ISGAN Annex 7 (Smart Grid Transitions)
Policy Brief No.1

Phase-sensitive Enabling of Household Engagement in Smart Grids

Today, flexibility in energy end-use, particularly by households, is not sufficiently stimulated in many countries. Hence system-level benefits such as reduced electricity bills, better integration of renewable electricity generation and lowering of grid costs, are not realized. Therefore, a widespread adoption of active demand[1] by households is needed to tilt the cost-benefit balance of the investment in advanced metering infrastructure (AMI) towards a net benefit for society.

Although a variety of interventions aimed at activating households have been piloted in smart grid projects, a consistent and integrated view on how to incentivize end users to change their behavior is still lacking. From an **energy policy perspective**, it is important to understand key enabling factors that contribute to active demand by households, in order to leverage them by targeted policy interventions. From a **research and innovation policy perspective,** social innovations and involving end users in the innovation process are important fostering factors to overcome the barriers in bringing smart grid technologies from technological readiness to system wide deployment. This policy brief therefore aims at highlighting key success factors for active household engagement in smart grids. Based on experiences from existing programs and projects, it has become clear that **two phases for active end-user engagement** need to be distinguished:

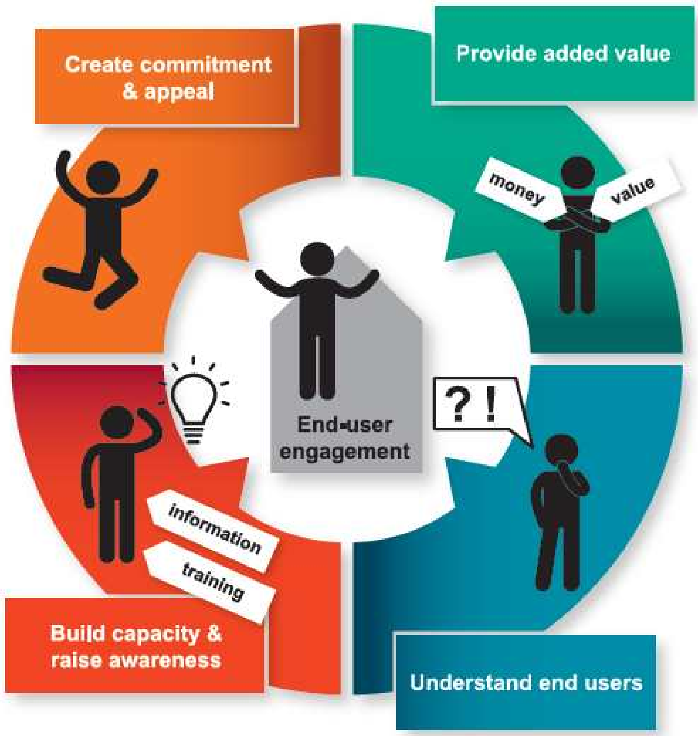
- **ACTIVATION PHASE**, an initial phase of end-user engagement and a
- **CONTINUATION PHASE**, to enable the entrenchment of the newly acquired energy behavior.

For each of the two phase's, diverse success factors were identified, with the main conclusion that a more differentiated, phase-sensitive view is needed on how to encourage greater user engagement through policy measures.

As the aim of ISGAN is to facilitate global knowledge sharing, this policy brief intends to disseminate these finding on user-engagement to a broader audience of policy makers dealing with smart grid policy.

[1] The active participation of domestic and commercial end users in the electricity system markets and in the provision of services for the management of the electricity system. Compared to demand response, in which the end user is merely responding to price signals or other incentives, active demand places the end user in a more pro-active role as a provider of flexibility (often through aggregation).

Key Success Factors for End-User Engagement in the ACTIVATION PHASE



Four success factors are key to the engagement of end-users in households in the initial phase of Smart Grid projects:

- *Provide added value*: Providing added value to customers means maximizing the enablers of engagement in smart grid programs, while addressing the possible barriers (cf. Section 0). This includes, for example, applying attractive financial incentives, ensuring comfort gains rather than losses, providing new information services, ensuring data privacy and security, and exploring possibilities to overrule automatic procedures while offering new forms of end-user control. Corresponding theoretical notions include considering Product & Price (4P model), Exchange (Social Marketing), Encouragement (4E model) and Rational appeals.

Change of energy-behavior is a complex and lengthy process. It involves numerous considerations that have to be taken into account when setting up effective end-user interventions.

To ‘activate’ end users in smart grid programs, the utility need to provide clear added value from the end user perspective, which means that requires an understanding of what drives your end users. Furthermore, capacity building (training) and creating commitment and appeal are essential ingredients of a successful activation.

The continuation of ‘smart’ energy behavior can be facilitated by linking feedback, communication and pricing strategies; using user-friendly interfaces and enabling social comparison. Because of the heterogeneity of energy end users, there are limitations of the extent to which ‘tailor made solutions’ can be offered. Above all, end-user engagement is a never ending endeavor featuring constant learning and adaptation to new expectations or changing household practices.

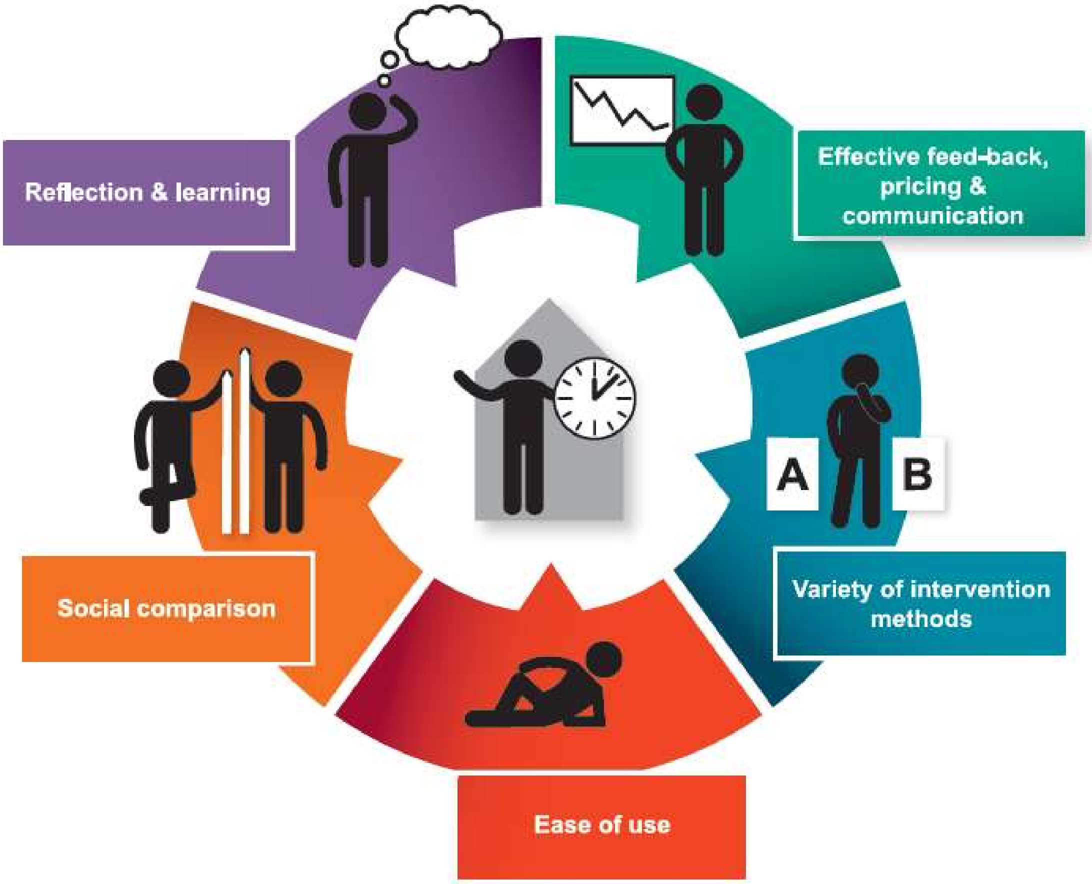
Many challenges for engaging end users in smart grid programs have been identified, stressing the need to continue, develop and extend end-user engagement research and practice in the future.

- *Understand end users*: Different target groups may be susceptible to very different enablers and barriers (cf. Section 0). The challenge is thus to understand which strategies are of particular relevance, and to base engagement strategies on such. Understanding the end user is strongly supported in the empirical literature, for example, in the recommendations to apply segmentation, to take into account a broad scope of behavioral determinants, to have a special focus for low income / vulnerable groups, and to understand social practices and daily routines in a social context. Corresponding theoretical notions include, for example, the need for 'Customer orientation', 'Theory', 'Insight', and 'Segmentation' (Social Marketing).

- *Capacity building and awareness raising of end users*: Relieving possible knowledge & information barriers will involve some form of capacity building and awareness raising as programs need to take into account consumer (non-)ability to deal with new technology. Corresponding recommendations in this context include educating end users before deployment (e.g. explaining how to shift usage to off-peak demand hours) and providing training to end users and installers. Theory equally stresses the importance of education, for example, to enable end users adoption of new practices (4E model) and in the provision of transparent and understandable information & training.

- *Create commitment & appeal*: Creating commitment & appeal involves taking full advantage of social processes as important enablers. This may include ensuring trust in the whole smart grid process, involving end users at early project stages by allowing a choice of involvement levels, involving role models respected by the selected group, believable customer testimonials, and dealing with possible free-rider effects. Creating commitment & appeal also requires effective marketing and outreach to create a 'desire' for new products, for example by emphasizing key benefits and creating new lifestyles around products. Corresponding theoretical notions can be found, for example, in the importance of the engagement factor (4E model), Cialdini's principles (Social Proof, Liking, Authority, Reciprocity, Commitment, Scarcity), and the need for consequent attention, interest, desire and action (AIDA model).

Key Success Factors for End-User Engagement in the CONTINUATION PHASE



Five success factors are key to keep households engaged after the initial phase of Smart Grid projects to enable the entrenchment of newly acquired energy behavior:

- *Effective feed-back, pricing & communication:* A lot is known about which factors need to be considered when designing effective feedback and pricing schemes. For feedback, this involves, for example, **considering direct and indirect feedback**, interactive and disaggregated feedback and linking feedback directly to advice on action. For pricing, this involves **taking into account various attributes of tariff structures** – i.e. the rationale of the scheme, the number of time blocks used, the price update frequency etc. Regarding communication, it is particularly important to ensure a **continuous information flow** to maintain high engagement levels. Moreover, it is considered appropriate to **link dynamic pricing, convincing feedback mechanisms and communication strategies** to achieve an optimal response. Related theory includes, for example, communications theory that highlights the sender, target group, aim, message, timing and communication channels as key factors to consider in a communications strategy.

- *Variety of intervention methods*: Although understanding of the end user is key, there are limitations of the extent to which 'tailor made solutions' can be offered, especially for a heterogeneous target group. Several studies therefore also stress the need for the adoption of a variety of intervention methods and techniques to serve different user types. This includes, for example, adopting a **variety of feedback information and channels** and adopting a **variety of tailored dynamic pricing schemes** to address different user segments.

- *Ease of use:* **User-friendly, intuitive designs** are considered important to minimize effort needed for operating new devices and schemes (i.e. to minimize knowledge & information barriers perceived by end users). Ease of use also includes adequate and **pro-active support and service,** e.g. by anticipating and answering questions before customers ask them. Support and service may actually **benefit from user-friendly, intuitive designs**, for example by using social media for support services.

- *Social comparison*: Interest may be stimulated by allowing end users to compare their (new) energy behaviors to that of peers. Besides setting **individual energy-saving targets**, this approach involves the comparison of targets, (and their fulfillment), to others. The case for social comparison is reflected, for example, in recommendations that **appeal to the competitive nature of people** and in the perceived effectiveness of **social feedback in influencing behavior**. Do note that the positive effect of social comparison on the total energy savings of a target group is still debated, as it may equally encourage low energy users to use more.

- *Reflection & learning*: Smart grid innovations can be considered 'complex', involving many connections to other domains and scale levels, with significant uncertainties on technical, social and other dimensions. Reflection and learning is therefore needed, starting in the activation phase and continuing throughout the continuation phase. This could involve, for example, **eliciting end users' expectations** at the start of the process, and evaluating their experiences later on, with fine-tuning of interaction schemes when needed. On a project level, **monitoring and evaluation cycles** may be incorporated to further update, upscale and replicate project designs and offerings. Also, allowing **initiatives be part of a wider program with clear objectives** can be stimulating for end users. All in all, smart grid innovation projects may function as 'niches' in which end users, suppliers, designers and other **actors collaborate and co-create knowledge** in the further development of the smart grid.

Key enablers and barriers for active demand

Literature reports on a variety of factors end users consider when deciding whether to engage in (and continue with) a smart grid program. These factors can be classified as either enablers (reasons why end users may be tempted to engage) or barriers (reasons why they would not)[2]. They are grouped under the categories *comfort, control*, *environment*, *finance*, *knowledge & information*, *security*, and *social process* (in alphabetical order):

- **Comfort**: Possible loss of comfort is an often mentioned barrier. Smart grid technology may also increase levels of comfort and is thus also reflected as a potential enabler.
- **Control**: A frequently mentioned barrier to engagement is the perceived loss of control over appliances, as automated control algorithms 'take over' appliances[3]. Smart grid technology, however, may also extend the possibilities for control, for example, through more advanced possibilities for controlling appliances (e.g. using mobile devices), extended possibilities to participate in the electricity market, and possibilities for becoming more energy independent ('energy autarky').
- **Environment**: The environmental benefits of smart grid development - reducing greenhouse gas emissions by integrating renewables into the grid – is a reported key benefit end users may strongly care about. Providing information about the avoided environmental and health costs of electricity generation, through energy conservation efforts, leads to higher energy savings. The persistence of this effect is however not yet proved.
- **Finance**: It is clear that financial or 'in kind' incentives and the expectation of a reduced energy bill may be enablers for engaging in smart grid programs. On the other hand, engagement may also require investment costs for smart appliances, and may also lead to higher energy bills for end users requiring electricity at peak times.
- **Knowledge & information**: More transparent and frequent billing information and detailed knowledge about energy use by different appliances are considered key benefits for end users engaging in a smart grid program. Yet, the lack of adequate knowledge and information provision about the smart grid program may act as a barrier. Additional barriers in this category are lack of competencies to deal with new technologies or to negotiate with energy suppliers, a lack of awareness about the concept 'smart grid' and its potential gains, and perceived risks like the (supposedly) adverse health effects of wireless signals.
- **Safety and Security**: A typical security issue often mentioned as an important advantage is improved reliability. On the other hand, privacy and security concerns are reported as potential barriers.
- **Social process**: The positive stimuli that social processes may provide are mostly reported as enablers of end-user engagement. This covers, for example, the stimulating effect of role models and customer testimonials, as well as the 'community feelings' and sense of competition smart grid programs may appeal to, thus making participation 'fun'. To some extent, social values are also reported as barriers, for example through 'free rider effects' (creation of a sense of unfairness, because non-participants of the smart grid also benefit from peak shaving) or job losses (as meter readers will no longer be needed), which end users don't want to be seen as being responsible for.

[2] Although generally meaningful, this distinction needs to be interpreted with care. What can be considered an 'enabler' or 'barrier' can be context dependent, and dependent on the perspective of the end user.

[3] A basic recommendation given is to always include possibilities to interfere / overrule automatic procedures (e.g. Verbong, 2013).

ENERGY PRACTICES AS A KEY ANALYTIC TOOL

End-user energy behavior is influenced by a broad range of both **behavioral** and **situational** factors. Behavioral factors include monetary motivators (financial gains), non-monetary motivators (beliefs, values, habits, and routines), social influences (norms and leadership), and personal capabilities (knowledge, skills, and financial means). Situational factors include institutional prescripts (laws, and regulations), culture, infrastructure and social networks. This range of considerations implies that a nuanced view on end-user behavior is required, taking both behavioral and situational factors into account.

A growing body of literature particularly highlights **energy-related practices** as key to understanding and influencing smart energy behavior. Practices reside at the 'interface' of individual behaviors and social structure, as these behaviors are the product of, and also reinforce, social structure. Energy practice theory postulates that **energy is not used consciously or rationally, but rather as the 'byproduct' of practices** like cooking, washing, showering, working, commuting, watching TV, socializing, and travelling. Such practices are often **driven by routines and socially shaped expectations**. Smart grid programs would thus benefit from a thorough understanding of the energy-related practices of their target groups.

> Everyday energy using practices (such as cooking, washing, showering, commuting, doing the laundry, etc.) should be taken as the primary unit of analysis for understanding energy behavior.
>
> Different types of intervention should be applied as end-users move from the ACTIVATION to the CONTINUATION phase in changing energy behavior.
>
> Key enablers and barriers of active demand are identified in the areas of comfort, control, environment, finance, knowledge & information, security, and social process.

Looking at energy-related behavior through the lense of social practices enables an analysis of behaviors at **different levels of consciousness**, ranging from habitual to reason based behavior. Energy-related practices as such – like washing, cooking, heating etc. – can typically be considered **habitual**. However, behaviors aiming for a change of practices – like deciding whether to engage in a smart grid project and / or to buy smart appliances – are rather more **reason based**.

Figure 3 presents this view in a highly stylized manner. The process of end-user engagement in smart grid programs and their consequent interaction with new technologies, feedback and pricing schemes (i.e. the 'end-user interaction scheme'), is interpreted as a process of practice-change towards a higher level of 'smartness'. At the start of the process, it is assumed that end users carry out their energy-related practices in a rather habitual manner. As end users become more engaged in a smart grid program, they are stimulated towards more conscious decision-making. This phase can be considered rather 'disruptive', as existing practices need to be reconsidered and redefined. In this **ACTIVATION PHASE**, end-user interaction is targeted typically at achieving active end-user participation and requires an explicit consideration of old and new practices. As new practices are adopted over time, behavior once again becomes more habitual. In the **CONTINUATION PHASE**, end-user interaction is then aimed more specifically at supporting and reinforcing the new energy practices.

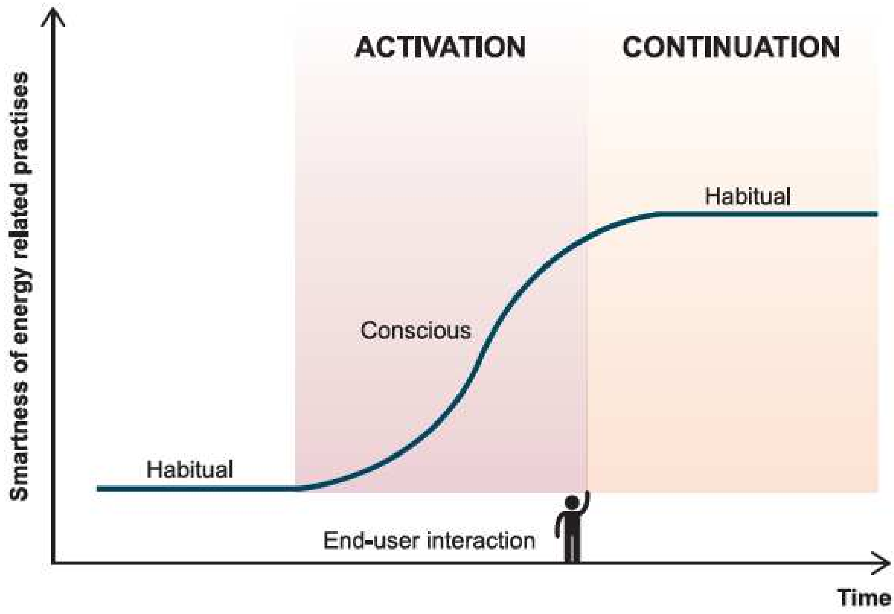


Figure1: The processes of end-user-interaction distinguishing an activation and continuation Phase.

EMPIRICAL FINDINGS

Different types of **incentive-based programs** are described to 'activate' end user participation in demand response. These may comprise monetary and/or non-monetary incentives, and the program could be operated on a capacity and/or use-oriented mode. End user questionnaires reveal that financial benefits, reliability, comfort, and the level of control over appliances are some of the key factors taken into account by these users when deciding to enroll in smart grid programs.

Alternatively, **dynamic pricing schemes** may be used. Various tariff structures may be offered, for which different levels of peak clipping and reduction of the energy bill have been reported. To better compare the different tariffs structures, several key attributes need to be identified, including the rationale of the scheme, the number of time blocks used, the price update frequency, duration of peak periods, rates and rebates offered, the price spread, the price components that are made dynamic, and whether automated or manual control is applied. Further key lessons include the need for a variety of tailored interventions to address different user segments, and the need for convincing feedback mechanisms and communication and engagement strategies to make dynamic pricing 'work'.

Feedback on energy consumption forms a key component of an end-user interaction scheme. Regarding **feedback channels and devices**, various options can be used. Most experience has been gained with in-home displays; but others channels like websites, ambient displays, informative billing, and smartphone apps are equally promising and rapidly developing. Considering the influence of the feedback channel (and its design) on energy use behavior, a suite of factors play a role. Therefore, there is no such thing as the 'optimal' feedback channel, as the choice of feedback channel needs to take into account the preferences of a heterogeneous end-user population.

Concerning **feedback content**, different types of information can be delivered to the end user, including current and expected usage rates, bill predictions, historical comparison, differentiation by appliance, unusual usage alerts, social feedback (comparison with others) etc. It tends to be difficult to assess which type of feedback works best, with partially contradictory empirical results. Nonetheless, direct feedback (e.g. real-time and historic usage) tends to be somewhat more effective than indirect feedback (e.g. processed via billing); with social feedback also appearing to be relatively effective. Other general recommendations include linking feedback directly to advice on actions and ensuring that feedback is interactive and sufficiently disaggregated.

Regarding **communication and engagement**, training given to end users and installers, innovative customer service and support (e.g. using social media), appropriate communication channels, face-to-face interaction and the need for continuous information, are highlighted as elements that generate long-term end-user interest and involvement.

Concerning **data privacy**, the literature stresses three important points: data minimization, transparency, and end-user empowerment (adequate information and permission requests). In addition, appropriate technical measures need to be taken to ensure data security.

Regarding **energy markets**, the literature describes new market structures and services that can be developed in an unbundled market and within a smart grid framework. Although largely uncharted territory, the concept of the application of principles of aggregation has emerged as a key contributor to these new energy markets. Aggregators enable small loads to participate in the market which would not be accessible for these end users otherwise. They typically take an intermediary role between end users and other market players on a multi-sided platform. Aggregators commercialize the aggregated flexibility from the end users to the other market players. This aggregated flexibility can provide a number of services to the different market players, like offering reserve capacity (for TSOs), distribution system congestion management (for DSOs), portfolio management (for BRPs and retailers), and energy usage monitoring and optimization (for end users). Such innovative business models currently remain largely untested (partly due to uncertainties under the current regulatory framework), but they will most probably become increasingly important over the coming years. The furthering of our understanding of end-user preferences in this context is an important next step. As an example, insight is needed on end user preferences regarding how their offered flexibility is used, such as for balancing of the local network, balancing energy consumption and micro-generation in their own home, or balancing the general, 'anonymous' energy market; or whether the nature of actors taking up the role of the aggregator has any impact on end user participation decisions.

Recent developments in the **telecommunication and mobile phone industry** provide a number of additional relevant lessons learned. These include consideration of new business models (e.g. tying arrangements) and thinking seriously about usability (e.g. simple, self-learning devices), design (devices that fit into every household) and marketing (e.g. emphasizing lower energy costs and more comfort, and creating desirable image lifestyles around products that fulfill the need for distinction). Furthermore, example projects in the field of energy monitoring and management of offices show how automated systems can be developed that reduce energy consumption, while minimizing the need for behavioral change on behalf of the end user.

ANNEX 2: RECOMMENDATIONS FOR FURTHER RESEARCH ON END-USER ENGAGEMENT IN SMART GRIDS

1. **Understanding the target group(s)**: Which instruments or approaches contribute to achieving a better understanding of the enablers and barriers of target groups and the type of end-user interaction scheme best suited to them?
2. **Products & services**: How / in what way can innovative products and services provide clear added value to end users, while contributing to the fostering of smart energy behavior?
3. **Incentives & pricing schemes**: Which (monetary or non-monetary) incentives and pricing schemes contribute to the fostering of smart energy behavior?
4. **End-user feedback** (system communication): What feedback information and which feedback channels contribute to the fostering of smart energy behavior?
5. **Project communication**: Which communication channels, information and marketing techniques contribute to the recruitment and engagement of end users in smart energy projects?
6. **Cooperation between stakeholders**: How does involvement of non-energy stakeholders contribute to end-user engagement and the fostering of smart energy behavior?
7. **Bottom-up support**: Which instruments or approaches contribute to facilitating end-user empowerment from consumer to customer and/or citizen?
8. **New market structures**: Which features of the interaction between end users and energy market structures contribute to end user engagement and to the fostering of smart energy behavior?
9. **Scalability/replicability**: Which issues hamper and/or facilitate the upscaling or replication of smart energy projects?

Table1: Summary of key challenges

A 1st challenge relates to **identifying and targeting specific end-user groups**. Although the overall scope of potential enablers, barriers and success factors for end-user engagement is relatively clear, it is as yet largely unclear how these should be applied to the different type of end users that may be targeted. End-user segmentation is one of the approaches that may require to be further developed in this respect. The challenge is thus to find instruments or approaches that contribute to achieving better understanding of the enablers and barriers of target groups and the type of end-user interaction schemes best suited to them.

A 2nd challenge relates to the **added value of smart grid related products from the perspective of the end user**. The current energy system in Western Europe operates with few flaws. End users are used to being able to use electricity whenever they see fit. The risk for customer activation programs is perceived as 'demanding' a lot from customers (in return for a reduction of price), rather than positioning a project that makes an interesting offer (for which end users may even be willing to pay). In that sense, smart grid technology is a challenging technology to 'sell'. The challenge is thus to find innovative products and services that provide clear added value to end users, while contributing to fostering smart energy behavior.

The 3rd and 4th challenges relate to available knowledge as to the effects of end-user interaction schemes. Although some research has been done on, for example, the effect of feedback and dynamic pricing on energy use peak clipping, empirical evidence on the effectiveness of the various engagement schemes remains weak. Notably, further research is needed to assess the effect of combinations of approaches and to identify critical success factors. The challenge is thus to understand **which (monetary or non-monetary) incentives and pricing schemes**, and which **feedback information and feedback channels,** contribute most efficiently to fostering smart energy behavior.

A 5th key challenge relates to the **use of communication channels, information and marketing techniques**. Although a number of general recommendations on communication and information provision can be given, empirical evidence on the impact of communication and information on smart energy behavior remains weak. Moreover, although the field of marketing has shown the added value of applying marketing techniques, actual use of such techniques in smart grid projects has been limited to date. The challenge is thus to better understand which communication channels, information and marketing techniques best contribute to recruitment and engagement of end users in smart energy projects.

A 6th key challenge relates to **cooperation between stakeholders**. Current smart grid projects may include various participants other than the traditional energy players. It is as yet unclear how the involvement of non-energy players may influences end-user engagement. The challenge is thus to understand the extent to which the involvement of non-energy stakeholders contributes to end-user engagement and smart energy behavior.

A 7th key challenge relates to the **end users as initiators of projects**. Whereas the literature describes a variety of results on end-user involvement, relatively little is reported on bottom-up projects in which end users are initiators and 'owners' of the projects. Most projects place end users in a consumer or customer role and were initiated by stakeholders other than citizens usually incentivized by a European/national/regional funding opportunity. Yet, very few projects have been reported in which the end users are placed in a citizen role. Here, combining smart grid research with research on smart cities seems promising, as the latter initiative does tend to place the end user in a more central role by default.

The challenge is thus to find instruments or approaches that contribute to facilitating end-user empowerment (from consumer to customer and/or citizen).

An 8th key challenge relates to **new market structures** and the role of end users in those structures. Although a number of projects have addressed this issue, further testing is needed. A specific matter for investigation is to identify how legislation and regulatory mechanisms may influence smart grid development within the framework of new market structures. A further issue is the development of new interpretations of the role of customers, as well as the market entry of completely new participants and roles, which in turn lead to new interactions and innovative value chains in the energy system. In particular, a tailored approach to different end-user segments will require that the end users provide a substantial amount of information of a potentially 'sensitive' nature (e.g. regarding lifestyles, values, preferences, etc.). The issue of trust is thus of particular importance when designing new market structures. All in all, the challenge is thus to understand **which features of the interaction between end users and energy market structures contribute to end user engagement and smart energy behavior**.

A 9th key challenge relates to **up-scaling and replicating pilot projects** that involve a diverse end-user group. Although significant experience exists with pilot projects, little experience has been gained in larger scale roll-outs. Findings from pilot projects - often targeting specific end-user groups (e.g. 'early adopters') - cannot readily be transferred and applied to larger scale roll-outs that deal with a substantially larger and much more diverse audience. In particular, when engaging with the typical 'indifferent', 'vulnerable' or 'stalled starters', specific strategies will be applied, such as making the technology highly accessible, and utilizing very easy to understand messages. The challenge is thus to understand which strategies hamper and/or facilitate up-scaling or replication of smart energy projects.

ANNEX 3: RESEARCH PARAMETERS

This policy brief draws upon the findings of S3C project ("Smart Consumer, Smart Customer, Smart Citizen"), and in particular on the research reported in the Deliverable 1.1 (downloadable from www.s3c-project.eu).

The project ran from 1 November 2012 – 31 October 2015. It was carried out by a consortium of 7 project partners:

- VITO (project coordinator) – the Flemish Institute for Technological Research (Belgium)
- B.A.U.M. consult GmbH (project management) (Germany)
- ECN – the Energy Research Centre of the Netherlands (the Netherlands)
- SP – Technical Research Institute of Sweden (Sweden)
- INEA Informatization, Energy Engineering, Automation, d.o.o. (Slovenia)
- EDP Distribuição (Portugal)
- RSE – Ricerca sul Sistema Energetico (Italy)

The project's objectives were:

- To gain an in depth understanding of **which activities and market roles different categories of end users are willing to take up in smart grids**; and to understand the enabling conditions required to take up these activities and market roles, as envisaged for 'smart' end users in future energy markets.
- To **identify and explain critical success factors and reasons for failure** through reviews and analyses of the experience obtained in programs, with specific reference to the implementation of instruments aimed at 'smart' energy end user behavior.
- To **identify innovative technology and best practices** and to **develop user-interaction schemes** that best induce efficient and effective behavior by end users.
- To **develop guidlines for the developers of technology and user-interaction tools** (energy management devices, tariffs, services, incentives, information, involvement etc.) as to how to improve effectiveness and efficiency of such means.
- To **actively disseminate the results** (guidelines and a toolkit) to relevant stakeholders, such as DSOs, aggregators, service providers and hardware and software manufacturers.

S3C combined a theoretical and experimental learning approach. The theoretical approach investigated market functioning and end user behavior; as well as published results of already existing meta-analyses. For the empirical element, the S3C consortium started from existing smart grid pilot databases (Grid+, EEGI, JRC) and screened these databases using targeted selection criteria designed to find interesting projects from the end user engagement point of view. In the end, 32 smart grid pilots were found that were willing to share their experiences on end-user engagement. These pilots form the so-called 'passive partners' in the S3C 'Family of Projects' (FoP), and they have been analyzed thoroughly using a research protocol designed on the basis of the theoretical investigations. A cross-case analysis revealed success factors, best practices and pitfalls in end-user engagement. The best practices have been translated into guidelines and tools for successful engagement of end users in smart grid pilots and rollouts, and are available on a separate website (http://www.smartgrid-engagement-toolkit.eu/). Pilot tests and experiments with a subset of pilots within the 'Family of Projects' have also been conducted to maximize learning and minimize risks of failure in practice. These projects are called the 'active partners'. In this way, S3C went beyond the current 'state of the art' of knowledge on user involvement in active demand programs, by using these 'active partners' to improve their programs and introduce new means and methods for the user participation in active demand side management and in the energy efficiency of the overall electricity system.

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Project website: www.s3c-project.eu

Toolkit website: http://www.smartgrid-engagement-toolkit.eu/

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