DEMAND SIDE MANAGEMENT IN THE FRENCH ISLANDS?

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ABSTRACT

Looking for a response to the challenges faced by its electric systems, the Island Energy System division of EDF (EDF SEI) decided to develop Smart Grids programs in its territories Corse and French overseas departments. The paper focuses on the Demand Response programs, based on large customers and residential ones.

INTRODUCTION

In the French islands, the lack of interconnection of the electric grid with a larger one, increases the risk of failure during peak periods. In case of a conventional power plant outage, the island has to compensate the loss of power available by the other electric productions, and demand could outpace supply if the outage happens at peak periods.

To avoid new additional power plants that would only be needed for relatively few hours during the year, EDF SEI has launched a Demand Response program that expects to provide a responsible and cheaper way to respond to these spikes of demand.

DEMAND RESPONSE PROGRAMS: AN OPPORTUNITY FOR THE INSULAR ELECTRIC GRIDS

In the french Islands, at peak periods, marginal costs of electricity generation can be seven-times higher than the regulated selling price (see fig 1). Due to this important difference, french islands benefit from financial compensation of the *Regulatory Commission of Energy*, an independent administrative body in charge of regulating the French electricity and gas markets.

Nevertheless, EDF SEI is aiming to keep this regulated compensation (and paid by mainland customers) as low as possible and therefore works hard to lower its costs of production and to promote energy savings. Shifting demand away from the peak periods could also be financially attractive for the general interest. In order to avoid important peaks in the electricity demand, the historical way to shift consumption was to build time-of-use tariffs based on statistical estimations of the future marginal costs. It is necessary to go further.

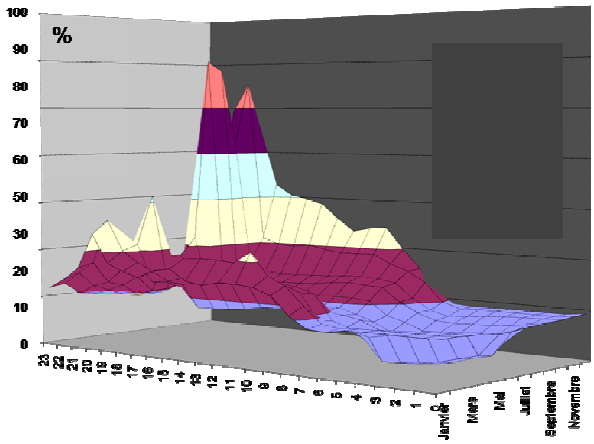


Figure 1 : previsional long-term (2020) marginal costs of electricity generation in a French island. Prices soar a hundred of hours in the year.

At a time when technologies are ready for Automatic Demand Response, EDF SEI has started two new programs that expect to shift load when really needed:

Program 1: curtailment energy commitments, a hundred of hours by year, with reduced delay of activation (up to one hour). If customers are flexible and reliable, the capacity could bring benefits close to the one of a real power plant. This Demand Response program is tested in the *Sigma* project, implemented on a tens of large customers for around 5 years now in *Martinique*, *Corse*, and *l'île de la Réunion* and evolved last year in *Martinique* with a new technology.

Program 2: automatic-load-shedding in residential houses. This Demand Response program is tested with the demonstrator called *Millener* implemented this year in *Corse, L'île de la Réunion and Guadeloupe* on a thousand of residential customers. The *Millener* project is being offered to residential customers with Demand Side Management devices and small energy storage systems to integrate rooftop solar.

This project is funded by the European Union, local institutions (The Regional Councils of Corsica, Guadeloupe and La Réunion) and the French State. The project partners are EDELIA, BPL Global, Delta Dore, Tenesol, Sunzil, Schneider Electric, SAFT and EDF as project coordinator.

DEMAND RESPONSE RESOURCES

Sigma and *Millener* are expected to build a remote-controlled capacity of power.
Sigma enrolls Commercial and Industrial customers with on-site generation, interruptible or deferred process (like cold storage) whereas *Millener* enrolls residential customers with air-conditioning or heating installations.

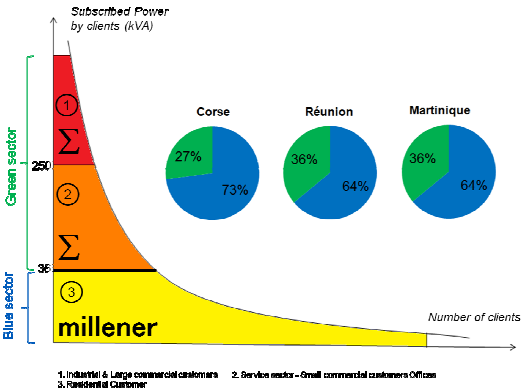


Figure 2 : Energy consumption vs subscribed power

Commercial & industrial resource for the *Sigma* project

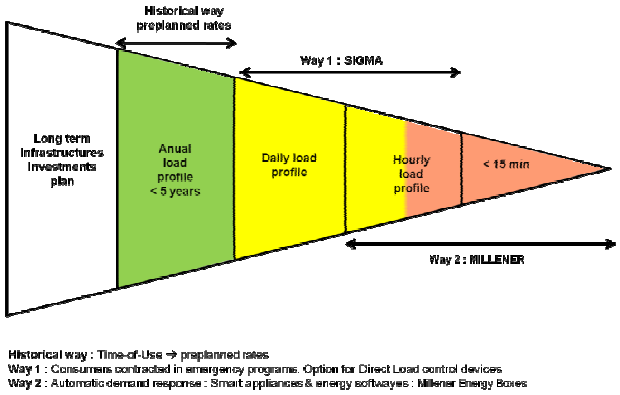
The green zone of the pie charts above represents Commercial and Industrial client's consumption. It concerns less than 1% of the Island Customers but a significant energy consumption, which makes this Demand Response Resource very attractive. The *Sigma* project was set up to take advantage of this resource expected to be cost effective in the short-term and requiring less time to build than a power plant.
Yet, part of those customers already consumes little energy during evening peak hours thanks to existing time of use tariffs. Nevertheless, today, a ten of the largest customers in the 3 islands have contracted to the project and receive the demand response events by fax. La *Martinique* wanted to increase the Demand Response resource for the project and decided in 2011 to develop an automatic technological chain to control it.
For clients with on site generation, the project has shown that the resource is technically accessible. For commercial & industrial customers with interruptible consumption, the resource may be technically more difficult to reach. Those clients are few and automation process may be expensive for them, as it would require a high level of technical expertise. *Sigma* targets a remote-controlled capacity for *La Martinique*, deployed in 5 years, and sufficient to postpone the investment in a new gas turbine or equivalent.

Residential Resource for the *Millener* project

The blue zone of the pie charts represents residential client's consumption. The individual consumptions represent little energy but the whole aggregated consumption represents a large resource for Demand Response, mostly during the evening peak period.

The *Millener* demonstrator will test automated-remote control of inertial energy use in residential clients' houses. Demand Response events will be sent, for supply-demand balances adjustments expecting a load response within 10 minutes. Some of the smart devices installed in the houses will also respond automatically to frequency deviation, with an expected load response within 5 seconds. By mid-2013, 500 residential houses will also be equipped with Li-ion batteries (6 kWh or 8 kWh) connected to roof-top PV (3 kWc) that will complete the demand response capability of the system.

Technical solutions to get access to the resource



Historical way : Time-of-Use → preplanned rates
Way 1 : Consumers contracted in emergency programs. Option for Direct Load control devices
Way 2 : Automatic demand response : Smart appliances & energy softwayes : Millener Energy Boxes

Sigma

For the *Sigma* project, Netseenergy, a subsidiary firm of EDF, developed a software platform used by the network operating Center to automatically send requests of load reduction (up to one hour before the event), choose where the load reduction should take place (congestion management), and get information on the load effectively shaded (real time response and historical analysis).

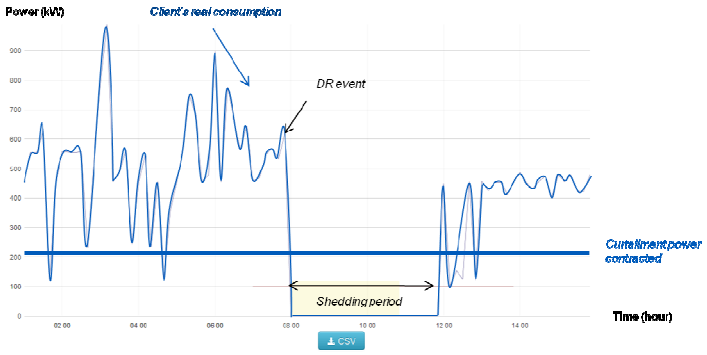


Figure 4: Client's consumption for a 4 hour Demand Response event sent by the Control Center

The software platform also gives the customer a view on the load really curtailed, a vision on the past events and a mean to follow the payback earned for that. He can naturally use the platform to declare his unavailability for load shedding. A remote-control option has been developed and tested at the end of last year to automatically disconnect clients with backup generators. In that case, it is really important to test the complete technological chain before starting to offer the option to customers.

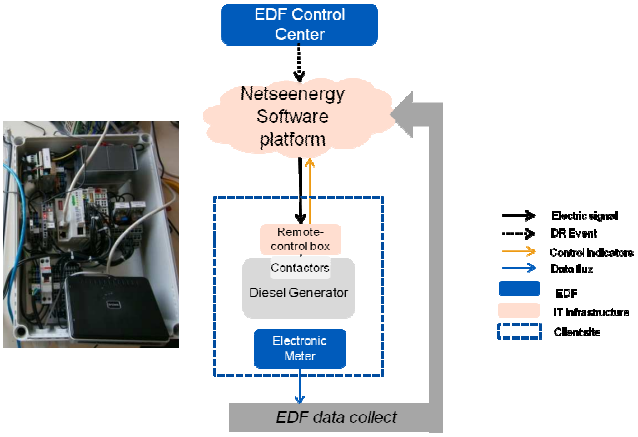


Figure 5: *Sigma* remote-control box for an automatic shedding process

Millener

About 200 energy gateways have been installed since the end of 2012, and they expect 1000 installations by the end of 2013. Connected with the network operating centre, these boxes are monitoring and controlling client's appliances (electric heaters, air conditioning units, water heaters…) to help to maintain balance of the network (frequency, power at period of peak demand...).

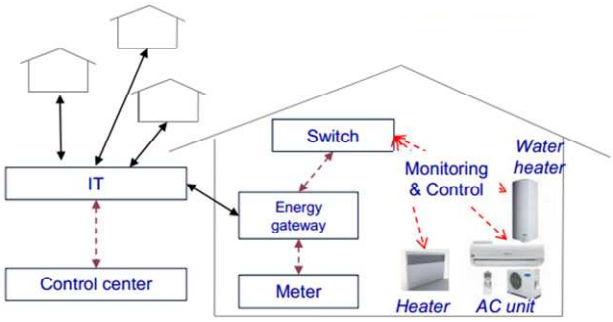


Figure 6: Millener energy gateway configuration

Simultaneously, information is delivered to the customer about its consumption in order to raise his awareness on energy savings.
Among them, 500 clients are equipped also with a photovoltaic system and a storage battery that will contribute to the regulation (shape the electricity produced by the PV panels, contribute in maintaining the balance of the network (frequency, power at period of peak demand…) and enable the client both to consume mainly its own electricity and have access to energy during a cut-off and grid outage).
Today, some customers are ready to experiment the solution, but the whole system should be tested before. Tests are presently going on in EDF labs at *les Renardières* (France).

The poor application of modern standards in the existing client's electric configuration has made the first installations more complex than predicted and some voluntary clients had to be refused for this reason.

The project contributes to assess possible long-term solutions for Demand Response and will help to assess clients' acceptation of the device. Residential clients are really careful about their comfort and may not appreciate easily the shedding.

Savings expected with Millener by individual reductions in electricity demand are not expected to cover the cost of the monitoring technology.
Though, the cost-benefit analysis may evolve if using Smart Meters, plug&play devices or the Internet boxes of the clients.

CLIENT'S ACCEPTABILITY OF DEMAND RESPONSE

Commercial & industrial customers

Commercial & industrial customers are very sensitive to the following arguments:

1) Financial: commercial & industrial customers ask for variable incentives at least equal to their shifting operating costs. For example, if the client has to use its backup generator, he will ask for a variable incentive that will cover the generator maintenance and its fuel costs, which are 200€/MWh higher than the operating costs of peaking generation plants. Yet, the investment costs are very small in comparison with the one needed to construct a new power plant. The knowledge of the exact reliability of the resource will then be necessary to assess to justify long-term contracts with high variable retributions. This is an important objective of the project.

2) Responsibility and privacy: Electricity is a major part of the business for this type of customers and they do not let anyone except their operator modify and control their installation. However, they appreciate to receive incentives if they install smart devices to shift their consumption.
3) Environmentally: diesel generators, even if more efficient than Gas or Coal Turbine (40% against 30%) are not CO2 free generators.

Residential clients

The first customer feedbacks that we have from Corsican sociologic studies show that the project and its interests are very well understood. However the motivations and sociotechnical profiles of the customers can be very diverse. Thus we already can distinguish 5 different customer profiles:

1/ "virtuous" customers, who think they already optimized their practices in term of energy consumption. If they get involved in the project it is mostly because of their interest in the benefits for the community (improvements of the quality of supply on the island and participation in the protection of the environment by the fall of the CO2 emissions), and approve their way of life. For them, energy consumption has a moral dimension.

2/ "sparing" customers, these customers are very financially constrained. They have already practices optimized in term of consumption, but are really interested in the follow-up of consumption to alert them on a possible skid related to a dysfunction of an electrical appliance in their housing.

3/ "comfort" customers do not wish to force themselves economically on the energy expenses. If they take part in the project it is because they consider that some economies can be made without too many constraints.

4/ "altruistic" customers take part in *Millener* to help the network, the Corsica community and the village in which their family reside.

5/ "opportunist" customers are implied in the project because they do not see much disadvantages, but on the other hand consider that it is an excellent opportunity for them since it is free. They see the smart grid system like a new tool in their daily management.

This first phase already brings return of experience:

- The issue of finding voluntary clients should not be underestimated ; deployment potential is limited by several aspects including the technical ones ;
- Customers understand the interest of such a project and they agree to be involved if there are interests without too many constraints ;
- Clients are generally suspicious when contracting for experimentation. The conditions of its end have to be clearly defined before contracting.
- Due to regulation rules, solutions should be found to incentivize clients without using tariffs ;
- The experimentation is bringing useful exchanges between manufacturers and utility in order to propose interoperable solutions fitted to the field potential needs.

It is major to take into account local habits and the recruitment phase is bringing a lot of information especially on how to approach our clients depending on cultural particularities (awareness for environmental questions, attractiveness for new technologies ...).

CONCLUSION

The undergoing transformation process for EDF SEI in order to integrate Smart Grid technologies has already started. Not only processes and IT systems have to be flexible to integrate Smart Grid technologies, but also customer service shall be put at the core of the operational strategy, which is what EDF SEI aims to do.

At present, our customers want reliable power and accurate billing from EDF SEI, but tomorrow they will ask for more, in particular they will want EDF SEI to be able to understand their consumption habits and to propose more services and products to enable them to manage their energy needs in a cost effective and environment friendly manner.

This transformation won't happen overnight and will require time and money as it will imply from EDF SEI an important investment to build deeper customer relationship with new services in order to give to our customer choices, to get them involve and be sure of their trust in EDF SEI services.