Enerficiency

An Overview

User Led Energy Efficiency Management
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aeltari international

Aeltari International

12a avenue de la Raquette
1150, Brussels
Belgium

www.aeltari.com
info@aeltari.com
Tel: +32 2 880 9486

Abstract:

The purpose of ENERFICIENCY is to produce a software platform capable of interaction with the power network and energy system users to allow better energy control and to improve efficiency use efficiency.

The ENERFICIENCY project is a collaborative research project under the Eureka ITEA 2 framework. Aeltari International is a member of ITEA 2 since December 2010 and a member of the ENERFICIENCY Project Consortium. The ENERFICIENCY Consortium comprises 16 companies & research organisations spread across the EU region and its periphery.

ENERFICIENCY Goals

The ENERFICIENCY project is an initiative to produce a software platform for energy efficiency monitoring and management from the consumer/prosumer-side. It will be capable of interaction with the power network and providing services to allow efficient energy use. The software platform will be capable of integrating many heterogeneous data sources and providing appropriate services to convert these data into valuable **information for energy efficiency management, audit and benchmarking**.

Computational intelligence modules will have data mining services able to obtain energy efficiency indices and to discover patterns in energy use. A challenge in ENERFICIENCY is to consider the bidirectional communication between prosumers and the power network in order to provide an overview of global power use.

We will build this common framework and validate it in several scenarios: industries, hotels, university campuses, administrative buildings and homes. Its development will be based on international recommendations (as the ISO 500001 initiative), experience of consortium partners with a large experience in energy audit/consulting and development of industrial solutions for energy monitoring.

What is ENERFICIENCY's Expected Impact?

To improve prosperity and competitiveness, Europe must focus on energy efficiency at all levels. Households, factories, office buildings and communities represent 70% of world energy consumption. We wish to reduce energy consumption, whilst maintaining activity levels and comfort.

The aim of the project is to lay-out the groundwork for future development of leading European products and services in the energy efficiency field. The ENERFICIENCY project partners represent the seed for the creation of a partnership of companies (Ecosystem) dedicated to maintaining the core of a standard energy platform management system.

The system will monitor all possible elements of local production and consumption of energy, due that in order to generate energy saving advices, detail energy data are required such as: solar, fuel cells, micro-turbines, heating, cooling, lighting, ventilation, air conditioning, PCs, electric vehicles, etc.

Therefore, the ENERFICIENCY project will provide an innovative **platform** for the development of a key piece in the new generation of "Smart Grid products". It represents a great opportunity to do research and proof of concept in the following areas:

- Energy Efficiency
- Smart Metering
- Smart Devices
- Active Demand Management
- Demand Response
- Energy policy management

There will be two variants of the software platform directed towards different market segments:

- **A platform for industrial plants and large scale buildings** that will be used to optimise the energy consumption with predesigned process patterns including all the processes proposed by the new ISO 500001 initiative.

- **A platform for EU citizens**: this platform will be less complex than the previous one but will enable the users to plan and monitor their consumption. This platform will of course be designed to be affordable and to be widely distributed.

Market relevance

Market State-of-the Art

In 2008, the energy industry invested over $4 billion on energy efficiency programmes and smart grid pilots with considerable increases planned for the coming years. Nevertheless, in spite of such investment and initiatives, the impact of the variety of factors that influence tomorrow's energy-efficiency market is not yet fully understood, leaving room for further research and exploration.

There is still much to do because previous efforts at monitoring of consumption have been motivated by the energy utilities wish to *control* their customers! However, throughout Europe, the energy user has witnessed the evolution towards a more open energy market, where a user can gain insights into their energy use, where they can compare energy options and pick their best solution.

Based on best practices and results of many national/international initiatives, ENERFICIENCY starts from the user perspective (behaviour, requirements, preferences, needs, expectations, energy profile etc) and from the current technologies to define an open platform that is able to support the users' energy-efficiency objectives.

Knowing the user's needs, expectations, capabilities, motivational issues etc., allows us to establish new and effective business models that will be accepted by all stakeholders, contributing in this way to reinforce competitiveness. ENERFICIENCY goes further than other recent R&D projects, whose focus has been to get energy efficient models that have been mainly based on price changes (e.g., subsidies for energy-efficient goods) and information disclosure (e.g., mandatory energy-efficiency labels on appliances and vehicles).

ENERFICIENCY allows us to set up indicators, recommendations, etc. that provide information for policy-makers. **ENERFICIENCY will help companies become the leading providers of this kind of technologies and solutions within Europe and beyond.**

All European countries face an important change in the energy market, going from centralized systems to decentralized ones. There will be new stakeholders and/or new and different roles for the existing ones. ENERFICIENCY's aims to deeply analyze new markets, newcomers and the new relationships between them. ENERFICIENCY will improve information gathering and accessibility for all stakeholders and interested parties. It does not matter what their interest might be (buy-sell energy, making business improvements, etc). ENERFICIENCY tools will facilitate decision making so that consumers will benefit from better prices, distributors from lower costs, and governments from better data, etc.

Such reinforced relationships bring to the stakeholders another agent, other role, which may be crucial for satisfying expectations and maximizing benefit. This new role is that of a **BROKER** that will assess each user's energy profile and recommend the best options to buy/sell energy and look for the balance among such consumption and generation. ENERFICIENCY **can bring the creation of new business models, where all stakeholders benefit.**

ENERFICIENCY is targeting two main criteria which should inform the prosumers of the results achieved by measuring:

- The cost savings: by optimising the consumption when Energy is the cheapest, the reduction of the costs should be substantial (**30% is a realistic target**);

- The limitation of the impact on the environment (expressed in percentage of fossil energy used and therefore in produced carbon emission). This criterion is more difficult to compute, but approaching figures can be drawn out from the energy prices computed regularly from the producers as a function of the time and smart statistics).

With a constantly updated dashboard, displaying essential dimensions, users will have the vision of the direct results of their energy purchases and will be motivated (and assisted by energy-efficient service providers) to go further, changing their habits to obtain better results. This is made possible thanks to tangible and measurable energy-awareness criteria that ENERFICIENCY is researching. The energy-efficiency market will then grow naturally on the base of the good results achieved by the first buyers.

In summary, the ENERFICIENCY project provides an important framework for the complete development of an Energy Efficiency Platform, and represents a significant step in the direction of the smart grid concept.

Market impact

ENERFICIENCY will have special licensing agreements where interested parties could install their metering software and build their own specific electricity monitoring and management systems with processes and roles needed for control. Such a platform would be good for starting new businesses (electric utilities) which has been traditionally closed to new-comers. When small businesses need software, they would start with the ENERFICIENCY platform and then add features that can be shared with other businesses. Other utility services (gas, water, heating) can also be potential targets of the platform.

The market is there, it already exists and now it is time to offer solutions: ENERFICIENCY. In order to penetrate the market, ENERFICIENCY provides a holistic solution working closely with stakeholders to define the target areas to be approached.

## *Technology state-of-the-art*

The importance of power monitoring is well known. In the last decade, it has gained importance due to the acute awareness of the financial implications of saving and efficiently using energy. The existence of specific EU directives to reduce CO_2 emissions further heighten needs. In this section the technological state of the of software oriented solutions to improve energy efficiency in buildings and organisations is reviewed

PowerLogic ION Enterprise: Schneider Electric power management solution.

Industrial solutions

In industry, several automation manufacturers have developed energy monitoring solutions, aligned with their business model, with enhanced visualisation, reporting and data management capabilities.
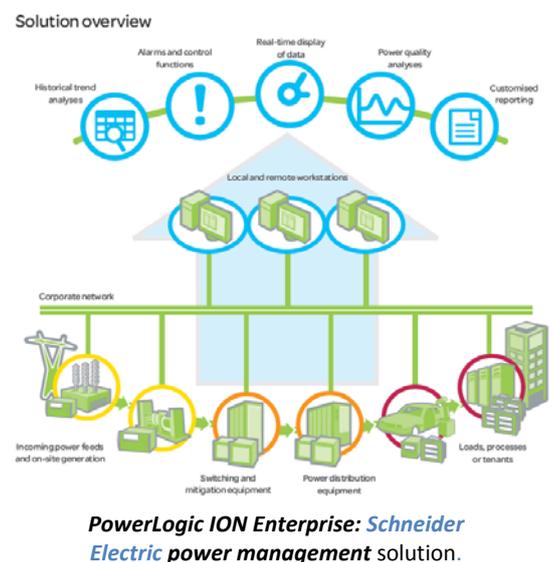
For example, *Power Logic ION enterprise* (Schneider Electric) or SENTRON (Siemens) are focused on electric energy monitoring in general allowing hierarchical connexion of power meters for monitoring and control with data access through corporate networks. On the other hand, *Corporate Energy Management Application* (Wonderware) is designed as an energy data integration platform capable to connect with ERP systems and it is addressed to all energy types including power, water, gas, chill, air, and steam at both main and sub-meters.
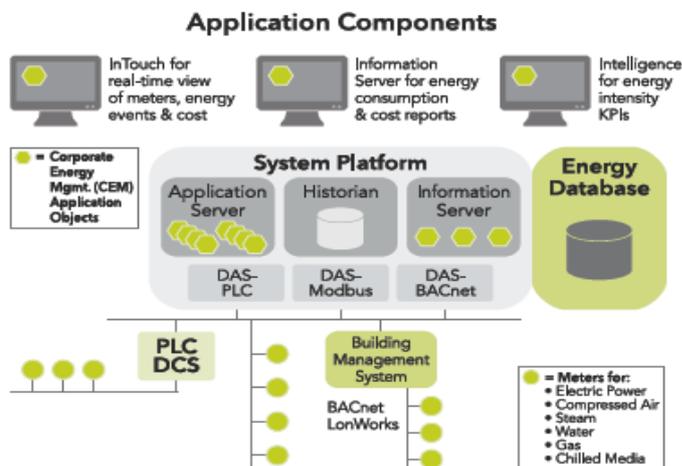
Components of the *Wonderware Corporate Energy Management Application*

The Schneider solution is designed to work with proprietary equipment (power meters). Whereas Wonderware, a SCADA provider, tends to be compatible with the most common industrial protocols and control automation devices through the Wonderware System Platform.

These and other existing solutions are designed to deal with energy data and provide more or less integration with other company information systems for further analysis.

ABB offers products for this purpose, e.g. cpmPlus Energy Manager. The cpmPlus Energy Manager is winner of the 2010 Control Engineering "Engineers' Choice" Award, helping customers in all industries to monitor, manage and optimize their energy usage for maximum efficiency and cost savings. It addresses the business side of energy management by producing accurate energy demand plans and taking advantage of them in energy supply planning and optimization.

Methodology issues and guidelines to address energy efficiency processes

Worldwide there is intensive work on the development of guidelines for conducting energy audits, action plans for energy management, lighting equipment, HVAC and others technical guidelines, benchmarking, database, etc. They share the common objective of providing tools for improving energy efficiency in equipment, facilities, buildings, organizations, neighbourhoods, cities, etc. Some of those organizations leading those actions are: European Green Building Programme, Efficiency Valuation Organization (EVO), Greenhouse Challenge Plus (Australia), RETScreen International to the Natural Resources (Canada) or the U.S. Department of Energy.

Forty countries are participating in the definition of the ISO 50001 Standard. It addresses topics as energy efficiency, energy performance, energy supply, procurement practices for energy using equipment and systems, energy use, measurement of current energy usage, implementation of a measurement system to document, report, and validate continual improvement in the area of energy management. This standard will imply a step further to convergence and the integration of existing solutions provided by companies specialised in power management, sensing metering, domotics, HVAC, and communications among others.

ISO 50001 provides organizations and companies with a common framework for efficient management of energy including assistance for the better use of existing energy-consuming assets and promoting energy management best practices throughout the supply chain, assistance to evaluate and prioritize energy-efficient technologies (energy efficient devices, machinery and procedures) but also guidance on benchmarking,

measuring, documenting and reporting energy improvements and impact and facilitates transparency and communication on the management of energy resources.

Energy efficiency software tools

Today the analysis of energy consumption in different contexts and control scenarios is studied by simulation before intervention. Many software tools for evaluating energy efficiency are available, eg.

- EnergyPlus is a popular and free stand-alone simulation program (sponsored by the U.S. Department of Energy) without a 'user friendly' graphical interface for energy simulation based on models for heating, cooling, lighting, ventilating, and other energy flows.

- Other similar packages as Energy-10 are oriented to commercial and residential buildings that integrates daylighting, passive solar heating, and low-energy cooling strategies with energy-efficient envelope design, and mechanical equipment whereas others as SPARK (oriented to simulation of short time-step dynamics) have a more specific orientation.

- Some companies as LUTRON (http://www.lutron.com/) offer integrated solutions for efficiency management covering any aspects related to lighting.

Recently the IEA (International Energy Agency) has created a number of procedures for testing and validating building energy simulation programs. Some of these procedures have been, or are in the process of being, adopted by international codes and standards organizations for certification of software.

Underlying technology for developing ENERFICIENCY

ENERFICIENCY focuses on the development of an open information platform with interfaces and communication protocols to guarantee the interoperability between information ICT tools and systems for energy efficiency monitoring and management. Interoperability has to be guaranteed at all different technological levels to provide consumers/prosumers with greater flexibility in selecting services and interacting with the power network. This technological challenge will be addressed at different levels using and integrating appropriate technologies:

Architecture Level: ENERFICIENCY platform will be designed as Service Oriented Architecture (SOA) mainly implemented as Web Services providing high level interfaces, minimizing the required communications by using a coarse-grained architecture, and by taking into account hardware device, security and deployment constraints.

Open source solution will be used to guarantee the openness and accessibility of the developed solution.

Communications and Protocols Level: Access to multiple, diverse and distributed sources of information (power meters, energy monitors, power management applications, sensing devices, HVAC and illumination control, simulators, data bases, etc.) will be guaranteed by the integration of an heterogeneous communication infrastructure (PLC, WiFi, 3G, GPRS, ADL, RF, ZigBee, fiber optics, etc) and the development of associated protocols. Existing standards and open source development will be the backbone to facilitate the integration at the different levels.

Data Management and Processing Level: Definition of the data model will take in to consideration existing initiatives as DATAMINE, the Smart Meter Data Model (Openmeter) or Building Information Model (BIM) to improve the penetration of ENERFICIENCY platform in other business models and to guarantee the interoperation among open source applications. Data management includes real-time management

(acquisition, transmission and data base access) to interact with energy devices and continuous sensor network monitoring at the lower level.

Innovation

The ENERFICIENCY project provides a complete energy management system solution for the **end user** of energy system. The system end-user ranges from an individual to a large manufacturing industry.

The ENERFICIENCY approach is innovative as it is different from the existing state of the art. The present technology is focused on data gathering and subsequent expert analysis. However, the ENERFICIENCY approach also considers all the management elements of the energy system, not just the energy data processing. **Energy management is a cross-departmental process**. Organisational aspects such as document management workflows, culture stimulating portals, collaborative working in innovative initiatives, web 2.0 supported internal and external communities, comfortable user interfaces, are key tools to maintain an energy programme in the organization.

To summarize the main innovation points within the scope of the ENERFICIENCY project:

- Extension of Energy-Management Applications to the energy consumer. The practical applications of this project aim to develop features and services that will enable the energy user to design its **own energy management processes** (from patterns provided), configure his (her) consumption profile, to monitor its evolution and to make smart decisions based on this information.

- Support of all aspects of the future **ISO50001** for Energy Management, facilitating the auditing and all ISO certification process. The new market opportunity created by the imminent worldwide launch of this government's supported standard requires innovative process management solutions, especially for large organisations.

- Research activities conducted within the project will evaluate the different channels and **business models** for making this information available to the final consumer (Smart Meter Displays, Internet, Digital Video Broadcast…), measuring the level of penetration of these channels in the different market segments targeted.

- From a technical point of view, the purpose of the project is to provide a flexible platform that supports the largest possible number of **energy data standards** (meter devices, protocols, technologies, etc.) and that can be integrated with the new generation of smart devices or smart metering devices. For this purpose, the project will take into account both, the leading devices and technologies that are currently available in the market, and the results from other projects standardization efforts, such as the European Framework project "Open Meter", which is currently being carried out by large utilities and metering device manufacturers. In order to achieve this goal, a standard data record has to be designed and approved by the different actors and stakeholders.

- Introduction of **computational intelligence and optimisation** methods in **energy efficiency monitoring and decision support** provide an avenue for the generation of new knowledge and methods in this field. As forerunners in the technology, we will improve the data analysis and processing algorithms to evaluate and improve the energy management system, as well as the security techniques and algorithms needed to increase trust in final users and companies providing energy services, in order to authenticate them according to their profiles and keep their specific information safe.

- New concepts facilitating **asynchronous processing in energy management**. The tools that will be delivered within the scope of this project will facilitate the emergence of the new decentralized

energy paradigm, **aligned with the smart grid implementation**, which it could otherwise not be achieved. We also propose the inclusion of a Business System to make the network more intelligent with regard to the use of energy. In this way, we will improve the data collection, monitoring and control capabilities for the economization in terms of energy consumption and cost of services.

Major expected results

The achievements of the project will be in the domains of:

- An open platform architecture (SOA) for the management of energy data and processes in industrial and service organisations, buildings, facilities, households, etc.
- Design and validation of core and pilot software modules (integrated in the common platform) to assist energy efficiency monitoring and decision support mechanisms to assist corrective action proposing, including the process to support the fulfilment of the future ISO 50001.
- Systematisation of the procedures and methods applied by the expert energy engineers to deal with certification and consulting activities.
- Proposals for new monitoring procedures, requirements and strategies for specific scenarios (such as hotels, office and administrative buildings, malls, etc.).
- Definition of methodological guidelines to assist energy efficiency consulting activities, including the definition of scalable/parameterised energy efficient profiles.
- Standard methods for integrating environmental sensors.
- Algorithms to precisely define (in near real time)/predict the energy needs and the use of the various devices such as illumination, air conditioning/heating etc.
- A reference implementation of the ENERFICIENCY platforms for the various types of end user profile.
- Local data processing for statistics/exploitation purpose, including the relations between environmental data/energy needs and possible lessons learnt from all the data sources.
- End user interfaces: customizable user interface capable of displaying real-time data, analytics, KPI, special event alerts, etc.
- Automatic mechanism for detection of abnormal situations and proposals of solutions.
- Contribution to standardisation of efficient building monitoring by definition of an open source prototype platform.
- An Intelligent Energy Management Methodology for Information Systems (IMIS) and a set of software engineering best practices for companies to envisage a wise and forthcoming energy management policy face to the integration of Information Systems.

The results and achievements of ENERFICIENCY will be highly visible due to the involvement of major European large groups (INDRA, EADS), the extensive network of relations of research organizations and universities and the ecosystem of IT producers. In addition, the results will be measurable, as the pilots will take place in real plants/buildings where quantifiable comparisons will be made between the situation before and after ENERFICIENCY.

Moreover, the achievements of ENERFICIENCY will be implementable in the short term. The platforms developed by ENERFICIENCY are an important step in the implementation of national/regional smart grids at mid and long-term but they can be implemented and used well before the overall smart grid is operational. It is expected that first ISO 50001 certifications will take place in 2011. Such a system in "stand-alone" mode (i.e. connected to the legacy energy system), will enable an important energy saving on the energy bill, which will make a huge impact at country level and will support the users in their evolution towards "greener" habits.

How is ENERFICIENCY Organised & Funded?

ENERFICIENCY is a well balanced consortium of 16 entities (4 large companies, 8 SMEs and 4 research/university institutions) from 5 countries: Belgium, Estonia, Finland, France and Spain. The participation of 5 different countries will provide an exceptional framework to establish common standardisation guidelines and at the same time will serve to detect regional/national requirements derived from regulation, weather and building particularities.

The ENERFICIENCY project (ITEA 2 10009) is a collaborative research project running under Eureka ITEA 2 framework.

ENERFICIENCY was launched in November 2011 and will end in early 2014. The ENERFICIENCY consortium is composed of 16+ European organisations and comprises large companies, SMEs, research institutes and universities. The research effort is supported in part by the different European public authorities involved in the project.

The partners within a consortium engaged in an ITEA 2 project are funded directly by the governments of their respective countries, according to national funding procedures. In Aeltari's case this is InnovIRIS, the R&D funding authority of Brussels which funds 60% of Aeltari's work.

EUREKA, founded in 1985, is a long-established European network, present in 40 countries. The European Union is one of its members. It is committed to improving the competitiveness of Europe through the support it offers to organisations – mostly businesses, which perform close-to-market R&D.