(7.5, 8.2)	6.5	(6, 6.8)
	4th quintile	471	5.3	(5, 5.6)	7.8	(7.4, 8.1)	6.1	(5.6, 6.4)
	5th quintile	457	5.4	(5.1, 5.7)	8.4	(8, 8.7)	6.5	(6, 7)
Is anyone in the household at home during the day on a weekday?	No	1012	5.0	(4.7, 5.1)	7.4	(7.1, 7.6)	5.9	(5.5, 6.1)
	Yes	1604	5.1	(4.8, 5.2)	8.2	(7.9, 8.3)	6.7	(6.5, 6.9)
Under-occupying?	Not under-occupying	1806	5.3	(5.1, 5.4)	7.9	(7.7, 8.1)	6.6	(6.3, 6.8)
	Under-occupying	810	4.5	(4.2, 4.6)	7.6	(7.2, 7.8)	5.9	(5.5, 6.2)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2351	5.0	(4.8, 5.1)	7.7	(7.5, 7.8)	6.3	(6.1, 6.5)
	In fuel poverty	265	5.3	(4.8, 5.7)	8.7	(8, 9.2)	6.7	(6, 7.3)

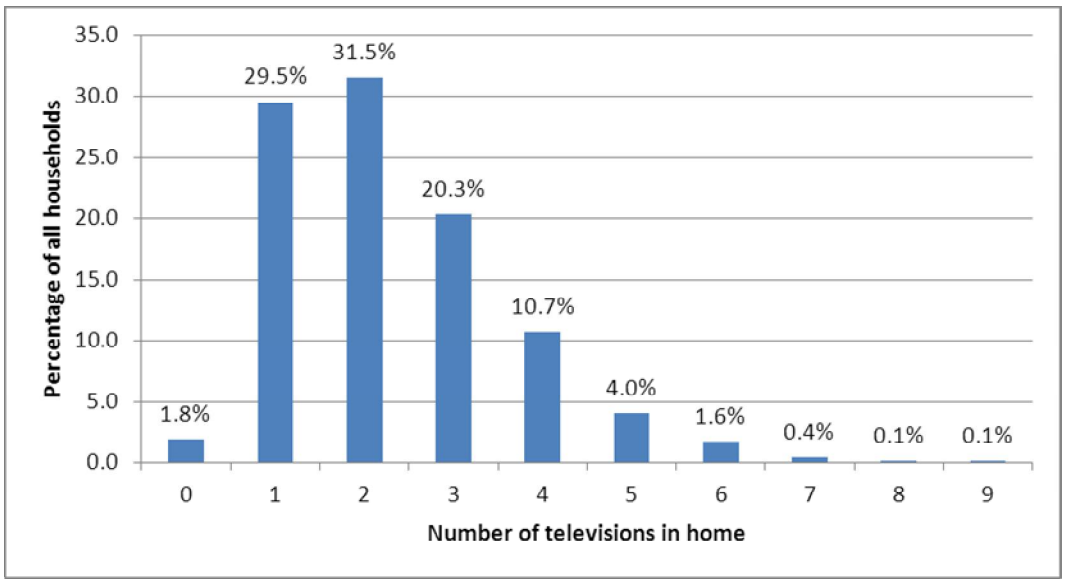
Base: all households in the EFUS 2011 Interview Survey owning each appliance (n=2616)

3.5 Televisions

Householders were asked questions about the total number televisions in their home. This was followed by more detailed questions on the type, size and use of the three most used televisions in the home.

The number of televisions in homes ranges from 0 to 9, with a mean of approximately 2.3 per household (and a median of 2.0). Just under 2% of households report that they do not have a television. Just over 83% of households have three or fewer televisions. This is shown in Figure 7.

Figure 7: Ownership of televisions



Base: all households in the EFUS 2011 Interview Survey (n=2616). Percentage of all households are shown above each bar.

There are however, differences in ownership levels across certain household groups. The analysis presented in Table 20 indicates that owner occupiers typically have more televisions than any of the other tenures. Additionally, the mean number of televisions in a household increases as household size increases. Households in the lowest income quintiles have less televisions on average than households in any of the four high income quintiles and households with children present and households where no pensioners are present also show a higher mean number of televisions compared to their counterpart groups.

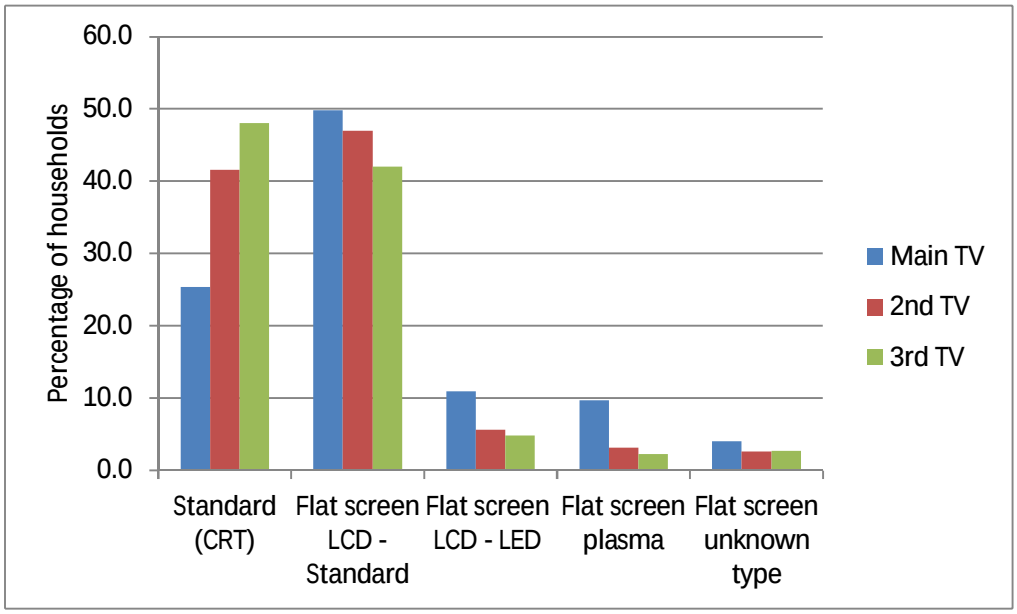
Table 20: Mean number of televisions across different household groups

Household characteristic	Characteristic category	Sample size	Number of televisions	
			Mean	95% CI
Tenure	Owner Occupied	1486	2.5	(2.4, 2.5)
	Private rented	385	1.8	(1.6, 1.8)
	Local Authority	405	2.1	(1.9, 2.1)
	RSL	340	2.2	(2, 2.3)
Household size	1	734	1.6	(1.5, 1.7)
	2	907	2.3	(2.1, 2.3)
	3	424	2.6	(2.4, 2.7)
	4	365	2.8	(2.6, 3)
	5 or more	186	3.3	(3, 3.5)
Pensioner Present?	At least one person of pensionable age	942	2.1	(2, 2.1)
	No persons of pensionable age	1674	2.4	(2.3, 2.4)
Children Present?	At least one child	807	2.7	(2.5, 2.8)
	No children	1809	2.1	(2, 2.1)
Age of HRP	16 - 34	395	1.8	(1.7, 1.9)
	35 - 44	477	2.6	(2.4, 2.7)
	45 - 54	524	2.7	(2.5, 2.8)
	55 - 64	494	2.4	(2.2, 2.5)
	65 - 74	426	2.1	(2, 2.2)
	75 or more	300	1.7	(1.6, 1.8)
Employment status of HRP and partner combined	1 or more work full time	1267	2.5	(2.3, 2.5)
	1 or more work part time	229	2.5	(2.3, 2.7)
	none working, one or more retired	774	2.0	(1.8, 2)
	none working and none retired	346	2.1	(1.9, 2.2)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	611	1.8	(1.7, 1.9)
	2nd quintile	578	2.2	(2.1, 2.3)
	3rd quintile	499	2.3	(2.1, 2.4)
	4th quintile	471	2.6	(2.4, 2.7)
	5th quintile (highest)	457	2.6	(2.4, 2.7)
Is anyone in the household at home during the day on a weekday?	No	1012	2.4	(2.2, 2.4)
	Yes	1604	2.3	(2.1, 2.3)
Under-occupying?	Not under-occupying	1806	2.3	(2.2, 2.3)
	Under-occupying	810	2.4	(2.2, 2.4)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2351	2.3	(2.2, 2.3)
	In fuel poverty	265	2.4	(2.1, 2.5)

Base: all households in the EFUS 2011 Interview Survey (n=2616)

The household was asked to report some details about the type and use of the three televisions in the home that were used most often. A summary of responses to these questions is shown in Figure 8. The main (most used) television in the home is much more likely to be a flat screen type (75% of the televisions used most often are a flat screen of one form or another) than the second and third most frequently used (approximately 60% and 50% respectively are flat screens). Almost 10% of households use a flat screen plasma television as their main television and just over 10% have a LED-LCD flat screen as their main television.

Figure 8: Type of televisions in use for the three most used televisions in the home



Base: all households in the EFUS 2011 Interview Survey with 1-3 televisions (n=2577)

Table 21 shows the differences in the type of main television used across the various household groups. Owner occupied households are more likely to have a flat screen television than a standard CRT type as the most used television compared to households in the social rented sector whereas households in the lowest income quintile are less likely to have a flat screen model as the television used the most compared to households with higher incomes. Additionally, single person households are also less likely to have a flat screen television as the most used television compared to larger households.

Table 21: Type of television (for the most used television) across the household groups

Household characteristic	Characteristic category	Sample size	Main television type - standard CRT		Main television type - Flat Screen	
			%	95% CI	%	95% CI
Tenure	Owner Occupied	1468	23	(20.5, 25.2)	77	(74.8, 79.5)
	Private rented	370	28	(22.8, 32.8)	72	(67.2, 77.2)
	Local Authority	404	34	(28.8, 39)	66	(61, 71.2)
	RSL	335	31	(25.1, 36)	69	(64, 74.9)
Household size	1	711	33	(29.6, 37.2)	67	(62.8, 70.4)
	2	901	22	(19.4, 25.4)	78	(74.6, 80.6)
	3	418	24	(19.4, 28.3)	76	(71.7, 80.6)
	4	362	21	(16.4, 25.7)	79	(74.3, 83.6)
	5 or more	185	22	(15.7, 28.9)	78	(71.1, 84.3)
Pensioner Present?	At least one person of pensionable age	930	25	(22.3, 28.4)	75	(71.6, 77.7)
	No persons of pensionable age	1647	25	(23.1, 27.7)	75	(72.3, 76.9)
Children Present?	At least one child	802	24	(20.3, 26.8)	76	(73.2, 79.7)
	No children	1775	26	(24, 28.5)	74	(71.5, 76)
Age of HRP	16 - 34	385	25	(19.8, 29.3)	75	(70.7, 80.2)
	35 - 44	471	25	(21, 29.7)	75	(70.3, 79)
	45 - 54	517	25	(20.8, 29)	75	(71, 79.2)
	55 - 64	488	27	(22.8, 31.5)	73	(68.5, 77.2)
	65 - 74	420	22	(18.1, 26.9)	78	(73.1, 81.9)
	75 or more	296	29	(23.2, 34.5)	71	(65.5, 76.8)
Employment status of HRP and partner combined	1 or more work full time	1251	22	(19.2, 24.2)	78	(75.8, 80.8)
	1 or more work part time	224	28	(21.8, 34.8)	72	(65.2, 78.2)
	none working, one or more retired	766	28	(24, 31)	72	(69, 76)
	none working and none retired	336	37	(30.9, 42.3)	63	(57.7, 69.1)
Annual gross income of the HRP and partner weighted quintiles	1st quintile (lowest)	594	38	(33.4, 42)	62	(58, 66.6)
	2nd quintile	569	28	(23.6, 31.6)	72	(68.4, 76.4)
	3rd quintile	497	23	(19.1, 27.3)	77	(72.7, 80.9)
	4th quintile	464	18	(14.6, 22.4)	82	(77.6, 85.4)
	5th quintile (highest)	453	20	(16.2, 24.4)	80	(75.6, 83.8)
Is anyone in the household at home during the day on a weekday?	No	999	24	(20.6, 26.4)	76	(73.6, 79.4)
	Yes	1578	27	(24.4, 29.2)	73	(70.8, 75.6)
Under-occupying?	Not under-occupying	1780	25	(23, 27.4)	75	(72.6, 77)
	Under-occupying	797	26	(22.5, 29.2)	74	(70.8, 77.5)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2321	25	(23.1, 27)	75	(73, 76.9)
	In fuel poverty	256	29	(22.5, 34.6)	71	(65.4, 77.5)

Base: all households in the EFUS 2011 Interview Survey with 1-3 televisions (n=2577)

Householders were also asked to estimate the size of the television. The distribution of sizes is shown in Table 22[5]. It can be seen that the television used most in the home tends to be larger than the next two most frequently used – only 40% of the most frequently used televisions are in the small or medium category, compared to over 80% of the second or third most frequently used televisions.

Table 22: Distribution of sizes for three televisions most in use (percentage of households with this television)

	Small (less than 19")	Medium (between 19" and 30")	Large (between 30" and 42")	Very large (greater than 42")
Television 1 (the television used most often)	4.1	35.3	51.3	9.3
Television 2 (used 2nd most often)	42.5	39.2	17.0	0.9
Television 3 (used 3rd most often)	51.0	37.0	10.5	1.6

Base: all households in the EFUS 2011 Interview Survey with 1-3 televisions (n=2577)

Questions on the total number of hours that each of the three televisions was switched on, on a typical weekday, a typical Saturday and a typical Sunday were also asked. Respondents were specifically asked not to include standby hours, but rather to only include hours when it was actually on. The responses to these questions are shown in Table 23. It can be seen that, on average, the television used most often in the house is used for considerably longer than the other televisions in the house (approximately 5 to 6 hours per day, compared to 1 to 2 hours for the other televisions). Main televisions are also reported to be in use for slightly longer at the weekend than in the week, although there is no significant difference in the average number of hours used weekdays compared to weekends for the 2nd and 3rd televisions.

Table 23: Mean hours of use for the three televisions most in use

	No. hours television is used on a weekday	No. hours television is used on a Saturday	No. hours television is used on a Sunday
	Mean (95% C.I)	Mean (95% C.I)	Mean (95% C.I)
Television 1 (the television used most often)	5.5 (5.3, 5.6)	6.1 (5.9, 6.2)	6.1 (5.9, 6.2)
Television 2 (used 2nd most often)	2.0 (1.8, 2.0)	2.1 (2.0, 2.2)	2.1 (1.9, 2.2)
Television 3 (used 3rd most often)	1.3 (1.1, 1.4)	1.5 (1.3, 1.6)	1.5 (1.3, 1.5)

Base: all households in the EFUS 2011 Interview Survey with 1-3 televisions (n=2577)

The average (mean) number of hours that the main (most used) television is watched on a weekday does differ between different household groups. As can be seen from Table 24, the average number of hours is greater for households that are in the social rented sector compared to owner occupiers or private renters, and is greater for households with children (compared to those without children),

[5] Televisions were not measured by the interviewer, and these results are based on household responses.

households with someone of pensionable age (compared to those without), households with someone in during the day (compared to those without) and households that are not under-occupying (compared to those not under-occupying).

Table 24: Average number of hours of use on a weekday of the main (most used) television by various household characteristics

Household characteristic	Characteristic category	Sample size	Number of hours of television use	
			Mean	95% C.I.
Tenure	Owner Occupied	1468	5.0	(4.8, 5.2)
	Private rented	370	5.6	(5.2, 5.9)
	Local Authority	404	7.3	(6.8, 7.7)
	RSL	335	6.8	(6.3, 7.2)
Number of persons in household	1	711	5.1	(4.8, 5.3)
	2	901	5.3	(5.1, 5.5)
	3	418	5.7	(5.3, 6)
	4	362	5.8	(5.4, 6.1)
	5 or more	185	6.9	(6.2, 7.6)
Pensioner Present	At least one person of pensionable age	930	5.9	(5.6, 6)
	No persons of pensionable age	1647	5.3	(5.1, 5.5)
Any children present?	At least one child	802	6.0	(5.7, 6.2)
	No children	1775	5.3	(5.1, 5.4)
Age of HRP	16 - 34	385	5.3	(4.9, 5.7)
	35 - 44	471	5.4	(5, 5.7)
	45 - 54	517	5.4	(5, 5.6)
	55 - 64	488	5.5	(5.1, 5.7)
	65 - 74	420	5.9	(5.5, 6.2)
	75 or more	296	5.8	(5.3, 6.2)
Employment status of HRP and partner combined	1 or more work full time	1251	5.0	(4.7, 5.1)
	1 or more work part time	224	5.8	(5.3, 6.2)
	none working, one or more retired	766	5.9	(5.6, 6.1)
	none working and none retired	336	7.0	(6.5, 7.5)
Income quintile	1st quintile (lowest)	594	6.3	(5.9, 6.6)
	2nd quintile	569	6.4	(6, 6.7)
	3rd quintile	497	5.4	(5.1, 5.7)
	4th quintile	464	5.3	(5, 5.6)
	5th quintile (highest)	453	4.2	(3.9, 4.3)
Is anyone in the household at home during the day on a weekday?	No	999	4.7	(4.4, 4.8)
	Yes	1578	6.2	(5.9, 6.3)
Household is under-occupying?	Not under-occupying	1780	5.9	(5.7, 6.1)
	Under-occupying	797	4.7	(4.4, 4.8)
In Fuel Poverty? LIHC definition	Not in fuel poverty	2321	5.5	(5.3, 5.5)
	In fuel poverty	256	6.1	(5.5, 6.5)

Base: all households in the EFUS 2011 Interview Survey with a television (n=2577)

3.6 Electrical cooling equipment

All householders were asked about their use of electrical equipment to cool their dwellings. 43% of all households (equivalent to 9.5 million households) use portable fans. Other fixed fans are in use by around 9% of households. Air conditioning use is very rare with less than 3% of households using fixed or portable air conditioning units (approximately 600,000 households) (Table 25).

Table 25: Type of cooling equipment used by householders

Q82: Does your household use any of the following to keep your home cool	Sample size	Number of households (000s)	Percentage of households	
			(%)	95% C.I.
Do you have any Portable fans	1146	9,471	43.3	(41.2,45.3)
Do you have any Other fixed fans	232	1,927	8.8	(7.6,10)
Do you have any Fixed Air conditioning	17	*165	*.8	*(0.4,1.1)
Do you have any Portable air-conditioning units	50	439	2.0	(1.4,2.6)

Base: All households in the EFUS Interview survey (n=2616)

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

3.6.1 Frequency of use of cooling equipment

The use of electrical cooling equipment will have an impact on energy usage levels. This data provides useful baseline information on the number of households with electrical cooling equipment and the frequency of use. Around 17% of households use portable fans on a daily basis during the summer months. Just under 40% of households with portable fans use them more than once per week but not every day, and a further 39% of households use them less than once a week (Table 26). The small number of surveyed households using air conditioning systems precludes detailed analysis of the use of these systems.

Table 26 Frequency of use of electrical cooling equipment by type of equipment

Q83: In a typical summer (June to August), how often does your household use the appliance to help keep your home cool	Portable fans			Fixed fans		
	Sample size	Number of households (000s)	Percentage of households (%)	Sample size	Number of households (000s)	Percentage of households (%)
Every day	208	1,631	17.2	53	396	20.6
5-6 days a week	59	458	4.8	13	*130	6.8
1-4 days a week	383	3,228	34.1	71	610	31.7
Less than once a week	441	3,734	39.4	85	717	37.3
Don't know	55	417	4.4	10	*72	3.7
Total	1146	9,471	100.0	232	1,926	100.0

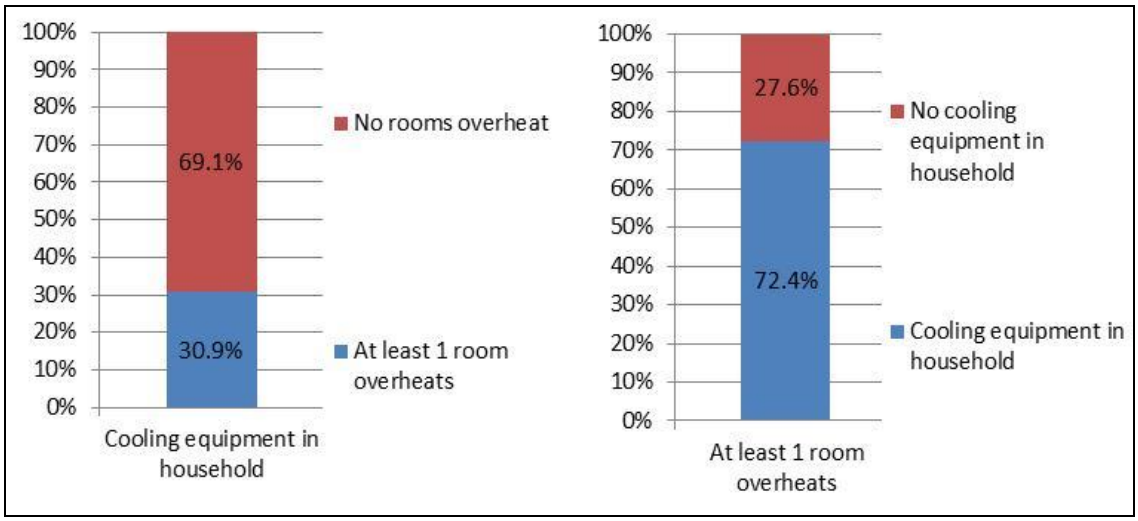
Base: All households using portable fans / fixed fans.

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

As reported in the EFUS 2011 Thermal Comfort and Overheating report, approximately 20% of households reported difficulty in keeping at least 1 room of their dwelling cool during the summer

months. Further examination of the data indicates that a high proportion (72%) of households who experience overheating use some kind of cooling equipment, although of all the households with cooling equipment, the minority (31%) experience overheating in 1 or more rooms (Figure 9).

Figure 9: Reported overheating and the use of cooling equipment



Base: All households in the EFUS interview sample (n=2616).

3.7 Other leisure equipment

A brief section of the EFUS asked specific questions on the ownership and use of a number of large appliances or facilities which may be found in some homes, and have the potential to significantly affect energy use, for example, heated swimming pools, Jacuzzis, saunas, pottery kilns and workshop machinery. Questions were also asked about some smaller appliances which are used outside the home which may not always be considered by monitoring programmes, for example, electric lawnmowers. These questions were primarily asked in support of the electricity consumption data, to allow the interpretation of this information and identify unusual usage patterns. Ownership of many of these appliances in the EFUS 2011 sample was typically very low (Table 27) and therefore cannot be reported on in any level of detail.

Table 27: Ownership of other leisure equipment

Appliance	Sample size	Number of Households (000s)	Percentage of households	
			(%)	95% C.I.
Barbeque	923	8,118	37.1	(35,39.1)
Patio heater	77	732	3.3	(2.6,4.1)
Chiminea	208	1,914	8.7	(7.6,9.9)
Electric or petrol lawnmower	1427	12,125	55.4	(53.3,57.5)
Greenhouse heaters	61	*538	*2.5	*(1.8,3.1)
Heated swimming pool	6	*58	*0.3	*(0,0.5)
Heated Jacuzzi or Hot tub	18	*190	*0.9	*(0.5,1.3)
Sauna	7	*77	*0.4	*(0.1,0.6)
Heavy workshop machinery	56	*537	*2.5	*(1.8,3.1)
Pottery Kiln	2	*18	*0.1	*(0,0.2)

Base: All households in the EFUS interview sample (n=2616).

4 Analysis of detailed electricity monitoring data

In order to investigate the demand from lights, appliances and cooking, the electricity used in seventy nine homes[6] was recorded at ten second intervals. The data from this monitoring exercise has been analysed and refined to profile how energy is used in the sample homes. This analysis includes an assessment of the base load of the properties and the average load of all properties. A comparison of weekend, weekday and monthly usage has also been carried out together with a power frequency distribution curve examining patterns of consumption across the sample.

4.1 Base load of all properties

There is interest in the low levels of electricity used within the home during the night and when the occupant is out. Much of this energy use is likely to be consumed by appliances in the home not actively performing their function (often described as 'stand by' power) although it should be recognised that some of this load may be providing a degree of utility to the household in the form of, for example, refrigeration appliances needing to be always on, overnight charging of mobile phones, updating of set-top box data, provision of security lighting etc.

It is possible, by examining the detailed electricity profiles collected for the EFUS, to assess the electricity demand at a time of day where there appears to be (or can reasonably assumed to be) no active appliance use by the occupants. At its simplest, the base load can be attributed to the minimum level of power demand in any particular period (e.g. in any 24 hour period). Alternatively an average over a representative period (such as an hour in the middle of the night) could be taken.

Preliminary visual inspection of the EFUS electricity monitoring data reveal that for many households the minimum demand level varied significantly over the monitoring period, most likely due to different occupant behaviour or the addition or removal of appliances. Power is also occasionally unrepresentatively low (e.g. in a power outage situation) or high (for example where electricity is being used during this time exceptionally). These periods are not considered to be representative of a household base load, where base load is defined as the "typical" low power state of the dwelling.

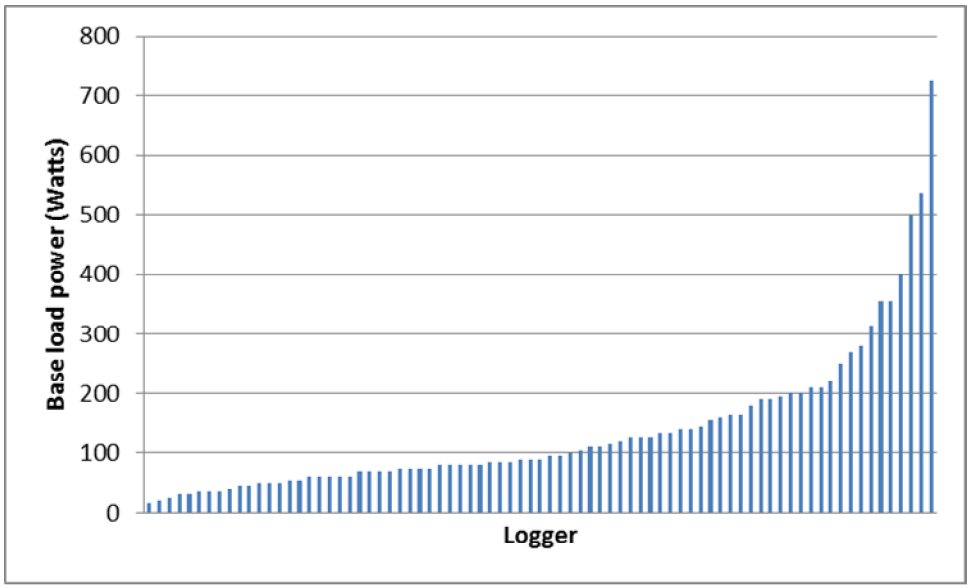
To assess the issue more robustly, power-frequency distributions (i.e. how frequently various power consumption levels occur over the period of monitoring) have been inspected for short period data. This allows the identification of typical low power loads which were said to correspond to the base load for the majority of households. Through careful consideration and inspection of these data a statistical basis for base load has been determined from these dwellings. The identified base loads correspond with the level of electrical power consumption in Watts exceeded for 90% of the monitoring period (when assessed using high-frequency data). This definition is found to give a good approximation to the base load when assessed manually, and has the advantage of being statistically derived (and therefore repeatable and non-subjective, allowing fair comparison with other/future studies).

[6] Excluding households with electric space and/or water heating. See the EFUS 2011 Methodology report for further details.

The 10th percentile definition of base-load does raise the question of what is happening the 10% of the time when a lower power consumption occurs. Some possible factors are: power cuts (caused by grid problems); the power being deliberately turned off (e.g. enabling electrical work to take place); holiday absences (where people may turn off things like modems which they normally leave on); changes in equipment ownership, where a new appliances with a standby load is added part way through the monitoring period, shifting the base-load upwards; and changes in householder behaviour during the monitoring period.

Using this definition, the base loads of the 79 electricity monitoring data sets have been assessed. These are plotted in order of increasing power in Figure 10.

Figure 10: Base load power for all the properties



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

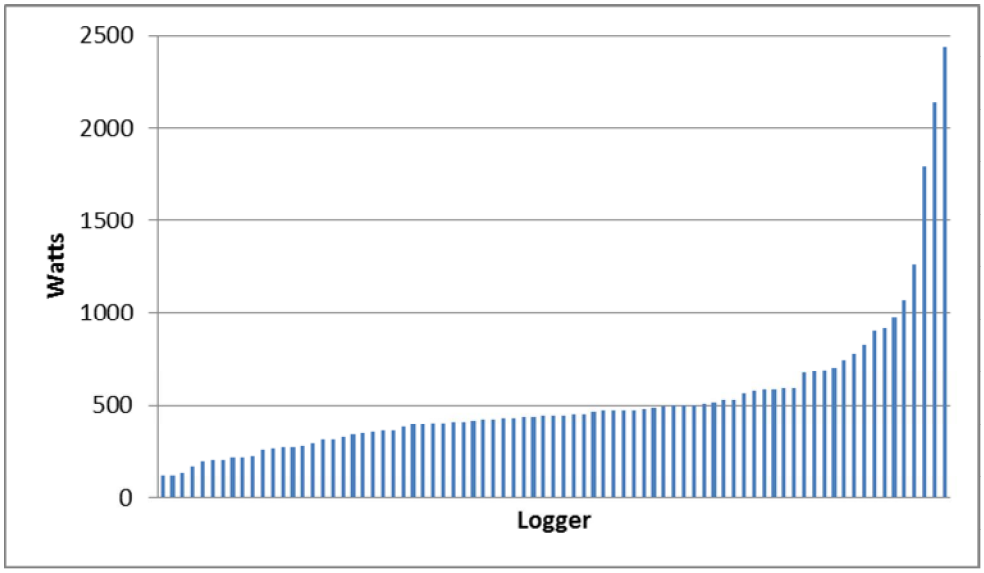
The median base load for the 79 homes in the sample is 90 Watts. This is considered a more representative average for the sample than the mean (136 Watts), which is significantly raised by a small number of high results.

4.2 Average load of all properties

In order to investigate the demand from lights and appliances, properties were selected to specifically exclude those with electric heating and electric water heating. However, as Figure 11 reveals, a large range in energy demand is still possible. The graph shows the range in average hourly demand (i.e. the instantaneous demands taken at 10 second intervals are averaged over an hour period, and then averaged across the monitoring period). It is clear that there is a very large range between the household using the least power at 121 Watts and the household using the most power at 2,438 Watts. The two households with the lowest usage had lengthy unoccupied periods over the duration of the monitoring but there are also a number of smaller single occupancy properties with exceptionally low usage. At the upper end there are a number of atypical households which information from the interview survey correlates with high TV and appliance ownership,

uncommon equipment such as a swimming pool (heated over the summer months) and high base load power.

Figure 11: Mean hourly power demand for all the properties



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

The range of power demand is shown by extracting the minimum and maximum for the individual properties with the highest and lowest usage. Table 28 shows that the property with the highest mean power demand ranges from 483 watts to over 13kW while the property with the minimum mean power demand ranges from effectively zero (likely to be a power outage situation) to 632 Watts. Across all the properties, the median power demand is 447 Watts (mean = 528 Watts).

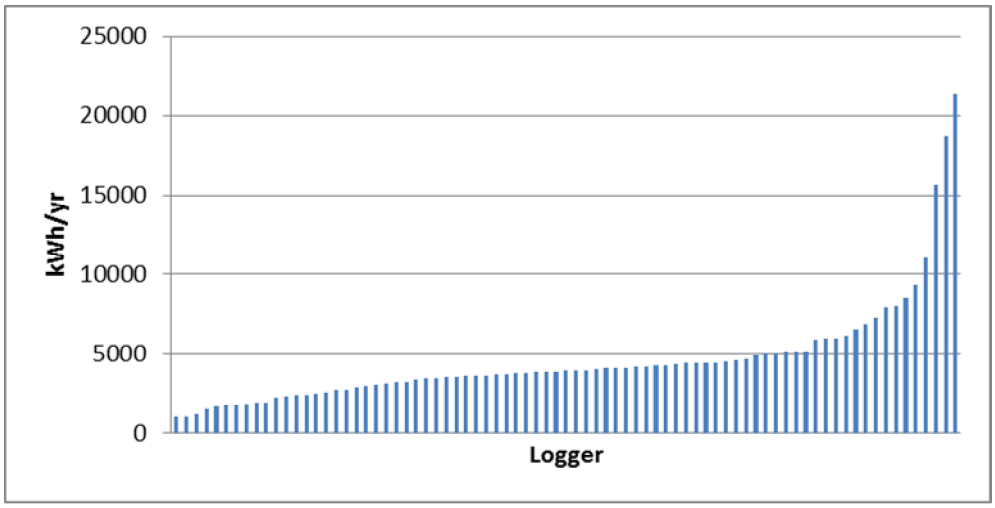
Table 28: Property maximum, minimum and average hourly power demand

	Range of power demand (Watts)		
	Minimum hourly demand	Maximum hourly demand	Mean hourly demand
Property with lowest hourly demand	1	632	121
Property with highest hourly demand	483	13,232	2,438
Average hourly power demand across all properties	85	3,791	528

Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

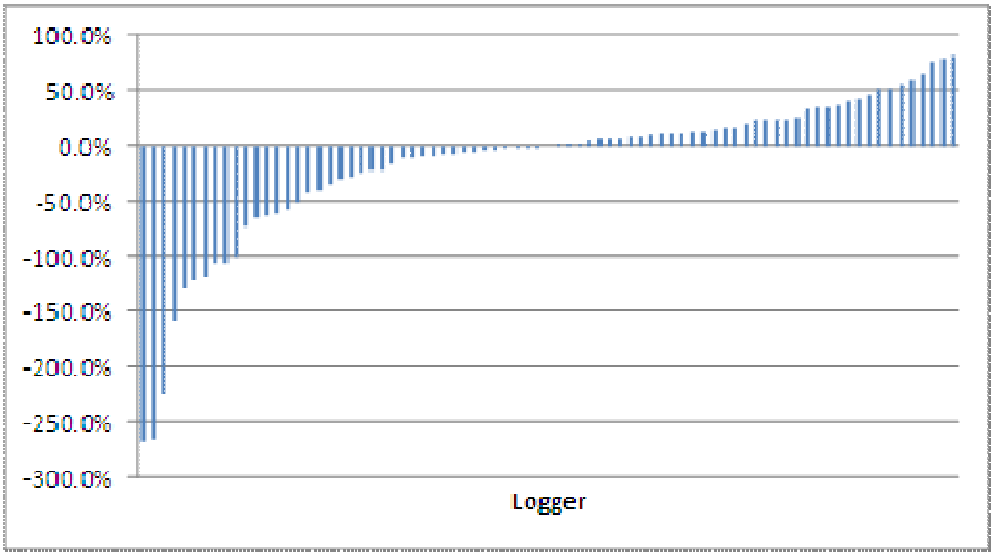
Figure 12 shows the estimated annual consumption for all the properties. The graph displays a large range in consumption consistent with the hourly data. The dwelling with the minimum demand consumed 1,064 kWh/year while the highest usage dwelling, with the swimming pool, consumed 21,341 kWh/year. The median electricity consumption of the data is 3,914 kWh/year (mean = 4,628 kWh/year). Analysis of the data shows that around 30% of homes consume between +/- 10% of the median. However, a substantial number of dwellings use considerably less as illustrated in Figure 13.

Figure 12: Estimated annual consumption for all the properties



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

Figure 13: Departure from the median of estimated annual consumptions



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

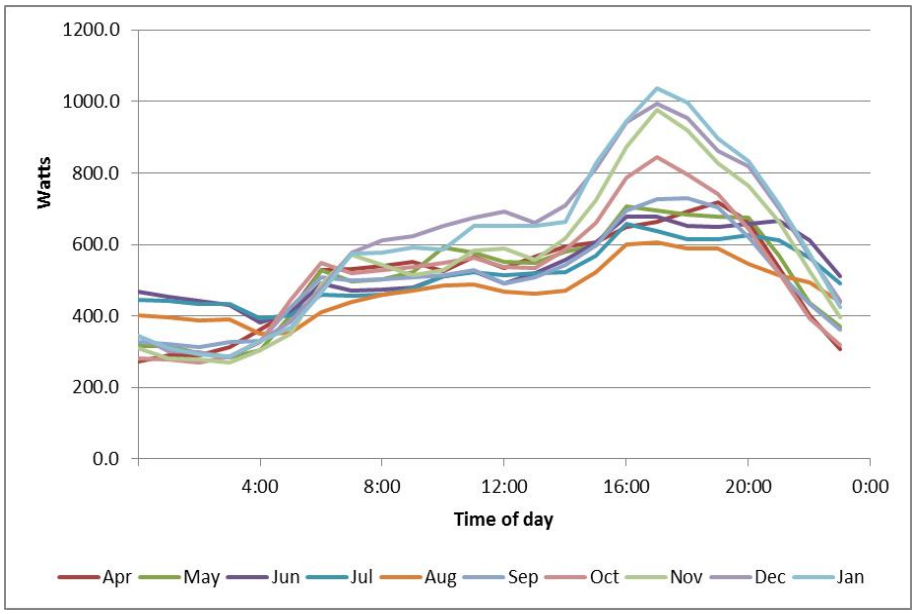
4.3 Comparison of weekend, weekday and monthly power

Evaluating the hourly demand for all the dwellings shows a regular time of day trend for all the months (Figure 14). As is to be expected, the lower monthly demand is in the summer; the higher demand is in the winter months. While the peak demand for all the months occurs in the early evening, the demand rises more rapidly and to a higher value in October, November, December and

January. An increase in lighting use in these months would be expected (as reported in the EFUS interview survey), but increased appliance use may also be partly responsible for these patterns (e.g. increased use of tumble-dryers, as described in Section 3 of this report).

It can also be seen that for all the months the minimum hourly demand occurs in the early morning at around 3am (n.b. it should be noted that this is the time of the minimum *hourly* demand and not the dwelling base load as defined in this report, which is discussed in Section 4.1.)

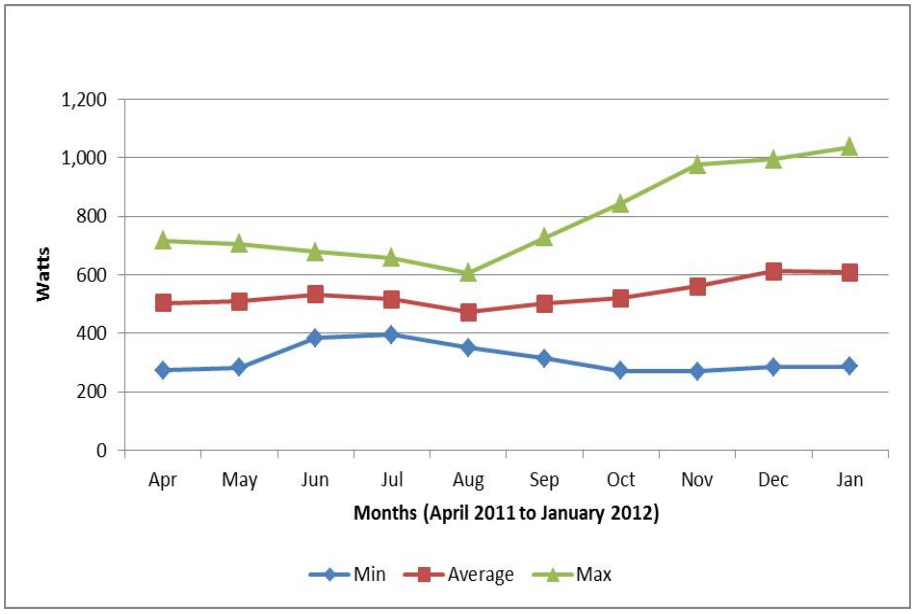
Figure 14 Average time of day demand by month



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

The electricity demand from lights and appliances varies with time of year and the trend can be illustrated by plotting the minimum and maximum demand for each month. In this data set, the highest maximum values occur over the winter months (November, December and January), due almost certainly to the increased use of lighting over the longer nights, alongside possible increases in appliance use (e.g. tumble dryers). By contrast, the highest minimum occurs over the summer (which in this survey year occurred in June and July), possibly due to refrigeration appliances operating for longer over the warmer months or due to the use of cooling equipment.

Figure 15 Monthly max, min and average electricity demand throughout monitoring period



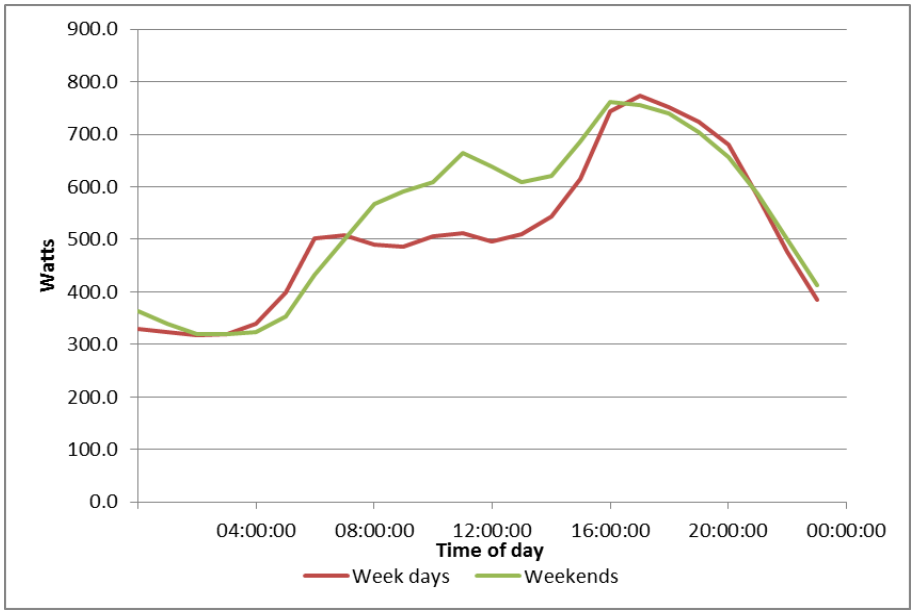
Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

4.4 Time of day usage

In addition to the time of day analysis, the data was also analysed to ascertain whether there was a discernible difference between weekday and weekend power demand. The graph in Figure 16 is a simplified time of day plot showing the hourly disaggregated weekend and weekday demand.

Broad conclusions are that electricity demand starts to increase earlier on weekdays than weekends, and demand increases throughout the middle part of the day at weekends. The evening peak appears to occur slightly earlier at the weekend (possibly associated with different occupancy and lifestyle patterns on these days) but the peak consumption is about the same for all days. Although weekend demand is slightly higher until later at the weekend, the minimum occurs between 2am and 3am on all days.

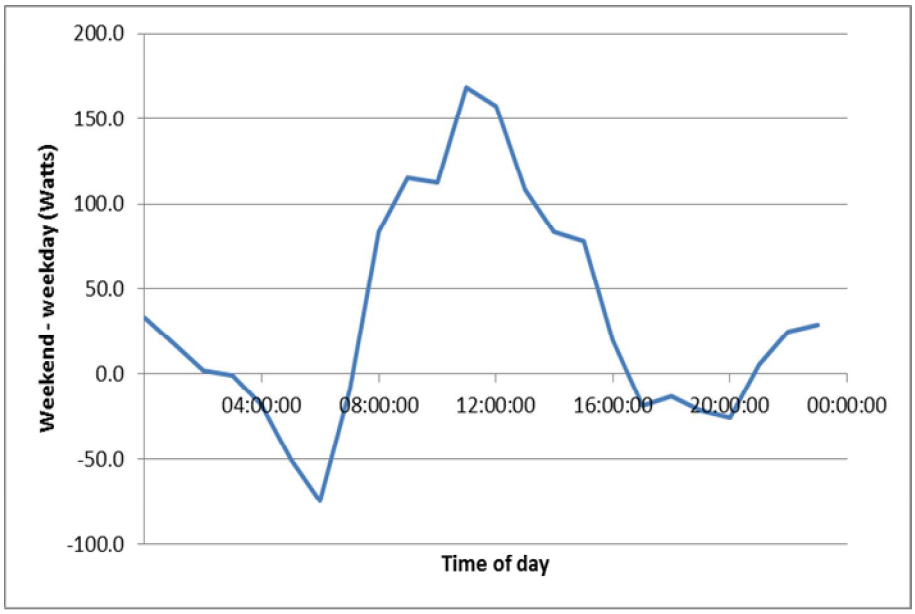
Figure 16 Time of day demand on weekdays and weekends



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

To simplify the difference between weekday/weekend power demand, the time of day energy usage at weekends was subtracted from that used at weekdays with a positive value indicating when more energy is used at weekends. So, between 07:00 and about 17:00hrs more energy is used at weekends. However, between about 04:00 and 07:00 and again between about 17:00 and 21:00hrs more energy is used on weekdays (Figure 17).

Figure 17 Average difference between energy demand at weekends and on weekdays



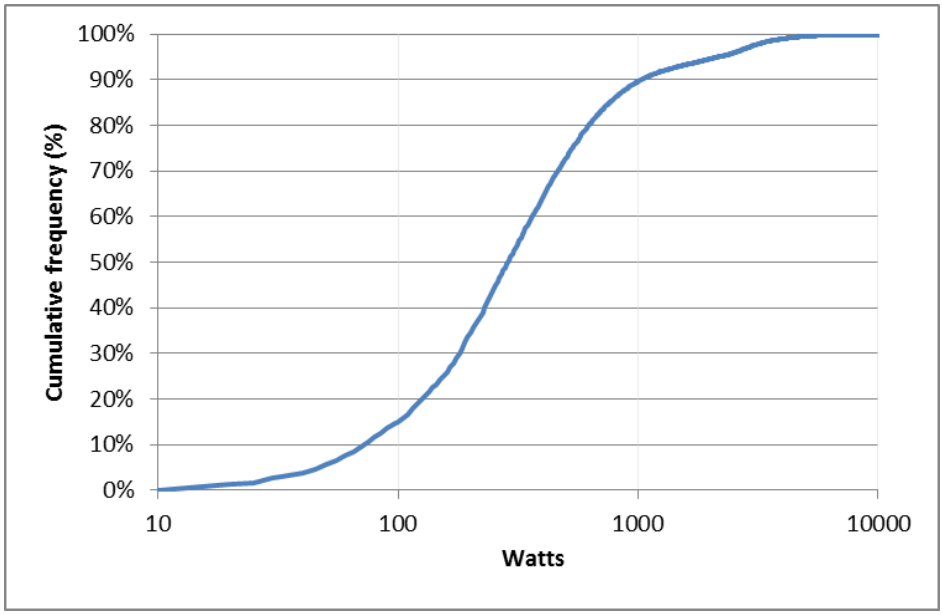
Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

4.5 Power frequency curves

A further useful way of looking at all the data collected, which allows the determination of patterns of consumption across the sample, is to plot it on a power frequency distribution curve. This is produced by counting the number of occasions on which the level of power consumption falls into certain 'bins' of power demand (e.g. between 90 and 100W). Figure 18 shows this type of plot for the entire sample of dwellings (plotting the data cumulatively).

This reveals, for example, that for 90% of the time electrical consumption is less than 1000 Watts and that it is between 100 and 1,000 Watts for about 75% of the time.

Figure 18: Cumulative power frequency curve for all properties (x-axis is $\log_{10}$ scale)



Base: All households in the EFUS 2011 electricity monitor sub-sample (n=79)

5 Conclusions

The EFUS 2011 has revealed detailed information on patterns of ownership and use of key domestic appliances, which is of use for the development of energy efficiency policy and refinement of energy modelling methodologies such a SAP and BREDEM.

Considerable scope has been identified for the replacement of older appliances in the stock, and the quantification of appliance ownership and use will allow energy models to be updated to reflect their use within the stock. The EFUS has also identified differences in patterns of ownership and use among different household groups. This is of use in targeting energy efficiency policies, estimating their effect, and modelling consumption for different groups.

The main findings from the analysis of the EFUS interview data, and electricity monitoring subsample are:

Laundry appliances

Approximately, 97% of households own a washing machine, and 62% of households own a tumble dryer. Owner occupiers are more likely to own washing machines and tumble dryers compared to the other tenures. Single person households, households without any children, households in which the HRP is 75 years old or more, households in which none of the occupants are working, households with incomes in the lowest income quintile and households that are not under-occupying are all less likely than their counterpart groups to own a washing machine or tumble dryer.

A large number of older laundry appliances are present in the stock, which may present an opportunity for energy savings. The survey suggests that over 2.1 million washing machines, and 2.6 million tumble dryers, are more than 10 years old.

The median number of washing loads per week is 4 and the median number of drying loads per week is 3 in the winter. Approximately 59% of households report typically running their washing machine at 40°C; 27% report typically washing at 30°C, and 8% report using temperatures hotter than 40°C.

The majority of households with tumble dryers tend not to use them in the summer. Households that own a tumble dryer do, on average, one more load of washing per week compared to households that do not own a tumble dryer.

As to be expected, there is a pattern of more frequent washing machine use among large households, particularly those with children. The median number of loads per week also increases as household income increases. However, households with at least one pensioner present, and households that are considered to be under-occupying use their washing machines less than their counterpart groups.

Refrigeration appliances

Ownership of refrigerators and freezers is almost universal. 99% of households own a refrigerator (either as a separate unit or combined with a freezer) and 93% of households own some kind of freezer.

There are no apparent differences in fridge ownership across the different household groups suggesting that this appliance is considered a necessity. Freezer ownership across the different household groups is more variable with similar differences in the patterns of ownership as those seen for the laundry appliances.

A large number of refrigeration appliances are more than 10 years old, including around 24% of standalone fridges and 24% of standalone freezers (equivalent to around 2.5 million of each of these types of appliance) which may represent a significant potential for energy saving. In general, the oldest fridges are more likely to be found in owner occupied households than in private rented households, in households containing an older occupant, in households without any children and in households under-occupying compared to their counterpart groups. There is no apparent relationship between income and the ownership of an older fridge.

Dishwashers

Dishwashers are present in less than half of all homes (41%). Dishwasher ownership across the different household groups shows similar differences in the patterns of ownership as those seen for the laundry appliances. There is a particularly strong relationship to income, suggesting that dishwasher ownership is perhaps considered as a 'luxury' rather than a necessity. Almost 70% of dishwashers are less than 6 years old. The median number of times households typically use their dishwashers is 4 times per week and half of all households use them between 2 and 7 times per week.

Cooking appliances

Ownership of ovens and hobs is almost universal, although only approximately 80% of households have a grill. Approximately 80% of households have a microwave. Ownership of a standard cooking appliance (oven plus hob plus grill) and/or a microwave is fairly uniform across different type of households.

Electricity is the dominant fuel used in ovens (almost 70% of households with ovens have electric ovens and just under 30% have gas ovens). For hobs, the prevalence of fuels is reversed with gas being the dominant fuel (38% of households have electric hobs, whereas 61% have gas hobs).

A significant number of older ovens are present in the stock. Approximately 22% of ovens are over 10 years old (equivalent to around 4.5 million ovens).

Households use their hobs and microwaves more frequently than their ovens or grills. The average use of hobs and microwaves is higher for households where someone is in during the day and households with children present, compared to their counterpart groups.

Televisions

The number of televisions in homes ranged from 0 to 9, with a median number of 2. Just under 2% of households report that they do not have a television. Owner occupiers typically have a higher mean number of televisions than any of the other tenures. Additionally, the mean number of televisions in a household increases as household size increases. Households in the lowest income quintiles report having fewer televisions on average than households in any of the four high income quintiles and households with children present and households where no pensioners are present also report a higher mean number of televisions compared to their counterpart groups.

The main (most used) television in the home is much more likely to be a flat screen type. Almost 10% of households use a flat screen plasma television as their main television and just over 10% have a LED-LCD flat screen as their main television. Owner occupied households are more likely to have a flat screen television than a standard CRT type as the most used television compared to households in the social rented sector whereas households in the lowest income quintile are less likely to have a flat screen model as the television used the most compared to households with higher incomes. Additionally, single person households are also less likely to have a flat screen television as the most used television compared to larger households.

The television used most often in the house is reported to be used for approximately 5 to 6 hours per day. The average number of hours is greater for households that are in the social rented sector compared to owner occupiers or private renters, and is likely to be higher for households with children, containing someone of pensionable age, where someone in during the day and households that are not under-occupying.

Cooling equipment

43% of all households (equivalent to 9.5 million households) use portable fans. Other fixed fans are in use by around 9% of households (2 million households). Air conditioning use is very rare with less than 3% of households using fixed or portable air conditioning units during the summer months.

The use of electrical cooling equipment will have an impact on energy usage levels. This data provides useful baseline information on the number of households with electrical cooling equipment and the frequency of use. Around 17% of households use portable fans on a daily basis during the summer months. Just under 40% of households with portable fans use them more than once per week but not every day, and a further 39% of households use them less than once a week.

Electricity demand

Data on electricity demand was collected for a specific subsample of properties, excluding those with any reported space heating or water heating load.

The median base load for these homes is 90 Watts. Base load has been defined at the power demand of the household for the level of electrical power consumption in Watts exceeded for 90% of the monitoring period (when assessed using high-frequency data).

The lowest average hourly power demand is 121 Watts while the highest is around twenty times more at 2,438 Watts.

The maximum power demand for all the households ranges from 483 watts to over 13kW while the minimum ranges from effectively zero (power outage situation) to 632 Watts. Across all the properties, the median power demand is 447 Watts.

Seasonal analysis shows that monthly demand is lower in the summer and higher in the winter. This is likely to be due mainly to the increased use of lighting over the longer nights, alongside possible increases in appliance use (e.g. tumble dryers).

Time of day analysis shows that electricity demand starts to increase earlier on weekdays compared to weekends and that demand increases throughout the middle part of the day at weekends. The evening peak appears to occur slightly earlier at the weekend, but the peak power demand is approximately the same for all days.

Analysing the data to produce a power frequency curve shows that for 90% of the time, electrical demand is less than 1,000 Watts and that it is between 100 to 1000 Watts for about 75% of the time.

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.