



Programme Area: Smart Systems and Heat

Project: WP1 Consumer Insights

Title: Literature Review Personality and Risky Heat Decisions - Behavioural underpinnings of Energy purchase, use & upgrade

Abstract:

This document contains a review of literature relating to the effect of personality on risky heat decisions. This review evaluated different approaches of personality research as well as behavioural economics and offers a set of recommendations on how these can be used in practice to drive change in the energy sector.

Context:

This project will provide insights into consumer behaviour relating to heat decisions. The project will be made up of four small pieces of consultancy work looking at specific issues:

- Consumer Response & Behaviour Analysis
- Literature Review Personality and Risky Heat Decisions
- Household Heating Design Aids
- Segmentation Analysis

Behavioural underpinnings of Energy purchase, use & upgrade

November
17
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Embedding a thorough understanding of the consumer is a key to drive change in the Energy sector.

The present Behavioural Review evaluates different approaches of personality research as well as behavioural economics and offers a set of recommendations on how these can be used in practice to drive change in the energy sector.

**Literature
Review Findings**

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1. Summary

Executive Summary

The variability in residential energy use reported by the ETI suggests that there is hardly a "typical" level of domestic use. This might be something to be expected, given the range of dwellings that exist in this country. It is however the case, according to ETI's research and others, that even when controlling for building characteristics, or other potential sources of variability such as family demographics, considerable variation remains. Specifically, control patterns are found to vary among households, pointing thus to the need for further exploration of each individual's personality and decision-making characteristics which might reveal why this variability occurs. Indeed, personality psychology studies personality and its variation among individuals, which leads to different behaviours. The term personality refers to the set of enduring traits and characteristics that relate to a person's thoughts, feelings, values, social adjustments, and consistently influences one's motivations, decisions, attitudes and behaviours. There is ample evidence that one's personality is affecting the way he/she behaves in financial, social, professional, health or environmental settings and it is found to predict human reactions to other people, problems, and stress. It is nowadays common practice for the majority of industry players to use personality research (through surveys) to understand consumers better because personality research seeks to answer valuable questions such as the following ones: In what ways do human beings differ? In what situations and along what dimensions do they differ? Why do they differ and how much do they differ? And how this will affect their behaviour and decision-making processes?

An individual needs to make decisions on a daily basis. But in order to reach a decision one has to first exercise his perception to obtain stimuli relevant to the topic at hand, his memory to categorize and retrieve stimuli, his judgment to compare and put a hierarchy when

synthesizing and thinking. These are just a few of the processes taking place when one is about to make a decision. Each and every process will be affected by one's personality. If on top of that one takes into account that when deciding, people take into account their need to get along with others and have a system of meaning (the extent and quality of which depend again on personality), then one can understand how important personality is in all situations.

Thus, the scope of this report is to examine energy-related literature in personality and decision-making psychology to suggest strategies of understanding better the consumer in view of a zero-carbon energy future. In fact, an overview of the research available in energy daily use, purchase and upgrade studies points to the conclusion that the role of human psychology and its variability stemming from each individual's personality, values and cognitive styles has been largely overlooked, despite the fact that it would significantly deepen the understanding of the energy consumer. In fact, there is no single article addressing directly the scope of the current report.

Despite the scarcity of relevant research, there were other hurdles associated with the current literature search such as the enormous amount of publications related to energy conservation and pro-environmental attitudes, which made search of appropriate articles time-demanding. However, days available were enough to review more than 1000 articles and cite more than 200 articles in the present review.

Daily energy use was analysed in relation to the factors that might motivate individuals to spend for heating as well as drivers of energy use limitation. We discussed how comfort as a value and priority in life may motivate consumers to spend for space and water heating by presenting evidence as well as psychometric tools to investigate this further in a (quantitative or qualitative) survey setting. We also proposed how other values and priorities in life such as social recognition, health, cleanliness and independence can influence daily energy use choices by providing examples from other industries. In this section, we also examined how the social environment can affect daily energy use choices and specifically how social norms

are found to influence consumption in the energy sector, and presented examples and tools to measure other social factors as well such as empathy and sociability and their relation to energy use. In the next section, money attitudes were explored and we showed how these influence consumers' spending patterns and consumption in other domains, irrespectively of an individual's income. In this section we outlined six different methods to understand individual's proclivities when it comes to spending and, thus, understand each consumer priorities and reasons for actions related to energy daily use. The chapter on daily energy use was then supplemented with a section on cognitive factors that affect individuals' attitudes to daily energy use planning by examining the famous need for cognition and impulsivity traits.

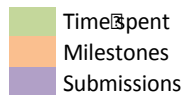
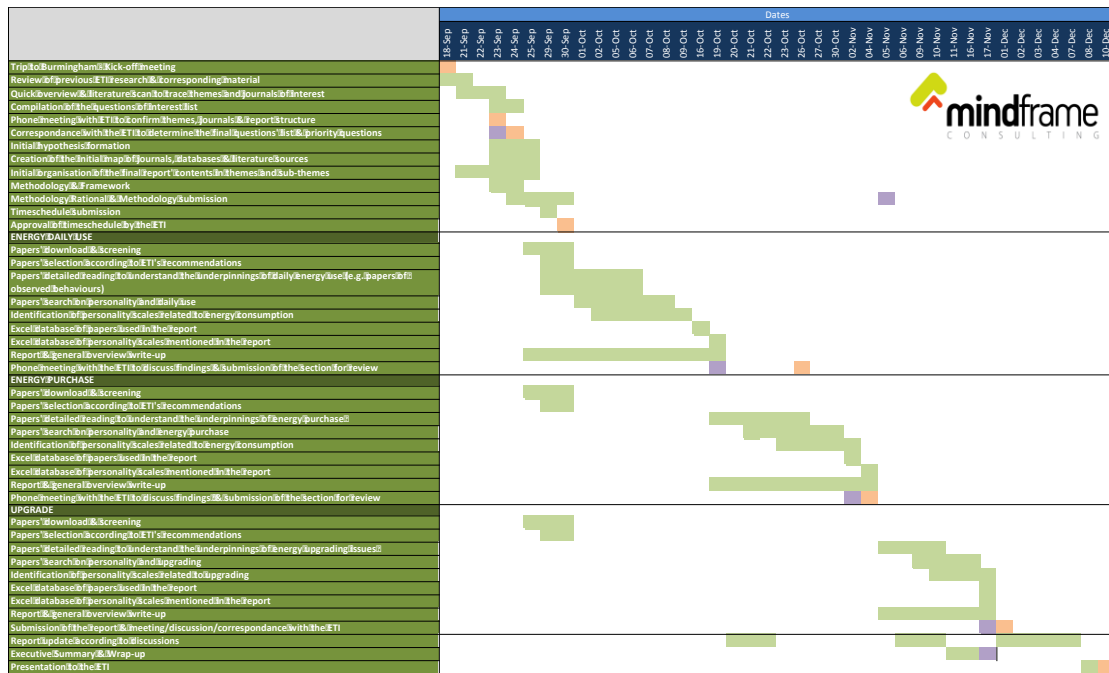
The energy purchase topic was explored under the lens of tariff choice and specifically the decision-making process and underlying biases as well as personality elements that are involved. The leading finding of the flat-rate bias was explained and light was shed on how this pushes consumers towards unlimited rather than pay-per-use tariffs. Its underlying drivers were also presented by explaining how insurance effects lead consumers to seek protection from unexpected high costs via flat rate tariffs as well as how instrumental risk-taking as a trait might lead consumers towards a pay per use tariff choice. Payment timing has also been reviewed as this is also found to lead to the choice of a flat rate tariff; pre-paid usage is found to be enjoyed as if it were free, while, pay per use schemes are associated with the pain of paying to consumption at the time of usage. Convenience, cognitive overload and default tariff choices were the last to be considered with regards to energy purchase. It was shown how convenience leads consumers to the choice of flat rate tariffs. A final section on the energy purchase topic highlighted how important trust to the provider is and how different individuals exhibit different levels of trust due to personal predispositions, which effectively affect subsequent choices. Propensity to trust the supplier can counteract the uncertainties that come with new energy systems and corresponding tariffs and as a result influence tariff choices especially in the case where there is a default choice suggested by the provider.

Finally, the energy upgrade topic was scrutinized by explaining the psychological underpinnings of boiler breaking probability underestimation, which is related to individuals' propensity towards optimistic predictions of future outcomes as well as phenomena that lead to a "resistance to change" attitude such as the status quo bias and indecisiveness' scores of an individual. Apart from reasons related to a negative attitude towards upgrades, there are a few reasons related to positive attitude towards upgrades; these are the early adopter attitude and the desire for social status which is found to influence home upgrade decisions. Finally, the issue of insurance decisions was investigated through revolutionary research in the field of decision-making that explains how these decisions are made on the basis of mainly emotional (and not rational/informational) reasons, which motivate the person to make this decision based on familiarity, vividness and past experience of similar outcomes rather than insurance costs and the individual's income.

2. Methodology

Here are the steps followed during the course of the project:

1. ETI and Mindframe first come up with the specific questions of this review.
2. Questions' list was compiled in cooperation with the ETI.
3. The list was discussed and approved by the ETI (the file "Questions Overview" already delivered to the ETI contains the final list of questions)
4. Questions were then prioritized in terms of importance for ETI. It was agreed that priority questions would be tackled first.
5. It was agreed that the report would contain three main sections; one on energy daily use, one on energy purchase and a final one on energy upgrade. It was further agreed that introductory sections would contain an executive summary outlining the review key messages, a methodology outlining the method and tools used to conduct this review and two general overview sections on personality and decision making under uncertainty principles, the two most relevant topics of psychological science for this project.
6. The timeschedule of the project was then compiled, reviewed and approved based on the aforementioned review structure. This is shown below.



7. Then, a quick scan of the energy literature was performed; the aim was for the Mindframe to become familiar with observed heating behaviours at home. It became immediately obvious that very few energy articles provided hints on the answers to the priority questions.

8. In the sequel, a quick scan of the psychological literature was performed to understand the size of the relevant literature and the relevance of its research themes to the questions at hand.

9. Then, a more thorough search of the literature was conducted to answer each of the priority questions in a peace-meal approach. Articles were screened according to the following criteria:

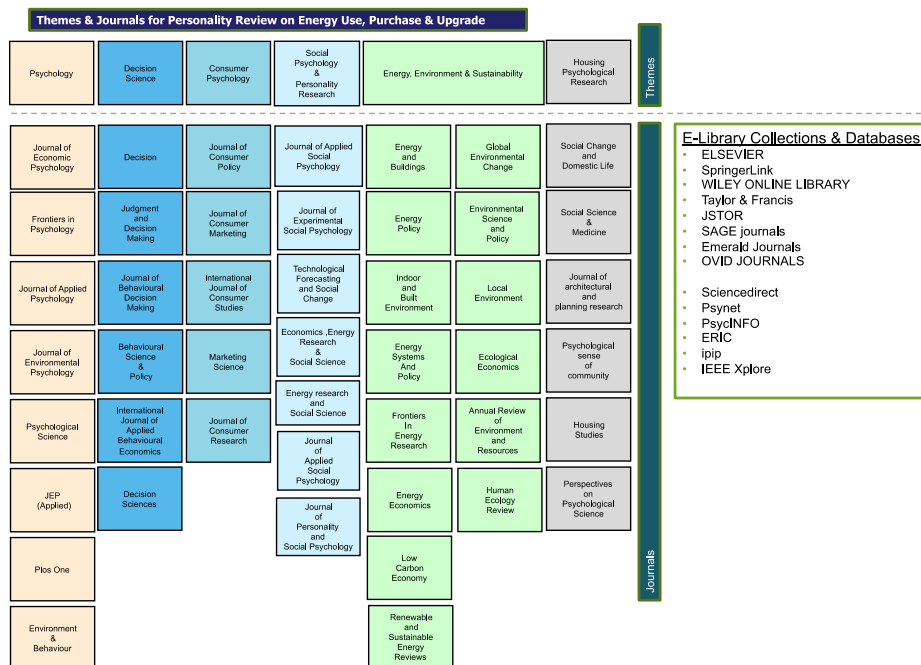
- Relevance to the questions identified

- Credibility of the source (measured by the impact factor of the journal) - Less-known or less-credible sources were excluded (see figure below which gives an overview of the themes and examples of credible journals taken into account in each subtheme as well as UCL databases used)

10. Credibility was further judged by:

- The journal's prestige, circulation, field of the publication
- The peer review process used (no peer review, single-blind, double-blind, open peer review)
- Accuracy of content
- Coherence with what is already known in psychology
- The use of existing literature and systematic reviews wherever possible.

Literature Review Themes, Journals & Databases



Next step was to gather, read and analyse the literature. This included the following steps:

11. First read of the articles (summary or abstract)
12. Initial classification and grouping of articles by type of source
13. Title, author, purpose, methodology, findings, outcomes quality classification
14. Second read of articles that were not screened out
15. For quality purposes attention was paid to the following questions regarding the article' characteristics:
 - Is the article thorough?
 - Is it current?
 - Is it citing primary sources?
 - Does it use appropriate language?
 - Is it objective?
 - Is it organized and clear?

Next step was the write up of the review. This was accomplished through the following steps:

16. Work out a detailed structure.
17. For each subtopic the following structure was used:
 - a. Identification of any evidence from the decision making under uncertainty literature which point to general proclivities associated to the question at hand
 - b. Identification of personality questionnaires & Evidence: This contained information about a personality questionnaire and evidence from energy or other domains on the effects of this scale and corresponding clustering of the population
 - c. Hypothesis developed (based on evidence): development of a hypothesis, unless evidence pointed directly to what we asked
 - d. Example items of the scale for the reader to get a sense of the scale items

- e. Reliability & Potential application: How reliable the scale and evidence is and how the ETI can use it.

18. Make an outline

19. Cluster and compare

20. The following criteria for writing were taken into account:

- Use short sentences
- Use accurate spelling and grammar
- Avoid long and confusing words jargon

Finally, here we should provide the reader with some methodological elements related to personality research:

- The term “Scale”: here, we refer to personality questionnaires that were developed to study one construct (for example, impulsivity scales refer to the questionnaires developed to measure the extent of a person’s impulsiveness). The term “Scale” is used among academics of this field.
- Criteria for the selection of Scales:
 - o Psychometrically sound instruments suitable for application in large-scale surveys and experiments
 - o Selection of the most reliable and wide-spread scales
 - o Selection based on:
 - The absence of serious opposition/arguments in the use of these scales based on checks of academic response’ articles.
 - The number of citations of each scale
 - The impact factor of the journals in which these scales appear
 - The impact factor of their citations
 - The academic experience of the researcher

- Selection of scales was made to ensure:
 - o The greatest reliability & predictive validity (based Cronbach's alpha coefficients)
 - o Internal consistency of the scale and the degree to which it succeeds to characterise individuals in a reliable way

We should mention here though that in terms of application of these scales in commercial or other settings, there is a degree of context sensitivity in the sense that some scale items might be more predictive in one domain (e.g. mobile phones) than another domain. The only way to find out what's the more predictive item in a scale for a specific domain and specific question is to run a survey, a field experiment or an online experiment where a dependent variable or a choice made between alternatives (for example tariff choice) is correlated with each of the scale items. This is the way personality research is conducted nowadays in all industry domains: researchers use available psychometric scales and design a survey specific for the domain of interest. Except from predictive and correlational results, more complex models can be developed to control for other variables (such as income, age, dwelling type etc). This way, the researcher can reveal the item's real predictive potential in applied settings.

In the final section of this chapter, we discuss some inherent challenges of the current project, which are mainly related to the fact that energy related issues are understudied in personality and decision-making under uncertainty literatures despite their immediate relation to those. Specifically, there was:

- Scarcity of articles on heating daily use psychology and individual differences (i.e. personality)
- Scarcity of articles on heating purchase psychology and personality
- A large amount of papers on energy use & conservation, which made search more difficult (these articles were mainly explaining proenvironmental behaviours rather

than generally psychological constructs and their relation to personality questionnaires – the ETI advised that these papers should not be taken into account in the current review)

- A vast amount of articles in personality research

These challenges were especially crucial because of the restricted time available for the project.

3. General Overview – Individual Differences

This chapter provides an overview of the basic information around individual differences in the form of questions and answers:

What is a personality trait?

The term “traits” or dispositions refers to habitual patterns of behaviour, thought, and emotions, which are relatively stable over time, differ across individuals and influence behaviour. Each trait usually consists of facets, which are unique aspects of a broader personality trait. A stable, organized collection of psychological traits that influence ones interactions with the psychological, social and physical environment is represented by personality.

What we mean when we refer to individual differences?

“Individual differences” is a broader term, covering any variable that differs between people, from decision style to cognitive ability to personality. In this report we will be examining all sorts of individual differences.

How do you measure individual differences?

Individual differences (IDs) can be determined through a variety of tests or questionnaires. Each questionnaire (or “Scale”) contains items (i.e. “Questions”). Some scale’ items might be reverse coded, pointing to the opposite of the trait at hand (e.g a reversed coded question for

extraversion points to introversion). To measure IDs, psychologists rely on self-report or observer report questionnaires. Other psychologists and many economists measure conventional economic preference parameters, such as time preference and risk aversion. Self-report questionnaires or scales are developed through rigorous research using factor analytic techniques. The concept of factors is central to psychology of individual differences and recent empirical work at the intersection of economics and psychology. This technique requires test items (i.e. questions) for a construct that are highly correlated to form a cluster. If items are highly correlated within a cluster but weakly correlated with items across other clusters, the set of tests are said to have both “convergent and discriminant validity” (“convergent” refers to the intercorrelations within a cluster and the “discriminant” refers to lack of correlation across clusters).

What is the Five Factor Model?

The five-factor model (FFM) by Costa & McCrae (1992) is the dominant approach for representing the human trait structure today. The model asserts that five basic factors describe most personality traits: extraversion, openness to experience, conscientiousness, agreeableness and neuroticism. Here are some brief descriptions of these traits:

- *Extraversion* is characterized by breadth of activities and energy creation from external means. The trait is marked by pronounced engagement with the external world. Those who score high in this trait (e.g. Extraverts) enjoy interacting with people, and are often perceived as full of energy. They tend to be enthusiastic and action-oriented individuals. Introverts on the other hand have lower social engagement and energy levels than extraverts. They tend to seem quiet, low-key, and less involved in the social world. Introverts need less stimulation than extraverts and more time alone.

- *Openness* is a general appreciation for art, emotion, adventure, unusual ideas, imagination, curiosity, and variety of experience. People who are open to experience are intellectually curious, open to emotion, sensitive to beauty and willing to try new things. People with low scores on openness tend to have more conventional, traditional interests. They prefer the plain, straightforward, and obvious over the complex, ambiguous, and subtle. They may regard the arts and sciences with suspicion or view these endeavours as uninteresting. Closed people prefer familiarity over novelty; they are conservative and resistant to change.

- *Conscientiousness* is a tendency to show self-discipline, act dutifully, and aim for achievement against measures or outside expectations. It is related to the way in which people control, regulate, and direct their impulses. High scores on conscientiousness indicate a preference for planned rather than spontaneous behaviour. People who score low on conscientiousness tend to be laid back and less goal-oriented.

- *Agreeableness* reflects individual differences in general concern for social harmony. Agreeable individuals value getting along with others. They are generally considerate, kind, generous, trusting and trustworthy, helpful, and willing to compromise their interests with others. Disagreeable individuals place self-interest above getting along with others. They are generally unconcerned with others' well-being, and are less likely to extend themselves for other people. Sometimes their skepticism about others' motives causes them to be suspicious, unfriendly, and uncooperative.

- *Neuroticism* is the tendency to experience negative emotions, such as anger, anxiety, or depression. It is sometimes called emotional instability, or is reversed and referred to as emotional stability. According to Eysenck's (1967) theory of personality, neuroticism is interlinked with low tolerance for stress. Those who score high in neuroticism are emotionally reactive and vulnerable to stress. They are more likely to interpret ordinary situations as threatening, and minor frustrations as hopelessly difficult.

Researchers have used the model to predict individual differences in numerous settings: clinical (reviewed in Costa, 1991), industrial and organizational (e.g. Barrick & Mount, 1991, 1996), counseling (McCrae & Costa, 1991), and more.

How we define the values of an individual?

Schwartz (1992) defines a value as “a desirable trans-situational goal varying in importance, which serves as a guiding principle in life”. Based on several decades of psychology research Schwartz (1992) proposed 10 basic motivational values that incorporate virtually all-specific values from different cultures around the world. The ten values are derived from universal requirements for humans as biological organisms and as social interactive individuals as part of social groups striving for survival and welfare. These are:

- Achievement
- Benevolence
- Conformity
- Hedonism
- Power
- Security
- Self-direction

- Stimulation
- Tradition
- Universalism

The Schwartz value inventory (Schwartz, 1992) is very often used to study the link between values and consumer behaviour. There are additional value questionnaires, which will be described later in this report in relevant sections.

Are there differences between personality traits and values?

The relative stability of both values and traits across context and time makes them useful psychological constructs. However, there are differences between the two. Traits are dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings and actions. Hence, traits are enduring dispositions. In contrast, values are enduring goals. Traits describe, “what people are like”, rather than the intentions behind their behaviour. Values refer to what people consider important, the goals they wish to pursue. Traits vary in the frequency and intensity of their occurrence, whereas values vary in their importance as guiding principles.

How wide is the use of individual differences in practice?

Individual differences continue to be widely used as explanatory variables, in everything from risk aversion in economics (Weber, 2002) to animal personality in biology (e.g., Herborn et al., 2010). Popular measure’ categories are: decision-making measures, risk attitude measures, cognitive ability measures, motivation measures and personality inventories.

4. General Overview – Decision-making under uncertainty

This chapter provides an overview of the basic information around decision-making under uncertainty in the form of questions and answers:

Why do people struggle to make decisions under uncertainty?

Collecting and processing the information necessary for complex decision-making is costly for humans (i.e. informational costs). Fully defining future states of the world, and probability-weighting them, is beyond anyone's cognitive limits even for relatively simple games, such as chess. In fact, chess grandmasters were found to be unable to evaluate fully more than 5 chess moves ahead and the largest super-computers cannot fully compute much beyond 10 moves ahead (Gigerenzer & Todd, 1999).

Most real-world decision-making is far more complex than chess. Herbert Simon coined the terms "bounded rationality" and "satisficing"¹ in 1956 to explain cost-induced deviations from rational decision-making (see for example Simon, 2000 for an overview).

What sorts of things do they do when they have to make these decisions?

To tackle the aforementioned problems, humans use heuristics; heuristics are simple, efficient rules, learned or hard-coded by evolutionary processes, to make decisions, come to judgments, and solve problems typically when facing complex problems or incomplete

¹ Satisficing denotes the situation where people seek solutions or accept choices or judgments that are "good enough" for their purposes, but could be optimized

information. Use of heuristics can often lead to biases but in other cases it can lead to accurate judgments (see for example Gilovich et al., 2002).

What is System 1 and System 2 thinking?

System 1 versus System 2 thinking is a dichotomy between two modes of thought coined by Daniel Kahneman (2011). The Nobel Laureate defined "System 1" as a fast, instinctive and emotional thinking mode (e.g. heuristical thinking) and "System 2" as a slower, more deliberative, and more rational thinking mode. System 1 handles our automatic, rapid and intuitive mental activity while System 2 handles challenging and effortful mental activities. In our daily lives, System 1 is generally the “go to” for much of our decision-making efforts. Each of the two systems leads humans to different cognitive biases.

What is loss and risk aversion?

When faced with making an uncertain decision, people perceive the disutility of losing something as far greater than the utility of gaining something (i.e., they expect they will feel the pain of losses far more than the pleasure of gains) (Kahneman & Tversky, 1984). Loss aversion leads to risk aversion when people evaluate an outcome comprising similar gains and losses since people prefer avoiding losses to making gains.

5. Introduction

Chapters' Overview

The scope of this report is to examine understudied areas of energy-related topics of personality and decision-making psychology in order to suggest strategies of understanding better the consumer in view of the upcoming changes in the energy sector towards a decarbonised future. Mindframe specifically examines the energy consumer psychology in topics concerning energy use, energy purchase and upgrades. In order to obtain generalisable insights, the aforementioned processes are investigated in a holistic way using research from various scientific fields and sources in the report.

Specifically, in the second chapter, Mindframe presents the basic methodological steps of this literature review outlining at the same time screening criteria for optimal and reliable outcomes as well as the set of sources and journal themes and subthemes available via UCL libraries and databases.

In Chapters 3 and 4, we present an overview of research principles and basic findings on individual differences and decision-making under uncertainty research, which are the two main areas of psychological literature that are directly associated with consumer decisions in energy settings. More specifically, in Chapter 3, we explain how personality is structured and measured. We also define basic personality terms that will be used throughout the report. We also provide a description of the Five Factor model of personality as well as Schwartz's Value Inventory, which are dominant in individual differences' research. Chapter 4 is devoted to decision-making under uncertainty. We explain why people struggle with decisions under uncertainty and what sorts of things they do when are faced with these decisions. System 1 and System 2 thinking modes as well as loss/risk aversion are also explained on the basis of research by the Nobel Laureate, Daniel Kahneman. In Chapter 5, we briefly touch upon the

issue of applicability and how the ETI will make use of the information of the core chapters via surveys, experiments and qualitative research.

Psychological factors of personality and decision-making related to daily energy use are investigated in Chapter 6, where we analyse consumers' motivations to spend for heating versus motivations to limit energy use as well as their competence and willingness in doing so. In the sequel, in Chapter 7 we present mainly research on tariff choice, which might affect purchase decisions in future energy systems settings and we explain the main biases and their underlying cause in tariff-choice settings. Energy upgrade is explored in Chapter 8 where we outline psychological reasons that may lead consumers not to upgrade their systems as well as ideas of why some consumers may choose to upgrade their systems. The final section of this chapter is devoted to insurance choices and risk attitudes.

Applicability - How will the ETI use this report?

The information outlined in this report aims to describe different modes of thinking and deciding as well as different characteristics of individuals, who purchase energy, use energy in their daily schedule and upgrade their energy systems. Each of these thinking modes and characteristics point to different underlying motivations of each individual using, purchasing and upgrading energy. Their aim is to help the ETI understand different individuals in more depth because dwelling characteristics and other variables (such as demographics) cannot explain energy-related behaviours on their own (ETI, 2015). Beyond a better understanding of individuals, here, the aim is to provide to the ETI all available and relevant tools should the ETI wish to run subsequent surveys, online experiments, discussions or focus groups with the end-user. This material could also inform the design of future energy tariffs and upgrade/maintenance offers in an optimal manner.

6. Daily Use of Energy

Background

Introduction

In the next sections we will look at space and water heating daily use from different angles that are meant to shed light on different individuals' personalities and decisions under uncertainty tendencies with respect to space and water heating daily use. We'll start off with a section discussing heating as a human basic need and how individuals might differ (depending on their personalities) in their ability to thermoregulate. The next section will be devoted to motivations of people to consume energy for space and water heating. This will include personal motivations such as comfort and social motivations such as caring for others at home. Then, we will discuss how financial costs associated with heating daily use affect individuals: how income as well as personality may motivate people to limit energy use and which individuals are more sensitive to financial costs associated with heating use. After analyzing, people's personality and motivations to consume or limit energy use, we will discuss their competence and willingness in doing so (e.g. in terms of planning). Some individuals might be more competent and willing when it comes to planning decisions while others are likely to react to what they find (independent of their initial tendencies towards energy use).

Heating as a human basic need

Thermal comfort is universally important to humans, as is food. Specifically, thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is determined by many environmental factors such as clothing insulation, air temperature, air speed, relative humidity and a multitude of dwelling characteristics (e.g. Sawashima & Matsubara, 2007). These are some of the external factors that affect one's ability to thermoregulate.

Characteristics of each individual also affect thermal comfort. Cold tolerance is increased by large body size, abundant subcutaneous fat, good physical fitness, gender, age and good health (e.g. Fiala et al, 2011). The ETI has already studied the issue of thermoregulation, hence, we will focus on personality research related to one's ability to thermoregulate.

Five Factor Model Scale & Evidence Recently, it has been shown that it is also *personality* that affects thermal responses, especially the levels of an individual's Extroversion and Neuroticism (i.e. from the the well-known Five Factor Model (discussed in the introduction) - also known as "Big Five" trait inventory or the NEO Personality Inventory² by Costa & McCrae (1992), a stable measure of individuals' traits (Soldz & Vaillant, 1999). Findings suggest that plasma levels of cortisol of an individual were positively correlated with extraversion and negatively correlated with neuroticism (LeBlanc & Ducharme, 2005). Cortisol levels are in turn related to blood circulation and autonomic thermoregulatory responses (increased levels of cortisol impair blood circulation and the ability to thermoregulate in low temperature environments).

Although a variety of personality scales exist, in this line of research, the five-factor model (FFM) is the dominant approach for the moment because it is widely accepted for

² The Revised NEO Personality Inventory (Costa and McCrae, 1992) is a 240-item questionnaire developed to measure the five major factors, or domains, of personality: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C).

representing the human trait structure. Researchers have used this model to predict individual differences in numerous settings mentioned in the general overview section.

Example items The specific paper, which is of interest here, relates thermoregulatory responses to Extraversion and Neuroticism traits.

Extraversion refers to the degree to which a person needs attention and social interaction and it is measured through items such as:

- *I see myself as extraverted, enthusiastic*

- *I see myself as reserved, quiet (R)*³

Those who score low on Extraversion can be briefly described as quiet, reserved and shy individuals while those who score high on this factor are usually talkative, assertive and active.

On the other hand Neuroticism (which is negatively correlated to Conscientiousness (e.g. - 0.27 in Gosling et al, 2003) refers to the degree to which a person experiences the world as threatening and beyond his/her control and is measured through items such as:

- *I see myself as anxious, easily upset*

- *I see myself as calm, emotionally stable (R)*

Those who score low on Neuroticism can be briefly described as stable, calm and contented individuals while those who score high on this factor are usually tense, anxious and nervous.

Reliability & Potential Application The aforementioned studies belong to a relatively new line of personality research where researchers make an effort to associate various aspects of

³ (R) refers to scale items that are reverse coded.

health status with the five-factor model of personality (or Big-Five/NEO PI) so, the aforementioned conclusions must be treated with caution as these are still early days in directly relating personality with health status and body responses. However, this is considered a very important line of personality research nowadays and would expect it to provide more evidence in the years to come.

On the other hand, the Five Factor Model of personality is widely accepted and tested in a variety of settings. So, if one wanted to test if there was a relationship between these basic personality traits with individuals' energy use, that would have been an easy task through the short version of the Big-Five questionnaire (the well-known Ten-Item Personality Inventory (TIPI) by Gosling et al, 2003), where individuals indicate the extent to which they agree or disagree with 10 statements (two for each of the five factors) in a 7 points Likert scale. This usually takes the respondent around 2 mins to answer. The exact form of the TIPI test is as follows⁴:

“Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.”

⁴ In this questionnaire, Neuroticism is reverse coded and named Emotional Stability

Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
1	2	3	4	5	6	7

I see myself as:

1. _____ Extraverted, enthusiastic.
2. _____ Critical, quarrelsome.
3. _____ Dependable, self-disciplined.
4. _____ Anxious, easily upset.
5. _____ Open to new experiences, complex.
6. _____ Reserved, quiet.
7. _____ Sympathetic, warm.
8. _____ Disorganized, careless.
9. _____ Calm, emotionally stable.
10. _____ Conventional, uncreative.

TIPI scale scoring ("R" denotes reverse-scored items): Extraversion: 1, 6R; Agreeableness: 2R, 7; Conscientiousness; 3, 8R; Emotional Stability: 4R, 9; Openness to Experiences: 5, 10R.

In a survey setting, TIPI responses could be used either in conjunction with a dependant variable of interest to reveal the extent to which of these personality characteristics affect individuals' motivations to use here or within a factor analytic model able to form the clusters of individuals with different motivations.

Beyond the basic human need

In essence, apart from the environmental, physiological and psychological responses to cold, humans are nowadays deciding to control for heat levels at home on the basis of other variables as well, such as, for example, money expenditures associated with energy daily use, the time & effort spent to control heating and so on. These additional elements, which also shape the nature of daily behaviour towards control of heat at home, will be discussed in subsequent sections based on research on individual differences as well as ETI's heat needs illustrative tool.

According to ETI research, heating control vary in the following dimensions:

- Considerations around satisfying own or others' needs

The majority of the population lives with others (75%). Some individuals choose to focus on others' needs, especially when there are elders or toddlers in the family. But singles report caring for others as well (e.g. guests, pets). However, there are individuals who prefer to be more focussed on their own needs.

- Considerations around money or time/effort dimension

Users have different preferences in terms of the time, the effort and the money invested in heating. Here are some examples provided by the ETI: some adjust their thermostats in an effort to spend as little time/effort as possible, others prefer not to touch their controls. Others try to save money by minimising how much energy they use (waste, not cost) while others will go cold to save money. On the other hand, there are other individuals who consider heat as a top priority independently of their income (e.g. they would prefer to sacrifice other needs for adequate heating at home).

In this report we will consider how personality relates to the aforementioned dimensions. We will break down dimensions for clarity (e.g. money considerations, time and effort considerations and so on).

Individual differences in daily energy use

Mindframe and the ETI have come up with a set of priority questions during the course of the project. These are analysed in subsequent sections. There are lots of additional questions that might be of interest with regards to daily use of energy. These are outlined in the final section of the report for ETI's consideration in the future.

6.2.1. Motivations to spend for heating versus motivations to limit energy use

This section will be divided in subsections of end user profiling approaches and more specifically, those focused on the following two broad dimensions:

- *Motivation to spend for heating*
- *Motivations to limit energy use*

Motivations to spend for heating

People might have several motivations to spend part of their income for space and water heating; feeling comfortable at home, satisfying personal cleanliness and hygiene needs, taking care of elder or younger members of the family, being sociable and inviting friends at home, following social norms by taking into account how others make use of their heating systems on a daily basis, are just some of these motivations.

In this first section of motivations to consume for space and water heating we will analyse gradually how personality and behavioural economics research inform us about different individuals' motivations to consume space and water heating.

Comfort as a personal value

Value Scales & Evidence In this section we will focus on individuals' values. Which individuals value heating as a central part of their quality of life and are, thus, motivated to sacrifice other needs in order to have proper and uninterrupted heating at home⁵? For these individuals who highly value the comfort provided by space and water heating, any decrease in this personal comfort, or, in other words, perceived threat to lifestyle' quality, is important. In fact, research shows that the combined effect of comfort and health priorities is a significant predictor, accounting for 30% of the variability in a household's actual energy consumption (e.g. Seligman et al., 1978). Results of this line of research reveal that the more a household perceives energy-saving behaviour as leading to discomfort and ill-health, the more energy that particular household consumes.

In essence, consumers' choices are directed by the relative importance of their values⁶. Personal values provide a powerful explanation of human behaviour and often serve as

⁵ In their mind, spending in heating is viewed as a gain

⁶ It is worth repeating here that values are relatively stable personality constructs over an individual's lifetime.

standards or criteria of conduct (Rokeach, 1973). It is shown by extensive research that individuals differ in their values and they usually behave in ways consistent with their values (Rokeach, 1973; Schwartz, 1992; Rokeach, 1979)⁷. Resulting behaviours, which stem from underlying values, are usually grouped in consumer lifestyles in consumer psychology settings (e.g. Vyncke, 2002). Comfort, social relations, money, health, pleasure, status and freedom are some of the values in which individuals may differ (see also Schwartz, 1992; Diener and Suh, 1997). In practice, individuals' values have been used to explain a wide variety of motivations, attitudes and behaviours. Some researchers go a step further and connect these goals with well-being, happiness and quality of life.

One example of how values theory (Rokeach, 1973; Schwartz, 1992) has been applied to get a better insight in the consumption of organic food is provided below. Researchers used Schwartz's value items to study people's motivations to consume organic food. Here are some interesting findings for some of the value items of the questionnaire and how these relate to organic food consumption:

1. Security. Safety, harmony, and stability of society, of relationships, and of oneself.

Several studies of this specific field concluded that health, which is linked with the value of security, is the strongest motive for purchasing organic food (e.g. Botonaki et al., 2006). Also other researchers have found a significant relation between consumer's health-related attitudes and their purchases of organic food (the same might apply for heating).

2. Hedonism. Pleasure and sensuous gratification for oneself.

⁷ For example, valuing conformity fosters compliant rather than unconventional behaviour.

Magnusson et al. (2001) found that good taste is the most important purchase criterion among Swedish consumers (same might apply for heating but instead of good taste, it might be thermal comfort underlying this value).

3. Conformity. Restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms.

This value influences “subjective norms” via the motivation to comply with others’ expectations. Chen (2007) and others find a significant positive relation between consumers’ consumption of organic food and their subjective norm (the same might apply for heating).

Also, self-enhancement values have been found to drive one's attention to *personal* costs and benefits in the area of environmental friendly attitudes and energy use (Steg et al, 2014). Self-enhancement values in this study encompassed egoistic values, focusing on safe-guarding and promoting one's personal resources, such as wealth and status.

Hypothesis In a similar way, value theory might reveal interesting findings for daily energy use motivations. Since values vary in their importance as guiding principles in people’s lives, it is logical to think that individuals with different values and, thus, priorities in life would have different motivations towards heating daily use.

Example items One example of the most widespread value hierarchy questionnaire would be the following (adopted by Rokeach, 1973)⁸:

A Comfortable Life a prosperous life (T)	Social Recognition respect and admiration (T)
Equality brotherhood and equal opportunity for all (T)	True Friendship close companionship (T)
An Exciting Life a stimulating, active life (T)	Wisdom a mature understanding of life (T)
Family Security taking care of loved ones (T)	A World at Peace a world free of war and conflict (T)
Freedom independence and free choice (T)	A World of Beauty beauty of nature and the arts (T)
Health physical and mental well- being (T)	Pleasure an enjoyable, leisurely life (T)
Inner Harmony freedom from inner conflict (T)	Salvation saved; eternal life (T)
Mature Love sexual and spiritual intimacy (T)	Self-Respect self-esteem (T)
National Security protection from attack (T)	A Sense of Accomplishment a lasting contribution (T)

Ambitious hardworking and aspiring (I)	Independent self-reliant; self-sufficient (I)
Broad-minded open-minded (I)	Intellectual intelligent and reflective (I)
Capable competent, effective (I)	Logical consistent; rational (I)
Clean neat and tidy (I)	Loving affectionate and tender (I)
Courageous standing up for your beliefs (I)	Loyal faithful to friends or the group (I)
Forgiving willing to pardon others (I)	Obedient dutiful; respectful (I)
Helpful working for the welfare of others (I)	Polite courteous and well- mannered (I)
Honest sincere and truthful (I)	Responsible dependable and reliable (I)
Imaginative daring and creative (I)	Self-controlled restrained; self-disciplined (I)

With guidelines such as the following ones: “*In this part of the questionnaire your task is to rate how important each value is for you as a guiding principle in your life. Use the rating scale below.*”

- -1 – *Opposed to my values*
- 0 – *Not important*
- 1 – *Important*
- 2 – *Very important*
- 3 – *Of supreme importance*

Reliability & Potential Application Rokeach scales are now cited in 14.000 papers⁹, while, Schwartz scales are now cited in 9.000 articles. Actual surveys, ask consumers who are

⁸ Schwartz’s values can also be used

presented with a list of these values to rank or rate them. Each individual's scores are then either correlated with the dependent variable, which is the variable of interest or target variable in each survey or with other independent variables to form clusters (or segments) of consumer profiles (i.e. an individual who prioritizes social endeavours might also be prone to follow social norms or, conversely, an individual who prioritizes wealth might be less affected by social norms but more affected by the cost associated with energy consumption). We should mention here that most of the times, researchers tailor the list according to the survey's needs (e.g. shorten the list in the case of Rokeach values). Mindframe would suggest the following values from the Rokeach questionnaire to be included in an energy use setting: Comfortable life, Social Recognition, Family Security, Freedom, Health, Pleasure, Capable, Clean, Helpful, Independent, Logical, Obedient.

Hygiene considerations

Foa's Scale & Evidence There might be other cases, apart from the ones mentioned above, where an individual would be motivated to spend more on water heating, as identified by the ETI. These individuals might place superior value to personal hygiene factors such as cleanliness (e.g. having frequent hot showers). There is a scale by Foa et. al (1998), which might help identify these individuals but no article linking this to motivations to spend for daily energy use.

Example items It comprises items such as: "*I like to tidy up*" or reverse coded ones such as "*I am not bothered by messy people*".

⁹ There is no single review paper, due to the volume of the Rokeach values citations, but rather separate review papers in each scientific field. See for example Gillis (1993) paper on determinants of health promoting lifestyles.

Comfort for others

Apart from each individual's personal motivations in relation to heating use, we should consider in this section how individuals might be influenced by others when using energy. In our view this can be done via three distinct pathways:

- Individuals who are influenced by social norms are likely to adjust their energy usage towards what they think others do or towards what they think would be approved by others - [**Social Norms** subchapter – see below]
- Highly empathetic individuals might be motivated to use energy to show care for others at home (possibly elders or toddlers or guests) - [**Empathy** subchapter – see below]
- Highly sociable individuals who enjoy inviting people at home are likely to use energy due to their social activities - [**Sociability** subchapter – see below]

In fact, the ETI has identified two groups who say they consider other people an important factor in how they use heat; individuals of the first group mention they use heat in the way they'd expect others to use it (i.e. they are affected by social norms) while individuals of the second group do whatever they can to make children/guests/unwell feel comfortable, even if this costs a lot.

Social Norms

Social Norms & Evidence Subjective norms refer to individual perceptions of the extent to which important others would endorse a given behaviour and individual motivations to comply with this social pressure. For instance, householders who think family members or neighbours/visitors will disapprove of them lowering thermostat settings, and who take their opinions regarding this matter on board, will be less likely to lower thermostat settings. On

the other hand, individuals whose social environment leans towards energy conservation strategies, are likely to lower their thermostats in line with their social environment's behaviour (e.g. Schultz et al., 2007). Schultz et al. (2007) studied 290 households in San Marcos, CA, with visible energy meters in a field experiment. All households received feedback about how much energy they had consumed in previous weeks in comparison with the average consumption of other households in their neighbourhood. Researchers then measured subsequent actual household energy consumption and they observed that households that consumed more than average during the baseline period, significantly decreased their energy consumption after receiving the normative message which compared their consumption with their neighbours' consumption.

Social norms can guide action in direct and meaningful ways (Cialdini et al., 1991) in a variety of settings. For example, shaping recycling behaviour (Vining & Ebreo, 1990) or in the context of food consumption (Vermeir and Verbeke, 2006). Not all individuals are influenced by social norms to the same extent (there is no paper assessing individual differences regarding the extent to which an individual will explicitly follow social norms but there is relevant research which for example reveals that empathetic, pro-social females are more likely to feel guilt and shame e.g. Tangney (1990)). It is also social desirability (e.g. Stober, 2001), which captures this notion by examining the extent to which an individual follows recommended social behaviours. Examples are provided in the Example section below.

Hypothesis Except for the energy conservation paper discussed above, there are no other papers linking directly social norms with heating's daily use. However, following this paper's results, it would be logical to hypothesize that social norms, influence daily heating use to a certain extent, even in the absence of normative messages as in the field experiment above.

Example items, Reliability & Potential Application Usually, the influence of subjective norms for different individuals is tested in surveys via customised questions such as those for example used in Botetzagias et al. (2014) survey:

- *Most of my acquaintances expect from me that I save electricity in my home*
- *Most people who are important to me think that I ['1: should not' to '7: should'] make an effort to save electricity*

These questions are structured so that it is clear how an individual's social environment expects a person to react.

Social norms' effect on a variety of variables has been studied extensively with more than 10.000 articles referring to their effects in different settings. Actual surveys, ask consumers who are presented with statements as the above mentioned ones to provide ratings in a 5 or 7 point likert scales (Agree/Disagree). Each individual's scores are then correlated with the dependent variable to determine the size of the effect.

Also, examples of the Social Desirability Scale by Stober (2001) are found below:

- *I sometimes litter (R)*
- *I always admit my mistakes openly and face the potential negative consequences*
- *In traffic I am always polite and considerate of others*
- *I have tried illegal drugs (for example, marijuana, cocaine, etc) (R)*
- *I always accept others' opinions, even when they don't agree with my own*
- *I take out my bad moods on others now and then (R)*
- *There has been an occasion when I took advantage of someone else (R)*
- *In conversations I always listen attentively and let others finish their sentences*
- *I never hesitate to help someone in case of emergency*
- *When I have made a promise, I keep it--no ifs, ands or buts*
- *I occasionally speak badly of others behind their back (R)*

- *I would never live off other people*
- *I always stay friendly and courteous with other people, even when I am stressed out*
- *During arguments I always stay objective and matter-of-fact*
- *There has been at least one occasion when I failed to return an item I borrowed (R)*
- *I always eat a healthy diet*
- *Sometimes I only help because I expect something in return (R)*

Recommended instructions (for the above items) is as follows: *Below you will find a list of statements. Please read each statement carefully and decide if that statement describes you or not. If it describes you, check the word "true"; if not, check the word "false"*

Empathy

Empathy Scales & Evidence Empathy is another element of the social environment that might influence people in their daily energy use. Psychological research has identified individuals that reflect concern for others via the concept of empathy, which is, in essence, the interpersonal process whereby one responds to emotions similar to those of others who are present¹⁰. Here are the most characteristic features of a highly empathetic man; he is someone who is socially perceptive of a wide range of interpersonal cues, who seems to be aware of the impression he makes on others and has insight into own motives and behaviour. Furthermore, it is a person who would evaluate the motivation of others in interpreting situations. On the other hand, a less empathetic person does not vary roles and relates to everyone in the same way. He judges self and others in conventional terms like ‘popularity’, ‘the correct thing to do’ and tends to transfer or project blame.

¹⁰ Another definition stemming from the role-taking tradition, defines empathy as the intellectual or imaginative apprehension of another's condition or state of mind.

High-empathy, compared to low-empathy individuals, are found to engage more in altruistic behaviours, are less aggressive, more affiliative and volunteer more to help others (Mehrabian et al, 1988). In other words, empathy is found to be a major determinant of pro-social and altruistic responding (e.g. Rushton, 1981). Higher levels of empathy and connectedness with others are also shown to be related to others' pain perception (i.e. the degree to which another person is in pain, see for example Loggia et al., 2008), which might be a crucial factor for daily energy use in the case where elders are present at home and might experience pain, suffer from lower temperatures.

Hypothesis There are no papers linking directly empathy with heating' daily use but since individuals vary in their levels of empathy and act accordingly in other domains (as shown above), it is logical to hypothesize that those higher on empathy would react differently in daily heating use when others who are in need (e.g. elderly) are present at home.

Example items A variety of scales can measure individuals' levels of empathy like for example, California's Institute of Personality Assessment and Research (IPAR) with items such as:

- *As a rule I have little difficulty in "putting myself into other people's shoes*
- *I have seen some things so sad that I almost felt like crying*

Or Davis (1980, 1983) Interpersonal Reactivity Index which measures the tendency to adopt the psychological point of view of others. Some examples are shown below:

- *I often have concerned feelings for people less fortunate than me*
- *Sometimes I don't feel very sorry for other people when they are having problems. (R)*

Or Reizer's (2007) MRC scale with items, which reflect one's perceived ability to recognize others' needs, such as the following ones:

- *I sometimes miss the subtle signs that show me how the other person is feeling (R)*
- *Sometimes, I don't notice when I've been asked for help (R)*

Reliability & Potential Application Measures of empathy have been used from the 1950s in psychological research and are established ways to understand individuals in terms of their concern for others. For example Davis' scale mentioned above is cited in 4087 articles and, thus, used extensively to study the concept of empathy in a variety of settings. Actual surveys, ask consumers who are presented with statements as the above mentioned ones to provide ratings in a 5 or 7-point likert scales (Agree/Disagree). Each individual's scores are then either correlated with the dependent variable, which is the variable of interest or target variable in each survey or with other independent variables to form clusters (or segments) of consumer profiles.

Sociability

Sociability Scale & Evidence Sociability is another factor that might influence daily energy use as a consequence of interactions with others. It might be that those who value more social relations, are more likely to view their home as a place for social interactions (e.g. social events – e.g. visitors coming frequently to the house). In fact, as mentioned before, the ETI has identified a cluster of people who state that they would do whatever they can to make guests feel comfortable, even if this costs a lot. Here, we should mention that sociability can be measured via value questionnaires but also via other personality questionnaires such as¹¹ Goldberg's (1999) AB5C Scale and specifically, its sociability subscale, or in other words the

¹¹ There is a number of other scales that measure Sociability such as Hogan Personality Inventory (Hogan, 1992) but AB5C has been selected here as more appropriate for ETI' purposes.

degree to which a person seems to need and/or enjoy interacting with others. Evidence from the field of food consumption suggests that those scoring high in Sociability tend to consume more meat fats, consume alcohol and smoke tobacco as a result of their outgoingness (Goldberg & Strycker, 2002).

Hypothesis There are no papers linking sociability and energy use but it is logical to hypothesize that those higher in sociability (or Extraversion, which is highly correlated with Sociability) would tend to have more guests at home than others who score low on sociability.

Example items The aforementioned scale contains items such as the following ones:

- *I can't do without the company of others*
- *I like to be alone (R)*
- *I enjoy silence (R)*
- *I dislike neighbors living too close (R)*

Reliability & Potential Application Measures of sociability and extraversion have been widely used in psychological research and are established ways of understanding individuals. Actual surveys, ask consumers who are presented with statements as the above mentioned ones to provide ratings in a 5 or 7-point likert scales (Agree/Disagree). Each individual's scores are then either correlated with the dependent variable or with other independent variables to form clusters (or segments) of consumer profiles.

Limiting energy use as a necessity (to satisfy other basic needs)

In the above section we discussed motivations of people to spend for energy use. Here, we will discuss motivations to limit energy use. Interestingly, the effect of income is found to be dominant in energy use. Newman and Day (1975) first documented the type and amount of energy used for home and water heating. They compared the energy consumption of the “poor” with the energy consumption of the “well-off” and concluded that the poor are already saving energy and cannot easily reduce their energy usage any further.

Income was identified as one of the strongest indicators of domestic energy use in many subsequent studies (eg. Sardianou, 2008; Cayle et al, 2011; Abrahamse & Steg, 2011).

Also, families of different financial background respond differently to rapid increases in energy prices. Research by Dillman and Dillman (1983) showed that, when faced with energy price increases, lower-income households made life-style cutbacks across nearly all end-uses.

This brings us to the conclusion that income is one significant factor for people who save from energy usage. However, it would only explain adequately energy daily use for extremely low-income households. This brings us to psychological motivations and personality effects in energy use; Are there any personality-related variables that point to people who prefer to limit consumption irrespectively of their income?

The next section will shed light on how personality might affect spending on heating.

Limiting consumption as a matter of principle

Although it would seem reasonable to assume that attitudes and beliefs about money are dependent upon one's income, previous research has been unable to establish a strong connection (Yamauchi & Templer, 1982). Individuals are found to carry beliefs about money and money usage learned in childhood into their adult lives (Furnham, 1996; Kirkcaldy & Furnham, 1993)¹².

Recent studies have also provided empirical evidence suggesting that individuals' beliefs and values about money are shaped by past experiences. For example, Rabow and Rodriguez (1993) found that individuals who experienced financial hardship in their youth were more inclined to place greater importance on money upon reaching adulthood. Lim and Teo (1997) also found that individuals who had experienced financial difficulties were more inclined to use money as a form of evaluation and experience greater financial anxiety.

These attitudes towards money can influence significantly spending behaviour (e.g. compulsive buying behaviour: Li et al (2009); credit card spending: Hayhoe et al (1999); Roberts and Jones (2001) and many others). They can also influence attitudes towards basic human needs, such as the physiological needs of food, water and shelter (Oleson, 2004). It would subsequently be sensible to say that these personality traits, which are related to how individuals react to spending, would also interfere with motives towards daily energy use (e.g. limit spending) and subsequent actions (e.g. avoid using energy unless one has to). There are a few personality scales that aim to measure a variety of attitudes towards money and spending. In the next paragraphs, a brief overview of these scales will be provided, focusing more on specific subthemes and facets of these scales that are more relevant to saving in daily energy use.

¹² This points to stable personality scales

Frugality Scale & Evidence Let's start off with an example of a scale developed by Lastovicka et al (1999): The *Frugality Scale*. Frugality concerns the extent to which individuals practice self-restraint in their use of money. Individuals high in frugality are rather "tight" with their money, trying to save resources and live with what they have. In contrast, those who are "loose" show little restraint in their everyday spending. Evidence from Lastovicka et al (1999) suggests that frugal adults were less compulsive in their buying habits, more conscious of a product's price and value, and more likely to engage in restrained consumer use behaviours (e.g., timing showers, using a clothesline instead of a dryer etc).

Hypothesis There is only one article so far examining frugal individuals' water heating use (e.g. timing showers by Lastovicka, 1999) but, since frugal adults respond differently than the average person in a variety of financial settings, it would be logical to hypothesize that frugal adults would react differently in all aspects of energy use (e.g. the higher they score in the frugality scale, the less they are motivated to consume energy for space as well as water heating).

Example items Below, you will find this scale' items to get a sense of what a researcher can ask the consumer in a survey to understand his frugality levels:

- *I believe in being careful in how I spend my money*
- *I control myself to make sure that I get the most from my money*
- *I am willing to wait on a purchase I want so that I can save money*
- *There are things I resist buying today so I can save for tomorrow*

Reliability & Potential application The Frugality Scale has been developed very cautiously and tested in a variety of settings. It is safe to use it as is with respondents indicating the extent to which they agree with the aforementioned statements in a 5-points likert scale.

Tightwad-Spendthrift Scale & Evidence Another example of a relevant scale developed by Rick et al (2008) is the Tightwad-Spendthrift Scale. The Tightwad-Spendthrift scale is designed to assess the extent to which people find the prospect of spending money painful. Tightwads tend to experience a high pain of paying and spend less than they would ideally like to spend, whereas spendthrifts tend to experience insufficient pain and spend more than they would ideally like to spend. Evidence from Manoj et al (2011) for example suggests that spendthrift individuals spend more on unhealthy food consumption.

Hypothesis There is no research so far examining these individuals' energy use but, since tightwad adults respond differently than the average person, it would be logical to hypothesize that these adults would be motivated to limit their heating consumption.

Example items Below, you will find this scale' items to get a sense of what a researcher can ask a consumer to understand his level of tightwadidness:

- *Some people have trouble limiting their spending: they often spend money for example on clothes, meals, vacations, phone calls when they would do better not to.*
- *Other people have trouble spending money. Perhaps because spending money makes them anxious, they often don't spend money on things they should spend it on.*

Reliability & Potential application This Scale has been developed very cautiously by well-respected researchers of the field. It is safe to use it as is with respondents responding the following 5-point likert scales:

- *How well does the first description fit you? That is, do you have trouble limiting your spending? (1-5 scale, where 1=Never and 5=Always)*
- *How well does the second description fit you? That is, do you have trouble spending money? (1-5 scale, where 1=Never and 5=Always)*

Money Attitude Scale & Evidence Another widely cited measure of money beliefs is Yamauchi and Templer's (1982) *Money Attitude Scale* (MAS). This scale consists of 29 items making up four money attitude factors:

- Retention-time [being prepared for one's financial future]
- *Distrust* [state of not wanting to spend money]
- *Anxiety* [worry about money as well as a desire to spend money]
- Power-prestige [use of money to influence others or show status]

It is found that individuals with higher levels of distrust and lower levels of anxiety tend to engage in more recommended financial management behaviours e.g. in savings (Hayhoe et al., 2012). Distrust measures a state of not wanting to spend money. Yamauchi and Templer (1982) describe individuals scoring high on this factor as hesitant, suspicious, and doubtful regarding situations involving money. Anxiety factor of this scale on the other hand is a mixed state of worry about money as well as a desire to spend money. Persons scoring high on this factor see money as a source of anxiety as well as a source of protection from anxiety. Compulsive buyers, for example, react to stress with higher levels of anxiety than do non-compulsive buyers (Edwards 1993; Valence et al. 1988).

Hypothesis Based on the evidence above, Distrust and Anxiety factors are likely to be related to daily energy usage as well although there is no paper supporting this notion directly. Individuals scoring high on the Distrust factor would be likely to avoid using their heating frequently and those high on Anxiety factor might exhibit peaks and lows in their heating daily use patterns.

Example items Example items for Distrust factor are the following:

- *I argue or complain about the cost of things I buy*
- *I hesitate to spend money, even on necessities*
- *It bothers me when I discover I could have gotten something for less elsewhere*

Example items for Anxiety factor are the following:

- *I show worrisome behaviour when it comes to money*
- *I worry that I will not be financially secure.*
- *I spend money to make myself feel better*

Also, here, we should present a few items of the Anxiety factor developed by Lim and Teo (1997) who found that individuals who had experienced financial difficulties were more inclined to experience greater financial anxiety.

- *I worry about my finances much of the time*
- *Compared to most other people I know, I believe that I think about money much more than they do*
- *I often feel inferior to others who have more money than myself*

Reliability & Potential application The Money Attitude Scale is widely used (439 citations) and can be safely implemented in an energy setting as well with respondents indicating the degree to which they agree or disagree with its statements. It is evident that this scale is also relevant to energy purchase and upgrade decisions. We will come back to this in subsequent chapters.

Locus of Control Scale & Evidence Individual's locus of control (LOC) might also play a role in everyday energy use. LOC refers the extent to which individuals perceive themselves to be in control of the things that happen in their lives.

There are two distinct LOC orientations:

- *Internals* who believe that whatever happens to them results from their own actions, and thus perceive life events as being within their personal control, and
- *Externals* who believe that whatever happens to them are not related to their own actions but determined by factors beyond their personal control.

LOC can influence individuals' money attitudes; people with an internal LOC orientation are more likely to budget their money carefully and be regular savers (e.g. Lunt & Livingstone, 1991). Internals are also less likely to be associated with problematic personal debts compared to externals (e.g. Livingstone & Lunt, 1992). In this line of research, it is argued that internals are less likely to worry about their finances since they would have taken steps to ensure that they are well-positioned where money matters are concerned.

Hypothesis There is no paper investigating how LOC influences energy use, but based on the research above, it would be reasonable to hypothesize that individuals with an internal LOC orientation will be prone to use energy more carefully if costs are not extremely low.

Example Items of the Locus of Control Scale (LOC) by Rotter (1966):

- *Many of the unhappy things in people's lives are partly due to their bad luck*
- *People's misfortunes result from the mistakes they make*
- *Unfortunately an individual's worth often passes unrecognized no matter how hard he tries*
- *I have often found that what is going to happen will happen*
- *When I make plans, I am almost certain that I can make them work*
- *When I get what I want, it is usually because I worked hard for it, and not because of luck.*

Reliability & Potential Application Rotter's I-E Scale (Rotter, 1966) is now cited circa 20.000 times in the literature and is considered a very reliable measure of LOC. It consists of 23 forced-choice LOC items and six filler items to obscure the purpose of the test.

Money Ethics Scale & Evidence Tang (1995) also developed the Money Ethic Scale (MES), which identifies six major beliefs about money:

- *Budgeting is important*
- Money represents achievement
- Money is a sign of respect
- Money is power
- Money is good
- Money is evil

Hypothesis The budgeting factor above may also influence energy spending tendencies. In fact, theory on mental budgeting (mental separation of economic budgets of household needs) postulates that each consumer sets a household finances budget (e.g. Antonides et al., 2011).

When consumers set a budget too low (high), they might underconsume (overconsume) goods they desire. The higher one scores in the mental budgeting factor, the lower their overall spending will be even when controlling for income (Heath & Soll, 1996). Mental budgeting can also result in different budget' levels for each of the expense' categories.

Hypothesis The budgeting factor shows that consumers can have different financial priorities – so, spending for heating or hot water can be viewed as a loss, if other expense' categories are more important.

Example items Example items of the budgeting factor are the following:

- *I am proud of my ability to save money.*
- *I budget my money very well.*
- *I use my money very carefully.*
- *I prefer to save money because I'm never sure when things will collapse and I'll need the cash.*
- *I have reserved money (budget) for different expenses, such as food, clothing, transportation, etc*

Reliability & Potential Application This scale is cited in 212 articles so it is used widely. It can be used to associate motivations to spend for heating with budgeting tendencies. Also, consumers' financial priorities can be tested in a survey, by having consumers *directly* rank their expense' categories in terms of importance/priority.

As a conclusion from this section, people might differ in their personality traits and underlying motives towards heating daily use. In this section, we conclude that even when controlling for income, and independently of their motivations to spend for heating, some

individuals might be more "price conscious" than others. The scales outlined in this section can be used as items in quantitative (but also qualitative) surveys or focus groups.

6.2.2. Cognitive styles and daily energy use decisions

While individuals have several motivations to spend for use of heating and, possibly, motivations to limit energy use to the minimum or to maximize utility of energy within budget constraints, this requires rational actors to acquire, analyse, and trade-off information about all possible alternatives before making a decision of daily energy use and corresponding control adjustments. Not always human intentions end-up to aligned decisions and subsequent actions. And this is because planning and implementation deliberative processes interfere. It is well known in behavioural sciences that planning and information processing of future outcomes with a degree of uncertainty, is an effortful or costly task for the human brain. Thus, it might be the case, for example, that an individual is tight with money and would have preferred to limit heating expenses. However, and in order for them to achieve that, they would need to plan actions accordingly (e.g. what time should I set my heating to come on if I'm not sure when I'll get home? what time should I heat my hot water tank if I'm not sure when I'll need hot water? Should I turn a radiator down if I'm not sure when I might need a room? – ETI, 2015). In this section, we will discuss how cognitive constraints or competencies (e.g. decision styles) can help or hinder people from realising their aspirations with regards to heating use and how individuals might differ in aspects of planning and reacting. This is an important element of one's daily decisions when it comes to heating, especially if we take into account that in future heating systems prices could vary during the day so may become much cheaper to plan than react (ETI, 2015). Fortunately, there are psychometrically sound measures to check for people's propensity and willingness to plan or their lack of planning. Planning here refers to decisions and scheduling for future outcomes that by definition involve some kind of uncertainty.¹³

¹³ In the case of energy use, planning might be also related to the complexity of the energy system and the predictability/regularity of occupancy.

Saving effort as a matter of principle

Humans tend to follow the path of least resistance in terms of effort and time needed in deliberative decision-making under uncertainty. They try to complete each task by investing the least possible effort and time (see for example Zauberman, 2003) and when possible the majority try to avoid hassles by taking the minimum action necessary to solve immediate problems.

Individual differences in planning and reacting

Need for Cognition Scale & Evidence However, there are personality characteristics that point to people who are more prone to planning than others. Need for cognition is one example. It refers to an individual's tendency to engage in and enjoy effortful cognitive endeavors. Individuals high (vs. low) in need for cognition, have been found to process information in a more elaborative, effortful manner (Cacioppo & Petty, 1982). On the other hand, individuals low in need for cognition are more likely to rely on others, on cognitive heuristics (short-cuts), or social comparison processes (e.g. in general, use more System 1 in their decisions). A sizable literature has emerged on individual differences in need for cognition in fields ranging from social, personality, developmental, and cognitive psychology to behavioural medicine, education, marketing, and law. Need for cognition is closely connected with conscientiousness – a personality trait from the well-known “Big Five” trait inventory (NEO Personality Inventory by Costa & McCrae, 1992). Also, need for cognition is positively correlated with intolerance of uncertainty (Buhr and Dugas, 2002), need for cognitive closure (Neuberg et al., 1997), and self-control personality characteristics (Lynch et al., 2010).

Hypothesis There is no research so far examining individuals' need for cognition in a daily energy use setting but, since individuals who score high in need for cognition respond

differently than the average person in a variety of settings mentioned above, it would be logical to hypothesize that they would react differently in energy use settings as well.

Example items The scale measuring the need for cognition contains items such as the following ones:

- *I would prefer complex to simple problems*
- *I like to have the responsibility of handling a situation that requires a lot of thinking*
- *I find satisfaction in deliberating hard and for long hours*
- *I would rather do something that requires little thought than something that is sure to challenge my thinking abilities*
- *I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something*
- *I only think as hard as I have to*
- *The idea of relying on thought to make my way to the top appeals to me*
- *I really enjoy a task that involves coming up with new solutions to problems*
- *I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought*
- *I usually end up deliberating about issues even when they do not affect me personally*

(see also Cacioppo et al, 1996, for a short version of the scale).

Reliability & Potential Application The original article of this scale is cited in 5000 articles so far so it is widely used as a scale in surveys, experiments and research. Usually, for each of these statements, one has to indicate to what extent the statement is characteristic of his personality:

- 1 = extremely uncharacteristic
- 2 = somewhat uncharacteristic
- 3 = uncertain
- 4 = somewhat characteristic
- 5 = extremely characteristic

People with low scores prefer to avoid cognitively demanding activities, whereas those with high scores possess an intrinsic motivation to think. Need for cognition scores can be treated statistically in combination with other variables in a survey to determine the size of this factor' effect.

Alternative Scales, Evidence & Items There are additional scales that measure planfulness (see for example, Gough's California Psychological Inventory (Gough, 1956), organization levels of an individual (see for example, Jackson Personality Inventory, Paunonen & Jackson, 1996). Other scales measure non-planfulness (such as Simms et al., 2011 CAT-PD scale) with items such as:

- *I do things without thinking of the consequences.*
- *I act without planning.*
- *I jump into things without thinking.*
- *I prefer to 'live in the moment' rather than plan things out.*

It is evident that some of the non-planfulness items mentioned above are closely related to the notion of impulsivity or the tendency to act spontaneously and without planning. Impulsivity is an important psychological construct, which appears, in one form or another, in every major system of personality (for instance, see Francis et al (1992) or Cloninger, Przybeck & Svrakic, 1991). In fact, Patton et al. (1995) have identified three higher-order factors which they argue reflect the different components of impulsivity: attentional impulsiveness (the

ability to focus on the tasks at hand), motor impulsiveness (acting on the spur of the moment), and non-planning (cognitive complexity). There are various scales to measure impulsivity such as the Multidimensional Personality Questionnaire Control Scale (MPQ) by Tellegen (see Patrick et al, 2002 for a brief version of the Scale).

Impulsive people who do not act with deliberation are found to process information inefficiently (Frederick, 2005). On the other hand, persons with greater ability to plan and imagine the future or imagine outcomes reduce the intrinsic uncertainty in their environments. Research in other domains of financial decision-making (e.g. mortgages, retirement savings), shows that those with lower propensity to plan are less likely to save (Ameriks, et al., 2003; Lusardi & Mitchell, 2007).¹⁴

Finally, we should mention here that people differ in whether or not they *like* planning and have positive associations with it such as competence and security or negative associations such as lack of spontaneity (see for example travel planning research by Stewart & Vogt, 1999). Preference for planning relates to greater propensity to plan.

Hypothesis It would be logical to hypothesize that individuals who score low in planning personality scales and high in impulsivity scales are more likely not to spend time/effort planning daily energy use and just react in the end to what they find. Those high in planning scales should enjoy more analytical thinking and are, thus, more likely to plan and organize their actions in terms of daily energy use.

Reliability & Potential Application These scales can measure reliably one's impulsivity levels. However, there is no paper linking planning or impulsivity personality elements with

¹⁴ Unfortunately, there is no impulsivity scale measuring sensory impulsiveness, which would have been useful to explore in this project.

energy use. This can be tested in a survey using the aforementioned questionnaires. Of course, it is evident here that the previous section relates also to purchasing and upgrading energy behaviours. This will become more evident in the corresponding chapters.

In this section it might have been relevant to consider the Myers-Briggs Type Indicator test designed to indicate psychological preferences in how people perceive the world and make decisions. However, there is widespread criticism about this test's validity (see for example, Gardner & Martinko, 1996) so, it might be best for ETI to avoid using this instrument to draw conclusions of people's propensity to plan and instead use the aforementioned well respected scales.

7. Buying energy

Introduction

The issue of energy purchase is a broad one. The ETI and Mindframe have agreed on specific themes related to tariff choice, the decision-making process and underlying biases as well as personality elements that may be involved in future energy purchase settings.

Decarbonising heat may change the structure of bills as a low carbon energy system will cost more to build and less to run. Wholesale electricity prices could vary more often and more dramatically with the time of day, costing less when there is more supply than demand. This might enable suppliers to introduce new types of energy tariffs structured differently from the current ones. This would certainly influence tariff choice at the point where an individual buys energy from a supplier. Today, the vast majority of households pay a small fixed cost for maintaining the energy system and a variable cost that grows with the amount of energy they use. In the future, consumers might be able to pay a fixed monthly fee for a heat package with costs that rise fast if consumers go beyond their bundle especially in peak hours (e.g. pay-per-use tariff, like current pay-per-use mobile phone tariffs) or for an unlimited heating tariff for a higher price (e.g. flat rate tariff). This type of tariff structure resembles much with current mobile phone tariffs. It would be interesting to understand, thus, how people make this type of decisions and what individual differences might be at play in each case.

The initial pay-per-use energy tariff might cost less than the unlimited one if one only made use within the bundle he purchased (as is the case currently in other industries currently). The advantage of a pay-per-use (PPU) type of package is lower price (again, if users consume within the bundle). If consumers make use beyond the bundle, they might even exceed the price for the unlimited tariff (of course, this depends on extra usage made as well as prices for this extra use).

Decision making and individual differences in purchase settings

The Flat-rate bias

Evidence from the mobile phone industry suggests that only 10% of those who chose the pay-per-use (PPU) service would have saved money with the flat fee (Kridel et al, 1993), while, 65% of customers who selected flat rates would have saved money if they had purchased a pay-per-use package. Also, studies on telephone service (e.g., Kling & Van der Ploeg, 1990; Economides et al, 2004) and health club tariff choice (DellaVigna & Malmendier 2006) show that consumers who would save money with a pay-per-use tariff often prefer a flat rate.

A common initial assumption underlying the analysis of consumers' choices among optional tariffs is that consumers choose the tariff that maximizes their surplus and, thus, the tariff that leads to the lowest billing rate for a given amount of usage. Yet, as we mentioned previously, many users prefer a flat rate even though their billing rate would have been lower with a pay-per-use tariff. This phenomenon is called 'the flat-rate bias' (Nunes, 2000; Train, 1991).

In psychological studies, researchers have identified a few potential causes of the flat-rate bias; these are insurance effects, payment' timing effects, convenience effects and trust effects. These will be analysed in subsequent sections.

Insurance Effects & Risk Aversion in tariff choice

Consumers may choose a flat rate to avoid variation in their monthly billing rate – especially upward variation. Insurance effects concern customers who seek protection from unexpected high costs. *Risk-averse* consumers who are unable to predict their future demand in an exact manner can choose a flat rate to insure against the risk of high costs (Miravete 2002b). We can think of other domains where this type of effect is present such as Internet unlimited versus PPU tariff choice, weekly or monthly passes for public transport systems, car rentals (free mileage vs full tank options) and so on. If future energy tariffs are to be designed with a structure where a consumer chooses between a flat rate scheme and a pay-per-use scheme, then it might be the case that insurance effects play an important role in energy purchase settings as well. In the “Example Items” section below we provide statements, which could be used to test the existence of insurance effects in practice.

In general, these effects could be interpreted in the same way as an insurance premium. Indeed, Kridel et al. (1993) show that the option value attached to flat rate plans is independent of the actual usage.

Here, we should mention that *risk aversion* which is directly related to these effects, is a phenomenon widely studied in Decision Sciences literature after the work of the Nobel Prize winner, Daniel Kahneman. This line of research (which is briefly explained in the general overview section about Decision Making under uncertainty) shows that people tend to be *on average* risk averse, and they under-value the chance potential savings (such as taking up a pay-per-usage tariff) in favour of smaller gains of which they feel are more secure; this line of research explains how uncertain losses (such as unexpected high costs) are particularly discouraging (Kahneman & Tversky, 1979).

The implications of this loss/risk aversion for acceptance of new pricing structures are apparent (Kahneman et al., 1991; Samuelson & Zeckhauser, 1988). These decision-making biases increase as the environment grows more complex (Kahneman et al., 1991). So, in the

case of energy tariffs, if future energy tariffs become increasingly complex with prices varying depending on the time of the day, it is certain that risk aversion will push more customers towards a flat rate tariff.

Insurance effects & Individual Differences

Instrumental Risk Taking Scale & Evidence However, not all individuals react the same way in risky situations; individual differences in (instrumental) risk taking¹⁵ (instrumental risk taking occurs in situations where a future economic profit is to be achieved) would push customers towards a pay-per-use package if this were to provide them with the chance to avoid a future loss;

The preference for (instrumental) risk taking has been found to associate strongly with achievement motivation (Jonassen & Grabowski, 1993). For high achievers, risk serves as an instrument to reach a particular economic goal in the future. This might be the case for energy consumers who aim to spend as less as possible for heating consumption. An instrumental decision maker is found to score low on impulsivity and deliberates more the kinds of possible consequences as well as analyses the probabilities while concentrating on negative outcomes (Nicholson et al., 2005).

Nicholson et al. (2005) showed also that (instrumental) risk takers score high on extraversion and openness and low on neuroticism, agreeableness, and conscientiousness (e.g. dimensions of the Big Five questionnaire). Also, women as well as older adults appear to be more risk averse in a variety of contexts and situations (Byrnes et al. 1999, Jianakopulos & Bernasek 1998; Jianakopulos & Bernasek 2006).

¹⁵ Instrumental risk taking refers to situations where the individual seeks to reach some future (mainly financial) profit. There is also stimulating risk-taking which refers to situations of strong excitatory value such as gambling. This type of risk is obviously not related to the present project.

Hypothesis Those scoring high on the insurance effects dimension would prefer a flat rate tariff while those scoring high in instrumental risk-taking attitude would opt for a pay-per-use package.

Example Items Insurance effects could be examined in a survey for energy purchase with customised items such as the following one:

- *For the security of knowing that my heating costs will never go above the amount agreed upon, I'm willing to pay a little more than average*
- *Even if a flat rate is somewhat more expensive than a pay-per-use rate, I'm happy because my costs won't exceed the fixed amount*
- *To be sure my costs of heating will never be higher than a certain predefined amount, I'm willing to pay a little bit more than average*

It is also possible to come up with conclusions on that by having consumers choose between tariffs. But also statements such as the above are useful to clarify the reasons why one may choose the specific tariff (e.g. insurance effects).

Also, here are some example items, which identify risk-taking individual differences according to the Instrumental Risk Taking questionnaire by Zaleskiewicz (2001):

- *At work I would prefer a position with a high salary which could be lost easily to a stable position but with a low salary*
- *To achieve something in life one has to take risks*
- *If there is a big chance of profit, I would take even high risks*

[To be answered on a four-point scale ranging from 1 – “does not describe me at all” to 4 – “describes me very well”].

Reliability & Potential Application

Insurance effects: these can reliably be measured with a question as the aforementioned ones as part of a wider survey or of an online experiment where a participant selects a tariff and then answers a few personality questions. Regression analysis to the dependent variable would reveal the size of potential influence in tariff choice of energy customers.

An example of the above methodology from the mobile phones industry would be the following:

Option 1:

- Price
- Number of minutes
- Number of texts

Option 2:

- Price
- Number of minutes
- Number of texts

The experimenter then systematically varies the levels of each attribute (price, number of minutes, number of texts) and deduce the relative importance of the three attributes from the choices they make at different levels.

Risk measures: Although risk measures have been studied in the literature, the fine distinction between different types of risks as well as the context-sensitivity of risk measures call for specific research in an energy setting. To find out how risk taking individual differences play

out with the selection of an energy tariff one could either run a survey by including items such as the above mentioned ones and correlating those with the choice of a flat rate versus a pay-per-usage tariff or one could run an online experiment where participants are presented with different tariff options and they get to choose among those (it'd be interesting to see where reversals (i.e. where preference for a fixed vs. variable tariff changes) occur, always in relation to the individual' scores in the risk-taking scale). There is no similar experiment in the literature in the context of energy tariff choice, but this could be easily created following a format similar to the risk elicitation task by Holt and Laury (2002), where a consumer is presented with six "multiple price lists", each consisting of 11 ordered choice pairs. The participant at Holt and Laury's experiment is asked to draw a horizontal line to indicate their willingness to switch from a fixed sure payoff to an increasingly attractive gamble (in the case of energy tariffs, instead of a gamble it would be suitable to insert an attractive pay-per-use tariff option). The risk aversion score in the case of the Holt and Laury' experiment is constructed as the summation of the line locations. An experiment such as the above would take 15-20 minutes to complete.

Payment' timing effects in tariff choice

It is well known in behavioural research that, paying a flat fee decouples consumption from payment because the costs are mentally prepaid (e.g., at the beginning of each month) (see Prelec & Loewenstein, 1998; Thaler, 1999). Thus, usage, which has been paid for beforehand, can be enjoyed *as if it were free*. Prelec and Loewenstein's studies ask people whether they would enjoy themselves more if they paid a fixed fee or if they were charged for actual use and they found that for most people, the pleasure would be greater with a flat rate than with a pay-per-use tariff even if costs associated with the flat fee were higher (they studied this effect within the savings and debt sector). In other words, the majority of consumers are found to enjoy their usage more on a flat rate than on a pay-per-use tariff because paying per use lessens the joy from consumption (e.g. mental accounting theory by Thaler, 1999); consumers attribute the cost and, thus, the pain of paying to consumption at the time of usage.

Hypothesis Currently, there is no flat-rate option for the majority of energy consumers. However, if in the future such tariff is brought forward, the majority of energy consumers might opt for the flat rate tariff to avoid the pain of paying for consumption at the time of usage (this preference would be even more pronounced if smart meters exhibit real-time cost information to the consumer at the time of usage – in other words, consumers might be even more likely to opt for a fixed tariff if they had real-time cost information).

Individual Differences & payment' timing effects

There is no paper linking these types of effects with customers' individual differences however, it would be logical to assume that frugality can potentially lead to preference for pay-per-use rates, because these rates facilitate achieving the goals of restrained acquisition and resourceful usage that frugal individuals are after. DeYoung (1986) who investigated the

psychological aspects of reduced consumption behaviours found that careful use of resources and avoidance of waste can contribute to these individuals' satisfaction; frugal consumers enjoy minimizing the quantity purchased or the money spent, and maximizing the utility of each product acquired. Thus, while their non-frugal counterparts are likely to resent the pay per use tariff, frugal consumers may enjoy keeping track of their spending. Hence, individuals who score high in frugality (this notion is analysed in the previous chapter) might enjoy more the pay-per-use tariffs.

Example Items Customised items that measure payment' timing effects for the purposes of the energy purchase could be the following:

- *It wouldn't be as enjoyable to use the heating when I would have to think about the costs increasing every minute with a pay-per-use tariff*
- *I would enjoy my heating usage more if consumption was independent of the usage time*
- *A flat rate in heating services is good because I don't have to think about the costs of energy*
- *I would enjoy using the heating less if costs were to increase every minute of use*

Frugality items are outlined in the energy use chapter.

Reliability and Potential Application Payment timing effects can be measured with questions such as the aforementioned ones as part of a wider survey. Regression analysis to the dependent variable would reveal the size of potential influence in tariff choice of energy customers.

Convenience Effects in tariff choice

Consumers might feel that choosing among optional tariffs is inconvenient and therefore might try to avoid the effort of identifying alternative tariffs and calculating the respective expected billing rate. To minimize information cost, they might choose the tariff that seems to be the “default tariff” (i.e., the tariff they are accustomed to choosing). If this tariff is a flat rate, a flat-rate bias can result from the convenience of not needing to search for the least costly tariff. When calculating consumer surplus for flat-rate and usage-based pricing, Kling & Van der Ploeg (1990) found that households that have not explicitly examined the cost difference under different tariffs are more likely to choose the flat rate.

Convenience effects & Individual Differences

Individual differences in planfulness, need for cognition and impulsivity (and, thus, propensity to System 1 thinking mode) could explain differences among individuals regarding the extent to which the convenience effect affects them. These are analysed in the energy use chapter.

Consumers' decision competency Here, we should add one additional element of human personality, which is likely to affect the size of the convenience effects; and this is individual's decision competency. Parker and Fischhoff (2005) report that decision-making competence correlates positively with endorsement of behavioural coping strategies and self-monitoring and negatively with polarized thinking (i.e. the tendency to think in black-and-white terms). Examples of each of these factors are shown in the Examples' section below.

Consumers' propensity to maximization Additionally, difficulties choosing the right tariff have also been identified by Turner et al (2012) who developed the Maximization Inventory. This scale consists of three separate subscales: decision difficulty, alternative search, and satisficing. In essence, maximizing refers to the tendency to optimize when making decisions

and it is characterized by increased information-seeking and social comparison while satisficing is the tendency to use shortcuts when making decisions and to settle for a “good-enough” option that passes a “threshold of acceptability”. The satisficing scale is positively correlated with positive adaptation, whereas the decision difficulty and alternative search scales are positively correlated with non-productive decision behaviour. Examples of each of these factors are shown in the Examples’ section below.

Example Items Customized example items aimed to measure the impact of convenience effects in a survey or an experiment on energy purchase would be:

- *It's too much trouble to find out the prices for heating use*
- *Figuring out which tariff is better takes so long that it isn't worth the effort*
- *The money you can save by finding a better heating usage plan doesn't make up for the time and effort involved*
- *The time it takes to choose a cheaper heating usage plan isn't worth the effort*

Example items for:

Decision Competency related items:

- Endorsement of behavioural coping strategies
 - *When I realize I have made a mistake, I usually take immediate action to correct it*
- Self-monitoring
 - *There are many things that I would only tell to a few of my friends*
- Polarized thinking
 - *I tend to classify people as either for me or against me*

Decision Maximization related items:

- Decision Difficulty
 - *I usually have a hard time making even simple decisions*

- Alternative Search
 - *I can't come to a decision unless I have carefully considered all of my options*

- Satisficing
 - *I usually try to find a couple of good options and then choose between them*

Trust in the provider & individual differences

Scale & Evidence Trust in motives and provider' capability at the point of purchase should play a major role in consumers' subsequent tariff choices because essentially, trust mirrors a risky choice that depends on another without being able to control the other's actions (Thielmann & Hilbig, in press). In the context of the current report, trust in the supplier can function as a mechanism for uncertainty reduction at the point of purchase decision and can be a substitute for possible lack of knowledge or information on product or market characteristics. In other words, potential customers might put up with more uncertainty if they trust their supplier. Thus, it can make energy tariff offers appear in positive or negative light. It has been shown that trust is an important factor in various purchase settings but also in energy purchase settings (e.g. Salmela & Varho, 2006), while the lack of it is frequently discussed as being an important determinant in energy settings, especially regarding the low uptake of green technologies (Macalister & King, 2011). Trust defines whether people have an overall positive or a negative feeling about a provider, which eventually colours their evaluations and services ratings (same applies for energy upgrades).

It has been argued that people base their trust judgements on the competencies (i.e., experience and expertise) of the involved parties as well as on their integrity (i.e., honesty, openness, and concern for public interests) (e.g. Terwel et al, 2009). However, it would be more useful in the report which analyses individuals' traits to look at how individuals differ in their trust levels towards a third party in terms of their personal predisposition towards trusting others (see Cloninger's 1991, Temperament and Character Inventory (TCI) trust sub-factor; Simms et al., 2011, CAT-PD trust sub-factor; Couch's 1996, trust items; Yamaguchi & Yamaguchi, 1994). This is important because propensity to trust has been found to influence perceptions of prices and price acceptance (e.g. tariff price), which in turn influence decisions. For example, it has been proposed that propensity to trust influences evaluations of costs and benefits of gene technology, which, in turn, shapes acceptability ratings (Siegrist, 2000). Trust has also been found to shape evaluations of costs and benefits of new or

unfamiliar systems: for example, a new hydrogen system in transport (Montijn-Dorgelo, 2008), as well as evaluations and acceptability of unfamiliar CO2 storage technology (Midden & Huijts, 2009).

Hypothesis: Thus, propensity to trust energy suppliers might be able counteract the uncertainties that come with new energy systems' tariffs. As a result of trust, uncertainty and risk perceptions might be reduced, and the consumer might experience a higher sense of control.

Example Items

From Simms et al. (2011), CAT-PD trust sub-factor:

- *I feel like people often are out to get something from me (R)*
- *I feel that others are out to get me (R)*
- *I believe that, sooner or later, people always let you down (R)*
- *I suspect hidden motives in others (R)*
- *I believe that people are basically honest and good*
- *I am pretty trusting of others' motives*

Or from Cloninger's Temperament and Character Inventory (TCI) (Cloninger et al, 1991) trust sub-factor:

- *I trust what people say*
- *I trust others*
- *I acknowledge others' accomplishments*
- *I feel little concern for others (R)*

- *Distrust people (R)*
- *Disregard the opinions of others (R)*

Or from the Trust Inventory by Couch et al. (1996):

- *I tend to be accepting of others*

Or from Yamaguchi & Yamaguchi (1994) scale which contains 6 sub-scales:

- General Trust (GT)
- Caution in Dealing with Others (C)
- Knowledge-Based Trust (KBT)
- Utility of Relations (UR)
- Reputation (R)
- Honesty (H)

With example items:

- *Most people are basically honest (General Trust)*
- *People are always interested only in their own welfare (Caution in Dealing with Others)*
- *I trust a person I know well more than one whom I don't know (Knowledge-Based Trust)*
- *Having a good reputation is most important for success in business (Utility of Reputation)*
- *I am trustworthy (Honesty)*

Respondents answer in a 5-point likert scale regarding the extent to which they Agree or Disagree with the statements.

Recent research on trustworthiness has also used the trust game (Berg et al., 1995). In this game, a trustor is asked to divide a certain endowment between herself and a trustee. The amount the trustor entrusts is multiplied (usually tripled) and transferred to the trustee who is then asked to decide how much to return to the trustor.

Application A subset of the above items could be used in a survey and then correlated with consumers' intention to choose a suggested/default energy tariff. Trust levels will also influence upgrading decisions.

8. Upgrade

Background

After analysing crucial behavioural topics related to energy daily use and purchase, we will proceed with energy upgrades and how behavioural economics and individual differences science can inform us about these settings. UK faces the challenge of replacing the gas central heating systems in 90% of homes with lower carbon alternatives like district heating and heat pumps, if it is to decarbonise at lower cost. Decisions about whether to pay for boiler insurance are relevant as are decisions about whether to try and fix or replace a broken (or nearly broken) boiler. Which aspects of the psychological literature can inform us about the way boiler replacement takes place and about the way insurance and maintenance services are sold?

It wouldn't be irrational to argue that compared to renters, homeowners are more likely to invest in energy efficiency measures. Homeowners tend to be wealthier and have greater financial security, hold longer tenure, and receive greater return on energy efficiency investments. In fact, research by Dillman and Dillman (1983) showed that, when faced with energy price increases, higher-income households were more likely to decide to invest in building and equipment energy-efficiency. Conversely, renters tend to be poorer, more transient, and less willing or capable of making home improvements, thereby leading to less financial investment in energy-efficient devices and new technology.

Decision making and individual differences in energy upgrade

8.2.1. Human decision-making and the decision not to upgrade

DECC evidence suggests that around 60% of people will replace their boiler when it is broken or about to break. Except for the obvious low vs high income and owner vs renter distinction mentioned in the introductory section, there are a few other psychological reasons that point to people with a tendency not to upgrade: these are the optimism bias, the status quo bias and resistance to change as well as indecisiveness. On the other hand, people would opt for an upgrade if they cared about their social status or if they exhibited the so-called exploratory purchase behaviour that leads to early adoption.

The optimism bias

Why is it the case that 60% of individuals will replace their boiler only when it breaks or is about to break? It seems that people on average underestimate the chance the boiler will break and the inconvenience this will cause. What psychology has to say about that? One of the major psychological obstacles to accurate predictions of future outcomes is the presence of psychological distortions in judgment. One apparent pervasive example is optimism bias (Weinstein, 1980). This refers to situations in which the judged likelihood of a positive event occurring is overestimated, and conversely underestimated for a negative outcome (e.g. in the context of the present work, the likelihood that the boiler will break). The impact of this kind of distortion (e.g. the optimism bias) on predicting future outcomes was acknowledged in the British government's 2003 'Green Book' intended for HM Treasury as a guide for Central Government. The Green book identified optimism bias as one of the key factors to be mitigated. Clearly, this psychological phenomenon is thought to have a severe bearing on several important real world issues. It might be the case that it operates in the domain of energy upgrades as well: people underestimate the likelihood of negative outcomes such as boiler breaking. The likelihood of a boiler breaking is uncertain, so people *on average* will underestimate the likelihood of this negative event and, thus, base their decisions on this distorted likelihood estimate.

There are at least three decades of empirical psychological research on optimism bias, and longer still if one takes into account related phenomena such as the desirability bias (Irwin, 1954). In psychological research, optimism bias (Irwin, 1953; Weinstein, 1980), desirability bias (Crandall et al, 1955), wishful thinking (Hogarth, 1987), value bias (Yates, 1990), and outcome bias (Cohen & Wallsten, 1992) are all related. The ubiquity of optimism bias is notable because of the wide range of domains in which researchers have uncovered it: Entrepreneurs (Baker et al., 2006), CEOs (Malmendier & Tate, 2005), Investment managers (Olsen, 1997), Physicians (Poses & Anthony, 1991), and Drug addicts (Sjoberg, 2003) have been shown to display optimism bias on probabilities' estimations.

Individual differences in optimism

Scheier et al (1994) developed the LOT-R scale, which was designed to assess optimism levels of different individuals with sample items such as the following ones:

- *In uncertain times, I usually expect the best*
- *I am always optimistic about my future*
- *Look at the bright side of life*
- *Have a dark outlook on the future (R)*
- *See difficulties everywhere (R)*

And ratings in a 5-point likert scale from Strongly Disagree to Strongly Agree.

Optimism bias is found to be stronger among men than women (Lin & Raghurir, 2005; Chapin & Coleman, 2009). It is also more pronounced for people living in individualistic cultures as compared to collectivist cultures (Heine & Lehman, 1995). In addition, those reporting that they are success-oriented individuals, as well as those scoring highly on measures of self-esteem and extraversion also tend to show stronger optimism bias (Darvill & Johnson, 1991; Kavussanu & McAuley, 1995; Nisan, 1972; Sanna & Meier, 2000). It might be the case that this bias plays a major role in upgrade decisions and differences found among individuals when they make these decisions. Only a survey would be able to reveal its predictive power in these decisions. Optimism questionnaires are quite short and not time-consuming and would therefore be a quick and reliable tool to investigate these decisions.

The Status Quo bias

Another pattern in human behaviour which might be related to the fact the people are not likely *on average* to replace their boilers before they break (or about to break) is the status quo bias. We discussed earlier that one of the implications of loss/risk aversion is the status quo bias (Kahneman et al., 1991; Samuelson & Zeckhauser, 1988). In situations where a new behaviour is to be put forward, people will typically focus on the risks, costs or losses associated with adopting this new behaviour (e.g. upgrade decision).

They will typically ask themselves questions related to financial costs (what will it cost me?), physical risks (is it safe/healthy?), social costs (what do others think?), time costs (will it take long?), functional risks (does it fit my routine?), and psychological costs (how will I feel?), and will tend to discount equivalent gains and benefits.

These decision-making biases increase as the environment grows more complex (Kahneman et al., 1991). So, in the case of energy upgrades, if these become increasingly complex, it is more likely that loss/risk aversion will push customers towards the status quo. In other words, the upgrade process should be extremely simple and as risk/loss free possible in order for an individual to overcome the status quo bias.

Individual differences and resistance to change

How people differ in their attitude to change and the influence of the status quo bias in their decisions under uncertainty? Are there individuals who are less sensitive to the status quo bias? Are there personality traits that point to individuals who resist to changes? Oreg (2003) developed a relevant personality measure to assess the extent to which individuals are prone to the status quo bias. The “Resistance To Change” scale was designed to assess individuals' tendencies to resist or avoid making changes, to devalue change generally, and to find change

aversive across diverse contexts and types of change. This scale contains 4 sub-scales, namely:

- Routine Seeking (RS): the behavioural component of resistance to change, “inclination to adopt routines”
 - *I generally consider changes to be a negative thinking*

- Emotional Reaction (ER): the affective component of resistance to change, “the amount of stress and uneasiness” induced by change
 - *When I am informed of a change of plans, I tense up a bit*

- Short-term Focus (SF): the affective component of resistance to change, “the extent to which individuals are distracted by the short-term inconveniences” associated with change
 - *Changing plans seems like a real hassle to me*

- Cognitive Rigidity (CR): the cognitive component of resistance to change, “frequency and ease with which people change their minds”
 - *I don't change my mind easily*

This scale is used with 5 or 6-point ratings (1 = strongly disagree to 6 = strongly agree).

People who score high in this scale are likely to be less prone to decide for an upgrade.

Indecisiveness

Another scale, which points to individuals who are likely to maintain the Status Quo, is the degree of indecisiveness of an individual. This addresses the question of *when* choices will be

made, which is directly relevant to boiler' replacement. Indecisiveness refers to the extent to which an individual experiences chronic choice difficulty and delay in decision-making. Indecisive individuals delay decision-making for a longer time than do decisive ones in different domains such as car purchase (Yates et al., 2003), college course selection (Ferrari & Dovidio, 2000) and many others. Interestingly, Patalano & Wengrovitz (2007) show that this is the case even if risk is involved in underlying decisions: indecisive individuals will delay their decision even in risky settings. In other words, indecisive individuals are found to be unresponsiveness to risk. In this specific paper, risk in the delay of course selection was essentially associated with a risk of loss of existing course alternatives. Results showed that indecisive individuals exhibited uniformly increased delay relative to others. This lack of response to risk information may put indecisive individuals in the position of more often choosing a less desirable alternative. Indecisiveness is found to be positively correlated with neuroticism (Jackson et al, 1999) and perfectionism (Gayton et al, 1994; Ferrari & Dovidio, 2001).

Example items from the Indecisiveness Scale (Frost & Shows, 1993) are the following:

- *I try to put off making decisions*
- *I always know exactly what I want (R)*
- *I find it easy to make decisions*

Another related scale is the General Decision Making Style by Scott and Bruce (1995), which is designed to assess how individuals approach decision situations. It distinguishes between 5 decision styles and one of its dimensions, namely, the Avoidant Decision Style is associated with the construct of indecisiveness we discussed previously. The 5 decision styles of the General Decision Making Style inventory are the following:

- An avoidant style emphasizes postponing and avoiding decisions (Avoidant)

- *I avoid making important decisions until the pressure is on*

- A rational style emphasizes “a thorough search for and logical evaluation of alternatives” (Rational)
 - *I make decisions in a logical and systematic way*

- A dependent style emphasizes “a search for advice and direction from others” (Dependent)
 - *I rarely make important decisions without consulting other people*

- An intuitive style emphasizes “a reliance on hunches and feelings” (Intuitive)
 - *When I make decisions, I tend to rely on my intuition*

- A spontaneous style emphasizes “a sense of immediacy and a desire to get through the decision-making process as soon as possible” (Spontaneous)
 - *I generally make snap decisions*

Respondents’ responses are rated in a 5-point likert scale (1 = strongly disagree to 5 = strongly agree)

8.2.2. Human decision-making and the decision to upgrade

In this section we outline two reasons, which may push consumers to upgrade their systems, namely, social status as well as exploratory buyer behaviour and its relation in implementation settings to social norms influences.

Social status

The consumption of material goods is assumed to fulfill three functions: instrumental, symbolic, and affective (cf. Steg & Vlek, 2009). Symbolic motives, or meanings, can be further subdivided into two components: the motive to express one's social status and the motive to express one's personal identity and values.

Social context exerts considerable impact on individuals' behaviours in various ways: for example, through established social heuristics facilitating social interaction (cf. Gigerenzer & Gaissmaier, 2011), through social norms (discussed in the previous chapter) resulting in a perceived social pressure to conform (Cialdini, et al., 1991), and through the attribution of symbolic meaning to behaviour and behavioural objects (Charon, 2007). In essence, behaviour is not simply an act; it always carries meaning. Through his or her behaviour, a person always indirectly makes a statement about his or her values and convictions and products are found to define one's social status (Solomon, 1983).

Boiler replacement can be seen as a symbolic act (e.g. buying the product to project a certain image to others), especially when taking into account that the household is a primary center of social activity. Symbolic purchases enable a person to signal their status and identity. For example, boiler replacement and adoption of new energy technologies can signal greater financial status or an innovative/early adopter personality.

Indeed, in many cases it is shown that energy customers incorporate “perceive *non-energy* benefits” into their decisions. Among these benefits is “first-on-the-block status”¹⁶. For example, Martinez et al. (1998) highlight that in Spain keeping up with neighbors or being ahead of them was an important driver for purchases of energy efficiency technologies. Gram-Hanssen et al. (2007), researching on residential energy consumption in Belgium and Denmark also conclude: “Social support and social recognition as well as consistency between several sources of information are crucial in household energy efficiency improvement”. Thus, homeowners may value non-energy benefits higher than the energy cost savings.

Customized example items to be included in a survey would be the following ones:

- *Upgrading energy systems can increase one’s prestige among friends*
- *I would be happy to talk to my friends and colleagues about my energy upgrade*

Exploratory purchases

People may be triggered to learn more about new products on the market and purchase them because of their tendency to explore new products (i.e. exploratory buying behaviour tendency). Baumgartner and Steenkamp (1996) developed a scale to measure consumers’ tendency toward exploratory acquisition of products. Even though some of the items of the scale relate to the consumption of specific products, this scale gave comparable results across product categories, thus ascertaining its validity (see Bearden & Netermeyer, 1999). Here are some of this scale (reverse) items:

- *Even though certain food products are available in a number of different flavours, you tend to buy the same flavours*

¹⁶ Other benefits are: increased comfort, reduced noise, improved health, safety, a sense of environmental citizenry, long-term value, and peace of mind.

- *You would rather stick with a brand you usually buy than try something you are not very sure of*
- *You think of yourself as a brand-loyal consumer*
- *When you see a new brand on the shelf, you are not afraid of giving it a try*
- *When you go to a restaurant, you feel it is safer to order dishes you are familiar with*
- *If you like a brand, you rarely switch from it just to try something different*
- *You are very cautious in trying new or different products*
- *You enjoy taking chances in buying unfamiliar brands just to get some variety in your purchases*
- *You rarely buy brands about which you are uncertain how well they perform*
- *You usually eat the same kind of foods on a regular basis*

The aforementioned scale could be used as a kind of proxy for early adopters. Sales of future upgrades should be *first* targeted towards this specific cluster of people. Then, the influence of social norms could be used to persuade the rest of the population (as in Cialdini's paradigm described in the previous section), provided the products are reliable, efficient and easy to use.

Consumers' susceptibility to interpersonal influence (e.g. tendency to conform to social norms) can be measured using Bearden et al.'s (1989) scale, which can of course be customized for the purposes of a survey in an energy setting. This scale' items are outlined below:

- *It is important that others like the products and brands you buy*
- *If you want to be like someone, you often try to buy the same brands that they buy*
- *To make sure you buy the right product or brand, you often observe what others are buying and using*

- *You rarely purchase the latest fashion styles until you are sure your friends approve of them*
- *You often identify with other people by purchasing the same products and brands they purchase*
- *You often consult other people to help choose the best alternative available from different brands*
- *If you have little experience with a product, you often ask your friends about the product*
- *When buying products, you generally purchase those brands that you think others will approve of*
- *You like to know what brands and products make good impressions on others*
- *You frequently gather information from friends or family about a product before you buy*
- *If other people can see you using a product, you often purchase the brand they expect you to buy*
- *You achieve a sense of belonging by purchasing the same products and brands that others purchase*

8.2.3. Insurance and risk attitudes

After analysing the upgrade decision, we will proceed by exploring the topic of insurance purchase. It would be logical to hypothesize that insurance purchases depend on the magnitude of the loss, its probability, the cost of insurance, and consumers' wealth and risk tolerance. However, in this section we will describe other factors of psychological nature that are found to influence consumers in their insurance purchases.

These emotional factors help explain one of the major paradoxes in decision making under uncertainty: people who purchase lottery tickets (exhibiting risk-proneness) also purchase insurance (exhibiting risk-aversion). This phenomenon is attributed to the overweighting of small probabilities, which stems from the disproportionate fear and pleasurable anticipation evoked by such prospects (i.e. emotional approach). Indeed, Hogarth and Kunreuther (1995) found that, when people make decisions regarding investment in protective measures such as warranties, they do not think about probabilities of malfunctions. Rather, they use arguments such as peace of mind or sleeping well at night to defend their positions. It is no coincidence that insurance marketers rarely provide probabilities but instead highlight emotional considerations and, likewise, lottery marketers highlight the pleasure of anticipation associated with lottery purchases with slogans such as "buy a dream". In the sequel we will discuss factors that influence emotional responses to insurance purchase.

Past Experience

Risk-assessments are subject to biases (e.g., Finucane et al, 2000) and they are often influenced by factors that do not have much informational value (but rather, emotional). For example, a disaster that can easily be imagined is perceived to be more likely than a disaster that cannot be as easily imagined. As a result, in one study, participants were willing to pay more for \$100.000 worth of life insurance that covered deaths due to '*any act of terrorism*'

than if it covered deaths due to '*any reason*' (Johnson et al, 1993). This means that people, who have had previous experience of a boiler breaking, might be more likely to purchase boiler insurance than those who never encountered problems with their boiler.

Familiarity

This leads us to the broader concept of familiarity. People are found to be underinsured against hazards that evoke relatively weak mental images. Flood insurance for example is notoriously difficult to sell (Browne & Hoyt, 2000). Slovic et al. (1980), speculated that people's willingness to insure against small-probability losses may be related to how much these potential losses cause worry or concern. A number of studies have shown that knowing someone who has been in a flood or earthquake greatly increases the likelihood of purchasing insurance (Browne & Hoyt, 2000). Similarly, consumers who know someone who has had a broken boiler might be more likely to purchase boiler insurance.

Mental Imagery and Insurance Framing

If the outcome (e.g. boiler breaking) is not familiar to the user, the extent to which the user purchases insurance may depend on his ability to form mental images. Several studies report a correlation between people's self-reported ability to form mental images and their responses in different settings. For example, compared with nonvivid imagers, vivid imagers salivate significantly more while thinking about their favorite food (White, 1978), and have greater ability to voluntarily increase their heart rate using visual imagery (Carroll et al, 1979).

However, the strength of anticipatory reactions to risk (and, thus, insurance purchase) may depend also on situational factors, such as how an outcome is described (e.g. during the sales process). For example, Hendickx et al (1989) found that warnings are more effective when

they are linked to people and anecdotes (and hence emotionally involving) than when they are based on statistics.

Anxiety and fearfulness

Eysenck (1992) proposed that highly anxious individuals attend preferentially to threat-related stimuli and interpret ambiguous stimuli and situations as threatening, and a number of studies have supported these predictions (e.g., Derakshan & Eysenck, 1997; Eysenck, et al., 1987; Vasey, El-Hag, & Daleiden, 1996).

Raghunathan and Pham (1999) found that induced anxiety increased individuals' preference for low risk, low-reward options, whereas induced sadness had the opposite effect. Lerner and Keltner (2000) found that fearful individuals make relatively pessimistic risk assessments and relatively risk-averse choices. Similarly, in energy settings, it might be that fearful and anxious (and, thus, neurotic) individuals are more likely to purchase boiler insurance.

9. Topics of interest for future research

Sometimes research and analysis gives rise to more questions to be answered in future projects and it is only time constraints that may limit the amount of findings for a certain topic of interest. In the current report we attempted to discuss decision-making and individual differences elements that were never explored in the past in the domain of energy. Except for surveys, online experiments and group discussions with end-users, which will reveal more about the weights of the underlying motivations of users in relation to their preferences for space and water heating, there are a few more literature topics to be explored. These will be outlined in the current section.

Energy Use

Group dynamics should be a topic of interest for future research in the energy use topic as decisions of daily energy use are made in group-settings. Research on gender dynamics, submissive versus dominant personality dynamics should be interesting to explore. The literature on this topic is quite rich. A useful point to start from would be decision making in patriarchic versus matriarchic families.

In the context of energy use, it would be also useful to explore in more depth effects of demographics such as gender, age, education and numeracy. Cultural norms should also be important in the domain of energy use. One may find ethnographic studies of household life and energy use within different cultures, which might show that energy consumption differentials can also follow from cultural background. Of course, cultural effects can also be easily traced in a survey where consumers indicate their country of origin in the questionnaire.

Moreover, the energy use chapter won't be complete unless more light is shed to the topic of on-peak versus off-peak use of services.

Another major issue around energy use is real-time data visualization and its optimal format. What information should be displayed, how people interpret this information, and how this might influence their decisions on energy use? This can also be explored via online experiments.

Finally, it would be useful to understand disinterested consumers and the reasons underlying their lack of concern for energy issues. Is this solely explained by income/wealth levels of the individual? Or is it also another topic where individual differences play their role? This might also be explored via a survey by inserting a question about their interest on the topic and then correlating this with other variables in the survey to shape the disinterested customer profile.

Energy Purchase

Energy purchase is a vast topic. Here, we outlined the most crucial work in psychology related to the flat rate bias. However, much behavioural research focuses on many additional elements that may affect energy purchase, for example, bundling, switching and lock-in as well as sunk costs. There are also other crucial issues of psychological nature, which might influence tariff choices, for example: what is the number of alternative tariffs offered to the consumer? In other words, what is the set of available options for the consumer? How will this affect decisions? Are decoy effects relevant to tariff choice? What's the period of the tariff offer (is it monthly, annual or weekly) and how will that affect decisions? Would the flat rate bias occur if users were offered a yearly flat tariff? And what are the effects of intertemporal choice in decision making of upfront costs? Timing plays a major role in these decisions as well as framing, presentation and changeability.

Energy Upgrade

The decision to upgrade would also depend on the investment costs (and the payback period e.g. whether those would be required in the form of an upfront lump sum amount or not), also on subsequent annual heating costs and the market value of the home (for homeowners). Beyond economic considerations, people faced with the upgrade decision will also have thoughts around the safety and security of a new system as well as the level of comfort this offers. Perceived comfort levels in relation to upgrades should depend on several factors such as: ease of use, required effort, system automation, maintenance requirements, durability, functional convenience, perceived risks, perceived controllability and compatibility with habits and routines. These are all considerations, which need further analysis from a psychological point of view.

Furthermore, more research on insurance and maintenance issues would be beneficial in the context of energy upgrade. Here, we outline the most crucial issues around insurance in upgrade decisions but there is an enormous amount of studies on insurance choice, presentation format, bundling, fixed/variable costs, intertemporal thinking and sunk costs which might influence the way these decisions are made.

Finally, the broad literature on future orientation that assesses the extent to which individuals are oriented to and affected by the future (or past/present) should be useful in the context of energy upgrade but also in the context of energy purchase. Similarly research on consideration of future consequences, shorttermism versus longtermism and control, might provide a better understanding of these decisions.

10. Appendix