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Industry 4.0 Application in Isolated Energy Systems Management

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Abstract:
The energy markets have been changing. Along the last years around the world, the different problems faced are embraced as an economic issue and intended to be solved as costs to be reflected in the tariffs. However, drawing the grid expansion based on this approach could not be the best way when one realizes that IoT and Demand side management are only reactive. Taking advantage of both, it is possible to lower investments in grid reinforcements that have a low share of installed capacity during most of the periods. This paper presents the alternative of defining stability islands of energy, enhanced by IoT and empowering the role of consumers. Consumers are informed of energy selling and buying prices, based on adjusted energy forecasts, to install or reinforce own renewable energy systems or energy storage devices. These islands are interconnected to increase flexibility but taken as last resource to reduce transmission losses.

Keywords:
Industry 4.0, System Congestion, IoT, Big Data, Cloud computing, Demand Side Management

1. Introduction

The recent “traditional” electric energy systems operation is unidirectional and top-down oriented and separated in the following phases:

- Network Development and Investment Plan (PDIR). The Network Development and Investment Plans (PDIR) correspond to planning instruments that envisage investment in the development of energy networks for a time horizon of 10 years, in the case of electricity and natural gas transmission networks, and a horizon of 5 years for electricity and natural gas distribution networks. These plans are the responsibility of and proposed by the concessionaires of the electricity and natural gas transmission and distribution network, analysis by focus on investment needs to ensure adequate levels of security of energy supply, compliance with energy policy goals and the reliability of the network and its equipment from the perspective of the security of people and goods.

- Operation of distribution networks. The operator of the High and Medium Voltage distribution networks, by State concession, and in Low Voltage, by municipal

concessions, has the role of applying, managing and implementing the processes of access to the networks, namely the connection, maintenance, intervention and disconnection. The choice of the supplier by the customers is free. Whenever a customer enters a supply contract with a new supplier, it is the customer who is responsible for activating the necessary procedures for the change of supplier to take place.

- Commercialisation. With the liberalization of the sector, the activity of commercialization of electric energy was opened to market agents that fulfil the necessary requirements. As the last stage of the electricity supply chain, it is the one that directly relates to consumers. Consumers can choose their retailer and change, free of charge, whenever they find offers that are more suited to their type of consumption. Traders, who freely form their commercial offers, purchase electricity from producers on the wholesale market and sell it to customers by paying their network operators the regulated tariffs for access to the networks.

In Portugal, there is a vertical and horizontal disaggregation leading to a competition in the whole sector except in the grids, that are considered natural monopolies.

The Logistics Operator for Change of Supplier (OLMC) is responsible for applying, managing and implementing the change of supplier, ensuring that it take place under the same conditions for all. The market agents, complying with the procedures and deadlines defined by the Energy Services Regulatory Entity. Currently, in Portugal it is ADENE Energy Agency that plays the role of OLMC and it is ERSE that plays the role of Energy Services Regulatory Entity, under the terms of Decree-Law no. 38/2017, of March 31. The deadlines for switching suppliers were approved by ERSE through Directive No. 15/201. Within the scope of Regulation (EU) No. 347/2013 of the European Parliament and Council, of 17 April 2013, on trans-European energy networks (TEN-E), the Projects of European Union Common Interest (PIC), which must at least comply with one of the following criteria: involve at least two EU MS (directly crossing the border of two or more MS); be located in one MS and have significant cross-border impacts in another MS; cross the border of at least one MS and a country belonging to the European Economic Area. These projects are defined and distributed by regions, as defined in Annex I of the TEN-E Regulation. Portugal, for the electricity and natural gas sectors, belongs, respectively, to the North-South electricity interconnections groups in Western Europe ('NSI West Electricity') and North-South natural gas interconnections in Western Europe ('NSI West Gas'). EU Regulation No. 347/2013, on guidelines for trans-European energy infrastructures, establishes in Article 9 (1) that by 16 May 2014, the competent authority (DGEG) must publish a Manual of Procedures for the licensing process applicable to projects of common interest. [5,6,7]

Most of the times the installations present electrical problems that, without the necessary equipment, it is not possible to notice. For households, there is unused devices left plugged into your wall outlet contribute to higher electric bills. Often called ghost electricity, vampire power, phantom power, or idle current, it is the power wasted by devices when they're not in use or even turned on. An industrial energy efficiency and quality consultancy makes it possible to reduce energy consumption and, not least, eliminate electrical disturbances. These disturbances are, in many cases, the main cause responsible for losses in productivity, quality and profitability, namely: production stops, protection trip, reading errors in the

instrumentation, communication failures in automation, among others. By minimizing energy losses and disturbances and improving production efficiency, energy and production savings are achieved, as well as greater profitability and competitiveness for the company.

Continuous energy availability is necessary for all consumers. However, it is impossible to store energy in a large scale, so, to ensure availability, there must always be a balance between the production and consumption of electricity. Reaching a balance is more difficult than it used to be, as production is increasingly based on renewable modes of production susceptible to fluctuations in weather, such as wind and solar power. The need for flexibility is increasing while the load-following capacity is decreasing. So far, the consumers have held the passive role of bystanders and payers – industrial facilities pay far less for their electricity than consumers, who cannot influence the markets. The active role to consumers and new marketplace would balance the load-following capacity markets and strengthen the consumers' role on these markets. They could be coupled as load-following capacity producers without middlemen and sell, for example, the solar power they have produced themselves on the same market where the wholesalers operate.

Thereby, a focus on consumers and how they use the energy for their activities and comfort is crucial for the health and efficiency of the energy systems. All the situations call for sophisticated control methods that can handle a quantity of information with limited time. Here is where the IoT has advantages and can contribute for ease the challenge.

2. IoT Applications in Energy Markets

The Energy Flexibility of buildings is commonly suggested as part of the solution to alleviate some of the upcoming challenges in the future demand-respond energy systems (electrical, district heating and gas grids). Buildings can supply flexibility services in different ways, e.g., utilization of thermal mass, adjustability of HVAC system use (e.g., heating/cooling ventilation), charging of electric vehicles, and shifting of plug-loads. However, there is currently no overview or insight into how much Energy Flexibility different building may be able to offer to the future energy systems in the sense of avoiding excess energy production, increase the stability of the energy networks, minimize congestion problems, enhance the efficiency and cost effectiveness of the future energy networks. Therefore, there is a need for increasing knowledge on and demonstration of the Energy Flexibility buildings can provide to energy networks. At the same time, there is a need for identifying critical aspects and possible solutions to manage this Energy Flexibility, while maintaining the comfort of the occupants and minimizing the use of non-renewable energy. Figure 1 illustrates the topology of demand side management. [8]

Often, the way one consumes energy is not the best. It is always possible to make this consumption more efficient so that there is a better use of energy, thus leading to unbelievable savings and a stable and defect-free electrical network. With a system that allows the recorded data related to the way energy is consumed in an easy and transparent way, it is possible to promote changes in perceptions and behaviours within the organization that strongly contribute to a more rational use of the energy resource. Figure 2 illustrates the Categories of demand side management. [9]

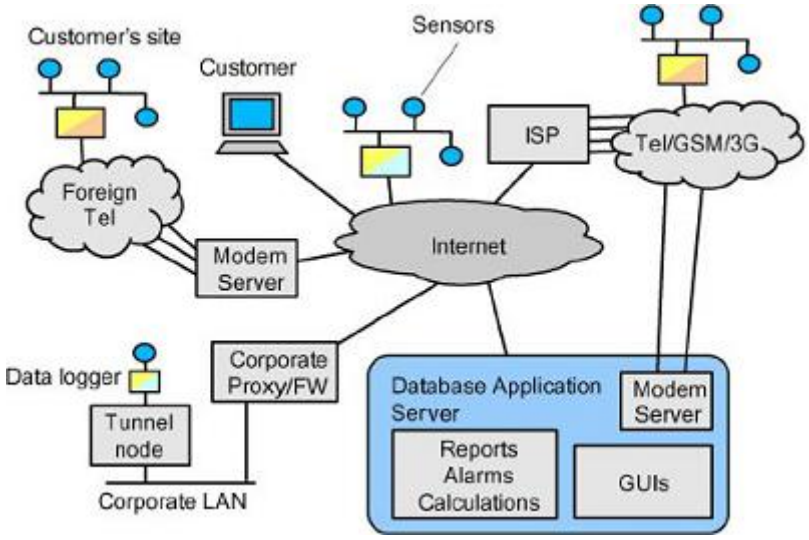

Figure 1. *Topology of demand side management.*

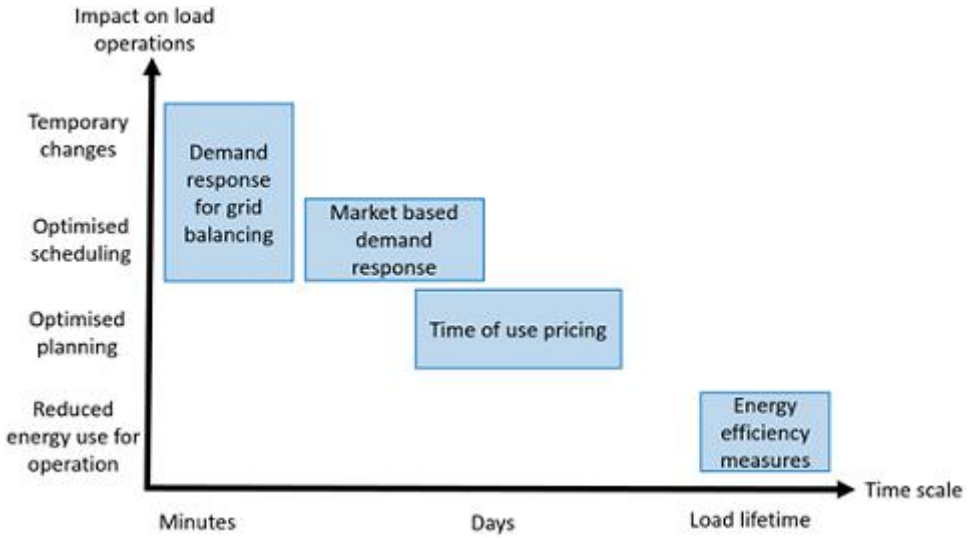

Figure 2. *Categories of demand side management.*

IoT devices offer the consumers with skills in the analysis of electrical installations and in the diagnosis of problems, offering know-how in the rationalization, consultancy and technical assistance plans in energy efficiency and quality. Figure 3 illustrates the IoT contribution for demand side management.

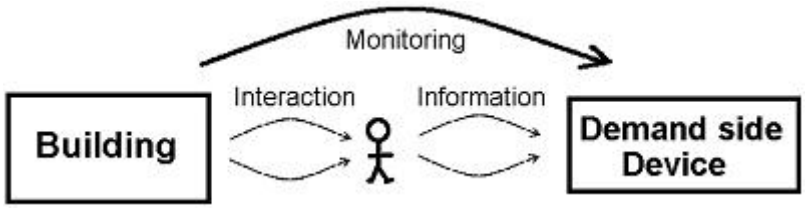

Figure 3. *IoT contribution for demand side management.*

An integral part of an energy management, the monitoring system is essential to know in detail how the energy is being consumed. In this way it is possible to carry out a qualitative analysis, and not just a quantitative one, as it is possible through energy bills. This type of system also allows the knowledge of the partial

consumption patterns of the installation, whether these sectors or even specific equipment.

The energy quality and management tools are designed to help the consumer to detect electrical disturbances, analyse energy networks and measure all the consumptions necessary to maintain the best performance and reliability. These tools allow to identify energy efficiency and quality problems through easy and efficient records and analysis.

The functioning and safety of equipment and installations are too important. The analysis of the data of the IoT systems allows to train experienced teams to serve customers in all their needs with speed and quality, managing to prevent in many cases serious malfunctions that jeopardize the company's operations. Maintenance contracts allow:

- Guarantee the optimized performance of your equipment and processes.

- Savings in costs and time, as they prevent future breakdowns and unexpected failures in operation.

- Reduction of energy costs and extending the useful life of your equipment.

Main services included in the maintenance contracts:

- Preventive and corrective maintenance, according to the needs of each client.

- Carrying out inspections in accordance with the legislation in force.

- Intervention requests with quick response times and prompt resolution.

- Information of all maintenance visits through individual records.

- Listing of the occurrence log.

- Supply and assembly of parts to repair your equipment.

An energy monitoring system allows to reduce rising energy costs and facilitates automatic consumption. In addition to solutions to act on efficiency and quality of electricity, these devices also have local and remote control and monitoring solutions.

When focusing on demand side management and demand response, drivers and benefits, shiftable load scheduling methods and peak shaving techniques. Demand side management techniques found in literature are overviewed and a novel electricity demand control technique using real-time pricing is proposed [10]. Currently users have no means to change their power consumption to benefit the whole system.

Energy monitoring aims to simplify the energy monitoring solutions available on the market, meeting the main requirements of those responsible for operating and managing a company:

- have an idea of the consumption of the installation,

- automatic indication of the respective costs already considering the contracted tariffs,

- graphically view consumption profiles

- have the data always available for processing in calculation tools such as Excel.

Consumption analyser with wi-fi connection, which shows instant and historical data of electrical consumption through any smartphone, tablet or PC, with the help of

the application or the integrated web server. It is the ideal tool to make a electrical installation efficient, to control and make decisions regarding energy costs.

The software available for consumers allows to manage and monitor different types of parameters:

- Electricity consumption

- Consumption of alternative energy sources (gas, water, steam, etc.)

- Monitoring of other parameters (lighting level, compressed air, temperature, calories, among others)

- Management of Energy Automation functionalities

It is a complete software, which allows the acquisition, storage and management of data.

- Allows you to control energy costs broken down by central costs

- It is the starting point for the definition of an energy saving plan

- Allows the identification of supply quality problems (eg voltage spikes or drops, interruptions)

- It allows identifying situations of network malfunction (eg low power factor, degradation in engine performance, generation of harmonics)

Standard graphs allow the consumer to view daily load curves or consumption on a monthly or annual basis. Navigation is very simple. Some examples of available graphics:

- Daily electricity consumption based on 15-minute periods

- Monthly electricity consumption on a daily basis

- Annual electricity consumption on a monthly basis

All operations performed while using the energy management software are recorded (e.g., busy telephone line, in the case of remote access). The events of the memory modules transferred automatically during data collection are shown. The software allows you to view parameters, such as: interruptions, voltage spikes, etc. Cloud technology makes it possible to manage the data collected through a standard internet browser, without having to install any software. Cloud storage can be used from a local device, can be installed on a server or can be purchased in SaaS mode (Software as a Service). Cloud storage consists of a dashboard in which it is possible to manage several functions. The basic elements of the dashboard are graphic components (widgets). With these widgets, the user can view, between instantaneous and historical values, states (on / off), alarms, etc., using standard or customized graphic interfaces. The user can select the widgets he wants and compose his own personalized dashboard. Personal Report module is designed to automate the sending of energy reports. Ideal for energy consultants, for example. This module automatically prepares and sends periodic reports (daily, weekly, monthly and annual) based on data collected and stored in the database that must be included in the reports. The report exported to Excel / CSV (containing data from different channels and locations) is then available in a final layout based on templates with logos, graphics, images, etc. The Excel / CSV file can also be sent as an attachment in an email or automatically saved to a remote FTP location. Online Measures Counters module that generates reports with the values of the energy meters of all the instruments in the network.

Useful, for example, for administrators who must download remotely and see the value of the values of a building, hotel, shopping centre, etc. The generated reports can be exported in HTML format and imported in Excel.

Digital services to improve the performance of small and medium-sized buildings, help building owners and managers to improve the performance of small and medium-sized buildings, ensure business continuity and optimize operation and maintenance costs, save money and improve efficiency. taking advantage of the latest data analysis technologies

By applying these technologies to monitor equipment, services will improve the performance and efficiency of facilities.

The service includes:

- Structuring of a cloud platform, displaying your data and trends.

- Reports, alarms and recommendations from our teams of experts.

- Network of local partners to implement the solution and support you in making savings.

Benefits

- Maintenance efficiency

- Plan and manage maintenance for all locations from anywhere

- Perform maintenance at the right time

- Track all maintenance events on all equipment

- Operating efficiency

- Landmarks

- Identify abnormal conditions in the equipment to optimize the equipment's efficiency and to prevent malfunctions

- Assign costs per tenant and activities

- Energy saving

- Identify abnormal consumption: energy losses, overheating / cooling, water leaks

- Pay less Power factor penalties

- Choose the right energy subscription and optimize your energy contract

- Define and follow energy performance indicators applications

To manage energy, it is necessary to have access to energy data with clear objectives, in all its establishments, by zone and use. Services provides access to this data through Cloud Computing technology. In addition, our experts will provide periodic reports in an easy-to-understand format. This will bring clarity to the energy analysis.

3. Demand Side Management

Demand-Side Management (DSM) represents a revolutionary approach to planning at electric utilities. Essentially, it broadens the scope of planning to integrate the customer’s needs and desires with the utility's goals. [1] Demand-side management

(DSM) is the planning and implementation of those electric utility activities designed to influence customer uses of electricity in ways that will produce desired changes in the utility's load shape. While the objective of any DSM activity is to produce a load-shape change, the art of successful implementation and the ultimate success of the program rests within the balancing of utility and customer needs. [2] Energy management means to optimize one of the most complex and important technical creations that we know: the energy system. While there is plenty of experience in optimizing energy generation and distribution, it is the demand side that receives increasing attention by research and industry. Demand Side Management (DSM) is a portfolio of measures to improve the energy system at the side of consumption. It ranges from improving energy efficiency by using better materials, over smart energy tariffs with incentives for certain consumption patterns, up to sophisticated real-time control of distributed energy resources. [3] The relatively low utilisation of generation and networks (of about 50%) means that there is significant scope for DSM to contribute to increasing the efficiency of the system investment. The importance of the diversity of electricity load is discussed and the negative effects of DSM on load diversity illustrated. Ageing assets, the growth in renewable and other low-carbon generation technologies and advances in information and communication technologies are identified as major additional drivers that could lead to wider applications of DSM in the medium term. Potential benefits of DSM are discussed in the context of generation and of transmission and distribution networks. The provision of back-up capacity by generation may not be efficient as it will be needed relatively infrequently, and DSM may be better placed to support security. We also present an analysis of the value of DSM in balancing generation and demand in a future UK electricity system with significant variable renewable generation. We give several reasons for the relatively slow uptake of DSM, particularly in the residential, commercial and small business sectors. They include a lack of metering, information and communication infrastructure, lack of understanding of the benefits of DSM, problems with the competitiveness of DSM when compared with traditional approaches, an increase in the complexity of system operation and inappropriate market incentives. [4]

4. Load-Shape Changes

Although there is an infinite combination of load-shape changing possibilities, six can illustrate the range of possibilities: peak clipping, valley filling, load shifting, strategic conservation, strategic load growth, and flexible load shape. These six are not mutually exclusive and may frequently be employed in combinations. The IoT does provide consumers with a whole new set of alternatives with which to meet energy needs. The concept that the load shape is not fixed but can be altered deliberately opens a new dimension in planning and operation. Figure 4 illustrates the objectives of demand-side management. [11]

The measuring devices allow not only the simple measure of energy, but also the obtaining of more data on the installation, such as instantaneous values of active, reactive and apparent power or measurement of harmonics, the most suitable solution is an electrical energy analyser.

- Instruments for measuring energy and environmental and process parameters
- Instruments for Energy Automation, energy management and energy quality
- Energy monitoring and remote management systems

- Web servers, gateways, converters and interfaces (Ethernet, wireless, series, Bus, etc.)

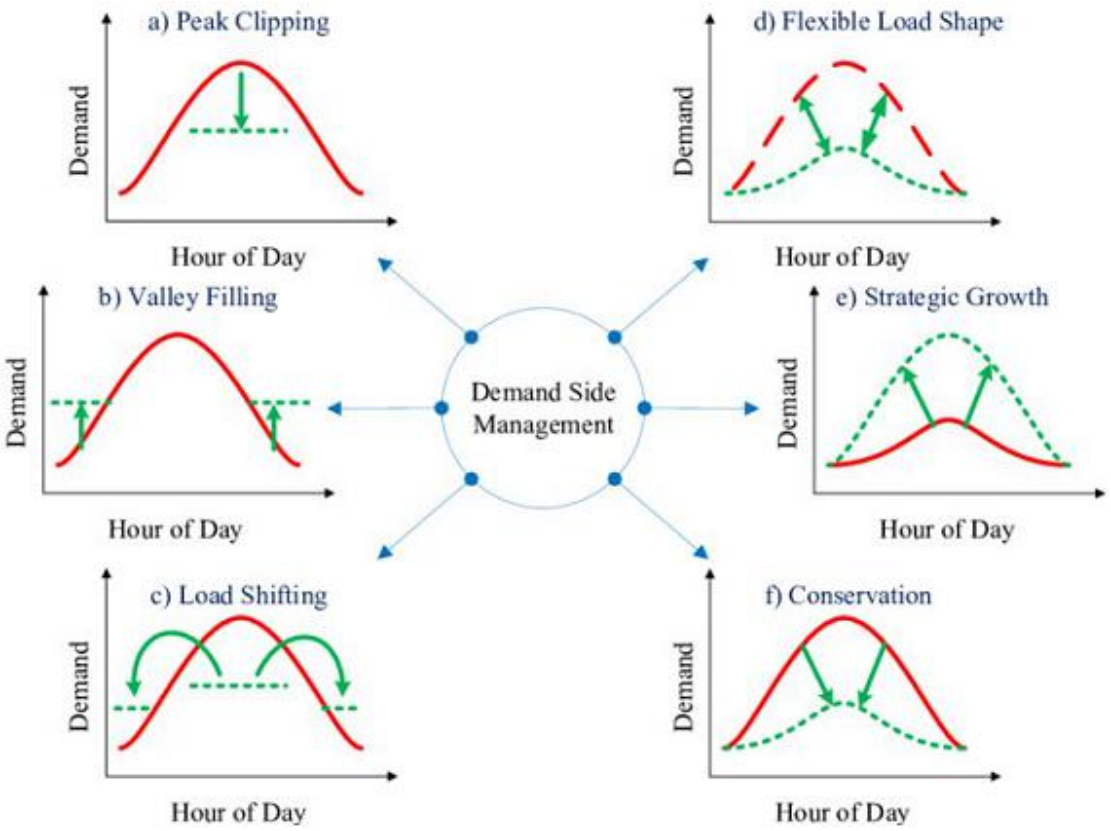

Figure 4. *Objectives of demand-side management.*

To make better choices and to further improve energy consumption, non-experts will follow their own energy parameters and inform when they are out of reach, enable higher value services and to improve own energy efficiency by connecting and monitoring key equipment 24/7.

Main features:

- Track assets for long-term maintenance schedules and task reminders.

- Record and access the history, documentation or collaborative information of your assets and generate activity reports directly from the field.

- Anticipate maintenance and repair more quickly thanks to the monitoring and remote control of the electrical panel of the key equipment, HVAC, lighting ...

- Collect information from your connected boards to manage more efficient installations and give visibility to energy consumption.

Figure 5 illustrates different types of demand-side management. [14]

The current advancements in metering, communication and control infrastructure make possible the development of demand-side management programmes, targeting different types of customers through appropriate incentives. Automation processes, enabled by using smart appliances (converting houses into smart homes), can increase the consumer's responsiveness to price signals. This solution tackles demand-side flexibility by increasing demand response to price signals.

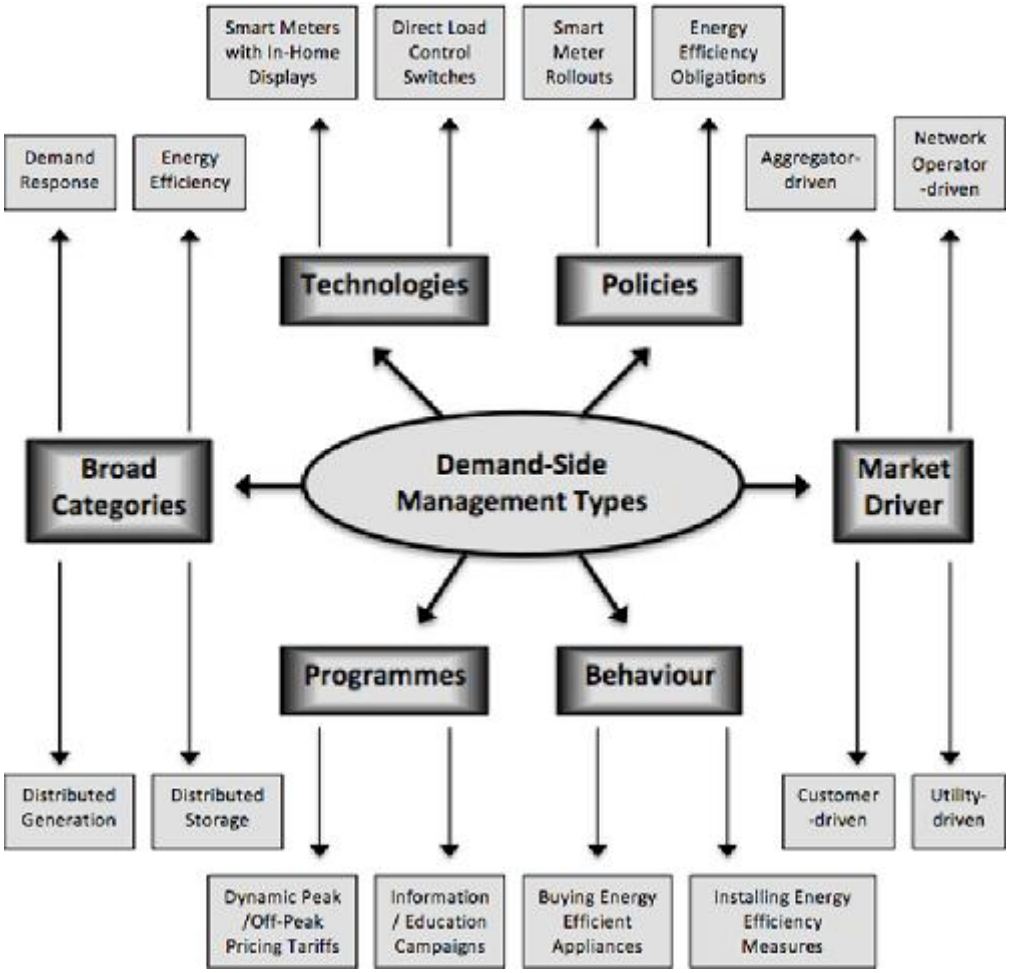

Figure 5. *Different types of demand-side management.*

From electrical energy to no less important thermal energy (steam, gas, etc.), including water or other important parameters for the installation's activity, other systems in market allows monitoring and control and performance to be maintained over all these variables, in real time and history, in a simple and intuitive way, contributing to avoid energy losses and increase the available resources. Other solutions can be acquired, such as online graphics for energy monitoring, instrument graphics equipped with the option of FFT harmonics, programmable graphics and other special configurable graphics with different units of measurement. This function makes it possible to view measurements generated by energy transducers of various dimensions (e.g., gas, water, temperature, humidity, steam, calories, pressure, etc.).

By making maximum use of the renewable energy produced, if available, or reusing energy losses energy, a monitoring system allows a reduction in consumption costs.

Some solutions offer QR code functions, making easily to record and access the history, documentation or collaborative information of assets and generate activity reports directly from the field.

Figure 6 illustrates demand-side management solutions for a renewable-powered future. [15]

New business models have emerged with digitalisation at the consumer’s end. Energy as a service (EaaS) is an innovative business model where a service provider offers various energy-related services rather than only supplying electricity (i.e., kWh).

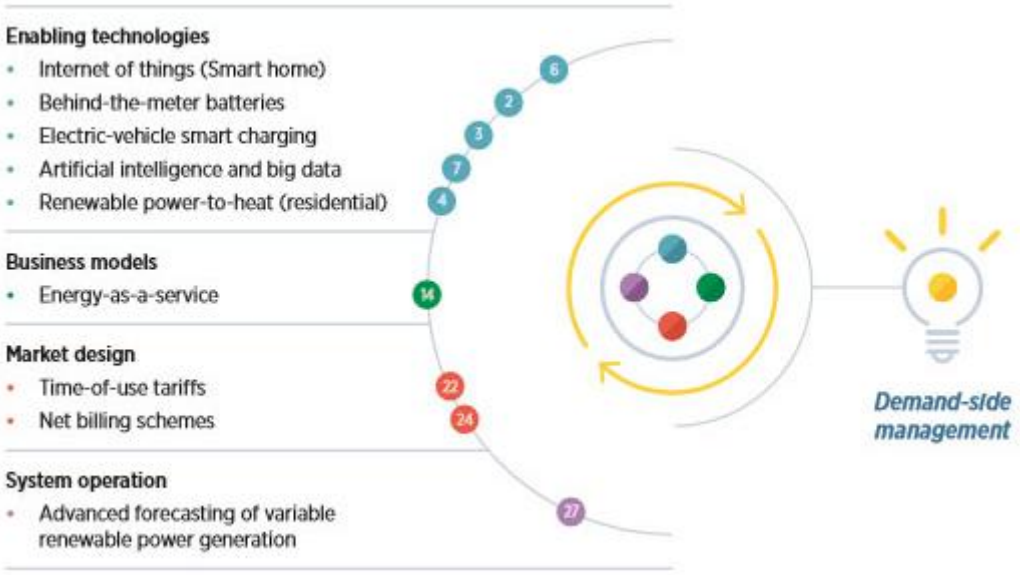

Figure 6. *Demand-side management solutions for a renewable-powered future.*

5. Energy Efficiency

Current EU's climate and energy policies are deeply driven to contribute to the global challenge of climate change as considering one of the most serious global threats. It is very important that increased climate policies are implemented without negative impacts on environment and public health. Reducing energy use has the best chances to fulfil that condition, but we also need to be alert when choosing specific technical solutions. Reducing energy use is the backbone of any effective climate strategy. According to IEA figures, energy efficiency measures are projected to account for two-thirds of abatement by 2020. Reducing energy use has several other advantages, including reduced energy costs for consumers and reduced dependency on fuel imports. Reducing energy use as a policy can trigger technological innovation, creates long-term, local jobs and can improve quality of life (for example in renovated buildings). [12]

More than half of global organizations plan to increase energy efficiency spending in next 12 months. Over the past decade, traditional energy efficiency measures – such as HVAC equipment improvements and lighting upgrades – have become table stakes for many organizations. Today, organizations identify greenhouse gas footprint reduction, energy cost savings, energy security and enhanced reputation as key drivers of investment fuelling growth in green, net zero energy and resilient buildings. Smart Buildings Driving Future Investment: Building system integration saw a 23 percent increase in respondents planning to invest in 2019 compared to 2018, the largest increase of any measure in the survey. Organizations are more interested than ever in leveraging energy efficiency, energy storage and distributed generation technologies to deliver smarter, safer and more sustainable buildings. Organizations are especially bullish about the future impact of systems interoperability, systems integration and cybersecurity technologies. Due to increasingly severe weather incidents around the world, the results also highlight a growing global focus on resilience and energy security. The ability to maintain critical operations during severe weather events or extended power outages is extremely important when considering future energy and building infrastructure investments. Many global are likely to have one or more facilities able to operate off the grid in the next years. Globally, plans to invest in

distributed energy generation, electric energy storage and on-site renewables also increased year-over-year. Analysis of the annual survey results from 2008 to 2018 revealed dramatic shifts in energy efficiency goals, actions and investments throughout the past decade. In 2008, very few organizations had any certified green buildings and few planned to certify new construction projects to a recognized green standard. Nowadays the number of organizations that have already achieved voluntary green building certification for at least one of their facilities is significant. In 2008, less believed green buildings would be very important in attracting and retaining future employees, but now are willing to pay a premium to lease space in a certified green building. [13] Figure 7 illustrates the impact of energy efficiency measures and behaviours by consumers. [8]

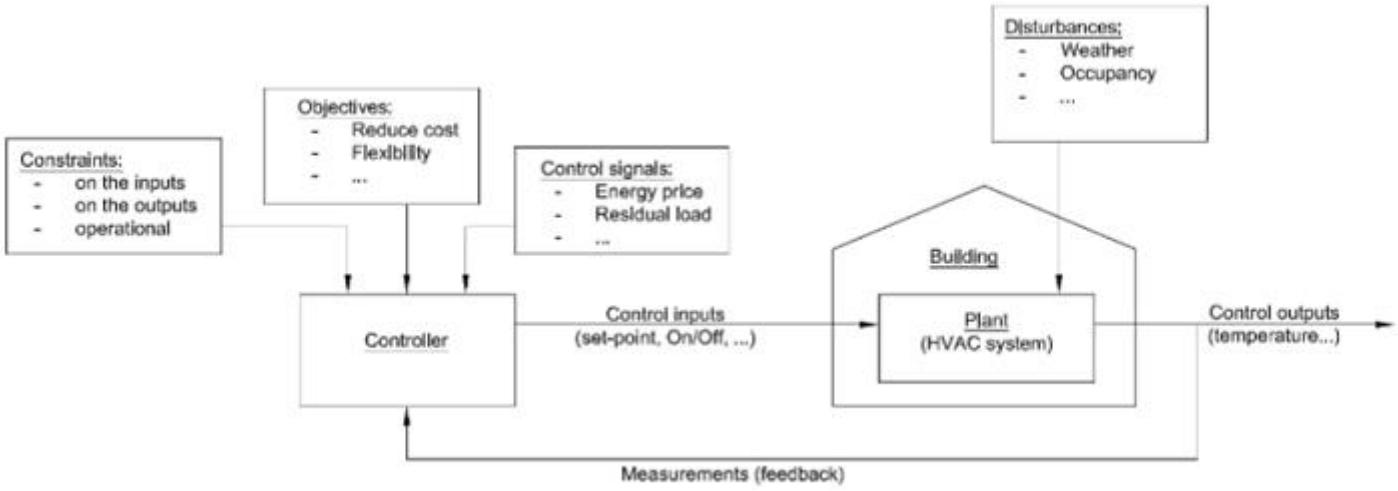

Figure 7. *Impact of energy efficiency measures and behaviours by consumers.*

6. Case Study and IoT Devices

From the options on market, the present paper uses the Cloogy [16] with the equipment, display of all electrical parameters (V, A, Hz, W, VAr, VA), multi-tariff measurement (max. 4 tariffs) (eg H. Point, Full, Empty, Super Empty), total and partial counting (E. Total Active, E. Partial Active, E. Total Reactive, E. Partial Reactive).

The main benefits of the functions involved are control of energy costs; integrated Energy / Production Management; real knowledge of consumption by zones or equipment; monitoring of power quality.

The use of this tool is important to provide visibility into energy consumption, as with its application, collection and manual registration of energy data, get the full picture of energy consumption with aggregate view and multi-site comparison modes, set goals and be alerted as soon as they are exceeded, monitor energy demand and power factors, receive monthly scorecards, documenting energy consumption, trends and results, track energy consumption in detail (by usage, zone, and meter), identify deviations and peak contributors, optimize energy budgets and allocate costs.

With this tool it is easy to find out which devices consume the most energy and where you can save. Using your computer, tablet or smartphone, control the operation of the various devices anytime, anywhere. At the end, understanding the energy consumption of home or business is straightforward.

The main devices are:

- Concentrator: Receives data from Transmitters and other Sensors, and communicates them to the Database;

- Sensor: Collects consumption data from electrical panel and / or microgeneration;

- Transmitter: Transmits the data collected by the Sensor to the Cloogy Hub;

- Transmitter Generation: Transmits Generation data to the Cloogy Hub;

- Monitor: Provides information about consumption in real time

- Outlet Intelligent: Monitor and control any equipment

It is possible to analyse the consumption profile during a week, as shown in Figure 8.

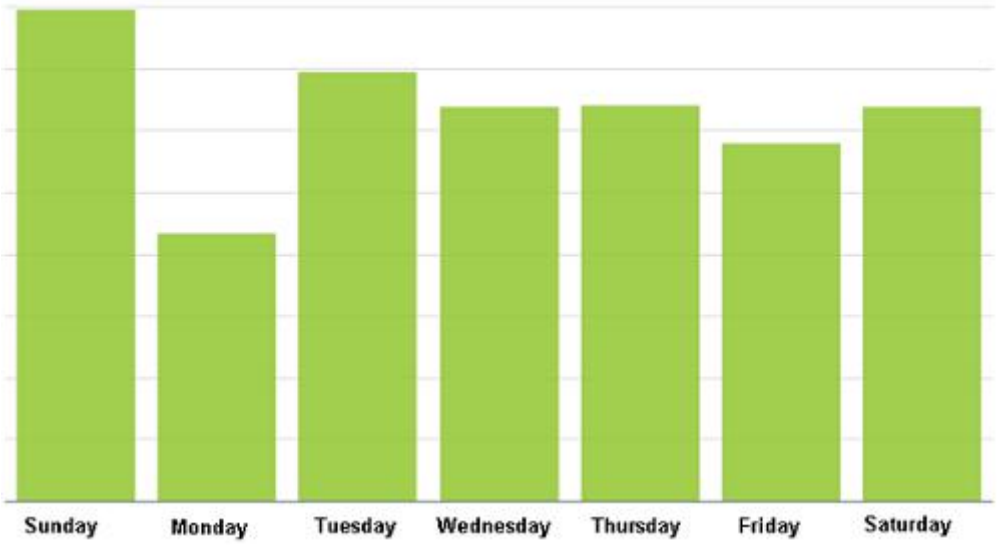

Figure 8. *Weekly electricity consumption.*

It is also possible to analyse the consumption profile during a day. Figure 9 presents a daily electricity consumption for a weekday, Figure 10 for a Saturday and Figure 11 for a Sunday.

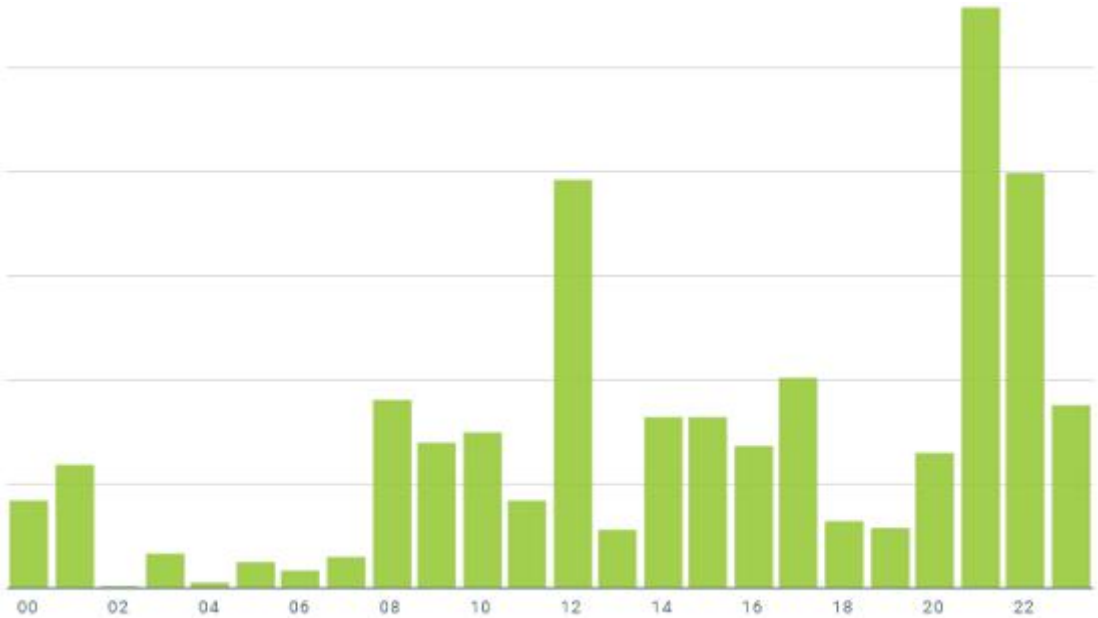

Figure 9. *Daily electricity consumption for a weekday.*

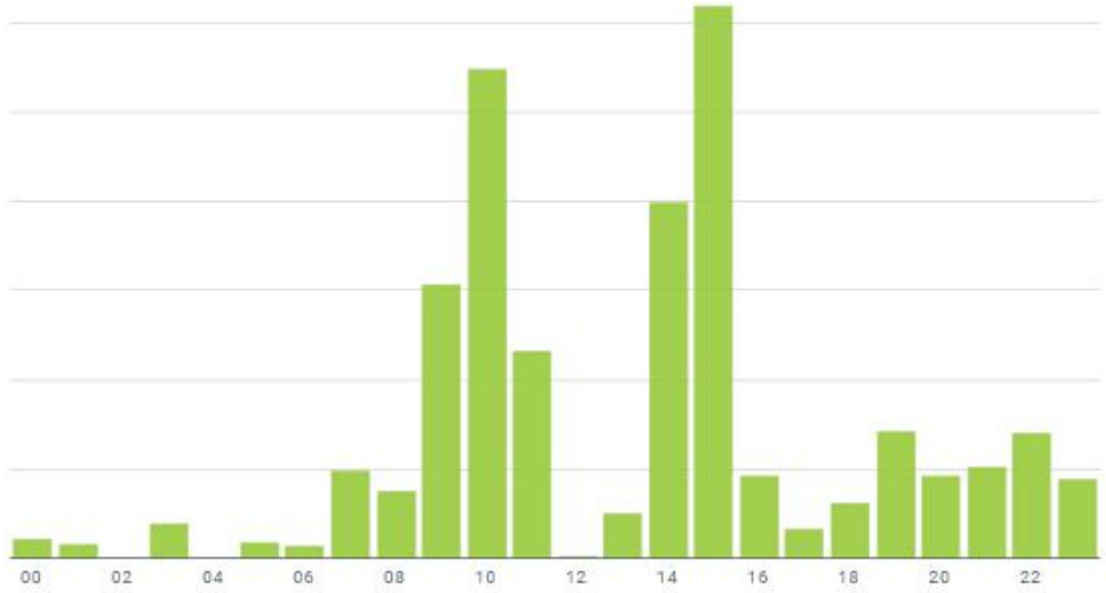

Figure 10. *Consumption in an home office during a Saturday.*

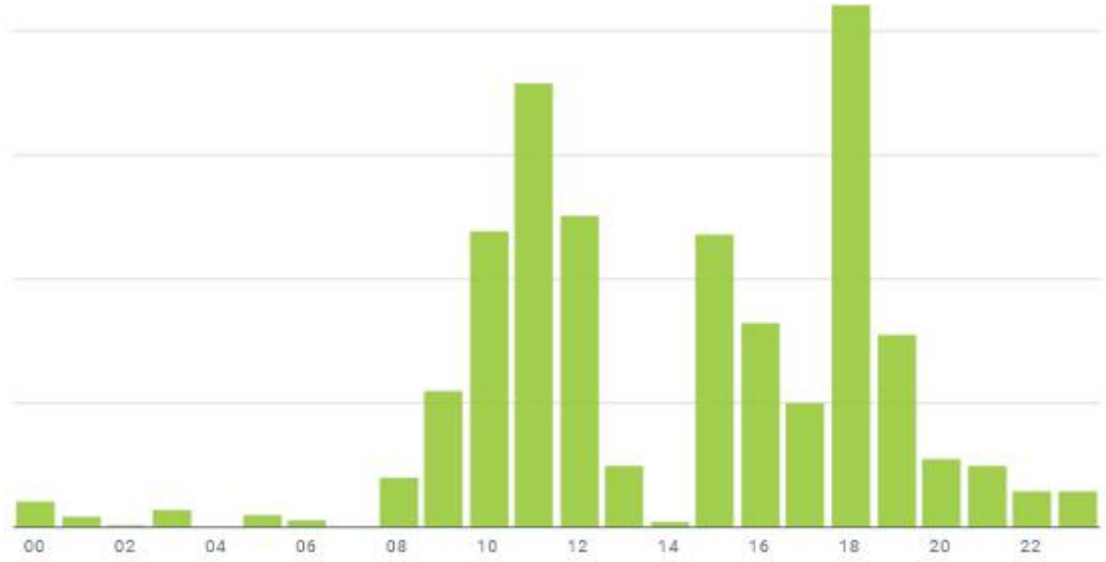

Figure 11. *Daily electricity consumption for a Sunday.*

The IoT systems have data acquisition devices for a single plug or a set of plugs that allows to monitories and control the equipment.

Figure 12 and Figure 13 presents the daily consumption of a set of plugs fully dedicated to a home office of a lecturer. Figure 12 is related to telework without lectures and Figure 13 is related to telework with lectures.

One can easily identify the changes in consumption profile in both situations. The system used was a Cloogy that produced from Figure 8 to Figure 13.

Figure 12. *Consumption in an home office during a full day (telework without lectures).*

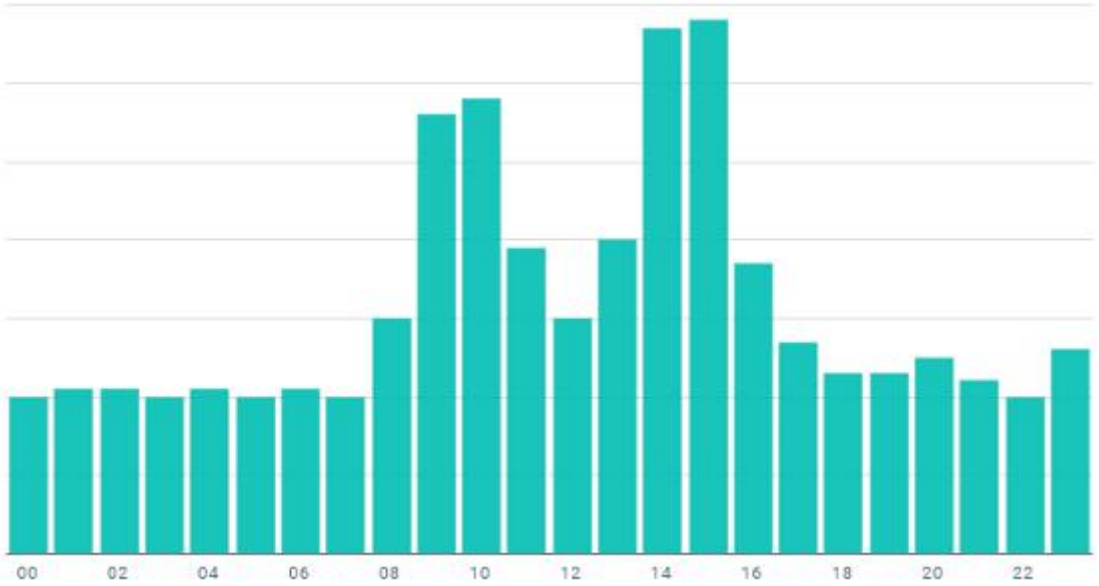

Figure 13. *Consumption in an home office during a full day (telework with lectures).*

7. Conclusions

When operations become more reliable, efficient and profitable, industry and services consumers can differentiate their business from the competition. For households, the economic benefit is evident.

The energy monitoring software allows the calculation of energy costs, in automatic consumption, on a daily, monthly or annual basis, as well as over a period defined by the user. It also allows cost simulation with different tariff structures to assess the suitability of different energy suppliers. When consumers have access to own electricity consumption and can control their own electrical devices in real time, anytime and anywhere, demand-side management key advantages to conventional alternatives of supply arise. Demand-side management is a viable and cost-effective resource that should be part of all electricity supply portfolio planning. Controlling more equipment means greater savings potential. One of the most important functions

is the allocation of costs by department or by process, to assess the impact of energy costs and to identify energy losses. This can be done by the plug option.

The monitor is the best option for users who value the convenience of a digital display, with an attractive and practical design, that integrates energy efficiency into their home experience. Adding smart outlets allows you to monitor the specific consumptions of a larger number of devices and control them remotely. The consumer can access all these functions through the Portal, available on PC, and through the Smartphone or Tablet application.

Designed for those who already have a traditional kit, the renewables upgrade kit allows to equip home or business with the necessary tools to monitor the energy production process through photovoltaic panels, in real time and at a distance. Thus, the consumer can understand how much electricity is being produced by the panels and, on the other hand, what measures you can implement to optimize your consumption and profit from production for self-consumption.

With remote notifications, detailed dashboards, reports, site benchmarking, the ability to track energy consumption and more, IoT systems for Energy allows the consumer to go beyond problem solving to offer customers energy services.

Conflicts of Interest

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