

SMART INFO AS A KEY ENABLER FOR WIDESPREAD ACTIVE DEMAND: ENEL INFO+ FROM PILOT TO LARGE SCALE

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ABSTRACT

Within smart grids consumers demand becomes “active” as it can be managed in line with the network conditions thus being a viable option for addressing challenges of electricity systems like the increase of efficiency and reliability, infrastructure planning and investments deferral. Providing consumers with an easier accessibility to the electricity metering data is key enabler for active demand.

Enel smart info has been designed by Enel Distribuzione to allow end users to have the certified information on electricity data managed by their electronic smart meter at their fingertips. It can be plugged in every domestic socket to start data collection from the smart meter through powerline and to display it on different visualization interfaces (in home displays, pc, smartphones, etc..).

It was tested on field within Enel Info+, an energy efficiency trial that has been carried out in the area of Isernia since December 2012 to December 2014. The results of this pilot showed that the awareness of consumers using Enel smart info towards their energy consumption increased and that they actually improved their energy behavior.

The present paper gives some insights on the key factors identified on field to scale up Enel Info+.

Consumers’ feedback and the several lessons learnt within the various stages of the pilot have been valuable inputs for investigating the monitoring solutions proposed in terms of usability, easy access to data and impact on the grid. Accordingly these solutions have been fine-tuned in order to be suitable for a wide spread.

Enel Info+ has finally turned into a large scale energy efficiency project that will be gradually extended nationwide in the context of the several smart city projects: at the beginning of 2015, it has been launched in the area of L’Aquila within the scope of “L’Aquila Smart City” and in the second half of 2015 it will be part of the NER300 project in Puglia.

Furthermore, in May 2014 the Italian Regulatory Authority for Electricity, Gas and Water (AEEGSI) published a consultation document presenting three possible technical solutions for providing consumers with

the information on their electricity consumption, one of them being based on the Enel smart info device. Thus in the next years Enel smart Info and the related energy monitoring solutions are going to involve more and more consumers.

INTRODUCTION

Actively managing the electricity demand in accordance with the network conditions is essential to cope with the current and future challenges of electricity systems such as the efficient integration of the increased share of distributed energy resources (DER) and in particular renewable (RES) with fluctuating generation profile.

Participating in active demand (AD) programs consumers play a significant role in the management of the electricity system. In fact AD management can contribute to improving the reliability and stability of the networks by increasing the overall system flexibility through means such as enhancing peak and voltage management or enabling ancillary services. As a result, the security of energy supply can be maintained, the overall electricity system efficiency increased and the related economic performance positively affected.

Most of the times consumers are not really aware of the actual power consumption of the devices they use and how effective it would be to change the way they make use of electricity for their activities towards sustainable lifestyle. Providing electricity consumers with information on their consumption is the first step towards their involvement in AD programs as it helps them improve their knowledge and control over their energy use. It can be obtained integrating energy monitoring technologies and easy to use interfaces in the consumers’ premises. 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 INFO+ IN ISERNIA

Currently, electronic meters are often installed in difficult to access locations and the user interface is usually a black-and-white small display with no graphical representation of data. In order to make it easier for consumers to access their energy consumption data, Enel Distribuzione designed Enel smart info: the only device that can be plugged in every socket to collect the certified data managed by the smart meter through power-line.

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. Wi-Fi or ZigBee) USB dongle makes communication with other devices and access to information easier.

A trial of Enel smart info, Enel Info+, was first set up in the mid south of Italy as an energy efficiency pilot to demonstrate whether enabling people to access in an easy way to their own energy consumption can increase their awareness and improve their energy behaviors.

It involved a representative sample of LV (low voltage) households and small commercial activities served by the Carpinone primary sub-station in some municipalities in the area of Isernia, since December 2012 to the end of 2014. All the consumers participating in the project received an energy monitoring kit including Enel smart info and dedicated interfaces to view their current electrical consumption and to process their historical energy data. A full colour, touch screen in-home display (Smart Info Display), and two software applications (for personal computers and smart-phones respectively) were designed and distributed to monitor, collect and analyze energy data. "Prosumers", consumers who are also producers of renewable energy (by photovoltaic or mini-eolic plants), received an additional Enel smart info in order to manage both production and consumption metering data. As establishing continuous communication with consumers is key to keep them "active" in this kind of projects, a sample of experimenters received quarterly personalized reports on their usage of energy as a feedback.

About 6000 kits have been delivered with an opt-in rate of about 23%.

RESULTS

The consumption of the LV households and small commercial activities in the municipalities included in the project has been observed by Enel Distribuzione since the end of 2011 (pre-pilot) and compared with the data measured during the pilot to assess the effect of using the Enel Info+ kit. This analysis showed a net reduction of some percentage points in the consumption level of participants. About 70% of participants reduced their consumption with very good percentages in average, the reduction level was higher after the reception of the feedback report and among well educated customers having a good familiarity with technology.

Data gathered within the project also include the answers to sociological surveys. Three waves of quantitative interviews have been carried out among a representative sample of participants. The feedback coming from the experimenters through these interviews are fulfilling as an high percentage of participants declared that thanks to the Enel Info+ kit they acquired a better understanding of their consumption (95%), gave a positive judgment of the kit (95%) and declared to be satisfied with the project (89%). Some participants (60%) declared they modified their habits in the usage of their appliances and/or the time in which they use them, reduced their consumption level (61%) and declared they replaced old appliances (6%).

Moreover a qualitative survey was carried out with 22

participants (7 with small commercial consumers and the rest with residential consumers.) within the scope of ADVANCED (Active Demand Value ANd Consumers Experiences Discovery), 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 AD in Europe. The outcome of this survey shows that the primary motivation for participating in the Enel Info+ trial was to reduce energy consumption and then energy costs, it was particularly true for small commercial customers who were the most interested in this kind of issue.. The participants in the project were very satisfied with the installation process of the Enel Info+ kit because they found it simple and greatly appreciated the touchscreen, colorful display provided..The most useful functionality perceived by experimenters was the alarm to prevent the load shedding, followed by the possibility to view consumption in graphics and have information of time bands. The concept of adopting technological solutions to moderate the usage and consumption of energy turned out to be successful. It suggested to most of the experimenters the possibility to adopt more advanced services, such as energy management solutions.

FROM PILOT TO LARGE SCALE

Given the good results of Enel Info+ in Isernia both in terms of consumption reduction and of customers awareness, Enel smart info has been considered a strategic tool to be widespread among consumers in the context of the several smart city projects that are ongoing or will be set up nationwide in the next years. By way of example it is worth mentioning the project "L'Aquila Smart City" that has been launched in the area of L'Aquila at the beginning of 2015, and NER300, that will start in the second half of 2015 in Puglia. Within the scope of these projects the implementation of smart grids technologies will be carried out and customers will be empowered with the services provided by Enel smart info.

So the smart info device and the related energy monitoring solutions are going to involve more and more consumers and Enel Info+ is turning into a large scale energy efficiency program. The transition of Enel Info+ from its "experimental" dimension to an actual service required the recruitment, the kit delivery and the customer assistance to be revised in view of an efficient management of the project. A web portal has been set up for the implementation of the aforementioned services. In this sense the several lessons learned on field in Isernia were of outmost importance.

Also the technological solution itself has been upgraded both in view of the large scale diffusion of the Enel Info+ kit and to keep the engagement of the future users high. In fact as an outcome of Enel Info+ in Isernia, consumers showed themselves willing to progressively exploit new functionalities and services and to be able to access and interact with Enel smart info using everyday devices (tablets and smartphones).

THE EVOLUTION OF THE ENEL INFO+ KIT

Smart Info plug&play

In order to start data collection from a smart meter, Enel smart info has to be set up with the address of that smart meter within the communication network, together with some additional configuration data.

A new connection procedure of Enel smart info to an electronic smart meter has been developed to have a fully plug&play solution and to allow an easy reconfiguration of the device when moving it to different LV connections.

This procedure is based on the upload of a proper configuration file, technically called "script file", through the USB port of the device.

As Italian LV production plants are typically managed with two different smart meters (one for production and the other for grid exchange), the association of a single Enel smart info to the consumption and the generation meters of prosumers simultaneously has been implemented (1 smart info communicating with 2 smart meters).

Moreover an algorithm that prevents data collision has been developed to make the communication on powerline robust even when several devices are on field under the same secondary substation.

WIFIDRIVE for Smart Info

A dedicated dongle has been developed in order to enable a Wi-Fi communication among Enel smart info and other Wi-Fi devices within the home area network. In this way energy data can be directly sent to a dedicated web-server through an internet router to make it available for remote monitoring by any device connected to the internet (pc, tablet, smartphone).

In case an internet connection is not present the Wi-Fi dongle acts as access point setting up a local wireless network thus allowing smart info to communicate with a visualisation device.

The use of the Wi-Fi dongle extends the data retention of Enel smart info to about 2 months.

Smart Info Application

Smart Info Application has been conceived as an application suite composed by different programs enabling end users access to consumption and production data both in local and remotely (provided that an internet connection is available within the customer premises). Smart info application indeed, provides a local software application for personal computers as well as a web application that can be accessed by pc, tablets or smartphones.

The installation procedure for the pc application is simple and the customer is guided through it step by step. The graphic interface of smart info application has been conceived in accordance with the Smart Info Display. Browsing through menus and functionalities is straightforward.

Besides this effort towards usability and familiarity, the

software offers a new set of features, with the potential to further improve them. First of all, data can be collected either from Enel smart info or from Smart Info Display. It can manage several different databases (i.e. the data of several Enel smart info devices can be managed by a single pc), automatically selecting the set of data regarding the Enel smart info that is currently connected. Power consumption and production are displayed on a single graph, thus self consumption is easily identified as well as the amount of energy that is injected in the grid. This data is very important for prosumers, since it determines the value of incentives, which are directly calculated using a simple tool of the software. Furthermore, it is able to measure and store the instantaneous power absorbed by any electronic device. Some of the experimenters in Isernia, who used the former application and suggested improvements during the trial, had the opportunity to use this new application. They were enthusiastic for its appealing user interface and its usability.

ENEL INFO+ WEB PORTAL

A web portal has been set up for the management of the project. It is accessible from the institutional Enel Distribuzione web site where customers can register to a private area and activate some services among which those related to Enel Info+.

Enel Info+ web portal is aimed at:

- giving general information about the project;
- collecting opt in requests;
- managing the configuration and distribution of the kits;
- giving technical support to participants.

General information

The scope of Enel Info+ is reported in this section that is public. A description of each site where the project is active is accessible. Details about the technical solutions are available together with a FAQ area. A news section is aimed at keeping visitors up to date regarding the evolution of the project and the relevant initiatives. This section is needed in order to provide customers with an acknowledged reference about the initiatives ongoing in their cities and to build trust.

Opt in requests

End users can make an opt in request for any LV user connections being in one of the cities or areas where Enel Info+ is active.

The Enel Info+ portal collects the opt in requests generating a list that is directly accessible by the couriers selected for delivery. This is done in order to speed up as much as possible the distribution process, as it is key to keep the momentum of customers engagement and start a good relationship with them.

Kit configuration

This functionality allows any operator of distribution points or couriers to configure smart info just

downloading a configuration file associated to the POD of the customer. This way smart info is delivered to customers ready to be activated, this is a major step forward improving customer experience. Also it is very useful for those working in this part of the process.

Technical support

End users are provided with a wizard to identify the technical problems they are encountering and either solve them by themselves or open a trouble ticket.

The Enel Info+ portal collects the trouble ticket requests generating a list that is sent to the third parties in charge of giving technical assistance. An escalation process is in place. This functionality is of outmost importance to keep customers engaged. A good service can keep the relationship good and alive. In this way it is possible to provide very good feedback on the solutions provided strongly contributing to their improvement and customers and allowing their needs understanding.

AEEGSI PUBLIC CONSULTATION

For the member states to comply with the European Energy Efficiency directive (2012/27/UE), consumption data should be available to the final customer.

In May 2014 the Italian Regulatory Authority for Electricity Gas and Water issued a public consultation document where different technological solutions for providing end users with consumption data are scouted.

Three technological solutions have been proposed:

- the acquisition through the existing DSO's remote reading system of the instantaneous power and of the load curves and the transmission of this data to a dedicated server in order to make it available online to the final customer via the internet;
- Enel smart info;
- the installation of a device reading the pulse LED output of the smart meter (that depends on the energy consumption) and, as an option, the transmission of this data to a dedicated server in order to make it available online to the final customer via the internet.

Following this consultation, the AEEGSI will define a framework for providing consumers with a direct access to their energy data in a transparent way, in accordance with the European Energy Efficiency Directive, that in Italy has been transposed with the Legislative Decree n. 102/2104.

REMARKS TO THE AEEGSI PUBLIC CONSULTATION

An important remark concerns the implementation costs of the first solution. At the present time, the Italian DSO's remote reading system only stores the data needed for invoicing, that is a subset of the data managed by the electronic smart meters. Thus for LV customers the

energy consumption is acquired on monthly basis and the instantaneous power is not stored. In order to increase the amount of data to be sent and stored and to make it available online, the whole existing system should be upgraded and the telecommunication costs would increase. These costs would be finally borne by all the end users, irrespective of whether they want or have the tools to access the service (e.g. an internet connection). On the other hand, the other solutions would be more "fair" as they would only be paid by the actual users.

Besides being different in terms of implementation and costs, it is worth saying that the aforementioned solutions do not offer the same level of functionalities. The major limitations in this sense are in the pulse reading solution. It cannot give the certified data measured and managed by the smart meter and additional information such as the reactive energy, the contractual power, etc.. Moreover the LED pulse reader needs to be installed on the smart meter that is often located in public areas for maintenance purposes: for this reason it can be easily accessed, tampered or removed by unauthorized third parties.

Furthermore, only the Enel Smart Info solution provides end users with real time alarms when the contractual power is exceeded so that load shedding can be prevented.

The aforementioned observations show that the Enel smart info solution grants the higher level of functionalities at the fairest conditions for end users.

The model proposed for the adoption of the Enel Smart Info solution foresees the protocol for the communication between Enel Smart Info and the visualization interfaces to be public, so that any third party (e.g. the retailers) can design dedicated applications or devices to offer added value services to consumers. All the end users should have the right to request Enel Smart Info and a dedicated interface in order to access a basic level of service at a regulated price in a non discriminatory way, independently from the different and more advanced commercial offers of their energy retailer or any other third party willing to offer value added services (e.g. telcos, Escos).

CONCLUSIONS

Enel Info+, was set up in the area of Isernia as a trial of Enel smart info to demonstrate whether enabling people to access in an easy way to their own energy consumption can increase their awareness and improve their energy behaviors. The results of the pilot both in terms of consumption reduction and of customers awareness were very fulfilling. A net reduction of some percentage points in the consumption level of participants was recorded. About 70% of participants reduced their consumption with very good percentages in average. An high percentage of participants declared that thanks to the Enel Info+ kit they acquired a better understanding of their consumption (95%), gave a positive judgment of the kit (95%) and declared to be satisfied with the project (89%).

Some participants (60%) declared they modified their habits in the usage of their appliances and/or the time in which they use them, reduced their consumption level (61%) and declared they replaced old appliances (6%). The most useful functionality perceived by experimenters was the alarm to prevent the load shedding. The primary motivation for participating in the Enel Info+ trial was to reduce energy consumption and then energy costs. The concept of adopting technological solutions to moderate the usage and consumption of energy turned out to be successful.

On the basis of these outcomes, Enel smart info has been considered a strategic tool to be widespread among consumers in the context of the several smart city projects that are ongoing or will be set up nationwide in the next years. The transition of Enel Info+ from its “experimental” dimension to an actual service required the recruitment, the kit delivery and the customer assistance to be revised in view of an efficient management of the project, so a web portal (that is accessible from the institutional Enel Distribuzione web site) has been set up for their implementation.

Also the technological solution itself has been upgraded both in view of the large scale diffusion of the Enel Info+ kit and to keep the engagement of the future users high.

A new connection procedure of Enel smart info to an electronic smart meter has been developed to have a fully plug&play solution. A dedicated dongle has been developed in order to enable the Wi-Fi communication of Enel smart info data. An application suite (Smart Info Application) composed by different programs has been conceived to enable end users access to consumption and production data both in local and remotely on pc, tablets and smartphones.

Enel smart info was one of the proposals reported in the public consultation document issued in May 2014 by the Italian Regulatory Authority for Electricity Gas and Water where different technological solutions for providing end users with consumption data have been scouted. The other solutions reported in the consultation document are the upgrade of the existing DSO’s remote reading system, in order to acquire the instantaneous power and the load curves, and the installation of a device reading the pulse LED output of the smart meter (that depends on the energy consumption). The aforementioned solutions are different in terms of implementation and costs and do not offer the same level of functionalities. The Enel smart info solution grants the higher level of functionalities at the fairest conditions for the end users.