Sussex Energy Group
SPRU - Science and Technology Policy Research

Affecting consumer behaviour on energy demand

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About the Sussex Energy Group

The Sussex Energy Group (SEG) at SPRU (Science & Technology Policy Research) is a team of 17 researchers dedicated to understanding the challenges and opportunities for transitions to a sustainable energy economy. We undertake academically excellent and inter-disciplinary social science research that is also centrally relevant to the needs of policy-makers and practitioners. We pursue these questions in close interaction with a diverse group of those who will need to make the changes happen. Core funding to the group is provided by the Economic and Social Research Council.

This report has been written by Mari Martiskainen, Research Officer at SEG.

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EXECUTIVE SUMMARY

This report provides a review of the literature on household energy consuming behaviours and how those behaviours can best be influenced with the goal of reducing energy consumption and carbon dioxide emissions (CO_2). The research also examines whether and how measures to encourage behavioural change can be included within future phases of the UK's Energy Efficiency Commitment and related policies.

As energy consumers, people do not simply consume gas or electricity in their homes, but rather the services that these energy sources provide. We all require energy for heating our homes, cooking, lighting, washing and using electrical appliances. There has been a significant increase in both gas and electricity consumption per household, as well as in relation to total energy consumption from households, related to the increase in household numbers. Household energy consumption will need to be significantly reduced if the UK is to meet its objectives for reducing CO_2 emissions.

If both buildings and transport are taken into consideration, households account for almost half of UK's CO_2 emissions. Domestic buildings alone account for 28% of UK's CO_2 emissions. These high emissions are partly a consequence of the UK's old and inefficient building stock. But the legacy of the building stock and the growth in incomes and household numbers form only part of the problem. The challenges associated with changing household behaviour form another and in many respects more challenging one.

For the majority of the time, energy use in the home is invisible and our energy consuming behaviours are based on routine and habit. We turn the lights on, leave televisions on standby and boil our kettles without having to think about how these actions are carried out, where the energy comes from or what the environmental consequences are. These behaviours are both complicated and difficult to change: partly because they are shaped by the characteristics of the building and the energy-using appliances, but more importantly because they are influenced by a range of internal and external factors, such as our beliefs, values and attitudes, other people's behaviours, the cultural settings we live in, and various economic incentives and constraints.

Behaviour can, however, be influenced and in some cases it has changed rather rapidly, for example in the increased popularity of organic food. Changing households' energy consuming behaviours, however, have been shown to be more complicated. Several studies have looked at the impact of intervention measures such as various forms of feedback on energy consumption, the use of better and more informative bills, or financial rewards and incentives, as well as employing techniques such as community-based campaigns or the use of micro-generation technologies. Some of these interventions appear to have resulted in considerable energy savings. For example, studies on feedback show an average of 5%-15% energy savings (at least in the short-term), while studies of community-based Eco-teams (where people get together on a monthly basis to discuss their energy, waste, transport and water use) suggest that even larger savings are possible.

However, existing research on intervention measures fails to provide clear evidence on which measure or a combination of measures is the most effective in achieving quantifiable, long-term energy savings. Many of the existing studies use small sample sizes, are prone to selection bias, fail to include a control group or have other methodological weaknesses. Many also only consider one type of intervention measure, or if they use multiple intervention measures, fail to distinguish

the relative contribution of each. This makes it difficult to estimate the potential impact of different forms of interventions with any confidence.

Nevertheless, previous research does suggest that feedback on energy use has the greatest potential to influence household energy consuming behaviours. Once people receive regular and effective feedback on their energy consumption, together with the associated costs and environmental impacts, they are more likely to change their behaviour, especially if their existing behaviour is not compatible with their values and beliefs. Feedback may also have the potential to change people's attitudes, make them aware of their 'bad habits' in relation to energy consumption, help them break these habits and form new behaviours.

Despite the fact that the evidence on behavioural change measures is still in its infancy, our results show that behavioural measures could be included in the next phase of the UK's Energy Efficiency Commitment (EEC). This has the potential to act as a pilot for behavioural change measures, and to provide further evidence on which measures, or combinations of measures are effective, to what extent and under what conditions. Since the existing evidence on the energy savings from behavioural measures is relatively weak, a rather conservative approach may be required to begin with. Behavioural change measures could be for instance ring-fenced to form their own part within EEC3, with the risk on the amount of savings being borne by the Government, rather than energy suppliers. EEC already allows flexibility in the choice of energy saving measures by suppliers, and this could also prove helpful in the inclusion of behavioural change measures, thereby encouraging innovative approach to trialling these measures.

In order to establish which intervention measure or a combination of measures prove to be the most effective, further research is required. The Government has already announced trials on feedback devices such as smart meters and direct displays, which are due to begin in Spring 2007. The inclusion of trials of behavioural measures within EEC3 would further contribute to the expanding evidence base. However, more fundamental changes in households' behaviour are likely to require a holistic approach, that goes beyond energy use in the home to also consider transport, waste and water use - all of which ultimately have energy and climate impacts.

Summary of key conclusions:

- Behaviour is a complex combination of our emotions, morals, habits, social and normative factors and changing any of these components can be challenging
- Majority of energy consuming behaviours are based on habits and routine (repetitive actions such as using lights and cooking), minority of behaviours are one-shot behaviours (e.g. investment in loft insulation)
- Habits need to be broken down and changed by introducing new behaviours, building awareness can help
- Measures such as feedback displays, better billing and micro-generation can help making people more aware of their energy consumption, and consequently influence their behaviour
- Research has shown that feedback on energy consumption can encourage households to save energy, by an average of 5-15% depending on the measure
- To be effective, intervention measures such as feedback via a display unit/bill have to be:
    - Clearly presented and consisting of simple messages
    - Containing information relevant to the household/consumer
    - Involving some kind of a goal or a commitment
    - Be visible, consistent and frequent.
- A combination of energy advice with display units and more innovative billing for example could provide households with a mix of better information and feedback on their energy consumption, and initiate awareness and possibly behavioural change
- Further experimental research is required to establish which behavioural change measures can achieve the most, long-term energy savings.

1 Introduction

This report is based on a review of research on households' energy consuming behaviours and how those behaviours can be influenced with the goal of reducing carbon dioxide emissions from domestic energy use. The research also highlights the relevant UK policy instruments aimed for the residential energy sector and how these are formed. The project is timely in that the third phase of the UK's Energy Efficiency Commitment (EEC) is being consulted on, while other recent policy developments such as outcomes of the 2006 Energy Review and the publication of the Draft Climate Change Bill consultation in March 2007 were able to feed into this research.

The research project was funded by EdF Energy, and undertaken by the Sussex Energy Group, based at the Science and Technology Policy Research (SPRU), University of Sussex.

As energy consumers, people do not only consume gas or electricity in their homes, but rather the services that these energy sources produce. We all require energy for heating our homes, cooking, lighting, washing and using electrical appliances. For majority of the time, energy use in the home is not visible and majority of the energy consuming behaviours that we undertake are based on routine and habit. We turn the lights on, leave televisions on standby and boil our kettles without having to think about how these actions are carried out or where the energy to power various household appliances comes from.

In 2003 the UK Government published its long-awaited Energy White Paper (DTI 2003), stating the following four objectives for the country's new energy policy:

- to mitigate climate change by cutting the UK's carbon dioxide emissions by 60% by 2050
- to maintain secure supplies of energy
- to promote competitive markets
- to ensure that every home is adequately and affordably heated.

Three years later, in 2006 the Government published a much debated Energy Review, which reinforced the 2003 White Paper's main goals, but also highlighted climate change, energy security and affordability as the key long-term challenges (DTI 2006). In March 2007, the Government also published its draft Climate Change Bill Consultation Document, which outlines a framework for the UK to achieve its emissions reduction targets (Defra 2007). Main contributors to UK's carbon dioxide (CO_2) emissions - the key greenhouse gas contributing to climate change - are business, transport and the residential sectors, of which domestic buildings account for about 27-28% of total CO_2 emissions (DTI 2006). As stated in the Energy Review, reducing emissions from all these sectors is a key focus for energy policy makers, a task which is both urgent and challenging.

This report '**Affecting consumer behaviour on energy demand**' focuses on the residential sector, with the aim to provide better understanding of energy consumption in the home and whether it can be influenced through behavioural change measures. The report identifies the main factors determining households' behaviours in relation to their energy use, and how these can be influenced. It also provides a better understanding of the methodological challenges relating to measuring energy savings. Given this, the following research questions are answered:

- What are the options for encouraging behavioural change?
- How can energy-using behaviour be understood?

- What are the potential savings from such 'behavioural' measures?
- How can such measures be included in the Energy Efficiency Commitment (EEC)?

Chapter 2 explains the methodology used in this study, while Chapter 3 reflects on the trends in previous research conducted on domestic energy use. Chapter 4 moves on to behavioural change models, outlining key models relevant to this study, as well as ways in which behaviours can be influenced or changed. Chapter 5 looks at the trends in domestic energy use in the UK's, and how these could potentially be changed, while Chapter 6 discusses the key intervention measures used in previous research on domestic energy consumption, including measures such as feedback displays, community-based campaigning tools and micro-generation technologies. Chapter 7 moves on to the most relevant policy measure to this study, the Energy Efficiency Commitment, and identifies ways in which behavioural change measures could be incorporated in the next phase of the Commitment. Chapter 8 concludes the research, including summary of findings and suggestions for future research. References and Appendices are included at the end of the report.

2 Methodology

The 'Affecting consumer behaviour on energy demand' report is largely based on a desk study, which involved a comprehensive review of academic and policy literature on technical and informational energy efficiency options, as well as behavioural and policy measures. A small number of informal telephone interviews were also conducted with energy experts in the UK, including BSkyB Ltd, Centre for Sustainable Energy, Department for Environment Food and Rural Affairs (Defra), Energy Saving Trust, and the Office of Gas and Electricity Markets (Ofgem). The interviews were semi-structured and included general questions on energy efficiency as well as more detailed questions on EEC. Each interview lasted for approximately 40-60 minutes. In addition, two workshops were held with EdF Energy during the project, one in the middle and another towards the end. Both workshops contributed to the final report.

The review of behavioural literature formed a large part of the project, particularly academic and policy literature on domestic energy consumption, as well as identifying those measures which can influence domestic energy consumption behaviours. Several models and theories have been developed on human behaviour, particularly in the field of sustainable consumption. Summary of key models relevant to this study are outlined in more detail in Chapter 4, based on an extensive review of behavioural models by Tim Jackson (2005). There are also several good existing reviews available on household energy use intervention studies (see particularly Abrahamse *et al.* 2005; Darby 2006; Dwyer *et al.* 1993), which were used as a basis for the literature review on intervention studies. Out of the key intervention literature a total of 31 studies were analysed in greater detail. This entailed an analysis of their methodological strength, for instance whether the studies included a theory as their base, included a hypothesis, how they selected their sample group and whether or not they used a control group (see Annex B for a summary table of these studies).

The literature review on EEC included key Government policy documents and reports. Furthermore, the stakeholder consultation focused on options for the next phase of EEC, EEC3 which is due to take place in 2008-2011. This report also includes case studies from other countries where behavioural measures have been used successfully in encouraging household energy saving.

3 Historical aspects to previous research

Saving energy and energy efficiency measures have been of interest to researchers for over 35 years, and the energy saving dilemma is by no means new, as Bittle *et al.* noted back in the late 1970s:

'One of the most important problems facing our society today is the problem of energy conservation. The rapidly dwindling known supplies of oil, coupled with accelerating energy needs has created a crisis like atmosphere which has stimulated activity in both political and scientific areas' (1979-1980, pg. 275).

There may have been differing motives as to why research has looked at this area, however, the overarching theme has been the focus on the need to use less energy, whether for economic, security or environmental reasons.

3.1 1970s-1980s - general theme oil price shocks

As a result of the 1970s oil price crisis, several academics conducted research into energy 'conservation', particularly concentrating on how to encourage households to reduce their energy consumption. Much of the research was undertaken in the US, often funded by energy industry. From the mid-1970s onwards the energy conservation research agenda was also partly driven by environmental reasons, with main interests in pollution control, energy conservation and recycling (Dwyer *et al.* 1993). This research peaked in 1977, and again in the early 1980s, declining steadily through the late 1980s and 1990s.

An important part of the 1970s energy conservation research was the use of various intervention measures, including methods such as information on energy conservation (including information campaigns and leaflets), feedback on energy use (for instance prompt cards displaying energy use) and domestic energy saving goals. Several of the studies conducted in the late 1970s-1980s included behavioural-intervention studies, concentrating on various strategies to modify environmentally relevant behaviour (Dwyer *et al.* 1993). Measures such as information leaflets, prompts on energy use, energy conservation workshops and public communication campaigns were often used to encourage domestic energy use. However, many of the studies analysing such measures examined the effects of only one intervention measure (Dwyer *et al.* 1993), making it difficult to draw conclusions on which measure or a combination of measures would be the most effective in inducing energy saving behaviours. In addition, some of the earlier studies were also not always directly replicable or representative of the wider population, as many of them used small sample sizes, were not always methodologically strong and lacked such academic measures as the use of a control group (Bittle *et al.* 1979; Hayes & Cone 1977; Hayes & Cone 1981). Furthermore, several of these studies were conducted in the US and are not necessarily comparable to UK conditions, for instance given the widespread use of domestic air-conditioning and electric heating in the US. However, results from several of these studies will be discussed in Chapter 6, as some of them do show interesting results despite some of the earlier research lacking in methodological strength.

3.2 1990-2000s - climate change dominates agenda

While earlier energy conservation research agenda was largely driven by high oil prices and concerns over energy security, research in the 1990s and the 21st century introduced an additional approach to consider, sustainability and climate impacts. Researchers have increasingly discussed

pro-environmental behaviours and the promotion of sustainable consumption in areas such as recycling, energy efficient appliances, waste and transport methods (Geller 2002; Jackson 2005). Some of the studies in the 1990s also found that environmental beliefs and attitudes did not have a significant influence on energy consumption, but monetary savings and making energy use visible were better motivators than environmental factors. This is also notable in the research terminology, instead of the 1970/80s 'energy conservation' agenda, in the 1990s/2000s researchers and policy makers talked about 'energy efficiency' or 'energy saving'. There has also been a clear interest in evaluating *how* much households save energy, rather than focusing on the reasons *why* households do not save energy or take advantage of existing energy efficiency measures.

3.2.1 Household energy use lacks a link to climate change

Research conducted in the 1990s-2000s has also found that in general people tend to be concerned about climate change, however, they do not always link their everyday behaviour as contributing to the problem of climate change.

'People are interested in the services and amenities energy provides them, not energy per se, and they largely ignore details about energy except when paying the utility bills, fueling up the car, or buying a large electrical appliance.' (Goldblatt 2005, pg. 76)

People may often choose more sustainable consumption patterns in some areas, buying organic food for example, but will not link their energy use at home to climate change. A public opinion study by Future Foundation (2006) for instance found that despite people's awareness of environmental issues, there is a general lack of knowledge about energy use and its impacts, and around 40% of respondents indicated that they have more important things to worry about than their energy use. People tend to know about climate change and are concerned about it but they often fail to make a link between climate change and their everyday actions such as the use of gas or electricity in their homes. Furthermore, people may perceive issues such as climate change to be so complicated and far in the future that they may feel disempowered and think that they themselves can not do anything to address it (Moser & Dilling 2004). Recent research in energy saving has also highlighted the need for a practical combination of behavioural intervention and social marketing measures to ensure that people do not only change their behaviour to more pro-environmental actions, but also sustain it for the long-term (Geller 2002).

3.3 Summary of previous research

A general theme is emerging from the earlier research - energy efficiency and consumer behaviour have been puzzling researchers for over 35 years and still are. The consequences of household energy use may have changed from 1970's concerns over dwindling energy supplies to today's climate impacts, but the overall question still remains the same: how to make people use less energy in their homes? Furthermore, much of the earlier research concentrated on *how* much households conserved energy, but did not necessarily identify the reasons *why* people do not use less energy or take advantage of existing energy efficiency measures. Studies conducted in the 21st century often found that people tended to be concerned about climate change, but did not link their everyday behaviour such as gas and electricity use in the home to increased emissions and subsequently climate change. The key question of why energy consumption in the domestic sector keeps rising, has been highlighted in the energy behaviour research time and time again.

4 The behavioural challenge

4.1 What is behaviour?

Before moving on to the various behavioural models, we define what we mean by *behaviour* or more importantly *behaviours* in the context of this study. Energy consumption in itself is not behaviour, but rather a consequence of behaviours, such as turning the lights off or lowering thermostat levels (Becker *et al.* 1981). In this study, we concentrate on behaviours which relate to households' direct energy requirements (electricity and space heating), including behaviours such as turning lights on, using electric appliances, adjusting thermostat settings, cooking and washing. The study also briefly discusses sustainable consumption behaviours, which are closely linked to purchasing decisions such as the buying of energy efficient appliances.

Researchers have divided household energy saving behaviours to two different groups:

Table 1: Energy saving behaviours

Behaviour type	Examples
Efficiency behaviours	One-shot behaviours - investment • loft insulation • cavity wall insulation • Double-glazing
Curtailment behaviours	Repetitive efforts - operational • Turning lights off • Closing curtains • Turning appliances off

(see for example Abrahamse *et al.* 2005; Dwyer *et al.* 1993)

These behaviours can be considered from an economics perspective, i.e. people's energy consuming behaviours are linked to and have monetary impacts; or from a value approach, i.e. energy consuming behaviours are linked to and have environmental impacts which are of concern to people. Researchers have used both perspectives in analysing households' energy consumption behaviours, as outlined in Chapter 6.

Behavioural researchers who have analysed energy consumption behaviours have not been able to quantify whether curtailment or efficiency behaviours are more effective in domestic energy saving (see for example Abrahamse *et al.* 2005). Some researchers have argued that curtailment behaviours initiate *actual behavioural changes* and sustain them for long-term (see Geller 2002), while some of the recent research has suggested that efficiency behaviours are in fact generally more effective in obtaining *actual energy savings* (Abrahamse *et al.* 2005), though the success of efficiency behaviours may be counteracted by the rebound-effect[1].

Whether our energy behaviours are based on one-off investment efforts or continuous efforts, our behaviours are overall influenced by wider societal, as well as personal factors. *Macro-level* factors such as technological developments, economic growth, demographic factors, institutional factors, cultural developments (so called TEDIC factors) influence our behaviour at the broader level, while *micro-level* factors such as motivation, ability and opportunity (MOA factors) shape our behaviour at the individual level (Abrahamse *et al.* 2005). Our behaviour is also influenced

[1] The so-called 'rebound effect' is the focus of a long-running dispute among energy economists, the question is whether improved energy efficiency will lead to a reduction in energy consumption for the economy as a whole. Sussex Energy Group is currently conducting a UKERC-funded research project '*Evidence on the impact of improved technical efficiency on energy consumption: the 'Rebound Effect*'', which is due to report in June 2007.

by habits and routines which people undertake without the actual need to think about them. Jackson (2005) divides these influencing factors into internal factors (attitudes, beliefs, norms) and external factors (regulations, institutions). Gärling *et al.* (2002) argue that in order to change people's environmental behaviour we need to consider both macro and micro-level factors - in other words, both internal and external factors.

Selecting the best measures to encourage behavioural change such as reducing domestic energy consumption is not easy. However, there is some amount of evidence from empirical energy consumption research, as well as from other pro-environmental behaviours (such as recycling), that behavioural change can take place under the right conditions and can be influenced by public policy. The remaining part of this Chapter outlines behavioural change theories, introducing some of the key social-psychological models which have been used in pro-environmental behaviour research. Chapters 5 and 6 then move on to discuss some of the research conducted on domestic energy consumption behaviours.

4.2 Different models of behaviour and change

The key theories and behavioural models discussed next are largely based on a review of socio-psychological models by Tim Jackson (2005). This is not a comprehensive review of the models, but rather an indication of the type of theories that have been used or could be used in relation to understanding domestic energy consumption behaviours and how behaviours could be changed through interventions. A total of 10 models are discussed, including their strengths and weaknesses, as well as suitability for environmental research.

4.2.1 Rational Choice Theory

One of the most widely used behavioural theories is the 'rational choice' model of neoclassical economics. This theory is based on the notion that consumers weigh the expected costs and benefits of different actions and choose those actions which are most beneficial or least costly to them (Jackson 2005). The theory is also based on the principle that in order to weigh the costs and benefits of various options, the consumer needs information on the possible actions or goods they can choose from in order to make rational choices. This theory was used in much of the 1970s energy conservation research, with researchers using measures such as information campaigns and workshops as tools of highlighting the benefits of energy saving measures in the home (see for example Becker 1978; Bittle *et al.* 1979; Bittle *et al.* 1979-1980). The rational choice theory is very limited, however, as it fails to account the influence of factors such as habits, emotions, social norms, moral behaviours and cognitive limitations (Jackson 2005), which was also shown by much of the earlier research with information only campaigns having little influence on people's behaviour.

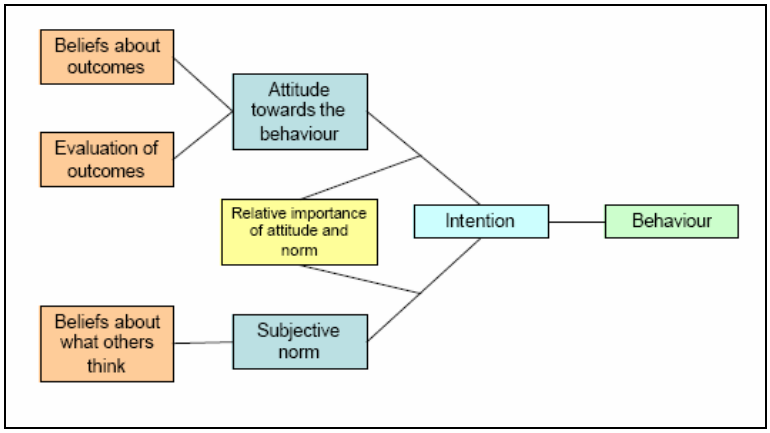
4.2.2 Expectancy Value Models - Theory of Reasoned Action and Theory of Planned Behaviour

The Theory of Reasoned Action (TRA) is a general theory of social action and has its starting point in the 'expectancy value theory', the notion that people expect certain values from the outcomes of their behaviour.

'Beliefs about and evaluations of outcome lead to an attitude towards the given behaviour, and this attitude towards the behaviour is one of two main influences on people's intention to act in the given way' (Jackson 2005, pg. 46).

The TRA also takes into account person's subjective norms, i.e. what other people think of his/her behaviour - as opposed to personal norms, i.e. individual's own opinion on certain behaviours. The TRA model could be used in understanding pro-environmental behaviour (See for example study by Becker *et al.* 1981), however the model has its limitations as it does not address issues such as habits and the influence of emotional or moral factors (Jackson 2005).

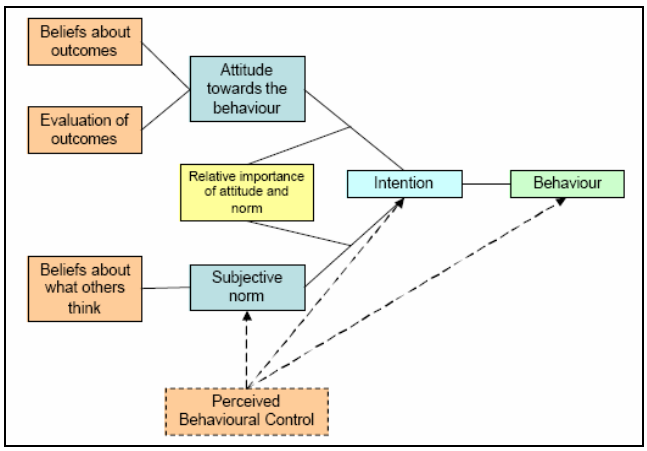
Figure 1: Theory of Reasoned Action



(Source: Jackson 2005)

The Theory of Planned Behaviour builds on the TRA model (Jackson 2005), including a new dimension of perceived behavioural control (PBC). PBC is based on the principle that person's beliefs on how difficult or easy a behaviour is influence his/her decision to conduct that behaviour, including a strong notion on person's ability to choose his/her actions (Jackson 2005). The theory of planned behaviour has been one of the most widely used in pro-environmental behavioural research, including research in recycling, travel mode choice and energy consumption (Jackson 2005), as well as in other areas such as quitting smoking, blood donation and the use of the Internet (Kalafatis *et al.* 1999). However, the model has been used more for measuring the relationships between attitude, intention and perceived behavioural control, rather than the measurement of *actual* behaviours or behavioural changes (Jackson 2005; Kalafatis *et al.* 1999).

Figure 2: Theory of Planned Behaviour



(Source: Jackson 2005)

4.2.3 Moral and normative conduct – Ecological Value Theory and Value Belief Norm Theory

There are several models which are linked to normative or moral aspects of behaviours - (such as the Value Theory, the Norm-Activation theory and the Focus Theory of Normative Conduct). This brief review will outline the principles of the Ecological Value Theory and the Value Belief Norm Theory, as these are directly linked to pro-environmental behaviours.

According to the Ecological Value Theory, those who mainly hold egoistic and self-interested values are less likely to perform pro-environmental behaviours than those who have pro-social values. However, having pro-social or pro-environmental attitudes is not a sufficient condition for pro-social/pro-environmental behaviours (Jackson 2005). This has been demonstrated for instance in studies on household energy saving behaviours (Gatersleben *et al.* 2002; Jensen 2002, as referenced in Jackson 2005), which have shown that those households who have higher pro-environmental attitudes often also belong to higher socio-demographic groups - which in turn often have the highest level of domestic energy consumption. Hence, in addition to pro-environmental and pro-social attitudes, contextual and situational factors need to be taken into consideration when applying behavioural change theories (Jackson 2005).

The Value Belief Norm Theory (VBN) was developed by Paul Stern and is based on the principle that pro-social attitudes and personal moral norms are predictors of pro-environmental behaviour (Jackson 2005). The VBN-theory builds on a causal chain of five variables that determine human behaviour (personal values, ecological worldview, adverse consequences for valued objects, perceived ability to reduce threat and pro-environmental personal norms) (Stern 2000, pg. 412).

Table 2: The Value Belief Norm Theory (VBN)

The Value Belief Norm Theory (VBN)			
Values →	Beliefs →	Pro-environmental personal norms →	Behaviours
• *Biospheric* • *Altruistic* • *Egoistic*	• *Ecological worldview* • *Adverse consequences for valued objects (e.g. family)* • *Perceived ability to reduce threat*	• *Sense of obligation to take pro-environmental actions*	• *Activism* • *Non-activist public behaviour* • *Private behaviour* • *Organisational behaviour*

'*The causal chain moves from relatively stable central elements of personality and belief structure to more focused beliefs about human-environment relation, their consequences, and the individuals responsibility for taking corrective action.*' (Stern 2000, pp. 413).

The three causal variables that lead from values to personal norms that activate environmental behaviour are beliefs. As a consequence, information can play an important role in influencing beliefs, which in turn can change pro-environmental norms that finally lead to environmentally significant behaviours. The above determinants are influenced by the following causal variables: attitudinal factors, contextual forces, personal capabilities and habit or routine. Examples of these variables are given in Table 3.

Table 3: Causal variables influencing environmentally significant behaviour

Causal variable	Indicators	Examples
Attitudinal factors	• Norms • Beliefs • Values	• General pro-environmental predisposition • Personal commitment • Product attributes
Contextual forces	• Interpersonal influence • Advertising • Monetary costs/benefits • Regulation • Support policies • Status	• Persuasion within communities • EEC • High energy prices • Grant programme • Owned/rented house
Personal capabilities	• Knowledge and skills • Availability of time • General capabilities and resources / socio-economic data	• Understanding of the function of a micro-generation technology • Information gathering • Literacy, money and social status
Habit or routine	• Energy consuming behaviour	• Switching lights off • Leaving appliances on standby

(Source: based on Stern 2000)

Most important for analysis using the VBN theory is to recognise that the different types of causal factors are likely to interact, and that 'different value orientations co-exist in the same individual and may all influence behaviour' with social contexts partly determining which of these values influence behaviour (Jackson 2005, pg. 57).

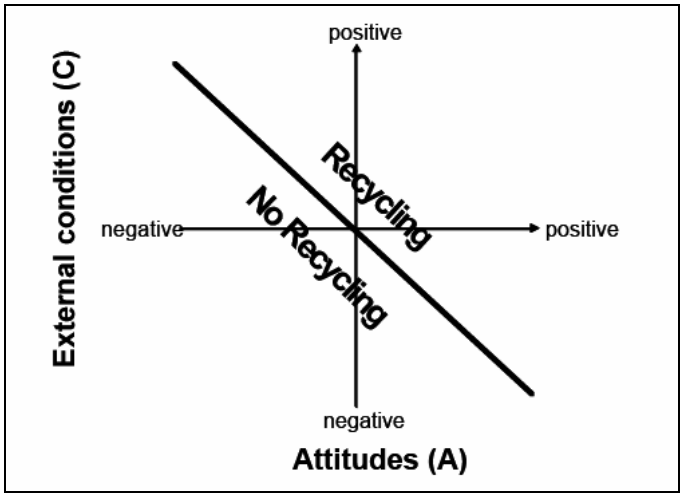
4.2.4 Attitude-Behaviour-Context model

The previously discussed models mainly concentrate on either internal (attitudes, values, habits and personal norms) or external (fiscal and regulatory incentives, institutional constraints and social practises) factors influencing behaviour. However, in order to fully understand behaviour, we need to also look at models which combine both internalist and externalist perspectives (Jackson 2005). In this context we briefly outline the Attitude-Behaviour-Context model which has been used in pro-environmental behaviour research.

The Attitude-Behaviour-Constraint (ABC) model of environmentally significant behaviour is based on the understanding that 'behaviour is a function of the organism and its environment' (Jackson 2005, pg. 92). Or in other words, behaviour (B) is an interactive outcome of personal attitudinal variables (A) and contextual (C) factors. Attitudinal variables include beliefs, norms, values and a tendency to act in certain ways, while contextual factors include monetary incentives and costs, physical capabilities and constraints, social norms, institutional and legal factors (Jackson 2005). The main dimension of the model is the interaction between attitudes (internal) and contexts (external). The model has been used for instance in the context of recycling:

'when access to recycling facilities is either very hard or very easy, it scarcely matters whether or not people hold pro-recycling attitudes. In the first case, virtually no-one recycles; and in the second case most people recycle. In a situation, however, in which it is possible but not necessarily easy to recycle, the correlation between pro-environmental attitude and recycling behaviour is strongest' (Jackson 2005, pg. 93).

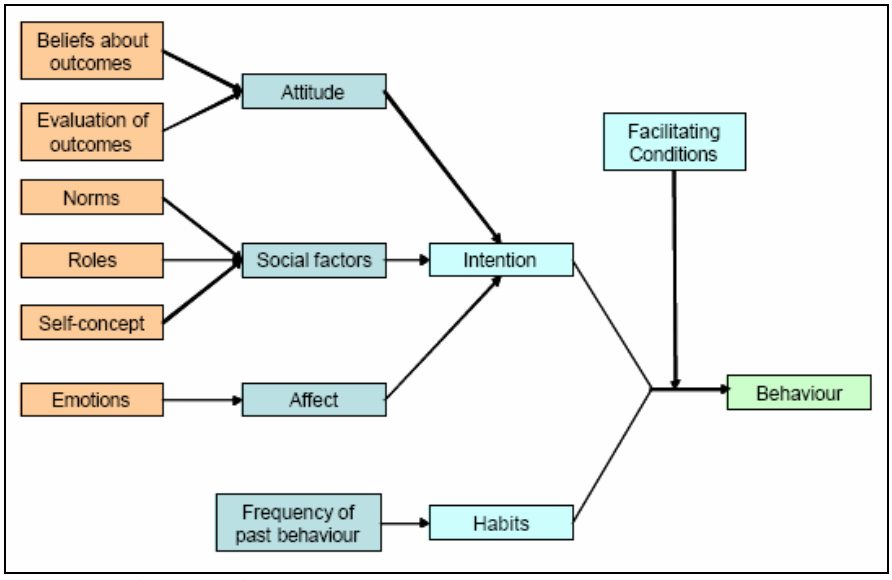
Figure 3: The Attitude-Behaviour-Context model applied to recycling



(Source: Jackson 2005)

However the ABC model does not take into account the influence of habits, which are acknowledged by some other models such as the Triandis' Theory of Interpersonal Behaviour (TIB) (see Figure 4, see also Chapter 4.2.6 on habits). In Triandis' model intentions, and habits, influence behaviour, which are also affected by facilitating conditions (external factors). According to Triandis' model, behaviour in any given situation is a function of what a person intends, what his/her habits are, any situational factors and the conditions in which the person operates (Jackson 2005). This model has been used in pro-environmental research, for instance in defining whether morals and habit had an influence on students' car use (Bamberg & Schmidt 2003). Furthermore, according to Triandis' model, person's intentions are influenced by rational thought, and social, normative and emotional factors. However, generally the more complicated a model is, the less it has been used in experimental research, hence for instance the Triandis' model has not been used as widely as for instance some of the earlier discussed models.

Figure 4: Triandis' Theory of Interpersonal Behaviour



(Source: Jackson 2005)

4.2.5 Persuasion and social learning theories

The previously introduced models show that in addition to external factors, we need to also take into consideration internal factors, the influence of attitudes, beliefs and norms. Persuasion theory and social learning theory are theories which focus on how these internal factors can be influenced.

Persuasion theory is based on three principles, the credibility of the speaker, the persuasiveness of the argument/message and the responsiveness of the audience/recipient, with the idea that recipients of persuasive enough messages will alter their attitudes and ultimately behaviour accordingly (Jackson 2005). This straightforward persuasion theory has its limitations, but versions of it, such as the Cognitive Dissonance Theory which places greater weight on individuals as active recipients of the persuasion process, have been shown to provide positive results in experimental research (Jackson 2005). The 'cognitive dissonance theory' is based on the principle that if person has two beliefs or items of knowledge that are not consistent with each other there is tendency to reduce this dissonant state, i.e. change behaviour accordingly. Other persuasion theory models include for instance the Elaboration Likelihood Model, which suggests that attitude change is based on two routes, both of which can result in attitude and ultimately behavioural change (Jackson 2005):

1. Central processing route - recipient's thorough attention to the persuasive message
2. Peripheral processing route - recipient's motivation to engage with the message is low but they may use other sources such as other people they look up to as source of influence on that issue

Social Learning Theory is another key behavioural change theory. According to this theory, people learn from their own experiences (trials, errors) as well as from other social models and from other people (family, friends, colleagues and people in the public eye) (Jackson 2005). The way people learn from these situations is varied, and people can for instance imitate others' behaviour but they are also influenced by others' experiences from their behaviours. In other words, our behaviour is influenced by our own experiences, other people's behaviour and their behavioural responses (Jackson 2005). For instance social learning theory can be used in the context of recycling – some people may be more likely to recycle if others in their street do so, and vice versa.

4.2.6 Changing 'bad' habits to positive behaviour

As mentioned earlier in this report, people's behaviours are influenced by several factors, some of which are more complicated than others. The more complex internal parts of our behaviours are formed by habits, and many of the behaviours that people perform are automatic and routine-like. This is particularly of significance with energy consumption behaviours which in many cases are based on routine and habit - for instance turning lights on, leaving appliances on standby, changing the thermostat level. People are often ingrained in their habits, and even though they may hold for instance pro-environmental values and attitudes, their behaviours are not guaranteed to be pro-environmental.

Many of our habits can be 'locked-in' - either because certain behaviours are easy for people to do (for instance leaving appliances on standby) or people live in certain conditions which lock in certain behaviours (for example people who live in rented accommodation and have little say over

the dwelling's insulation). People may also behave in certain ways even though those behaviours may routinely conflict with their rational thoughts or beliefs. Furthermore, the strength of our habits is based on two factors: how often we undertake certain habits and the positive reinforcement we receive from these habits - though much of our routine behaviour is based on counter-intentional habits, behaviours which we did not intend to do (Jackson 2005).

Jager (2000) distinguishes between 'reasoned behaviour' and 'automated reactions'. While economic models largely focus upon reasoned, 'deliberative' behaviour, much of our daily behaviours are based on habits and routines. In a similar manner, Jaeger distinguishes between those behaviours and decisions that are relatively independent of the behaviour of others (individually determined) and those that rely heavily on the observation of others (socially determined). This leads to a four-fold typology of behaviours, illustrated in Table 4.

Table 4: A model of different types of behaviour

	Automated	**Reasoned**
Individually determined	**Repetition / habit** • Conditioning	**Deliberation** • Planned behaviour - Attitudes - Behavioural control
Socially determined	**Imitation** • Social learning / normative conduct	**Social comparison** • Planned behaviour - Social norm • Relative deprivation / social comparison

(Source: Jager 2000)

Geller (2002) identifies three stages of behavioural change which can be applied to environmental behaviours as shown in Table 5.

Table 5: Three stages of behavioural change

Behaviour	**Competence**
Turn unintentional environment-destructive habit into environment-productive self-directed behaviour	Unconsciously incompetent
Change self-directed environment-destructive behaviour to environment-productive self-directed behaviour	Consciously incompetent
Turn environment-productive self-directed behaviour into environment-protective habit	Consciously competent Unconscious competence

(Based on Geller 2002)

Geller furthermore continues:

'The critical challenge is to help people get so personally committed to environmental protection that they would use self-management techniques to increase their pro-environment behaviour. This requires a shift from being accountable to feeling responsible. … Long-term pro-environment behaviour requires that people extend their responsibility for the environment beyond that for which they are held accountable.' (2002, pg. 535).

Efforts such as 'cognitive framing', using certain subjective cultural and/or emotional implications in addition to the explicit meaning of a certain behaviour, can be used as ways to

influence our attitudes and beliefs (Jackson 2005). An example of this would be the use of cognitive framing for instance on recycling or domestic energy saving to make these behaviours appeal to different audiences.

In order to establish behavioural changes, we need to consider options for changing 'bad' routine behaviours, such as driving a car for short journeys, disposing recyclable waste and leaving appliances on standby. Habits and routine behaviours are difficult to change, however, there is evidence that 'bad' environmental habits or routines can be changed (Jackson 2005). One way to approach the changing of bad habits and routines is to challenge and 'unfreeze' our existing beliefs, and discuss change and alternative behaviour openly, ideally in a group or community setting - the idea being that people will eventually break bad habits and form new, better ones. Such settings have been shown to provide positive results, and examples include the Dutch EcoTeam experience (see Chapter 6.3.1) and in the UK 'Action at Home' programmes run by Global Action Plan (Jackson 2005), which take a grass-roots level approach to environmental action by arranging group meetings with households on the issues of energy, waste, water and transport.

4.2.7 Social symbols, identity and the role of communities

In addition to habits, our behaviour is also influenced by social symbols. Symbolic Interactionism and Symbolic Self-Completion Theories argue that we purchase certain goods or symbols not only for their practical value but also to construct our identity, and use those goods or symbols for the image they portray of us to the outer world (Jackson 2005). Some researchers argue that under the idea of sustainable consumption, our aim should perhaps be to move away from using goods as social symbols and the basis of our identity to some other, more sustainable, and non-material resources (see Jackson 2005). This notion has also been supported by research in 'self-concept', the way we think about ourselves. For instance research in the purchase of organic food has found that people who think of themselves as 'green consumers' are more likely to purchase organic food (Jackson 2005).

Kantola *et al.* (1984) found that Cognitive Dissonance Theory could be used to encourage energy conservation. In a study of 118 high electricity use households who felt that it was their duty as responsible citizen's to conserve electricity, those who were made aware of their discrepancy between their attitudes and actual electricity consumption reduced their consumption the most compared to a control group. Kantola *et al.* (1984) conclude that if people are made aware of the difference between their attitudes and their actual behaviour, they are likely to change their behaviour.

Other research in behaviour and self-concept include the so-called 'spillover effect' (see for instance De Young 1993) between different types of environmental behaviours. A positive spillover effect occurs when those who are for instance keen recyclers also start to save energy in their homes or start to buy organic food, i.e. one pro-environmental behaviour leads to another (note that this can also work both ways and result in a negative spillover effect).

As described above, attitudes can influence behaviour. However, socio-psychological research also suggests that behaviour can influence attitudes, and in certain situations behaviour acts as a forerunner of attitudes (Jackson 2005). Furthermore, there are situations where our 'social identity', our inter-group behaviour, dictates our behaviour. For instance in some cases the only reason why people will not recycle is 'because recycling for me is associated with a certain kind

of person belonging to a certain kind of social group and *this group is not the one I belong to*' (Jackson 2005, pg. 83). In addition to social identity models, research in behavioural models has also employed models from cultural theory and has concluded that different approaches of pro-environmental policy options are required for instance for hierarchist types (prefer established traditions and institutions) than for individualistic types (prefer innovation and individual choice) (Jackson 2005). On the other hand, behavioural changes can also be driven by social trends or by individuals, the 'early adaptors', who can initiate a social change, and we can be 'locked-in' as much in *behavioural trends* than in actual fixed behaviour (Jackson 2005).

Community-based social marketing tools which bring people together from same communities can be a powerful tool for policy makers to use to encourage pro-environmental behaviours (Jackson 2005; McKenzie-Mohr 2000). This approach is based on the following linear steps (see for example McKenzie-Mohr 2000):

1. Select behaviour related to an environmental goal (such as turning lights off)
2. Identify barriers to the activity
3. Design a programme/strategy to overcome barriers
4. Pilot the programme/strategy
5. Evaluate the impact of the programme/strategy

The idea behind social marketing is that it is vital to understand the barriers that people perceive when attempting to undertake certain behaviours (Jackson 2005; McKenzie-Mohr 2000), but the model also uses social norms and community engagement. Examples of successful social marketing exercises include for instance a household composting strategy in Nova Scotia, which formed a community composting norm by using public commitments and visible signals. The results from the programme showed that 80% of those initially contacted were still composting months after the programme began. Another study concerning lawn-watering strategy showed that social marketing strategy reduced water use on lawns by 54% while an information-only control group increased their use by 15% (Jackson 2005, see pg. 119). Further examples of social marketing techniques are also discussed in Chapter 6.

4.2.8 Behavioural change guidance for policy makers

The UK Government has developed two behavioural change guides for delivering sustainable development which are relevant to this study. The first one explained here is available from the Environment Agency and is a checklist guide on behaviour to policy makers (Environment Agency 2005). This guide is based on seven key principles, bringing together key models from behavioural economics, including those discussed earlier in this report. The seven key principles are:

1. Other people's behaviour matters - people observe other people's behaviour which influences their own behaviour
2. Habits are important - many of people's behaviours are based on habits and routine
3. People are motivated to 'do the right thing' - in some cases money may be demotivating for people's behaviour
4. People's self-expectations influence how they behave - people want their actions to be in line with their values
5. People are loss-averse - people want to keep their things

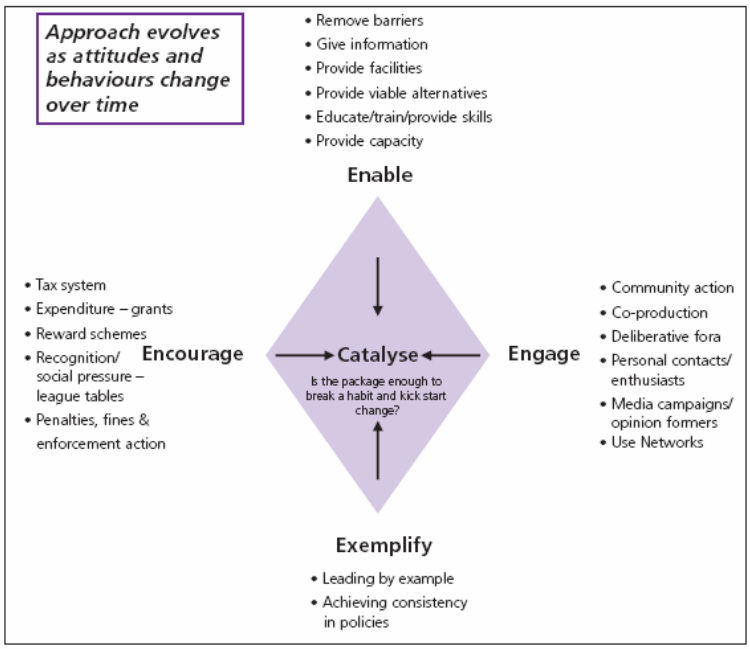
6. People are bad at computation - when making decisions, people tend to concentrate on the near future and can be strongly influenced on how information is presented to them
7. People need to feel involved and effective to make a change - incentives and information alone are not enough

Another guide available from the Government is aimed at helping policy makers to deliver sustainable development, and sustainable behaviours. This guide is based on four principles: *enable*, *encourage, engage* and *exemplify* (HM Government 2005). This model is based on the notion that all four steps are required in order to achieve behavioural change (see also Figure 5):

1. *Enable* people to make responsible choices by providing them with information, educational campaigns and facilities
2. *Encourage* behaviour change through regulation and reward schemes
3. *Engage* with communities and get people involved by giving them responsibility
4. *Exemplify* through leading by example.

Furthermore, the Government also identifies the need to design policies that 'catalyse people to behave differently' (HM Government 2005, pg. 26).

Figure 5: UK Government model for delivering sustainable development



(Source: HM Government 2005)

As can be seen from the discussion on behavioural change models, both the seven key principles and the '4 *E*s' guide are based on many of the previously discussed models and combine several of their key principles. It should be noted however, that not all of the principles are applicable in all situations, though many of them are relevant to energy consuming behaviours, especially the notion of habits as many energy consuming behaviours are routine-like; people are also loss-averse and want to maintain comfort in the home by heating their houses and owning various appliances; people can also be bad at computation and not necessarily consider the long-term climate impacts of their domestic energy use.

4.2.9 Conclusion on models of behavioural change

Several behavioural models and theories have been developed in socio-psychological research, and the range of these models shows that selecting the right type of measures to achieve behavioural change is not an easy task. Behaviour is a complex combination of our emotions, morals, habits, social and normative factors and changing any of these components can be challenging.

Table 6: Factors affecting behaviour

Factors affecting behaviour		
Internal	External	Habits / Routine
• Beliefs • Attitudes • Values	• Institutions • Regulation • Social contexts	• 'Doing by not thinking'

Despite the complexity of determining and influencing behavioural change, our behaviours do change and often do so on a regular basis, influenced by social trends or by individuals. Cases such as the use of mobile phones and personal computers, and the popularity of organic food are good examples of rather rapid behavioural changes.

In order to achieve behavioural change, and despite the complexity of the issues involved, there are methods available to encourage behavioural change. Ideally any measures intended to change behaviours take into account both internal (attitudes, values, habits and personal norms) and external (fiscal and regulatory incentives, institutional constraints and social practises) factors. Theories such as the value belief norm theory and the theory of interpersonal behaviour expand on the more traditional rational choice theory by considering the influence of both internal and external factors (Table 8 at the end of this Chapter summarises key theories, their descriptions and possible limitations). Furthermore, measures such as the persuasion theory and community-based social marketing tools have been shown to achieve positive results in influencing pro-environmental behaviours such as recycling or water conservation.

Out of the various models introduced here, Triandis' theory of interpersonal behaviour (TIB) is the most interesting in relation to the objectives of this study. Triandis' model does not only take into consideration internal and external factors influencing behaviours, but also includes the most complicated parts of people's behaviour, those of habits and routine. Triandis' model is thus particularly useful in relation to energy consuming behaviours, much of which are based on habits and routine (see also Table 7 below). Some of the earlier models such as the rational choice theory are too limited to be used in relation to energy consuming behaviours as they do not take habits or routine into consideration.

The Triandis' model 'attempt[s] to explain the intention to perform a specific behavior and the actual performance of that behavior' (Bamberg & Schmidt 2003, pg. 268). Furthermore, the model suggests that the stronger the habit, the less people have to think about that particular behaviour (Bamberg & Schmidt 2003), which can also be correlated to people's everyday energy consuming behaviours of cooking, washing and using lighting for instance. Even though Triandis' model has not been as widely used as for instance some of the simpler models (for instance the rational choice theory or the theory of reasoned action) it is increasingly of interest to researchers and policy makers who want to 'explor[e] the influence of habitualization on everyday

behaviors' (Bamberg & Schmidt 2003, pg. 269). It can therefore be of particular use to those wanting to explore energy consuming behaviours.

Table 7: Triandis' Theory of Interpersonal Behaviour in relation to energy use

<table>
<tr><td>Beliefs about outcomes
Turning lights of saves energy</td><td rowspan="2">Attitude
Saving energy is good</td><td rowspan="6">Intention
I will turn lights off</td><td rowspan="8">Facilitating conditions
Pay energy bill without heartache, type of lighting</td><td rowspan="8">Behaviour
Turn lights on/off</td></tr>
<tr><td>Evaluation of outcomes
Saving energy saves money/is good for environment</td></tr>
<tr><td>Norms
Saving energy is somewhat admirable but not mandatory</td><td rowspan="3">Social factors
Family members encourage energy saving</td></tr>
<tr><td>Roles
The one who pays the bill is responsible for energy saving</td></tr>
<tr><td>Self-concept
I save energy</td></tr>
<tr><td>Emotions
Saving energy makes me feel good</td><td>Affect
Saving energy is good for the environment</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="2">Frequency of past behaviour
Daily use of lighting</td><td>Habits
Use light switch without thinking</td></tr>
</table>

In considering how people's behaviours are formed and influenced, and how they could be changed, policy makers have to take into consideration internal and external factors; the social and regulatory contexts in which people live and how these are linked to the wider society and policy environment. The Triandis' model can be useful in determining these. Furthermore, more practical guidelines such as the Environment Agency checklist and the Government's guide to delivering sustainable development via *enabling*, *encouraging*, *engaging* and *exemplifying* can help in formulating various policies for different circumstances.

Table 8: Summary of behavioural change models and theories

Behavioural theory/model	Key authors (for full references see Jackson 2005)	Main concept	Limitations?
Rational Choice Theory	Elster 1986, Homans 1961	Consumers weigh the expected costs and benefits of different actions and choose those actions which are the most beneficial or the least costly.	The Rational Choice Theory does not take into account habit, emotion, social norms, moral behaviours and cognitive limitations.
Theory of Reasoned Action (TRA)	Ajzen and Fishbein 1980	People expect certain values from the outcomes of their behaviour.	The Theory of Reasoned Action does not address issues such as cognitive deliberation, habits and the influence of affective or moral factors.
Theory of Planned Behaviour	Ajzen 1991	Builds on the TRA model and includes a new dimension of perceived behavioural control (PBC) - person's belief on how difficult or easy a behaviour will be influences his/her decision to conduct that behaviour.	The Theory of Planned Behaviour model has been used more so for measuring the relationships between attitude, intention and perceived behavioural control, rather than the measurement of *actual* behaviour
Ecological Value Theory		Those who mainly hold egoistic and self-interested values are less likely to perform pro-environmental behaviour than those who have pro-social values.	Pro-environmental behaviours can be motivated by self- interest, altruism, and biospheric values. The influence of attitude-behaviour gap.
Value Belief Norm Theory	Stern *et al.* 1999, Stern 2000	Pro-social attitudes and personal moral norms are predictors of pro-environmental behaviour.	All variables have to be analysed to identify the most influential factors.
Symbolic Interactionism and Symbolic Self-Completion Theories	Blumer 1969, Mead 1934, Wicklund and Gollwitzer 1982	People purchase certain goods or symbols not only for their practical value but also to construct their identity, and use those goods for the image they portray of them to the outer world.	Evidence suggests that people's responses to goods and symbolic also occur at a sub- or semi-conscious level.
Attitude-Behaviour-Context Model	Stern and Oskamp 1987, Stern 2000	Behaviour (B) is an interactive outcome of personal attitudinal variables (A) and contextual (C) factors.	Does not take into account the influence of habits.
Theory of Interpersonal Behaviour	Triandis 1977	Intentions, and habits, influence behaviour, which are also affected by facilitating conditions (external factors).	Has not been as widely used in empirical research as could have been.
Persuasion Theory	Hovland et al. 1953, Petty *et al.* 2002	Persuasion Theory is based on three principles, the credibility of the speaker, persuasiveness of the message and the responsiveness of the audience. The recipients of persuasive enough messages will alter their attitudes and ultimately behaviour accordingly.	A straightforward persuasion theory has its limitations, but versions of it, such as the cognitive dissonance theory which places greater weight on individuals as active recipients of the persuasion process has been shown to provide positive results in experimental research
Social Learning Theory	Bandura 1977	People learn from our experiences (trials, errors) as well as from other social models and observing others around us (family, friends, colleagues and people in the public eye).	

(Note these exclude previously discussed two UK Government policy guides which are based on several of these theories.)

5 Energy consumption and behavioural change

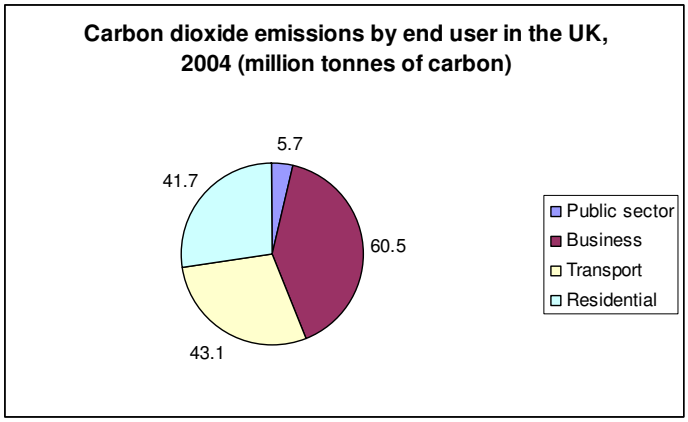
Key questions relating to domestic energy consumption behaviours are *why does domestic energy use keep rising* (Abrahamse *et al.* 2005) and *how can we make energy use and its impacts more visible to the householder so that they can consume less* (Darby 2006)? Despite the amount of information available on energy efficiency, recent steep increases in energy prices and energy consumption's impact on climate change, domestic energy use in the UK is predicted to rise unless the issue is addressed.

One of the key issues facing domestic energy consumption is the difficulty of making people aware that their behaviour at home is linked to increased CO_2 emissions (Brandon & Lewis 1999) and ultimately climate change. Energy use is not visible and people are often detached from their domestic gas and electricity use. Most domestic customers are trapped in the 'direct debit' dilemma - they only receive a monthly or a quarterly bill on their energy use for which payment goes directly from their bank account, hence not even having to open their bills (Brandon & Lewis 1999; Darby 2006; Roberts & Baker 2003). This can lead to little knowledge about how much gas or electricity people actually use in their homes. If gas and electricity bills are indeed opened, they include information which is not always clearly presented and can be confusing to the customer. Measures such as feedback on energy consumption, which are discussed in Chapter 6, can help to address this problem. First, however, we look at briefly the framework and trends relating to domestic energy consumption in the UK.

5.1 Domestic energy consumption in the UK

Domestic energy consumption at present contributes to around 27-28% of UK's CO_2 emissions, a figure which is predicted to increase over the coming years unless immediate action is taken to reduce those emissions. A recent report by Cambridge Econometrics predicts that 'CO_2 emissions from households are expected to be 11.25% above the 1990 level by 2010 and they, along with road transport, continue to be the major obstacle to achieving the Government's 20% domestic carbon reduction goal'[2].

Figure 6: Carbon dioxide emissions by end user in the UK, 2004 (million tonnes of carbon)



(Source: figures from DTI 2006)

[2] Cambridge Econometrics press release on *UK Energy and the Environment* report 18.09.2006 is available at http://www.camecon.co.uk/whatsnew/releases/uke3/uke3062.htm

Partly responsible for the increased use of energy and related emissions from households is the UK's building stock, both existing houses and new homes being built. It is estimated that out of today's 24 million homes, 21.8 million will still be existence in 2050 (Boardman *et al.* 2005). Furthermore, another 10 million new homes, equal to around 220,000 homes each year, are estimated to be built by 2050, which could potentially contribute a large amount of CO_2 emissions from both construction and household energy consuming behaviours (Boardman *et al.* 2005).

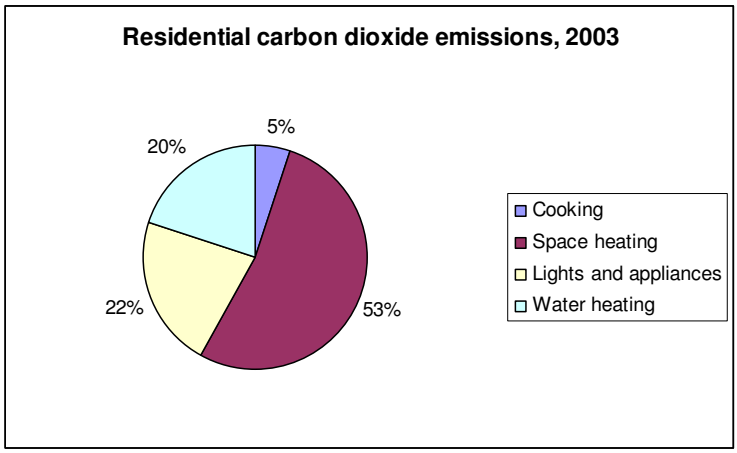
Many people in the UK are 'locked-in' to poorly built and inefficient houses, thus having less control over the emissions their homes produce. The majority of existing housing stock is old and inefficient; around 2 million of existing homes have a Standard Assessment Procedure (SAP)[3] figure below 30 while the average is around 50 (Boardman *et al.* 2005). A typical Scandinavian home has a SAP rating of approximately 90-100[4]. The UK Government has however indicated that by 2016 all new homes should be zero carbon while those being built before that will meet Scandinavian standards (DCLG 2006b, c). Furthermore, in Budget 2007, Chancellor Gordon Brown announced that zero carbon homes which cost less than £500,000 will be exempt from stamp duty, while zero carbon homes of value less than £500,000 will receive a £15,000 stamp duty reduction (HM Treasury 2007).

Despite Government signals to encourage low and zero carbon homes, there is a lack of confidence in these statements and that they will actually deliver better housing stock. There is evidence that existing Building Regulations, particularly Part L which covers energy efficiency standards, are not taken seriously by the building trade, or being enforced by authorities. A survey by Future Energy Solutions (2006) found that Part L is not a priority for builders and there are several areas which do not comply with the regulations: '…thermal bridging is the most frequently cited area of non-compliance. Conservatories, u-values of constructional elements, internal lighting, and windows, doors and roof lights closely followed these' (Future Energy Solutions 2006, pg. 38). In other words, new houses being built in the UK do not necessarily comply with Building Regulations requirements for energy efficiency and more than often these regulations are not enforced, leaving it possible for builders to construct inefficient houses.

In addition to the quality of existing and new housing stock, the increase in energy consumption is also linked to technological developments, economic growth, as well as cultural changes (Abrahamse *et al.* 2005). We may live in inefficient houses, but generally they are more comfortable with increased use of central heating and a range of electrical appliances. For instance the average internal temperatures in centrally heated UK homes have increased from 13.8 degrees Celsius (^{o}C) in 1970 to 18.2 ^{o}C in 2004[5], meaning that over half of today's household emissions are linked to space heating (see also Figure 7 below).

[3] SAP, which is based on thermal performance of the a building, heating appliances and energy prices of different heating fuels, has a scale of 1-120. Higher number indicates a better rating .
[4] Figure from Energy Efficiency Advice Centre, http://www.swansea.gov.uk/index.cfm?articleid=1308
[5] DTI statistics are available from http://www.dti.gov.uk/energy/statistics/publications/ecuk/domestic/page18071.html

Figure 7: Residential carbon dioxide emissions, 2003



(Source: figures from DTI 2006)

The increase in the use of electrical appliances has also been considerable. While ownership of some household appliances has remained relatively steady over the last 30 years (such as irons and TVs) and some have fallen slightly (coffee makers), we are increasingly owning more and various different types of appliances, a selection of which are shown in Table 9, while Table 10 outlines the energy savings due to efficiency measures.

Table 9: Percentage of households owning domestic appliances, 1970 to 2004

Appliance	1970	2004
Fridge freezer	1%	64.9%
Kettle	56.1%	96.6%
Dishwasher	1.2%	26.5%
Garden equipment	4.3%	79.7%
Electric shower	0.4%	36.3%
Mobile phone	0.6% in 1985	96%
TV	90.5%	98%
Iron	96.3%	99%
Coffee makers	27%	24.3%

(Source: DTI)[5]

Table 10: Energy saving due to insulation and heating efficiency (million tonnes of oil equivalent)

	Energy consumption	Insulating saving	Heating efficiency saving
1970	35.9	0.0	0.0
2004	47.3	20.2	22.2

(Source: DTI) [5]

Even though many of today's appliances have improved efficiency, they also have features which can counteract some of these efficiency savings. For instance standby modes were initially designed to make consumers lives easier, but are now linked to increased energy wastage. A recent study by the Energy Saving Trust found that the UK is the largest energy waster compared to European countries such as France, Germany or Italy, with habits such as using the car for short

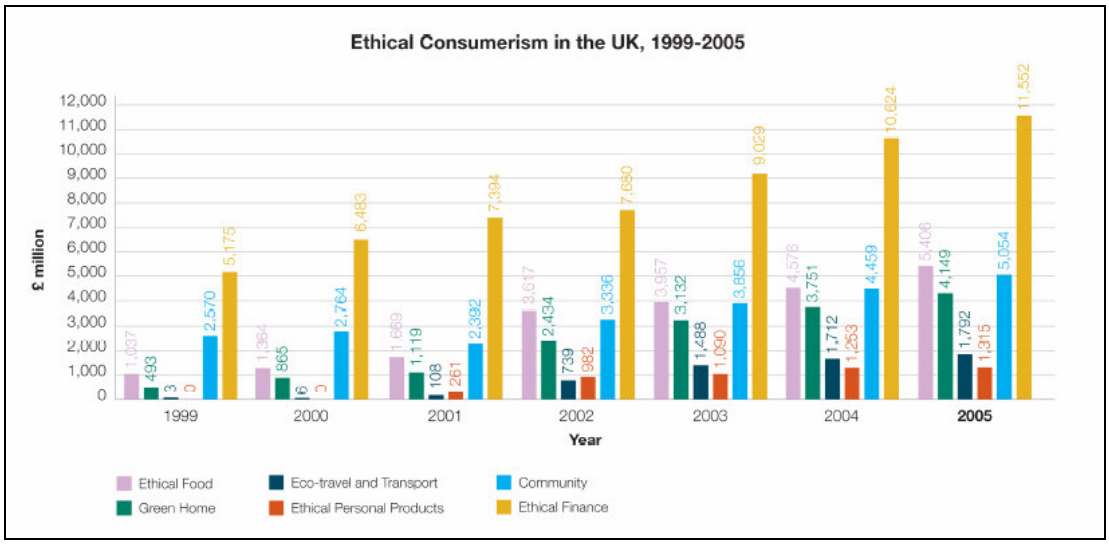
journeys, leaving appliances on standby, mobile phone chargers plugged in and the lights on forecast to cost the UK around £11 billion by 2010 (EST 2006). Around 71% of UK consumers leave appliances on standby, while 67% boil more water than they need in a kettle and 63% leave lights on in unoccupied rooms (EST 2006).

5.2 Sustainable consumption and purchasing decisions

While the trend in housing and the use of electrical appliances has clearly indicated increased energy consumption in the home, there has also been another trend, albeit a much smaller one, with certain consumer groups beginning to consider the environmental impacts of their purchasing decisions and the types of products they buy. This has partly been helped by the increased availability of environmentally friendly products in the market place (Kalafatis *et al.* 1999), as well as general fashion towards sustainable and ethical consumption.

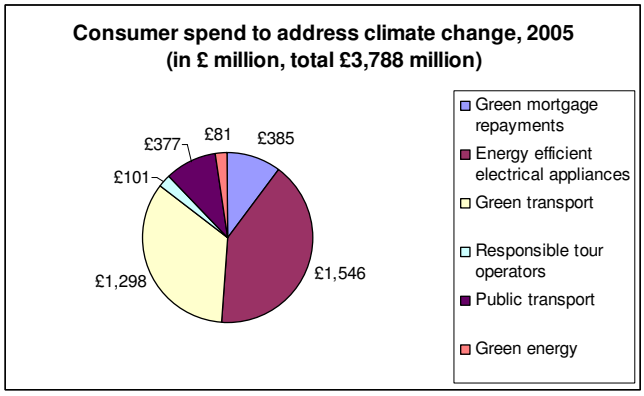
A good example is the rapid increase in the sales of organic produce in the last few years, as more people have become more health/environment conscious and are consequently reflecting this in their purchasing decisions. Organic food sales for instance doubled between 2000 and 2005 in the US and Europe, from EUR 15 billion (£10 billion) in 2000 to EUR 25 billion (£17 billion) in 2005 (Datamonitor 2006). This trend has also been reflected in other areas as the Co-operative Bank's '*Ethical Consumerism Report*' shows, with considerable year-on-year increases in ethical spending including food, travel, green homes and finance (Co-op 2006). For instance spending on 'green homes' has increased from £493 million in 1999 to £4,149 million in 2005 (Co-op 2006), with a total of £29.3 billion spent on 'ethical consumption' and £3,788 million directly to address climate change (see Figures 8 and 9 for more details).

Figure 8: Ethical consumerism figures for the UK



(Source: Co-op 2006)

Figure 9: Consumer spend to address climate change



(Source: Co-op 2006)

Even though there has been a large increase in sustainable consumption, it still forms only a part of total consumption. While 'ethical consumption' totalled £29.3 billion in 2005, cigarette and alcohol sales for instance accounted for around £28 billion, and total UK domestic consumption was around £719 billion[6].

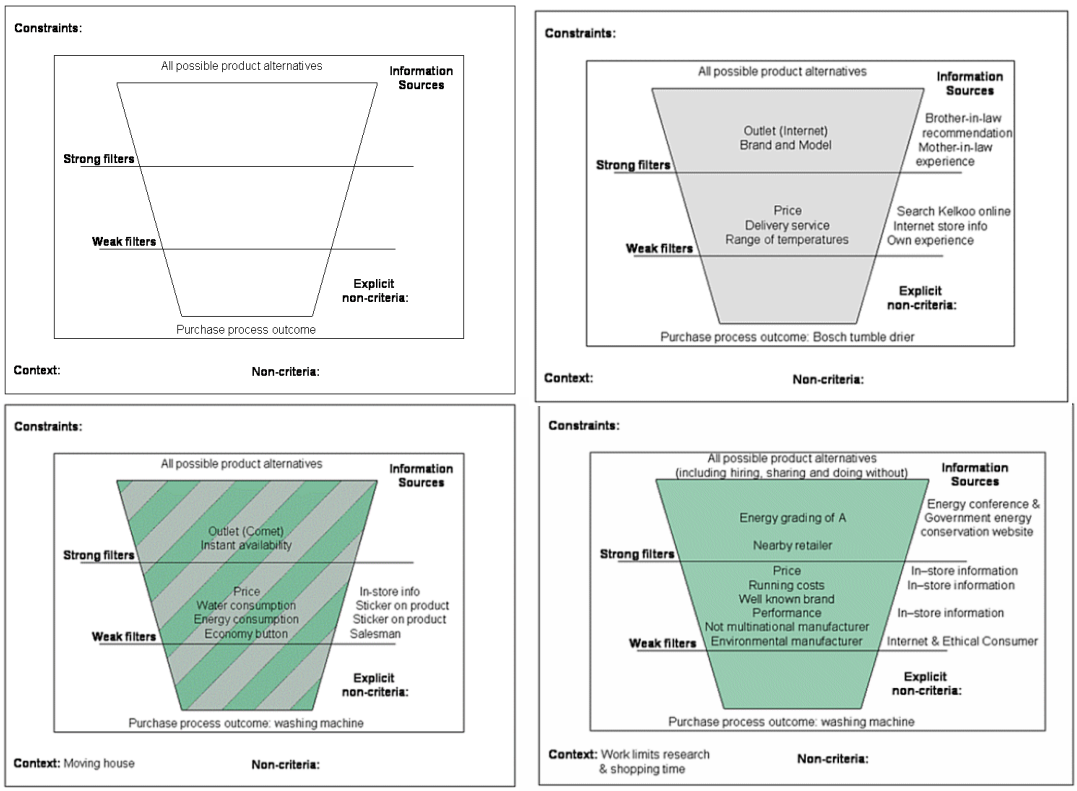
When considering sustainable consumption, the key questions arise on who makes purchasing decisions, how can these be affected and how will people end up buying more energy efficient appliances for instance?

A research project by University of Leeds, The Robert Gordon University and University of Sheffield has defined how green consumers make decisions about purchasing household and electrical appliances, and have formed a purchase model, which can be applied in different combinations and sequences[7]. They have defined three different types of consumers, the 'grey consumer', 'green consumer' and 'grey/green consumer'.

Green consumers have a preference for independent sources of information and advice, and they prioritise environmental and ethical reasons over other purchasing criteria. This group also takes longer to make decisions and are less inclined to rely on brand reputation. Grey consumers on the other hand are likely to spend less time on finding information, and may trust recommendations from friends and family. Grey consumers also rely on brand name and trust members on the shop floor for product information. Grey/green consumers combine ethical and practical concerns and are more aware of information sources than grey consumers, however they may not use all this information in their purchasing decisions. Grey/green consumers are also more likely to consider the ethics of the product manufacturer rather than the retailer.

[6] Figures from http://www.statistics.gov.uk
[7] More information about 'No such a thing as a green consumer?' project is available at http://www2.rgu.ac.uk/abs/sustainabletechnologies/index.htm

Figure 10: Clockwise from left: basic template model, grey consumer, green consumer and grey/green consumer



(Source: http://www2.rgu.ac.uk/abs/sustainabletechnologies/ppm10.htm)

In order to influence behaviour and encourage sustainable consumption some researchers (see for instance Uzzell *et al.* 2006) recommend a mixture of measures. These include for instance:

1. The use of social networks, particularly identifying leaders within communities who can promote sustainable consumption
2. Provoking emotions related to purchasing decisions, especially encouraging positive emotional responses
3. Restricting consumer choice.

These are measure that can be also linked to encouraging sustainable consumption in terms of household energy consumption - for instance using 'energy champions' in local communities to promote the purchase of energy efficient appliances and by removing inefficient products from the market place and thus restricting consumer choice. Similar actions were echoed in our stakeholder interviews, particularly in the case of using social networks and restricting consumer choice by having only the most energy efficient appliances available in the market place (Roberts 2007) by for instance removing white goods which are C- or D-rated and only leaving A- and B-rated white goods for the consumer to chose from. Restricting choice is not yet widely researched area and hence lacks evaluation, while any attempts by the Government to restrict choice may be seen by the public as 'nanny' state control. However, there are some good case studies which show that restricting choice and increasing regulation can result in behavioural change. For instance the London congestion charge and subsequent increase in the numbers of people cycling, as well as a ban on smoking in public houses in countries such as Ireland and Italy (Uzzell *et al.* 2006).

After three years since the introduction of the London congestion charge, car traffic had reduced by 30% and congestion by 30%, while cycling within the charging zone had increased by 30%[8].

In any case, decisions made on sustainable consumption are linked to several factors, just us our wider behaviours are influenced by several factors. As discussed in Chapter 4 habits form an integral part of our behaviour, in both positive and negative terms, and the same applies to our purchasing behaviours.

5.3 How to change energy consuming behaviours?

As discussed in Chapter 4 there are several economic, social and psychological factors which influence behaviour, including energy consuming behaviours. The key question is how to define the right measures which will make people change their energy consuming behaviours. McMakin *et al.* (2002) for instance conclude that people are more likely to carry out energy efficiency behaviours under certain conditions:

- people value energy efficiency measures more if they have benefits to themselves
- energy use and savings must be visible, providing goals and motives
- information is personalised and presented in a clear way.

Furthermore, McMakin *et al.* (2002, see page 850) continue that people are more likely to change their energy consumption behaviours *permanently* if the new behaviour is easy to perform, they have the skills/resources required to change behaviour, their neighbours and friends change their behaviours too, and people make public commitments to change their behaviours. These are notions that have been echoed by several of the previously discussed socio-psychological models and behavioural change guides (see Chapter 4).

Regarding domestic energy consumption, habits such as turning lights on/off can have either a positive or negative impact on the amount of energy used in the home. In order to change people's energy wasting behaviour towards more positive behaviour, habits need to be broken down and changed by introducing new behaviours. How this is done can be complicated, and requires careful consideration of the types of messages consumers are provided with; this is particularly important with communicating issues such as energy security and climate change. As Uzzell *et al.* note:

'…it is well researched that a small amount of fear can have a positive effect in encouraging behaviour change. However, too much fear can have the opposite effect, causing no behaviour change and undue worry and stress for people receiving such information.' (Uzzell *et al.* 2006, p. 25).

Furthermore, the actual monitoring of purchasing decisions and how these change can be complicated, and is considered to be effective in cases where an explicit behaviour is available for independent monitoring, such as for instance the availability of shopping receipts identifying what products people have actually bought (Uzzell et al. 2006, p. 23).

[8] Figures from Transport 2000, http://www.transport2000.org.uk

6 Intervention measures

Academic research conducted on domestic energy behaviours has focused on evaluating several different types of intervention measures. This chapter discusses these options in more detail, reflecting on previous research findings in both energy conservation tools as well as social marketing techniques.

Intervention measures were particularly popular in the 1970s and early 1980s, following mid-1970s oil price shocks. However, many of the studies analysing such measures often compared the effects of only one intervention measure or were based on studies which used a selection of different measures (Dwyer *et al.* 1993), making it difficult to draw conclusions on which measure or a combination of measures would be the most effective in inducing energy saving behaviours. In addition, some of the earlier studies were subject to selection bias, were not always directly replicable or representative of the wider population, as many of them used small sample sizes, were not always methodologically strong and lacked such academic measures as the use of a control group (Bittle *et al.* 1979; Hayes & Cone 1977; Hayes & Cone 1981). Furthermore, several of these studies were conducted in the US and are not necessarily comparable to UK conditions, for instance given the widespread use of domestic air-conditioning and electric heating in the US. However, some of the research is robust enough and though in most cases only based on one or two academic studies, they indicate interesting results in terms of the potential of intervention measures in changing households' energy consuming behaviours. Measures for the promotion of energy saving can be divided into three categories:

Table 11: Measures for promoting energy saving

Intervention measure category	Examples
Antecedent measures	• Information materials (information workshops, energy audits, energy saving campaigns) • Use of modelling
Consequence measures	• Feedback measures • Rewards and incentives
Social influences	• Use of groups • Use of commitment techniques

(Source: see Abrahamse *et al.* 2005; De Young 1993; Katzev & Johnson 1987, pg. 7)

De Young (1993) also discusses the following criteria for evaluating interventions:

- Reliability - whether a technique can be relied upon to activate behavioural change
- Speed of change - how quickly a technique can effect behavioural change
- Particularism - whether a technique can be used for universal application
- Generality - the degree to which target behaviour 'spills over' to related but untargeted energy saving behaviour
- Durability - whether behavioural change can be maintained without repeated intervention

The rest of this Chapter discusses the various intervention studies conducted on domestic energy consumption, using De Young's (1993) category of antecedent measures, consequence measures and social influence techniques.

6.1 Antecedent measures

6.1.1 Information materials and energy saving advice

There is a range of energy saving information available in the UK and organisations such as the Energy Saving Trust, the National Energy Foundation, local and regional energy advice centres, local authorities and energy supply companies offer advice and information on energy efficiency measures to households. Much of the early research conducted on information measures was based on rational choice theory (although not always explicitly) and the notion that consumers require relevant information on their possible actions or purchases in order to make rational choices.

Research has shown that information alone - be it information leaflets or communication campaigns - is generally not enough to change households' energy consuming behaviour (see for example Abrahamse *et al.* 2005; Darby 2006; Roberts & Baker 2003). For instance energy conservation workshops which were popular in the 1970s were shown to be ineffective in changing behaviour. This was shown to be the case particularly with self-administered questionnaires when respondents' self-reported energy using behaviour was compared to their *actual* behaviour. Research by Geller (1981) for example found disparities between what people say and what they actually do, hence information on its own may not be enough to change behaviour even though the respondents may imply so. However, combined with other measures, such as feedback on energy use, information can have a part to play in contributing to behavioural change (Abrahamse *et al.* 2005; Darby 2006).

Henryson *et al.* (2000) found in a study conducted in Sweden that householders were often confused over the amount of information on energy efficiency and energy saving technologies. This was partly the consequence of frequent changes in energy policy, as well as developments in energy efficient appliances (Henryson *et al.* 2000). On one hand, householders feel that they have an energy efficiency information overload, but on the other hand they do not know how best to use that information for their own benefit. Furthermore, households are often 'energy conscious, but not energy knowledgeable' (Henryson *et al.* 2000, p.178), i.e. people are aware of the importance of low energy use but they may not know how to carry out energy efficiency measures in their homes. Similar results have been shown in the UK. In a recent study on public attitudes towards energy efficiency more than 70% of respondents wanted more practical information on home energy use, such as a weekly or monthly profile of their home energy use, while 27% felt that there was an information overload on energy efficiency and 'they did not know where to start' (Future Foundation 2006, pg. 16). Other research has also concluded that consumers prefer personalised energy efficiency advice tailored to their specific situation (Brandon & Lewis 1999), rather than advice which is too general to adapt to their individual circumstances. These findings were also confirmed by stakeholders interviewed for this study - there was a strong feeling that people do not generally know how to reduce their energy use/carbon emissions (Rohr 2007), and that simple and repeated messages from trusted sources can help in getting people to take notice of energy efficiency information (Samuel 2007).

6.1.1.1 The issue of trust

A key issue with providing information and advice is trust, whether people trust the source they are getting information from. Craig and McCann (1978) showed that the credibility of the source of energy information/advice influences the extent to which energy efficiency measures are

adapted; this is also predicted by the Persuasion Theory which suggests that the credibility of the messenger will influence how the recipient reacts to the message. Practical experience with energy efficiency programmes suggests that interpersonal contacts and recommendations count for significantly more than leaflets or labels (Stern 1984). Similarly, US evaluations of energy efficiency programmes have shown that people frequently ignore information even when it is freely available (Ester & Winnett 1982).

A study conducted in the US on 1,000 households with a high demand for electricity found that a message from a trusted source was more effective in encouraging both interest in energy conservation and reduction in actual energy use (Craig & McCann 1978). The research implied that messages from a high credibility source, in this case the US Public Service Commission, were considered more effective than messages from a lower credibility source, the electricity supplier Consolidated Edison. Similar results were found in an insulation programme by US Hennepin County government in 1984 (see Stern 1992). The County employed a private company to carry out energy audits and subsequent insulating measures. All participating homes were sent a letter, which either included the company's logo only, both the company's and the County's logo, or the County's logo only. The letter with the County's logo only received most requests for energy audits (31%), while the company logo only and company plus County logo received 6% and 11% respectively.

The issue with trust and credibility was also confirmed by our stakeholder interviews, with several interviewees stating that generally people may not trust advice they receive from energy suppliers since ultimately energy suppliers' core business is seen to be to sell gas and electricity to their customers, rather than trying to get households to reduce their energy consumption (Roberts 2007; Rohr 2007). Hence households may rather trust sources such as friends, family, local authorities and other independent organisations such as energy advice centres.

Different people may also have different opinions on who they consider to be a trust-worthy, which implies that energy advice and information tailored to each households' situation may prove helpful. Perceptions of trust and credibility will depend on a variety of factors including (Stern 1984):

- The nature of the source (e.g. private, government, charity or pressure group)
- Past experience with the source
- The nature of interactions with the source
- Recommendations from colleagues
- Recommendations or impressions from a wide range of contacts within professional and social networks.

Of these, it is clear that interpersonal contacts and recommendations count for significantly more than labels, pamphlets and paper qualifications (Stern 1984, pg. 67). Most of these contacts are made through existing professional and social networks which therefore play a fundamental role in transmitting information and establishing trust. For example, US domestic energy efficiency programs achieved greater success when implemented through existing community groups which had established credibility through extensive personal contacts (Stern 1984).

Furthermore, the issue of trust works also the other way, with households generally only trusting established energy supply companies to supply their gas and electricity (Roberts 2007). In order to address the issue of trust and credibility, energy suppliers may need to be open about their

motives when they approach households with energy saving advice. In the UK context, energy suppliers could be more open about the fact that EEC requires them to install energy saving measures and that they are installing such measures as a part of a national programme (Roberts 2007; Rohr 2007). For instance stakeholders we interviewed mentioned the British Gas energy efficiency scheme, whereby customers who install energy efficiency measures with British Gas receive a discount from their council tax bill. On one hand British Gas is working with a known and possibly trusted partner, i.e. a Local Authority, but on the other hand they are providing a hidden subsidy as British Gas is giving a subsidy to the local authority rather than directly to the customer (which would be the case under EEC), and the customer still ends up paying the same amount for the energy efficiency measures (for instance Roberts 2007). Generally it was felt by the stakeholders that there is a lack of explicit acknowledgement from energy suppliers that EEC is a Government obligation. Furthermore, energy suppliers could form partnerships with not-for-profit organisations which could endorse suppliers' energy efficiency messages and actions.

6.1.1.2 Energy audits

Energy audits have a potential of providing more personalised information and advice on energy efficiency measures. They are often undertaken either by energy supply companies or specifically trained organisations. In a study of energy audits and rebates on energy saving, Gonzales *et al.* (1988) found that using the term 'loss' in energy conservation advice was more effective than using the terms 'gain' or 'save' money through conservation measures. However, in later research Geller (2002) argues that people's actions are motivated by the gain of positive consequences or the avoidance of a negative one, with positive consequences being the ones that can lead to the improvement of behaviour and attitudes. Furthermore, positive consequences and attitudes linked to behavioural change tend to be more effective than negative consequences - for example instead of penalising environmentally damaging behaviour we should reward pro-environmental (positive) behaviours (Geller 2002).

A Finnish study by Department of Home Economics, VTT Building Technology and Finnish District Heating Association of 105 district-heated households found that following monthly feedback and *focused* energy saving advice, 54% of households reduced energy consumption by turning off lighting in empty rooms, 27% lowered room temperature, 27% dressed more warmly and 23% paid attention to thermostat valves (Haakana *et al.* 1997). The study also found that for 68% of the respondents economic reasons provided the motivation to save energy, while 20% considered environmental reasons to be the main motivator (Haakana *et al.* 1997). Furthermore, 40% of respondents reported that the monthly meter reading feedback they received on their energy consumption made them think about their consumption, and 13% altered their habits following the feedback. The results also showed that households were able to reduce monthly electricity consumption by 11-16% without compromising their level of comfort. Furthermore, heating energy consumption decreased by an average of 5% following meter readings and by 3-9% following feedback on consumption compared to previous year. Electricity consumption in the treatment groups decreased an average of 17-21% following feedback, however, there was little influence linked to advice which was given after feedback (Haakana *et al.* 1997).

Energy audits are ideal in that matter that they provide households with personalised and relevant information (Ball 2007; Roberts 2007; Rohr 2007), which enables people to consider their energy consumption behaviours in their own personal settings instead of being confused or overwhelmed by too general energy saving information and advice. Furthermore, audits can also remove the issue of trust if for instance they are undertaken by credible independent organisations. However,

further research is required to establish how much savings audits can provide as studies also show mixed results on the amount of savings these can provide (Abrahamse *et al.* 2005)

To be effective, information and energy saving advice need to be clear, simple and available close in time to the relevant energy behaviour decision. Specific and personalised information, for instance provided by energy audits, is considered to be more effective than general information on energy saving tips. Furthermore, to be effective and taken into consideration by the household, advice and information will ideally come from a trusted and credible source, such a family member, local authority or independent, not-for-profit advisory organisations.

6.2 Consequence measures - feedback, rewards and incentives

6.2.1 Feedback

Feedback on energy consumption can take many forms and several studies have analysed the effect of feedback on domestic energy behaviours (see for example Abrahamse *et al.* 2005; Darby 2006). Measures include techniques such as giving respondents either daily, weekly or monthly feedback on their energy consumption and using methods such as postcard prompts, comparative monthly bills, or technologies such as direct displays or smart meters. A comprehensive review of feedback measures is given by Darby (2006).

Feedback can be seen to be based on Bem's self-perception theory: 'if an individual is given information indicating he is saving energy, he may develop a positive attitude toward doing so and, thereby, actually become an energy conserver'. (Katzev et all pg. 217.) See Table 12 for various feedback measures available regarding domestic energy consumption.

Table 12: Summary of the types of feedback on domestic energy consumption

Type of feedback	Example
Direct feedback available on demand	• Self-meter reading • Direct displays • Interactive feedback via a PC • Pay-as-you-go meters • Ambient devices • Meter reading as part of energy advice • Cost plugs on appliances
Indirect feedback data processed by utility and sent to the customer	• More frequent bills • More frequent bills based on either comparative, historical, or disaggregated feedback, or annual/quarterly reports
Inadvertent feedback Learning by association	• Microgeneration • Community projects such as Dutch Eco-teams
Utility controlled feedback Learning about the customer	• Smart meters

(Source: Darby 2006, pg. 8)

Research suggests that direct feedback (immediate either from a meter or a display monitor) has generally resulted in 5-15% energy savings, while indirect feedback (via a bill or processed in other way) has normally seen savings of 0-10% (Darby 2006). Research has also suggested that continuous feedback on energy use and costs has proven useful as it deals with current behaviour rather than past behaviour (Dwyer *et al.* 1993). Some earlier studies (see for example Katzev *et al.* 1980–1981) suggest that feedback can reduce electricity consumption by 10-20%, however, there is still relatively little evidence on which feedback measure or a combination of measures

are the most effective. Furthermore, longevity of behavioural change from feedback needs to be taken into consideration, as often once the feedback is removed households tend to reverse back to their old behaviours. For example the Energy Saving Trust when evaluating their energy efficiency advice programmes makes conservative assumptions on the longevity of carbon savings, and therefore assumes a lifetime of 1 year for carbon savings from behavioural change advice measures (Samuel 2007).

The way feedback is presented needs careful consideration, whether for example the cost of electricity is presented in a daily or cumulative way, particularly if daily costs are relatively low in comparison to other living costs (Bittle *et al.* 1979). Furthermore, whether feedback is presented in monetary terms or in kilowatt hours can have an influence, for instance energy prices are influenced by several factors and can change considerably without necessarily directly reflecting consumers' energy consuming behaviours (Hayes & Cone 1981). Several intervention feedback studies have also found that the level of households' previous energy consumption can have an influence on the effect of feedback. Researchers have found that high and medium users are likely to reduce energy use with feedback while low users are likely to increase it (Brandon & Lewis 1999); hence the different types of energy consuming groups have to be taken into consideration when designing the type of feedback they will receive.

In a study which looked at the attitudes of 207 couples to their winter energy use, Becker *et al.* (1981) found that people's comfort was more important than monetary savings from energy conservation measures. Results from this study suggest that feedback which has a theme on saving energy *and* saving money needs to also incorporate the message that it is possible to save energy and money while maintaining comfort. Furthermore, there is also a difference between how much weight people put on the various benefits resulting from energy saving behaviours, whether for instance these are monetary or environmental benefits. In a six-year study conducted in Canada during 1973-1978 which measured the links between 136 households' electricity use and attitudes Heslop *et al.* (1981) found that price consciousness had a greater influence on energy consumption than environmental or social responsibility attitudes. This has been shown repeatedly in other industries and for instance in a study analysing people's car use Gärling *et al.* (2002) found that if people had to make changes to their behaviour which was costly in one way or another (resulting in monetary or psychological costs, or other inconveniences), they would actively look for alternatives with smaller costs.

6.2.1.1 Direct feedback

Technological developments have allowed real-time feedback to be provided using a combination of smart meters and digital displays. In a study on households' energy consumption in Japan researchers found that respondents who were provided with display systems which showed the energy consumption of the whole house and appliances reduced their total energy consumption by 12%, while 60% of respondents reduced their standby power consumption and in general became more aware of their energy consumption (Ueno *et al.* 2005).

Another study evaluating the influence of a feedback monitor (an Energy Cost Indicator) on the gas and electricity use of 300 households in the US and Canada (California; British Columbia and Quebec) found that those who saved the most energy (4-5%) lived in the coldest, in this case Canadian, cities (Hutton *et al.* (1986). The study also found that Canadians had a higher level of previous knowledge about energy conservation than those in the US, which may have explained why Canadians saved more energy (Hutton *et al.* 1986). The study did show an increase in knowledge levels among the US respondents, however, these did not result in energy saving.

These findings also link with the Theory of Reasoned Action (TRA) which is based on the notion that people's beliefs and evaluations of the outcome of certain behaviours affect their attitudes towards those behaviours, which consequently can influence people's intention to act in a certain way.

Some direct feedback measures such as prompting (for example a weekly post card showing meter reading) are generally not reliable, as behaviour often returns to normal after the prompt is removed (De Young 1993). Therefore to be effective direct feedback, as well as other types of feedback, needs to be continuous. For instance, in a Dutch study on 285 respondents' gas consumption, researchers found that feedback displays which showed constant or cumulative information on energy consumption resulted in monthly energy savings of as high as 15% during the study, but once feedback was removed consumption had increased for all respondents one year after the initial study (van Houwelingen & van Raaij 1989).

6.2.1.2 Indirect feedback

Indirect feedback is defined as feedback which is processed, in most cases by the energy supplier, and can include measures such as more frequent bills based on either comparative or historical feedback. In a study on the effects of cumulative feedback (in kilowatt hours) on 353 families' electricity use, Bittle *et al.* (1979-1980) found that feedback had the greatest effect on those who used large amounts of electricity, while those who used less electricity tended to increase consumption following feedback (see also Brandon & Lewis 1999). Furthermore, cumulative feedback was more effective than daily feedback for high users of electricity, while this was the least effective for the low user groups, particularly in hot weather conditions. The careful design of how to use feedback in different weather conditions is important as reduced energy consumption by high users may be offset by the increased use of low users (Bittle *et al.* 1979-1980).

In a largest ever study conducted in the UK on household energy use Brandon & Lewis (1999) analysed various forms of feedback on the gas and electricity consumption of 120 households, including comparison of consumption to the previous year, energy consumption in both kWh and equivalent monetary value, and energy consumption in relation to environmental problems. The study found that the level of previous energy consumption had an impact on energy using behaviour. Following comparative feedback high users of energy reduced their use an average of 3.6%, medium users an average of 2.4%, while low users increased their consumption by 10.7% following feedback. The study also found that environmental beliefs and attitudes did not have a significant influence on energy consumption, but monetary savings and making energy use visible were better motivators than environmental factors:

'While people were sympathetic about environmental issues, there was no broad agreement that one should 'bring one's environmental attitudes home' when it comes to heating, lighting, cooking and washing, or indeed that stressing environmental issues was the best way to motivate people to conserve energy.' (Brandon & Lewis 1999, pg. 82).

Brandon & Lewis (1999) also suggest that socio-demographics have an influence on households' energy saving potential, with low income households likely to be using low amounts of energy, and hence not having the potential to save much while those in higher income groups are also likely to be the largest consumers of energy and hence have the largest potential for saving.

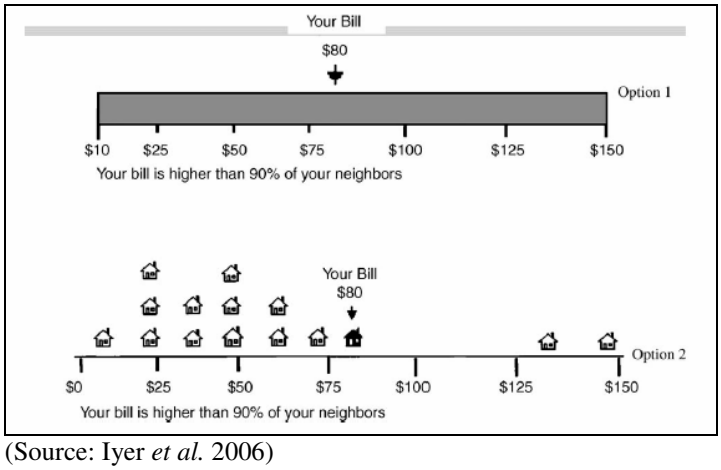
6.2.1.2.1 Innovative billing

Better and more innovative billing is another indirect feedback measure which can be used to activate consumers to consider their energy use and become more aware of how much gas or electricity they use in the household. There are several ways to make bills more informative including for instance charts which visualise households' energy use trends, comparisons of energy use to for instance the previous month or the same month in the previous year, and comparisons to certain user groups such as households in the same street (see for example Iyer *et al.* 2006; Roberts & Baker 2003). The key is to provide householders with better, more informative bills on how much energy they use and how much it is costing them, either in monetary or environmental terms. More clearly presented bills would also give households an opportunity to see how much gas or electricity they are saving. Furthermore, better billing is fairly universal way to give people better information on the gas and electricity use.

A study conducted on a database of 114,000 customers in the US evaluated two aspects of innovative billing, the format of bills and how customers were clustered into comparison groups. Iyer *et al.* (2006) showed that the best way to cluster customers into comparison groups, whereby their energy consumption would be compared to other households, was by house data (floor area, house type and type of heating/cooling), street name or meter books (houses from which one meter reader collects data from in one day). Geographical allocation to groups is considered to be beneficial for both the customer and the energy supplier. When allocated by street name for instance, customers will know which particular houses they are compared to, while housing types and social characteristics are often similar in houses which are close together (Iyer *et al.* 2006). Furthermore, Iyer *et al.* (2006) concluded that geographical groups are often relatively easy for utilities to establish and describe to customers.

Iyer *et al.*'s (2006) analysis furthermore showed that for comparison presentation with other households, a distribution chart was the most preferred method, both statistically and as the most preferred one by customers (see Figure 11).

Figure 11: Example of a comparison bill



(Source: Iyer *et al.* 2006)

It should be noted that even though this study may not be directly comparable to the UK, mainly regarding the clustering of customers by street as all houses in one UK street are not necessarily supplied by the same utility. Furthermore, there may be different preferences in different countries regarding the way the information on the bill is represented. Iyer *et al.* (2006) for

instance point out to a Norwegian study which found that when a variation of the distribution chart used by Iyer *et al.* was used with Norwegian households, the respondents found the chart to be too simple and childish (see Wilhite *et al.* 1999).

Better billing combined with for instance direct feedback displays could also avoid the 'direct-debit' dilemma whereby those who pay their energy bills by direct debit often tend not to know how much energy they use or what information is in their energy bills (Roberts & Baker 2003). However, the UK Government has been slow to improve feedback and improve billing. A report by the Centre for Sustainable Energy (Roberts & Baker 2003) concluded that feedback and more informative billing could reduce energy consumption by 5-10%. However, over three years later relatively little action has taken place in terms of providing customers with more informative billing and identifying which presentation formats would be the most effective for the UK consumer.

6.2.1.3 Inadvertent feedback

6.2.1.3.1 Micro-generation

Micro-generation is the generation of heat or electricity at the smaller scale, using technologies such as photovoltaics, solar thermal heaters, micro-wind turbines, biomass technologies, ground- and air-source heat pumps and micro combined heat and power (CHP). Micro-generation allows households, schools, businesses and communities to become their own energy generators, and to provide electricity or heat at the point of demand. It may initiate behavioural change, as early research suggests that people who install micro-generating technologies are more likely to be and become more aware of their overall energy use (Dobbyn & Thomas 2005). Furthermore, micro-generation technologies provide *visible* of zero or low carbon energy use to both those people who install the technology and those around them.

A survey of UK households with a solar power system found that those who had installed a solar power system had an above average awareness about climate change issues and solar power technology itself, compared to those who had only installed energy efficiency measures (Keirstead 2005, pg. 1252). Dobbyn and Thomas (2005) compared the impact of micro-generation in UK households who had actively purchased the technology to households who were 'passive' users of micro-generation technologies (e.g. by moving into a social housing scheme that already had micro-generation installed), and to mainstream households with no micro-generation device. While mainstream households were largely 'unconscious' of their energy use the study showed that those who had a micro-generation equipment tended to become more aware: '……choosing to install micro-generation….or living in a house where it has been installed…can significantly shift awareness, attitudes and behaviour' (Dobbyn & Thomas 2005, pg. 7). In the case of passive households, the potential for micro-generation to raise awareness depended upon the associated communication and information provision including advice and explanation on how the technology works. Both active and passive households tried to adapt their consumption behaviour to match the output from their micro-generator (Dobbyn & Thomas 2005, pg. 53).

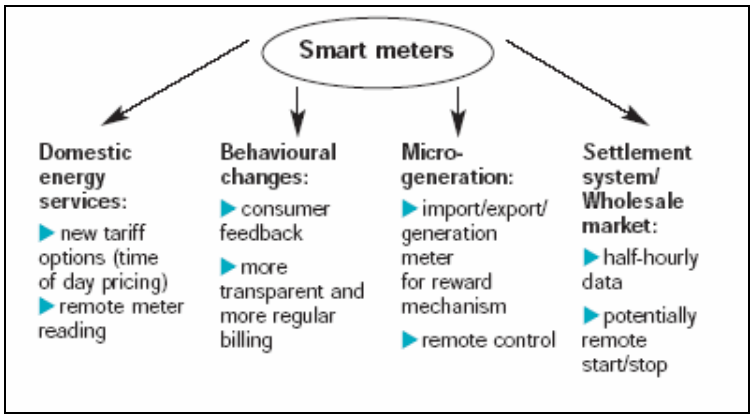
Clearly more research is required in the link between micro-generation and behavioural change, but the early signs are positive and these technologies combined with measures such as feedback could play a key part in changing households' energy consuming behaviours. Furthermore, some micro-generation technologies are still at early stages of development and require further research in terms of their performance and suitability particularly for urban locations, as well as financial

support to reach sustainable levels of mass market deployment (see for instance Watson *et al.* 2006). In February 2007, the Energy Saving Trust for instance announced plans for a UK-wide field trial of one hundred household wind turbines (EST 2007). The trial will monitor and assess the overall performance of domestic wind turbines, taking into account the impact of factors such as wind speed, location, surrounding buildings and the effect of turbulence. The trial is scheduled to report in Autumn 2008 and is expected to answer some of the questions surrounding the performance of domestic wind turbines. Micro-generation has a part to play in encouraging people's understanding of energy consumption, however, these technologies should always be considered alongside energy efficiency measures.

6.2.1.4 Utility controlled feedback - smart meters

Smart meters utilise technologies such as smart cards and two-way metering (Darby 2006) and can be combined with devices such as direct displays, the use of TVs and PCs, and ambient displays which can provide current and historical consumption data. 'Smarter metering' is by no means a new concept; meters which could provide information to the customer on the amount of electricity for the day and the month, as well as including an indicator which would show when consumption was exceeded have been discussed in academic literature since the late 1970s (see for example Hayes & Cone 1977). Smart meters allow energy suppliers to collect automated meter readings (as part of some smart metering systems) and the domestic consumer to receive feedback on it (Darby 2006). Furthermore, automated meter reading reduces the requirement for manual meter readings and reduces account enquiries related to estimated meter readings, which are often the most common customer complaints (see also Figure 12).

Figure 12: The potential impact of smart metering



(Source: Watson *et al.* 2006)

Studies conducted in the US and Norway on smart meter systems suggest that households who receive feedback on their energy consumption, save an average of 10%-15% (Darby 2006). Research has also found that feedback presented by a computer is more likely to be used or accepted than feedback given by a person (see McCalley & Midden 2002). Furthermore, smart meters are allow the use of such as

There are also some countries which have rolled out smart meter technologies, such as Italy, Canada and Sweden, and early indications are that these technologies have improved demand side management by providing customers with accurate bills, hence reducing the amount of meter reads, as well as moving demand from peak to off-peak times (Ofgem 2006a). The UK Government is also about to embark on a smart meter trial. Energy Demand Reduction Pilot

(EDRP)[9], run by the Department of Trade and Industry (DTI) and Ofgem, will include a total of around 50,000 households across the UK and will involve several research consortiums formed of energy supply companies, meter manufacturers and academics. The EDRP project aims to understand how smart meters and other feedback devices are used by consumers, and what potential they have in changing households' energy consuming behaviours. The project is due to start in April 2007 and is expected to report in Summer/Autumn 2009. Furthermore, the European Directive on End-use efficiency and Energy Services requires that

'in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings...customers...are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use' (2006)[10].

Article 13 of the Directive states that smart meters should also be used when an existing meter is replaced, as long as it is technically feasible and cost-effective, and they should always be installed in new buildings or in major refurbishments. Generally EU Directives have to be implemented within three years after they have come into force.

6.2.2 Rewards and incentives

Other types of consequence measures are rewards and incentives which encourage households to save energy by offering 'carrots'. These measures can be either monetary or other benefits such as free energy efficiency measures or appliances. Incentives or rewards work best when used in conjunction with feedback, otherwise households cannot monitor their performance. Furthermore, rewards or incentives can in effect be seen as one way of giving feedback to householders whether or not they are saving energy.

Several studies in the 1970s looked at rewards and their effects on energy saving, and showed that high rebates resulted in reduction of electricity use. A study by Bittle *et al.* (1979) noted that most of the rebates in these studies were made by the experimenters, rather than energy suppliers which may have influenced the way households perceived them. One of the first studies in the US on the effect of incentives was conducted on 1,811 households who were given energy conservation advice and a free shower flow control device from the Department of Energy (Hutton & McNeill 1981). The study found that those households which received an information booklet and installed the accompanying free shower flow control device adapted more energy saving tips than the control group. In another study which analysed the effect of tax credits on energy saving behaviour (Pitts & Wittenbach 1981), researchers found that tax credits had little impact on the decision to purchase home insulation - in fact 39% of participants were unaware of the tax credits, while 62% did not consider them to make a difference on their purchasing decisions (see also Dwyer *et al.* 1993).

Rewards can be effective if designed well, however, research has shown that the effects of rewards and incentives are not always maintained for the long-term, but in most cases only for as long as the intervention is in place (Dwyer *et al.* 1993). In addition to offering material rewards or incentives, consequence techniques can also be combined with social pressure techniques, such as using rewards in a group or community setting, such as the previously discussed EcoTeams.

[9] Sussex Energy Group will be part of an EdF Energy led consortium in this trial.
[10] Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC, http://ec.europa.eu/energy/demand/legislation/end_use_en.htm

This can be an effective way to achieve behavioural change, however, there is also a chance that people may want to take on forbidden behaviour or are not willing to do what they feel forced to do – as has been noted regarding research conducted on kerbside recycling programmes: 'homeowners will, on occasion, creatively misbehave' and not recycle despite the fact that there may be social pressure to do so (De Young 1993, pg. 498). Other forms of social influences based intervention measures are discussed next.

6.3 Social influences

6.3.1 Eco-teams

A good example of social influences is the Dutch EcoTeam Programme (ETP). EcoTeams are voluntary groups of 6 to 10 people who usually know each other already as neighbours or friends (Staats *et al.* 2004); similar groups are run in the UK by Global Action Plan[11]. These teams meet once a month and share personal experiences, ideas, and achievements related to environmental household behaviour. They usually focus on six themes, each for four consecutive weeks, as presented in the EcoTeam Workbook: waste, gas, electricity, water, transport, and consumer behaviour (Staats *et al.* 2004). A three-year study of 150 EcoTeam participants found that after the ETP programme, participants had reduced their gas, electricity and water use considerably compared to a group representative of the Dutch population (Staats *et al.* 2004). A two-year follow up study showed that majority of the initial behavioural changes had been maintained, see Table 13.

Table 13: Behaviour change in EcoTeams

Eco-teams	**Consumption after ETP programme** (compared to control group)	**Two-year follow up** (compared to control group)
Gas use	-20.5%	-16.9%
Electricity use	-4.6%	-7.6%
Water use	-2.8%	-6.7%
Waste	-28.5%	-32.1%

(Source: Staats *et al.* 2004)

It is likely that the people who took part in the EcoTeam programmes were generally more motivated to behave in a pro-environmental way, however the results suggest that the programme achieved considerable, and more importantly, long-term behavioural changes. The success of the EcoTeams can partly be related to their holistic approach to environmental issues, and they tick most boxes on behavioural change checklists guides by getting groups of people together and hence allowing them to observe others' behaviours; they also provide people with opportunities and responsibility to 'do the right thing' as well as allow people to get directly involved and more importantly providing them with feedback on their behaviours.

6.3.2 Goal setting and commitment

Goal setting is another method of encouraging households to save energy. This measure is often applied on a self-selective basis, i.e. households themselves will define and commit to a certain

[11] More information about Global Action Plan is available at http://www.globalactionplan.org.uk.

energy saving goal, or it can be set by the researcher. Becker (1978) found that the level of the goal can have an influence on how well people perform towards their energy saving target. Furthermore, an energy saving goal combined with feedback resulted in higher savings, indicating that feedback can help householders determine how they are meeting their goal.

Becker's (1978) research examined the electricity use of 80 families in the US, who were asked to set either an easy (2%) or a difficult (20%) energy saving goal. The sample was further divided into those who received feedback three times a week on a postcard placed on their kitchen window and to those who did not receive feedback. A control group of additional 20 families received neither a goal nor feedback. Those who had an energy saving goal of 20% and who received feedback, reduced their energy use the most, by 15.1%, while those on the same goal without feedback saved 4.5%. A 2% goal with feedback resulted in 5.7% savings while that same goal with no feedback only showed a 0.6% saving in domestic electricity use. The results show that both the level of the goal and whether the goal is combined with feedback play a key part in energy saving behaviours. Later research has confirmed these findings, as noted by McCalley & Midden (2002) who conducted a washing machine control panel trial of 100 respondents. The researchers found that feedback without a goal is not effective at all:

'When goal-setting was not used, feedback was not successful in encouraging energy conservation and resulted in no difference in energy use from a control condition in which no-feedback was given. Thus it is concluded that conservation is dependent on having a goal to save energy as a primary goal of the user.' (pg. 600).

The aspect of whether a goal is self-set or assigned seems to also have an influence, and McCalley & Midden (2002) found that those who had a self-set goal were the most successful in reducing their energy use, by a total of 21%.

Commitment, which includes actions such as getting households to commit to carry out certain energy efficiency measures, is another measure which can be applied to energy saving behaviour and is closely linked to wider social marketing techniques, which are discussed in more detail in the following Chapter. Commitment can be effective, and in some cases even more effective than material incentives or rewards in terms of rapid behaviour change, and it can also result in long-term behaviour change (De Young 1993). In a study of 66 respondents electricity using behaviours Katzev and Johnson (1983) for instance found that those in the commitment intervention groups conserved more energy and produced more energy conservers than the control group. In the UK, the Energy Saving Trust is running an ongoing 'Save you 20%'- campaign[12], which invites people to pledge their energy savings through measures such as turning thermostats down, turning appliances off standby, installing insulation measures and using energy efficient appliances. At the time of writing this report, EST had not published evaluation results of the campaign, however, over 33,000 people had committed so far. For evaluating the campaign the Energy Saving Trust uses a model which has 10 segment groups, which are then divided into 61 sub categories; and within these 10 segments there are 4 priority groups[13] of types of consumers (Samuel 2007). Commitment also plays a key part in the previously discussed Dutch Eco-Teams, by asking people who take part to commit to monitoring their behaviours on waste, energy, water and transport use.

[12] See more details at http://www.est.org.uk/commit/
[13] EST is happy to share more information about the evaluation of this campaign directly with EdF Energy.

6.4 Social marketing techniques

Social marketing techniques, especially community-based social marketing techniques can be effective ways of encouraging behavioural change. This chapter will outline some of the successful social marketing initiatives undertaken within the environmental field.

Community based social marketing techniques were used in a community water efficiency campaign in Toronto, Canada in 1997, which showed encouraging results in domestic lawn watering conservation (see McKenzie-Mohr 2000). The campaign identified barriers to lawn watering efficiency, by using both survey and observation methods. An experimental group received a visit and water conservation advice, while a control group received an information pack on water conservation only. In the experimental group, students visited households during summer months, speaking to residents about water conservation and providing them with a lawn watering gauge and a prompt reminding households to check how much it had rained, prompting them to water their lawns only as required. The householders were also asked to commit to water their lawns only once a week. The results of the social marketing initiative showed that 72% committed to water their lawns only once a week, and watering in the experimental group decreased by 54% while it increased by 15% in the information only group. Furthermore, excessive watering lasting over an hour decreased by 66% in the experimental group, while it increased by 96% in the information only group. A summary of the results is also presented in Table 14:

Table 14: Summary of results from water conservation campaign using social marketing techniques

Community based social marketing techniques for a water conservation campaign - Toronto, Canada, 1997		
	Experimental group	**Control group**
Social marketing technique/intervention	Cycling students visited householders, providing advice on water conservation, a lawn watering gauge and a rain prompt	Information pack only
Commitment to water lawns only once a week	72% signed up to the commitment	N/A
Lawn watering behaviour after experiment Decrease (-) / increase (+)	- 54%	+15%
Excess watering behaviour (watering for over an hour) after experiment Decrease (-) / increase (+)	- 66%	+96%

Another good example of social marketing techniques is the ongoing Ashton Hayes Going Carbon Neutral Project launched in January 2006[14]. The village of Ashton Hayes in Cheshire, UK, is aiming to become the first carbon neutral village in England, supported by most of the local community. Actions in the project include carbon footprinting of the village, home energy audits conducted by students from the University of Chester, renewable energy initiatives, increased recycling, and the planting of trees locally to be used as carbon sinks. The village project has also received a two-year grant for communication activities from Defra's *Tomorrow's Climate – Today's Challenge* campaign. In the first four months since the launch of the initiative, energy saving actions - mainly the use of energy efficient light bulbs and energy counters - had resulted in savings of around 1% of the village's total emissions (Ashton Hayes Parish Council 2006).

Key successes of the Ashton Hayes Going Carbon Neutral Project has been that around 75% of the village adult population were interested in the project at its launch and it has attracted wide support from the whole community, including the local school, the local Women's Institute, the

[14] More information about the Ashton Hayes Going Carbon Neutral Project is at http://www.goingcarbonneutral.co.uk

Parish Council, local businesses and organisations (House of Commons 2007). Similar initiatives have also been launched elsewhere in the UK, for instance in Stirling, Scotland[15]. How these initiatives will influence people's behaviour in the long-term is still to be evaluated, but they are indicating that local community initiatives have a real potential in empowering people to take action, and in many cases local community initiatives can precede and be a driving force for influencing policy measures. Furthermore, many of these types of community-based activities have a local 'champion' driving the initiative, who is often a trusted and well-known figure in the local community.

6.5 Conclusions on interventions

One of the challenges regarding energy consuming behaviours and selecting the right type of intervention measure/s, is that there is not yet enough evidence to clearly say which measures lead to behavioural changes and provide the largest and long-term energy savings. There is also some disparity amongst the research available in intervention studies, with many of the studies lacking in methodological strength. For instance some of previous studies had very small sample sizes and/or biased sample selection, only considered one type of intervention measure or did not include a control group. Therefore more robust research is required in order to establish which types of intervention measures or a combination measures would be the *most effective* in changing energy consuming behaviours and resulting in quantifiable long-term behavioural changes and energy savings. However, some conclusions of behavioural change can be drawn from existing intervention research. Even though some of the evidence may not be fully reliable or representative of current UK circumstances, it indicates that behaviour can and does change. Good examples of this include for instance direct or indirect feedback, social marketing based campaigns and groups such as the EcoTeams, all of which are summarised in greater detail below.

To be effective, intervention measures such as feedback, are ideally:

- Clearly presented and consisting of simple messages
- Containing information relevant to the household/consumer
- Involving some kind of a goal or a commitment
- Be visible, consistent and frequent.

Information techniques are based on the notion that once people understand the nature of the problem and receive information on how to change their behaviour, they are likely to change their behaviour. However, studies show that regarding domestic energy use, information alone is not enough to make people change their energy consumption behaviours and even similar information campaigns can have very different results. Furthermore, information and advice are only useful as long as the recipient of the advice trusts the information source. If people do not trust or think the information source to be credible, they may ignore even free advice.

Direct feedback interventions (via a display or monitor) can result in an average of 5-15% energy savings, while indirect feedback (via a bill or processed in other way) has normally seen savings of 0-10%. There is little evidence yet however, on which type of feedback measure would show the most energy savings. Research has also suggested that more frequent feedback is better and continuous feedback is best on energy use and costs is more effective as it deals with current

[15] See more information at http://www.goingcarbonneutral.net/.

behaviour rather than past behaviour. In addition to direct displays and metering systems, better and more innovative billing is another measure which can activate households to consider their energy use and become more aware of how much gas or electricity they are using in their homes. The key is to provide households with better, more informative bills on how much energy they use and how much it is costing them. More clearly presented bills would also give households an opportunity to see how much gas or electricity they are saving.

Table 15: Summary of savings from selected intervention studies

Study	Intervention	Saving
Becker (1978)	Goal setting + feedback on electricity use • easy (2%) or a difficult (20%) energy saving goal • feedback three times a week on a postcard	• 20% goal -> savings of 15.1% • 2% goal -> savings of 5.7%
Hutton *et al.* (1986)	Direct feedback monitor (gas and electricity use) • Energy Cost Indicator	• Savings of 4-5%
Haakana *et at.* (1997)	Feedback and focused advice - feedback had more effect • monthly feedback and focused energy saving advice (heat & electricity)	• Heating consumption saving 5% • Electricity consumption saving 17-21%
Brandon & Lewis (1999)	Comparative feedback on gas and electricity use • comparison of consumption to the previous year, energy consumption in both kWh and equivalent monetary value, and energy consumption in relation to environmental problems	• Comparison to previous consumption saving 3.6% • Low users increased 10.7%
Staats *et al.* (2004)	EcoTeams (with 2-year follow up) • Monthly meetings which discuss energy, water and waste use	• Gas saving 20.5% (after 2 years 16.9% saving) • Electricity saving 4.6% (after 2 years 7.6% saving)
Darby (2006)	Various different feedback systems	• Saving of up to 10-15%

Using De Young's (1993) criteria on evaluating feedback intervention measures of reliability (whether a technique can be relied upon to activate behavioural change); speed of change (how quickly a technique can effect behavioural change); particularism (whether a technique can be used for universal application); generality (the degree to which target behaviour 'spills over' to related but untargeted energy saving behaviour); and durability (whether behavioural change can be maintained without repeated intervention), direct display units and smart meters will probably be more reliable then self-read meters for instance. Some direct feedback measures such as direct displays are also likely to be more reliable than indirect feedback based on bills. Furthermore, direct, indirect and utility controlled feedback are more universally available than inadvertent feedback - for instance microgeneration is likely to be less applicable in some circumstances while smart meters can be seen to be rather universal. Direct and indirect feedback are also likely to require repeated intervention. More research is, however, required to establish both reliability (actual behaviour change activation) and generality (spill-over effect) regarding all forms of feedback.

Positive motivational techniques generally involve either monetary or social support such as electricity tariffs which reward reduced consumption or social recognition for conservation behaviours. Interventions can have both positive and negative effects, and studies have found that following feedback, low energy users may in fact increase their consumption. One of the issues facing energy consuming behaviours is the trade-off between comfort and expenditure with money commonly being identified as the main motivation for energy saving, rather than environmental reasons.

The challenge with selecting intervention measures is to provide long-term behavioural changes. A combination of energy advice with display units and more innovative billing for example could provide households with a mix of better information and feedback on their energy consumption, and initiate awareness and possibly behavioural change. Furthermore, micro-generation technologies are also potential drivers for behavioural change, as there are indications that those consumers who install micro-generation technologies are likely to consider their energy consumption and energy efficiency measures more than those without micro-generation. Some micro-generation technologies such as micro-wind turbines, still require further research in terms of their performance and suitability to certain locations.

Social marketing techniques and community-based measures such as the Dutch EcoTeams have shown to provide both considerable and long-term behavioural changes. These include techniques such as getting groups of people together each month to discuss their energy, water and waste use. It is possible that people who take part in these groups are already motivated to 'do the right thing' and reduce their impact on the environment. However, they offer a clear indication that group settings with trusted sources such as independent organisations or friends and family, together with simple and personal advice, commitment and feedback can motivate people to change their behaviours and also maintain those changes.

The following questions arise for future research on intervention measures:

- What combination of intervention measures is likely to be the most effective?
- How should individual intervention measures be designed to ensure maximum impact, for example:
    - Where should displays be located?
    - How should consumption information be presented (e.g. numbers, graphs)?
    - What are the relationships of feedback on consumption, costs and environmental impacts, or a combination of all three?
- How to ensure that intervention measures provide long-term behavioural changes?
- Does effective behavioural change require a combination of feedback and other measures such as goals, rewards and social marketing?

Many of these questions are expected to be answered through the forthcoming EDRP project, which will involve several feedback measures and a combination of measures being trialled in a large-scale, long-term and methodologically robust UK-wide study. This study will involve a total of around 50,000 households across the UK, which will be monitored over two years for their energy consumption and behaviour. Intervention measures will include both paper based and electronic feedback using smart meters, display units, and web-based tools. Final details of the trial will become public in the Summer 2007.

7 UK's energy efficiency policy

The UK Government has set a target to reduce carbon dioxide emissions by 60% by 2050 (DTI 2003), and in March 2007, the Government also published its draft Climate Change Bill Consultation Document, which outlines a framework for the UK to achieve its emissions reduction targets (Defra 2007). Main contributors to UK's CO_2 emissions are business, transport and the residential sectors, of which domestic buildings account for about 28% of total CO_2 emissions (DTI 2006). Reducing CO_2 emissions from residential buildings is one of the key challenges for UK's energy policy. The focus of this study and the key policy instrument designed to deliver emissions reductions from the household sector is the Energy Efficiency Commitment, as it is the most interest for EdF Energy within the context of this project. Other regulatory measures such as the Home Energy Conservation Act which requires local authorities to undertake energy efficiency measures are not discussed in the remit of this project.

7.1 The Energy Efficiency Commitment

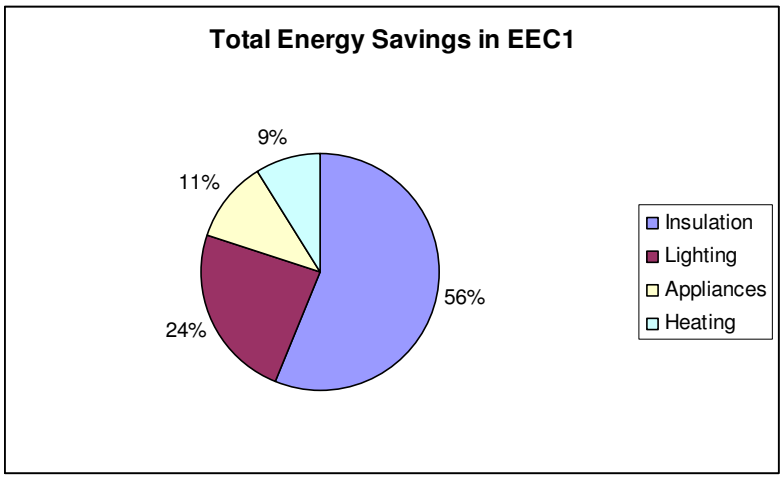
The Energy Efficiency Commitment was introduced in 2002 and is a legal requirement for UK's gas and electricity suppliers to deliver energy efficiency measures to their customers. At least 50% of the savings have to come from priority groups, mainly from low-income households who receive certain benefits or tax credits, and many of which live in 'fuel poverty', i.e. have to spend more than 10% of their income on fuel to keep warm (Defra 2004). Hence EEC acts as a two-way measure in delivering Government policy; by reducing carbon emissions EEC forms a part of the UK's Climate Change Programme (HM Government 2006) and by targeting priority groups, EEC delivers policy formulated under the Fuel Poverty Strategy (Defra 2006).

EEC runs in three three-year phases, 2002-2005, 2005-2008 and 2008-2011. The current phase of EEC, EEC2, runs until 2008 with an obligation on electricity and gas suppliers to deliver a total of 130 terawatt hours (TWh) of 'fuel standardised lifetime discounted energy benefits' through energy efficiency measures. This is approximately twice the level of energy benefits required during the previous phase, EEC1, during 2002-2005 (62 TWh - 86.8 TWh was delivered). Third phase of the obligation, EEC3 is due in 2008-2011, and is going to be a subject of a statutory consultation which will be published in May 2007.

7.1.1 EEC1 and EEC2

The first phase of EEC, EEC1, delivered more energy saving measures and more cost effectively, than was initially estimated by Defra. During EEC1 energy suppliers invested around £850 million directly in households energy efficiency measures, equivalent to 1.3p/kWh and 0.5p/kWh of a delivered unit of electricity or gas saving respectively (Eoin Lees Energy 2006). Furthermore, more than 2 out of 5 priority group households benefited from EEC1, mostly through the installation of energy efficient appliances and lighting (Eoin Lees Energy 2006). EEC1 also contributed to market transformation by increasing demand for A-rated white goods (Eoin Lees Energy 2006), as well as for condensing boilers which are now mandatory for new installations.

Figure 13: Total energy savings in EEC1



(Source: Eoin Lees Energy 2006)

EEC2 is required to provide twice as much energy savings as EEC1. Evaluations from EEC2 are not due until at the end of the scheme after 2008, however, early indications show that EEC2 is also delivering more energy savings than were initially estimated, echoing the success of EEC1. By the end of 2005, EEC2 had delivered around 60% of the overall target (Ofgem 2006b), indicating that the second phase of EEC is likely to deliver more savings than initially estimated and in a shorter than expected time, with some energy suppliers likely to have completed their target earlier than the end of the programme in 2008 (Ofgem 2006b). This demonstrates that current EEC targets may be relatively straightforward for energy suppliers to meet, raising the question on whether the next phase of EEC, EEC3 should have more stringent targets. However, the way EEC credits are calculated and valued has an impact on how quickly suppliers deliver energy efficiency measures.

7.1.2 EEC3

The third phase of EEC, EEC3 is due to start in 2008 and run until 2011. Final energy efficiency measures to be included in EEC3 will be decided following a statutory consultation which will be published by Defra in May 2007. There is increasing amount of interest in the possibility of including behavioural change measures in the third phase of EEC. So far, EEC has been an obligation of technical solutions rather than taking into consideration user behaviours in the home:

'EEC has been very successful at delivering technical measures such as loft and cavity wall insulation, but it does not address the important issue of consumer behaviour, getting us to reduce waste or think about the energy efficiency of the appliances that we buy' (DTI 2006, pg. 45)

The above statement was also confirmed by our stakeholder interviews. EEC is delivering well on areas such as cavity wall and loft insulation, and the use of efficient appliances, particularly lighting (Ball 2007; Hargreaves 2007; Roberts 2007; Rohr 2007). The next challenge for EEC however is to potentially integrate behavioural change measures, ultimately influencing they way consumers use energy in their homes. Recently, the International Energy Agency praised EEC in its review of UK's energy policy, with Claude Mandil, Executive Director (IEA), stating that the UK had created:

'a robust and simple framework with the Energy Efficiency Commitment in which energy companies are encouraged by market incentives to deliver energy efficiency improvements'. (IEA 2007)

However, some stakeholders directly involved with the UK's energy efficiency industry believe that despite EEC delivering energy savings and more than meeting its targets, the obligation has partly failed in that it does not take a whole house approach and look at both technical and behavioural measures. EEC is delivering on for instance cavity wall insulation but other areas still require more work (Hargreaves 2007; Samuel 2007). Furthermore, there is still also plenty of capacity to undertake cavity wall insulations (approximately 9 million cavity walls are not yet insulated), and solid wall insulation remains an area requiring more effort (Hargreaves 2007; Samuel 2007), while areas such as increasing consumer awareness on their energy use and the efficiency of electronic consumer appliances were mentioned as areas requiring action. Increasing consumer awareness on their energy use in particular was seen as one of key issues to be considered in any future energy efficiency measures; for instance people do not tend to know how much the use of standby wastes energy. All stakeholders agreed that behavioural measures and in general increasing consumer awareness on energy use could be included in EEC.

7.1.3 Integrating behavioural change measures to EEC

Results from our interviews show that there is a strong belief from stakeholders that behavioural measures, for instance the use of energy audits, feedback displays and consumer goals and commitment, could be included in EEC3. However, there is still not a clear idea of which measures would form the basis of potential behavioural measures within EEC3, but according to Defra, any measures that can reasonably be expected to save energy could be considered (Rohr 2007). In any case, behavioural measures will not be easy to incorporate to EEC3 and are likely to form only a small overall percentage (<5%) of EEC credits, hence there are proposals that behavioural change measures could be ring fenced to their own area within EEC3. However our results show that it is not easy to define which measures will be included and for how much they would account for in terms of actual energy savings.

The Government will publish its consultation on EEC3 in May 2007, which will include more details on the proposed behavioural change measures, as well as how the savings from these could be evaluated. Early indications are that EEC3 could potentially have a ring fenced area for behavioural measures, which could provide more information and monitoring on which measures provide the most energy savings. Potential measures could include for instance feedback displays and energy audits. However, more information are required for instance regarding in-house displays and how much energy savings are achieved by actual behavioural change and how much through physical measures – so that possible measures are not double-counted (Rohr 2007), meaning that those measure which are already required by other regulation are not accounted for under EEC. There is also an issue with how measures should be evaluated, and there is strong notion from the stakeholders, that both qualitative and quantitative information are required on how consumers react to various measures. The behavioural measures which could potentially be included within EEC3 will become clearer from the forthcoming Energy White Paper due in Spring 2007 and its subsequent policies on billing and metering. Furthermore, EEC3 consultation will also have more details on possible trials that could be run on behavioural measures under EEC3, how they can be evaluated, how potential additionality will be considered, and what administrative measures may be required.

Defra has a view that EEC3 could partly be used as a pilot for future behavioural measures, particularly for obtaining information and data on which measures result in behavioural changes and to what extend, as well as for determining how energy savings from behavioural changes should be measured (Rohr 2007). Behavioural measures could possibly include feedback measures and energy audits, however, these should be conducted by qualified organisations such as energy suppliers or local authorities, for instance through the proposed energy performance certificates (EPCs) (DCLG 2006a). Possible trials under EEC3 could also inform policy for post 2011 and form a basis for future energy efficiency policies, and whether for instance they would be part of a wider white certificate scheme.

The success of behavioural measures to be included within EEC3 also partly depends on whether energy suppliers show interest in trying out different behavioural measures. EEC was designed to give flexibility to energy suppliers to chose which EEC accredited measures they want to invest in and install to their customers. Early indications regarding behavioural change measures are similar - flexibility within EEC allows exploration, hence Defra sees that there is potential for EEC3 to act as a pilot for behavioural change measures (Rohr 2007). Furthermore, our results show that some stakeholders feel that the Government should take the risk in evaluating the value of various behavioural measures. If for instance energy suppliers would can get 100,000 customers to commit to a 20% energy saving goal and customers only end up saving 5%, the supplier should still get credit for that under EEC (Roberts 2007). However, if Government took an all the risk it would not give suppliers and incentive to find the best measures, hence it would be better if the risk in evaluating the value of various behavioural measures is shared.

There is a clear indication from Defra and other stakeholders that EEC3 could be used as a pilot for acquiring more information on behavioural change measures. However, neither the Government nor stakeholders interviewed for this project were able to identify the exact measures that could prove the most energy savings through behavioural changes. Furthermore, there is a strong notion that further experimental research is required to determine which behavioural measures achieve the most energy savings.

7.2 Engaging with consumers

One of the objectives of this study was also to find out how energy suppliers such as EdF Energy could encourage energy efficiency amongst households through measures other than EEC. Some stakeholders saw no reason for suppliers to engage in any other measures than EEC as EEC was considered to be an important part of energy suppliers' commercial business and therefore other measures may not prove attractive to suppliers. Furthermore, some stakeholders indicated that while some of the UK's energy suppliers could be more proactive with EEC, most suppliers as a whole are already 'doing their bit' with energy efficiency and some suppliers are seem to be very proactive (Hargreaves 2007).

7.2.1 Education in schools and the workplace

There are several ways in which energy suppliers could engage with customers, one of the most often mentioned was the engagement with schools and children. Energy use and energy efficiency can be seen as educational issues; energy efficiency advice has to start from an early age to have real impact. It was also mentioned that there are cultural differences in the area of energy efficiency and for instance historically UK has not had to consider this issues as the

country has had a long history of own coal production, plenty of energy resources and subsequently cheap energy prices which historically have not encouraged people to think about energy efficiency - put simply, there has not been a need for it. However, with today's reality of climate change and UK's reducing domestic energy resources, energy efficiency should be taught from an early age and engagement with schools can be ideal. This could include for instance educational workshops with children, and home energy audits conducted by children, who could then also become 'energy champions' and subsequently influence the attitudes and behaviour of their parents and other members of the local community.

A general view, also supported by our literature review, was that information leaflets or educational 'resource packs' only are not effective in changing people's behaviour if they are not combined with other measures such as feedback. Engagement with customers and the use of educational measures should be based on simple and clear messages which empower people to take action. For instance Internet-based tools may work for the younger generation, while energy audits could be a good way of providing clear energy saving advice to households as they can be tailored to each individual household's circumstances. It is important to note that different measures are likely to work with different people, hence for instance marketing measures may be required to be adjusted according to market segmentation.

Another way is to engage with people in the workplace. For instance BSkyB Ltd runs an employee energy efficiency programme, which includes energy saving campaigns at BSkyB's offices. Furthermore, since May 2006 employees joining the company have received a 'carbon credit card', which encourages them to use less energy by for instance cycling to work (Ball 2007). BSkyB also became carbon neutral in May 2006 and they now consider all of their employees' car and flight mileage, and consider the whole company's energy use by investigating the use of renewable energy.

BSkyB is also running a '*Join the bigger picture*' climate change campaign for their customers. The campaign's key message is to empower people to act on climate change, and that BSkyB's 8.5 million customers together can have a positive impact on climate change, i.e. if all 8.5 million customers decided to take action and start using for instance energy efficient light bulbs, their action together can account towards a large-scale collective effort. The campaign is communicated through various media including the internet, BSkyB marketing, advertising and programming, as well as through the staff at their call centres. Furthermore, BSkyB are also training their engineers on energy efficiency so that when they go to households to install Sky products, they can also educate customers on how to use Sky products (mainly digital set top boxes) more efficiently. So far all these initiatives have been very successful within the company and early evaluations from their customer campaign show positive results.

Part of the '*Join the bigger picture'* campaign is evaluation through a pilot scheme. BSkyB distributed free light bulbs to its 1,200 customers together with an energy saving information pack. The pilot also included tips on energy efficiency, and an advice pack was included which BSkyB designed together with the Energy Saving Trust. A personalised letter was sent to all the 1,200 customers, which included the following five simple energy saving tips:

1. Free light bulbs
2. Details of carbon calculator on Sky website
3. Advising customers that switching a set top box to standby rather than leaving it on saves 30-50% of energy
4. Advising customers to turn down thermostat by 1 degree

5. Details of a free home energy check on EST website.

The pack also included a message that the use of three energy saving light bulbs will save the amount of energy one set top box produces in its life time; and an offer of a 10% discount on eco-gifts. Market research of the pilot shows that 95% of customers were using the energy efficient light bulbs, however BSkyB is undertaking ongoing evaluation of the campaign (Ball 2007) and are also presenting results to other organisation and companies to share their experiences. BSkyB's main motive behind the campaign was to make their customers think about BSkyB differently; they also decided to partner with the Energy Saving Trust in order to have expert advice and to get their facts right on energy efficiency. Furthermore, BSkyB wanted their customers to think and consider specifically climate change, rather than BSkyB products as selling their products as part of the campaign was not one of their aims.

7.2.2 Openness creates trust

Another way to engage with consumers and particularly to build up trust and credibility amongst households is openness to consumers about what energy efficiency measures energy suppliers are required to perform under current regulation. Energy suppliers should clearly indicate that they do not carry out energy efficiency measures all by themselves, but form part of EEC and that there is a Government obligation to do so (Roberts 2007; Rohr 2007). Suppliers should therefore tell their customers that also energy suppliers have to play their part in reducing energy consumption, and that their business is not just about selling gas or electricity. Some stakeholders went even a step further, implying that in order to acquire trust, a change in the whole energy supply market may be required, and for instance measures such as capping household energy use and encouraging suppliers to sell less energy may be required for that.

7.2.3 Holistic approach to household energy use

In addition to EEC and other measures, there was also an indication from our stakeholder interviews that in order to really tackle the issue of climate change and increased energy use, we may have to consider a more holistic approach to household energy using behaviours and need to think beyond household energy consumption. In addition to energy efficiency, particularly once you have people's attention to energy efficiency, they should also be made to consider the type of transport they use and energy use and emissions related to that, as well as the use of renewable and low carbon energy sources such as micro-generation (Samuel 2007). Overall, energy efficiency is more effective in providing actual energy savings but micro-generation may be considered to be more exciting, inspirational and more importantly visual. Furthermore, consumers may generally be more inclined to talk about micro-generation and cars than for instance about cavity walls. Considering issues such as households' transport use, however, are not within the remit of energy suppliers core business.

One of the most often mentioned messages from our interviews however was the message that individual action is important and does matter. Empowering people to act and multiplying this by several thousands or even millions of other people can actually have a real impact. These are also messages which are taken forward both by community initiatives such as the Dutch EcoTeams, and the Ashton Hayes community carbon neutral project, as well as increasingly by businesses such as BSkyB and their climate change campaign of Join the bigger picture.

8 Summary and conclusions

Below is a short summary of key conclusions from the research, which are expanded on in this concluding chapter:

Summary of key conclusions:

- Behaviour is a complex combination of our emotions, morals, habits, social and normative factors and changing any of these components can be challenging
- Majority of energy consuming behaviours are based on habits and routine (repetitive actions such as using lights and cooking), minority of behaviours are one-shot behaviours (e.g. investment in loft insulation)
- Habits need to be broken down and changed by introducing new behaviours, building awareness can help
- Measures such as feedback displays, better billing and micro-generation can help make people more aware of their energy consumption
- Research has shown that feedback on energy consumption can encourage households to save energy, by an average of 5-15% depending on the measure
- A combination of energy advice with display units and more innovative billing for example could provide households with a mix of better information and feedback on their energy consumption, and initiate awareness and possibly behavioural change
- People are more likely to carry out energy efficiency behaviours under certain conditions:
  - Measures have direct benefits to them
  - Energy saving measures are easy to perform, visible and meet their goals & motives.
- To be effective, intervention measures such as feedback via a display unit/bill have to be:
  - Clearly presented and consisting of simple messages
  - Containing information relevant to the household/consumer
  - Involving some kind of a goal or a commitment
  - Be visible, consistent and frequent.
- Further experimental research is required to establish which behavioural change measures can achieve the most, long-term energy savings:
  - Display units - How to design them, in which location to install them, and what formats will they use (kWh, monetary, carbon)?
  - Smart meters - Will they make people more aware of their energy use?
  - Better billing - How frequent should a bill be (monthly?), what information should it contain (comparative/historical data), what type of graphics to use?
  - Micro-generation - Will the technology make people more aware of their energy use, will they use less energy? What type of micro-generation unit will have the most impact (solar thermal, micro-wind, micro-CHP for instance)?
  - Goal setting & commitment - How to ensure these work for long-term?

The results of this study show that our behaviours, particularly energy consuming behaviours are formed and influenced by several factors, including our internal beliefs systems and external influences such as existing regulations. Our behaviours can be locked-in, but can also change in relatively short time frame, influenced by social trends or by individuals. Cases such as the popularity of organic food and consumer electronics are good examples of rather rapid behavioural changes. However, initiating behavioural change can be very challenging and there

are several theories in socio-psychological literature which propose models on how to achieve behavioural change.

In terms of domestic energy consumption, several factors influence our behaviours, from people's internal factors to, external influences such as the type of houses we live in, the appliances we use or the heating systems we have. Furthermore, these behaviours are also influenced by the whole energy supply system, the way householders for instance are kept informed by the utilities on their energy behaviours such as gas or electricity consumption - for instance via their monthly or quarterly bills. Habits such as turning lights on/off can have either a positive or negative impact on the amount of energy used in the home. In order to change people's energy wasting behaviour towards more positive behaviour, habits need to be broken down and changed by introducing new behaviours. How this is done can be complicated, and requires careful consideration of the types of messages consumers are provided with.

There is clear indication from stakeholders that EEC3 could be used as a pilot for acquiring more information on behavioural change measures. However, neither the Government nor stakeholders interviewed for this project were able to identify the exact measures that could prove the most energy savings through behavioural changes. Hence, there is a strong notion that further experimental research is required to establish which behavioural change measures can achieve the most energy savings.

Selecting the right type of intervention measures to initiate behavioural change in domestic energy consumption is a challenging task; behaviour is a complex combination of our emotions, morals, habits, social and normative factors and changing any of these components can be a difficult. In relation to domestic energy use, measures such as feedback displays, better billing and micro-generation can help making people more aware of their energy consumption, and consequently influence their behaviour. However, there is disparity amongst the research available in intervention studies, with several studies lacking in methodological strength. Therefore more research is required in order to establish which types of intervention measures or a combination measures would be the most effective in changing energy consuming behaviours and resulting in quantifiable long-term behavioural changes and energy savings.

There are some indications of behavioural changes that can be drawn from existing intervention research, even though the discussed studies may not be representative in all circumstances. Previous research indicates that better billing, smart metering and feedback on energy consumption can encourage households to save energy, by an average of 5-15% depending on the measure. To be effective, intervention measures such as feedback have to be clearly presented, ideally containing personal information, involving some kind of a goal or a commitment, be visible, consistent and frequent. One of the main issues facing energy consuming behaviours is the trade-off between comfort and expenditure with money commonly being identified as the main motivation for energy saving, rather than environmental reasons. Information alone is not always enough to make people change their energy consuming behaviours and even similar information campaigns can have very differing results. Furthermore, information and advice are only useful as long as the recipient of the advice trusts the information source. If people do not trust or think the information source to be credible, they are likely to ignore even free advice.

The challenge with selecting intervention measures is to provide long-term behavioural changes. A combination of energy advice with display units and more innovative billing for example could provide households with a mix of better information and feedback on their energy consumption, and initiate awareness and possibly behavioural change. Furthermore, micro-generation

technologies are also potential drivers for behavioural change, as there are indications that those consumers who install micro-generation technologies are likely to consider their energy consumption and energy efficiency measures more than those without micro-generation. Some micro-generation technologies such as micro-wind turbines, still require further research in terms of their performance and suitability to certain locations.

Social marketing techniques and community-based measures such as the Dutch EcoTeams have shown to provide both considerable and long-term behavioural changes. These include techniques such as getting groups of people together each month to discuss their energy, water and waste use. It is possible that people who take part in these groups are already motivated to 'do the right thing' and reduce their impact on the environment. However, they offer a clear indication that group settings with trusted sources such as independent organisations or friends and family, together with of simple and personal advice, commitment and feedback can motivate people to change their behaviours and also maintain those changes.

Our results also show that perhaps in some cases it may be too difficult to try and change people's behaviour, and measures such as restricting consumer choice may be required. There is still relatively little research available in this area however, so further research is required to establish which regulatory measures could provide the most cost-effective changes. Furthermore, some experts argue that in order to change households' behaviour, we need a holistic approach of not only concentrating on energy use in the home, but also considering transport, waste and water use, all of which ultimately have energy and subsequently climate impacts.

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Annex A

Stakeholder interviews

A small number of informal telephone interviews were also conducted with energy experts in the UK, including EdF Energy, BSkyB Ltd, Centre for Sustainable Energy, Department for Environment Food and Rural Affairs (Defra), Energy Saving Trust, and the Office of Gas and Electricity Markets (Ofgem). The interviews were semi-structured and included general questions on energy efficiency as well as more detailed questions on EEC. Each interview lasted for approximately 40-60 minutes. Interviewees included:

- Fiona Ball, Head of Environment, BSkyB Ltd. 12.03.2007
- Charles Hargreaves, Head of Energy Efficiency, Ofgem. 23.02.2007
- Simon Roberts, Chief Executive, Centre for Sustainable Energy, 13.05.2007
- Carsten Rohr, Sustainable Energy Analyst, Division of Climate and Energy, Defra, 15.03.2007
- Brian Samuel, Head of Policy Research, The Energy Saving Trust. 28.02.2007.
- EdF Energy staff views collected during a workshop at SPRU. 28.03.2007, attendees:
    - Richard Burton EDF Energy
    - Richard Sykes EDF Energy
    - Rosie Heath EDF Energy
    - Michael Sozansky EDF Energy
    - Hans Lang EnBW
    - Jean-Paul Krivine EDF Business Line
    - Luc Lorge EDF Commerce
    - Dominique Glachant EDF Commerce
    - Isabelle Moussaoui EDF R&D
    - Sylvie Douzou EDF R&D
    - Dominique Osso EDF R&D
    - Paul Baudry EDF R&D
    - Emmanuelle Cayre EDF R&D

Annex B

Summary of intervention studies (partly based on Abrahamse *et al.* 2005)

Author(s)	Theory	Design of study	Demographics of respondents	Intervention(s)	Design of intervention	N	Control group	Target behaviour	Duration	Effect during intervention/study	Long-term effect	Country	Notes
Becker (1978)	Positive effect of information on feedback or knowledge of results on behaviour (Ammons, 1956; Bilodeau & Bilodeau, 1961) - Rational Choice Theory	N/A	Typical family - college-educated - couple in early 30s - with two small children - average income $20,000-$24,999	(1) Feedback (2) Goal setting (3) Information, however this was not separated out in the study as a variable	(1) 20% goal, feedback - 3 per week (2) 2% goal, feedback - 3 per week (3) 20% goal (4) 2% goal (5) Control	100 families - 80 families in experimental group 20 in control group	Yes	Electricity use	1 month	(1) 20%-feedback: 15.1% (2) 2%-feedback: 5.7% (3) 20%-no-feedback: 4.5% (4) 2%-no-feedback: 0.6%	N/A	US - New Jersey	Study conducted in August, one of the hottest months and peak for air-conditioning use; respondents may have changed behaviour due to the fact that they were told to be part of a study looking into energy conservation; selected groups not largely representative in terms of education, income and family size
Becker et al. (1981)	In order to influence people's energy consumption behaviour it is important to know how their attitudes correlate to their energy consumption; Factor analysis for survey results. Theory of reasoned action.	207 couples surveyed for their energy related attitudes and their gas consumption in winter December 1976 to January 1977	1) middle class professionals in mid-30s 2) average family income $20-25,000 in 1976 3) majority had college education 4) average of two young children 5) 168 families in three-bedroom townhouses 6) 26 families in two-bedroom townhouses 7) 13 families in	N/A		207 couples	No	Gas and electricity use	1 winter (3 months)	N/A	N/A	US	The following factors show which variables had a loading of more than .45: Factor 1: comfort was more important than saving energy Factor 2: most people thought they were financially better off at the time of the survey than before Factor 3:

			four-bedroom townhouses 8) all townhouses identical in construction and all had central air-conditioning and natural gas for heating, 110 houses used natural gas for water heating and cooking.										Respondents believed that technical solution was to be found for the energy crisis Factor 4: Respondents belief in the reality of the crisis was not significantly correlated with their energy use Factor 5: belief of just how much extra people could save by conserving energy considered a small amount on a daily basis Factor 6: individuals' role in the energy crisis and how they were contributing at home by wasting energy Factor 7: Relationship between family health and warm house in the winter
Bittle et al. (1979)	Previous studies have shown feedback and monetary rebates to be effective on energy saving behaviour. Rational choice theory.	30 families selected - 2 groups of 15. One group (A) received feedback while the other (B) did not, then feedback reversed from group A to group B	Middle-income families	(1) Feedback	(1) Daily feedback (costs) (2) Control	30 families	Yes	Electricity use	42 days	Feedback group reduced electricity use by 4%, compared to baseline, and conserved more than the control group.	*24-day reversal* Experimental group no longer received feedback; still used less electricity than control group, now receiving feedback.	US - Illinois	Study conducted in 1976 for 78 days in total between June and September. During the reversal period, group B received feedback for 24 days, while Group A had received for 42 days.
Bittle et al. (1979–1980)	Previous studies have shown feedback and monetary rebates to be effective on	353 families	N/A	(1) Feedback	(1) Cumulative feedback (kWh) (2)	353 families	No	Electricity use	35 days	For high consumers of electricity, all four types of feedback resulted in a lower rate of	Not measured	US - Illinois	Study did not use information as one of the interventions, however utility

	energy saving behaviour. Rational choice theory.				Cumulative feedback (costs) (3) Daily use feedback (kWh) (4) Daily use feedback (costs)					increase, but for medium and low consumers of electricity it resulted in an increase in consumption.			bills at the time had information on energy conservation tips including insulation and conservation tips. The study was conducted during very hot summer months.
Black et al. (1985)	Causal model: contextual variables (demographic, economic and structural) may affect behaviour through personal variables (attitudes, beliefs, norms). Theory or reasoned action.	Survey drafted after consultation with staff at state utility regulator, utility and consumer representatives.	N/A	N/A	Self-reports	478 residential customers - 54% response rate	No	Electric space heating (oil) and electricity use	3 months	1) Capital investment in energy efficiency - direct effects of home ownership, belief that personal benefits can come from ee, number of people in the household 2) Low-cost efficiency improvements - direct effects by personal norm (consequence of ee to others & responsibility to save energy), high household energy bills, direct payment for home heating 3) Ambient temperature - personal norm for curtailment: people who feel personal obligation to save energy by curtailment report lower temperature settings; homes with older people and those present at midday being kept warmer; occupants of larger homes have lower temperatures 4) Minor curtailments - larger homes and		US - Massachusetts	Data consists of behavioural self-reports rather than observed behaviour - possibility of over reporting exists. Study conducted in Massachusetts following the 'oil shocks' due to the 1979 Iranian revolution, (June-August).

										economic suffering due to energy costs produce more minor curtailment			
Brandon and Lewis (1999)	50% of variance in energy consumption could be explained by attitudes to energy conservation (Seligman & Kriss 1979); socio-demographic factors have an impact on energy use. Value-Belief-Norm Theory?	Feedback, questionnaire and focus groups	Male 45% Female 55% Housing association 4% Local authority 16% Mortgaged 29% Owner-occupier 30% Private rent 21% Age <41: 32% 41-60: 38% 60>: 30% Full time occupants 1: 47% 2: 39% 3: 14% Income <20k: 557% 20-40k: 30% 40k>: 13% Social class professional 65% junior managerial 23% manual worker 12%	(1) Feedback (2) Information for environment feedback, leaflet feedback and computer feedback groups (though Abrahamse didn't mention this as information)	(1) Comparative feedback (2) Individual feedback (3) Cost feedback (4) Environment feedback (5) Leaflet feedback (6) Computer feedback (7) Control	120 households	Yes	Gas and electricity use	9 months	(1) Comparative: 4.6% (2) Individual: 1.5% (3) Cost: 4.8% (4) Environment: 4.5% (5) Leaflet: 0.4% (6) Computerized: 4.3% (7) Control: 7.9% Marginally significant difference between feedback groups combined and control.	Not measured	UK - Bath	Focus groups showed that people were aware that they had received feedback, people were pleased with computer displays but generally across the study disappointed by the lack of personalised information.
Geller (1981)	Not reported	1) Seven three-hour energy conservation workshops including engineering and behavioural strategies (home insulation, disadvantages of fireplaces, prevention of air infiltration, efficient use of water-flow restrictors and changes in	N/A	(1) Information (workshop)	(1) Information (2) Control	117 people in workshop 40 households in behavioural follow up 40 households in behavioural follow up control group	Yes	Electricity, gas and water use	3 hours	The workshop resulted in an increase in levels of determinants.	*6– 12 weeks after workshop* No behavioural effect was found.	US	Study between 1978 and 1979 - near Richmond, Virginia (semi-urban) and Southwest Virginia (rural). Following the workshop people were more concerned about the energy crisis and overall better understanding of energy related

		lifestyle). 2) Behavioural follow-up.											issues and people's own role in the system, however, no behavioural change following the home visits.
Gonzales et al. (1988)	Study based on four social-psychological principles: 1) vivid information - comparing to "superconservers" 2) personalization of statistical data 3) commitment 4) information framing - *losing* money more effective than *gaining/saved* via conservation action. Theory of Interpersonal Behaviour?	18 auditors in total; 9 were trained - 9 acted as control group; telephone interviews were used for the selected sample size of respondents	N/A	(1) Information (audits) (2) Rebate	1) Information (trained auditors), rebate (2) Information (nontrained auditors), rebate	408 audit recipients	No	Gas and electricity use		*1– 2 weeks after audit* Households in trained-audit group reported a greater likelihood of following through on recommendations.	*4 months after audit* Households in trained-audit group had followed recommendations more often, but no difference in energy consumption.	US	The study resulted in behavioural change but not in reduction in electricity and gas consumption. 1985-1986
Haakana et al. (1997)	Not reported	1) Families interviewed in Oct-Nov 1993 on various aspects of energy use and where they could save 2) Energy meters installed in 40 appliances in different households 3) Random allocation to different treatment groups and control 4) All households sent monthly form with readings of heat, electricity and water consumption during Dec 1993-Aug 1995 5) Feedback was sent on consumption 6) Focused advisory	Not reported	(1) Feedback (2) Information	(1) Feedback and information (video) (23) (2) Feedback and information (literature) (27) (3) Feedback only (29) (4) Control (26) Feedback - monthly comparative in graphic form * 83% comparison to similar houses * 69% also wanted to comparative figures with participants	105 single-family houses	Yes	Heat, electricity and water consumption	17-21 months	Heating energy consumption decreased by an average of 5% when households began to read meters. After feedback on consumption, households reduced energy consumption for space heating by 3-9% compared to previous year. Electricity consumption decreased after feedback by 17-21%. After feedback, focused advice had no further influence. 54% of households reduced energy consumption by turning of lighting in empty rooms, 27% lowered room	Not reported	Finland	1993-1995. The most common energy saving measures where turning off lights in empty rooms (50% of households willing to do), reducing water consumption relating to personal hygiene (51% willing), sealing windows and doors (37% willing), lowering room temperature (33% willing), changing habits in use of fridge/freezer (28%). Most Finnish district heating customers have had feedback on heat

		information sent to groups 7) Inquiry in May 1994 to all households asking their opinion about the feedback material 8) May 1995 households asked about any changes in their habits using space heating, electricity and water								temperature, 27% dressed more warmly and 23% paid attention to thermostat valves			consumption since the 1980s, reports have been variable in different regions and companies though.
Hayes and Cone (1977)	Previous research had addressed two dimensions of energy use: patterns and level of consumption. Previous research had also examined the effects of reasonable classes of independent variables. Rational Choice Theory.	1) Baseline meter readings - covert (pre-group selection) and overt 2) Payments - differing amounts 3) Feedback - daily flyer including cost information on a) the amount of electricity consumed the previous day b) the amount of electricity consumed so far in the week c) the amount of electricity which would be consumed for the week at that rate of consumption d) the % above/below covert baseline levels that "c" represented 4) Information - poster which described ways to reduce electricity consumption and included rate of consumption for the year 5) Post-intervention structured interviews on the trial	Students married with children, no socio-demographics available	(1) Rewards (2) Feedback (3) Information	Multiple baseline design: interventions sequentially implemented.	4 student families (married with children)	Yes - natural control group (baseline only) from the data for the overall building complex	Electricity use	91 days	All households reduced electricity consumption, compared to baseline. 2 groups considered payments to be the most effective treatment, 1 group said information and last group feedback.	Not measured	US	Study conducted in an 80-unit housing complex for married students at West Virginia University. Results showed that a) daily feedback had at least some effect on energy consumption on those who normally received no electricity bill b) monetary payment + daily feedback reduced consumption further c) high payments alone worked as well as payment + feedback

Hayes and Cone (1981)	Previous research had looked at feedback but mainly from uneconomical way. Theory of Reasoned Action?	1) Two baseline periods in 1973-74 and 1975-76 2) Monthly feedback was implemented in February 1976 and withdrawn in June 1976 3) Control group remained in the baseline phase throughout; Two dependent measures used: a) raw (present consumption - previous month) b) % change scores (present consumption as a % change from average for that month in 1973-74.	N/A	(1) Feedback	(1) Monthly feedback (2) Control	40 families (20+20)	Yes	Electricity use	4 months	Feedback group: consumed 4.7% less than previous year Control group: consumed 2.3% more than previous year	*2-month follow-up* Feedback: consumed 11.3% more than previous year Control: reduced use by 0.3% compared to previous year	US	
Heberlein and Warriner (1983)	Social psychological theory on attitudes and behaviour, cognitive consistency and social learning; this study concentrated on two parts of attitude - cognitive, i.e. the belief component and conative, the motivational or predisposition to action component. Social Learning Theory and Cognitive Dissonance.	1) First year time-of-day rates developed, participants electricity use monitored (590 households) 2) Participants randomly assigned to separate design cells according to 1975 consumption levels and ownership of air conditioner and electricity for water heating, participant put on special electricity rates 3) Monthly feedback on KWh used on-peak and off-peak, compared to previous month and same month in	N/A	(1) Feedback	(1) Monthly feedback (price ratio) (2) Control	600	Yes	Electricity use	3 years	Larger price differences between on-peak and off-peak periods resulted in larger reductions of on-peak electricity use.	Not measured	US	Rewards and punishments alone are sufficient to change consumer behaviour; personal sense of commitment to shift is largely independent of price ratio - those who were strongly committed changed behaviour no matter what price ratio they were on.

		previous year Two mailed questionnaires 1) First questionnaire just before participants went on special electricity rates - looked at type & number of appliances owned, size, age and usage of these, time of day usage of energy-related household activities, home building characteristics and socio-economic and demographic family information 2) Second questionnaire two years after implementing special rates and one year prior to concluding experiment - measured attitudes about time-of-day pricing, opinion on utility company, knowledge of special pricing structure and peak lengths, concern and beliefs about energy and environmental issues.											

Hirst and Grady (1982-83)	Not reported	1) Free *voluntary* on-site energy audits to 19,000 homes between 1978 and 1980: winter heating seasons of 1977/78 (preaudit), 1978/79 and 1979/80. 2) 1979 evaluation of the programme focusing on owner-occupied households 3) Information from three sources: utility bill, energy audit, and 27-page questionnaire.	Audit group/Nonaudit group: Household income: $19,800/$19,700; Education level years: *13.8/13.2*; Household members: *2.9/3.2*; People older than 65 years: *0.5/0.3*; Floor area of house (ft2): 1,560/1,590; Value of house: *$51,800/$46,200*; Time in present home: 13.7y/13.6; No plan to move home: 79%/83%	(1) Information (audits)	(1) Information (2) Control	850 (466 audited households and 384 non-audited households, who acted as a control group)	Yes	Gas use	3 years (three heating seasons)	One year after home visits: gas savings of 2%, compared to control group.	*2 years after audit* Gas savings of 4%, relative to control.	US	Wisconsin 1978-1980; evaluation of Wisconsin Power and Light company's energy audits. Programme participants and nonparticipants had similarities in terms of pre-audit gas consumption, demographic characteristics, adoption of conservation practises and attitudes on energy issues. Self-selection may have occurred because the audit was voluntary. Gas consumption was less for the audit group than the nonaudit group for each of the three winter heating seasons.
Hutton and McNeill (1981)	Not reported	1) Direct distribution of Low Cost/No Cost energy conservation booklet to 4.5 million households 2) Direct distribution of shower flow control device along with LC/NC booklet 3) Paid advertising campaign including TV, radio and newspapers 4) PR activities - public service announcements,	Fuel source, age, marital status, education.	(1) Information	(1) Information (media campaign), shower flow device (2) Control	1811 (1207 + 604 control group) households	Yes	Gas, electricity and water use	1 month	Experimental group adopted more energy saving tips than the control group. No data reported on actual energy savings.	Not measured	US	First campaign of its kind in the US (six New England states) whereby the government (DoE) sent incentives (show flow control device) to 4.5 million householders.

		press conferences, talk shows, newspaper articles and editorials 5) Telephone survey questionnaire including four major components: Screening (dwelling type and readership of booklet), Reported behaviour, Attitudes towards LC/NC advertising, Demographics.											
Hutton et al. (1986)	Feedback as one dimension in the principles of behaviour modification, communications and motivation. In behavioural sciences feedback is seen by some as the critical element controlling learning and performance. For this study the framework is formed of four parts: environment, strategies, mediating variables and consequences. Learning theory?	1) Treatment groups received energy conservation booklets and a feedback monitor, the Energy Cost Indicator (ECI), which was designed from the back of literature reviews, focus group interviews with consumers, interviews with manufacturers and retailers and laboratory testing at the US National Bureau of Standards. 2) Energy consumption was recorded for one year preceding and one year following the treatments. 3) Survey questionnaire on knowledge and attitudes.	Not reported	(1) Feedback (2) Information	(1) Feedback, information (ECI feedback monitor + conservation literature) (2) Information (conservation literature) (3) Control (experimental control, subjects informed they were part of energy consumption study 4) Blind control (subjects unaware that they're participating in the study)	300 households	Yes	Gas and electricity use	At least 2 years	Feedback+information group and information only group conserved more energy than controls (but only in Canadian cities).	Not reported	US and Canada	California; British Columbia and Quebec. Knowledge of energy conservation was possibly higher in Canada than in the US before the treatments. There were no change in knowledge levels in Canada but those who took part in the ECI+conservation leaflet used 4-5% less energy than the control group. Meanwhile an increase in knowledge in the US occurred during the study but there were no changes in behaviour.

Kantola et al. (1984)	Cognitive dissonance theory - when a person has two beliefs or items of knowledge that are not consistent with each other, then there is tendency to reduce this dissonant state. Cognitive dissonance theory.	118 households surveyed for their attitudes on energy conservation and whether this impacts their behaviour; study included feedback on the level of their energy use (in the form of a letter) and information tips on how to reduce electricity consumption	Suburbs in the middle to upper socioeconomic range. Questionnaire asked about family size and income, age, sex of family members	(1) Feedback (2) Information	(1) Dissonance feedback (letter saying respondent high user against their attitude on conservation), information (tips on conservation) (2) Feedback (letter saying respondent high user), information (tips on conservation) (3) Information (tips on conservation) (4) Control	118 (Dissonance 31, feedback 32, tips 30; control 25)	Yes	Electricity use	4 weeks	The cognitive dissonance group saved significantly more electricity than the other groups. For the second two weeks, this group only differed from control. Consumption during experiment in kWh: Dissonance 640 Feedback 705 Tips 667 Control 729	Not measured	Australia - Perth	Experiment conducted in the hot part of the year but outside peak holiday period; some effect of dissonance on consumption but not on attitudes
Kasulis et al. (1981)	Electricity consumption has not only seasonal but also time-of-day (TOD) peak and off-peak periods. Rational choice theory.	1) Pre-experiment survey - 1,452 respondents 2) Experiment - households divided into groups, experimental rates implemented September 1st 1977 until August 31st 1978; electricity usage data collected throughout experiment. Three experimental treatments: rates and rate structure, group vs. individual rates, information feedback 3) post-experiment survey	Income, home ownership, appliance ownership	1) Rates and rate structure 2) Group versus individual rates 3) Information feedback	1) 6 different TOD rates with varying costs for on- and off-peak 2) Individual vs. group metering 3) Information pack on energy saving and monthly meter reading feedback on usage	360	Yes	Time of Day electricity use	20 months	Schedule and conserve measures statistically significant, purchase statistically insignificant. Households on individual metering were more likely to schedule their activities during off-peak times than households on group meters. Full information was more effective than limited information. Peak and off-peak power are weak substitutes, short term demand elasticities are lower than elasticities estimated in nearly	Not measured	US	Edmond, Oklahoma (March 1977 to November 1978). Those on low income (less than $5,000) excluded from the study

										all other TOD studies. Subjects were unable to make even small lifestyle changes - more substantial peak off-peak price differentials required. Information feedback significant for the schedule variable. Individual initiative outperformed group pressures. There were no reductions in overall demand.			
Katzev et al. (1980–1981)	Psychological research, a significant amount of energy consumption stems from needless and excessive waste. Theory of Reasoned Action?	Study for seven weeks: 1) Baseline 2 weeks 2) Information 1 week 3) Treatment 2 weeks 4) Follow up 2 weeks	All age levels, middle-class income bracket	(1) Feedback	(1) Daily feedback - meters read daily, feedback taped to door (2) Feedback every 3rd day - feedback taped on door (3) Non-contingent feedback - feedback slip (4) Control	44 apartments	Yes	Electricity use	2 weeks	No significant differences between experimental groups and control group.	*2-week follow-up* No significant differences.	US -	Portland, Oregon - Summer 1977. All-electric households included air-conditioning, study conducted during summer.
Katzev and Johnson (1983)	Various behavioural techniques have been employed to encourage energy saving, including information, prompts, feedback, and incentives. This study based on minimal justification principle - application of weaker, more moderate justifications for behaviour. Social Pressure/ Theory	Study over five months: homeowners were asked to curtail electricity consumption by 10%. 2 week baseline period, 4 week request period, 12 week follow-up period.	Middle-class	(1) Commitment (2) Information	(1) Request (questionnaire) (2) Request (commitment) (3) Both requests (foot-in-the-door) (4) Control	66 homeowners (control 18, first request questionnaire 18, second request only commitment 16, foot-in-the-door 14)	Yes	Electricity use	4 weeks - over a five month period	No significant differences between groups.	*12-week follow-up* Experimental groups conserved more electricity than control group. Foot-in-the-door group produced more energy conservers than other groups.	US	Portland, Oregon. Foot-in-the-door group produced more energy conservers than other groups.

	of Reasoned Action?												
Katzev and Johnson (1984)	Foot-in-the-door & commitment; strong external incentives *and* social pressure promote pro-social behaviour. Social Pressure/ Theory of Reasoned Action?	Homeowners were asked to curtail electricity consumption by 15%. 4.5 month study; 11-day baseline period, 18-day request period, 15-day conservation period, initial 18-day follow-up period.	Middle-class	(1) Commitment (2) Incentive (3) Information	(1) Request (questionnaire) (2) Request (commitment) (3) Both requests (4) Incentive (5) Both requests, incentive (6) Control	90	Yes	Electricity use	2 weeks	The commitment only and the group receiving all interventions conserved more electricity than the other groups (but only in first week).	*2 months follow-up* No significant differences between the groups.	US	Portland, Oregon. Commitment group conserved more energy and contained more energy conservers.
McCalley and Midden (2002)	Behaviour is responsible to waste in domestic energy consumption, this can be attributed to a lack of knowledge on how much energy is being used for various purposes. The user will need correct information on energy use in order to reduce energy consumption. The study uses feedback technology to relay information and focuses on the interaction between the product and the user through product-integrated feedback in an effort to induce energy saving behaviour. Feedback Intervention Theory (FIT)	1) Short list of questions asking age, gender, education level, household size, and number of washes done on a weekly basis. 2) Short test of social orientation, which was in the form of a game. 3) Subjects given ten washing trials to complete via a graphic representation of the washing machine control panel. Served as practice and to set the baseline level of energy used per wash. 4) Subjects then completed 20 more washing trials and ended the session with a short questionnaire about their opinion of the interface and of energy issues.	Questionnaire asked age, gender, education level, household size, and number of washes done on a weekly basis.	(1) Feedback (2) Goal setting	(1) Feedback (2) Feedback, self-set goal (15%/20%) (3) Feedback, assigned goal (20%) (4) Control	100	Yes	Doing laundry (load and temp. setting)	20 washing trials	Feedback combined with goal setting was more effective than feedback alone. Participants with a self-set goal saved 21.9%, those with an assigned goal saved 19.5%. Virtually no difference in the amount of kWh saved between individuals who chose a 5% conservation goal and those who chose a 20% conservation goal. Self-setting a goal was found to be most successful overall and resulted in a savings of 21%.	Not measured	The Netherlands	Self-setting a goal was found to be most successful overall and resulted in a savings of 21%. Product-integrated energy feedback, when coupled with a means for the user to set an energy conservation goal, offers a convenient and highly successful means to save energy, at least in the laboratory setting.

	(Kluger & DeNisi 1996).												
McMakin et al. (2002)	Considerable uncertainty remains about what motivates people to behave in environmentally responsible ways, these include such factors as environmental knowledge, environmental values, attitudes, personal characteristics, and behaviours. Numerous theoretical approaches have been developed to integrate various combinations of these factors. Energy conservation behaviour is multifaceted and complex. There is no single and general construct that predicts environmentally friendly behaviour. A broader social-psychological model to describe energy conservation behaviour integrates societal-, group-, and individual-level processes. It also provides support systems to aid behavioural	Military installations in Washington and Arizona. Tactics included site-specific video programs with residents modelling the desired behaviours, print mat serials showing progressive energy savings, cartoons with conservation story lines, electronic reader boards, diffusion through military chains of command, and display booths at on-post fairs.	Not reported, but military base.	(1) Information (tailoring)	(1) Information	1231 and 175	Not reported	Gas and electricity use (related to heating); Electricity use (related to cooling)	1 year heating-related energy, 4 months cooling-related energy.	Households saved 10% energy compared to baseline in the heating-related sample. Households used 2% more electricity, compared to baseline in the cooling-related sample.	Not measured	US	Military installations in Washington and Arizona. Families who live on base do not pay their own energy bills, so motivation must be noneconomic. Most residences are not individually metered, and the lack of individual bills also means that residents receive no feedback on their own energy use or any savings that may occur.

	change and overcome barriers such as lack of information and everyday life needs. Theory of Interpersonal Behaviour?												
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Bar-charts 2 years, energy saving tips, six bills annually. Debit of real consumption. Reading by own staff.	Not reported	(1) Information (2) Feedback	Bar-charts 2 years, energy saving tips, six bills annually	1400	?	Electricity use	3 years	10% energy saving. Increased energy consciousness, changed energy habits. Earlier bill, more thorough reading	Not reported	Norway	Oslo (1989-92)
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Electricity report with statistics and charts, saving tips. 10 bills annually. Debit of real consumption. Reading by own staff.	Not reported	(1) Information (2) Feedback	Electricity report with statistics and charts, saving tips. 10 bills annually.	700	?	Electricity use	3 years	2% energy saving. Thorough reading of the information letter. Almost all customers satisfied and want to continue.	Not reported	Finland	Helsinki (1989-92)
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Electricity report each month with statistics and saving tips.	Not reported	(1) Information (2) Feedback	Electricity report each month with statistics and saving tips.	1500	?	Electricity use	2 years	Increased information does not cause changed attitudes. Spendthrift people find it easier to save than others.	Not reported	Denmark	AKF project (1989-91)
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Simplified bill with 2 years' statistics and saving tips. Six bills annually.	Not reported	(1) Information (2) Feedback	Simplified bill with 2 years' statistics and saving tips. Six bills annually.	1000	?	Electricity use	3 years	3% energy saving. The bill is made simpler and acts as a control tool. More conscious customers.	Not reported	Denmark	MSE (1988-91)
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Electricity reports as an appendix in the bill, compared with other customers.	Not reported	(1) Information (2) Feedback (comparative)	Electricity reports as an appendix in the bill, compared with other customers.	1400	?	Electricity use	2 years	2% energy saving. More energy conscious customers. The electricity bills work as an alarm clock to take measures.	Not reported	Sweden	Tibro (1989-91)
NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Graphical information, comparison with equivalent house. 3, 6, or 12 bills annually.	Not reported	(1) Information (2) Feedback (comparative)	Graphical information, comparison with equivalent house. 3, 6, or 12 bills annually.	600	?	Electricity use	1 year	No energy-saving. Almost all the customers prefer the new bills. Easier to control the bill and obtain info on energy consumption.	Not reported	Sweden	Helsingborg (1992-93)

NUTEK (1996) as referenced in Henryson et al. (2000)	Not reported	Energy letter each month with consumption statistics and saving tips	Not reported	(1) Information (2) Feedback	Energy letter each month with consumption statistics and saving tips	50-1300	?	Electricity use	< 1year	12% saving. Changed habits due to the energy letters.	Not reported	Sweden	Umeå (1989)
Staats et al. (2004)	Intervention techniques that only change one specific type of behaviour, and then only for the duration of the intervention, have limited practical value. Social learning theory.	1) 445 people who were ready to start ETP in January or February 1994 received a request to participate in the research. 2) 289 (65%) cooperated prior to participation in the ETP by completing the first set of mail questionnaires. 3) October 1994, 205 participants (71%) completed the post-ETP questionnaires. 4) In December 1996, this group was approached again with the request to complete a third set of mail questionnaires in order to obtain a similar set of data 2 years after participation. 5) The sample of respondents who completed both T1 and T2was reduced to 150.	Final sample of ETP participants had an average age of 52 years, a higher income and higher education level than the average Dutch population, and consisted of 85% women.	(1) Information (2) Individual feedback (3) Comparative feedback	(1) Information, individual & comparative feedback (2) Control	150	Results compared to eight specific behaviours were phrased identically to those asked in a longitudinal study on environmental household behaviour that is administered each year among a panel (N = 1,500) representative of the Dutch population	Gas, water, electricity use, waste, food, transport	8 months	Gas use: 20.5% Electricity use: 4.6% Water use: 2.8% Waste: 32.1%	*After 2 years* Gas use : 16.9% Electricity use 7.6% Water use: 6.7% Waste: 32.1%	The Netherlands	EcoTeams are groups of 6 to 10 people who usually know each other already as neighbours, friends, club members, church members, and so forth. EcoTeams meet once a month and personal experiences, ideas, and achievements related to environmental household behaviour are shared. EcoTeams focus on six themes, each for 4 consecutive weeks, as presented in the EcoTeam Workbook: waste, gas, electricity, water, transport, and consumer behaviour.
Van Houweling en and Van Raaij (1989)	Research on feedback is inconclusive, with some studies suggesting that feedback is effective, while others saying that it should be combined with other measures	1) Households contacted for participation in the study, sample selected 2) Families interviewed to check the type of appliances which use natural gas 3) Households	Middle-class residential area, rental homes.	(1) Feedback (2) Goal setting (10%) (3) Selfmonitoring (4) Information	(1) Continuous feedback, goal setting, information (2) Monthly feedback, goal setting, information (3) Monitoring, goal	285	Yes	Gas use	1 year	(1) Continuous feedback: 12.3% (2) Monthly feedback: 7.7% (3) Self-monitoring: 5.1% (4) Information: 4.3% (5) Control: 0.3%	*After 1 year* Gas use increased for all groups, compared to baseline; difference between groups disappeared	The Netherlands - Utrecht	Households received the same information

	such as goal-setting, commitment or cognitive dissonance. Cognitive dissonance theory.	assigned to one of six conditions, those with a conservation goal of 10% reduction and those without (plus other measures such as feedback, information)			setting, information (4) Goal setting, information (5) Control								