

TO BE ACTIVE OR NOT TO BE? CUSTOMER'S FEEDBACK AND BEHAVIOUR IN THE FRENCH OVERSEAS TERRITORIES

Sophie BOULY DE
LESDAIN
EDF R&D - France
sophie.bouly-de-lesdain@edf.fr

Caroline DUCHARME
EDF SEI - France
caroline.ducharme@edf.fr

Joseph MAIRE
EDF SEI – France
joseph.maire@edf.fr

Christian DUMBS
EDF SEI – France
christian.dumbs@edf.fr

ABSTRACT

In the aim of exploring new means to enhance the electrical system design and operation in the French island territories, EDF's Island Energy System division (EDF SEI) has decided to initiate various Smart Grid projects, in Corsica and the French overseas departments Martinique, Guadeloupe, Guyana and Reunion Island. The paper describes 2 projects while focusing on sociological analyses of the customer's behaviour with respect to demand control. Customer expectations are outlined and indications are given on how to achieve the customer's active involvement in the enhanced control of energy consumption.

INTRODUCTION

Islands are territories with specific characteristics which make them ideal laboratories to test, evaluate and deploy smart grid components and systems:

- Electrical system stability is more fragile than in interconnected systems and consequently it is more difficult to provide good service quality;
- Electricity generation costs are higher than in large continental networks, driving the development of energy saving mechanisms and creating opportunities for the growth of renewable energies;
- The integration of a significant share of intermittent renewable energies needs special attention not to become a threat to the stability of the electric system.
- Due to the limited size of the systems, regulatory frameworks are generally simplified.
- Last but not least, the energy consumption is generally growing faster than in continental Europe and the social environment is quite sensitive to energy prices.

In Corsica and the French overseas departments electricity supply and distribution fall under the responsibility of EDF's Island Energy Systems Division (EDF SEI).

Within these territories, EDF SEI conducts several smart grid projects, exploring new paradigms in the balance of the system, which is a major concern in island electric systems. The projects also aim at the reduction of the carbon footprint incurred by the current fossil fuel plants used, by allowing more renewable

energy into the grid and, at the same time, aiming to manage electricity consumption.

Technologically speaking, the integration of smart grid technologies is at an early stage in the island electric systems.

The acceptability of smart grid solutions and their deployment to whole territories shall be achieved with the customer's full involvement in order to limit a generally growing demand and its effect on peak loads. Habits take time to be changed, and small tools helping customers to understand and to manage their consumption are essential to succeed.

TWO MAJOR PROJECTS IN THE RESIDENTIAL SECTOR

Within SEI, several smart grid projects are deployed that give an opportunity to apprehend the response of residential end customers towards a more proactive approach.

The Millener project is a consortium project funded by the French government and Europe, gathering 7 industrial partners coordinated by EDF. In contrast to this, Clik'conso is an EDF in-house project aiming to assess the smart meter's potential in SEI's island territories.

Millener is deployed on Corsica, Guadeloupe and Reunion Island. A total of 1000 residential customers are equipped either with solar generators and smart energy storage or with energy gateways. An IT platform enables the distant control of all equipments from EDF's dispatching unit. One of the major goals is to evaluate the customer's response to demand side management and control, in order to find out whether innovative business models and regulations enabling the deployment of these systems are possible at acceptable costs for all stakeholders. In order to assess customer's unbiased interest in the project, the energy gateways are installed in their homes for free. As for the photovoltaic systems, the solar panels have to be financed by the participant, but the storage and all the associated advanced electronics are also supplied and installed by the industrial partners of the project free of charge for the participant.



Photovoltaic panels (left), inverter and battery (right) of a Millener participant in Corsica

Energy gateways are controlled by EDF's local dispatching unit and load-shedding is performed on a daily level. During peak hours heating or air conditioning appliances of the participants are switched off for a short period of time. Such load control is designed not to impact the customer's comfort who'll ideally feel no difference. In counterpart, the participant has online access to a survey terminal displaying his consumption, detailed by usages. The project is based on voluntary participation which has to be kept in mind with respect to the statistical representativeness of the sample.



An energy gateway – Millener project (left) and the local dispatching centre of EDF in Corsica

The Klik'conso project is based on the deployment of smart meters on 1000 households in Martinique, which was achieved at the beginning of 2014. The aim of this project is to evaluate the interest of smart meters in the insular environment. It includes a cost benefit analysis covering the entire energy value chain and is not limited to the sole distribution aspects. Especially, it aims at evaluating possible impacts of smart meters on demand side management and energy efficiency.

This panel of 1000 has been chosen to statistically represent the customers of Martinique Island. They have access to an internet site enabling them to display their consumption of the previous day, or the previous week, or to program alarms with respect to energy spending thresholds, etc. The way customers are using their survey system is monitored and sociological studies are conducted in order to understand the customer's perception of such a tool.

The electrical consumption of the participants will be compared with an equivalent sample of users with standard meters and no access to an electrical consumption survey site. The objective is to assess the effectiveness of the whole setup on people's real

behaviour regarding energy consumption in order to appreciate whether benefits may be expected from the access to information.

FOCUS ON THE SOCIOLOGIC ASPECTS OF OUR SMART GRID PROJECTS

Different means are used within our projects to assess the customer's involvement. This paper focuses on the sociological studies and the demand response tools developed in both projects.

Two experiments based on different customer profiles

Our behavioural studies are based on the Millener and Klik'conso projects, which rely on different customer profiles.

The Millener project calls for voluntary adhesion of the participants, hence their social background is likely not to be entirely representative of the overall population in the islands.

On the contrary, Klik'conso is deployed among a predefined test sample of participants, which have been selected to be representative of the population of Martinique.

Hence the sociologic responses of the customers will be different and both projects will provide complementary results, although not in the same timeframe. This paper mainly presents the results of Millener as it is the more advanced of the 2 projects on this topic.

Millener: participants willing to act on their energy consumption

The participants of Millener equipped with the energy gateways are from a broad variety of social backgrounds: blue collar and office workers, farmers, middle class executives, hotel managers, computer engineers, architects, doctors, dentists, academic workers such as journalists or teachers, and retired persons from different fields.

On the other hand, the participants equipped with photovoltaic storage systems include profiles from the wealthiest of the above social categories, especially with the investment capacity which is necessary for the acquisition of the solar panels. It is important to place the participant's profiles in the social context of the respective islands, where unemployment rates are very high.

The participants equipped with the energy gateways have generally joined Millener for complementary reasons: free adhesion, the attractiveness of a project they see as innovative and in line with the enhancement of global well being on the island, and also to understand their electric consumption. The participants

of the photovoltaic storage part share these motivations, but also join to take advantage of a storage battery for energy autonomy and backup.

The persons enrolled in Millener are generally sensitive to demand side management, especially with current habits such as switching off the lights, decreasing the heating or air conditioning when leaving home, etc. They rely on different sources for their energy needs, electricity of course, but also wood fired heating and gas. However, participants may have a variable number of electric equipments at home, and may adjust their inside temperature to values from 18°C to more than 23°C. Their technological approach varies from “technology addicts” to persons claiming a weak understanding of electric usages.

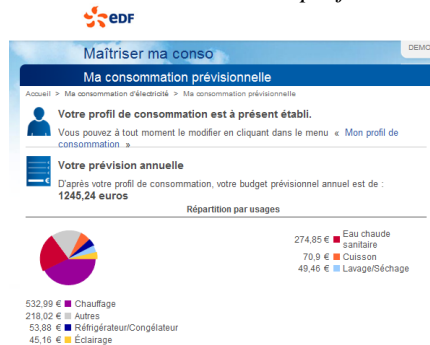
Giving a means of action to the participants: the main role of the web portal

Both Millener and Klik’conso rely on a web portal displaying the consumption data of the participants, allowing them to be active and to know how to improve their energy consumption. On the web portal of the PV storage participants, their photovoltaic production is also displayed, as well as their energy sales to the grid and the state of charge of their battery.

For the present paper we have analyzed first results obtained in Corsica for the energy gateways (remote control of room heaters), and in the Reunion Island for the photovoltaic and storage systems.



Screen capture of the web portal of an energy gateway in Corsica – Millener project



Detailed view of the consumption of a participant equipped with an energy gateway – Millener project

For the participants of the photovoltaic storage part of the Millener project, the display is important and should help them to balance their consumption against solar generation. This balance is particularly critical during longer power cuts when the consumers have to manage the use of limited resources. The system design foresees that under normal operating conditions the end user will not be aware of the operating mode of the system, whereas an alarm function is necessary to indicate the loss of the grid supply: during outages the participant will have to adapt his behaviour and reduce his electrical consumption to essential needs, such as lighting or minimum supply for freezers or fridges. This need was a direct outcome of the project when a hurricane hit Reunion Island early this year.



Screen capture of the web portal of photovoltaic storage system in the Reunion Island – Millener project

Klik’conso also includes a web portal with advanced functionalities with a mobile remote access is available. The first issue is to collect customer’s email addresses. Up to 40% of the emails have been collected during the installation campaign of the smart meters. Around half of these people show a first interest in the online information, but without any particular teasing or incentive, they rapidly cease to use it. Only 10% of the customers log on regularly. The use of the mobile access is marginal. These results are not the final ones but it already shows that this kind of portal is probably not self sufficient. Sociological surveys will bring more understanding about this lack of spontaneous end user interest.



Screen capture of the Klik’conso portal showing the hourly consumption of the customer (Green: night tariff, blue: day tariff)

Without waiting for these results, new services will be tested. The latter will include load curve analyses to produce a customized consumption diagnosis to help the customer to reduce his bill, give him personalized advices to save energy and challenge him to put them into practice, etc.

Measuring the behavioural response: sociologic studies in the frame of Millener

A central part of the Millener project is to assess the willingness of the participants to play an active role in optimizing the energy system of their island, and how to do so. Hence, Millener focuses on behavioural studies of both qualitative and quantitative aspects, on the three islands and on both parts of the experimentation (photovoltaic storage systems and energy gateways).

In total more than a hundred face-to-face interviews of one to two hours duration were conducted at the participants' homes.

In addition to the questions about the web portal, the main themes discussed during the interview were related to the experimentation in itself (the customer's appreciation from the first contact to the installation and operation of the equipments, expectations vs. observations), to a critical analysis of the current form of customer's energy management, and also to the customer's overall comprehension of electricity generation and grid operation in the islands. For the photovoltaic storage project, questions were also asked regarding the financial aspects of the photovoltaic installation (expected ROI), and on self-consumption.

Not all the participants enrolled in Millener have the same level of understanding and the same expectations towards the information given by the web portal; but all share a wish to understand their own energy consumptions.

Among those who consider that the display will have an impact on their consumptions, some believe it will be achieved through a change of habits, whereas others rely on a more passive approach based on technical improvements (for instance the change of their heating mode) or on explicit incentives provided by EDF (for instance an alarm system alerting in case of a faulty equipment). In other words, being an active player in controlling the household's energy consumption takes several forms.

But there are also participants who do not change their behaviour, either because they do not want to modify their level of comfort, or because their financial constraints do not allow them to change, or because they considered having already an optimized consumption level that cannot be diminished. Among the latter type of customers there are sometimes contradictory behaviours when heaters are run at low room

temperature, for instance around 18°C, while at the same time a big number of other electric apparels may add up to a significant overall electric consumption. The limitation of room heating and the respect of some energy saving habits are enough to make them believe their way to consume energy is optimal.

The case of the participants with low incomes highlights the small margin they have to effectively lower their electricity bill. The online information shows them that even though their electricity consumption may be very low, half of their bill will remain unchanged, due to taxes and flat rate fees.

All of this underlines the more general question of the means which would allow individuals to act on their consumptions, in addition of the actually provided information. Consumers generally ask for a more detailed view, separated by each of their main electrical usage and personalized advices and diagnoses. In the latter case, being an active consumer is to delegate the management of potential energy savings to EDF.

As for the remote load control by itself, none of the participants seemed reluctant, which may be explained by the recruitment mode and the fact that all participants volunteered to accept remote control.

At the end of the first load-shedding season, manual refusals of the remote control were only at a 5% rate and were mostly accidental, linked to children or elderly presence, or happening when the load shedding lasted more than 20min. The experimental nature of Millener itself also prevents some participants from refusing the load control, as they fear to degrade the experimentation results.

Millener: analysing customer expectations

Various profiles of participants can be observed.

The expectations of the participants equipped with energy gateways are mainly economic, environmental or technical motivations (using a new energy management tool), or turned towards the improvement of the global island system, such as minimizing network failures.

Surveys conducted on the photovoltaic energy producers on Reunion Island, first territory where these installations have been deployed, highlight four main profiles:

- 1- the income-based profile, which assimilates the installation to a saving tool, although this profile is less important since 2010, when the solar feed-in tariff started to rapidly decrease;
- 2- the self-sufficient profile looking for a maximised energetic independence of his home, which is part of the global political objective of the French island territories to reach electrical autonomy by

2030;

- 3- energy management and active reduction of the electricity bill, where the Millener system is a part of a global approach of energy savings while keeping the same level of comfort;
- 4- the profile seeking for an uninterrupted power supply, where the main purpose of the installation is to guarantee a constant supply of electricity through the inverters, and a security backup from the batteries.

NEXT STEPS AND ELEMENTS OF CONCLUSION

Clik'conso will conduct its sociological studies within the next months, in collaboration with the local universities. It will be particularly interesting to compare the results with those obtained with the sample of self-motivated Millener customers. For the latter, a behavioural survey is currently ongoing. It will give a quantified evaluation of each profile and will enable a detailed comparison between each of the territories.

The central learning of the Millener project is about the diversity of the participants' profiles we observed: various forms of active behaviour have been identified, reaching from those customers being aware of their use of energy in the household and acting consciously to more reactive customers who will expect EDF or technical equipments to provide assistance. For all, information only is barely self-sufficient, and complementary assistance is needed in order to enhance the participant's energy management approach.

Secondly we have seen that not all individuals have room for change: those participants that are economically constrained have generally little possibilities to actively reduce their consumptions that are already pushed to a minimum. Technical improvements through the investment in low-energy appliances are rarely possible due to limited financial resources.

Thirdly, we have noticed that the subjective appreciation of comfort is not easy to influence. Energy savings as a result of lowered heating temperatures are generally accepted when they are the result of a personal choice. For some participants a heating temperature around 18°C may even give a moral comfort because it is in agreement with their environmental belief. However, some customers have a contrary perception of comfort, where high heating temperatures (or low air conditioning temperatures) are a sign of wealth.

This leads us to our fourth point of conclusion: some participants wish to be active consumers without

necessarily answering to economical motivations. In this context we may refer to customers whose driving forces will be civil or environmental considerations, or those who wish to optimize their electrical equipments or to add remote control functions. Specific incentives will have to be developed according to the participant's profiles. They could be included in commercial offers containing smart grid services and for which participants have shown an interest: alerts in case of malfunctioning and overconsumption of an equipment, remote alerts in case of a supply interruption, remote control of one's heating equipment, etc.

Finally, we observed the wish of some customers to enhance their independence from unknown future situations. We are talking here about customer profiles willing to invest in PV-storage solutions and who wish to anticipate upcoming evolutions, let it be of the energy market (increase of electricity prices) or increasing constraints on the electric system leading to more frequent power outages. For those customers, producing their own electricity allows to limit the above risks.

For the electric system, these participants may offer an enhanced flexibility, as the end user's investment will allow acting on both the electricity consumption and generation, with load shedding during peak periods and the use of energy stored in the battery.

In conclusion, all of the participants of Millener are aware of the local dimension of electricity generation, management and consumption. This may be a result of the voluntary participation of end users in the project which selected indeed the most energy conscious inhabitants. To go beyond this restriction and extend the experimented approach to the scale of the whole island, a combined breakthrough in incentives and technologies will be needed.