SMART GRIDS NEED SMART CITIZENS

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ABSTRACT

Customers must be aware of all social benefits obtained by playing an active role in a Smart Grid context. As such, emotional incentives should be considered, beyond financial ones, in order to motivate them and turn them into Smart Citizens. The project InovCity, in the Portuguese city of Évora, was launched by the main electricity Distribution System Operator (DSO), EDP Distribuição (EDP Group) Portugal, in 2010, involving approximately 32,000 Customers. This project is assessing the changes of behaviors and consumption patterns when Customers are given information about their consumption and additional tools such as detailed access to their data and experiments with some consumption-related "gadgets". Some of the results suggest that tariff-based incentives, on their own, may not be enough to change the Customer's behavior in a sustainable and optimal way. For this purpose, some projects regarding Consumer engagement, like S3C, in which EDP Distribuição is involved, are in place to assess how much elasticity with respect to load-shifting and consumption efficiency can be induced on Customers. This paper concludes by referring the main types of non-tariff incentives that can be implemented, as well as some results that have been reached so far in Portugal and some European pilot projects.

INTRODUCTION

Customers are used to living in a world with little need of interacting with electricity utilities, except about billing and power outages. This reality gave rise to relatively passive Customers, with little awareness of how their proactive role can impact their lives and communities they belong to.

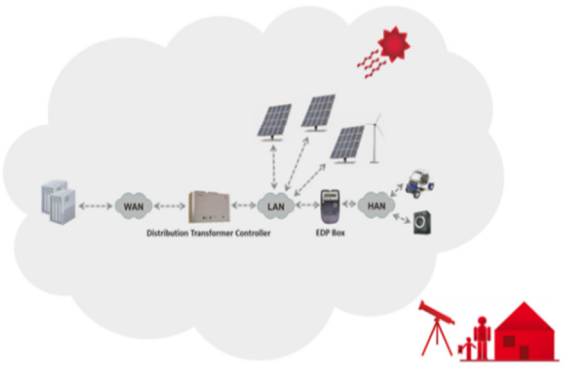

Figure 1 – Providing a Smart Grid Vision to Customer

However, in the last few years, this situation has been slowly changing, with environmental targets such as the 20/20/20 directive, a higher efficiency level of electrical devices, the spread of electrical vehicles and a higher penetration of distributed generation and number of prosumers. One of the electricity DSO's major challenges, acting as Market Facilitator, is to ensure that markets incorporate enough information and price signals to ensure an efficient utilization of grid capacity, particularly in peak hours. To achieve this goal, active demand response policies can be taken, particularly in terms of load shifting from peak to off-peak hours. Smart grids allow for better and easier access to consumption information, which can help Customers respond more actively. If this active demand response does not become effective - due to lack of awareness or low level of confidence on the utilities - the investment in smart grids will not deliver the return expected by the power system agents. Cost-Benefit Analyses (CBAs) have been requested by Utilities' regulators, to estimate the potential value of smart grids' roll out. Their outcomes suggest that the biggest share of the benefits results from expected improvements in energy efficiency and are captured by Customers. In this sense, utilities and other market players should create a new, more dynamic and closer environment, where Customers wish to belong. Many pilot projects across the world are evaluating how engagement can become effective and ensure the powerful demand response that the sector, and utilities in particular, are interested in.

EDP Distribuição is aware of the importance of Customer engagement. The company has been implementing some of the best practices through project pilots, and is assessing the Customers' propensity to use new technologies and services. The evolution of the outcomes has constantly been compared over time, allowing for adjustments to new processes and strategies to engage not only Customers "*per se*" but also their entire communities.

FINANCIAL RESULTS OF ONGOING PROJECTS

Grid operators and Customers have different concerns and, as such, they respond differently to the impact of smart grids. For instance, DSOs want to reduce peak consumption and ensure there is no network congestion at any time. On the other hand, the Customer is interested in lowering the amount of money he pays for his electricity consumption.

The Municipality of Évora, in Portugal, with approximately 32,000 electricity Customers, was chosen as EDP's living Lab for the implementation and test of smart grid technology, as part of *InovGrid, EDP*'s Smart Grid project. In this context,, smart meters have been installed in all Customers between October 2010 and March 2011. They were provided with:

- A smart meter ("EDP BOX");
- Information on smart meter features and how to use them;
- Information about how to access to their own web portal (with detailed daily consumption data);
- General awareness about project and the importance of energy efficiency.

These four changes, with respect to the traditional environment, were what *EDP Distribuição* called "Smart Grid Environment" (SGE).
In order to compare results inside and outside the SGE, a control group was used in another Portuguese Municipality, with similar weather conditions and social background (consumption, capacity, income, age and education) to the Évora group. These Customers belonged to the conventional "non-Smart-Grid" environment.
The main goal of these tests was to estimate the impact of SGE on consumption. It is important to note that the results show the impact on aggregate consumption, not on peak consumption. In the years 2011 and 2012, the results for Customers using simple tariffs showed a reduction in average daily consumption of 3.9% and 3.8%, respectively, compared to the control group.
In Portugal, the average electricity monthly bill of a low voltage Customer is approximately 46.5€. However, the volumetric component of energy of that bill accounts for around 36€ (VAT included). This means that Customers responding to consumption and efficiency information managed to save approximately 1.45€/month.
Given that simple tariffs could be a limitation to these results, some alternative tariff schemes were also tested, although the length of the simulation period was lower than one year. Three different tariff schemes were tested:

1. Time-of-Use tariff, with three different tariff rates;
2. Consumption staging tariff scheme, in which the price per kWh increases as higher consumption levels are reached;
3. A target tariff scheme, based on the Customers' average consumption in the previous twelve months: price per kWh goes down if he manages to consume less than the average, but becomes higher if its level of consumption goes beyond the average.

For these alternative tariff schemes, the sampling period went from November 2011 to June 2012, and was compared to the 2010 values. The results show that, where these schemes were applied, electricity average daily consumption went down by no more than 4%. In some cases, consumption was actually lower in the Control Group. This indicates that the use of a SGE, combined with tariff schemes incentivizing Active Demand Response, led to a similar consumption reduction to the one verified in the simple tariff scheme case. However, the combined tariff schemes' samples were limited, and therefore they do not allow us to take any precise and clear conclusion.

CBAs were developed in some European countries under the European Directive 2009/72/CE. According to them (where CBAs had positive results) the implementation of smart meters would lead to a consumption reduction lying in the range of 3%±1.3%, in two thirds of the cases [1]. In the case of the British and German CBAs, the impact of smart meters on consumption is expected to stay below this level. In France, according to the *Linky* smart meter implementation project, launched by *ERDF*, electricity bill savings are expected to be between 5% and 15%. For an electricity bill of 400€ per household, this means saving less than 4€ a month.
For these levels of reduction in consumption (and even for higher electricity bills), the financial impact by itself does not seem to be enough to change significantly Customers' behaviours.
It is also important to take into account that this economic saving requires Customers to find ways to optimize consumption, using the new tools they are provided with, and this process can be expensive in terms of wasted time. So, why should they make an effort to be more efficient if the impact of Smart Grids on their budgets is not that high? Such effort will only become real if price-signals are combined with other types of incentives.
We believe Customers should be involved in the challenge of optimizing and reducing peak consumption, not only to save money, but also to promote a sustainable lifestyle.
In conclusion, if the appropriate set of incentives is created, the individual consumption decision will internalize the DSO goal of managing the grid in an optimal way.

EMOTIONAL INCENTIVES

The risk of a low perceived financial impact of smart grids by the Customers can be a barrier to their successful implementation.
Eureletric advocates that the transition to Smart Systems can only be achieved by increasing Customers' awareness and trust**,** so that they actively accept to make choices in a competitive environment [2]. Trust can be seen as the perception from Customers that the innovation and changes proposed by the utility will be

in their benefit. Lack of trust is, however, one of the aspects they often mention when commenting on utilities. As such, it is crucial to regain their trust, in order to achieve an effective engagement.
In Europe, one of the most relevant players in this transition to smart grids is the DSO, given that in most European countries they are the responsible party for the smart meter roll out process. Additionally, they are capable of reaching all Customers irrespectively of their retailers. As part of its Market Facilitator role, no conflicts of interests related to consumption reduction will be faced. In order to foster awareness and increase Customers' trust, DSOs must be prepared to communicate effectively in 3 phases [2]:

1. Planning of the roll out process. In this phase, DSOs must be prepared to answer what, why, when and how (WWWH) Customers will benefit;
2. Installation process in which installers must be recruited based on how they engage with Customers;
3. Post-installation phase, in order to maintain high levels of engagement and continuous improving in utility processes.

This process is key to provide an overall positive experience. Some best practices have been put in place by several utilities, e.g. creating a specific support info line to answer all questions about the smart metering process, and well supported communication plans to create awareness about social, technical and economic advantages smart meters will bring. The way players communicate with Customers is essential to foster their interests.
CEIVA Energy, a provider of Home Energy Management Systems has incorporated five lessons [3] to help utilities strengthen the engagement level:

1. Tell a Story, translating energy data into a clear and simple story using Customers' language;
2. Make it easy and fun with entertaining messages and visuals that create an enjoyable experience in order Customers care about;
3. Make it actionable, presenting right data at the right time and context to drive Customer's change;
4. Respect the Customer, not demanding response, but asking nicely;
5. Empower the Customer since people change behavior when they have knowledge that makes action irresistible: "*Before, I didn't make any changes because I was not aware of the impact of everything I did*".

This philosophy's results were encouraging. For instance, in a deployment process by a water company, conducted by *CEIVA*, 83% of the company's customers changed their consumption behavior.

Utilities are becoming conscious of the role emotional incentives play in turning a passive Customer into a proactive Citizen, calling out for the importance of building a closer relationship. The approaches must include 2 phases [4]:

1. An initial activation phase for end-user engagement. In this stage, success factors involve providing added value and new information, allowing for automatic procedures and create a lifestyle involving the product;
2. A continuation phase, aimed at enabling an easy use of the demand response tools. In this way, all the activation efforts will last in time and become unconscious routines that Citizens will practice every day.

In this sense, many games / apps where consumption is compared among friends, neighborhoods or even towns were created, in the last few years. Here, utilities could promote, with the support of software companies, a "*gamification*", based on the goals they are interested in (e.g. a competition between cities comparing the reduction of energy consumption at peak hours).
Recent studies agree on the importance of taking advantage of this competitive side of Customers: their idea of control, competitiveness, independence and community feelings spark emotional drivers as basis for human action.
Some examples have been put in place, and the outcomes were encouraging. For instance, in a Sidney neighborhood, some chalkboards display information on the household consumption were put up where people could update everyday with their consumption compared to previous day and their neighborhood ranking.

A research study about social and environmental psychology is also being addressed in the community of Évora [5]. Its main goals are:

- To characterize the level of use of the information provided by *EDP BOX*;
- To compare the evolution in different years and among different segments of Customers;
- To assess the predictors of adherence, use and consumption.

The main results were the following:

- Customers' greatest motivation is to confirm their electricity bill changed in the way they expected, after the implementation of the *EDP BOX*;
- Two thirds did not consider themselves fully informed about the main services of *EDP BOX*;
- One of the Customers' main concerns is that the smart meter may end up contributing to a higher energy bill somehow;

- The variables that justify a positive attitude towards *EDP BOX* are directly related to age, academic background (younger and more literate people evidence a better attitude), degree of confidence in the company, ease of use and propensity of adherence to new technologies.

Utilities must embody all of these terms in their DNA, to build positive relationships with Customers. Asking "how will this improve my Customer's day?" is a good way to unlock the mistrust issue and engage them, starting a new era in the history of grid modernization.

ÉVORA – LESSONS LEARNED

Some lessons were learned during this project in Évora, particularly regarding the timing of the project's implementation and sustainability:

- Peak consumption weeks (particularly during winter or summer), are not appropriate for the smart meter installation, because people might associate the higher consumption to the use of a smart meter;
- The impact of smart grids in consumption habits seems to persist over time, in spite of a minor decrease;
- The utility should transmit the information in a personalized and kind way. For instance, the bill should contain tips about efficiency, preferably based on actual consumption patterns.
- An important percentage of Customers still consider Smart meters difficult to use;
- The use of applications related to consumption behavior was mostly used by males and young people. This habit proved to have a positive effect in terms of energy efficiency.

EMOTIONAL APPROACH MODEL

Below we summarize, the main ideas we have collected from our study, in a framework with an emotional approach that we called the "Six E of Emotional Incentives", which could help utilities and other market players turn Customers into Smart Citizens.

Figure 2: Six E's of Emotional Incentives

CONCLUSIONS

The Évora *InovCity* project was useful to estimate the impact of a Smart Grid Environment on Customers' consumption and attitude towards the smart meters. Results indicate that financial savings are not significantly high. Hence, using only economic incentives may not lead to a considerable and lasting change in individual consumption behavior. This is why it is important to create emotional incentives, in the future, to increase the Customer's level of engagement. Awareness and trust are, in our view, two crucial features utilities need to induce on Customers to trigger a different behavior. DSOs, acting as Market Facilitators, are key players in all this process since in most European countries they are the party responsible for the smart meter roll out process, and will be the first entity approaching Customers. Because of this, DSOs should internalize new processes that must include the necessary time and qualified human resources to explain Customers the benefits they and their Community can drive from smart meters. On the other hand, DSOs should bear in mind that changes in the consumption behavior will only be sustainable if there is an ongoing interaction with Customers in a post installation phase. Hence, the DSO will have to make a persistent effort to guarantee a long-term and sustainable change. This effort requires higher costs and investment. DSOs will need to explain their regulators how important it is to recognize these costs, and how they will ensure a positive NPV for the electricity system. The development of applications and games focused on changing the way Customers behave can be a very effective tool, especially for young and more literate and open-minded people to change their mindset. In fact, these early adopters can foster a spillover effect of efficiency awareness among their communities.
It is our belief that the change through the "Six E of Emotional Incentives" is a way to help utilities achieve a higher level of engagement with their Customers. This is the change that turns a Customer, dealing with Smart Grids, into a Smart Citizen capable of making the best sustainable decisions for them, their Community and the whole power system.

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