Intelligent energy feedback: Tailoring advice based on consumer values

Caitlin Bent
Energy Saving Trust
21 Dartmouth Street
London, SW1H 9BP
UK
caitlin.bent@est.org.uk

Zoltan Kmetty
Ariosz Ltd./Eötvös Lorand University
Faculty of Social Sciences, Sociology Institute
1033 Budapest, III. Sorompó utca 1.
Hungary
kmetty.zoltan@ariosz.hu

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Abstract

With the roll-out of smart meters across the EU comes the opportunity for more tailored, informative feedback to be offered to domestic consumers regarding their energy consumption. To maximise the energy saving potential of this feedback, it must be accompanied by relevant, interesting advice. In this paper, we explore a mechanism for more effectively tailoring such advice, which is being developed by the Natconsumers project. There are two strands to developing tailored advice: determining what advice to give someone, and determining how to give it. In this paper, we focus on the latter: based upon their interests and motivations, how should advice be framed for different types of people? In what terms should the message be communicated, and in what tone? To investigate this, we have conducted a survey of 4,000 people across four European countries, examining their attitudes, values and demographics. Using these results, we present an attitudinal segmentation model, which allows us to identify what types of messages will be most resonant to different segments of energy consumers. In the wider Natconsumers project, this will be linked with additional segmentation models of load profiles and household characteristics/demographics in order to create a mechanism for the generation of tailored energy efficiency advice across Europe.

Introduction

With the residential sector responsible for around 25 % of emissions in the EU (Eurostat, 2017), reducing household energy consumption will be critical to meeting greenhouse gas reduction targets. The roll-out of smart meters across Europe provides one opportunity to do this. Allowing consumers to access more detailed, accurate feedback on their consumption will, it is hoped, encourage them to take greater control over their consumption and avoid wastage. However, current levels of consumer engagement with energy use are low; indeed an Energy Saving Trust survey of over 2,000 householders found that only 15 % claim to fully understand the information on their energy bills (EST, 2014). Energy itself is an abstract concept, difficult to visualise and understand; people do not consume energy itself, but the services that energy provides (heating, lighting, charging devices, entertainment etc.). As such, we are one step removed from our direct consumption, making it harder to relate the data on our energy bills with day-to-day habits and practices.

Smart meters offer the opportunity to provide consumers with more accurate data and feedback on their consumption. However, given current low levels of engagement and understanding of energy data, simple feedback alone is unlikely to stimulate significant behavioural change. Rather, this feedback must be made more accessible to the consumer – easier to understand, interesting, and relatable. Not only this, the feedback must be designed to provide motivation for consumers to act, and to provide consumers with sufficient knowledge to know how to act. Natconsumers is an EU-funded Horizon 2020 project[1] which aims to contribute to this. Incorporating

1. Natconsumers has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 657672.

10 partners from 8 European countries, Natconsumers is creating an automated mechanism for the generation of tailored energy feedback and energy efficiency advice, based on smart meter data, and delivered in 'natural language'. Within the context of this project, we define 'natural language' as a process of communication which speaks to consumers in an accessible, emotionally intelligent way, forming a dialogue which develops over time. The style of this dialogue will vary by user, and will develop in complexity as the conversation evolves.

A key premise of Natconsumers, and integral to the generation of 'natural language', is that for advice to be effective, it should be tailored. Multiple studies have found tailored advice to be more effective than more generic advice provision (see Abrahamse, 2007; Sütterlin and Siegrist, 2013; Berveots, 2014, etc.). Tailoring can, however, be implemented to differing extents. In this project, we do not consider generic messaging which incorporates personalised consumption data to be true 'tailoring'. Rather, tailoring means provision of a specific piece of relevant advice, constructed based upon the information gathered about the householder, and framed in a way which will interest them. Given the highly heterogeneous energy demands displayed by households, this level of tailoring is required to ensure the advice is relevant, and therefore more likely to be acted upon (Faiella, 2011). By providing only relevant advice, we reduce information overload, which could disengage the consumer or lead them to overlook pertinent advice (Ford et al. 2014).

Within Natconsumers, we have identified two strands to tailoring:

- Determining **what** advice to give: what advice is relevant and useful to that particular householder?
- Determining **how** to say it: how should that advice be framed to make it interesting to that individual?

In this paper, we will focus on the latter: how advice can be tailored to a particular individual, based upon their values and motivations to act.

We will begin by investigating the theoretical background, discussing how various psychological variables influence energy usage and willingness to change it. We will then describe the methodology used by the Natconsumers project to translate this insight into a mechanism for advice generation. This included a survey of 4,000 people across 4 countries in order to create an attitudinal segmentation model. We will then discuss the results, looking at the different segments generated and how this relates to tailored advice provision.

Theoretical background

In order to generate behavioural advice, it is first necessary to understand why people behave in the way that they do: what influences the ways in which we use energy? Only by understanding this can we develop advice which could change our behavioural choices.

There are, of course, a multitude of different factors influencing our day-to-day energy use, most of which are not independent of each other. There are complex relationships between these factors, and cyclical relationships between the influencers and the behaviours they produce. For example, habits around everyday practices such as washing and cooking are strongly influenced by social norms, yet these social norms themselves are consolidated by the behaviours they generate (Shove, 2009). Separating out such interconnected factors is therefore difficult. In Bent & Shreeve (2015), we attempted to categorise the factors influencing energy use at three different scales (adapted from Wallenborn, 2007); the wider context, the household context, and the individual context:

- **Wider context factors:** this represents the broad, socio-technical regime within which we operate; as Wallenborn (2007, p15) describes it: "*the age and society in which consumers live*". This provides the structural context within which all behaviours take place and all energy usage decisions are made. It incorporates the political and economic landscape, which influences regulatory context, education, investment and pricing signals. It also incorporates the broad physical and climatic context which influences our energy requirements, and the cultural landscape, including widely held social norms and the state of the 'energy conversation'[2] in a country or region.
- **Household context factors:** within a particular region, there can be significant variations between the context of individual households. This household context can influence and constrain people's ability to change their behaviours, by limiting the opportunities available to them. Household context includes physical factors, such as the characteristics of the home and technology in it. For example, the household size, age, thermal performance and heating fuel will all influence people's energy use and ability to reduce it. However, household context also incorporates socio-demographic factors and localised social norms. For example, tenure will influence people's ability to make changes to their home, whilst income may influence people's ability to invest in changes, or their willingness to make behavioural changes for small economic gains.
- **Individual context factors:** at a very personal level, individual context encapsulates those factors which influence how you choose to behave. This incorporates psychological factors such as motivations, attitudes and values. It also depends upon knowledge and understanding of different actions and their impacts (both at a personal level, e.g. impacts on bills, and a more systemic level). Essentially, the individual context explains why two people in the same circumstances may choose to act differently.

The importance of these different sets of variables is contested. When looking at the impacts on current energy use, many studies find that the psychological variables (i.e. our 'individual context' factors) have limited direct relationship with behaviour; there is an attitude-behaviour gap or value-action gap. Wallenborn et al. (2006), for example, found socio-demographics to be much more powerful explanatory variables of behaviour than attitudinal variables. Similarly, a study into environmental behaviours by Ramos et al. (2015) found that attitudes had no influence on pro-environmental habits, and limited impact on

2. A term used here to describe the level of awareness and discussion amongst the general public about how energy is produced, distributed, consumed and conserved.

purchasing decisions, whilst demographic variables had much greater impact. However, by contrast Abrahamse and Steg (2011) argue that psychological variables play an important mediating role between context and behaviour; the context may determine what behaviours are possible, but psychological variables will influence our decision to undertake that behaviour. With regards to advice provision, we must consider not only what influences our current behaviour, but also what influences out *intentions to change* behaviour. We therefore contend that individual context factors are an important set of factors to consider when developing advice, since these will influence people's willingness to change and, subsequently, their receptiveness to advice. Context may make a behaviour more or less likely, but the extent to which people then engage with that action depends upon their motivation to do so (Steg et al. 2015).

When tailoring advice, we must consider both what advice to give to people and how it should be given. These three groups of factors – wider, household and individual context – therefore feed into tailoring in different ways. When determining **what** the message should say, an understanding of wider and household context is crucial. For the piece of advice to be practicable and relevant, it must account for the context within which that householder is living. When determining **how** to say the message, individual context factors must be considered. The same message could be framed in a range of different ways depending on the audience; a full understanding of people's values and motivations, and that of others within the household, is therefore required to allow the message to be framed in a way which will interest them and stimulate them to take action.

In the remainder of this paper we will focus primarily on the latter: tailoring the framing of messages towards different people depending upon their differing motivations. This involves developing a greater understanding of individuals' attitudes and values, in order to develop advice which resonates with them. Attitudes reflect the way we perceive or comprehend an idea, object or behaviour, and our emotional evaluations of it (Bergman, 1998; Bent and Shreeve, 2015). Attitudes are relatively transient, and may change over short timescales or in different contexts. By contrast, values are more stable, durable sets of beliefs. They are underlying principles which guide our perceptions, evaluations and world-views. Indeed, our attitudes are constructed from, and rooted in, our underlying value-systems (Bergman, 1998; Parkhill et al. 2013). To generate effective, tailored messaging therefore, we must understand individuals' attitudes and underlying values. Indeed, as noted by Mirosa et al. (2011, p. 469): "if we want to change behaviour, it must be recognised that it is unreasonable to expect people to behave in ways they are opposed to". Advice must therefore be framed in order to portray the recommended behaviours as aligned with each individual's value-set.

In the following section, we will describe our methodology for collecting and analysing data on people's attitudes, values and motivations, and how this can then be used to develop tailored messaging.

Methodology

As discussed in the previous section, in order to effectively tailor energy saving advice, an understanding of each individual's attitudes and values is required. To achieve this, we have conducted online surveys in four countries: the UK, Hungary, Italy and Denmark. These countries were selected to represent a range of the different 'wider contexts' seen across Europe, providing a spread of different energy systems and different levels of engagement with energy use. In each of the four countries, a sample of 1,000 individuals aged 18–65 completed the survey[3]. Data collection occurred via an online survey in March-April 2016, and was conducted by Ipsos Mori in the UK, Denmark and Italy, and by NRC in Hungary. The samples were recruited from the consumer panels of these survey companies, and were weighted to be nationally representative of each country.

The survey incorporated a range of questions designed to test people's values and attitudes. Investigating values through a quantitative survey is difficult; we therefore chose to use Schwartz's (2003) Portrait Values Questionnaire (PVQ), which is a well-tested, theory-based questionnaire used in the bi-annual European Social Survey to measure 10 core values[4]. In addition, we also tested the strengths of 7 attitude dimensions, identified from the literature, which may have an influence on decisions affecting energy use:

- Environmentalism: prioritisation of environmental preservation
- Economic rationality: prioritisation of money and reducing expenditure
- Technological innovation: a desire to have the latest technologies
- Need for comfort: a prioritisation of comfort and convenience
- Need for control: a need to take control of things in the home
- Sensitivity to social pressure: a desire to conform with social norms
- Aesthetic value: a sense of prestige gained through the aesthetic value of your home

The following analysis has been conducted separately for each country, however in this paper, due to limited space, we will focus primary on the results of the UK.

Our primary analytical aim was to segment the samples based on the above described theoretical attitude or value dimensions. The survey provided a wide set of initial variables, with a large number of questions used to investigate the 7 attitude dimensions and Schwartz's 10 primary values. We therefore began by running several explanatory principal axes factor analyses, in order to identify those questions whose responses were most strongly related. Factor analysis identifies 'latent variables', unobservable variables constructed from a set of observed variables with a common variance (Yong and Pearce, 2013). The factor analysis therefore combined attitudinal and value-based questions to identify the most important attitude/value dimensions, and thereby reduce the number of input variables to the segmentation. Through an iterative pro-

3. The final sample size was smaller as some incomplete responses were removed during data validation: Denmark: 916, UK: 896, Hungary: 812, Italy 783.

4. For more information on the survey and the 10 value sets it identifies, please see Schwartz (2003).

Table 1. Rotated factor analysis for the UK.

	Empirical Factors (latent variables)		
	Technological innovation	**Environment preservation**	**Economic rationality**
I think it's fun to try new things	**0.87**	-0.05	0.05
I always like to have the latest technologies	**0.82**	-0.06	-0.25
How interested are you in: Smart phones, tablets, laptops	**0.46**	-0.22	-0.09
I don't trust new technologies	**-0.73**	0.04	0.28
I like to avoid buying new technologies when possible	**-0.77**	0.06	-0.10
He/she strongly believes that people should care for nature	-0.10	**0.85**	0.16
I am concerned about climate change	-0.07	**0.65**	0.08
I don't mind spending a bit more now, if it saves money in the long run	0.00	0.03	**0.42**
I'm always looking for ways to save money in my day-to-day life	-0.11	0.13	**0.35**

The scores in the table show the 'factor loadings' of the original 9 variables. The higher the absolute value of the loading (in a positive or negative direction), the more it contributes to the newly created latent variable.

cess, we removed all poorly fitting variables and identified the 3 most important attitudinal dimensions (which were measured by 9 variables within the questionnaire). As can be seen in the rotated factor analysis[5] in Table 1, the three most important dimensions identified were: technological innovation, environmental preservation, and economic rationality.

Having identified the three most important attitude/value dimensions, the next stage was to utilise these dimensions to create a segmentation model. For this, we did not use the output variables of the factor analysis, since by definition these are not correlated to each other. Rather, the 9 (5+2+2) original variables used to generate these factors (as shown in Table 1) were included in three independent Principal Component Analyses. The three Principal Component variables produced were then taken to indicate the three main attitude variables.

In addition to the primary factors, we also retained a number of secondary factors for use in the segmentation. These are attitude/value facets which have either been identified as important theoretically – sensitivity to social pressures, control, comfort, and aesthetics – or have emerged during the iterative process of the above described factor analysis – 'self-expression' and 'responsibility'[6].

The segmentation was generated from the 3 primary attitude dimensions using hierarchical cluster analysis. For each of the four countries, we examined solutions with 4, 5, 6, 7 and 8 clusters. The 6-cluster solution was chosen as the most valid, since this led to the most similar segments forming across the four countries, and provided the most interpretable solution. The 6-cluster solution was also found to be the most valid statistically. Whilst the structures across the four countries are similar, they are not identical; due to variations in social context there are differences in ways of thinking and mentalities between nations. As such, whilst 6 clusters were generated in each country, in total we were left with 7 clusters, with one segment missing in each country.

Results and analysis

In this section we will describe the results of the cluster analysis and discuss how these results can be utilised in developing tailored messaging. We will begin by describing the 7 clusters' relationship to the three primary attitude dimensions used in their formation. We will then investigate these clusters in more detail, looking at their demographic characteristics and their relationships with secondary attitude dimensions. A full, detailed profile of each segment will then be drawn together, to discuss how this can influence the style of advice message suitable to each group.

PRIMARY ATTITUDE DIMENSIONS

Table 2 shows, for each segment and each country, the factor scores of each attitude dimension. These scores indicate how typical the given attitude is for the people in that segment. Based on these, we have named each segment in accordance with its relationship to the primary attitude dimensions.

In each country, the average score for the total population, in all three attitude dimensions, is zero. This means that positive or negative factor scores indicate a deviation from the national average for that segment; with larger (in the positive dimension) and smaller (in the negative dimension) scores representing greater deviation.

However, since the national average in each country is different, it is not possible to use these scores to make direct comparisons between countries. For example, in the first segment, **environmentally sensitive – cost conscious**, the 'environmental preservation' attitude has a larger positive value in the UK than Denmark. This does not mean that people in the UK are characterised more by environmentalism than the Danish, rather that the given segment differs more from the national average in the case of the British than in the case of the Danish. Comparing the magnitude of the exact numbers is not relevant, as these can only be interpreted internally within countries.

5. The rotation changes the partitioning of variance in order to make the interpretation of latent varaibles more straightforward (see Abdi, 2003).

6. In the following analysis, only a sub-set of these secondary attitude dimensions are explored. For more detail on the other secondary attitudes, please see Kmetty et al. (2016).

Table 2. Factor scores for each attitude segment in each country.

Countries	Technological innovation	Environment preservation	Economic rationality	%
1. Environmentally sensitive – cost-conscious				
UK	-0.84	1.18	0.91	16 %
DK	-0.54	1.02	0.39	29 %
IT	-0.75	1.26	0.81	15 %
HU	-0.84	0.61	0.84	24 %
2. Environmentally insensitive – cost-conscious				
UK	-0.63	-1.14	0.91	10 %
DK	-0.35	-0.10	0.95	15 %
IT	-0.14	-0.45	0.99	20 %
HU	-0.87	-1.32	0.48	9 %
3. Technology fan				
UK	1.23	-0.52	0.10	21 %
DK	1.50	0.08	-0.21	15 %
IT	0.99	0.10	-0.49	30 %
HU	0.78	0.14	0.38	30 %
4. Not cost-conscious				
UK	0.34	-0.42	-1.33	16 %
DK	0.20	0.07	-1.38	13 %
HU	0.86	-0.09	-1.07	13 %
5. Moderately green				
UK	0.13	0.55	0.14	22 %
IT	-0.64	0.58	-0.54	13 %
HU	-0.43	0.24	-0.77	19 %
6. Environmentally insensitive – not cost-conscious				
DK	0.81	-1.42	-0.50	9 %
HU	0.23	-1.89	-1.39	5 %
7. Unconcerned				
UK	-0.90	-0.11	-0.50	15 %
DK	-0.63	-0.92	0.01	19 %
IT	-0.59	-0.90	-0.45	22 %

From this, we can begin to build up a picture of each of the 7 identified segments. The strength and direction of each attitude in each segment is summarised more simply (across all four countries) in Table 3. This shows, for example, that the **environmentally sensitive – cost conscious** segment is primarily driven by a strong desire for environmental preservation, but would also be perceptive to messaging around cost. This group, however, is not at all interested in new technologies. By contrast, the **technology fan** segment is very open to new technologies, but is indifferent to environmental and economic arguments. Interestingly, whilst this segment is present in all four countries, it is much more prevalent in Hungary and Italy than in the UK or Denmark. Indeed, in Hungary and Italy the **tecnology fans** make up the largest segment. In Denmark and the UK the environmental segments are more significant – the largest segment in Denmark is the **environmentally sensitive – cost-conscious** group, accounting for 29 % of the population, whilst in the UK the largest segment is the **moderately greens**, accounting for 22 % of the population.

The first three segments were identified in all four countries. However, the other four segments were not universal[7].

DEMOGRAPHICS

Whilst the above analysis provides a basic picture of the motivations and drivers for each segments' behaviours, it does not, at this stage, provide a particularly detailed description of the types of people each segment contains. To investigate

7. The *not cost-conscious* segment was not identified in Italy. The *moderately green* segment was not identified in Denmark. The *environmentally insensitive – not cost-conscious* segment was not identified in the UK or Italy. The *unconcerned* segment was not identified in Hungary.

Table 3. Summary of attitude segments across the 4 countries.

	Technological innovation	Environmental preservation	Economic rationality	Size
Environmentally sensitive – cost-conscious	− − −	+ + +	+ +	**15–29 %**
Environmentally insensitive – cost-conscious	− −	− − −	+ +	**9–20 %**
Technology fan	+ + +	0	0	**15–30 %**
Not cost-conscious	+	0	− − −	**13–16 %**
Moderately green	−	+ +	−	**13–22 %**
Environmentally insensitive – not cost-conscious	+	− − −	− −	**0–9 %**
Unconcerned	− −	− −	− −	**0–23 %**

\+ *Affirmative attitude*
− *Dissenting attitude*
0 *Indifferent attitude*

the segments in more detail, we have therefore examined their demographics. Figure 1 shows the relationship between each segment and various demographic variables for the UK sample. From this, some clear patterns emerge:

Age

Two segments, the **technology fans** and the **not cost-conscious** group, have a considerably younger demographic than the other groups. In both groups, at least a third of the population are under 30 years old. By contrast, the **environmentally sensitive – cost-conscious** group generally has an older demographic, with almost half (49 %) over 50 years old. Similarly, the **unconcerned** segment has a generally older demographic.

Gender

In general, there is limited gender-based variation between the segments. In only two segments are gendered differences notable: the **technology fans** segment is primarily male (59 %), whilst the **unconcerned** segment has an overrepresentation of females (65 %).

Education

Variations by education are of limited magnitude, although some patterns can be identified. Those groups which are more environmentally sensitive (**moderately green** and **environmentally sensitive – cost-conscious**) tend to have higher levels of education, with a higher proportion of postgraduates in these segments. The **technology fans** segment also has generally high levels of education. By contrast, the **environmentally insensitive – cost-conscious** and **unconcerned** segments have lower levels of education.

Income

As might be expected, the two cost-conscious segments tend to incorporate lower income households. In the **environmentally sensitive – cost-conscious** segment 29 % of households have an income below £20,000, whilst in the **environmentally insensitive – cost-conscious** segment this rises to 32 %. This is compared to an overall average across all segments of only 21 %. By contrast, the **not cost-conscious**, **technology fans** and **moderately green** segments have above average income levels.

SECONDARY ATTITUDE DIMENSIONS

Thus far, our segments have been investigated based upon their primary attitudes and their demographics. To build further detail into these profiles however, it is also worth considering secondary attitudes and values. Whilst our factor analysis identified only three primary attitude dimensions, the literature suggests a number of additional potential drivers of behavioural change, which were also explored in our survey. Indeed, in our survey we investigated Schwartz's 10 value-sets plus an additional seven attitude dimensions. In this section, therefore, we will explore the relationship between the established segments and some of these secondary attitude/value dimensions, focusing on those which displayed the strongest relationship to the segments.

In the following analysis, we have selected two of the attitude/value questions from the survey which, based on theoretical judgement, we considered to be the most relevant to each attitude dimension, and analysed the relationship of the segments to these. In Figures 2 and 3, we show the results for two secondary attitudes (looking at the UK sample):

- Sensitivity to social pressure
- Need for comfort and convenience

For an analysis of additional secondary attitudes/value sets, and analysis in the other three countries, please see Kmetty et al. (2016). Figures 2 and 3 use the 'Top 2 box, Bottom 2 box' data reduction method, whereby the top two options on a the Lickert scale for these questions (Agree, Strongly Agree) are summed, and the bottom two options in the scale (Disagree, Strongly Disagree) anre summed. This allows for a comparative analysis of positive and negative responses to each question, whilst retaining the general distribution of responses.In the figures, segments which showed statistically significant correlations with the analysed variables are indicated using a left or right arrow.

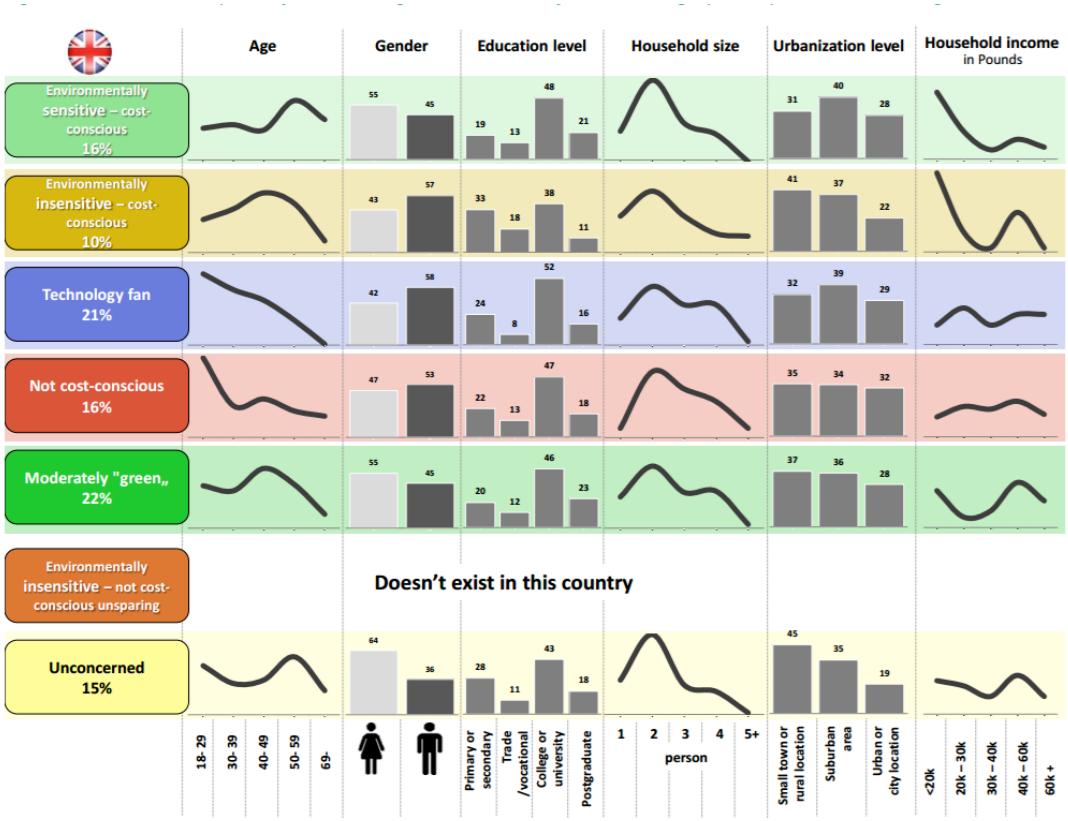

Figure 1. Demographic profiles of each segment in the UK.

Figure 2 shows responses to two questions which are indicative of people's susceptibility to social norms and pressures: 'what friends or neighbours think of my home is important to me' and 'I try to buy products which suit my image'. Both of these questions focus on the way we present ourselves to the outside world, one through our homes and one through our possessions. The importance of this 'image' we portray to the outside world is reflective of our needs to be judged positively by those around us.We can see, from this, that two groups in particular are more highly sensitive to social pressures: the **not cost-conscious** segment and the **technology fans**. Interestingly, the **unconcerned** segment also displays relatively high sensitivity to social pressures. For both the **not cost-conscious** and **unconcerned** groups, who are relatively neutral or negative towards all three primary attitudes, this could therefore be a useful angle from which to position messaging. Conversely, the two **cost-conscious** groups both display below average susceptibility to social pressures, indicating that messaging around what other people are or are not doing would be of little interest to these groups.

Figure 3 shows responses to two statements around comfort and convenience: 'I like my home to be comfortable – I don't mind spending a bit more on my energy bills if it makes my home more comfortable' and 'I'm happy to spend money on things which make my life more convenient, like household gadgets or car travel'. The pattern here is similar, if more pronounced, as in Figure 2. The vast majority of the **not cost-conscious**, **technology fan** and **unconcerned** segments all agree with the statement around comfort. Similarly, the majority of people in the **technology fan** and **not cost-conscious** segments also agree with the statement on convenience. Unsurprisingly, those in the two **cost-conscious** segments (both **environmentally sensitive** and **environemtally insensitive**) are significantly more likely to disagree; being more frugal with their expenditure, these groups are less likely to be swayed by arguments around comfort and convenience if it could increase their bills. Again, this provides an additional hook with which to interest particular groups, since much advice around energy use, particularly heating and cooling, can result in a more comfortable home.

THE SEGMENTS

Drawing all of this information together, it is possible to paint a much more detailed picture of energy consumers in each of our seven segments. Using this information, we can therefore tailor energy efficiency advice effectively to ensure messages are framed and presented using themes and terminology which will interest the reader. The 6 segments present in the UK are outlined below[8].

1. Environmentally sensitive – cost-conscious

This segment is made up of people for whom environmental preservation is a key driver, with financial savings also a high priority. They are generally older, living in 1–2 person households without any children living at home. They have limited trust in new technologies and avoid buying it where possible,

8. The 7th segment, *environmentally insensitive – not cost-conscious*, is only present in the Hungarian and Danish samples, and so has not been included here. More detail on this segment can be found in Kmetty et al. (2016).

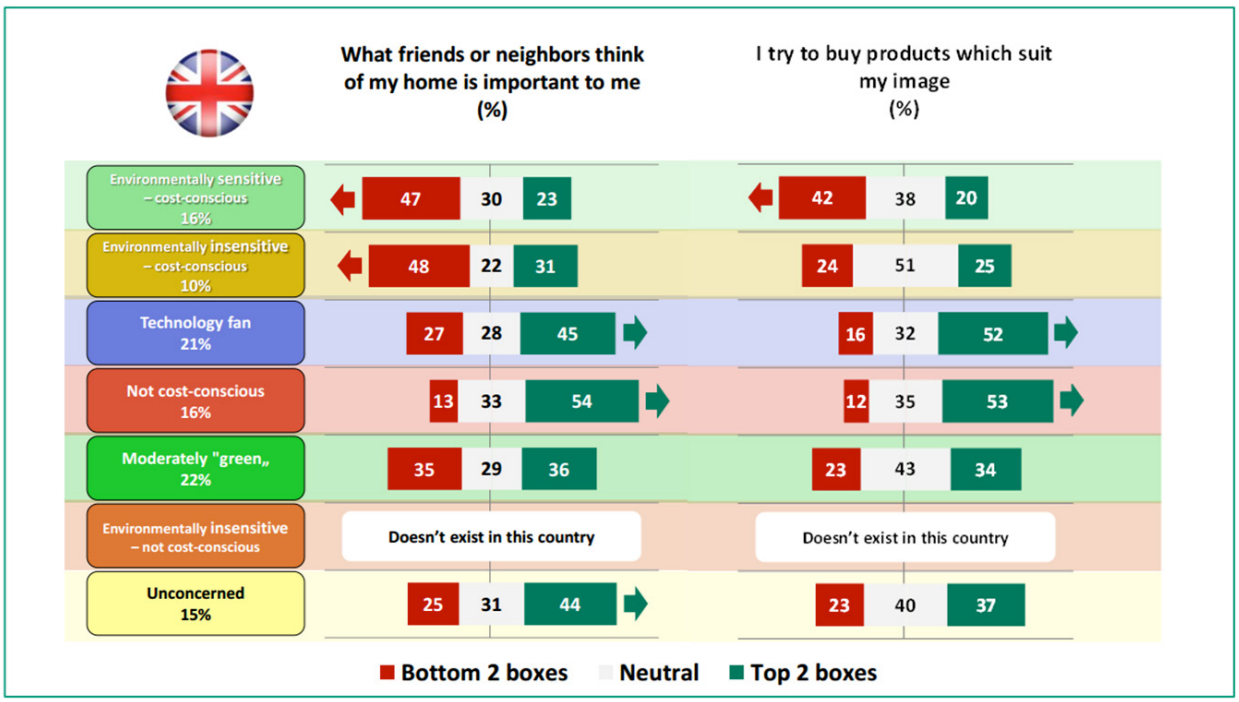

Figure 2. Sensitivity to social pressure.

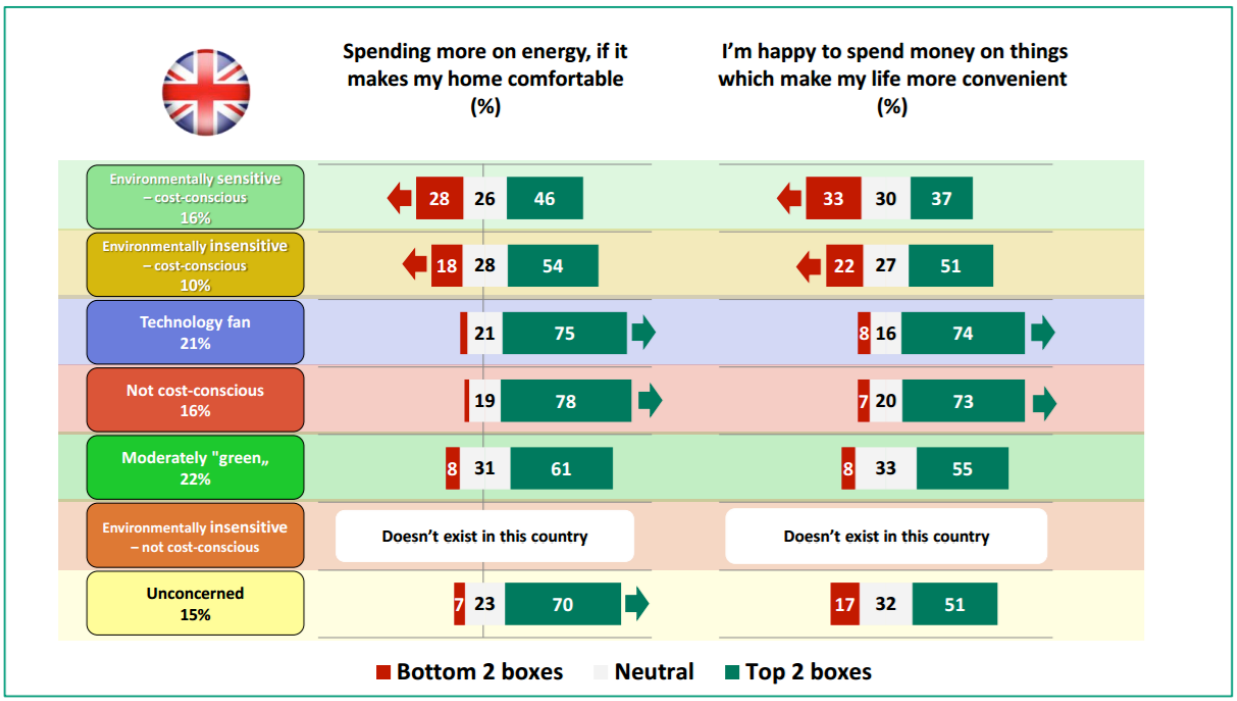

Figure 3. Need for comfort and convenience.

indeed they tend to have fewer appliances than the average household. They generally have a below average disposable income, and so are very cost-conscious; this means they are willing to sacrifice comfort and convenience in order to save money. Advice targeted at this group should therefore focus on ways of saving money, even if only small amounts, and on the potential environmental benefits of various energy saving actions. Advice could, for example, be associated with an estimated bill saving, or carbon dioxide reduction. Advice around new installations should be treated with caution; actions which require large a financial outlay are likely to be seen as unobtainable and therefore frustrating, whilst advice around installation of new or unknown technologies may be regarded with suspicion due to their lack of trust in new technologies.

2. Environmentally insensitive – cost-conscious

This segment is, in many ways, very similar to group 1; they have relatively low disposable income, are wary of new technologies, and are uninterested in measures promoting comfort, convenience or social image, prefering to save money wher-

ever possible. However the segment has an average, rather than older, age profile, and is made up of people with generally lower levels of education. The key difference between these groups however is that group 2 has no interest in environmental preservation – money is their only strong driver. For these people, therefore, framing all messaging around the potential financial savings available through energy efficiency is likely to be the most effective strategy.

3. Technology fan

This group are very open to and interested in new technologies; they always like to have the latest technologies and think it's fun to try new things. This segment is made up of relatively young people, predominantly male, with slightly above average income. Unlike the previous two groups, they have a generally indifferent attitude towards money. Messaging for this group should therefore not focus on financial savings. Rather, these people are interested in using new technologies to make their home more comfortable, make their life more convenient, or to keep up with their peers. For such people, advice around new devices for home automation and smart controls may therefore be of most interest, and messaging should focus on how these technologies can improve their overall lifestyle and image.

4. Not cost-conscious

The primary feature of this group is that they are uninterested in financial matters. Unsurprisingly, the segment is made up of people with high disposable income. This segment has a relatively young age profile, and an above average number living in households with children, indicating that this group is primarily young families, or young people still living at home. Whilst they are not interested in money, people in this group are interested in improving their comfort and convenience, and are also influenced by social pressures. This indicates that comparative messaging may be effective for this group, for example, information on how much energy you are consuming compared to your peers, thereby encouraging a reduction in consumption to conform with social norms.

5. Moderately green

This segment has a slightly negative attitude towards new technologies and financial statements, but a relatively strong positive attitiude towards environmental preservation. It is a predominantly middle-aged, well-educated group with slightly above average income. They displayed no strong attitudes around any of the secondary attitude/value dimensions explored; the focus of messaging for this group should therefore be purely around the environmental benefits of particular energy efficiency actions.

6. Unconcerned

This final segment is perhaps one of the hardest to engage. They have negative attitudes towards the three primary attitude dimensions: money, environmental preservation, and new technologies. However, they do display an interest in comfort and a sensitivity to social pressures. They are generally older households of average income, with no children living at home. Messaging for these households should therefore be framed in terms of how to improve the comfort of your home, rather than how to save money or the environment.

MESSAGE STYLE

In the above analysis, we have focused on how to frame message content based on indivudual's interests and motivations. Another aspect to consider when tailoring messages however is message style and tone, and how this should vary between users. For example, are people more responsive to messages which are confrontational, humourous, conversational etc. Within the survey, we presented respondents with a range of different message styles, based around a similar message theme. For example, relating to standby, a range of different message styles were constructued, a subset of which are shown in Table 4.

Respondents were then asked to select their strongest emotive response to these messages: funny, irritating, interesting or boring.

When analysing these responses against the different segments, no clear relationship was found; cluster membership cannot be used to determine how respondents are likely to react to different messaging styles. The segments identify which aspects of advice we should emphasise for different people (e.g. cost, environment, technology, comfort etc.), but they do not tell us what tone of voice we should use to communicate.

Subsequently, we have followed up this analysis with focus groups in Italy and Hungary, to gain greater depth of understanding around people's responses to different message styles. The results of these focus groups will not be elaborated here, however two key conclusions should be noted:

1. There is no single 'message style' which is appropriate or inappropriate for a particular type of person. What is more important to consider is the sender of the message. Consumers respond negatively to a confrontational or sarcastic message sent by their energy company, but are more likely to find this entertaining if it is sent from a consumer or-

Table 4. Messaging styles.

Style	Standby message
Factual	The standby mode of your devices consumes electricity. You could save energy by switching them off at the wall.
Confrontational	Are you serious? You're leaving your devices in standby? It saps so much energy! Turn them off completely!
Creative	The surface is dark. Empty. Only a little red light survives. The eye of a dragon. A powerful energy monster snoring in silence.
Sarcastic	Rest mode. Sleep mode. Wake up button. You know your devices aren't really alive, right? They don't need to go to sleep or take a nap, you can turn them off completely. Believe me, they will be fine.

ganisation or other advice provider. Segmenting the consumer is therefore not an effective way to determine appropriate message tone; rather, the tone should vary with the sender.

2. The most appropriate or effective message styles to use will not be fixed; message style and tone should vary based upon the stage of communication with a consumer. Whilst in early stages of communication messages should be relatively factual and to the point, as the conversation develops the message style should evolve. 'Natural language' must therefore be a process of communication, evolving into more conversational, and perhaps more provocative, messaging as trust in the advice builds up.

Conclusion and next steps

Through this analysis, we have identified seven segments of energy consumers, based upon their attitudes and values. Three attitude dimensions were found to be 'primary' factors, used to develop the segmentation: environmental preservation, economic rationality, and technological innovation. In addition however, we have also examined the relationship of these segments to secondary attitude dimensions, in particular the sensitivity to social pressures and norms, and the desire for comfort and convenience. Each segment displays a distinct set of attitudes and is constructed of different demographic groups.

The next stage therefore is to utilise this segmentation to effectively tailor energy advice provision. Tailoring of messages involves two key strands: determining what to say, and determining how to say it. This segmentation contributes to the latter; it allows us to frame messages in different ways, according to the different attitudes displayed by each segment. For example, consider a message advising consumers to turn down their thermostat to save energy. For the **environmentally insensitive – cost-conscious** group, we may wish to frame this purely in economic terms – how much money could you save by doing this action. For the **technology fans**, we might discuss how a 'smart' thermostat could manage their home remotely, and that they can turn down their heating via an app wherever they are; i.e. providing advice in a less direct manner, but playing on themes which we know they find interesting. Different again, for the **not cost-conscious** we could talk about how gaining greater control over their heating controls can help them improve the comfort of their home, advising on how to adjust their time and temperature controls to reduce energy consumption without compromising comfort.

This segmentation however is only part of the tailoring. Our analysis has also found that whilst attitudinal segmentation can help us tailor message framing, it cannot be used to determine the most effective message style or tone to use. For this, we must have a greater appreciation of the stage of communication, how tone should vary over time, and an appreciation of consumers' attitudes towards the advice provider.

The other important part of message tailoring is, of course, determining what advice to give – what information is relevant to that household, and what advice would they be able or willing to act on. For this, the Natconsumers project is conducting two additional segmentations, one based on load profiles, and one based on demographics and household characteristics (the 'household context'). The former allows assessment of how and when energy is used in the home, and therefore what changes may be required. The latter allows us to estimate how much energy a household is likely to use, and what advice may be appropriate or inappropriate depending on their context.

In the next stage of the Natconsumers project, these three segmentations will be combined in order to create a mechanism for generating tailored, natural language energy advice. By using consumers' smart meter data, plus a short questionnaire to identify each consumer's demographic and attitudinal segment, this mechanism will allow for the creation of advice tailored not only to your energy consumption, but also to your houshold context and your motivations to change behaviour.

References

Abdi (2003). 'Factor rotations in factor analyses', Encyclopedia for Research Methods for the Social Sciences. Sage: Thousand Oaks, CA, pp.792–795.

Abrahamse (2007) 'Energy conservation through behavioural change: Examining the effectiveness of a tailor-made approach'. Groningen: University of Groningen. PhD thesis.

Abrahamse and Steg (2011) 'Factors related to household energy use and intention to reduce it: The role of psychological and socio-demographic variables', Human Ecology Review, 18 (1), pp. 30–40.

Bent and Shreeve (2015) 'Characterising energy consumers: Report on the conclusions about profiling studies', Report of the Natconsumers project. Available from: http://natconsumers.eu/?wpdmdl=1389.

Bergman (1998) 'A theoretical note on the difference between attitudes, opinions and values', Swiss Political Science Review, 4 (2), pp. 81–93.

Bervoets (2014) 'Analyse van de sensibiliseringscampagne Energiejacht' University of Hasselt. Master's thesis.

Faiella (2011) 'The demand for energy of Italian households' Banca d'Italia Temi di Discussione (Working Paper) No. 822.

EST, Energy Saving Trust (2014) UK:Pulse II, unpublished raw data.

Eurostat (2017) 'Figure 3: Final energy consumption, EU-28, 2014' in Consumption of Energy, Eurostat: Statistics explained. Available from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Consumption_of_energy#Source_data_for_tables_and_figures_.28MS_Excel.29 [Accessed 12/01/17].

Ford, Sumavsky, Clarke, and Thorsnes (2014) 'Personalised Energy Priorities: A user-centric application for energy advice' Presented at the HCI International 2014 Conference.

Kmetty, Molnár and Fischer (2016) 'EU energy consumer classification', Report of the Natconsumers project. Available from: http://natconsumers.eu/?wpdmdl=1586.

Ramos, Labandeira and Löschel (2015) 'Pro-environmental households and energy efficiency in Spain', Economics for Energy.

Shove (2009) 'Beyond the ABC: climate change policy and theories of social change', Environment and Planning A 42 (6), pp. 1273–1285.

Steg, Perlaviciute and van der Werff (2015) 'Understanding the human dimensions of a sustainable energy transition', Frontiers in Psychology, 6, article 805.

Sütterlin and Siegrist (2013) 'Segmentation and characterization of energy consumers: Consumers' differences in energy related behaviours and commonalities in perceptions of others' behaviours', report by ETH Zürich for Bundesamt für Energie (Swiss Federal Office of Energy).

Wallenborn (2007) 'How to attribute power to consumers? When epistemology and politics converge', in Zaccai, E (ed.) Sustainable consumption, ecology and fair trade. Routledge, pp. 57–69.

Wallenborn, Rousseau, Aupaix, Thollier, and Simus (2006) 'Détermination de profils de ménages pour une utilisation plus rationnelle de l'énergie' Politique Scientifique Fédérale, Plan d'appui scientifique a une politique de developement durable.

Yong and Pearce (2013) 'A beginner's guide to factor analysis: Focusing on exploratory factor analysis', Tutorials in Quantitative Methods for Psychology, 9 (2), pp. 79–94.