

ENEL INFO+ PROJECT: A DEMO TO EVALUATE THE IMPACT OF THE CONSCIOUSNESS ON THE CUSTOMER ENERGY CONSUMPTIONS

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ABSTRACT

The development of smart electricity grids represents one of the most important topics in the European energy strategy. Enel Distribuzione designed a high performance, reliable and secure smart grid that will be carried out in the south of Italy and tested under real operating conditions within the Isernia Project, which aims at implementing innovative solutions to optimally regulate the bi-directional energy flow on the Medium Voltage distribution networks while integrating Distributed Energy Resources. In this context, consumers will be involved in “Enel Info+”, a large scale trial of the “Enel smart info” device, that sets out to increase understanding and control of their own usage of energy as a first step towards “Active Demand”: providing electricity consumers with information on their consumption and the ability to actively manage it in line with the network conditions, such that modifications in consumer demand become a viable option for addressing challenges of electricity systems like the increase of efficiency and reliability, infrastructure planning and investments deferral.

Most of the times, end users are not really aware of the actual power consumption of their home appliances and how effective it would be to change the way they make use of electricity for their domestic activities towards sustainable lifestyle.

Integrating energy monitoring technologies and easy to use interfaces in the consumers’ houses can lead to economic benefits helping them to improve their knowledge and control over their energy use.

Enel smart info has been designed to provide end users with the certified information on electricity consumptions managed by the electronic smart meter, addressing more efficient behaviors while enabling further integration of smart home appliances and the participation to demand response programs. It can be plugged in every domestic socket to start data collection from the smart meter through powerline.

End devices (e.g. display or pc) can be connected using two dedicated USB plugs in order to enable consumers to view how much electricity is currently being used and to process the preceding load curves. Moreover, the use of a wireless

(e.g. ZigBee) USB dongle makes communication with domestic appliances easier.

A monitoring kit including Enel smart info, a dedicated display and two software applications (to monitor, collect and analyze consumption data by pc and Smartphone) will be supplied to a representative sample of families of Low Voltage end users participating to the trial “Enel Info+”, whose consumes will be observed for the whole duration of the project and compared with the previous ones. Besides, a “control group” of consumers who will not receive the kit will be selected and monitored, to verify that to the use of Enel smart info is actually responsible for any change in the load curves.

In-depth qualitative interviews and quantitative surveys will be carried out among an appropriate representative sample of families participating to the trial and among the control group likewise. The collected data will be used to analyze the actual awareness, understanding and attitude towards energy and its use, while estimating the effect of the proposed monitoring technologies..

INTRODUCTION

The development of smart electricity grids represents one of the most important topics in the European energy strategy. Enel Distribuzione designed a high performance, reliable and secure smart grid environment that will be carried out in the south of Italy and tested under real operating conditions within the Isernia Project.

Objective of the project is the implementation of innovative solutions aiming at optimally regulating the bi-directional energy flow on the Medium Voltage distribution networks while integrating Distributed Energy Resources (DERs) and assuring high system reliability and security. Advanced regulation of input flows is provided by optimizing power exchanges between the nodes and the feeder. A broad band communication system connecting primary substation, secondary substations and DERs is implemented, alongside an innovative automation system for fault detection and isolation and a reliable protection system with anti-islanding functionalities.

A multi-functional storage facility, which will be used for voltage control and power flow modulation, has been installed. The installation of an innovative electric vehicles

recharging infrastructure will be carried out by the integration with the multi-functional storage and a photovoltaic power plant, enabling an optimized energy management with possibility to provide ancillary services to the distribution network. A system for DERs production forecast and active and reactive power measurement exchange with the Transmission System Operator (TSO) system will be implemented, to improve the distribution network observability.

In this context, consumers are involved in “Enel Info+”, a project that sets out to increase understanding and control of their own usage of energy as a first step towards “Active Demand”: providing electricity consumers with information on their consumption and the ability to actively manage it in line with the network conditions, such that modifications in consumer demand become a viable option for addressing challenges of electricity systems like the increase of efficiency and reliability, infrastructure planning and investments deferral.

Enel Info+ results and lessons learnt will be processed within ADVANCED, a research project co-funded by the European Community’s Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 308923, that aims to shed light on ways to overcome the barriers hindering the mass deployment of Active Demand in Europe.

In the current “smart” energy landscape Active Demand can be considered a proper energy resource within the smart grids, potentially having a considerable role in increasing the energy system efficiency and reliability because it concurs to enhance peaks and voltage management thus making the whole system more flexible and secure.

Although consumers may benefit from the participation in Active Demand initiatives while contributing to environmental protection, at the moment only few real Active Demand programmes (not being field tests or pilots) are implemented in Europe, the majority of which are addressed only to industrial consumers.

Today the Active Demand potential of residential consumers remains largely invisible and inaccessible and the main reason behind it is insufficient consumers awareness regarding their own energy consumption and the benefits of altering it in line with the network constraints.

Integrating energy monitoring technologies and easy to use interfaces in the consumers’ houses enables solutions for the implementation of economic benefit strategies for the consumer helping them to improve their knowledge and control over their energy use.

The key enabler of these solutions is providing consumers with an easier accessibility to the electricity metering data. Thus smart metering is the basic layer for their implementation.

Enel smart info has been designed by Enel Distribuzione to provide end users with the certified information on electricity data managed by the electronic smart meter.

It can be plugged in every domestic socket to start data

collection from the smart meter through powerline. Enel Smart Info is shown in Figure 1.

General purpose or dedicated user interfaces aimed at data visualisation (e.g. displays, pc) can be connected using two dedicated USB ports. Moreover, the use of a wireless (e.g. ZigBee) USB dongle makes communication with domestic appliances easier.



Fig 1. Enel Smart Info

ENEL INFO+ CONCEPT

Enel Info+ is a large scale trial of the Enel smart info device that will involve a representative sample of families served by the Carpinone primary sub-station in 14 municipalities in the area of Isernia.

The scope of the project is to demonstrate whether giving to end users a feedback on their energy consumption can address more efficient energy behaviours.

The consumers participating to the project will thus receive an energy monitoring kit including Enel smart info and dedicated interfaces that they will use for one year to view how much electricity is currently being used in their household and to process their historical consumptions. A full colour, touch screen in-house display (Smart Info Display), and two software applications (Smart Info Manager and Smart Info Mobile, for personal computers and smart-phones respectively) have thus been conceived to monitor, collect and analyze energy data. “Prosumers”, consumers who are also producers of renewable energy (by photovoltaic or mini-eolic plants), will receive an additional Enel smart info in order to manage both production and consumption metering data.

The Enel Info+ kit and the related monitoring solutions are modular and foresee three levels of analysis.

The first one, named “Monitor”, is based on the use of Smart Info Display, that lets the consumers keep an eye on their household energy consumption pattern easily. Smart Info Display provides both close to real time and historical information on energy consumptions, which are shown in bar graphs and pie charts to highlight their mean value and how they split in tariff time bands for different periods of time (a single day, one week, one month, a bi-month, one year). The actual power and tariff time band are displayed,

together with the date and time of tariff time band switching. Moreover additional feedback contents are given such as alarms at pre-defined, modifiable thresholds and when the contractual power is exceeded, DSO's announcements and contractual data. Smart Info Display home page is shown in Figure 2.



Fig 2. Smart Info Display home page

The second monitoring solution, named “Examine”, is based on Smart Info Manager and it allows the consumers to examine their consumption data in depth on their personal computers and the energy prosumers to compare production and consumption data.

The third monitoring solution, named “Remote”, is based on the smartphone App Smart Info Mobile that enables the consumers/prosumers remote access to their own energy data.

As the current level of knowledge and awareness regarding electricity of the potential participants to Enel Info+ is quite poor, a step by step approach for their involvement in the project has been chosen. At the beginning they will only receive Smart Info Display, that is they will be equipped with the simplest feedback means (“Monitor” solution). This choice is expected to incline end users towards the subject matter avoiding their rejection of the kit as “too difficult”. After a few months their kit will be gradually upgraded to provide them with an increased complexity and value, enabling the “Examine” and “Remote” solutions.

A “pre-trial” test involving about 60 consumers and prosumers has been arranged to have an idea of the people’s acceptance of the proposed technological solutions and helped to fine-tune them. The participants in this test have been chosen among employees working in the local department of Enel Distribuzione and their relatives and friends. The results showed that the gradual approach of involvement is well founded. The experimenters of this test have been provided with all three of the interfaces (Smart Info Display, Smart Info Manager and Smart Info Mobile) at the same time, but actually Smart Info Display was immediately used by almost all the experimenters, while Smart Info Manager and Smart Info Mobile only after some weeks. A telephonic survey one month after the delivery of the Enel Info+ kit among a sample of participants in the “pre-trial” test (about 62,5%) revealed that 80% of the

experimenters gave a positive judgment (“Very much” or “Sufficiently”) of the kit in terms of satisfaction and usefulness in addressing more efficient energy behaviours, against the 20% who gave a negative judgment. (“Little” or “At all”).

34% of the interviewed experimenters declared they acquired a better understanding of their consumptions and they are more careful in the use of electricity. 6% discovered unexpected consumptions due to their appliances. 12% believe the kit is a good means to shift their peaks of consumption in the lower tariff time bands. 17% still needed some time to explore the functionalities of the kit. 31% declared themselves as “advanced” energy users, and believe the “Examine” solution is the most effective for them to improve their level of knowledge and understanding (such a percentage is related to the particular recruitment criterion adopted for the “pre-trial” test, involving some Utility employees).

Smart Info Display has been used by 80% of the experimenters “Regularly” or “Sometimes”, Smart Info Manager by 20% and Smart Info Mobile by 3% (8% of all those having a smart phone). The interviewed experimenters stated that the “Monitor” solution gives them a quick access to data with minimum effort and thus they use it more often. Moreover one of the main reasons behind the lower percentage of adoption of Smart Info Manager was the number of steps experimenters had to go through for the installation of the software. On the basis of this feedback the installation procedure has been significantly improved.

The consumes of the families living in the 14 municipalities included in the project have been observed by Enel Distribuzione since 2011.

Moreover the experimenters’ consumes will be observed by Enel Distribuzione for the whole duration of the trial and compared with the pre-pilot ones as well as analyzed in relation to other factors (e.g. household size, number and type of appliances, etc..). Besides, a “control group” of consumers who will not take part to the trial will be selected and monitored, to verify that the use of the Enel Info+ kit is actually responsible for any change in the load curves.

Additional information will be gathered by means of interviews that will be carried out among an appropriate representative sample of families participating to the trial and among the control group likewise. Three waves of quantitative surveys have been foreseen. The first wave (to be completed before the massive distribution of monitoring kits to the trial participants) is aimed at defining a representative model of the families living in the area of Enel Info+ in terms of habits, household size, family composition, education, etc.. The second wave (to be completed within two months after the distribution of monitoring kits to the trial participants) is aimed at collecting the early on consumers’ awareness, understanding and attitude towards energy and its use and to the first impression of the Enel Info+ kit. The last wave (to be

carried out at the project completion) is aimed at verifying whether the consumers' awareness, understanding and attitude towards energy and its use have changed during the project, while estimating the effect of the proposed monitoring technologies. Moreover in-depth qualitative interviews with approximately 20 residential consumers will be carried out within the scope of the ADVANCED project and their outputs will extend the study with some insights into socio-economic drivers of consumers' behaviour.

On the basis of these complex investigations the experimenters will receive quarterly reports as a feedback (e.g. an evaluation of their consumption levels, also compared with what they did in the previous year as well as with the other participants, and/or with the neighbors having similar-sized households, etc...).

PROMOTION AND RECRUITMENT

Participation in the Enel Info+ project is voluntary, and it requires the consumer to sign an agreement with Enel Distribuzione defining the pilot's terms and conditions, and the rights and liabilities of the parties. This agreement also addresses the privacy issues related to the collection and processing of sensitive consumers data during the trial.

In order to successfully activate consumers Enel Distribuzione conducted an advertising campaign for conveying the objectives of the trial. At the beginning a meeting with the mayors of the 14 municipalities included in the project and a meeting with the local consumers' associations were arranged for presenting Enel Info+ and establishing a collaboration aimed at the achievement of the recruitments goals.

A web portal (www.enelinfopiu.it) has been designed to provide general information about the project and technical support to the experimenters (who can also refer to a dedicated help desk).

Then the company has been present at summer local fairs and other events for a large scale promotion, while the "pre-trial" test helped to fine-tune the communication efforts. Since the end of 2012 and in 2013 some dedicated meetings have been arranged with the potential participants for them to know the project in greater detail and to receive their own monitoring kit. To this day about 90 monitoring kits have been delivered in occasion of the first dedicated meetings.

CONCLUSIONS

Enel Info+ is a large scale trial of the Enel smart info device within Enel Distribuzione's Isernia Project, that aims at demonstrating whether giving to end users a feedback on their energy usage can address more efficient energy behaviours. The consumers participating to the trial will receive an energy monitoring kit including Enel smart info and some dedicated interfaces to have an easy access to the electricity data managed by the electronic smart meter.

To this day about 150 monitoring kits have been delivered and the feedbacks coming from about 62,5% of the pre-test

experimenters (interviewed one month after the delivery of the Enel Info+ kit) are fulfilling: 80% of them declare themselves "Very much" or "Sufficiently" satisfied with their kit and believe the monitoring solution is useful and can help them to save energy.

34% of the interviewed experimenters declared they acquired a better understanding of their consumptions and they are more careful in the use of electricity. 6% discovered unexpected consumptions due to their appliances. 12% believe the kit is a good means to shift their peaks of consumption in the lower tariff time bands. 17% still needed some time to explore the functionalities of the kit. 31% declared themselves as "advanced" energy users, and believe the "Examine" solution is the most effective for them to improve their level of knowledge and understanding.

The system most appreciated features are the easy installation of Enel Smart Info, and the comprehensive and easy-to-use functions for showing data. The visualization of tariff time bands is considered very helpful. Smart Info Display is the most used interface as 80% of the experimenters use it "Regularly" or "Sometimes", and it is mainly appreciated for giving a quick access to data with minimum effort. Smart Info Manager is used by 20% and Smart Info Mobile by 3% (8% of all those having a smart phone). On the basis of this feedback the smart Info Manager installation procedure has been significantly improved. Prosumers are the most keen experimenters to use the monitoring kit.

The lessons learnt within the advertising campaign and the first recruitment meetings concern the great communication effort that is requested to successfully involve and engage consumers and the importance of relying on the full support of the local administrations for the achievement of the recruitments goals.