#9 Spotlight on clients' peak shaving flexibilities in the Demo6

Type of solution
• Equipment / Hardware / Firmware • Information system • Process
Work Stream considered
• Active Demand • LV Innovation
Location / Topology (with regards to distribution grid)
• HV/MV Substation • MV • MV/LV SS • LV • Meter • Downstream meter
Thematic(s)
Active demand / DSM
Use Case(s)
• Peak demand reduction • Encourage resident to adopt smarter habits according to network state
Key figures
• 220 residential clients • 12 commercial clients • 1 municipality

Table- 15 – Technical table of clients' peak shaving flexibilities in the Demo6

Introduction

This document aims at describing **flexibilities** located at customer (residential and industrial) premises in order to reduce the peak demand in winter between 6:00 and 8:00 PM. Such flexibilities are managed by two **aggregators** (provided by EDF), in order to respond to grid operator requests

Objective and technical requirements

Context

The idea of Demo6 was born in 2010 from the energy context in the *Provence-Alpes-Côte d'Azur (PACA)* region in France, and in particular in the *département of Alpes Maritimes* and its capital-Nice. On the one hand, *PACA*'s Mediterranean coast is powered by a single bulk transmission line (400 kV)[6], which supports power demands with a peak between 6:00 and 8:00 PM that has been steadily growing over the years. Since the city of Nice is located at the end of this line, it is structurally fragile in terms of its electricity supply, especially at peak hours. Studies carried out by RTE have shown that 60% of the impact of a load reduction at a primary substation in Le Broc-Carros, near Nice, was passed on to the bulk transmission line through which transit the largest volumes of current in the *PACA* region. **One of the aims of Demo6 was therefore to investigate the power reduction at the Le Broc-Carros primary substation between 6:00 and 8:00 PM, and also to investigate the islanding mode operation of part of the network during a given period.**

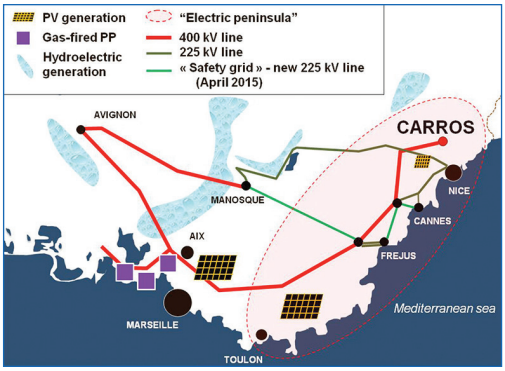


Figure 104 - PACA energetic context

6. Although a "safety grid" was commissioned in April 2015 (*see Figure 1*)

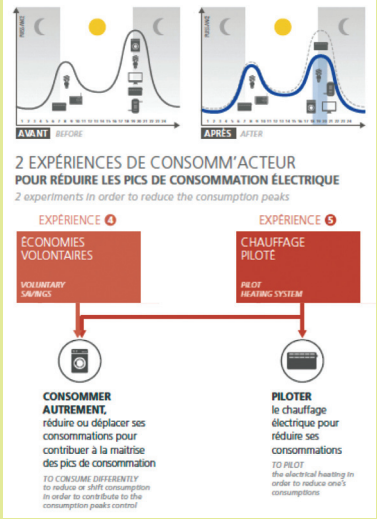
Residential offers

In the context of Demo6, two experimental solutions were offered by EDF to volunteering residential customers:

• Behavioral Load Management (BLM): In the winters 2014 and 2015, households who significantly decreased their power consumption between 6:00 and 8:00 PM (during 20 peak demand days) received gift-vouchers in reward for their efforts.

• Electric Heating Control (EHC) via the Linky smart meter, designed to switch off or cut down the heating system for a short time during peak periods without impacting the participant's comfort.

Participants also benefited from customised hourly tracking of their electricity consumption.



Industrial offers

The following solutions were offered by EDF to participating businesses and local authorities:

- **Controlled Load Management** offer via remote control of their energy uses (heating, HVAC, domestic hot water, etc.) and/or processes (steam ovens, refrigeration units, furnaces, etc.), together with remote consumption tracking.
- **Behavioral Load Management** offer controlled manually following load management requests.

Quarterly meetings of participants were held in the context of a dedicated users club for discussions on the trial progress and sharing of best practices.

Regulated public lighting

With support from the Nice Côte d'Azur metropolitan authority, **smart meters** and light dimmers were installed in Carros to reduce power to the public lighting upon load management requests.

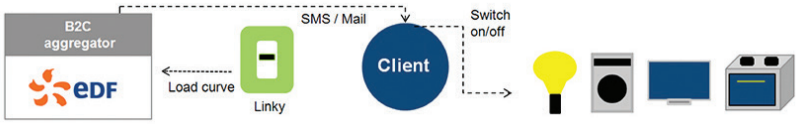
Development and implementation

Architecture

- **Residential customers**

Behavioural Load Management (BPM)

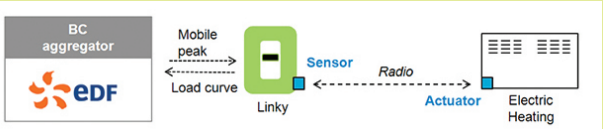
EDF sends alerts the previous day via text and/or e-mail messages and a Mobile Peak to the Linky Information System. EDF analyses the load curve to calculate the incentive.



Electric Heating Control (EHC)

Experimenters who signed a "Electric Heating Control" contract agreed to have their electric heating system controlled automatically by EDF Commerce (via EDELIA and Linky IT systems).

The system is controlled via a "mobile peak signal" sent via the experimenter's Linky meter; the signal is detected by a dedicated device installed in the home, leading to the cutoff or load management of the heater (switch over to "Eco" mode for convectors equipped with pilot wire regulators).



Consumers who signed a "**Smart Solar Equipment (SSE)"** contract were also engaged to load shedding. This offer includes the generation of solar PV power via panels installed on the roof and energy storage in a battery. The principle of this offer is identical to the ***Electric Heating Control*** offer, except that a participant equipped with a battery can use the stored energy during peak periods. The controlling system thus involves storing electricity in the battery during Off-Peak Hours (lower tariff) and discharging the battery during Peak Hours between 6:00 and 8:00 PM on winter peak days, for optimised billing rates. *More information in spotlight S1.*

- **Industrial customers**

Load management requests are sent from the **NEM (Network Energy Manager)** to the **B2B aggregation platform** for mutual negotiation on the load-shedding capacities. Instructions are then transmitted either to the GIS central unit controlling the **Optilesteurs** which interfaces with the various **Optilesteurs** or CKS optimizers installed in the field, or to the Prosumer platform developed by Schneider, or to the Ercogener module. The data from the **B2B aggregation platform** are concurrently transmitted to the TCC platform (Tele-Tracking of Load Curve), a service provided to the experimental users to visualise their load shedding results. The TCC platform is equipped with the necessary mechanisms to read the site's power distribution meters and display the readings to the customer.

Upon instruction from the GIS unit, the remote-control devices in the field shut down or reduce the power of the equipment subjected to the load management request. These equipment units are listed below in this document for each of the sites.

At some sites, the load management was done manually or via **the Linky meter** and voltage regulators (Public Lighting).

Architecture with "CKS" optimizers installed in the field :

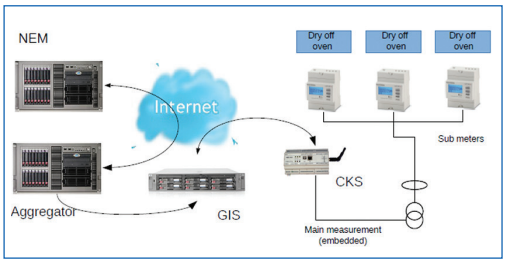


Figure 105 – Control load management for companies

- **Public lighting**

An interface connected to the **Linky smart meter** was used to control a public lighting system.

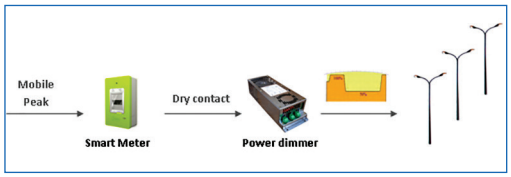


Figure 106 – Public lightning control

Deployment

Residential customers

The recruitment of experimental users and the equipment roll-out took place in several waves, in line in particular with the roll-out of **Linky smart meters** in Carros. The first wave of recruitments for "**Electric Heating Control**" and "**Behavioral Load Management**" participants started in September 2013 for a first experimental season in winter 2013-2014.

	Oral agreements			Contracts			Active participants		
	C1	C2	**T**	C1	C2	**T**	C1	C2	**T**
EHC	32	17	**49**	29	11	**40**	16	18	**34**
BLM	110	110	**220**	101	76	**177**	100	76	**100**

With:
C1: Recruitment Campaign 1 (September/October 2013)
C2: Recruitment Campaign 2 (September/October 2014)
T: Total recruitments over the two campaigns

Figure 107 - Final recruitment figures

13% of eligible households agreed to participate in the Demo6 project. The recruitment rate was 11% for the ***Behavioral Load Management*** offer and 2.4% for the ***Electric Heating Control*** offer.

Industrial customers

12 businesses and one local public administration participated in the Demo6.

- **9** of them received a "**Controlled Load Management**" offer: implementation of a remotely controlled use solution, consumption tracking (TCC) and organization of a Nice Grid "Players Club".
- **4** businesses subscribed to the "**Behavioral Load Management**" offer: load management manually controlled by the participant following requests, and participation in the Nice Grid "Players Club".

The engagement of businesses was high: 100% of the businesses approached (with a power contract above 200kW and sheddable potential from 6:00 to 8:00 PM), agreed to participate.

Overall across the entire B2B segment, (industrial, commercial and public services), 50% of the eligible potential pool agreed to participate.

Technical results

Results achieved for residential customers[7]

220 volunteer households participated in the experimental trial in Carros during the winters 2014 and 2015. On peak demand days, they reduced their power consumption by **21%** on average[8], between 6:00 and 8:00 PM. 77% modified their consumption behaviour in winter 2013/2014, versus 60% in winter 2014/2015. The graph below shows the average consumption of participants on a peak day and on a standard day (results from winter 2013/2014):

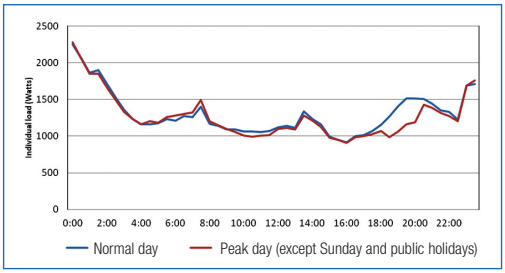


Figure 108 - Average consumption of participants on a peak day and on a standard day (results from winter 2013/2014)

The sum of the various individual contributions is thermo-sensitive.

The mean value of individual contributions was 40kW in winter 2013/2014 versus 25kW in winter 2014/2015 (average outdoor temperature 10.3 °C).

Home appliances mostly affected by load shedding during demand peaks involved dishwashers and washing machines, and to a lesser extent cooking appliances frequently used during these time slots. Some households also focused on low-power uses such as mobile phone charging, or even aquarium power supply. Uses of entertainment devices (TV, computer, hifi, etc.) were less likely to be postponed or reduced.

In winter 2013/2014, nearly half of the households (47%) **combined all three "gestures": reduce the use of the most power-intensive appliances, postpone their energy use and act on the heating system.**

Participating households show a positive outlook on the experiment: in their view, it provides for enhanced energy management on a local level. **The challenge of energy demand management during winter peak periods was well perceived.** For the laod shedding offers to residential customers, the "good citizen" attitude was valued as much as (if not more than) the financial reward offered in the form of incentive vouchers. However, adapting practices does not necessarily lead to any real impact on the energy bill. The **Load Management Bonus** (€20 to €40 depending on offers and efforts) paid as an incentive to encourage participants to reduce or postpone their power consumption during peak days was actually found to be higher than the estimated value of energy savings.

Results achieved for business customers

12 businesses participated in Demo6. Companies located in Carros were highly mobilised: all of the businesses approached with subscribed power above 250kW (and load-shedding potential between the hours of 6:00 and 8:00 PM) participated in the trial. Over the BtoB segment (industry, private and public commercial sector), they accounted for 50% of the eligible potential.

The sum total of business contributions reached 301kW on average, ranging from 184 to 483kW per session, i.e. equivalent to a relative demand reduction of 3% to 9%. Differences between sessions may be explained by waivers linked to the customer's activity (some days are "eligible" for laod management while other days are not), potential malfunctions of the controlling devices or consumption variability of the controlled appliances.

7. Results from Memo 1-34.2 Final evaluation of demonstrator

8. Results obtained from an analysis of the load curves of 180 participants

Nevertheless, it was possible to simulate the maximum sheddable power on colder days by cumulating the best results obtained in the trials for each site. These test results yielded a maximum load-shedding potential of 1.2 MW.

The main motivations for businesses to participate were largely based on the issue of security of the electrical grid in the *PACA* region (regarded as an "electric peninsula"), and fears of a black-out that would have considerable impacts on the local industrial fabric. In their views, Demo6 is a legitimate initiative in the context of a responsible and good corporate citizen approach.

Participation in Demo6 is also regarded as an opportunity to investigate issues of energy management and to prepare for any potential problems of energy supply, by identifying in advance the useful drivers along with technical and organisational solutions to be implemented.

Apart from the demand management, the businesses derived a number of positive benefits from participating in Demo6 in particular their membership in a network of companies with shared values, improved understanding of their energy consumption and the operation of their processes, and closer links with EDF. Participation in the demonstrator project was directly leveraged in terms of external marketing communication, in particular with environmentally aware customers thanks to the use of the logo "*Engaged in Nice Grid*".

The principle of demand side management is seen as legitimate and accepted all the more if the process is occasional and limited. However the businesses are expecting financial incentives to take things further.

Results achieved for local authorities

During the trial on variable public lighting, the Nice Côte d'Azur metropolitan authority managed to reduce its average power by 18 kW on eight streets, i.e. a reduction of around 30%.

Split of consumption decreases in winter 2014/2015

- 52% → Demand reduction from 11 businesses
- 5% → Demand reduction from residential customers
- 43% → 2 grid storage systems (1MW and 33kW) providing for power by discharge.

Even though residential participants were highly engaged, with a 21% average demand reduction, their contribution in terms of power was low as compared with the contribution from businesses and batteries placed on the grid.

An extrapolation of these results to 1,400 household in the town of Carros, i.e. 1/3 of all households (assuming they are eligible for the offered solutions) would yield a load-shedding potential of 200kW, comparable to the potentials obtained with grid batteries and tertiary flexibilities.

In addition, a winter with colder weather would likely result in a higher demand reduction potential.

Conclusion and key messages

Good understanding of the challenges of the Energy Transition by consumers

- Residential customers are aware of the challenges related to energy transition, but prefer to become **engaged in behavioural solutions that are less costly**, rather than being forced to invest in solutions or equipment downstream of their meters.
- Once household objects become "connected" (large appliances, heating, etc.), this will facilitate the response of residential customers to behavioural-type load management requests. Participants (residential and businesses) need and request networked coordination for exchanges and sharing of best practices.
- A dynamic policy of regional development and awareness to energy issues is a genuinely positive factor to engage consumers.
- Communications via connected appliances are preferable to adding new devices (plug-in type) downstream of the meter, which are costly and require human intervention for installation and maintenance.
- Businesses have a major role to play in the energy transition; not only do they get actively involved but they are also engaged via their own CSR policy to disseminate key messages and best practices to their employees.Business may also get involved in behavioural solutions which they can control when prompted by load management requests.
- Participants do not have any real knowledge of the value of their actions should these be evaluated on a market, but their estimation is much higher than the real value.
- Targeted and coordinated recruitment initiatives, based on relationships of trust with the supplier, are essential aspects to drive the engagement of businesses.

Flexible electrical appliances

"Connected" electric heating systems (storage heaters, heat pumps) or dual-energy heaters (electricity plus wood or fossil fuel) can be controlled remotely to reduce power consumption peaks and mitigate the need for high-carbon peak generation facilities.

In the future, these increasingly connected electrical uses and appliances combined with related technologies will be able to adapt to intermittent power generation and therefore to support the feed-in of renewable energies into the grid. Among these, the uses linked to home heating and hot water heaters account for the most efficient and actionable electricity control potential, while other more diffuse uses account for lower and more uncertain volumes.

Other lessons learned from the experiment:

- Flexible electricity uses support and will continue to support the development of renewable energy sources, whether local or on the grid.
- Such solutions are cost-efficient for the local authorities and residential customers since they relate to mature technologies. In addition, they can be activated remotely, for start-up or shut-down, based on various notification schedules.
- These uses currently address primarily air or water heating. In the future, they will evolve thanks to more connected objects and less electric heating (consequence of RT2012[9]).

9. The new RT 2012 thermal regulations aim to limit energy consumption in new residential and commercial buildings. It corresponds to the application of a part of the commitments defined under the Grenelle 2 environment forum concerning better management of our energy consumption.

Appendix

To go further

Document	Topic
dD6.8	Sociological studies
dD6.9.1	Key messages (§3)
dD6.9.2	Key Performance Indicators (KPI)
dD6.9.3	Conclusions
Spotlight S1	Residential storage
Spotlight S4	Network Energy Manager (NEM)
Spotlight S11	Residential flexibilities for PV integration

Glossary

Term	Definition
B2B Aggregator	This platform offers the system operators (ERDF and RTE) some upward or downward power flexibility options to help them respond to grid constraints. Potential flexibilities from business customers reside in the control over various devices downstream from the meter and information displayed to the experimental users to turn them into agents of such flexibilities.
B2C Aggregator	This platform offers the system operators (ERDF and RTE) some upward or downward power flexibility options to help them respond to grid constraints. Potential flexibilities from residential premises reside in the control over various devices downstream from the meter and information displayed to the experimental users to turn them into agents of such flexibilities.
Behavioral Load Management (BLM)	Participants are alerted on the day before via text and/or e-mail messages about a request to cut back their consumption between 6:00 and 8:00 PM. Contributors are rewarded with the "Visibilité Conso" service and a gift-voucher if EDF records a significant reduction of their consumption (Load Management Bonus).
Electric Control Heating (EHC)	The heating system is controlled by EDF via the Linky smart meter.
Flexibility	A flexibility is a mean to modify (increase or decrease) a load curve, at client or network level in order to solve grid constraints.
Linky meter	Linky is a communicating meter, which means that it can receive and send data without the need for the physical presence of a technician. Installed in end-consumer's properties and linked to a supervision centre, it is in constant interaction with the network. This is what makes it "intelligent".
Mobile peak ("pointe mobile")	In addition to regular tariff calendars, the suppliers have the possibility to define several mobile peak calendars in the smart meter of their customers. These calendars can be remotely activated for a group of customers with an 8h delay.
Network Energy Manager (NEM)	Software platform in charge of allocating flexibilities to solve grid constraints on the day-ahead basis, relying on PV and load forecast, as well as on grid operators requests. It deals with aggregators managing flexibilities.