Changing Energy Demand Behavior: Potential of Demand-Side Management

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Abstract

There is a great theoretical potential to save resources by managing our demand for energy. However, demand-side management (DSM) programs targeting behavioral patterns of energy consumption face several challenges. One of the most important ones is the challenge of sustaining the changed behavior. People may respond to intensive incentives and encouragement in the short term, but if their social and physical context does not change, they will easily revert to their old behaviors once the interventions end. It is also important to realize that different types of behaviors depend on different mechanisms: one-shot behaviors like the purchasing of an energy-efficient appliance are different from routine behaviors like turning off lights. It is in the latter that achieving lasting change presents an enormous challenge.

This chapter introduces a socio-technical approach to energy DSM. Rather than focusing merely on individuals and their motivation to change, a socio-technical approach acknowledges that individual behaviors are nested within broader societal change processes. People learn much of their behavior from other people and from their immediate physical environment. Change interventions need to be accompanied by changes in culturally shared norms and values

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and supported by adequate technologies, policies, regulations, and infrastructures. Successful DSM programs require a good understanding of how energy consumption is shaped by everyday life routines and cultural conventions. They also require a good understanding of the target group and their concerns. This kind of understanding helps program managers to change the context or make the change fit the context, make energy consumption visible, to time their interventions appropriately, and to involve the relevant stakeholders in their program.

Several instruments are commonly used in DSM programs. These include financial instruments, information and education, metering and feedback, energy audits and advice, and voluntary programs and commitments. A socio-technical approach suggests that there is no "one-size-fits-all" instrument, but that the best combination of instruments needs to be tailored for each target group, targeted behavior change and context. This chapter offers advice and examples on how to tailor instruments to their context, as well as highlights from an online toolkit to help program managers in this task. In conclusion, an example is offered on how to shift electricity demand from one period to another. The key message is that interventions should be tailored to the specific contexts in which they are employed, building on a good understanding of how energy use is embedded in the users' everyday life and its social and physical surroundings.

1 Introduction

As concerns for sustainable development and security of resource supply increase, there has been a renewed attention to managing the demand of various commodities or services, among others, energy, water, and transport infrastructures (Van Vliet et al. 2005). Achieving carbon reductions, arriving at more efficient use of materials and resources, and reducing pollution are however major challenges. A variety of measures are used to motivate this more sustainable pattern. There are, for instance, subsidies to encourage the production of renewable energy, there is R&D support for innovation of materials, hazardous waste is banned, measures are proposed to set up recycling systems, and there are policies that ban traffic from the inner cities at certain times of the day. These measures however demonstrate an asymmetry in the responses as they mainly address the supply side, leaving the demand side relatively unchallenged. However, to create a more sustainable supply and demand pattern, both the supply of and demand for all sorts of products and services need to be challenged.

Demand side has been the focus of various types of demand-side programs (DSM) for decades and interest in managing demand has been recently reinvigorated. In the field of transport policies, for example, Transportation Demand Management is a vibrant field of research and development (Gärling and Schuitema 2007). Also, in the field of water, DSM is dearly needed. Spain is suffering severe water shortages; Barcelona even had to ship in drinking water from Marseille in 2008 – an unprecedented and worrying intervention (Barcelona's Water Supply Case 2008). Ideas for household water DSM involve both new appliances – for

example, rooftop reservoirs to catch rain water – but also changes in daily practices and behaviors. For instance, using the same water several times: the water flow first serves drinking purposes, then the water is used for showering; this water is then used for washing and cleaning, and finally to flush the toilet (mixed with rain water) (Roestenburg 2008). In recent years, energy efficiency and energy conservation have gained renewed interest as the cheapest and most feasible ways to meet climate change mitigation targets (and other environmental objectives). Concerns about security of supply, "peak oil," and other resource shortages have added to the urgency of energy conservation (Geller and Attali 2005). The European Commission's 2011 Energy Efficiency Plan, which requires all member states to impose some kind of energy-saving obligations on their energy suppliers (European commission 2011), has strengthened the implementation of DSM programs focusing on the energy consumption behaviors and behavioral patterns of households and other small-scale energy users that hold great potential for energy efficiency. (For more information about percentages and ranges per target group, see Breukers et al. 2009:26–43.) One way to achieving energy conservation is through changing the patterns of energy consumption on the side of the (individual) end users by means of Demand Side Management (DSM) programs. Breukers et al. (2009) define energy demand-side management programs as "an organised set of programs and initiatives that primarily aim to change the quantity and patterns of energy consumption on end-user level. The programs and initiatives do so by initiating interaction schemes between end-users and program initiators to motivate and facilitate end-user energy demand reduction." Examples of DSM programs range from energy audits being provided to households, to regional or even national campaigns focusing on the reduction of energy consumption, to metering and tailored feedback displayed on smart phones or an in-home display.

DSM programs targeting behavioral patterns of energy consumption face several challenges. An important challenge is that many interventions to change the behavior of an individual may be fairly successful as long as they last, but the individual tends to revert to her/his original behavior once the program has ended (e.g., Abrahamse et al. 2007; Kurz 2002; Wilhite et al. 2000). In those cases, the DSM project might have been successful for its duration but it has not contributed to durable efficiency improvements in energy behaviors and as such might even be considered a failure. So far, the dominant approach toward energy DSM has been based on a belief in the unproblematic transfer of expert knowledge on energy efficiency solutions into end user practices. In contrast, this chapter (based on extensive research and practical work) argues for a more interactive, user-oriented, and context-sensitive approach to demand-side management. Here, context refers to the physical, social, cultural, economic, institutional, and political environment (including various actors) in which the individual operates. It spans from the immediate context of the family, household, workplace, and everyday surroundings to national media and policies and to the global economy. Learning about and with end users and about the particular context in which a project is implemented is crucial and for that reason, interactions are needed between experts, designers, policy makers, and end users.

Next to the end users (consumers targeted in energy DSM projects), a host of other relevant stakeholders influence the successfulness of DSM projects: from national and local authorities, utilities and retailers, energy auditing specialists, manufacturers of energy-efficient products, financial specialists, and the program designers or intermediaries. In the past, national governments and utilities were the ones promoting energy efficiency and implementing DSM programs. The liberalization and privatization of the energy sector in the 1990s has changed this. Intermediary organizations have emerged that address the demand side of energy efficiency. Energy intermediaries seek to intervene on either a project basis or more broadly in energy systems. They do this by, for instance, raising public awareness, helping the visibility of alternative ways of producing and consuming energy through pilot projects. Or they promote low energy buildings, via replacement product programs (e.g., energy efficient appliances). Energy intermediaries encompass a wide variety of organizations, including private, public, and semipublic organizations that work at different levels (e.g., local pilot project to national awareness campaigns) and across different time scales (e.g., a short-term 6-month project to 10 years programs). A wide range of intermediaries can be identified: specialized energy service companies (ESCOs), government-funded energy agencies, nongovernmental organizations (NGOs), consultancies or organizations that gain their funding from public benefit charges. They can perform functions like the provision of energy advice; consultancy activities; energy audits; project preparation, implementation and management; demonstrations; technology procurement; installation; promotion; advocacy; lobbying, dissemination and awareness raising; organizing campaigns; education; training and courses; and network building.

This chapter addresses the question of how DSM programs can achieve lasting behavioral changes. It focuses on DSM programs targeting behavioral change of energy end users at small-scale levels. These include households, schools, the building sector, municipalities, and small- and medium-sized enterprises. When formulating an answer to this challenge of creating lasting energy consumption patterns, a first step is to acknowledge that two types of behaviors exist and that different mechanisms underlie these different behaviors.

- Efficiency behavior: one-shot behavior, for instance, the purchase of energy-efficient equipment or appliances
- Curtailment behavior: repetitive efforts to change routines and habits to reduce energy use, for instance, showering less often or long, turning of lights, lowering the thermostat

Since different mechanisms underlie efficiency and curtailment behavior, different DSM interventions are necessary to effectively change these two types of behaviors. Purchasing an energy-efficient appliance is a rather discrete event, usually preceded by significant processing of information and the use of specific decision rules. DSM interventions that intend to change this behavior therefore need to target the decision-making process and the rules applied in it. Achieving lasting change is successful as soon as the investment has been effectuated. Curtailment behavior, in contrast, refers to habitual and routine behaviors which are less

subject to conscious decisions. It is here that achieving lasting changes presents an enormous challenge.

Below, this chapter first introduces a socio-technical approach to energy DSM. Drawing on several social-scientific disciplines, this approach combines relevant insights that help to understand behavioral change processes and provides insights on how to create lasting behavioral change of curtailment behavior. Next, relevant issues that DSM project should reckon with are highlighted and the use and effectiveness of different DSM instruments in creating lasting change is discussed. In conclusion, the main insights that follow from a socio-technical approach to energy DSM are highlighted.

2 Toward a Socio-technical Approach to Energy Demand-Side Management

Several disciplines have focused on understanding energy consumption patterns and ways to change them. A review of the main lines of research in economics, psychology, social psychology, and sociology provides an overview of the contributions that these strands can make to understanding why it is so difficult to change the energy consumption patterns of households and other small-scale users and how these problems can be surmounted.

- Economists have proposed a number of reasons why often even highly cost-efficient energy-saving measures are not taken. Reasons include end users' high implicit discount rates, the risks and uncertainties of new technologies and the low liquidity of investments (Golove and Eto 1996). Economists further point at the fact that the cost of capital may be high for small-energy end users, and that they may be reluctant to incur additional debt. In addition, appropriate services may not be readily available.
- Psychologists stress that few energy end users are able to carefully track their own energy consumption, let alone understand fully what they could do about it. They claim that energy information is so complex that end users lack the capacity to make sense of it (e.g., Anderson and Claxton 1982) – or energy experts lack the capacity to speak to end users in a way that is meaningful to them (Parnell and Larsen 2005).
- Sociologists in turn stress that in everyday life, energy is "invisible" (Lutzenhiser 2002); people do not consume it consciously; it is a side effect of other activities (Wilhite et al. 2000). Moreover, a broader social or sociological context compounds the problems of promoting energy efficiency. Much of our energy use is habitual; and many energy-use habits are further consolidated as social conventions (Shove 2003), that is, socially shaped expectations about appropriate levels of cleanliness, comfort, and convenience. Another reason is that not all institutions – that is, rules, patterns, standards, and norms of appropriate behavior – in society are aligned to the cause of reduced energy demand. Policy makers and the institutional system are often sending ordinary energy

users "mixed messages" (e.g., Biggart and Lutzenhiser 2007). Thus, individual end users – even if they are aware of the problems and potential solutions – may feel unable to individually make a difference and thus can feel helpless, disempowered, or not responsible for the collective problem.

Thus, while economics and psychology traditions focus on the individual level – not paying a lot of attention to the context in which behavior is situated – sociological research stresses the importance of acknowledging the social level in order to understand individual behavior and opportunities for behavioral change. Sociological research thus acknowledges that individual change processes are nested within – and interacting with – broader societal change processes. Building on these different disciplines, a socio-technical approach acknowledges that individual behavior interacts with and is shaped by its context. This interaction between the individual and his or her context defines to great extent a person's motivations to save energy, his/her attitude toward energy efficiency and saving, and his/her capacity for action. As such this interaction coshapes his or her consumption practice and the possibilities to change the behavior in such a way that the change lasts (see Breukers et al. 2009). In other words, the potential to change a behavioral pattern not only lies with individuals. If others do not learn to change too, and if the change is not accompanied by changes in culturally shared norms and values, or supported by adequate technologies, policies, regulations, and perhaps even infrastructures, then the individual will soon revert to his/her "old" behavior because the context is not supportive of or may even impede the "new" behavior. Therefore, socio-technical approaches to change address both the individual and the social levels of change – in order to be able to achieve lasting change. For example, if someone wants to behave more energy-efficiently but this is regarded as uninteresting and unimportant by this person's friends, family, colleagues, and neighbors, then it is likely to become a lonely battle. If the social norm is to not worry about a boring issue like energy efficiency, this is not supportive for those who do worry about energy efficiency. In addition, if there are no technologies or appliances like for example, more energy-efficient boilers available, or if there are appliances on the market but no installers that can inform this person properly on what are the pros and cons of different appliances, then this will discourage the purchase. Also, if no tailored energy audits can be made, it will be very difficult for this person to get a clear idea on what else (s)he can do to improve the energy efficiency of his/her household. Imagine furthermore infrastructural barriers, for example, that the apartment is heated by block-heating system, which cannot be controlled at the level of the household, but only at the level of the apartment block. In this imaginary case, a person who is motivated to change his/her behavior to become more energy efficient is likely to become disillusioned because of all the impediments at the social, physical, institutional levels. Only someone who is extremely motivated has the time and ability to learn and arrange and build everything him/herself will succeed in actually achieving something. Hence, new behaviors need to be supported to some extent by existing or newly rising norms, technologies, policies, and infrastructures to actually enable these behaviors to become embedded and lasting.

Table 43.1 summarizes the results of the review discussed above, as well as the practical implications for DSM interventions (Breukers et al. 2009). The table refers to several DSM instruments that are discussed later on in the text.

Table 43.1 Barriers and possibilities for intervention to improve energy efficiency

1. "Barriers" to energy efficiency	*Multiple issues:* – Perceptions of risk, of long payback times; limited availability of capital. – Market failures: high information costs, externalities (e.g., when environmental costs are not reflected in current prices); transaction costs (e.g., costs of information), agency issues (e.g., tenants cannot force their landlord to install energy-efficient applications). – Psychological issues (lack of feedback or information processing capacity; lack of social pressure; lack of skills and opportunities; habits; helplessness). – Social systems that discourage energy-efficient behavior: prevailing infrastructures, institutions and networks, "ways of doing," norms, culture.
2. How can actors be motivated and mobilized to save energy?	*By addressing issues at different levels.* – Market failures: providing cheaper information, new institutions, and incentives. – Information, feedback and (social or economic) incentives in suitable formats and combinations. *By aiming a strategy at social interaction and mobilization*: – Collective action. – Interaction, negotiation, and reorganization of socio-technical networks (networks around innovations and the technologies that are part of these innovations). – Capacity building.
3. What intervention instruments are relevant	• Measures that transfer risk or that address some of the transaction costs and agency problems (e.g., performance contracting, energy service companies). • Instruments to correct market failures, e.g., financial instruments, information (audits and feedback) and combinations of instruments. • Instruments that address: – Pre-disposing factors (motivation, knowledge, norms and self-efficacy). – Enabling factors (providing means for change: resources and skills). – Reinforcing factors (mobilization of resources and strengthening intentions – feedback). • Strategies that take account of the broader social system in which current practices are embedded and that aim at transforming current systems. Focus on interaction between promoters of solutions, end users and other stakeholders. • Learning from bottom-up alternatives (e.g., new systems of co-provision). • Encouraging processes of learning (group dynamic, user participation and flexible design). • Market transformation, transformation of urban infrastructures.

Below, DSM programs and the considerations that are important from a socio-technical point of view are first presented. Next, different DSM policy instruments are addressed in more in depth.

3 Issues Pertaining to the Success of Energy DSM Programs

The successfulness of DSM programs in achieving lasting change depends on many conditions, pertaining to, for example, the project management, available technologies, norms and values, policies, infrastructure, marketing, the target group behavior, and other issues. There are several basic conditions that are important for any DSM program to be successful. These basic conditions include sound funding, continuity in the project and organization, having a clear focus, clear and preferably measurable goals, and sound technical and energy-related knowledge. In addition, research has shown other issues that are less well known but nevertheless crucial (Breukers et al. 2009; Mourik et al. 2009). These are briefly elaborated on below.

3.1 Understand How Energy Consumption is Connected to Everything

Energy consumption habits are shaped by social and cultural conventions (such as practices of washing, heating and living, i.e., brushing your teeth twice a day, cooking around a fixed time). Individuals generally want to behave according to these culturally shared norms, because the price of not doing might be exclusion, or at least being labeled "different." In addition, much of our everyday behaviors and routines are shaped, guided, and mediated by the collective *systems of provision*. Vice versa, our everyday practices sustain or reshape these systems in the long run (Otnes 1988:131). These systems of provision include collective infrastructures and institutions providing various types of services and utilities to citizens, such as our water and sewerage system, the electricity supply system and grid, and waste management systems (Mont and Power 2010:2240).

Energy DSM programs can be successful if they are based on a proper understanding of what conventions shape individual behavior, that is, why people behave the way they do, of how systems of provision and social norms influence their behavior. For instance, if intermediaries know that the target group is somewhat indifferent to energy efficiency issues, but interested in combating health problems that originate from the unhealthy level of moisture in a house, then a DSM project can start by informing this household about other ventilation behavior and its relation to temperature. Through that motivation, a DSM program can continue discussing energy efficiency and other benefits such as saving money, enhancing comfort, or saving the environment. In the course of the process, an intermediary

can try to learn more about why people are indifferent and how that might change. An energy intermediary can attain this improved understanding of the target group by asking (and inquiring) how the DSM project fits with the existing institutions, the capacities of the target groups, the existing values and norms (in the local area), and infrastructures and available technologies. Once it is clear what connections and lock-ins impede the behavioral change on the individual level, different financial, informational, and agreement-related instruments can be used to facilitate change on the individual level.

3.2 Change the Context or Make the Change Fit the Context

As discussed above, social habits and conventions and accompanying systems of provision enable or constrain the scope of action for individuals, and thereby their ability to change. To ensure that the changes last beyond the duration of the project, these institutions and context need to change too or at least not impede the new behaviors. DSM projects aimed at behavioral change at the household level should thus not only target the behavior of respective individuals in a household, but also the behavior of stakeholders that are influential in terms of this broader context such as the family, neighbours, community, retailers, policymakers on the local level (e.g., Wilhite et al. 2000; Lucas et al. 2008; Ornetzeder and Rohracher 2006; Rohracher 2001). For example, for a person to be able to undertake measures to insulate his/her apartment and install more energy-efficient heating appliances, it is important that there is good quality information available and that installers can inform him/her about various options. In addition, if other people also take up similar initiatives toward more sustainable behaviors, this is a strong encouragement for the individuals to change their behavior accordingly (Heiskanen et al. 2009). People learn everyday behaviors from other people via social modeling. Kurz (2002) claims that if people are to change, they need to learn how to change, what should be the new appropriate, right and normal behavior and need to see that others are changing, too. Individuals can feel helpless about their possibilities to influence large problems like climate change. However, if friends and neighbors (peers) also do their bit, then this creates confidence that energy saving is the right thing to do and that it is effective.

Most DSM projects are too small and last too short to really change the broad systemic context. However, a DSM intermediary can try to at least make sure that the current context will not impede the desired behavioral changes, for example, clarifying where people can get information, having local policy makers endorsing more energy-efficient practices in local policies, by getting other relevant stakeholders to also support the DSM initiative (local politicians, SMEs, NGOs, etc.). Or if a DSM project aims at changing employees' energy use in the office, the intermediary might need to change some of their equipments and some of their work practices, and they might even need to change some of the rules set by the IT department.

3.3 Make Energy Consumption Visible

Most people do not consciously consume energy and most energy use is invisible to the users. Rather than being a conscious action, energy use is implicated in all sorts of activities and practices – and the necessary products and services to enable these practices. Examples of such practices are cooking, showering, laundering, and caring for the family and the home (Guy and Shove 2000; Shove 2003). Different metering and feedback instruments can be used to make energy flows and the impact of behavioral changes more visible.

3.4 Know Your Target Group

Explaining to people the need to use less energy is in itself not sufficient to get people to change their behavior. It is important to make sure that the target group sees the benefits of changing their energy consumption. What benefits are meaningful to the target group differ from individual to individual and can include economic benefits but also other benefits like home improvement, self-improvement, green spaces, or national pride. It is therefore key to find out about problems the target group is facing, and how these might be alleviated through the reduction or shifting of energy consumption. When assessing these benefits, attention can be paid to the benefits of new routines and habits, but also to the real losses people are suffering as a result of their current unsustainable behavior. To be able to do so a DSM program needs to know its target group. Knowing the target group helps to define what content to convey and what instruments to use. In a DSM project in Latvia, the intermediary discovered that peoples' limited enthusiasm in investing in energy efficiency strongly related to their lack of trust in the Building Management Company that was involved as an important stakeholder in the project. Hence, it was clear that this relationship had to be improved first (Kamenders 2009).

An intermediary can perform a good prior analysis of the (different sets of) problem(s) that underlie(s) the unsustainable behavior of the target group and what and who influences this problem. Knowing the target group also entails that the intermediary learns about their interests, their habits, their social networks, and their preferred communications channels (Futerra 2005; Mourik et al. 2009). Several types of interaction schemes can help intermediaries to learn about their target groups: surveys, interviews, group meetings; user-driven design, familiarity, and informal interaction with the target group. In addition, a social-learning approach such as "community-based social marketing" in energy conservation projects, using peer-to-peer communication, social support, and social pressure, making sure everyone "does their bit" and participation can be very useful.

3.5 Timing and Taking Time is Essential

There are good times and bad times to start a DSM program. Knowing the target group also helps to assess when the intervention will be most effective

(timing). A DSM project can take advantage of periods in which the routines are reevaluated or disrupted, for example, getting married, moving, renovations, new jobs, and a birth or retiring, and purchasing moments. These "change" moments provide windows of opportunity because people are more open to reevaluate their behavioral routines and to consider the uptake of more sustainable equipment. These change moments can also take place on the social level of change and include, for example, a neighborhood reconstruction or other regional development initiatives. Intermediaries can identify suitable change moments with the same techniques mentioned under the topic "know your target group." Furthermore it takes time to achieve lasting behavioral changes. Changing routines does not happen overnight. The program needs to support the behavioral change at least for several months in a row, and preferably the monitoring and feedback on the behavioral change needs to continue after the program officially has ended.

3.6 Involving Relevant Stakeholders in the Project

Involve the target group and other key stakeholders from the moment the preparations of the DSM program start onward to ensure that all the capacities, expectations, and needs of all relevant stakeholders are taken into account. In addition, participation facilitates the empowerment of the target group and the other relevant stakeholders that influence the target group and helps them to take the change process into their own hands, to create a sense of ownership (Futerra 2005; Stern 2000). Several DSM projects have trained members of the target group to become proponents and supporters of the behavioral changes – for instance, a Finnish project trained volunteers to become energy experts to whom people in the neighborhood could turn with questions about improving energy efficiency (Anttonen 2009). There are several participatory methods and tools for user involvement and interactive learning such as field trials, participatory design, and user participation. Success of a DSM program also depends on the effective use of already existing (social) networks. These already established networks can help embed the behavioral change more quickly and in a durable manner, and in addition these networks are free multipliers of the change message.

Below, the traditional DSM instruments are presented, and examples are offered on how these can be used to deal with the issues discussed above. After this, a toolkit for the design of context-sensitive DSM programs is introduced, which incorporates both the traditional DSM instruments and additional tools that take into account the key issues discussed above.

4 DSM (Policy) Instruments

DSM Policy instruments can be categorized in different ways. A distinction can be made between regulatory command-and-control instruments, financial instruments, instruments based on information, instruments that involve some kind of voluntary agreement or commitment, and instruments that focus on end user involvement

and social participation. Regulatory command-and-control instruments and financial instruments often target efficiency/investment behavior, although they can stimulate actual long lasting behavior change in use practices. Regulatory command-and-control instruments usually are policy instruments adopted at the level of local, regional, or national government. Although such instruments can be supportive of activities promoted by DSM programs, they are not directly applied by such projects.

Below, each traditional DSM instrument is first introduced. Then, the perspective on these instruments taken by economists, psychologists, and sociologists is presented. This is followed by a discussion on what the adoption of a socio-technical approach entails for the use of those instruments.

4.1 Financial Instruments

Even though energy efficiency investments are usually profitable to the end user, at least in the long term, these end users are often impeded by a lack of attention to information about energy efficiency, expectations for short payback periods, limited access to capital, and principal-agent problems (for instance, the fact that contractors do not always act in the principal's best interests; other agency problems entail that tenants cannot force their landlord to invest in more energy-efficient appliances).

Different forms of financing energy efficiency investments have therefore gained increasing attention. One example are specialized energy service companies (ESCOs) that deliver energy services and/or other energy efficiency improvement measures in a user's facility or premises, and takes on all or part of the financial risk of the investment. Other examples are energy performance contracting, in which an outside company takes charge of the energy management and bears the related risks and costs, and shares part of the benefits; and third-party finance where a third party provides the capital for efficiency measure.

4.2 General Information and Education Instruments

These information and education instruments include campaigns, leaflets, knowledge provision, educational adverts using multiple media. These instruments can target one-shot and curtailment behavior, focusing on motivation and capacity to undertake long lasting behavioral changes in terms of energy consumption (Maibach 1993; Weiss and Ischer 1994). The target groups can vary from very broad, that is, the whole population of a country or region, to very specifically defined target groups, that is, children at a specific school, house owners, women in a specific neighborhood.

4.3 Metering and Feedback Instruments

This group of instruments aims to make energy use and efficiency and conservation efforts (more) visible and generally target habitual and unthinking types of behavior

(frequent behaviors, curtailment behavior). Knowing how much one consumes and at what costs is a crucial first step toward a more efficient and sustainable everyday life. Besides the costs, additional information on the environmental impact can be provided. Feedback, in particular when combined with advice on how to reduce energy use, can trigger up to 20% electricity savings (Wilhite et al. 1993; Darby 2006; Fischer 2007). The more personalized the feedback is, and the more this is combined with advice on how to reduce consumption, the better the results.

4.4 Energy Audits and Energy Advice Instruments

Basically an energy audit consists of an evaluation or review of the existing infrastructure (building and appliances), energy-users' activities, an identification of savings potentials and measures, and recommendations for efficiency investments. As such, energy audits primarily target investment behavior, by calculating the most cost-effective savings measures. Curtailment behavior is only a secondary target of audits, and relates to an audit of the activities of the target group. The audit findings are compiled in a report (Väisänen 2003; Bartiaux et al. 2006). Advice programs aim to provide target groups with skills and solutions for energy-related problems. A variety of parties provide these audits and advices, ranging from energy agencies, to ESCOs and NGOs. The availability of reliable and qualified third-party information is key to success of an audit or advice program.

4.5 Voluntary Programs and Commitments

Voluntary programs and commitments aim to enhance energy end users' engagement with energy issues and create social support and pressure for change in energy use patterns. Usually, end users make a commitment to an energy-saving target and receive some kind of acknowledgment for doing so. Commitments and voluntary programs aim to increase people's sense of responsibility for changing their routine and habitual energy behaviors, although they might also change their efficiency investment behavior as a result (Bertoldi and Rezessy 2007).

4.6 Toward a Socio-technical Approach to Traditional DSM Instruments

As discussed earlier, different disciplines have different perspectives as to what impedes behavioral change and how this can be addressed by several instruments. These differences in perspective are briefly discussed, followed by an elaboration on how a socio-technical approach addresses instruments available to DSM programs.

Economists have focused most on instruments that aim to address financial and organizational barriers. These include measures that transfer risk or address some of the transaction costs and agency problems (e.g., performance contracting, energy service companies). Other instruments focus on correcting market

failures, for example, financial instruments, information (audits and feedback), and combinations of instruments. Psychologists state that instruments should address three levels: predisposing factors (motivation, knowledge, norms, and self-efficacy), enabling factors (providing means for change: resources and skills) and reinforcing factors (mobilization of resources and strengthening intentions – feedback). Sociologists claim that strategies to change energy behavior should take account of the broader social system in which current practices are embedded and that aim at transforming current systems. The focus should be on interaction between promoters of solutions, end users, and other stakeholders. Learning should occur from bottom-up alternatives (e.g., new systems of co-provision). Processes of learning (group dynamic, user participation, and flexible design) should be encouraged.

A socio-technical approach emphasizes that there is no "one-size-fits-all" intervention to change energy behaviors. The potential to change energy behaviors is contingent on many conditions that differ for each DSM program (Mourik et al. 2009). In addition, employing only a single instrument, for example, feedback, is very unlikely to be particularly effective. One single instrument cannot target all the barriers that need to be addressed. Combining approaches and instruments makes it possible to design an intervention that addresses multiple barriers to change. Furthermore the exact choice and combination of instruments depends on the behavioral change aimed for, the context of the project, and the target groups themselves. The bundle of instruments should at least take into account and tackle the following issues: behavior is embedded in a broader context, the context needs to change as well, energy and behavioral efforts need to be made visible, and timing is essential and getting to know the target group and the other relevant stakeholders and getting them engaged. An effective strategy could, for example, consist of a combination of instruments that correct market failures (e.g., financial instruments), instruments that provide information (audits and feedback, word of mouth, social marketing), measures that transfer risk or that address some of the transaction costs and agency problems (e.g., performance contracting, energy service contracting), and instruments that aim to create supporting networks of knowledge and technology and address both the individual and the broader societal changes needed. The exact choice and content of the overall approach of a DSM program needs to be tailored to the project's specific aims and context, the intermediary's capabilities, the end users, and other stakeholders. Section 4.7 discusses possibilities to tailor the instruments to this specific context.

4.7 Tailoring DSM Instruments to the Specific Context

The context, stakeholders, and energy end users you are working with place different requirements on the DSM program. Because of this, the generic instruments introduced above need to be tailored to their particular context.

Economic instruments and financial services like ESCOs can be made more effective if you understand how the end users you are targeting make decisions,

for example, the time frames that they consider when thinking about investments. Financial support may not be sufficient: the end users may also need detailed technical support and additional competencies. It is also important to recognize that people tend to follow the example set by their peers. For example, positive examples of other similar households' experiences may encourage hesitant end users to invest. Nonetheless, the same solution may not work for everyone, so it is important to allow for tailoring and flexibility to find the right solution for each user or user group.

Information and education campaigns are usually targeted at broad target groups. However, intermediaries can take some steps to tailor them to their context. Messages should build on topical concerns that are relevant to your targeted end users. Timing can be relevant here: for example, heating issues are more relevant during the heating season and climate change concerns vary depending on the level of public debate. Information and education should not place the entire burden for change on individuals – it is important to show what others are doing. If the campaign is promoting particular solutions, it is important to make sure that people can actually follow up on the information, and that the necessary solutions, support, and services are available. It is also important to make sure that information sources, media, and messengers are trusted by your target group. This implies that intermediaries need to be aware of what and whom the targeted end users are likely to trust.

Metering or other forms of feedback on energy consumption are crucial for sustaining change in energy use patterns. Yet they, too, need to be tailored to the end users' needs and the requirements of the particular context in which you are working in order to find the best formats for collecting, organizing, and communicating feedback on energy use. Because energy information is usually quite peripheral to most energy users, it is important to ensure that the feedback provided actually gets your target group's attention and helps them take action. Benchmarks can be important in helping to make sense of and take action on the basis of energy use feedback. Hence, information that allows your target group to compare their own performance with others, or the users' own previous consumption, can be valuable and should be highlighted.

Energy audits are similar to metering and feedback insofar as they help energy end users understand their own energy use. There are many generic audit models, yet implementation of audit recommendations is always a challenge. For example, timing can be an issue: good timing can connect the audit to existing investment cycles and avoid conflicts with other priorities. Actionable audit recommendations can be produced when the end users are involved in the audit and learn directly from the process, and not just the audit report. Audit recommendations are also more likely to be implemented if you can make sure that qualified service providers are available to help in taking the next steps.

Energy advice involves guidance that is specific to the situation and actions that can be taken by energy end users. Hence, a first step in tailoring advice to context is to learn to understand the end users' practices and find out what advice is needed and in what form. People need advice at the right time and place and in the right form.

This suggests different advice delivery formats, for example, for reducing electricity consumption in the home or the office, or for promoting energy renovations. Advice should be provided through channels that are familiar to the energy end users and make use of their usual contacts. For example, advice from peers is often more salient and understandable than advice from distant sources. Advice obtained in or near the hardware store may reach more people for whom it is relevant than advice available during working hours at the city hall. In order to ensure relevance, acceptability, and possibilities to act on the advice, you can also involve energy end users in the development of advice formats, and should at least test advice formats and revise them on the basis of feedback gained.

Voluntary programs aim to engage end users by getting them to commit to some kinds of efforts to reduce their energy use. They can include setting targets or, for example, competitions on who saves most. The stimulus for participating in such programs usually relates to the social context – participating households or organizations gain social support and sometimes even admiration. Hence, understanding the prevailing values in the social context is extremely important when designing such programs. Voluntary programs should involve efforts that are clearly ahead of what the mainstream is doing, but may also be a way to introduce and test behaviors and solutions that later become mandatory. It is worth considering how the behavior will be institutionalized once the program ends: local intermediaries can be relevant in keeping the activities going once the program itself is terminated.

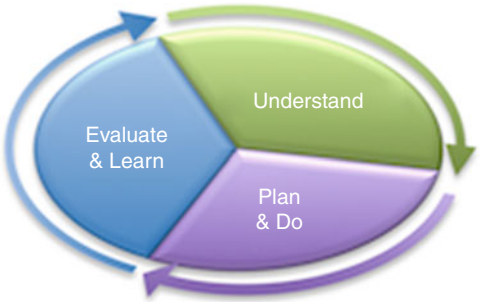
4.8 The Socio-technical Approach in Practice

Tailoring the DSM policy instruments is, however, only one of the necessary steps in the design of an effective DSM program that achieves lasting behavioral changes. Although the traditional instruments do tackle some of the issues discussed earlier, for example, that energy consumption needs to be made visible, they are not sufficient to tackle all the issues discussed earlier: that energy consumption is connected to everything, that the behavioral change needs to either fit the context or that the context needs to change as well, that the intermediary needs to know and understand the target group, that all relevant stakeholders need to be engaged, and that the intervention needs to be timed and take time.

In the introduction, emphasis was placed on the importance of learning about and with end users and about the particular context in which a project is implemented. For that reason, interactions are needed between experts, designers, policy makers, and end users. All that has been discussed in this chapter is the outcome of an intensive 3-year learning process between intermediaries, policymakers, researchers, and end users (see http://www.energychange.info). This learning process resulted in a toolkit that effectively addresses all the issues discussed in this chapter and thus is a valuable aid in the design of a DSM program that actually achieves at changing energy consumption patterns on the long term (http://mechanisms.energychange.info). Tailoring the instruments to fit the particular context of the DSM program is one of the steps in this toolkit. The toolkit shows in concrete detail the steps that can

Table 43.2 Design Steps for energy DSM intermediaries

Step 1: Pinpoint your problem
Step 2: Get to know your target group
Step 3: Understand your context
Step 4: Is the time right?
Step 5: Identify relevant stakeholders
Step 6: Define goals
Step 7: Plan with your target group
Step 8: Select and adapt your instruments
Step 9: Test your ideas
Step 10: Engage your target group
Step 11: Motivate through feedback
Step 12: Get some feedback
Step 13: Evaluate and improve
Step 14: Develop a learning culture



be taken to learn more about the target group, the project context, and timing as well as issues in implementation and evaluation. For an overview of the different toolkit steps, see Table 43.2.

4.9 Energy DSM to Shift Demand

The focus of this chapter has been on energy DSM aimed at demand reduction. However, DSM can also be aimed at the shifting of demand to other periods, for instance, to ease the peak demand in electricity at certain points of the day, and ease the burden on the electricity network. Several smart metering devices have been brought to the market in recent years, and several of these have been applied in practice as part of smart grid systems. For instance, in the Dutch town of Hoogkerken, a pilot is running with households having "smart meters" that provide household members with information on their energy usage and that provides them with incentives to shift activities. When it comes to shifting demand, different behavioral changes are asked for compared to behavioral changes toward more efficiency and saving. A similarity is however that people are asked to change their routines, by performing some activities (e.g., turning on the dish washer or washing machine) on other moments of the day or by adopting a flexible attitude to postponing activities whenever asked to do so. When use is made of "smart meters," care should be taken that these devices offer information and services tailored to the needs of the recipient and that they do so in a format, at a time and place that fits the practices of the end user. Ideally, smart meters address different target groups differently. Different people may differ in their readiness to participate in or be committed to a smart meter, let alone a smart grid and they may respond differently to products or services (e.g., tariffs, contracts) offered. The eventual success of a smart meter as a DSM tool depends on the end users' readiness to become engaged. A good understanding of these end users is hence needed in order to align their needs

with the technologies and the information, products, and services offered. Here also, context-dependent conditions can be relevant, for example, existing social structures and user practices.

5 Conclusion: Behaviors in Context

This chapter has attempted to explain what a socio-technical approach to energy demand side management entails both conceptually and in practice when preparing interventions. Generally speaking, a socio-technical approach addresses innovation as a process in which social and technological processes interact. Building on insights from different disciplines, a socio-technical approach acknowledges that individual behavior interacts with and is shaped by (energy) technologies, (energy supply) systems, and social networks. For the topic of energy DSM and the question of how to achieve *lasting* behavioral changes, a socio-technical approach combines insights on change processes from several disciplines (economics, psychology, sociology). This combination is not random, but based on the acknowledgement that behavior is embedded in social, cultural, economic, technological, and physical contexts and cannot be understood (let alone changed) without understanding these contexts as well. Since contexts differ across time and space, for each new DSM project, the intermediary will need to get acquainted with the context for which the project is planned. In other words, when considering how to motivate people to behave more energy efficiently, it is important to address both the individual and the social levels of change. In addition, these changes might require different time spans. However, if the change on the individual level is to last, the social, political, technical, and other environments need to change too in time.

There are several DSM instruments that can be used in DSM programs. These instruments can involve policy instruments employed by national governments that can facilitate the work by intermediaries, but they can also involve instruments that can be organized and adopted by intermediaries or other stakeholders themselves to design successful DSM interventions. Whatever instruments or mix of instruments are selected, they should be able to deal with several relevant issues: the instruments should focus on both the individual and his or her context, and should either attempt at simultaneously changing both levels, or provide the individual with the means to circumvent the context that impedes his or her behavioral changes. In addition, the instruments should focus on engaging the end users, on making use of or creating socio-technical networks that support and sustain the individual behavioral change, and preferably create new norms as to what energy consumption patterns are normal. Furthermore, the instruments should allow for a good understanding of the individuals that are targeted, getting to know them, the best time to introduce the DSM program, the problems the individuals experience, and the solutions and/or benefits the behavioral change could bring them.

To conclude, our key message that the DSM program should take account of the particular context where the program is going to be implemented also applies to the instruments to be used. The traditional instruments discussed in this chapter derive

from various disciplines, for example, economics, psychology, sociology and they are not based on a socio-technical understanding of behavioral change and/or energy DSM. Therefore, these instruments need to be tailored to the specific contexts in which they are employed. In addition, they are one element of an overarching toolkit that is grounded in theory yet is a useful practical aid for DSM program designers and implementers.

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