

**elementenergy**

***Further Analysis of  
Data from the  
Household Electricity  
Usage Study:  
Increasing Insight and  
UK Applicability***

Final report for

**Department of Energy  
and Climate Change**

**and**

**Department for the  
Environment Food and  
Rural Affairs**

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## 1 Executive summary

### Objective

The Household Electricity Usage Study (HEUS) performed by the Department of Energy and Climate Change (DECC), the Department for the Environment Food and Rural Affairs (Defra) and the Energy Saving Trust (EST) between 2010 and 2011 has produced a comprehensive dataset describing how 250 households across England consume electricity. To increase the insights that can be extracted from the HEUS findings, and to more accurately scale them to the UK and specific regions therein, it is necessary to link the HEUS data to a larger, spatially resolved demographic dataset such as Experian's Mosaic UK.

The Experian dataset divides UK consumers into 15 categories – referred to as Mosaic Groups – and contains information on the geographic distribution, consumer behaviour and demographics of each group. These groups are formulated by Experian for consumer and marketing purposes. They are not in any way endorsed by Government. The 15 Experian Mosaic Groups (which are summarised in more detail in Table 1) are:

- A. Alpha Territory
- B. Professional Rewards
- C. Rural Solitude
- D. Small Town Diversity
- E. Active Retirement
- F. Suburban Mindsets
- G. Careers and Kids
- H. New Homemakers
- I. Ex-Council Community
- J. Claimant Culture
- K. Upper Floor Living
- L. Elderly Needs
- M. Industrial Heritage
- N. Terraced Melting Pot
- O. Liberal Opinions

Element Energy's objective in this project was to link each of the 250 households in the HEUS to a specific Mosaic Group and to assess the suitability of this association along with how it can be applied to better understand UK electricity use. This builds on our previous cluster analysis work<sup>1</sup> which identified 7 discrete consumer archetypes within the 250 HEUS

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<sup>1</sup> Element Energy (2013), "Further Analysis of Data from the Household Electricity Usage Study: Consumer Archetypes" for DECC and Defra.

households corresponding to different electricity usage behaviour, occupant demographics and building characteristics. The potential for electricity savings and demand side response have been calculated for each of the 7 consumer archetypes. The 15 Experian categories used in this report are based on consumer datasets and offer an alternative perspective on the potential for electricity savings and demand side response in the UK. Though the Experian categories are less specific to electricity usage behaviour (since they are focused on more general consumer characteristics), they offer greater potential for scaling the HEUS findings to different regions of the UK.

### Findings and Recommendations

- Experian Mosaic Groups were successfully assigned to each of the 250 households in the HEUS dataset. A good fit between the HEUS and Experian data was shown via an analysis and comparison of the metrics on household demographics and building characteristics that were common to both datasets.

**Recommendation:** The HEUS and Experian datasets are sufficiently correlated for them to be used together.

- We examined several new household demographic and behavioural characteristics from the Experian dataset (including household qualifications, green classification, carbon footprint, vehicles owned, annual distance driven, weekly expenditure, net income and net wealth). Application of these new variables to the HEUS sample revealed that the HEUS sample gave an excellent representation of broader national trends in each case.
- Combining the HEUS and Experian datasets to scale up the HEUS data on household electricity use revealed a total UK domestic electricity demand of about 105.5 TWh/year. This is in close agreement with national data from DECC's Energy Statistics which reports a figure of 111.6 TWh/year for domestic electricity consumption over the same period<sup>2</sup>. The excellent correlation with DECC national data provides further evidence that the HEUS domestic electricity consumption data links well with the Experian Mosaic Groups and can be used to scale the HEUS findings to the UK as a whole or apply them to specific regions of interest within the UK.

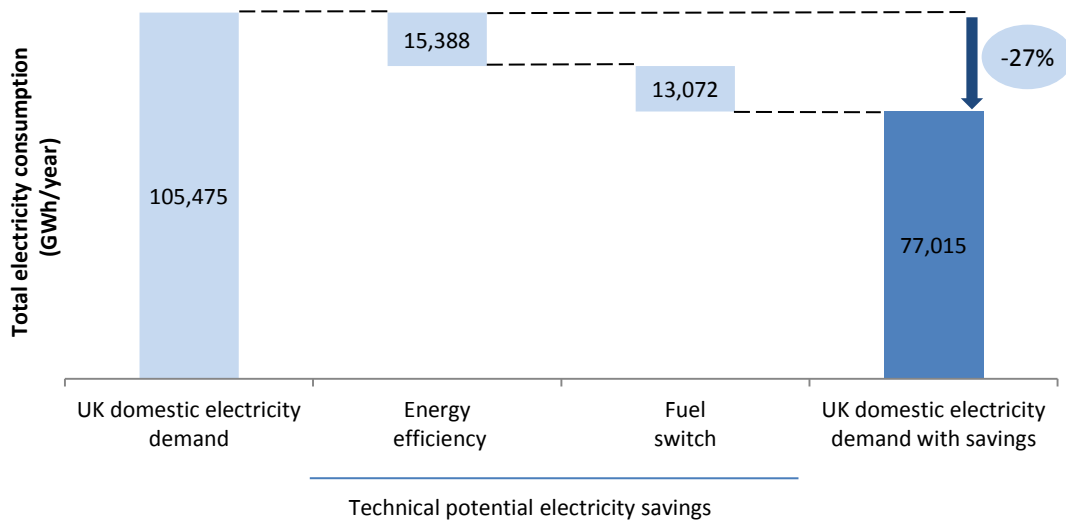
**Recommendation:** The Experian Mosaic Groups can be used to scale HEUS findings to the entire UK or smaller regions therein. Care should be

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<sup>2</sup> Department of Energy and Climate Change (2013) "Energy trends section 5: electricity", Available from: <https://www.gov.uk/government/publications/electricity-section-5-energy-trends>

taken for Experian Mosaic Groups which contain only a small number of HEUS households and consequently higher levels of uncertainty.

- We also applied HEUS estimates of the maximum technical potential for electricity savings from improvements in appliance energy efficiency and switching heating fuels (or to a more efficient electric heating system) to the Experian Mosaic Groups. When scaled across the UK, it can be seen that interventions in these areas could potentially reduce UK domestic electricity consumption by about 27% (Figure 1).



**Figure 1: Total UK domestic electricity demand (including space heating) and the potential savings from improvements in appliance energy efficiency and switching electric heating systems to alternative fuels.**

- The greatest opportunity for electricity savings from upgrading old appliances to efficient modern equivalents exists in the “Ex-Council Community” and “Terraced Melting Pot” Experian segments (which offer over 1.8 TWh/year each nationally). Over 50% of households in both of these segments fall into the lowest two green classifications used by Experian: “10: wasteful and unconvinced” and “9: constrained by price” suggesting there is significant scope for energy efficiency interventions targeting these two groups.

**Recommendation:** Target awareness raising and other energy efficiency interventions at the “Ex-Council Community” and “Terraced Melting Pot” Experian Mosaic Groups that take into consideration the income and wealth constraints that underpin the age and inefficiency of their appliances.

- The “Professional Rewards”, “Small Town Diversity” and “Suburban Mindsets” Experian segments also contribute significantly to the national appliance efficiency improvement potential (1.54, 1.76 and 1.71 TWh/year, respectively), not because they own particularly inefficient appliances but more due to their generally high levels of electricity use combined with a strong representation in the UK population.

**Recommendation:** Ensure broader scale energy efficiency interventions also capture the big energy use segments in the UK represented by households in the “Professional Rewards”, “Small Town Diversity” and “Suburban Mindsets” Experian categories. Further work investigating the usage behaviours in these three high consumption groups would also help to better understand the types of interventions that are most appropriate for these segments.

- The UK potential for electricity savings from switching heating fuel (or upgrading to a more efficient electric heating system) is most apparent in the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups. While these two segments only account for 6% of UK households each, in combination they offer 4.6 TWh/year of savings potential from switching heating fuel (i.e. 35% of the UK’s technical potential in this area). For both segments, electric space heating contributes almost 80% of the savings opportunity.

**Recommendation:** Tailor measures aimed at existing electric heating (particularly space heating) to the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups since they currently account for over a third of the UK’s electric heating demand.

- The opportunities for shifting electricity demand out of the 6-7pm peak load period are distributed broadly across many of the Experian Mosaic Groups. As such, the Experian consumer segments may not be the ideal metric for identifying the most promising segments for achieving the approximately 2 GW of UK load shifting potential (during the 6-7pm peak) identified in this report.

**Recommendation:** Use other consumer segmentation strategies that incorporate electricity usage behaviour when determining household archetypes (such as the Element Energy Household Archetypes<sup>3</sup>) to better understand the consumer groups that should be targeted for peak load shifting interventions.

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<sup>3</sup> Element Energy (2013), “Further Analysis of Data from the Household Electricity Usage Study: Consumer Archetypes” for DECC and Defra.

## 2 Introduction

Between 2010 and 2011, the Department of Energy and Climate Change (DECC), the Department for the Environment Food and Rural Affairs (Defra) and the Energy Saving Trust (EST) conducted the Household Electricity Usage Study (HEUS) which examined the electricity usage behaviour of 250 owner-occupier households in England. A large dataset was produced by this study on the appliance and electricity usage characteristics of each monitored household, as well as various details about the demographics of the household occupants and the characteristics of the buildings in which they live.

To increase both the resolution and wider applicability of the HEUS data within the UK, it is possible to combine it with a more detailed consumer segmentation dataset, such as Experian's Mosaic UK, which contains additional socio-economic and demographic variables not captured in the survey. By providing access to these additional variables, the Experian dataset enables a more comprehensive analysis of social and demographic factors in household and appliance electricity usage.

Furthermore, since the Experian dataset covers the entire UK, once a link between the HEUS and the Experian data is established, it is possible to scale the HEUS findings to the national level or apply them to a specific region anywhere in the UK. In the context of this report, this makes it possible to examine the national implications of the HEUS findings. Similarly, future work targeting specific regions within the UK can make use of the relationships established in this project to adapt the HEUS findings to the context of that particular focus area.

### 2.1 The Experian Mosaic UK Dataset

Experian is a large information services company that aggregates data from sources such as the national census, local public records, property/realty records, the electoral role, credit records, etc. Mosaic UK is Experian's system for classifying UK consumers and households into 15 archetypes based on details of the occupant demographics, lifestyle and consumer behaviour. Table 1 provides a summary of each of the 15 Experian Mosaic Groups. The names used for each of the consumer categories are as defined by Experian – these do not reflect Government naming conventions.



Table 1: Overview of the 15 Experian Mosaic Groups<sup>4</sup>.

Experian Mosaic Group	Description
<b>A. Alpha Territory</b>	People with substantial wealth who live in the most sought after neighbourhoods
<b>B. Professional Rewards</b>	Experienced professionals in successful careers enjoying financial comfort in suburban or semi-rural homes
<b>C. Rural Solitude</b>	Residents of small villages and isolated homes where farming and tourism are economic mainstays
<b>D. Small Town Diversity</b>	Residents of small and medium-sized towns who have strong roots in their local community
<b>E. Active Retirement</b>	Elderly people who have sufficient pensions and savings to choose pleasant locations in which to enjoy their retirement
<b>F. Suburban Mindsets</b>	Maturing families on mid-range incomes living a moderate lifestyle in suburban semis
<b>G. Careers and Kids</b>	Families with young children where both parents are likely to earn solid incomes providing for a comfortable modern home
<b>H. New Homemakers</b>	Young singles and couples in small modern starter homes
<b>I. Ex-Council Community</b>	Residents with low levels of education but sufficient incomes who live in the better right-to-buy council houses
<b>J. Claimant Culture</b>	Families reliant on benefits living in low-rise council housing where there is widespread disadvantage
<b>K. Upper Floor Living</b>	Young, mostly single people on limited incomes renting small flats from local councils
<b>L. Elderly Needs</b>	Elderly people who are reliant on support either through specialised accommodation or the basic state pension
<b>M. Industrial Heritage</b>	Families and couples owning affordable older style housing in communities historically dependent on manufacturing
<b>N. Terraced Melting Pot</b>	Lower income workers, mostly young, living in tightly packed inner urban terraces, including some areas of high diversity
<b>O. Liberal Opinions</b>	Young, well-educated city dwellers enjoying the vibrancy and diversity of urban life

<sup>4</sup> Further information on the Experian Mosaic UK consumer segments can be found at: [http://www.experian.co.uk/assets/business-strategies/brochures/Mosaic\\_UK\\_2009\\_brochure.pdf](http://www.experian.co.uk/assets/business-strategies/brochures/Mosaic_UK_2009_brochure.pdf)

## 2.2 Objective

Element Energy's objective in this project was to match each of the households in the HEUS to the appropriate Experian Mosaic Group classification and thereby improve the resolution, scalability and insights that can be obtained from the HEUS dataset. This report examines:

- a) The correlation between the HEUS and Experian datasets for household information common to both.
- b) Examples of the new demographic information for HEUS households available from the Experian dataset and the insights these reveal on any HEUS sample bias relative to the broader UK population.
- c) The UK-wide implications of the findings from the HEUS scaled to the national level using the Experian Mosaic Group classifications.

## 3 Methodology

### 3.1 Step 1: Linking the HEUS and Experian datasets

The first step was to match each of the HEUS households to an Experian Mosaic Group classification. The most robust method for making this link is via the postcode details of each household. To preserve the anonymity of each of the HEUS households, for data protection reasons, a multistage data transfer process was used (Figure 2). In the first stage of this process, Intertek sent full postcodes to Experian with an alias for each household (i.e. they were numbered from 1 to 250). Experian then linked each postcode to the appropriate Mosaic Group classification and deleted the postcode data. Finally Experian sent the Mosaic Group corresponding to each household alias to Element Energy and Intertek provided the actual household codes associated with each household alias, from which Element Energy was able to build the household Mosaic Group list.

It is worth noting that two of the household postcodes were not available in the Experian database. In these two cases, the nearest available residential postcode was used instead to determine the closest estimate for the Experian Mosaic Group.

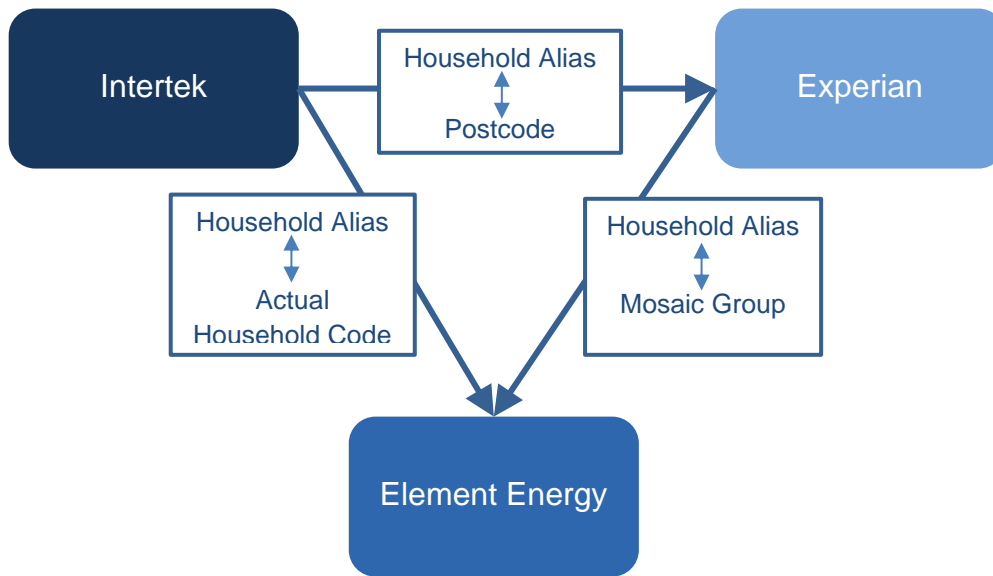


Figure 2: Overview of the multistage anonymised data transfer process used to determine the Mosaic Group for each household.

### 3.2 Step 2: Testing the correlation between the HEUS and Experian datasets

Once the Experian consumer segments were identified for each household in the HEUS, it was then possible to compare how well the HEUS and Experian datasets correlated for household characteristics that were available from both sources. Seven household variables were found to occur in both datasets: household type, number of occupants, social grade<sup>5</sup>, ethnicity, building age, building type and number of rooms. The HEUS data were used to determine the averages of these seven variables for each Mosaic Group and these were then compared to the corresponding values reported by Experian in each case.

### 3.3 Step 3: Integrating the HEUS and Experian datasets

After confirming the correlation between the HEUS and Experian datasets in the previous step, it was then possible to examine new household characteristics from the Experian database in the context of the HEUS study. Conversely, electricity usage metrics from the HEUS database that do not exist in the Experian dataset were determined for each Mosaic Group, thereby extending the functionality of the Experian dataset and

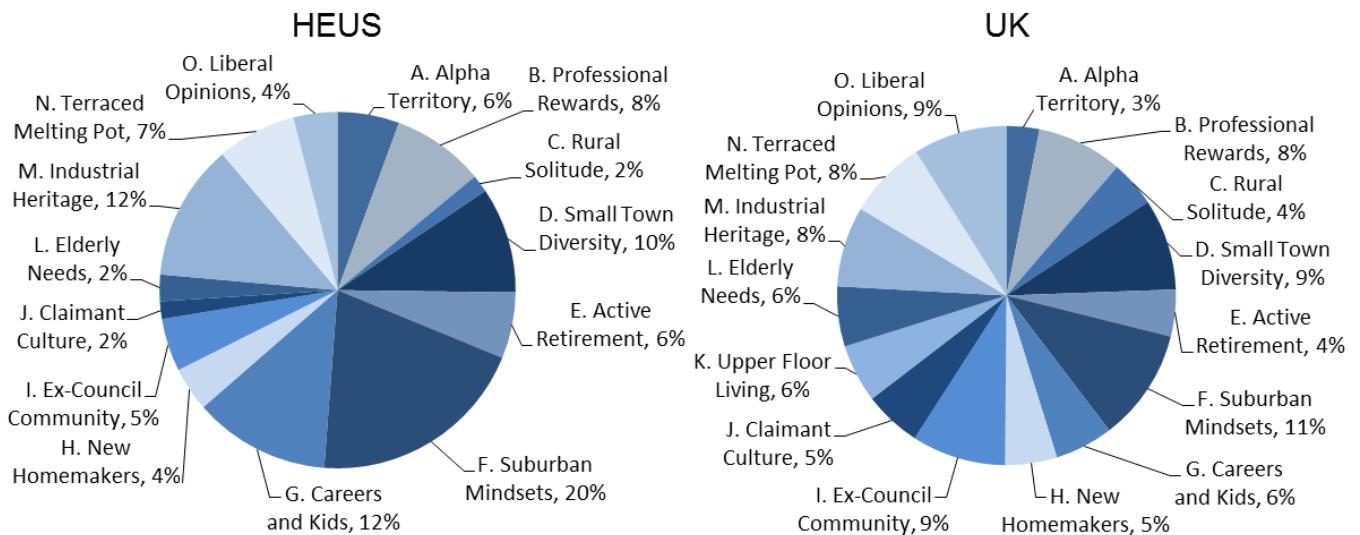
<sup>5</sup> Social grade classifications are as defined by the National Readership Survey (NRS). Further information on the details of each social grade in this classification system are available from: <http://www.nrs.co.uk/lifestyle-data/>

opening new opportunities for examining household electricity usage characteristics on a regional basis across the UK.

Finally, the ability to scale Experian Mosaic Group data to the UK national level was exploited to determine national technical potential levels for appliance energy efficiency savings, peak shifting and fuel switch savings in the context of national domestic electricity use.

#### 4 Distribution of HEUS households across the Experian Mosaic Groups

The representation of the 15 Experian Mosaic Groups across the 250 HEUS households is shown below in Figure 3. For comparison, Figure 3 also shows the Mosaic Groups composition of the UK as reported by Experian<sup>6</sup>.



**Figure 3: The distribution of Experian Mosaic Groups across the 250 HEUS households and the broader UK national average (as reported by Experian<sup>6</sup>).**

The difference in Mosaic composition of the HEUS households and the broader UK is likely due to the fact that all HEUS households are limited to easily accessible owner-occupiers in England<sup>7</sup>. The English Housing Survey reports that, in 2011, owner-occupiers account for 66% of the housing stock with a further 17.5% of households renting social housing and 16.5% renting privately<sup>8</sup>. Social and private renters are distributed to

<sup>6</sup> Experian (2009), “Mosaic UK Grand Index”.

<sup>7</sup> AEA Technology (2012), “Household Electricity Survey: A study of domestic electrical product usage” for DECC, Defra and the EST.

<sup>8</sup> Department for Communities and Local Government (2012), “English Housing Survey: Tenure Trends and Cross Tenure Analysis”.

varying degrees across all the Experian Mosaic Groups<sup>9</sup> and this is reflected in the under-representation of Experian Mosaic Groups: H “New Homemakers” (78% renting), I “Ex-Council Community” (74% renting), J “Claimant Culture” (94% renting), K “Upper Floor Living” (98% renting), L “Elderly Needs” (91% renting) and O “Liberal Opinions” (86% renting). Experian’s Mosaic Group K “Upper Floor Living” is a consumer classification specifically for young, mostly single people renting small flats from local councils (with the highest fraction of renters: 98%) and is, therefore, not represented at all in the 250 HEUS owner-occupier households. Experian Mosaic Group C “Rural Solitude” is also under-represented in the HEUS households, likely as a consequence of the reduced accessibility of these homes which are found in the lowest household density regions of all the Mosaic Groups.

Given the small sample size of HEUS households available for some of the Experian Mosaic Groups, particularly “Rural Solitude”, “Claimant Cultures” and “Elderly Needs” (4, 4 and 6 households, respectively), caution must be applied when using these results. For this reason, we have included standard errors in the main output figures of this report which reflect the uncertainty introduced by the small sample sizes and highlight where limitations on interpretation exist.

## 5 Correlation between the HEUS and Experian datasets

*Due to confidentiality requirements relating to the proprietary Experian data used in this chapter, we are unable to include the figures from this chapter in the publically released version of the report. However, the main findings of this chapter are summarised below.*

A comparison was made of the seven household variables that were available from both the HEUS and Experian datasets (NRS social grade, ethnicity, household occupancy, household type, number of rooms, dwelling type and building age). For each variable, the average obtained for the households in each Mosaic Group was determined for both the HEUS and Experian datasets. Given the sample size constraints of the HEUS (for example, there were only four households available for two of the Mosaic Groups in the dataset), there was good agreement between the HEUS and Experian datasets, confirming the validity of the Mosaic Group allocations for each HEUS household. Since there were no HEUS households assigned to Experian Mosaic Group K “Upper Floor Living”, it was not possible to compare the two datasets for this particular Mosaic Group.

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<sup>9</sup> Experian (2009), “Mosaic UK Grand Index”.

## 6 New household data from the Experian dataset

*Due to confidentiality requirements relating to the proprietary Experian data used in this chapter, we are unable to include the figures from this chapter in the publically released version of the report. However, the main findings of this chapter are summarised below.*

The good correlation between the HEUS and Experian databases opens the possibility to augment the HEUS data with additional demographic and behavioural information from the larger Experian dataset. This chapter provides an indication of the new kinds of household data that can be obtained from the Experian dataset by means of the Mosaic Group classifications. The new household characteristics covered in this chapter include:

- Qualifications
- Green classification
- Carbon footprint
- Cars per household
- Distance driven annually
- Composition of household expenditure
- Average weekly household expenditure
- Net household income
- Net household wealth

For each of these household characteristics, the average values for each Mosaic Group (as determined by Experian<sup>10</sup>) were examined. These values were scaled, using the HUES Mosaic Group composition, to determine the HEUS sample average which was compared to the national average (as provided by Experian) in each case.

The side-by-side comparison provides a useful extension to the initial sample profiling work conducted by AEA for the HEUS in which the demographic data collected from the HEUS households were checked for correlation with broader national trends<sup>11</sup>. It was found that for all of the variables listed above, that the HEUS sample provides an accurate representation of broader UK trends. Close correlations were also observed between household income and wealth with social grade, number of rooms, education qualifications, carbon footprint, number of vehicles owned, annual distance driven and household weekly expenditure.

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<sup>10</sup> Experian (2009), "Mosaic UK Grand Index".

<sup>11</sup> AEA (2012) "Household Electricity Survey: A study of domestic electrical product usage" for DECC, Defra and the EST.

## 7 Electricity usage characteristics of the Mosaic Groups

Using the links established in this project between the HEUS and Experian datasets, it is possible to apply HEUS data on electricity usage and savings potentials (assembled in earlier work by Element Energy<sup>12</sup>) to the Experian Mosaic Groups. The advantages of doing this are twofold:

1. It reveals the best segments among the Mosaic Groups to target for different electricity usage interventions (such as energy efficiency measures, demand side response programmes, heating strategies, etc.).
2. Detailed Experian data on the geographic distribution of Mosaic Groups in the UK can be used to scale the HEUS findings on electricity use and savings potential to the UK as a whole or any specific focus regions within the UK.

In this chapter, we determine the electricity use and savings potentials for each Mosaic Group and relate these to the various demographic parameters we have examined earlier in this report. We also use Experian data on the Mosaic Group composition of the UK (Figure 3), along with Office for National Statistics data on the number of households in the UK<sup>13</sup>, to scale the HEUS findings on domestic electricity use and potential savings to the national level. Since the HEUS data is limited to 250 owner-occupier households in England, it is important to keep in mind that the UK level estimates shown in this chapter are approximations only and should be used with caution, taking into consideration the limitations of the underlying HEUS dataset.

The HEUS electricity usage metrics examined include:

- Total electricity use.
- Percentage of electricity used during the 6-7pm peak.
- Appliance efficiency potential savings (i.e. the electricity that could be saved by switching to modern energy efficient appliances such as those with classes of A+ or A++ and low standby power).
- Peak shift potential savings (i.e. the amount of electricity use that could feasibly be shifted out of the 6-7pm peak period).
- Fuel switch potential savings (i.e. the electricity that could be saved by switching existing electric water and space heating systems to an

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<sup>12</sup> Element Energy (2013), "Further Analysis of Data from the Household Electricity Usage Study – Lot II, Package I: Consumer Archetypes" for DECC and Defra.

<sup>13</sup> An estimate of 26.4 million households in the UK was used from: Office for National Statistics (UK) "Families and Households, 2012", Available from: [http://www.ons.gov.uk/ons/dcp171778\\_284823.pdf](http://www.ons.gov.uk/ons/dcp171778_284823.pdf)



alternative fuel or partially saved by switching to a more efficient electric heating system).

It should be noted that since there were no instances of Experian Mosaic Group K “Upper Floor Living” in the HEUS data, all other Mosaic Groups were proportionally scaled to fill the missing 6% of UK households represented by this Mosaic Group.

## 7.1 Electricity Usage

### Total Annual Electricity Use

Total electricity use in this context includes all household electricity consumption with the exception of space heating. Electricity use for space heating was not included in this case because many HEUS households were monitored outside of the colder months (November to March) in which space heating would typically be used.<sup>14</sup>

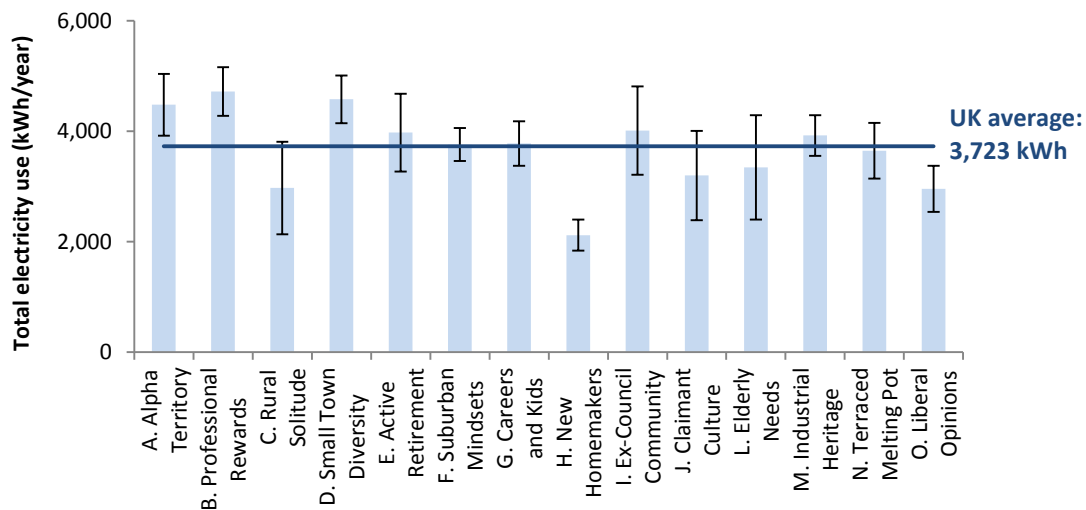
The average annual household electricity use for each Mosaic Group from HEUS data is shown below in Figure 4. When scaled nationally (using the Mosaic Group composition for the UK), this yielded a national average household electricity use of 3,723 kWh/year. The low representation of Experian segments “Rural Solitude”, “Claimant Cultures” and “Elderly Needs” in the HEUS sample (4, 4 and 6 households, respectively) accounts for the relatively large standard errors in these cases.

The high electricity use from the “Alpha Territory” and “Professional Rewards” Experian consumer segments is linked with their high social grades, household incomes, household expenditures and carbon footprints. Though these demographic characteristics are not as high for “Small Town Diversity” households, the high electricity use in this case may be linked to their high proportion of large bungalow, detached and semi-detached homes with relatively high occupancy levels in the HEUS dataset. Conversely, the low electricity use of the “New Homemakers” Experian consumer segment is thought to be related to the small dwellings with few rooms and low occupancy levels found in this Mosaic Group.

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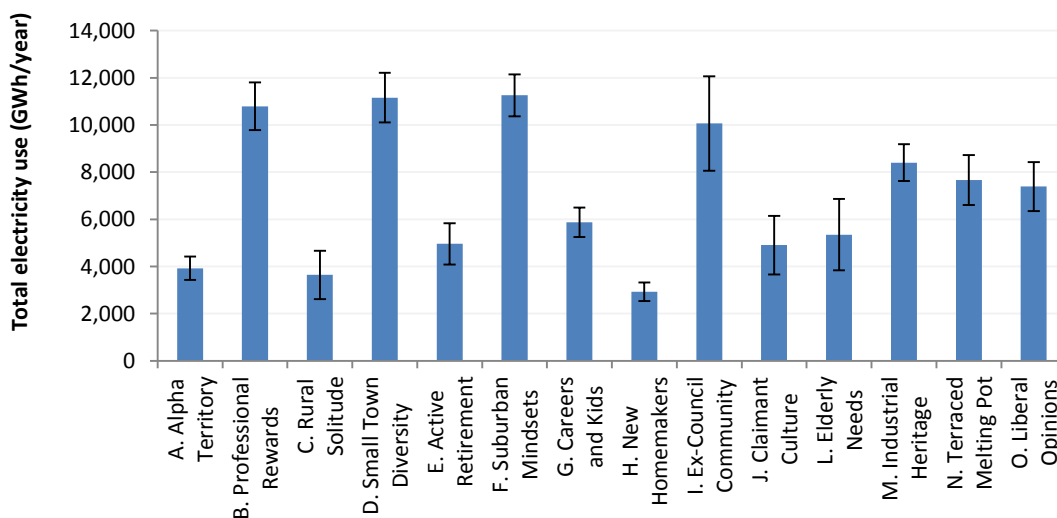
<sup>14</sup> In the 224 households that were monitored for a month, a seasonality factor (determined from the 26 households that were monitored for the whole year) was used to estimate the annual electricity consumption for appliances that were typically used throughout the year. Further information on seasonality factor derivation and calculation of annual electricity use in this dataset can be found in: Cambridge Architectural Research, Element Energy and Loughborough University (2013), “Further Analysis of the Household Electricity Use Survey – Electrical Appliances at Home: Tuning in to Energy Saving”, for DECC and Defra.





**Figure 4: The average household electricity use (excluding space heating) for each Experian Mosaic Group. The UK average, calculated by scaling the HEUS data according to the national Mosaic Group composition, is also shown.**

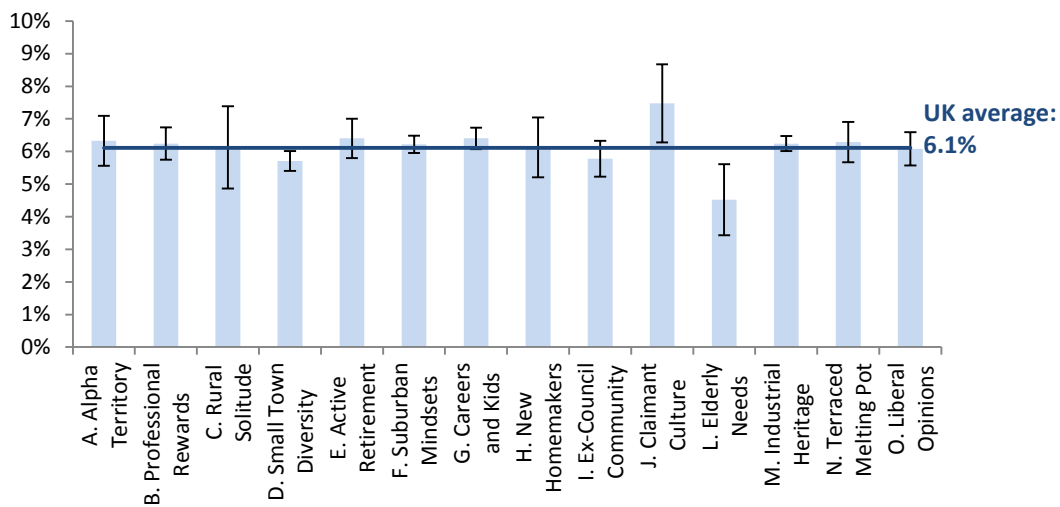
The total UK electricity use corresponding to each Mosaic Group is shown below in Figure 5. The proportion of each Mosaic Group in the UK obviously plays a big part in determining their contribution to total national electricity use with the highest contribution (11 TWh/year) coming from “Suburban Mindsets” – the most common Experian Mosaic Group in the UK (11% of UK households). Summing the national contribution of each Mosaic Group gives an estimate for total UK domestic electricity use (not including space heating) of 98.3 TWh/year.



**Figure 5: The total electricity use (excluding space heating) from each Experian Mosaic Group when scaled to the UK national level.**

**Electricity Used in the 6-7pm Peak**

The fraction of total household electricity consumed in the evening 6-7pm peak period was broadly consistent across the Experian Mosaic Groups around the national average of 6.1% (Figure 6). The high and low values for the “Claimant Cultures” and “Elderly Needs” Experian segments, respectively, may be a consequence of the small sample size and high levels of uncertainty for these consumer segments.



**Figure 6: The percentage of electricity used in the 6-7pm peak for each Experian Mosaic Group. The UK average, calculated by scaling the HEUS data according to the national Mosaic Group composition, is also shown.**

**7.2 Household Technical Potentials**

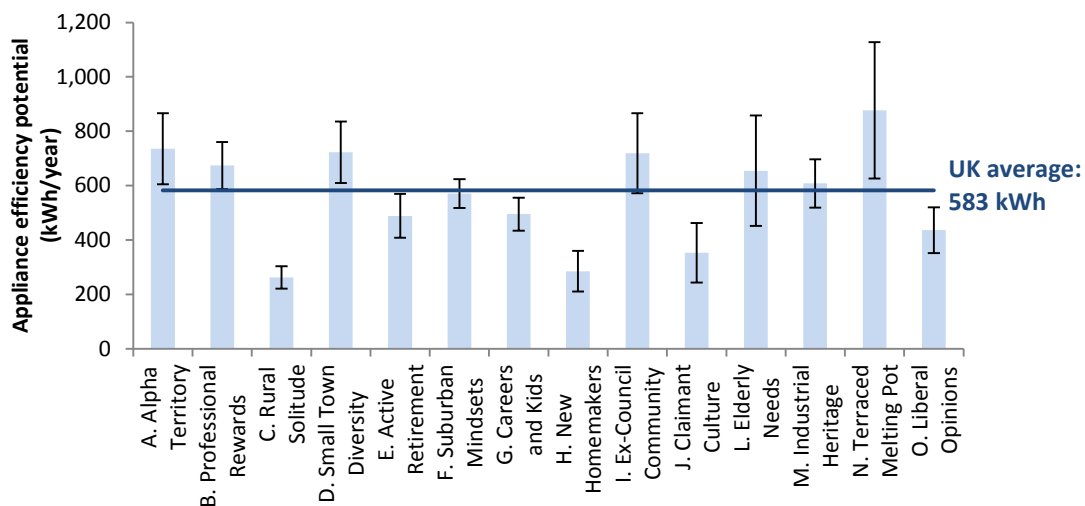
In this section we consider the technical potential for electricity savings across the different Mosaic Group classifications from improved appliance energy efficiency and conversion of electric heating to an alternative heating fuel. We also examine the fraction of peak time load (i.e. between 6 and 7pm) that could be shifted to lower demand periods for each Mosaic Group. For each of these household technical potential metrics, we report the total national opportunity for electricity demand reduction and management.

**Appliance Efficiency Potential Savings**

The technical potential for appliance efficiency savings for each household was obtained from the original Household Electricity Usage Study report<sup>15</sup> and measures the electricity that could be saved annually by:

- replacing all cold appliances with class A+ or A++ equipment;
- replacing all incandescent and halogen light bulbs with compact fluorescent lights;
- reducing all standby power for the audiovisual and computer sites;
- replacing existing washing machines, clothes dryers and dishwashers with energy efficient alternatives; and
- replacing desktop computers with laptops.

Figure 7 shows that the potential savings from upgrading to more efficient appliances varies considerably between different Mosaic Groups.



**Figure 7: The potential household electricity savings for each Experian Mosaic Group from converting to efficient appliances. The UK average, calculated by scaling the HEUS data according to the national Mosaic Group composition, is also shown.**

The high appliance efficiency opportunities for the “Ex-Council Community” and “Terraced Melting Pot” Experian segments (Figure 7) are reflected in their poor Experian green classifications. These two segments are among the lowest rated Mosaic Groups in this regard, with over 50% of households in both of these segments falling into the two lowest green classifications:

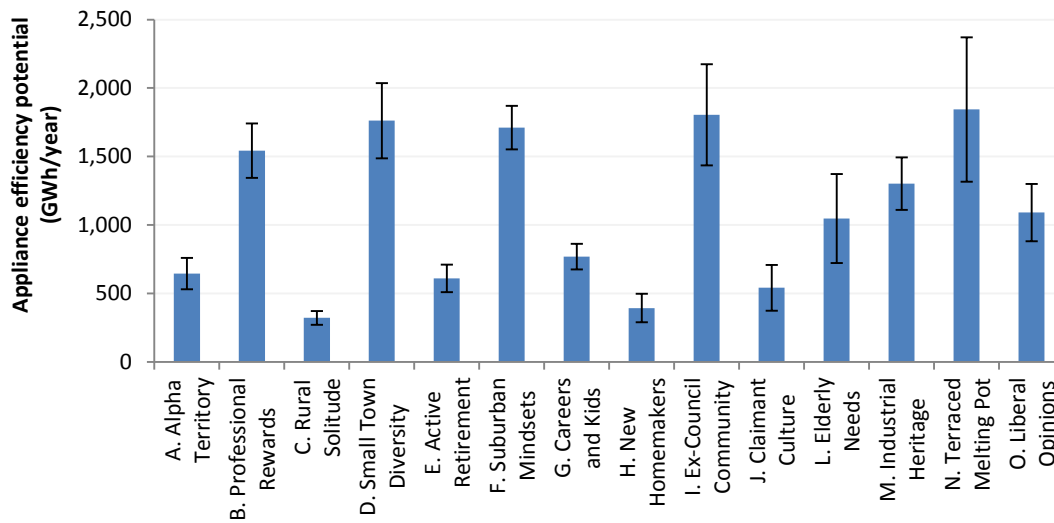
<sup>15</sup> AEA Technology (2012), “Household Electricity Survey: A study of domestic electrical product usage” for DECC, Defra and the EST.

“10: wasteful and unconvinced” and “9: constrained by price”. To realise the large opportunities in these two Mosaic Groups, interventions will need to take into consideration the drivers behind these low green classifications, such as income and wealth constraints.

The appliance efficiency potential for the “Alpha Territory”, “Professional Rewards” and “Small Town Diversity” Experian segments is largely due to their generally high levels of electricity use rather than possession of particularly inefficient appliances. That is, the moderate levels of appliance efficiency potential in these segments only achieve the reasonably high potentials observed in Figure 7 because of how much they are used.

Figure 8 shows that the potential for energy efficiency improvement in the “Ex-Council Community” and “Terraced Melting Pot” Experian Mosaic Groups scales well nationally, offering about 1.8 TWh/year each. In aggregate, the total UK potential electricity savings from upgrading to efficient appliances is about 15.4 TWh/year.

At the UK level, the small number of households in the “Alpha Territory” Experian segment (3% of the UK) means that the national opportunity in this group is limited (Figure 8). However, the “Professional Rewards” and “Small Town Diversity” Experian segments, which have higher prevalence in the UK (9% each), continue to be of importance at this level, as is the “Suburban Mindsets” Experian Mosaic Group owing to its strong representation in the UK (11%). A relatively high fraction of the “Professional Rewards” (25%), “Small Town Diversity” (41%) and “Suburban Mindsets” (22%) Experian segments fall into the three highest Experian green classifications (“1: eco-evangelists”, “2: convinced consumers”, “3: green but doubtful”), which may indicate an existing predisposition towards adoption of interventions that appropriately target these high consumption groups.



**Figure 8: The total appliance efficiency savings potential from each Experian Mosaic Group at the UK national level.**

### Fuel Switch Potential Savings

The savings discussed in this section relate to electricity consumption that could be avoided by switching existing electric water and space heating systems (including both primary and auxiliary heating appliances) to an alternative fuel (e.g. natural gas, biogas, renewable hydrogen, microgenerated heat, district heat, etc.). Alternatively, part of this total saving potential could be achieved by switching to a more efficient electric heating system (e.g. a modern air source or ground source heat pump). While these options represent significant interventions in terms of installation costs and disruption, the impact on electricity use can be considerable. It is worth noting that many of the HEUS households were monitored outside of the November to March heating period and were, therefore, excluded from the calculation of the space heating component of the Mosaic Group fuel switch potentials. This accounts for the relatively large standard error values for several segments in Figure 9.

The highest fuel switching potential was observed for the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups, which exhibited around three times the UK average household potential. In both cases, almost 80% of this potential is from electric space heating, and as such, should be the focus area for interventions aimed at these consumer segments.

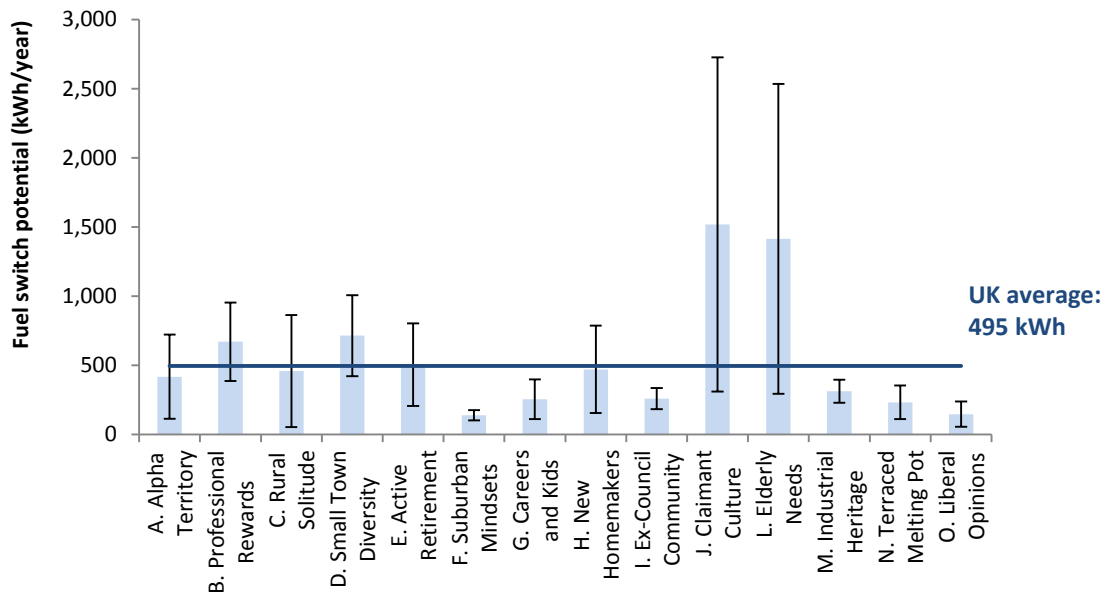


Figure 9: The average household savings potential from switching heating fuel for each Experian Mosaic Group. The UK average, calculated by scaling the HEUS data according to the national Mosaic Group composition, is also shown.

Figure 10 shows that even though households in the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups only account for 6% of UK households each, they still combine to give 4.6 TWh/year (i.e. 35%) of the UK’s total 13.1 TWh/year savings potential from switching heating fuel.

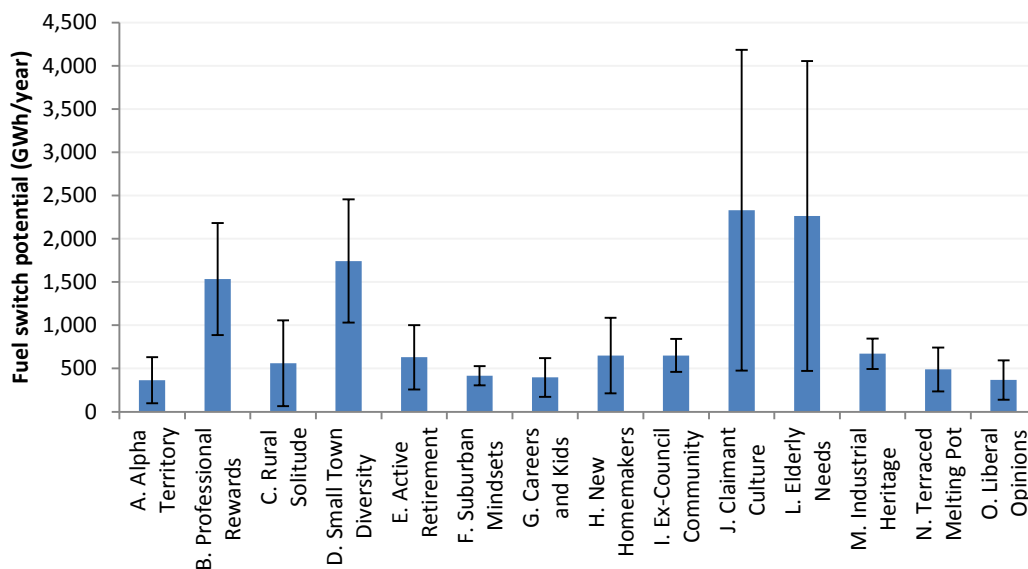


Figure 10: The total appliance fuel switch savings potential from each Experian Mosaic Group at the UK national level.

**Peak Shift Potential Savings**

It is assumed that the electricity usage arising from certain appliance types can be shifted to varying degrees around peak usage periods. We have focused on fully shiftable appliances (washing machines, tumble dryers, dishwashers and water heating) as well as partially shiftable cold appliances because they offered the clearest potential for shifting from a socio-technical perspective. Depending on the appliance type being considered, various fractions of the peak load (from 6-7pm) were assumed to be movable to lower demand periods as shown in Table 2. The assumptions behind the figures shown in Table 2 are discussed in Element Energy’s report: “Further Analysis of Data from the Household Electricity Usage Study: Consumer Archetypes”<sup>16</sup>. For the purposes of this analysis, load shifting from lights, TVs, audio equipment, computers, and cooking appliances have not been considered.

Households in the “Small Town Diversity” and “Ex-Council Community” Experian segments offer the highest peak load shifting potential at the household (Figure 11) and national (Figure 12) levels. However, when the standard error ranges that apply to the HEUS data sample are taken into account, there are many Mosaic Groups that offer similar peak shifting potentials.

**Table 2: The fraction of peak load that is assumed to be shiftable out of the evening peak load period (6-7pm) for various appliance types.**

Appliance type	Fraction of appliance peak-time load that can be shifted
Cold appliances (fridges and freezers)	9%
Washing appliances (washing machines, tumble dryers and dishwashers)	100%
Water heating appliances (household hot water and electric showers but not including kettles)	100%

Since the scope for peak shifting potential is significant for many Experian consumer segments, a targeted peak shifting strategy using the Experian Mosaic Groups is probably not appropriate based on existing data. However, it is worth noting that the Experian Mosaic Groups targeting the

<sup>16</sup> Element Energy (2013), “Further Analysis of Data from the Household Electricity Usage Study: Consumer Archetypes” for DECC and Defra.

retired community (such as “Active Retirement” and “Elderly Needs”) offer some of the lowest peak shifting opportunities.

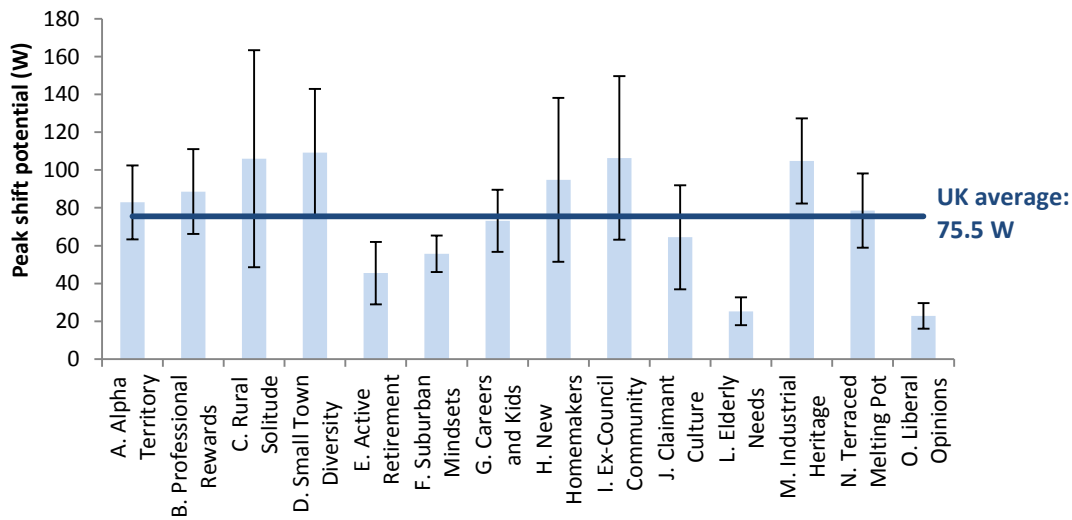


Figure 11: The average peak shifting capacity per household for each Experian Mosaic Group. The UK average, calculated by scaling the HEUS data according to the national Mosaic Group composition, is also shown.

While the Experian Mosaic Groups may not offer the best opportunities for targeted peak shifting strategies, when used to scale the HEUS findings, they indicate a significant national peak shifting potential of about 2 GW during the evening 6-7pm peak load period (Figure 12).

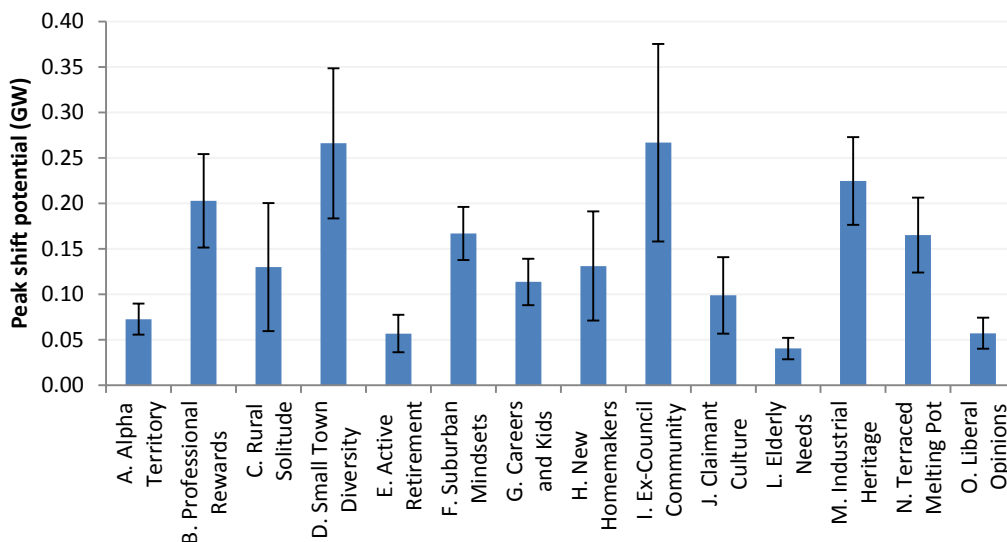


Figure 12: The total peak shift capacity from each Experian Mosaic Group at the UK national level.



## 8 Conclusions and Recommendations

- Experian Mosaic Groups were successfully assigned to each of the 250 households in the HEUS dataset. A good fit between the HEUS and Experian datasets was shown via an analysis and comparison of the metrics on household demographics and building characteristics that were common to both datasets.

**Recommendation:** The HEUS and Experian datasets are sufficiently correlated for them to be used together.

- We examined several new household demographic and behavioural characteristics from the Experian dataset (including household qualifications, green classification, carbon footprint, vehicles owned, annual distance driven, weekly expenditure, net income and net wealth). Application of these new variables to the HEUS sample revealed that the HEUS sample gave an excellent representation of broader national trends in each case.
- Using the Experian Mosaic composition of the UK<sup>17</sup> to scale up the HEUS data on electricity use from each Mosaic Group (Figure 4), gave an estimated UK domestic electricity demand of about 98.3 TWh/year (not including space heating). An additional 7.2 TWh/year of UK electricity use is estimated to derive from electric space heating<sup>18</sup>, yielding a total UK domestic electricity demand of about 105.5 TWh/year according to the combined HEUS and Experian datasets. This is in close agreement with national data from DECC's Energy Statistics which reports a figure of 111.6 TWh/year for domestic electricity consumption over the same period<sup>19</sup>. The excellent correlation with DECC national data provides further evidence that the HEUS domestic electricity consumption data links well with the Experian Mosaic Groups and can be used to scale the HEUS findings to the UK as a whole or apply them to specific regions of interest within the UK.

**Recommendation:** The Experian Mosaic Groups can be used to scale HEUS findings to the entire UK or smaller regions therein. Care should be taken for Experian Mosaic Groups which contain only a

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<sup>17</sup> Experian (2009), "Mosaic UK Grand Index".

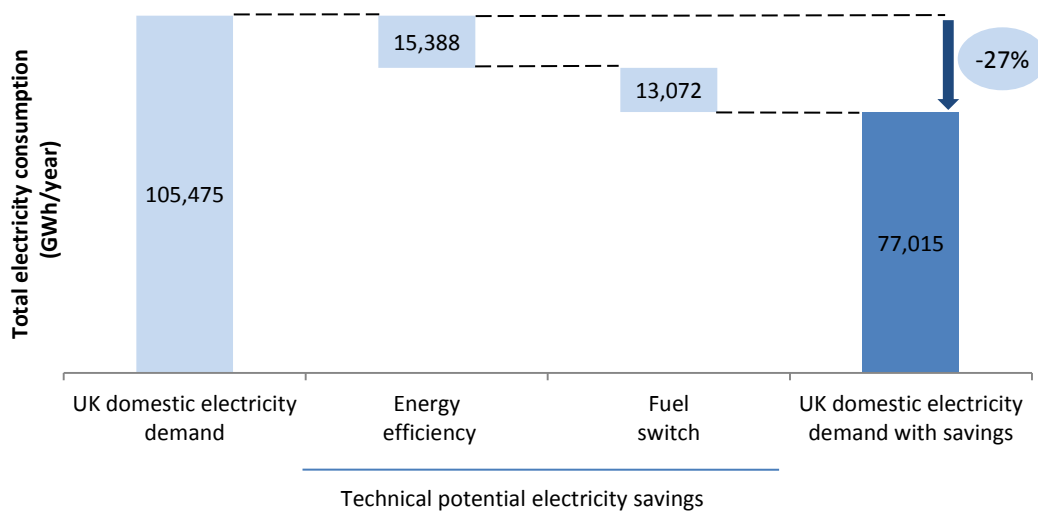
<sup>18</sup> Electricity use from space heating was determined from only those HEUS households that were monitored during the November to March heating period, whereas electricity use from all other appliances use was calculated from all 250 HEUS households.

<sup>19</sup> Department of Energy and Climate Change (2013) "Energy trends section 5: electricity", Available from:

<https://www.gov.uk/government/publications/electricity-section-5-energy-trends>

small number of HEUS households and consequently higher levels of uncertainty.

- We also applied HEUS estimates of the maximum technical potential for electricity savings from improvements in appliance energy efficiency (Figure 7) and switching heating fuels (Figure 9) to the Experian Mosaic Groups. When scaled across the UK, it can be seen that interventions in these areas could potentially reduce UK domestic electricity consumption by about 27% (Figure 13).



**Figure 13: Total UK domestic electricity demand (including space heating) and the potential savings from improvements in appliance energy efficiency and switching electric heating systems to alternative fuels.**

- The greatest opportunity for electricity savings from upgrading old appliances to efficient modern equivalents exists in the “Ex-Council Community” and “Terraced Melting Pot” Experian segments (which offer over 1.8 TWh/year each nationally). Over 50% of households in both of these segments fall into the lowest two green classifications used by Experian: “10: wasteful and unconvinced” and “9: constrained by price” suggesting there is significant scope for energy efficiency interventions targeting these two groups.

**Recommendation:** Target awareness raising and other energy efficiency interventions at the “Ex-Council Community” and “Terraced Melting Pot” Experian Mosaic Groups that take into consideration the income and wealth constraints that may underpin the age and inefficiency of their appliances.

**Table 3: Technical potentials for each Experian Mosaic Group scaled to the UK national level.**

Cluster	Efficiency potential (TWh/year)	Fuel switch potential (TWh/year)	Peak shift potential (GW)
A. Alpha Territory	0.64	0.37	0.07
B. Professional Rewards	1.54	1.54	0.20
C. Rural Solitude	0.32	0.56	0.13
D. Small Town Diversity	1.76	1.74	0.27
E. Active Retirement	0.61	0.63	0.06
F. Suburban Mindsets	1.71	0.42	0.17
G. Careers and Kids	0.77	0.40	0.11
H. New Homemakers	0.39	0.65	0.13
I. Ex-Council Community	1.80	0.65	0.27
J. Claimant Culture	0.54	2.33	0.10
L. Elderly Needs	1.05	2.26	0.04
M. Industrial Heritage	1.30	0.67	0.22
N. Terraced Melting Pot	1.84	0.49	0.17
O. Liberal Opinions	1.09	0.37	0.06
<b>UK Total</b>	<b>15.39</b>	<b>13.07</b>	<b>1.99</b>

- The “Professional Rewards”, “Small Town Diversity” and “Suburban Mindsets” Experian segments also contribute significantly to the national appliance efficiency improvement potential (1.54, 1.76 and 1.71 TWh/year, respectively), not because they own particularly inefficient appliances but more due to their generally high levels of electricity use combined with a strong representation in the UK population.

**Recommendation:** Ensure broader scale energy efficiency interventions also capture the big energy use segments in the UK represented by households in the “Professional Rewards”, “Small Town Diversity” and “Suburban Mindsets” Experian categories. Further work investigating the usage behaviours in these three high consumption groups would also help to better understand the types of interventions that are most appropriate for these segments.

- The UK potential for electricity savings from switching heating fuel (or upgrading to a more efficient electric heating system) is most

apparent in the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups. While these two segments only account for 6% of UK households each, in combination they offer 4.6 TWh/year of savings potential from switching heating fuel (i.e. 35% of the UK’s technical potential in this area). For both segments, electric space heating contributes almost 80% of the savings opportunity.

**Recommendation:** Tailor measures aimed at existing electric heating (particularly space heating) to the “Claimant Culture” and “Elderly Needs” Experian Mosaic Groups since they currently account for over a third of the UK’s electric heating demand.

- The opportunities for shifting electricity demand out of the 6-7pm peak load period are distributed broadly across many of the Experian Mosaic Groups. As such, the Experian consumer segments may not be the ideal metric for identifying the most promising segments for achieving the approximately 2 GW of UK load shifting potential (during the 6-7pm peak) identified in this report (Table 3).

**Recommendation:** Use other consumer segmentation strategies that incorporate electricity usage behaviour when determining household archetypes (such as the Element Energy Household Clusters<sup>20</sup>) to better understand the consumer groups that should be targeted for peak load shifting interventions.

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<sup>20</sup> Element Energy (2013), “Further Analysis of Data from the Household Electricity Usage Study: Consumer Archetypes” for DECC and Defra.