

A SURVEY ON THE ROLE OF CONSUMERS IN SMART GRID

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ABSTRACT

The utilities have been investing in R&D Smart Grid deployment in Brazil for the last 4 years. This technology brings new challenges to the sector that will deeply change the way of the operations and services. One of the most relevant factors in this process is the consumer engagement. This paper address preliminary results of the AES Eletropaulo Smart Grid Deployment Initiative regarding the uncertainty of the relationship between consumers, utilities and Smart Grid.

The methodology proposed in this project defines the consumer's needs for information as the foundation for the company's Consumer Information System development. We conducted a survey with consumers from different consumption segments and socio-economic classes, including low income, to assess their perception and expectation about Smart Grid.

INTRODUCTION

The Smart Grids represents the main innovation movement for the Power Sector through the convergence between Information Technology, Telecommunications and Power System. Also, is the key enabler for operational efficiency, reliability improvement, cost reduction, distributed generation integration and availability of energy information for consumers.

The drivers that move a country to invest in Smart Grid deployment are different. Europe invests as an action to reduce greenhouse gas emissions. United States selected as one of their drivers, the improvement of operational security of the grid. Asia has a strong focus on the search for alternatives to meet the growing demand for energy and views Smart Grid as a way to promote the local industry [1]. On the other hand, Brazil looks to improve reliability and reduce the energy losses and theft.

The current scenario for the Power Sector in Brazil is a complex environment with concerns about the rise of the energy price related to a rain shortage, more demanding consumers each day, in the presence of regulatory, political and economic uncertainties.

In this scenario, the consumers become a key player in the success of Smart Grid deployments considering their inclination towards using and adopting new technologies that make them more active by better managing their energy consumption or generating their own energy [2]. In this context, there is an opportunity to strength the relationship with the energy consumer by disseminating

Smart Grid concept. Then, the consumer will play a central role in a sociocultural change that takes the society to a level where energy consumer have conscious and efficient habits [3].

Smart Grid component directly linked to consumers is the Customer Information System (CIS), a term used to describe tools that allow any consumer to view information registered by Smart Meters and presented in a series of devices such as web portals, smartphone and tablets apps, in-home displays, etc[2].

The main challenge in the planning process of the CIS tools is getting the approval of the final users [4]. Ensuring that the consumers adopts the new technologies is making sure that the technology makes sense in their reality. Thus, the development of these solutions must consider several aspects of the consumer's sociocultural context, as well as his perception over the developed tools [3].

The consumer's lack of identification with the Smart Grid concept took several utilities to experience negative relationship with their consumer during Smart Grid deployment. For example, Pacific Gas & Electric, a California utility, received several complaints, in 2009, about high-energy bills after new meters installations. The company attributed the cause of this issue to inefficient communication about the project in the early stages of the deployment [5]. In Canada, one of the largest cases of Smart Grid communication, British Columbia Hydro, commonly known as BC Hydro, created an opt-out program due to consumer pressure over the installation of the smart meters, after a 1.8 million meters deployment [6]. Furthermore, in some cases, the consumers showed privacy concern about smart meters data collection [7]. Moreover, several social movements against smart meters installation started to arise in some countries. For example, "Stop Smart Meters!" is a group that acts in United Kingdom, United States and Australia [8]. For this reason, the inclusion of consumers in the Smart Grid development process becomes a key strategy for success.

The lessons learned in the international environment influenced the strategies developed by Brazilian utilities. These companies have included in their pilots, initiatives for evaluating consumer perception about Smart Grid. The Brazilian Association of Electricity Distributors (Abradee) conducted a qualitative survey about the value perception of the customer over the Smart Grid concept. The results were the foundation for creating mechanisms for assisting utilities communication with public [9]. Light, responsible for electricity distribution in Rio de Janeiro's region, applied Human-Computer Interaction (HCI) concepts and design approach to develop their CIS tools [10]. Cemig, Minas Gerais utility, evaluated the profile of the consumers participating in their Smart Grid pilot using

qualitative and quantitative surveys [11]. AES Eletropaulo's case is also concerned about consumer's perception. The project strategy proposes the evaluation and improvement of customer relationship through the design of Smart Grid.

ELETROPAULO DIGITAL – SMART GRID PROJECT

Eletropaulo Digital is the main company's initiative on improving their grid into a Smart Grid. The project foresees a Living Lab deployment of Smart Grid functionalities becoming a test-bed for solutions, from Distribution Automation and Advanced Metering Infrastructure to CIS and Distributed Generation.

The Smart Grid pilot is been deployed in Barueri São Paulo, consisting of a 60 thousand smart meters deployment in a metropolitan area with 240 thousand inhabitants, 1.208.232 MWh of energy consumption per year and 304 km of primary electric power distribution network.

The main driver that took the company choose Barueri as the pilot region was the consistent sample that the city represents of AES Eletropaulo's concession area. Besides that, this city is in frequent expansion, has a diverse group of consumers with residential, commercial and industrial customers, with a high-level demand for service quality in a region with severe urban restrictions and critical need for customer care. Moreover, the methodology proposes defining solutions that attend the consumer's needs at the same time it reduces risks of acceptability by the customers.

METHODOLOGY

This paper presents a consumer-centric methodology proposed in the project for evaluating the consumer's perception over Smart Grid and for assisting CIS tools development.

A Consumer-centric Solution Development Approach for Smart Grid

The proposed methodology establishes a strong relation with an international benchmark of CIS solution and the consumer's profile, especially, in their perception over the propensity of using new Smart Grid technologies. The natural need for aligning AES Eletropaulo's strategy with market technology trends, successful Smart Grid cases and consumer's needs motivated the definition of these drivers for the project. Figure 1 presents the consumer-centric approach proposed.



Figure 1. Consumer-centric Approach

The methodology began by performing a solutions benchmark focused on evaluating national and international projects. Then, a list of functionalities results from a critical analysis of the CIS projects evaluated. In this step, we also designed the list of functionalities and the Smart Grid concept in a simple way to facilitate the communication with the consumers in a research survey. Next, we submitted a qualitative study and a quantitative survey to different segments of consumers that reside in Barueri. Based on the results of this survey, we have defined the CIS main functionalities. AES Eletropaulo will still evaluate the specification to validate the company's strategy. Next step will be the development of the prototype that will be the basis for the co-creation process. The consumers will validate the functionalities and usability. In this phase, we expect that the customer experience brings new perspectives over the CIS tools development and assist the improvement of the final solution.

In this paper, we discuss the preliminary results achieved in this project from the application of the proposed methodology. Especially, the survey submitted to the consumers.

Research Survey Methodology

The survey conducted had two phases. In the first, we performed a study that applied exploratory qualitative techniques such as focus groups and in-depth interviews. In the next phase, we performed a quantitative survey. The qualitative survey searched to deepen AES Eletropaulo's knowledge over the consumers' profile, their perception about the use of communication channels and digital devices and energy consumption habits. The objective of this phase was to identify relevant information for attending consumers' demand by customizing the functionalities of the tools and formulating the communication channels.

In the first phase, we performed in-depth interviews with opinion formers (4) and stakeholders from large companies from industrial and commercial segments (19). We also performed 16 discussion groups with residential consumers from different socio-economics classes: A, B, C, D and low income. Non-residential consumers supplied by Low Voltage networks also participated of the discussion groups. Those customers are from commercial,

services and industrial segments. We performed the in-depth interviews and focus groups between February 5th and 18th, 2014.

For the interview and groups, we followed a pre-defined guide to conduct the research. The survey approached the topics: evaluation of energy services, AES Eletropaulo's image, energy consumption habits and management, Smart Grid concept – benefits and disadvantages, introduction and evaluation of the Smart Grid project and list of CIS functionalities, tools assessments and overview of potential benefits.

For the qualitative survey, we prepared a specific material for presenting Smart Grid concepts and the project for the consumers in a didactic approach using images, graphics and text. This strategy intended to mitigate risks of miss comprehension of the presented subjects. This material was fundamental for the survey success. Figure 2 introduces an example of the material, which had the objective of synthetizing Smart Grid concept for consumers.

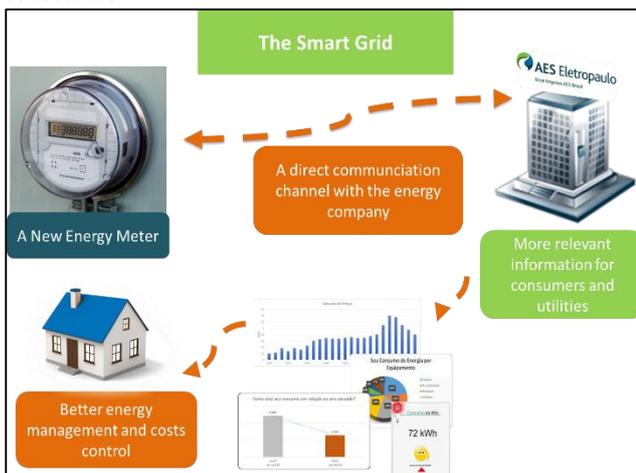


Figure 2. Smart Grid Concept

Next step, we performed the quantitative survey with a sample of 300 residential consumers that resides in Barueri. The data was collected between March 6th and 10th, 2014.

The chosen sample comprehended men (48%) and women (52%), ages from 25 to 65 years with an average of 41-year-old, with a socio-economic classes distribution – A (5%), B (32%), C (53%), D/E (10%), residents of Barueri and responsible for the energy bill.

RESULTS

The results of the surveys demonstrate that the energy consumers see the energy service as essential and have a positive image, especially, when compared with other utilities such as water and telephony. However, they consider distant the relationship with the utility. In addition, we notice that the critical moments in the relationship between utilities and consumers happen in

negative moments: energy fault and bill arrival, which is when the interviewed consumers explained they remember the existence of the energy utility.

In general, consumers considered electricity service invisible and do not see the utilities' activities as pro-active and transparent. This second perception results directly from the complexity of the information displayed in the energy bill, considered by the customers as "hard to understand". It is relevant to evaluate that Brazilian Regulatory Agency, Aneel, regulates a major portion of the information displayed in the bills, so utilities have few options to change this scenario.

As result of questions about energy consumption and management habits, most consumers declare that engage in energy savings and take the measures needed to avoid waste. Nevertheless, we identified that this behaviour is more frequent in classes C and D. This result is reasonable if you evaluate the weight of energy costs in the budget of these socio-economical classes. The same applies to enterprises, once the energy costs affects the financial balance of these entities.

Most of the survey attendants answered that have no knowledge about Smart Grid, even between the opinion formers and large companies' stakeholders. At least 77% of the residential consumers have never had any contact with the subject "Smart Grid", which contrasts with the mass communication announcement about the project performed by AES Eletropaulo. At the same time, the consumers that declare that have some knowledge about Smart Grid were mistaken in their explanation, relating the subject to Internet, broadband and light sensors. Thus, it grows in importance the communication strategy with the consumers, above all, specific and individual communications that guarantee that Smart Grid resonates in a positive way to consumers, in order to avoid communications issues as the ones faced by some projects in Europe and United States.

After we explained both the Smart Grid concept and the project premises, all the interviewed groups responded positively to the subject matter. Figure 3 presents the perception of energy consumers over Smart Grid. We asked them, which of the statements listed they agreed.

They also identified a series of benefits to the energy consumers such as availability of detailed information and transparency. The most emphasized benefit noticed by consumers was the opportunity to control and save energy. The survey also evaluated the consumers' preference of communications channels for receiving new information as well as the relevance of the possible content made available. As a result of this questioning, the consumers responded that receiving information to better control their energy is valuable. Non-residential consumers also highlighted that this is a relevant factor for their business management, mainly functionalities related to bill control and forecast.



Figure 3. Smart Grid Perception

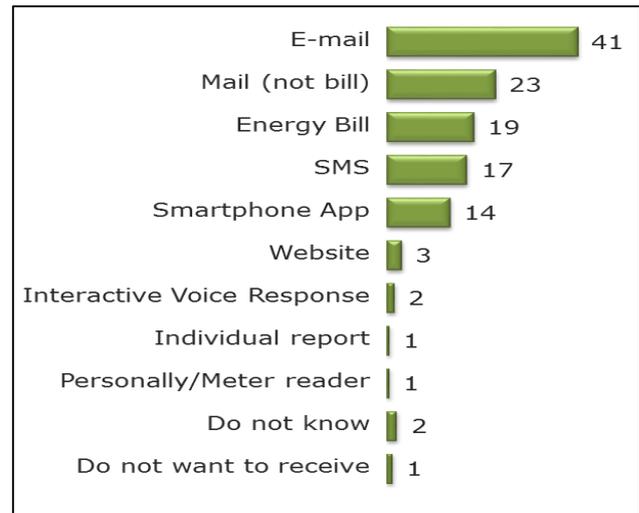


Figure 4. Communication Channel Evaluation

This paper's survey also evaluated the list of functionalities that resulted from the benchmark. This list includes:

- 1) Hourly Energy Consumption ;
- 2) Energy consumption per device;
- 3) ap presenting regions with energy faults;
- 4) Energy consumption alerts with goals setting;
- 5) Bill-to-Date Estimate and Forecast;
- 6) Comparing consumption monthly or yearly;
- 7) Comparing consumption with similar households;
- 8) Comparing average consumption with current month consumption.

The explanation of the list to the different consumers segments resulted in a preference for functionalities that demonstrate pro-activity from de utility such as notifications and alerts. Utilities could use these functionalities as a positive vector to strength the utility-consumer relationship. Additionally, bill control tools had a high acceptance by the surveyed consumers.

For communications channels, the consumers preferred receiving information by e-mail, mail and energy bill. More than half of the interviewed from classes A and B (66%) elected the e-mail as the main channel for accessing information. For other classes, the results demonstrate a more balanced distribution for communication channels. Figure 6 shows the results of communication channels evaluation by consumers. The chart demonstrate that social media and smartphone apps presented low acceptability by consumers. The use of these channels is growing in Brazil, but the average age of the surveyed consumers (41 years old) reflected in the channels preference results.

CONCLUSION

In this paper, we presented a methodology for Smart Grid CIS development with a survey on consumers and Smart Grid. The results shown are part of AES Eletropaulo Smart Grid project being developed in Barueri, SP, Brazil. The methodology proposes a consumer-centric approach for designing CIS tools based in consumers' Smart Grid perception.

The partial results show that consumers have a positive image of energy distribution service. Even with the distant relationship, they have with the distributor. Smart Grid represents an opportunity to strength this relationship by creating new communication channels and a pro-active interaction in positive moments, as opposed to the current situation, utilities only interacting when bill arrives and energy faults.

As a result of the survey, consumers almost have no knowledge about Smart Grid. Therefore, the utilities have to engage in specific and individual communication strategies to manage consumers' expectations and insert them in Smart Grid development to ensure their identification with the new solutions adopted by the utility. Once Smart Grid concept and potential is presented, as we performed in the survey, consumers recognizes the value of Smart Grid as a technological advance for the electricity sector and seems to have intention of participating in more active way. Besides that, consumers demonstrate the ability to acknowledge conscious consumption habits and the benefits of a Smart Grid deployment.

Thus, Smart Grid rules needs to be clear to provide benefits to all stakeholders and ensure the consumers take the role of an active player in this new system with Smart Grid.

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