IDENTIFYING THE FACTORS FOR ENSURING CUSTOMERS ARE ACTIVELY ENGAGED IN SMART GRIDS

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ABSTRACT

Smart Grids are becoming widely regarded as an essential component of ensuring sustainable energy supplies going forwards. There is considerable focus on the technological aspects of delivering Smart Grids. However, little is understood of the extent to which consumers are willing and able to embrace new technologies and initiatives that enable their use of energy to be actively managed. This paper highlights the key findings of an international project to explore consumer participation in Smart Grid related activities.

INTRODUCTION

This paper highlights the findings of an international project established within the IEA Demand Side Management Implementing Agreement to explore how customers interact with Smart Grid related initiatives. The project is entitled The Role of the Demand Side in Delivering Effective Smart Grids.

The project focussed on Smart Grid related activities requiring an element of consumer engagement. Specifically, on activities that deliver cost and/or energy efficiency savings by enabling or stimulating energy behaviour change by consumers.

ENERGY BEHAVIOURS AND PRACTICES

The factors that influence the way that consumers interact with Smart Grid related activities, i.e. their energy behaviours, are wide ranging and complex. Energy behaviour can be defined in terms of a number of elements. Firstly, it involves the decision maker, the individual who makes the decision and performs the behaviour. The second element is a well-defined outcome or action. This could be switching off lights, buying low energy light bulbs, reducing indoor temperature or deciding when to use a washing machine. The context is relevant, i.e. does the action take place at home, at work or in the car. Time is also an important element. Is it a one-off action that takes place today, or is it repeated over several weeks and months?

Once the behaviour is well defined, a behavioural model can be used to help understand the factors that influence the decision maker's choice over whether or not to perform the behaviour.

Energy Behaviour Model

A number of models or frameworks of understanding exist. No single model or framework of understanding is considered to be ideal, but they are a useful tool to help achieve an outcome that depends on behaviour change.

Some focus on individuals; others focus on the individual in his/her social environment. Some focus only on behaviour; others also consider the context. Some focus on one-off behaviours; others on habitual activities. Some focus on discrete actions, others consider a complex set of inter-related actions.

It is believed that valuable insights can be gained from considering both the characteristics of the individual, and also the physical, social and political context within which the decision is made. Therefore, the following model was selected for this study [1,2].

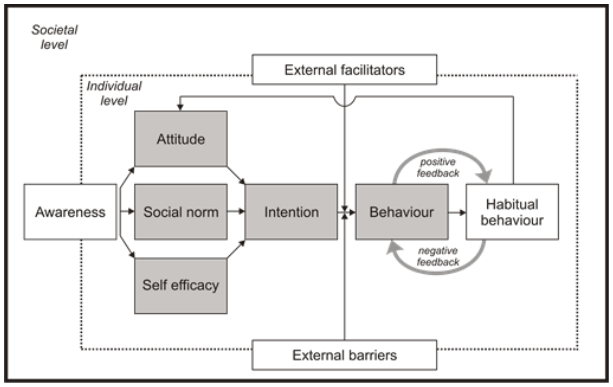

Figure 1, Theoretical model of energy behaviour

As indicated in Figure 1, an individual's behaviour is defined by their own attitudes, abilities and the social norms to which they are exposed. They are also influenced by their context, and the opportunities or barriers presented to them. In order to understand behaviour, it is therefore necessary to consider all of these aspects, rather than just one element in isolation.

OUTCOMES REQUIRED

A range of Smart Grid related initiatives have been trialled and, in some cases, rolled out to large numbers of consumers. Those involving an element of consumer energy behaviour change have focussed on delivering one or more of the following outcomes:
(1) **An overall reduction in energy consumption**. This may seem the logical place to start, but if the primary goal is to reduce peak demands it may be more effective to focus on changing the pattern of consumption.
(2) **A different, but enduring, underlying pattern of consumption.** This can be used to address situations where peak demands occur over extended periods of time (i.e. over several months of the year).
(3) **A pattern of consumption that responds dynamically to the varying operational requirements faced by the electricity system.** Achieving this outcome is beneficial for dealing with short term constraints that require changes to the pattern of demand on an infrequent and unpredictable basis.
(4) **Enabling industry stakeholders to access and utilise energy consumption information**. Improved information about electricity usage and voltage levels on the distribution networks offers the potential to improve the efficiency of the electricity system. Smart Meter data can help network operators optimise the way they manage and operate their networks and can reduce the need for network investment. `

CROSSING THE CHASM

Despite the extensive trials and pilots that have been carried out, many Smart Grid technologies and initiatives are relatively new to consumers. They are yet to reach the 'mainstream'. Many innovations and/or disruptive technologies fail to be taken up on a wide-scale because of the 'chasm' that exists between early adopters and the majority [3,4], see Figure 2. Crossing this chasm is one of the main challenges for Smart Grid implementers going forwards.

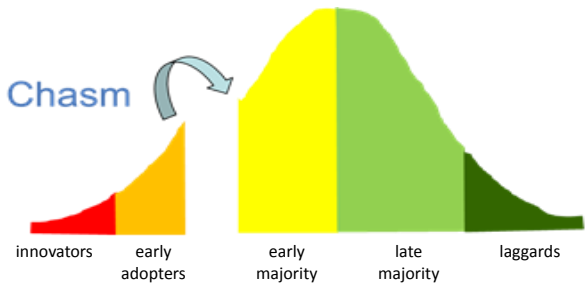

Figure 2, Diffusion of innovations model

DESIGNING CONSUMER OFFERINGS

There are a number of different factors that need to be taken into consideration when designing a Smart Grid initiative to ensure that consumers are willing to engage. This implies that consumers 'sign up' to the initiative, undertake any actions that enable them to participate (i.e. install technologies) and deliver the required outcomes.

Some of the important factors to be taken into consideration when designing a Smart Grid initiative are described below.

Provide Choice

When an individual is unhappy with a situation, they can react by exiting (choosing something else) or voicing their concerns (protesting). Therefore, it is important to provide consumers with an element of choice. These protests can, in some cases, be extreme. For example, one woman in Houston, Texas, brandished a gun at a utility worker to prevent the installation of a Smart Meter in her home.

However, it is also important to ensure that consumers are not faced with too many choices, otherwise they can be paralysed by an inability to choose from the myriad of options available to them [5]. This is attributed to a number of factors including concerns that they may make the wrong choice (the anticipation of regret) and the difficulty of assessing the trade-offs between the different options.

Therefore, it is important to provide consumers with choices, but not too many.

Provide Tangible Benefits

A significant amount of analysis has been undertaken, and is currently on-going, to demonstrate the benefits of Smart Grids. Many of these studies focus on the benefits to industry stakeholders or on the benefits to society as a whole. However, it is important to ensure that they also provide tangible benefits directly to consumers themselves.

A review of a number of surveys of consumer attitudes and views towards Smart Grid related activities shows that consumers generally say that they prefer/expect to receive a financial reward [6].

Tangible benefits are not just limited to direct financial benefits, but include other aspects such as improved comfort, improved health or reduced environmental impact.

Take Care When Framing the Initiative

The way that Smart Grid initiatives are framed has an important impact on the way they are assessed and evaluated by consumers.

As indicated in the energy behaviour model in Figure 1, an individual's decision to perform an action depends on a number of factors, including their own views, opinions and beliefs. This implies that different segments of consumers react (behave) in different ways in response to a given initiative. So it is not possible to make generalisations that apply to all individuals. However, some general observations can be made about how the framing options can have an important impact on the decision making process.

This includes focussing on the avoidance of losses rather than achieving benefits, taking care over the reference point used to compare benefits and the timing of payments and benefits. An example of 'avoidance of losses' is provided below.

Avoiding loss and wastage

Many consumers are risk averse, i.e. they are reluctant to take a course of action that has an uncertain outcome. They are more likely to select an option with a certain outcome, even if the expected outcome from an alternative, but uncertain, option is higher. However, individuals are much more willing to 'take a gamble' where losses are involved.

The following is a well cited example of the powerful effect of framing on decision making that was originally developed by Tversky and Kahneman [7].

Consider a scenario where an unusual disease is expected to kill 600 people. Two alternative programs have been proposed to combat the disease, with different outcomes expected. The way that these programs are framed has a significant impact on which of the proposed programs is preferred.

If the options are framed in terms of how many people are saved (option 1: 200 people saved, option 2: 1/3 probability that 600 people will be saved, but a 2/3 probability that no-one will be saved), the majority (72%) select option 1.

If, however, the options are framed in terms of how many people will die (option 3: 400 people will die, option 4: 1/3 probablity that no-one will die but a 2/3 probability that everyone will die), the majority (78%) select option 4.

Therefore, there may be advantages in framing the initiative in terms of avoiding waste or losses rather than in terms of the benefits that could be achieved.

Ensure Consumer Concerns are Addressed

Consumer concerns must be identified and addressed. The results of previous field trials and case studies provide a useful starting point for identifying concerns, but it is important to realise that the results of one study will not necessarily apply to a different group of consumers or within a different context.

For example, Smart Meters have been rolled out to all of Enel's consumers in Italy. The roll out was driven by Enel's desire to improve the cost effectiveness of their metering activities, and consumers were not provided with any choice over whether or not they wished to have a Smart Meter. Despite this lack of choice, no strong opposition was raised by consumers.

The same is not true for consumers in the Netherlands, for example. A mandatory roll-out was proposed, with consumers facing a possible €17,000 fine or six months imprisonment for refusal. Consumers and consumer groups raised concerns over the violation of right to privacy and the possibility that the data could be misused. This led to the Dutch First Chamber refusing to approve the Smart Metering Bill.

A review of a number of Smart Grid related case studies and surveys of consumer opinions conducted as part of the project shows that there is a wide range of issues that present barriers to consumer engagement.

Consumer concerns relating to health, safety and data privacy are reasonably well documented, but it is important that other concerns are not overlooked.

Disruption and inconvenience

Consumers cited a number of concerns relating to disruption to their property or routines. In particular, the impact on time is important.

Many relate to the installation process itself, i.e. the inconvenience associated with the time spent waiting for installers to arrive and during the installation process itself. In addition, householders cite that they can be put-off by the installation process itself, i.e. due to the need to move possessions in order to allow the installation to take place or the need to redecorate after the installation has been completed.

Although seemingly innocuous, these concerns can have a significant impact on consumer engagement. For example, large numbers of consumers are put off having free or subsidised loft insulation fitted within their home due to upheaval and disruption. This is particularly true when large volumes of possessions are stored in the loft which would need to be relocated.

Consumers also cite a general dislike of people coming into their home, for example to install new technologies. This relates not just to the inconvenience caused, but also concern over the potential for damage. For example, an Australian demand response trial involved installing technology to allow the air-conditioning equipment of householders to be controlled remotely. The trail reported that householders were more likely to participate if their air-conditioning units were located outdoors [8].

Financial commitments and uncertainty over benefits

The anticipation of regret, i.e. of being worse off, is an important factor influencing consumer willingness to participate. The possibility that they will end up paying more than they do at the moment outweighs the possibility that they will end up paying less.

Some schemes remove the risk by providing assurances that consumers will not pay more under the new initiative than they would have done on their existing tariff. Whilst this may help consumers enrol, it may not necessarily provide a cost effective approach for stakeholders. For example, the principle of not exposing the consumers to any risks can constitute a barrier to a larger rollout by a distribution operator. It may lower revenue and thereby decrease the possibilities for the network operator to invest and operate the system.

It is essential to provide consumers with information that is as accurate and reliable as possible, rather than 'best case' scenarios. Claims that Smart Meters can help householders save up to 10% on their bills typically represent the upper limit on the savings obtained from trials. In practice, many consumers achieve savings much lower than this, leading to dissatisfaction and disappointment.

Lack of confidence over the level of benefits could be even more important where an individual has to make an upfront investment in order to participate, i.e. they know how much they need to invest but may not have certainty over when (or if) they will get a return on their investment.

However, it is important to note that ensuring consumers are financially better off if they do participate is not sufficient to ensure that consumers will take action. This does not imply they are behaving irrationally, but rather that there are other factors that are considered to be more important.

CONCLUSIONS

Over the coming years, Smart Grids offer the potential to support the move to a low carbon future. They could help to deliver a fundamental change in the way that the balance of electricity supply and demand is managed. In particular, they enable a co-ordinated approach whereby the actions of all users connected to the energy system can be integrated. This includes the actions of the consumers themselves.

However, there is a real risk that if consumers do not adopt new approaches to the way that they consume electricity, Smart Grids may not be able to achieve their full potential.

A neo-classical economic analysis of the potential benefits and losses does not accurately predict whether a consumer will adopt a particular initiative or technology. Rather, there are a number of different factors and elements that influence the decision maker; only some of which have been identified in this paper.

Understanding these factors, addressing consumer concerns and ensuring that Smart Grids provide tangible benefits to consumers are important aspects to be taken into consideration when designing Smart Grid initiatives.

A number of general guidelines can be identified in order to help ensure a Smart Grid initiative is more likely to be adopted by consumers: a selection of which have been identified here. However, the decision of whether or not to engage is **always** made by an individual.

The factors that influence the decision making process are wide-ranging and complex. As a result, an initiative that is successful for one group of consumers may not necessarily be effective with another group in a similar context due to the differing views and beliefs of the individuals involved. Likewise, what works for one group of consumers may not succeed with another group of like-minded consumers due to the existence of differing opportunities and barriers.

REFERENCES

[1] M Fishbein & I Ajzen, 2010, *Predicting and changing behaviour: the reasoned action approach*, New York: Psychology Press.

[2] C Egmond & R Bruel, 2007, *Nothing is as practical as a good theory. Analysis of theories and a tool for developing interventions to influence energy-related behaviour*, SenterNovem

[3] E.M. Rogers, 1962, *Diffusion of Innovations.*

[4] G.A. Moore, 1998, *Crossing the Chasm, Marketing and Selling Technology Products to Mainstream Customers*

[5] B Abbott, A Mannella, K Mcnamara & A Tripathy, 2007, *Optimising Choices for How People Really Buy, Not How we Think They Buy* , Diamond Management and Energy Consultants.

[6] Interaction between Consumers and Smart Grid Related Initiatives, Task 23 Report, November 2013

[7] Tversky and Kahneman, 1986, "The Framing of Decisions and the Evaluation of Prospects*", Studies in Logic and the Foundations of Mathematics*, vol 114, 503-520

[8] ETSA Utilities, 2007, *Demand Management Program Interim Report No.1 June 2007*