EDF EVALUATES SMART METERING IN MARTINIQUE: EXPECTATIONS & LOCAL REVIEW

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

Laure CHOSSEGROS
EDF SEI - France
Laure.chossegros@edf.fr

Gilles RONDY
EDF Martinique - France
Gilles.rondy@edf.fr

ABSTRACT

Smart meter installation in small territories can have different outcomes and challenges than the expected results in larger territories. EDF is examining these on some of their overseas territories, to better understand the acceptance of smart metering across island communities.

INTRODUCTION

In 2009, a European directive mandated that member state must rollout at least 80% smart meters before 2020 unless they were able to demonstrate that it makes no economic sense in their local context.

In mainland France, Electricité Réseaux Distribution France, the main DSO, has planned to roll out 35 million smart meters over the next 6 years.

In Corsica and the French overseas territories, EDF Insular Energy System division (EDF IES) is presently evaluating smart metering roll out possibilities.

In the overseas territories, smart meters will bring the same benefits as in France mainland, namely, an end to estimated bills, remote readings, remote intervention, etc.

However, there are 4 main differences:
1. Smart meters life span may be reduced in most of the overseas territories, apart from Corsica, due to the hot and humid weather.
2. The investment cost for the meters installation is higher than in France mainland due to the isolation of the locations.
3. The local lower telecom coverage quality may have some consequences on the communication between some of the smart meters rolled and the utility.
4. Due to the size and the specificity of its territories, EDF IES is a vertically integrated utility, in charge of the supply-demand balance, transmission, distribution and supply activities. The rollout of smart metering will then provide benefits to IES across the different parts of its activity and this seamless situation will facilitate the exploitation of smart meters benefits.

To evaluate the technologies and the benefits of this technology, a smart meter pilot has been launched on Martinique Island mid-2013.

SMART METERING FIELD TEST IN MARTINIQUE: EXPECTATIONS & LOCAL REVIEW

SCOPE OF THE PILOT

More specifically, the main objectives of the pilot are the followings:

• to validate the main functions and services brought by this technology in the specific context;

• to test of customer appetence for energy services ;

• to get a feedback from the field enabling reasonable evaluation of costs and benefits that could be reached in a global roll out

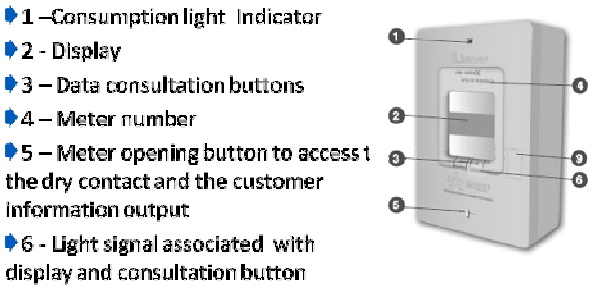
The technical aspects: type of smart meters, telecom infrastructure

For the experimentation, EDF IES has chosen to rely on the same technical solution than ERDF in France (meters and concentrators and PLC technology. The experimentation is hosted by ERDF in mainland France for the supervision of the metering system and the data collection for efficiency, economy and industrial policy reasons.

Characteristics of the smart meter
The main function assured by the new meter are including all the functionalities existing in the actual electronic meter (including memory) to assure the compatibility and the continuity. Its includes the same type of output for metering information for the customer and a dry contact to pilot customer ‘s uses when tariff is changing

The new functions are :
- An integrated breaker enabling customer connection or

disconnection either distant or local (overtake of subscribed power or detection of dangerous overvoltage).
- 4 quadrant metering ability of active and reactive energy either produced or consumed;
- 20 possible indexes enabling elaboration of sophisticated tariffs;
- customer load curve metered with an sampling period that could be modified remotely;
- PLC integrated Modem ;
- enhancement of the customer information interface ;
- customer power quality measurement (power cut and abnormal voltage)



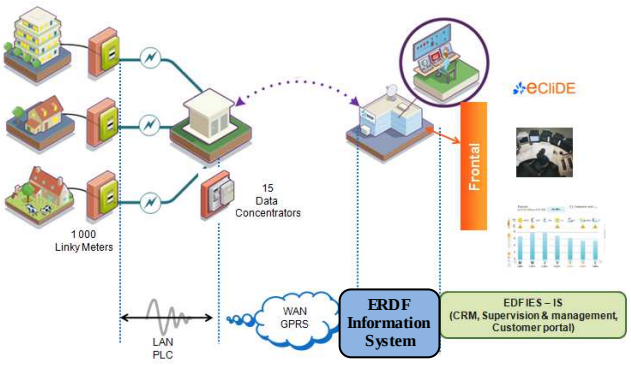
Characteristics of the infrastructure used
As shown in the figure below, a specific portal ("frontal" on the figure) has been developed to collect data from the meters mainly for:

• eFluid (EDF IES CRM application),

• the customer portal,

• mobile application for rollout and maintenance purposes.

Architecture of communication for the Smart Meter experiment in Martinique



(With ERDF Courtesy)

For customers with internet access, a web portal is available giving information on individual consumption. Moreover, 100 home displays have also been distributed for testing purposes.

The organization

Calendar
The field test includes the rollout of 1000 smart meters for small customers (domestic and commercial, with subscripted maximum power below 36 kVA) and is operational for a period of 24 months.

The rollout was divided into 3 steps:

1. Installation of 15 concentrators between May and September 2013

2. The rollout of 70 smart meters during the first days of July 2013 to test the whole system at a reduce scale

3. Finally, the rollout of the others meters from September to the end of December.

Preparation phase
Before the roll out, the preparation phase has enable to:

• train the technicians of EDF IES to install and programme concentrators. The training was provided by ERDF

• train the EDF IES technicians, along with technicians from some private companies to install and programme meters and use the monitoring devices

• supply the equipment

• inform local authorities, clients and employees of EDF IES about the programme, the proposed benefits and ensure participant buy-in.

• build the guidelines of the sociological study led by the local university: the study will be used to analyse and track customer behaviour.

To simplify the process (trainings, return of experience, ...), EDF Martinique decided to rely on a limited number of workers directly involved in the test. It enables EDF to optimise the analysis and to identify the organisational impact in case of a full-scale rollout.

The choice of customers, the devices installed at their home

Customers have been chosen :

- to statistically represent the average energy consumption of the Martinique population ;

- to cover multiple urban and rural conditions and environments ;

- to provide as much as possible, a wide geographical spread without impacting too much on rollout costs while enabling a good technical operation of the system.

Additional Costs of a massive rollout compared with the France mainland

The isolation of islands, the scarcity of local resources, the quality of local communication are parameters that may increase the cost of a complete roll out in comparison with the main land situation.

The local environmental conditions are equally important parameters to take into account in the study of costs because ambient humidity and temperature are likely to reduce meters and concentrators life time span reducing mechanically the amortisation time.

Several ways have been used to evaluate the equipment life span:
- Temperature and humidity cycling test in EDF Lab test facility ;
- Analysis of the field life span of already existing classical electronic meters which are close from smart meters as aging is concerned;
- Humidity and temperature measurement campaign to evaluate more precisely the field environmental working conditions.

THE METHODS USED TO CAPITALIZE EXPERIENCE FROM THIS EXPERIMENT

Functionalities tested

During the test, the functionalities of the metering infrastructure under evaluation are the following :

• Roll out functions: meter and concentrator programming with portable tools, reconciliation process between the concentrator and the ERDF Information system, anomaly treatment ….
• Punctual and cyclic distant meter reading, distant operated interventions such as modification of subscribed power or customer connection or disconnection, ...)
• Billing on real consumption instead of estimated one,
• Free delivery of information to the customer on its own detailed consumptions and the related costs through WEB and mobile WEB portal
• Real time information to the customer on its consumption through distant display;
• Collection and use of alarms issued by the different level of the metering chain;
• Collection and use of alarms on local voltage quality;
• Non Technical Losses detection (during roll out and operation) ;
• Load curve reconstitution at different perimeters to make analysis on network (quality of the power, network unbalance, …) and on electric system (customer habits and uses knowledge, possible available flexibility, ….) ;
• Ability to enhance low voltage distribution network operation.

Key performance indicators

Different type of indicators needs to be collected both during the roll out of concentrators and smart meters and during operation.

During roll out

It is necessary to get information on concentrators and meters deployment naturally to survey how it is going (number of meters and concentrators versus time and category of situation) but also to identify all the difficulties encountered by categories (technical, wrong or incomplete data, meter accessibility, ...) in order to determine the number of meters that would definitively not be installed and the average time needed to replace a classical meter by a new one for the main categories of situation. This has to be done also for concentrators installation.

Behind that, parameters should be collected from the customer side during this period: how many call has been received? What are the efficiencies of the different information media used to prepare the roll out? What is the feedback of the customer on the meter installation? .... It is also important to evaluate the quality of the data available in the information system and to determine whether this is worth improving this quality before. The objective of this data collection to size properly the complete roll out: how long will take?, how much will it cost ?, how many people will be needed ?, etc.... but also to fix the right strategy for the roll out which should be connected to the existing local situation and parameters.

During operation

During operation, all the cost should be followed in order to quantify added and suppressed operational costs.

First added cost is naturally associated with the telecom link which has its own operational cost either external (use of the GPRS network by the concentrator) or internal (management cost of PLC communication). More generally the maintenance and the supervision of the whole metering infrastructure (devices, communication, information system) is increasing the costs and should be monitored.

Introducing new devices may have consequences on the reliability. The number of meter and concentrator failure and the time needed to resolve the problem should be collected and compare to the actual situation.

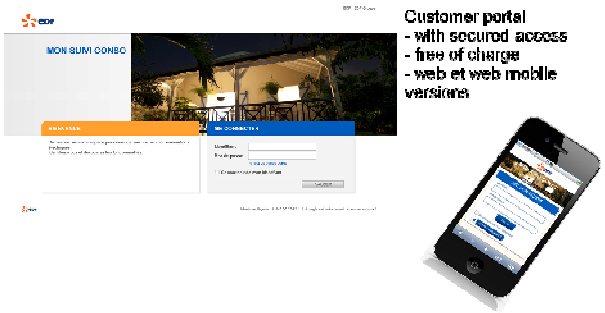
On the other hand, many field interventions are no longer necessary which is cutting costs. The number of such suppressed interventions should be monitored. Naturally the reading of the remaining old meters cost per unit will

increase and it should be appreciated to evaluate the global economy.

Simultaneously, the calls coming from the customers are supposed to be reduced because they are mostly related to estimated bills. This calls should be followed and classified to see if smart meters are effectively producing an effect as expected. Same approach is applied for mail and email.

The possibility to interrupt remotely the delivery of electricity is also helping to recover more rapidly the unpaid bills. Comparison should be made with usual situation in order to evaluate the magnitude of the benefit in that field.
Non technical losses are also a source of potential benefits brought by the new meters. Part of this benefit is collected when preparing the roll out and during the roll out itself. The amount of these recovered losses should be followed. When the system is running, the detection of such losses may need some efforts such as installing a meter close from the concentrator in order to compare the load curve of the distribution substation with the sum of the load curves of all the meters situated downstream.

As a web portal is proposed to consumers and its is also important to collect information on the number of web addresses collected, number of calls on this subject, etc… and to evaluate whether or not, the meter is helping to decrease the customer consumption, meaning energy saving and lower bill.



THE MAIN RESULTS OF THE EXPERIMENT

The pilot has already shown that the solution selected is performing well, that preparation was a very important step in the case of the rollout, but some technical points have to be dealt with, such as the effect of tropical environment on the life duration of meters.

Life span studies of smart meters

IES mandated the R&D teams of EDF to make aging tests on the Linky smart meters. Those tests will assess the ability of the equipment to withstand the environmental conditions of each territory and assess the life expectancy of those materials. Those tests were made on concentrators, single and three phase smart meters coming from different manufacturers. Results show that :
• the withstand capability differs from a manufacturer to an another ;
• life expectancy in the Caribbean climat will be over 9 years, the most sensitive material of the meters being generally the screen (except for one provider) but is likely to be less than the 20 years expected in France mainland ; the power supply (mainly the condensator are the next weak point).
• there is a progressive derive of the power of the CPL signal while the meters ages ;
• during the test, metrology is stable
Those results show that EDF IES can install smart meters without exception but with a shorter life span than may handicap the return on investment of the total project. Some discussions are going on with the fabricants to see how to make the meters more robust without burdening costs. The result on the ongoing temperature and measurement campaign will also bring information for the roll out strategy in that field.

The technical feasibility of a smart meters rollout: quality of communication, and operating procedures

The first feedback shows:

• there were no technical difficulties in the installation and operation of the smart meters and concentrators, probably largely due to the fact of being largely hosted in ERDF information system and having received the ERDF formations and advices ;

• there is a need to master the PLC technology with trainings sessions before the rollout; more generally, the performance of the total communication chain is slightly lower than in France mainland but should not be considered as a fatality ;

• the efficiency of remote interventions ;

• there are improvement to be made on the actual local vision of the supervision and work is on going on that field in coordination with ERDF.

The level of customers and local authority interest and the impact on professional skills and work forces training needs

Thank to the contribution of local sociologist from Université Antille Guyane, there is a lot of information collected on the customer perception of this system in Martinique island :

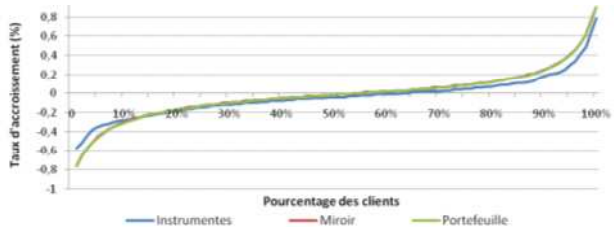
• Customers are interested in receiving bills based on real indexes

• Without any specific incentive, there is limited interest from consumers for registering and using the web portal. (only 25% of the clients with internet connectivity have connected to the portal).
To go further, some stimulation of the customer will be tested like complementary information given through a dedicated diagnostic send to some customers, or possible effect of a real display. Analysis will be conducted with sociologists from the local university (UAG);

Comparison of customer behavior between the smartmetered group and a mirror group

To evaluate the possible effect of smart meter on consumption, several comparisons have been made :
- on consumption of the residential customer group equipped with smart meters before and after deployment of the meters (710 residential customers on a total of 950 active meters)
- on the consumption of this group with the one of a mirror group of customers (35 258 customers) having the same statically representative characteristics.

The results are on the curves below showing the repartition of customer depending on the relative level of their increase of consumption between a period before deployment of smartmeters and after. The blue curve is the curve representing the group of customers equipped with smart meters. The red one is the one of the mirror group that is almost exactly the one in green representing the whole residential Martinique residential customers.



Around 53% of the customer of the mirror group or the whole population of residential customers did reduce their consumptions after july 2013. On the smart group this figure is higher (62%) but those who increase their consumption did it less than those of the mirror group.
During this period of time, all the residential customers reduce their average consumption but apparently slightly less (-1,87%) than those of the smart meter group. This result is going in the right direction, but one should use it with care due to possible bias due the geographical position of the equipped customers grouped in the west part of the island.

Conclusion

The average generation costs on the islands are three-times higher than on the mainland but, by French law, prices are set for these territories, in order to allow for all customers in these islands to pay the same price for electricity.

The difference existing between the buying price and the selling cost of energy is compensated by a tax paid by all the French electricity consumers. To limit this compensation, EDF IES is very involved in energy consumption savings and peak load shaving.

Smart meters and the associated web portal will bring up-to-date information on consumption that could help the customers to make substantial energy savings thanks to new services and advices. The experiment aims at giving objective assessments to qualify smart metering potential in terms of energy efficiency. In a first step, promotion of the portal has been done during the rollout period. A more active period is presently being studied for the second part of the test. This will concern a limited number of customers and will test new way to get a more active engagement.

As a conclusion, the smart meter is certainly a major issue also for islands but one should consider that the benefit of such an infrastructure is to be taken for granted and will need deep evolution and commitment to become real, meaning also a strong modernisation of the distribution and commercialisation business.