Changing Behaviour

Basic approaches to studying energy-related behavioural change

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2. Basic approaches to studying energy-related behavioural change

This chapter summarises three major approachs to studying energy-related behavioural change: economics, psychology and social psychology and sociology, including the sociology of technology. The boundaries between these disciplines are not clear-cut. Moreover, there is not room to give a comprehensive presentation of all research and the various approaches that exist within these disciplines. The focus is on research that is relevant for energy efficiency and the design and evaluation of DSM programmes. The purpose of this chapter is to identify the main 'lessons' for energy DSM programme design that can be drawn from these research approaches, and understand how the assumptions underlying the approaches influence the kinds of 'lessons' produced.

The starting point is that all these disciplines have valuable contributions to the design and evaluation of DSM programmes. Yet each discipline examines energy issues from a partial perspective, whereas the reality of energy use and DSM practice cuts across the disciplinary boundaries. Table 1 provides an overview of the issues discussed for each discipline in the following sections. Also some specific issues for each discipline are discussed.

Table 1. Key questions and a summary of the perspectives of each discipline (with reference to 'the mainstream' within each discipline).

	Economics	Psychological and social psychological research	Sociological and sociotechnical research
1. What are the key units of analysis in energy-related behavioural change?	Individuals Markets (Institutions)	Individuals ('Internalised others' – via social norms)	Society Social practices Sociotechnical networks Systems of provision
2. What is the logic of action of programme managers/policy makers?	Rational action (public choice)	Usually rational action (bounded by lack of psychological competence)	Reflexive: programme managers are part of the society they are trying to manage, and their action is influenced by social structures as is the action of the target group.
3. What is the logic of action of target groups?	Goal-oriented, self-interested Rational action or bounded rationality	Multiple motivations (self-interested and altruistic) Experience-, goal- and norm-oriented Bounded and multiple rationalities	Norms-oriented, driven by conventions and social structure Structurated: actors can also change structures through action
4. What are the barriers to energy efficiency?	Market failures: high cost of information, externalities, transaction costs	Lack of feedback or information processing capacity Lack of social pressure Lack of perceived self-efficacy Lack of skills & opportunities Habits Helplessness	Embedded in sociotechnical systems: prevailing infrastructures, conventions, social organization of the market & institutions
5. How can actors be motivated and mobilized to save energy?	By correcting market failures: providing cheaper information, new institutions, incentives	By providing information, feedback and (social or economic) incentives in suitable formats & combinations	Through collective action Through negotiation and reorganization of sociotechnical networks
6. What intervention instruments (with relevance to DSM programmes) have been studied within this tradition?	Institutions that correct market failures Financial instruments Information (especially audits and feedback)	Innovative informative instruments Combinations of information & incentives	The same as the others, but from a more critical perspective Change in broader social systems Social movements Social innovations
7. How do the different traditions evaluate successful action/ successful interventions?	Cost-effectiveness Social welfare (Pareto-optimality)	Behavioural change (Social change)	Social change Social learning Legitimacy

2.1 Economics

General introduction and basic position

Economics is a broad field encompassing microeconomics and macroeconomics, as well as many specialized fields such as industrial economics, consumer economics, organizational economics, information economics, welfare economics, new institutional economics and evolutionary economics. These fields disagree on many fundamental issues, but they agree on one thing: society is made up of individuals and these individuals act in a goal-oriented fashion ('teleological action') aiming to promote their own interests in one form or another: utility maximization (neoclassical economics), rent-seeking (industrial economics) or survival (evolutionary economics)[1].

Economic action is structured by markets (neoclassical economics), organizations (organizational and industrial economics), institutions (institutional economics) and/or the state (welfare economics), and the efficiency of these structures can be judged from a rational perspective. In welfare economics, the role of the state is to correct market failures (see below) and to steer markets to a Pareto-efficient state, i.e. a situation where no individuals can be made better off without making someone else worse off. So the welfare of society is the 'sum' of the welfare of all individuals in that society.

The basic neoclassical proposition is that competitive markets will steer resource use to the most productive purposes, thus maximizing total utility. If companies are using energy inefficiently, their products will be more costly than those of their competitors, and they will disappear from the market. Most economists, however, acknowledge a number of 'market failures', which lead to inefficiencies. The most well-known of these are *economic externalities* (e.g., environmental impacts like climate change), *imperfect competition* (monopolies, barriers to entry, etc.), *transaction costs* (search and information costs, contracting costs, enforcement costs) and *agency problems* (contractors do not always act in the principal's best interests).

There are three basic approaches to energy efficiency within economics (Golove and Eto 1996):

- Engineering economics: From an engineering and industrial accounting perspective, individuals and society consistently under-invest in energy-efficiency (see e.g. Lovins 2004). They thus demand much higher returns on investment in energy efficiency than on other investments. Whereas the cost of capital can be assumed to be about 7-11% (European Central Bank Statistics 2008), energy consumers often have an 'implicit discount rate' of about 25-80% (corresponding to payback periods of 4 to 1 years), in some cases even 800% (payback period 5 months), in their investment decision in energy efficient technologies (Geller and Attali 2005)[2]. From a social perspective, the "efficiency gap" is even larger. Individuals and society are thus not behaving rationally, and this is due to the existence of 'barriers to energy efficiency'.
- Neoclassical economics argue that this is not the case (because if such opportunities existed, market actors would invest in them), or at least not to the extent that engineers claim. They argue that the high discount rates are in fact warranted given the riskiness of the technologies (they may not provide the

[1] These assumptions are to some extent relaxed in such alternative strands of economics as humanistic economics that take a broader view on the purpose of economics and economic life. They focus on the human being and his/her nneeds and their satisfaction, and believe that the aim of economics is to increase human (rather than economic or social) welfare of well-being (Ekins and Max-Neef 1992; Lutz and Lux 1998). Such alternative economic approaches can contribute to explaining why people voluntarily reduce their energy consumption. Even though the underlying reasoning is somewhat different from that in economic sociology, the empirical subject matter is similar, so the findings are discussed under the heading of 'sociology', except from a final comment at the end of this chapter concerning economic well-being in society.

[2] In fact, high implicit (i.e., 'informal') discount rates are typical in behavioural economics, especially for low-income people (Antonides 1996). Thus, the unwillingness of firms to invest in energy efficiency partly suggests that energy decisions are not subjected to as rigorous accounting procedures as other investments, and there is evidence that extremely simple payback rules (e.g. 2 years) are often used ( ).

benefits promised in real-life situations, and the future cost of energy is always uncertain[3]). The investments may also be difficult to turn back into cash (e.g. installed HVAC equipment vs. stocks and bonds). Information, search, maintenance and training costs for efficient products may be higher than for conventional ones). Some consumers or small businesses may have a very high cost of capital, or may not be at all eligible for loans. Moreover, the profitability of energy efficiency investments is only one of the attributes energy consumers consider when making investments (i.e., if it is not prioritized, then other attributes, e.g., comfort, obviously provide greater utility) (Golove and Eto 1996).

- Institutional economics acknowledges that there are market failures that lead to underinvestment, most notably the failure to internalize the environmental cost of energy production into the price of energy. Nonetheless, they argue that transaction costs also explain a large portion of the underinvestment in energy efficiency (Golove and Eto 1996; Praetorius and Bley 2006). These costs relate to the costs of information and the costs of monitoring and controlling economic exchanges "Agency problems" or "mismatched incentives" are one example, e.g., tenants cannot force their landlord to provide the most efficient equipment, or managers cannot ensure that their employees use equipment in the most efficient way. The fragmented nature of the energy end-use market compounds such problems. There are also barriers to entry for new energy services, e.g., they may have a higher cost of capital than existing players in the market.

  In addition, the costs of information and the risks of new technologies may be too high to be borne by individual players. In addition to the cost of obtaining information, there is also a cost to using information. Thus, economic players are in reality "boundedly rational", i.e., they try to be rational, but in fact usually follow simple 'rules of thumb' (March and Simon 1958): a company may, for example, set a rule that it invests in projects with a payback period of less than a year, rather than perform sophisticated analyses of the net present value of various investments. To correct these many different market failures, institutional economists argue that new institutions are needed (e.g., government regulation, DSM programmes, mandated energy efficiency standards).

- Recent studies in behavioural economics have examined consumers' preferences for particular energy-related products or energy-saving measures (Burkhalter, Kaenzig and Wüstenhagen 2007; Belz and Billharz 2005). The most popular technique in this context is the conjoint analysis[4], a statistical procedure to determine the importance of particular characteristics of a product, service or measure for the consumer. In 2003 Poortinga et al. (2003) applied this approach for the first time to energy-saving measures. Since then, surveys on green electricity, heating systems and wet appliances have been carried out (e.g. Sammer and Wüstenhagen 2006).

All of these streams of economic thought assume that policy makers are rational – or are at least capable of being rational provided the correct information – but they have different advice for public policy. The engineering economists would argue for very forceful policies such as stringent energy efficiency standards, whereas the neoclassical economists would say that markets will solve the problem in time. Institutional economists argue that policies should be applied to the extent that they correct the existing market failures, and lead to socially optimal level of investment in energy efficiency.

A further barrier to energy efficiency is identified in evolutionary economics, which takes into account history and learning. History is understood as an "irreversible branching process" (David 2000); once a 'path' has been taken, capital and knowledge accumulate around the selected path, and it is difficult to

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[3] Thompson (1997), however, argues that this is a flawed approach to accounting for risks, since risks are only considered for the investment and not for the status quo.

[4] Economics usually does not study consumers' preferences, as they are assumed to be revealed through their purchasing decisions. Conjoint analysis is based on a fundamental observation in consumer economics that products are actually bundles of characteristics, and it is these characteristics that the consumer has preferences for, not the entire product or service (Lancaster 1966). Thus, consumers' choices in the market do not necessarily reflect their preferences if they are unable to accurately judge the characteristics of the product or service they are choosing. The utility of a product or service or measure is thus considered to consist of 'part-worths' which together add up to the total utility, and conjoint analysis is a technique to measure these part-worths.

change to an alternative one (even if it may later appear to be more efficient). From this perspective, the economic organization and institutions of our times have emerged in an era of cheap and abundant energy (and ignorance of environmental problems). From this perspective, also the policy makers and programme managers are boundedly rational (Green et al. 1999), because they draw their knowledge and decision rules from the legacy of the dominant path.

Instruments for DSM

From an economic perspective, the rationale for policy intervention is to correct market failures (Golove and Eto 1996). Thus, the preference would be for broad-scale measures, such as increasing the price of energy via energy taxes to reflect its full cost, including externalities. Individual interventions (like target-group specific programmes) are viewed with more caution, because they run the risk of 'policy failure' (i.e., misplaced interventions that interfere with the efficient operation of the market).

Because the cost of energy efficiency information is prohibitively high, publicly funded information provision is a warranted instrument from an institutional economics perspective. Since it may be difficult for customers to judge the merits of energy efficiency claims, public energy labeling programmes deal with information asymmetries. Training and publicly support for energy auditing may reduce the cost of obtaining and managing energy-related information.

Institutional solutions can transfer the risk of energy investments or solve some of the transaction costs and agency problems hindering investments in energy efficiency (Golove and Eto 1996). Peformance contracting and energy service (ESCO) contracting are prime examples of instruments that aim to minimise the total cost of obtaining energy services. Energy service contracting aims to reduce the problems related to capital allocation (i.e., the difficulties in raising capital for energy efficient investments), as well as the transaction costs related to the cost of searching for trading partners, negotiating and writing contracts, as well as of monitoring performance and enforcing compliance (Sorrell 2006).

Financial incentives are viewed as an effective instrument by economists, but not necessarily as an efficient one. They run the risk of distorting the market. Nonetheless, if the risks of adopting a new technology are high, especially for first movers, grants are deemed acceptable to start the diffusion process. R&D is another area in which policy intervention is acceptable, because in a neo-classical perspective new knowledge is a public good (i.e., a positive externality).

Effectiveness of instruments

The economic tradition has had a strong impact on DSM programme evaluation. From an economics perspective, programmes are effective if they are capable of eliminating market barriers or market failures at minimal social cost and without distorting the market. They should be cost effective, i.e., the inputs should be a small as possible compared to the outputs gained. The costs of DSM programmes can also include indirect costs such as lost revenues or taxes. In most evaluations, however, only the direct programme costs are included (Vreuls 2005). Cost-effectiveness calculations can be made from various perspectives, e.g. those of the participants, the service providers, the programme administrators, total resource costs, of costs and benefits to society. There are quite sophisticated ways of evaluating the financial soundness of energy efficiency projects (see Jakob 2006), but the most commonly used effectiveness indicator is the Net Present Value of programme impacts, i.e., a sum of the benefits of the programme during its effective period divided by the costs of the programme plus the cost of capital (interest rate) (Vreuls 2005). Programme evaluations often also place a lot of emphasis on free rider or 'deadweight' effects, i.e., energy efficiency effects that would have occurred even without the programme, for example grant recipients who make use of the grant even if they would have made the efficiency investment without it (Vreuls 2005).

Golove and Eto (1996) argue that direct calculations of the costs and benefits may not capture many of the social welfare impacts of an energy-efficiency promoting policy or instrument. At the very least, the benefits due to reduced environmental externalities (as well possible contributions to job creation) should be included

(Tonn and Peretz 2007). Moreover, programmes may have positive spin-off effects, and influence not only the direct target groups, but also provide “free” benefits to other target groups, for example by increasing the supply and reducing the costs and risks of energy-efficient products and services (Golove and Eto 1996).

Another critique of the existing forms of effectiveness analysis arises from the fact that energy users value other features, as well as cost reductions, when deciding on energy efficiency investments. Many authors provide evidence that the co-benefits of energy efficiency (e.g. health, safety and quality improvements) can be equally large as the cost savings (Jakob 2006), or even larger (Knight et al. 2006).

The rebound effect is a special issue in the analysis of the effectiveness of instruments from an economic perspective. This widely debated phenomenon is based on work by economists Brookes, Khazzoom and Saunders and is summarized and debated in a special issue of *Energy Policy* (Schipper 2000). Rebound effects refer to the increased use of energy services caused by the reduction in their effective price due to greater efficiency. They can be divided into four categories of effects (adapted from Jalas 2001; Herring 2006):

1. Direct effects: consumers can use more of an energy service due to its lower price
2. Income effects: with smaller outlays for energy services, more income is available to spend on energy
3. Substitution effects: consumers use more energy services and less final consumption goods when energy services become less expensive than other goods; firms replace other factors of production (capital, labor) with energy services in the production of final goods
4. Transformational or ‘enabling’ effects: technological advances and concurrent increased energy efficiency enable new practices (e.g., second homes, long-distance travel, office work automation)

Thus, it is argued that energy efficiency at the micro level may in fact increase (or at least fail to decrease) energy consumption on the macro level by leading to the use of more energy services either directly, or via increased disposable income, or via overall economic growth and development. The magnitude of rebound effects is still subject to debate. Evidence from econometric studies (Greening et al. 2000) indicates, however, that the direct rebound effect is small for residential appliances and residential and commercial lighting (10%), less than 20% for industrial processes, and in the order of 10-40% for residential space heating and water heating.

There is also evidence that the magnitude of the direct rebound effect declines as incomes rise, energy costs take up an ever smaller share of total budgets, and demand for services such as lighting or heat saturates (Geller and Attali 2005) – i.e., when people have ‘sufficient’ amounts of energy, they will not consume more even if it becomes cheaper. Thus, for example, Darby (2000) presents evidence that households in the UK with an average indoor temperature of 14°C will use much of the energy efficiency gains to have a warmer home, whereas when the indoor temperature is 18°C, a larger part of the gain will go to actually reducing energy consumption.

The indirect rebound effects, however, are more evident causes for concern (see Dimitripoulos 2007 for a review). In a growing economy, it is obvious that money saved in one place will be used for something else (consumption or investment) leading to a certain amount of related energy use, but because all other sectors are less energy intensive than the energy sector, reduced use of energy is bound to gradually decrease the energy intensity of the economy (Heiskanen et al. 2001; Geller and Attali 2005).

A final point in the analysis of effectiveness concerns the goals of the economy. Mainstream economists believe that economic growth (broadly) reflects increased welfare. This notion has been challenged for years by alternative and humanistic economists (see Ekins and Max-Neef 1992). More recently, alternative measures of welfare have gained ground also among mainstream economists (Easterlin 2001; Layard 2005), who have suggested ‘life satisfaction’ or ‘happiness’ as better measures of societal welfare. If these notions are taken up more broadly, we may have very different measures for programme effectiveness in the future.

2.2 Pychological and social psychological research

Many schools of psychological thought have contributed to the debate on energy efficiency and how to best promote it. The three most visible contributions to the field of energy DSM come from behavioural psychology, cognitive psychology, and social psychology (especially attitude-behaviour models)[5]. We first review the major assumptions about the key actors in and major barriers to energy efficiency as understood in behavioural psychology, cognitive psychology (including cognitive antrophology) and social psychology, especially attitude-behaviour and norm-value-behaviour models. Because many researchers apply eclectic models drawing on many different schools of psychology, the sections discussing preferred DSM instruments and effectiveness combine the different approaches.

While there are many differences in these approaches, they share a focus on individual behaviour. In the case of social psychology, this is modified by the inclusion of 'social norms', i.e., individuals' perceptions of how others expect them to behave. The preferred research approach in psychology is controlled laboratory experiments, but survey instruments are frequently used. Nonetheless, the research design is usually similar to a controlled experiment insofar as key variables are pre-defined and measured, preferably before and after an intervention (and ideally, for a 'treatment' and 'control' group). Thus, this type of approach implicitly assumes that the programme manager is rational and able to control the behavioural determinants of the research subjects (the target groups). The programme manager is also implicitly assumed to be 'invisible' to the target groups (in other respects than the intervention). Thus, researchers have not paid much attention to the interactions between the programme managers and the target groups, or to the broader political context of these interactions (see Kempton et al. 1992).

Behavioural approaches are based on a once-popular approach to psychology, behaviourism, pioneered by B.F. Skinner in the 1950s on the basis of research conducted on animal behaviour and learning. This school wanted to make psychology a 'science' by focusing research only on visible, measurable behaviour and by conducting experimental research. People are assumed to react to stimuli in their immediate environment and learn from the immediate consequences of their action (positive or negative feedback). Learning is measured as changes in observable behaviour rather than by studying what people think or say. The major barrier to energy efficiency from this perspective is that there are not immediate stimuli for energy conservation today (e.g., electricity is very easy to use compared to collecting firewood). Moreover, feedback on the consequences of energy use or conservation is delayed (for some consequences like climate change, very much so). Behavioural research in energy efficiency focuses on individuals' reactions to various antecedents (stimuli or 'triggers') or consequences of the behaviour (feedback). This is an approach to learning that is not based on cognitive processing but on direct behavioural modification. Various prompts (reminders) or rewards (financial incentives or feedback) are applied, and their influence on changes in behaviour is measured (Kurz 2002).

Cognitive approaches are interested in how people understand, diagnose, and solve problems. Energy users are thus understood as decision makers who solve complex problems when dealing with energy. They do so by drawing on existing cognitive structures and previous experience. In contrast to the behaviourist approach, users thus also retain, combine and process information and learn in more complex ways. In contrast to the neoclassical economic view, however, the customers' ability to make use of market information is limited by their cognitive capacity[6] and by the nature of the information environment. People

[5] There are many other fields of psychology and social psychology that are potentially relevant (such as humanistic psychology and symbolic interactionism), but which are not discussed here (see e.g. Czicksentmihalyi 2000; Parnell and Larsen 2005; Martiskainen 2007).
[6] Limited cognitive capacity refers to the information users' inability to attend to and process all the limited information in an ideal manner. The limitations derive from the information users' information processing resources, on the one hand, and from contextual factors, on the other. Experience and learning, for example, can help people to process larger amounts of information because they develop cognitive structures to deal with the information.

are not motivated by price as such, but by their representations of price, on the one hand, and the social meaning of the costs and benefits of their current energy usage patterns (Kurz 2002)[7].

Most of the cognitive research on energy end-user decision making has stressed the cognitive difficulties in dealing with energy related information. Energy users have limited cognitive capacity for understanding, recognising, sorting, comparing, analysing, and acting on the information (e.g., Anderson and Claxton 1982). Others, however, stress the characteristics of the information environment: with information overload, attention will only be given to salient messages (de Young 1990). Moreover, there has been criticism of the 'deficit' model in energy information which stresses the recipients' limitations, rather than exploring what they *do know* and how they *do process* energy related information (Devine-Wright and Devine-Wright 2005). Research on 'folk models' of energy has been used, for example, to study how people understand energy usage (Kempton and Layne 1994) and the workings of the thermostat (Kempton 1987), as well as nature conservation, air pollution and climate change (Kempton et al. 1995). The barrier to energy efficiency from this perspective can be constructed, thus, in two ways. Either it is the limited cognitive capacity of the users of energy-related information, or the way in which energy information is communicated to lay people. Thus, research can focus on the information processing of energy users (Anderson and Claxton 1982) or on the interactive communications between energy-users and experts (Parnell and Larsen 2005).

<u>Social psychology</u>

Attitude-behaviour models have been dominant for a long time in social psychology research on energy conservation. A variety of such models exist and they have evolved over the years (Table 2). The theory of reasoned action (TRA) is one of the first such approaches to predict (and influence) behaviour on the basis of attitudes, norms and behavioural intentions (Fishbein and Ajzen 1975). It has been widely used in consumer health and environmental behaviour research, but results have been mixed, especially in the environmental and energy domain (Kurz 2002; Corbett 2005). An extension of this model is the Theory of Planned Behaviour (e.g., Ajzen 1985; 2002), which included an additional independent variable, "perceived behavioural control". This means the extent to which the behaviour is difficult or easy to perform, which can depend on practical skills and task knowledge needed to perform the behaviour, as well as on external factors such as available facilities and infrastructure. This extension has increased the predictive power of the model considerably (e.g., Kaiser et al. 1999).

Triandis (1977) has extended this model further by including emotions and the resulting affect as an independent variable, as well as the role of past behaviour and habits. There is strong empirical evidence in the field of energy and the environment that including 'past behaviour' and 'habits' improves the predictive power of attitude-behaviour models (Thøgersen). Macey and Brown (1983) found that for residential energy conservation, frequently performed behaviours were most strongly determined by habits and past experience, where as infrequent behaviours were determined primarily by intentions.

Attitude-behaviour models are based on a notion of goal-oriented behaviour and expectations about the outcomes of that behaviour. Another set of models are linked to moral aspects of behaviour, norms and values (Stern 2000; Martiskainen 2007), and stress the altruistic aspect of pro-environmental behaviour. An example is value-belief-norm theory, which assumes a dominant role for values and norms in determining the results of behaviour (Stern 2000). This model introduces altruistic values into the set of factors determining behaviour. Kaplan (2000) starts out with an altruistic model, but argues that it is when altruistic and individualistic goals support each other that the strongest motivation for environmentally oriented behavioural change is provided. In addition, a feeling of helplessness is the most severe obstacle to change, and such helplessness is also engendered by "being told what to do", rather than allowing people to process information at their own pace and participate in devising solutions. Thus, participation and the possibility to gain behavioural competence are mediating variables of behavioural change in what Kaplan (2000) has termed the "Reasonable Person Model", which has also gained some empirical support (Corbett 2005).

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[7] Economic psychology, for example, has consistently found that people are more sensitive to losses than to gains (Kahneman and Tversky 2002). This is clearly reflected in energy related decisions where decision makers consistently value the investments higher than the gains from cost savings.

Table 2. Determinants of behaviour considered in various attitude-behaviour models (in a very simplified form).

Theory of Reasoned Action, TRA (Fishbein & Ajzen 1975)	Theory of Planned Behaviour, TPB (Ajzen 1991)	Theory of Interpersonal Behaviour (Triandis 1977)	Value-Belief-Norm Theory VBN (Stern 2000)	Reasonable Person Model, RPM (Kaplan 2000)
Attitude towards the behaviour Social norms ↓ Behavioural Intentions	Attitude towards the behaviour Social norms Perceived behavioural control ↓ Behavioural intentions	Attitudes Social norms Affect ↓ Behavioural intentions Past behaviour ↓ Habits Facilitating conditions	Values Beliefs Pro-environmental personal norms Behaviours	Coincidence of self-interest and altruistic motives Personal control – including participation and behavioural competence as intrinsic values ↓ Behavioural intentions

Much of the psychological and social psychological research on energy has focused on energy conservation in households, whereas energy conservation in organizations or by employees has been examined less. When considering the behaviour of individual employees, similar models have been used as in consumer research (e.g. Siero et al. 1996; Payne 2000; Scherbaum et al. 2008). Many of the barriers found in the residential sector are found in small business as well (Payne 2006). In organizations, however, energy-related behaviour is also structured by the organization – its way of managing information, its power relations and control structure, as well as its organizational culture, which captures collective beliefs, values and organizational identity. Even though many organizations today have made explicit commitments to environmental responsibility and the efficient use of natural resources, existing practices are often strongly entrenched (not only in attitudes, but also in structures, competences, responsibilities and performance evaluation systems).

Instruments for DSM

Psychological research acknowledges that self-interest (at least in a purely economic sense) is not the sole driver of behaviour, but that people have diverse and complex motivations, and that their behaviour is enabled and constrained by the available information. In addition to economic motives, recent psychological research has acknowledged other motives, such as environmental concern.   .

The different psychological schools of thought suggest some ‘preferred’ instruments on the basis of their conceptualization of human behaviour and the barriers to energy conservation:

- Behaviourist psychology would favour such instruments as triggers and stimuli, rapid feedback, and changes in the physical environment such as product design. These are instruments that are ‘close’ to the desired behaviour and aim to directly influence behaviour (actions) rather than people’s thoughts or attitudes. Geller et al. (1982) distinguish between the antecedent strategies for modifying behaviour and a type of influence that is called “consequence strategy for modifying behaviour”. While the announcement of a reward is an antecedent strategy, the reward or punishment itself is a consequence strategy. Most instruments include a combination of both. Behavioural interventions are often quite successful in the short term. Unfortunately, the change in behaviour is rarely lasting – the subjects usually revert to their original behaviour (i.e. “go back to responding to the original triggers of their old behaviour”) once the interventions are discontinued (Kurz 2002), unless the interventions are embedded in the technology used in the home (e.g. Svane 2007).

- Cognitive psychology would focus on structuring the environmental information provided, providing locally relevant information, vivid information, using peer-to-peer networks, as well as improving information flow between lay people and experts by increasing mutual understanding (Parnell and Larsen 2005) or by dividing information analysis tasks more efficiently between energy consumers and providers (Kempton and Layne 1994). These types of interventions are most suitable for rarely occurring behaviours that involve extensive decision making (e.g. large investments), where people indeed do plenty of process information (Kempton and Layne 1994). Routine behaviours, in contrast, are rarely the subject of cognitive processing or explicit decisions.
- Attitude-behaviour models, in their most basic form, suggest that knowledge about the object of the attitude (e.g., the importance of energy conservation), and the presence of social pressure (norms) should lead to behavioural intentions and then to behaviour. Extensions of such models additionally suggest that one should take measures aimed to increase the perceived self-efficacy of the subjects (i.e., to build up their confidence), secure conditions to facilitate the desired behaviour (e.g., provide infrastructure and facilities) as well as provide domain knowledge and skills (i.e., practical knowledge about how to accomplish the desired behaviour) ( ). The VNB and RPM models would also suggest that the facilitation social of co-operation and the formation of norms, as well as of participation and a sense of agency would support energy-related change.
- One could additionally note that behaviourist interventions (triggers, feedback) are more likely to influence routine, habitual and unthinking types of behaviour (frequent behaviours, curtailment behaviour), whereas cognitive, attitude-based and norms-based interventions are probably more likely to influence rarely occurring behaviours (e.g., efficiency-related investments). It is also possible to change routine behaviours by encouraging reflection about them (Darby 2000), as well as by supporting the routinisation of new behaviours, but this is a process that requires significant effort.
- In between the cognitive models and the attitude behaviour approaches the model of observational learning might be of interest for long-lasting changes in energy behaviour. Backed by the social learning theory, Bandura's (1986) social cognitive theory (SCT) explains how people acquire and maintain certain behavioural patterns through watching the actions of others. Observational learning refers to the factors environment, people and behaviour (Glanz et al. 2002). Discussing behavioural capabilities, Bandura (1997) points to the important aspect of self-efficacy, which can reinforce or weaken the aim of interventions.

Many studies of interventions draw on a number of different psychological approaches. In a review of intervention studies, Abrahamse et al. (2005) categorise the interventions into two categories:

- *Antecedent interventions*: commitment, goal-setting, information, workshops, mass media campaigns, audits and modeling (i.e., providing examples of recommended behaviour). The review found that information alone (e.g. mass media campaigns) is not generally an effective intervention (see also). More specific information, like energy audits, resulted in energy savings. The antecedent interventions 'commitment' and 'goal-setting' were found to be successful in changing energy-related behaviour, especially when combined with feedback.
- *Consequence interventions:* feedback (continuous, daily, weekly or monthly, comparative) and rewards. Rewards were found to be effective, but indications were also found that the positive effect can disappear once the reward is removed. Feedback, especially when given frequently, was found to be an effective intervention, but it was also found to work differently for low and high energy consumers, with low energy consumers sometimes even consuming more as a result.

Stern (2000) argues that both attitudes and external conditions need to be positive for changes in energy behaviour. He has found that combinations of information and incentives, which are more effective than either information or incentives alone. This is because different people have different barriers to change, and the more effective programme is the one that removes the largest number of barriers.

Considering the suitability of various instruments for organisations, Egmond et al. (2006) have applied a model that has some features of attitude-behaviour models to examine the suitability of various policy instruments to different kinds of housing organisations. The PRECEDE-PROCEED model by Green and

Kreuter includes three categories of behavioural determinant: (1) predisposing factors – e.g., attitudes, knowledge, norms and self-efficacy, (2) enabling factors – i.e., resources and skills and (3) reinforcing factors – i.e. feedback on actions taken. The predisposing factors form the intention to change, the enabling factors provide the means for change, and the feedback on achievements reinforces this process, leading to mobilization of further resources and strengthening of the intention. Egmond et al. (2006) use this framework to examine which policy instruments are suitable for 'early market actors' and 'mainstream market actors'. For example, the early market actors were found to be more visionary and strategic, whereas mainstream actors drew more on standard operating procedures and were more risk-averse. Thus, early market actors are more amenable to knowledge transfer, stimulating communication and serving as demonstrators, whereas mainstream actors are more amendable to covenants and agreements, which share the risk among multiple players.

In general, there is more and more interest in examining combinations of instruments. Psychologists are also increasingly stressing the role of participation, social context and peer-to-peer networks (e.g. Olli et al. 2001), as well as macro-level factors contributing to energy use (technology, economy, demography, institutions and culture) (Abrahamse 2005). As the motives for energy conservation are more and more related to environmental impacts, there is also increasing discussion about the social dilemmas related to energy conservation: nothing that consumers could do as individual actors makes any difference for climate change, for example, it is the cumulative impact of all consumers' behaviour that counts (Thøgersen 2005). Thus, psychologists and social psychologists are extending their models beyond the traditional individualistic focus.

Effectiveness of instruments

Changes in the desired behaviour are obviously the preferred measure of effectiveness for psychology-based interventions. Often these are based on self-reported behaviour, but preferably naturally on measured energy use. An example of the types of results obtained is provided by Martiskainen (2007), with a focus on interventions with a feedback or social element. Her review found the following level of savings achieved:

- Goal-setting + feedback: households setting a 'difficult' goal of 20% saved about 15%, whereas those setting a 2% goal saved about 6%
- Direct feedback monitor: savings of 4-5%
- Feedback and focused advice: heating savings 5%; electricity 7-12%
- Comparative feedback on gas and electricity use: comparison to previous consumption saved about 4%, low users increased with about 11%
- EcoTeams (a form of social commitment with monthly meetings): gas savings about 20%, electricity savings about 5%

Nonetheless, Abrahamse et al. (2005) argue that little is known about how the interventions influenced the determinants of behaviour and why they were effective. Other concerns relate to the fact that many studies are based on small and unrepresentative samples (Kurz 2002; Abrahamse et al. 2005), which also gives rise to concerns about whether the results are generalisable to other segments of the target group and other types of behaviour (de Young 1993). A particular issue is the durability of behaviour change: often, short-term interventions will indeed have the desired effect as long as the intervention lasts and potentially for a short time after it, but once the intervention is discontinued, changes are rarely lasting or self-sustaining. This is especially the case for behaviourist-based interventions, which do not aim to provoke changes in cognitive structures, i.e., they ways in which we think about energy use (Kurz 2002).

Ideally, psychological research would evaluate interventions by comparing their effectiveness in a 'treatment' group receiving the intervention with a 'control' group that does not receive the intervention. Some researchers have also argued that experiment-type interventions are not feasible in real life, and that the 'experimental' focus in psychology and social psychology leads to results and prescriptions that are not necessarily valid in real life (Kurz 2002). For example, separating the attitudes from the infrastructure, situational factors and the social system fails to recognize the systemic and mutually interacting nature of these different factors. Interventions can have other effects than those intended – either positive or negative –

but they are rarely studied in this type of research (Kurz 2002; Parnell and Larsen 2005). It is rare that programme managers could control all the variables that are relevant for behaviour, or even identify them on the basis of preconceived models. Also, if we recognize the social system as a relevant factor in supporting behavioural change, this system can rarely be subjected to controlled, 'total' interventions.

2.3 Sociological and sociotechnical research

For sociology, the key units of analysis in energy conservation are not individuals, but society and social groups, or social practices. Further, the sociology of technology has stressed the role of sociotechnical networks: the kind of technology we use is shaped by social forces, but it in turn also mediates social action (for example, by enabling new kinds of interactions). So we would not only look at individuals making a decision about whether or not to change their way of using energy, but also at how their possibilities are structured by infrastructural networks and other people's decisions at other points in that network.

Traditionally, sociology viewed social structure – the norms, roles and institutions that govern the social order – as the key determinant of human behaviour. Most present-day sociologists, however, would view human behaviour as *structurated* (e.g. Giddens 1979). This means that while the social structure creates the limitations and opportunities for our choice of behaviour, actors can also change the structure through their actions. People, for example, can form new social movements that enable them to change the structure. Nonetheless, for sociologists, even economic behaviour is fundamentally social rather than individual: people cannot know about what they want or what they can do to get it unless they learn it from other people around them (Granovetter 1985).

Practice theory is an approach that follows this line of thinking: *practices* are the main source of order in social life, and thus the key targets for changing energy related behaviour. Practices are routinised behaviours that consist of visible activities, mental activities, physical objects and social understandings (Reckwitz 2002), and they enable and constrain the scope of action for individuals[8]. Thus, rather than targeting individuals or target group segments, we should target how social practices and expectations influence for example the frequency of showering, temperature control, etc. and examine how they are socially shaped and how they change (Shove 2003; Guy and Shove 2000).

Policy makers and programme managers are not as a rule viewed as being 'above' or 'beyond' the social system they are trying to influence. Current sociological though has largely discarded the old notions of 'social engineering', i.e., the belief in the ability of policy makers to control people's behaviour 'from above' (Beck et al. 1995). Firstly, human behaviour in modern society is very complex, and attempts to control it usually have unintended consequences. Secondly, experts and policy makers' are not followed blindly today: people want to know why they are expected to change their behaviour in a particular way. Finally, from a societal perspective, policy makers and programme managers are also part of the networks of actors shaping society – they cannot step 'outside' society or the shared base of knowledge, technology and institutions (Green et al. 1999; Wilhite et al. 2000; Rohracher 2001). Thus, the focus is on reflexive, deliberative and participatory policy making and programme planning.

For sociologists, the barriers to energy efficiency or conservation are not merely characteristics of individuals. Early sociological research on energy use focused on demographic patterns and lifestyles as key determinants of energy use (Lutzenhiser 1993; Aune 2006). Important points brought to the fore in this line of research include the following:

- People do not actively *consume* energy; energy use is a consequence of action with some other purpose, such as raising a family or running a business (Wilhite et al. 2000). As energy provision has historically become based on centralized systems, energy users have less involvement and less responsibility in how they consume energy (Hughes 1987; van Vliet et al. 2000).

[8] It might be useful to also discuss here Spaargaren's (2003) notion of social practices and the two different approaches from which they can be examined: the structural (systems of provision) and the actor (lifestyle) perspective.

- Energy use is thus socially invisible (Lutzenhiser 2002). When we want people to become aware of their energy consumption, we are asking them to do something that they are not used to doing.
- There are large variations in energy use that cannot easily be explained by attitudes toward energy, but that are a side-effect of other demographic and lifestyle factors. Declining household size, increasing mobility and variations in cultural expectations lead to markedly different patterns of energy use.
- We should not examine energy consumers in isolation; energy consumption (and conservation) is always a result of social processes on the family, community and institutional level (Lutzenhiser 1993; Wilhite et al. 2000).
- Even though today there are many efforts to promote energy efficient practices, there are also counter-forces. Not all institutions in society are aligned to the cause of energy efficiency and reduced energy demand. Thus, policy makers and the institutional system are often sending ordinary energy users 'mixed messages' (e.g., Biggart and Lutzenhiser 2007).

The sociology of technology has further added to this picture by examining how technology and sociology interact in the development of wasteful or efficient practices of energy use. Individual choice is limited by the way cities, energy supply systems, housing designs and products are configured (Wilhite et al. 2000). Thus, change in energy-related behaviour is viewed as part of a larger change in the social and technical organization of 'systems of provision'. The systems of provision define the opportunities and limits for individuals' patterns of energy usage.

We can thus say that if habits, infrastructural possibilities and practical abilities to change behaviour are 'intervening' variables in social psychology, in sociological analyses of energy use they are the most important determinants. The attention then turns to how habits and conventions, infrastructures and users' capacities are shaped, and what are the possibilities to reshape them. This suggests a collective, rather than an individual approach to steering energy use.

Instruments for DSM

Some of the sociological and socio-technical research has been very critical toward existing approaches to DSM, which have focused on individual behaviour. They argue that this line of research and intervention has not led to much change in actual energy use in the past decades. They also argue against the notion of ordinary energy users (and their irrational behaviour) as 'barriers' to energy efficiency (Guy and Shove 2000). They stress that research should focus on the drivers of increasing energy use: how new 'needs' are constructed and how expectations of comfort and convenience evolve (Wilhite et al. 2000). These expectations are not created by energy users alone: they are also co-constructed by producers of energy-using equipment, such as air conditioning system manufacturers (Shove 2003). Wilhite (2007) points to new technologies as even change agents: the introduction of these technologies may on the one hand increase efficiency "but at the same time create potentials for new energy intensive practices" (Wilhite 2007, p. 23).

Sociologists of technology argue that effective means to change energy related social behaviour can only be found by examining the socio-technical networks that build up around new solutions, the way in which tacit knowledge[9] about energy efficiency develops, and the way in which the adoption of new solutions starts to 'make sense' in a specific context (Guy and Shove 2000). Here, it has been found that the introduction of innovative practices is often the result of long-term negotiations involving 'relevant social groups.'

Rohracher (2001) provides an example from an Austrian project to promote sustainable refurbishment of buildings. Here, an orchestrating type of policy is suggested to get the relevant actors out of the deadlock of lacking supply and demand by mapping the problems in the entire sociotechnical system. Because buildings are increasingly complex, specialised service packages are needed, and can be created by encouraging service providers to network and by providing a certification scheme. Demand is increased by supporting

[9] Tacit knowledge is implicit rather than explicit knowledge. It is personal, context-specific, and therefore hard to formalize and communicate (Nonaka 1991).Tacit knowledge is used by all people and it is an important component of many human skills and abilities.

institutional users (e.g., housing associations) to articulate and specify qualified demand and to turn this demand into procurement procedures. End-users are not forgotten: studies are needed of how they use the buildings as well as on user requirements and expectations.

There are, however, some preferences also for concrete instruments or features of instruments to promote energy conservation:

- *Transforming systems of provision:* Rather than examining the attitudes of energy users, sociologists argue that more focus should be placed on the interaction between the promoters of energy efficient solutions, energy users and other stakeholders such as service providers (Guy and Shove 2000; Rohracher 2001). Sociological researchers thus give qualified support for programmes aiming at *market transformation*, i.e., the development of more energy efficient products and service systems, like energy labelling or technology procurement (Wilhite et al. 2000; Rohracher 2001). Market transformation efforts, however, should simultaneously attempt to tackle problems on both the supply and demand side (Rohracher 2001).
- *Drawing on local and 'alternative' practices of frugal energy use:* Guy and Shove (2000) question whether energy efficient practices necessarily derive from the expert community, i.e., from outside the users' context. Potentially innovative and valuable practices can also arise from the local context and from users' everyday experiences. One way to identify such practices can be to examine the differences in the energy use practices of different households or organisations in order to identify alternative ways of 'providing energy services' (Wilhite et al. 2000). Another approach is to study and support user-driven attempts to develop alternative 'systems of provision', such as sustainable buildings or sustainable urban developments (van Vliet et al. 2005; Ornetzeder and Rohracher 2006). A survey on UK households showed that those who had invested in a micro-generation system are also more aware of their energy behaviour in general (Dobbyn and Thomas 2005)
- *Building on group rather than individual change processes:* Consumption is central in defining the consumers' identity and social relations (e.g., Douglas and Isherwood 1981, for environmental implications, see Jackson 2005). Thus, belonging to 'greener' social groups might influence people's behaviour in the long run – this is also suggested by research conducted on intentional communities or car-free settlements (Mulder et al. 2006; Ornetzeder et al. 2007). This can also suggest programmes to support social lifestyle movements toward 'voluntary simplicity' or 'downshifting', i.e., communities choosing a simpler lifestyle with lower energy consumption (Hamilton 2003; Hofstetter and Madjar 2003; Jackson 2005; Meroni 2007).
- *Timing of interventions and critical thresholds:* A further point concerns the timing of change initiatives, because energy consumption is largely determined by historical decisions and routines, as well as national systems and infrastructures. Attention should thus be focused on moments and thresholds of change (Wilhite et al. 2000). These can relate to the individual level (changes in the course of family life or major refurbishments at home), but also to urban structure and national-level infrastructures. Schäfer and Bamberg (2008) focus on the opportunities presented by specific life events – like the birth of a child, severe diseases or the beginning of retirement - to change habits and routines to a more sustainable behaviour.
- *User participation and flexible design:* Because change is a process of negotiation of new systems of provision, a process of social learning is required. This learning is based on interaction between the relevant social groups. If experts develop new, energy efficient practices on their own, they may not take users' needs into account. Moreover, it is known that users will use new solutions in various ways, and the solutions can be built to be flexible for such innovation in the process of diffusion. Thus, both users involvement and flexible design can promote the adoption and appropriation of new practices (Rohracher 2001; Rohracher 2003; Aune et al. 2002; Midden et al. 2007).
- *Focusing on ideas and social movements that mobilize and align the interests of different actors:* For example, Biggart and Lutzenhiser (2007) discuss the different impact of 'energy efficiency' and 'green building' ideas on building practices in the US. Energy efficiency is perceived of as a prosaic goal, whereas 'green buildings' (often with largely the same technical contents) have been able to mobilise business leaders, NGOs and federal agencies with moral (sustainability) as well as self-interested arguments.

- *Promoting the durability and reinforcement of change through intermediaries*: Following the intervention the behavioural change has to be stabilized and this can be promoted by intermediaries as Brohmann (2006) discussed in the context of local programmes. On one hand they create a trustful context, provide impartial information and ensure quality standards, on the other hand they support informal communication and social exchange that facilitates implementation and provides role models.

Effectiveness of instruments

Sociologists argue that traditional DSM programmes have not been effective because they have not reduced the overall demand for energy. In contrast, standards and conventions relating to comfort, convenience and cleanliness have risen, and have thus undermined the achievements in energy efficiency (Wilhite et al. 2000; Shove 2003). Thus, effectiveness is examined on the societal level, rather than among individual target groups.

One of the problems in existing policies is that the focus is only on policies and programmes targeted at increasing energy efficiency. Yet we know that many other policies, programmes and developments also have an impact on energy efficiency (e.g., land use planning, building codes, standards, etc.). Sociologists working in the field of energy argue that we should analyse these (often adverse) effects when planning energy saving initiatives (Wilhite et al. 2000).

On this level, few instruments have indeed been effective. It can be argued, however, that some ‘instruments’ or approaches to reducing energy demand have more potential than others, in terms of some early indications:

- *Emergence of new practices and new systems of provision.* For example, van Vliet et al. (2005) identify the restructuring of utility systems in terms of three models: ‘distributed generation’, ‘network integration’ and ‘co-provision’. Especially, they see promise in the emergence of new systems of co-provision that challenge the former linear view allocating responsibilities for energy provision either to large-scale providers or to decentralized users.
- *Social change (rather than change merely on the individual level).* This usually entails conflicts and negotiations, which need to be resolved before a new social order emerges. Emerging new concepts that represent energy efficiency could be one indication of social change (Rohracher 2001). Another indicator could be if we have new kinds of actors (e.g., intermediaries, NGOs or citizen groups) active in energy efficiency (e.g. Marvin and Medd 2004; Biggart and Lutzenhiser 2007).
- *Social learning:* Sociologists of technology have suggested that ‘social learning’ is a prerequisite for changes in sociotechnical systems. It refers to a long-term process in which developers, implementers and users learn from experience and interaction. The concept stresses negotiation and interaction among a wide range of actors, subject to conflicts and differences of interest and power. Social learning also entails the emergence of new routines, institutions and networks (Russel and Williams 2002).

All in all, a sociological analysis of the effectiveness of instruments would not only target their impacts on individual behaviour, but also examine the potential of changes in broader social systems, including those initiated through changes in individual behaviour. Such broader social change ensures that changes in energy use patterns become part of the social structure or social practices. They thus become durable and self-reproducing.

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