



ENCOURAGE

Embedded iNtelligent Controls for bUildings with Renewable generAtion and storaGE

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Executive Summary

This document describes the intermediate analysis and assessment of the market for energy management systems and smart metering networks, which represent the target markets for the ENCOURAGE partners. Both markets are foreseen to grow substantially, and it is also foreseen that the ENCOURAGE results will contribute to improved market positions for the partners.

The participating university partners also expect improved market positions within research grants and research-based education.

A new preliminary market idea on middleware for energy management systems is currently being discussed among the partners. The basis for the discussion is the middleware as developed in the project. This idea will be further discussed and finalized during the final project year.



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1. Introduction

This report describes the intermediate analysis and assessment of the markets of energy management systems and smart-metering devices for the ENCOURAGE project partners. Following a short description of the markets in Chapter 2, the individual partners present their contributions as follows:

ENEL, ENORD, GNERA, ATOS, ESVAL and EZMON present analyses and assessments of the energy market and the market for energy management systems. The overall joint conclusion is that the markets are rapidly growing and that the expected results of ENCOURAGE will improve their positions.

SEL, ISA and ADV present analyses and assessments of the market for smart-metering devices, and the overall joint conclusion is the expectation of a growing market and also that the expected results from ENCOURAGE will improve their market positions.

AAU and ISEP expect to adapt the results into their study programmes and into their further research strategies.



2. Market Segments

The ENCOURAGE project and its partners have focus on the two market segments: energy management systems and smart metering networks as follows:

Energy management systems consist both of energy brokerage systems and systems for supervisory control:

Energy brokerage – The dynamic economic environment of the future smart grids will bring new challenges to individual participants in the energy market. The ENCOURAGE project will therefore aim to enable the building owners to play an active role in this market and operate outside the traditional envelope. Today's energy efficient buildings can frequently cover part of their energy consumption by their own generation, utilizing usually renewable energy sources, or they can sell their energy surplus back to the grid. This form of distributed generation from various, usually small-scale sources is a big challenge for electricity distribution companies, and therefore it makes sense to coordinate the overall balance between generation and consumption locally, in given district, campus, or neighbourhood. The energy brokerage module to be developed in the ENCOURAGE project will enable buildings to coordinate with other participants in the electricity market and exchange electricity at the local level. Any time when a building requires more electrical energy than is the threshold specified in the tariff, it will have the capability to communicate directly with neighbouring buildings or local producers and negotiate with them possible use of the electricity produced locally in their premises.

Supervisory control strategies – Modern buildings are often equipped with a number of subsystems (heating, air conditioning, heat pumps, lighting, etc.) and individual appliances – each having their own specific functionality and energy consumption profile. The project will develop advanced energy management strategies, which exploit the capabilities of the appliances and subsystems and coordinate them in an optimal way while not compromising the desired level of comfort. The solution will take tariff structure and pricing information from the market into account while optimizing the use of energy. Several differentiated strategies will be addressed:

- Load management will focus solely on reduction of the energy consumed in buildings
- Balancing generation and consumption will also consider generation elements – i.e. renewable generation sources utilizing wind or solar, or conventional cogeneration (CHP)
- Use of passive and active storage elements will enable dynamic control strategies such as night pre-cooling (passive storage mechanism), or using electric batteries for peak demand reduction (active storage mechanism)
- Advanced strategies for microgrid systems may consider all generation, consumption and storage components. This type of optimization will be conducted in a predictive



manner, taking into account short-term forecasts of future load demand and renewable generation.

Smart metering and building networks - The individual discrimination of electrical loads in the building (sub-metering) is a fundamental step towards the development of any smart energy consumption strategy. However, the high costs associated with placing individual meters in each device make this approach unfeasible. Thus, it is the goal of this project to develop sub-metering and control technologies (signalling via power supply, or infrared ports) that are both simple and economical, having potential for wide-spread adoption by building owners and other end users. The project will utilize PLC or wireless networks like 6LoWPAN, Z-Wave, or ZigBee for connecting indoor sensors (temperature, humidity), controllers, and other devices. The metering information will be made available for the event-oriented middleware that will support basic as well as advanced processing of the raw data.



3. Individual Assessment and Analysis of the Market

Below, the individual partners present their present assessment and analysis of the market as seen from their own perspective.

3.1. Energy management systems segment

3.1.1. Energi Nord A/S

Energi Nord A/S (ENORD) is a Danish energy trading and counselling company based in Aalborg. Energi Nord is co-owned by the two energy companies Nord Energi and HEF. The primary business objective of Energi Nord is to act as the electricity distribution company on behalf of its owners, while managing operational and customer related tasks. Energi Nord co-owns Denmark's largest trading company, Energi Danmark. Energi Nord was founded on 16 January 2001. However, its competencies within the field of distribution of electricity can be tracked further back in time. Geographically, Energi Nord's main presence is in Northern Jutland, but the company provides services to other customers throughout Denmark. Currently, Energi Nord distributes electricity to 228,000 customers (both private households and large businesses). This supply equals 2,7 TWh. Energi Nord employs more than 74 people, generating a turnover of DKK 550 million (EUR 73 million). Energi Nord's expertise encompasses sales and billing, energy advisory service, and customer service.

In Denmark, customers pay the highest taxes and public fee for electricity in Europe. At the same time, the interest in electrical energy is low, firstly because it is considered a natural thing to have electricity, and secondly because it is a generic product.

A smarter grid can make life easier for customers with online electrical appliances that can turn on and off depending on whether the electricity price is high or low. Or if for example, they can control their appliances via mobile phone. The highest value for customers is if they always get the cheapest price of electricity without compromising on comfort. Customers will also have many more options for comfort and convenience, as they do not have to be present when heat or washing machine is turned on, for instance.

Experience shows that customers will not compromise on the comfort that power gives them. Therefore we cannot expect the customers to reduce their electricity consumption by themselves. On the contrary, electricity consumption increases as the technologies grow, but smart grid delivers value in terms of both energy savings and sustainability. At the same time it will provide a completely different experience and awareness of electricity consumption.



The main business idea for ENORD is to have a system where the costumer can manage his energy - both consumption and production - so he will use the produced energy when it's produced and be able to use the overall surplus energy on the grid. By installing the ENCOURAGE platform the user should be able to archive energy savings.

The market for ENORD is the private customers who have some kind of energy production or have the possibility to save energy. If the ENCOURAGE product has the right potential and the right price, we estimate that it can be sold to approximately 5% of our smaller customers. In our utility company we have approximately 200,000 potential customers, corresponding to approximately 10,000 customers with the following profiles:

- Residential where there is energy production
- Smaller industries where there is production
- Residential where there are possibilities to save energy

The main competitors are the smart house companies who offer the same products and solutions as ENCOURAGE and the risks for market success are:

- The products will be too expensive
- The user interface is too complicated for the users

3.1.2. GNARUM

GNARUM is an IT Services Company specialized on renewable energy. GNARUM is aimed at developing IT tools for energy producers, utilities, operators, and marketers providing individualized solutions for optimal management of renewable energy assets, improving daily functionality and profitability in energy markets. GNARUM's suite of offerings includes accurate supply-side forecasting and demand-side management, efficient and effective monitoring and operation of generation plants, and management of energy distribution systems. Hence, the main business idea is to provide IT solutions for the integration of renewable energy sources into electricity markets, with a service-based approach.

The main markets developed by GNARUM and linked to ENCOURAGE developments, are:

1. Generation forecasting for intermittent renewable plants
There are few commercial solutions for energy forecasting adapted to renewable plants. Some of the major commercial suppliers of forecast renewable (mainly wind) services are: Meteológica (Spain), Garrad Hassan (UK), 3TIER (USA) or Enfor (Denmark).
2. Buildings energy consumption forecasting
A relevant number of commercial Energy Management Software (EMS) for buildings includes some kind of consumption forecasting. GNARUM's approach is, in contrast to most markets solutions, to integrate consumption forecasting in a more global energy management platform, including generation.



3. Energy management for renewable plants, electric vehicle and smart grid and other IT services for renewable production plants.

An Energy Management Software (EMS) is an enterprise-scale software aimed at monitoring, analyse and reduction of energy consumption. The EMS market is constantly growing since last years and today more than 200 international firms offer different types of software, including features such as monitoring and sub metering, load or plug control, demand-response mechanisms, bill management, enterprise energy management or carbon accounting, for different customer types (residential, domestic, large buildings, companies, industrial...). Generally not all features are offered together in the same tool. Some of the lead vendors are: IBM, Schneider, Carbon Systems, SAP, Hara, and Verisae.

Moreover, many free applications are available online with general advises regarding safe energy, without forecasting or monitoring.

GNARUM is working worldwide, especially Spain, Europe and USA. For ENCOURAGE exploitation areas, the focus will be on Europe as main potential market, because of the European legislation (and for example the target 20/20/20) motivating energy efficiency real measures, high public awareness concerning energy and sustainability issues and, of course, because of the raising energy prices in the EU, affected by their petrol and gas reserves.

The market profile and application framework varies strongly from country to country, even inside the EU, depending on public awareness about energy efficiency, legislation and energy prices trends, among other variables. For example, in Spain the focus is on energy savings (mainly because there are no proper law regarding the net consumption), whereas in Germany there is a much bigger market for combination of solar photovoltaic production and energy consumption.

The main exploitable areas of ENCOAURGE for GNARUM are

- Consumption forecasting
- Small-scale generation forecasting
- Energy monitoring and data acquisition
- Load control
- Energy Management Software for energy meter readings display, analysis and control
- Energy brokerage: intelligent analysis of loads and production, taking into account energy prices and demand curve flattening

and the target customers identified for these areas are:

- Industrial facilities with both energy generation and consumption
- Large buildings (residential, offices, campuses....) with both energy generation and consumption
- Large buildings or industrial facilities with only energy production OR consumption
- Energy Service Companies (ESCOs) or energy managers
- Small-medium size utilities



Some of the innovations addressed by these exploitation areas are:

- Combining energy production and consumption: interesting added value for green businesses and buildings with self-production.
- Including in the same platform monitoring, analysis and control
- Combining monitoring and energy planning with real energy prices. The demand ‘flattening effect’ can be very interesting for utilities.
- In-depth energy analysis tool with automated KPIs and possibility of ad-hoc KPIs definition: interesting tool for energy managers and ESCOs.
- Inclusion of electric vehicle.

As for the possible risks of further development of the market is foreseen:

- Legal framework: the electricity legal framework is quite changing. Some drivers are essential for the spread of these applications, and their changing or lack of development can be a risk. For example, in Spain the law of net metering will be a definite boost for domestic or building renewables installations, but its approval is still pending.
- Energy prices: electricity price follows a growing trend, but some gas applications could lower gas energy price, switching some electricity applications to gas and discouraging energy savings (low risk).

So far, GNARUM has obtained the following results within the ENCOURAGE project:

- Development and fine tuning of generation forecasting for large renewable plants
 - Adaptation of generation forecast software to small-scale plants
 - European market prospective
- By the end of 2013 the expectation is to achieve:
- Development of data models and ETL structure for a smart grid energy management Business Intelligence tool.
 - Development of a usable dashboard for energy manager applications.
 - Development of a consumption forecasting algorithm and integration in energy management systems
 - Integration of different modules.

By the end of the project, GNARUM expects to have obtained a commercial energy management tool integrating data acquisition, consumption and production forecasting, energy intelligence and control, and energy brokerage. GNARUM also expects to start the commercialization phase at that phase.



3.1.3. ATOS

Atos Spain S.A. (<http://atos.net/>) is an international information technology services company. Its mission is to advance the performance of its clients by offering innovative solutions that deliver measurable business value. Through High-Tech Transactional Services, Consulting, Systems Integrations and Managed Operations, and its deep industry knowledge, the Group is able to provide innovative and individually tailored end-to-end IT solutions. The company's annual revenue is EUR 5.1 billion and it employs 49,000 professionals in 40 countries. Predominantly based in Europe, 71% of 2009 Group's revenue was generated by multi-years contracts in Application Management, Managed Services, High Tech Transactional Services and Medical BPO. **Atos Research & Innovation (ARI)**, node of R&D at ATOS in Spain, is a point of reference for innovation for the whole ATOS group. Over the years, a strong partnership with several public and private institutions from all European Countries has been consolidated. ARI work is focused on several R&D areas: Service Oriented Middleware Infrastructures, Cloud Computing, Grid Services, Semantic Technologies, Open Source & Software Engineering, Future Internet, Security, Media, Innovation Management, eLearning, Biotechnologies & Healthcare, Transport & Logistic.... Thanks to our extensive background on R&D&I, Atos Research & Innovation leverages, for both ATOS staff and customers, research activities that are being performed on the newest technologies, and takes the outcomes of this research to specific projects with customers, introducing innovative elements in their business processes.

ENCOURAGE follows the idea of the smart grid. These systems of interconnected technologies enable two-way communications between different parts of the electric power system, from generation through to the appliances that consume electricity. It includes:

- **Sensors along the transmission and distribution system** to allow grid operators to know the condition of the grid in any given location.
- **Smart meters**, also called “advanced metering infrastructure” (AMI) in homes and businesses that can automatically measure and report electricity usage throughout the day.
- **Appliances that can respond to signals** from grid operators or their owners in response to events on the grid.

This system of communication gives grid operators to have a greater awareness of the condition of the electrical grid at any given location, compared with current, largely analog, systems. It also allows consumers the opportunity to have a better understanding of their own energy use – potentially down to individual appliances' consumption.

These systems also help consumers better understand their own energy use, which in turn allows consumers to identify energy saving opportunities.



Relevant target markets are national and international energy users of family houses, neighbourhoods, general buildings, enabling them to deliver measurable improvements in efficiency, quality and cost reduction.

ATOS covers multiple markets such as banking, financial services, insurance, media, oil and industry, public sector, retail, telecom, transport, utilities and health. As a major software integrator, ATOS develop every day millions of code lines within the different sectors. ATOS could perform its own developments to build such environments in similar platforms for customers in different sectors of application.

ATOS has identified the following potential exploitable areas: Energy Saving, Energy Grid Efficiency and Micro energy trading. This is supported the current activities within the IoT area where ATOS already has a bevy of successful IoT implementations and where ATOS features as one of the top 10 leading organizations working in the IoT area.

Smart grid technology deployment provides an opportunity to stimulate economic growth while promoting environmentally sustainable approaches to the generation and consumption of electricity.

Smart grid policy lowers the cost of power by lowering operational and capital expenditures and enables greater integration of renewable generating resources and energy efficiency. It also lower the outflows of expenditures for imported energy, build human capacity in the growing technology, and reduce CO2 emissions.

Electricity generation is currently highly dependent on fossil fuels, which is responsible for a relatively large percentage of emissions.

Many of these measurement assets, such as the AMI (advanced metering infrastructure) and communications systems are essential to performing basic smart grid functions, such as automated meter reading and sending price signals.

Measurement and verification benefits are thus an added advantage, requiring minimal additional cost.

The incremental cost is limited to the cost of additional sensors that may be needed and the integration of data from existing sensors to feed central analysis software. In some cases, measurement and verification software can be distributed to the end-use points, rather than a central point, to reduce the need for a more capable communications system.

Using smart grid approaches can potentially lead to significant reductions in carbon footprint from the power sector, through both increased energy efficiency and increased penetration of non-carbon based renewable energy resources.

Consumer information and feedback systems can also be coordinated with AMI and demand response controls to motivate conservation and energy-efficiency measures.



The Exploitation results might be in risk if the system would not avoid important threads, so it guarantees energy supply and grid stability. ENCOURAGE needs to assure the avoiding of the following threats:

System-level threats: it must be assured unauthorized commands to meters or other control devices in the grid. These actions might cause denial of service (DoS).

Service-level threats: When electrical service could be stolen; that is, power is diverted without the utility provider being paid, for instance, a user could subvert a meter to report low or zero usage.

Lack of privacy and confidentiality: In this type of threat, personal and identifiable information could be revealed to unauthorised people.

3.1.4. ESVALL project SA

ESVALL PROJET SA will deliver the results achieved within the ENCOURAGE project to its clients. Results from the ENCOURAGE project will enable to achieve better energy efficiency in buildings by optimizing the energy resources including both renewable and conventional energy. Easier networking of various control components and smoother integration of generation and storage devices with the typical building infrastructure will also enable better energy efficiency in buildings. Taking into account that the Spanish government has recently halted subsidies for renewable energies, Energy Service Companies (ESCOs) hold a great opportunity to start new business models. Thus, results achieved in the ENCOURAGE project will be useful for existing Energy Service Companies (ESCOs) and ESVALL PROJET will deliver them to related stakeholders.

3.1.5. ENEL Ingegneria e Innovazione

In the following we analyse the energy efficiency issues in residential and tertiary sectors, referring to the Italian context and taking into account regulatory, technological and market aspects, with particular attention to the diffusion of building automation systems [1].

A description is given of how the spread of distributed generation of small size is evolving in Italy, what are the issues and what could be the role in this context of sustainable energy efficiency of buildings.

Energy efficiency in residential and tertiary sectors

The technical potential for energy efficiency associated with the residential and tertiary sectors covers 60% of the total potential; in these contexts interventions are fundamental for the achievement of targets for reducing emissions. In Italy the application plan on energy efficiency (PAEE) plans to move from 166.5 Mtoe of energy consumption in 2005 to 133 Mtoe in 2020.

From the building sector point of view, 88% of the buildings are residential ones, the buildings accounts for 36% of total energy consumption and almost 70% of buildings were constructed before the introduction of any law on energy efficiency in construction (1976). Italy is in first place in Europe in the ranking of average emissions of CO₂ in buildings (before France and Spain)[1].

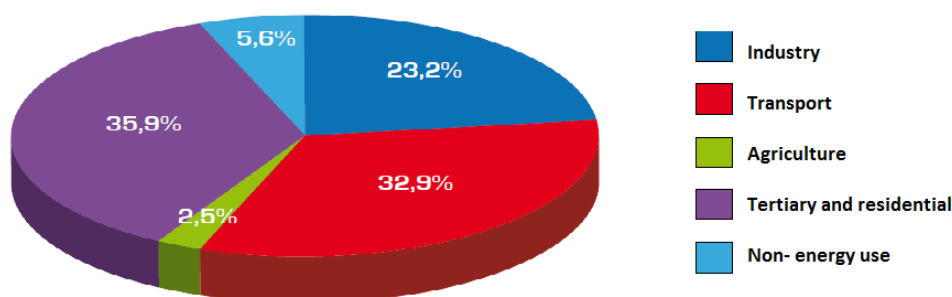


Figure 1. Breakdown of energy consumption in Italy in 2010 (Ministry of Economic Development)

Current Legislation and Regulation

Existing legislation tends to consider energy efficiency as part of a building's value, starting from the performance computation up to their monitoring and increase. The performance evaluation includes heating, cooling, water heating and lighting.

As far as heating and hot water are concerned, energy performance indexes must be certified, while for cooling the casing is evaluated only qualitatively. Looking at renewables, today in public buildings renewable integration is required with different indexes depending on whether thermal energy (50% of consumption for hot water + a % of consumption for hot water, heating and cooling) or electric energy (1kWp / 80 m²) is concerned.

The energy efficiency certificates (Italian acronym TEE) are an additional incentive mechanism: they are compulsory to electricity and gas distributors, and can be purchased from ESCOs or individual subjects with energy managers. To date, despite the TEE quote is increased by law, their availability on the market is low and fragmented.

The latest legislation is carrying on until 2014 an incentive mechanism based on fiscal deductions. A demand for simplification urges for the incentive system and a requirement for differentiation of the incentives which takes into account the actual degree of structural impact and the actual cost of intervention.

As for building automation, in Italy there is no specific technical standards to which a building automation system should be subject, as for the electrical and mechanical systems. On a voluntary basis, the European standard UNI-EN 15232 'Energy performance of buildings-Impact on Building Automation, Controls and Building Management' is used: it estimates the savings which are achievable through the application of automation systems in new or existing installations, dividing



them into four classes of efficiency (from D to A) and into the different applications (heating, cooling, lighting, ventilation and air conditioning).

Economic analysis of different technological solutions

The solutions for energy efficiency in buildings can be divided into two types:

- 1) reductions of energy consumptions
 - Equipment
 - Building Structure
- 2) reduction of the supply dependence, keeping the same consumption level
 - Electricity generation
 - Thermal production

The building automation is part of equipment intervention, along with lighting, heat pumps, condensing boilers, and appliances. The economic analysis in the first case takes into account the cost of the saved kWh while, in the second case, the cost of the generated and sold kWh is compared with the cost of the purchased or traditional boiler generated kWh. Two separate cases must be taken into account for already existing or new buildings.

As regards residential buildings, automation is today affordable only in the case of new buildings, although with a high complexity adoption, while interventions related to lighting, condensing boilers, heat pumps are considered as very affordable.

At present, there are quite a few implementations of such systems in the Italian territory: only a 0.7% at residential level, against the 10-15% in other types of buildings.

The achievable savings through these building automation systems are quantifiable in a 15% of electricity demand and a 26% of heating requirements for residential buildings, against respectively 10% and 28% for non-residential ones [1]. In fig. 4 the savings achievable by the adoption of class A systems are reported.

The main obstacle in respect to a greater spread of these systems is the high cost of the initial investment. There is also a significant difference in economic affordability between the application in new buildings or existing buildings, due to the invasiveness of intervention. Convenience is clearly higher for thermal energy savings.

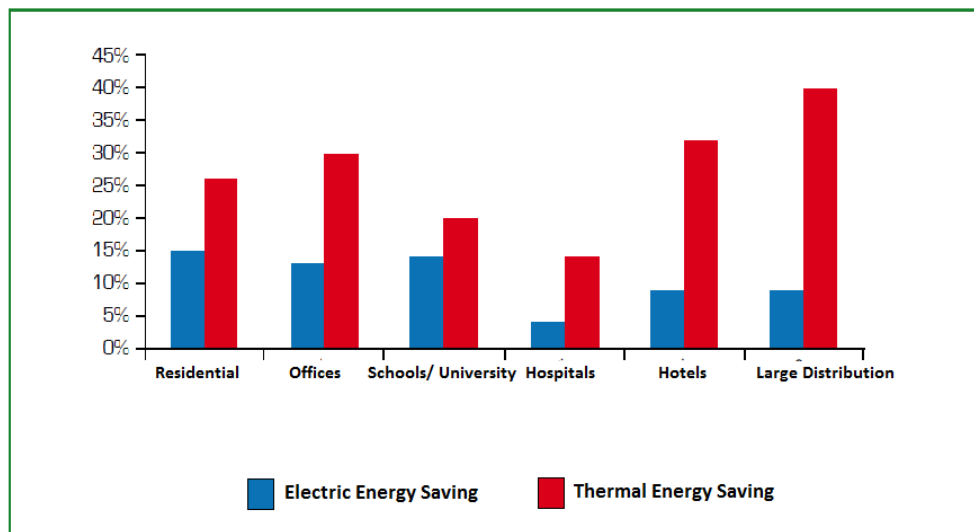


Figure 2. Achievable savings with the class A building automation system

Market Analysis

The analysis results reported here refers to the application of the most cost effective solutions and the consequent evaluation of the theoretical potential energy saving and the expected penetration degree. The reference horizon taken into account is 2011-2016.

Starting from a potential of 150 TWh /year of electricity savings and 60 TWh /year of thermal energy, achievable within 2016, a penetration of 14% for the electric potential and 18% of the thermal potential is provided.

Lighting and condensing boilers are considered the highest penetration rate solutions, heat pumps and appliances are considered as average penetration rate, while the building automation solutions are considered as the lowest.

Despite the amount of heat and power (especially residential) that can be saved with the introduction of building automation systems, and its considerable volume of business, the feasibility of this theoretical potential is very limited. Based on the collected opinions [1], only 3-7% of the theoretical potential of the existing building will be realized, with a real savings of 0.6 to 1.4 TWh of electricity, 3.2 to 7.4 TWh heat and a volume of business of 0.7 to 1.5 billion €. The extensive use of wireless technologies would be a favourable element.

In new buildings, however, a penetration of 10-20% with an expected volume of business of € 20-40 billion is estimated [1].

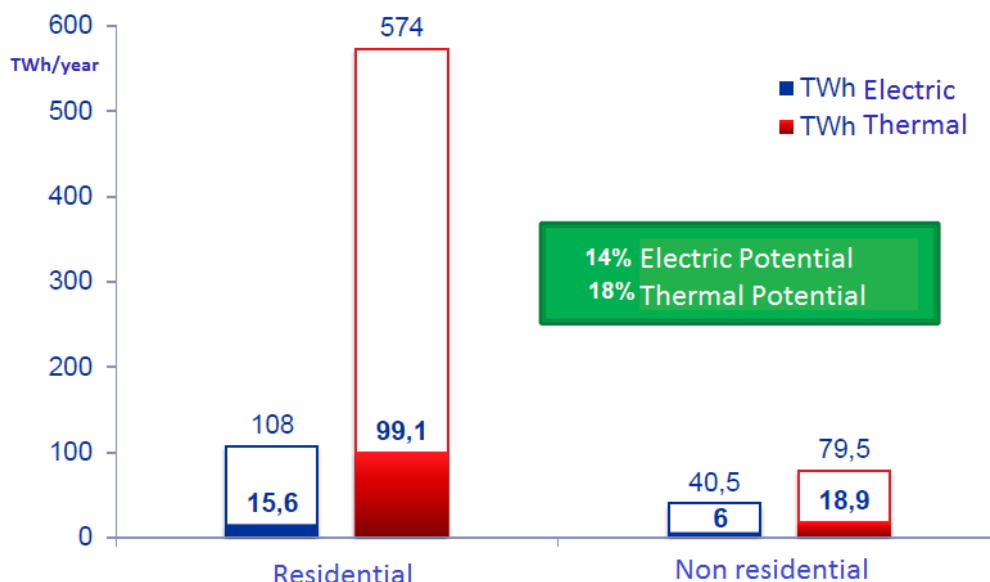


Figure 3. Expected global potential savings

The role of the ESCOs

ESCOs provide energy services and other forms of energy efficiency improvements at the user premises and accept some financial risk, because the payment of services is based in part or whole on improving energy efficiency or achieving in a stable way other objectives.

In Italy, the volume of ESCO business increased by 30% from 2007 to 2011, with a prevalence of interventions on lighting. The activities range from the Energy Audit (to a lesser extent), to design and implement solutions, and finally monitoring and maintenance, the latter being the most implemented.

The models of contract can be divided into two main classes:

- Standard agreements, such as outsourcing in energy management with flat compensation, with no sharing of risk
- Advanced Contracts, EPC (Energy Performance Contracting) which share the savings achieved according to the obtained level of improvement.

To date, the first contract class covers about 80% of the contracts. The range of medium level efficiency services is covered by medium and large sizes companies that are diversifying their business of energy efficiency, but also by small firms established ad hoc. The main customer segment is the private residential and public administration, while services are concentrated on energy audit with flat compensation. The medium level type of services is offered mostly in public administration from the early ESCOs entering the energy sector.

The highest level services are offered through EPC contracts by the so-called Certificated ESCOs (IEC 11352:2010): they are typically large companies with considerable financial skills to enable interventions.

Significant Evolution Elements

To fulfil a significant market growth for energy efficiency, some action lines should be undertaken:

- Release from the incentive mechanisms, to focus on solutions inherently advantageous for the customer.
- Diffusion of advanced contract forms and increase of the risk sharing
- Greater integration of energy efficiency services and gradual extension to local generation.
- Extension of energy efficiency services to industry, to increase the profit margins in terms of energy and economic.

Evolution of the Italian market for small and medium size distributed generation (up to 20 kW) and incentive framework.

The numbers related to installations and produced energy of distributed power generation in Italy in recent years have had such a growth to produce a significant impact on transmission and distribution networks.

In the case of renewable energy plants, the preliminary statistics for 2011 [2] show a gross installed capacity of about 41000 MW and a total of 84000 GWh produced energy, almost doubled compared to 2008. On the low voltage network, in particular, Enel Distribution declared the connection to the grid of about 70000 plants, for an amount of 652 MW, mainly PV panels.

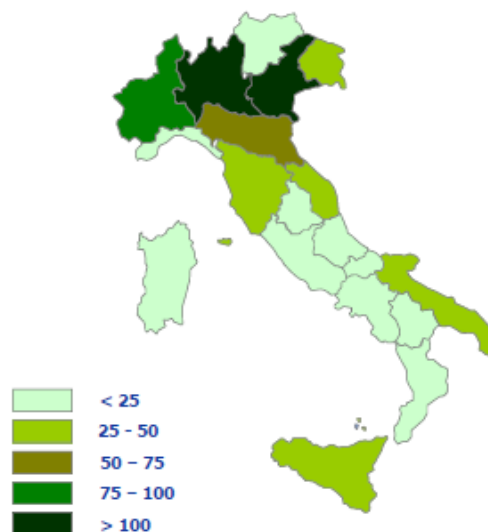


Figure 4. Regional diffusion of LV distributed generation in Italy



A dramatic and rapid penetration of non-programmable renewable and distributed generation into the electricity system, and especially such a high percentage of electrical power connected to the grid, requires that distribution networks, progressively, change from passive to active; besides production and consumption plants had to progressively become more "involved" in effective, efficient and safe management of the overall electric system.

The increase of photovoltaic generation may also determine relevant critical situation in the safe operation of the national electrical systems, as such type of plant is characterized by standard connection which, in presence of frequency variations higher than the 0.2 to 0.3 Hz did connect themselves from the grid. The transmission network operator (TSO) highlighted how such a sudden increase in distributed generation, as observed recently, is having a significant impact on the equilibrium of the national electricity system, by subtracting regulating capacity from the primary system and reducing beyond the design limits the efficiency of defense plans.

It is necessary to intervene on various aspects of regulation, among them the provision, also from photovoltaic and distributed generation plants, of some network services (starting from the need to expand the range of operating frequency) [3]. Beyond a number of interventions designed to improve the operating mode of distributed generation connected to distribution network, the path indicated by the service provision to the electrical system by the distributed generation is becoming more concrete, even though much remains to be done in terms of definition of the regulatory environment and remuneration, and business models by producers and ESCo as well.

As a matter of fact, incentive programs related to photovoltaics are designed to lay the foundations for growth and to provide a basis for a medium to long term growth of the photovoltaic industry; by the end of 2016 the economic self-sufficiency (grid parity) is expected to be reached. Besides, additional bonus is provided for (up to 30% of base remuneration):

- energy re-qualifying projects on the shell of the building on which the PV system is located; a minimum 10% reduction of both summer and winter energy performance indexes for the building shell must be obtained.
- photovoltaic systems on new buildings, where buildings achieve, on the basis of appropriate certification, an energy performance of at least 50% less than the minima specified by the legislation, for the summer cooling of the housing, as well as for winter air conditioning.

Furthermore, the possibility of introducing incentive systems for PV plants which are able to comply with a curve of production forecast is envisaged, being capable to respect such a make sure a program for a certain percentage of days per year.

This overall picture is clearly going in the direction of coupling the small generation from renewable sources (typically one on BT) to energy storage systems and energy efficiency measures.

The compensation of fluctuating generation through the active management of demand constitutes the integration and completion of this future framework of intelligent management of energy resources, which is oriented to energy savings and to the provision of services for the distribution network as well.



The smart management of distributed resources can be implemented only if additional business models are identified in respect to those already available for energy efficiency. These models should involve on one side the presence of an economic operator (Retailer / ESCO / Aggregator) that buys and sells such services in the energy market; on the premise side adequate technologies which allow an easy modification of consumption patterns must be available. The availability of appropriate communication systems to ensure exchange of information between customers, ESCO and, possibly, network operators, is, in this framework, fundamental.

At present the overall technological, regulatory and incentive framework does not appear ripe for the commercial deployment of such a complex business model, while models related to energy efficiency functions within the residential, commercial or industrial described above appear more feasible.

3.1.6. eZmonitoring

eZmonitoring believe there is a significant opportunity for the ENCOURAGE brokerage platform. As world governments see the cost of fossil fuels increase at significant levels, there is an increased focus on renewal energy. The brokerage element of the ENCOURAGE project could have significant influence on the operation and management of this renewable generation scenarios with localised trading and automated managing of facilities and systems. eZmontoring customers are primarily heavy energy users and therefore there is an onus on them to minimise energy usage and to increase renewables.

In Ireland Department of Communications, Energy and Natural Resources are committed to spending on greener environment. To date over €115m has been paid in grant support towards 270,000 upgrade measures in 110,000 homes [4]. There is also a noted continued downward trend in the typical cost of works, particularly in the case of wall insulation.

In the UK this year the government launched the “Green Deal”. The green deal aimed at industry and businesses, allows people to manage their energy bills. The vision is an ambitious and far-reaching one, putting the consumer in charge, with nationwide brands, small local businesses and community organisations competing to deliver the best offers. Competing not just on price but on quality and service and all underpinned by the highest standards. With a game changing scheme like the green deal, some in the supply chain will feel uncomfortable that it changes ways of working they have become used to. Eight million solid wall homes have had no affordable solution to insulate. The green deal will change that.

Key to this competitive new market in energy efficiency will be to ensure the demand is there in the first place which is why the UK Government is putting up £200m when the green deal kicks off to provide introductory offers. There will also be a market in the private rented sector with minimum energy-efficiency standards from 2018.



3.2. Smart metering and building networks segment

3.2.1. Seluxit

Throughout the last two years Seluxit has felt a pull from the market to include solutions of the type that the ENCOURAGE solution provides.

Especially Solar panel installers and heat pump installers have been interested to supply remote control solutions. This requirement has been driven by 2 factors:

1. Power utilities that want to optimise the grid efficiency
2. End customers that want to optimise the own buildings energy efficiency

Up to now Seluxit has only provided remote control and data logging solutions, but with an increasing complexity and an increasing number of installations, a more intelligent control mechanism is needed. By developing this mechanism in the ENCOURAGE project, our already good market position for this type of solutions will be further improved.

Our customers are usually system installers or power utilities that need a solution that fits with the end customers' demands and also fits with their smart grid strategy. The ENCOURAGE project will provide the mechanism for this.

Seluxit has its main market in Northern Europe. The market is still an emerging market with many small and large companies looking for solutions.

The ENCOURAGE platform will enable us to offer a wider range of services and solutions to our customers because our solution can now be integrated with the solutions of our partners. During the ENCOURAGE project we have extended our platform to support additional devices such as heat pumps and solar powered Inverters, this increases interest into our solution. The added intelligence in the ENCOURAGE platform puts our solution at the technological forefront compared to our competitors.

Within our market there are numerous ideas for solutions emerging, however there are no or very few solutions that are ready for deployment. Through the ENCOURAGE project, together with our partners we are now much closer to having a solution that is ready for market. We estimate that our time to market has improved by about one year also because we will now enter the market together with a relevant partner that already operates in this market.

The main risk is that the smart grid area is heavily driven by legislation. This can change very quickly as it has in Denmark in the PV sector. A second risk is that standardization in some areas is missing. Heat pumps for example do not use a standardized interface for smart grid control.



The results within the project are so far: By the end of 2011 we achieved integration of a Danfoss solar inverter device into our system and we were able to sell this solution to our first customers.

By the end of 2012 we achieved integration of a DVI heat pump device into our system and we are planning to offer a remote control and monitoring solution for the DVI heat pump customers.

By the end of the project, we expect to achieve integration of our solution into the ENCOURAGE platform and we aim at using this to offer this solution to other power utilities than the ones that participate in the ENCOURAGE project. Also, we expect to achieve a larger customer base due to a more complete solution and a better known brand due to marketing and dissemination efforts.

3.2.2. Advantic Sistemas y Servicios

Partner profile

ADVANTIC SISTEMAS Y SERVICIOS is a high tech SME specialized in information and communication technologies for remote wireless monitoring systems applied to a wide variety of business markets such as energy, construction, agriculture, environment and other industrial processes.

ADVANTIC is always betting on research and development as basis for offering new products and services and extending the market opportunities. ADVANTIC has a solid scientific and technological background in wireless sensor networks.

ADVANTIC holds a wide worldwide collaboration network, including Asia and Latin America.

ADVANTIC consists of a team of highly skilled professionals, marked by their multidisciplinary approach, their experience in new technologies' field and their clear customer orientation. ADVANTIC is always betting on research and development as basis for offering new products and services and extending the market opportunities.

ADVANTIC participates in cooperative R&D projects at National and European level in different areas:

- Internet of Things, including cutting-edge technologies such as 6LowPAN, RFID and others.
- IEEE 802.15.4-based wireless sensor networks
- Innovative ICT solutions for environmental monitoring and energy efficiency in buildings.

Business idea

ADVANTIC pretends to offer companies, SMEs, particulars and also R&D partners in investigation projects, its services related to finding WSN solutions in miscellaneous market areas such as: industry, construction, environment, etc.



ADVANTIC is specialist in developing monitoring solutions in WSNs and it is involved in consultancy area too, not only designing the solutions but also helping and monitoring the development and deployment of these kinds of systems.

In addition ADVANTIC offer its experience and background to train other professionals to develop its knowledge in this area proving its capacity of transferring all its expertise.

Another important point is the interest of ADVANTIC in R&D. ADVANTIC has participated in RTD projects related to Energy Efficiency in Buildings and it is interested in collaborating with national or foreign partners in investigation projects related to WSN area.

As a SME which search challenges, has contacts with other SMEs all over the world, Asia, Europe, Latin-America, etc.

So, to sum up, ADVANTIC plans to target two main distinct groups:

1. Companies/SMEs/particulars: ADVANTIC can offer its background:
 - To develop monitoring and management data solutions in WSNs.
 - To provide consultancy services about the viability of deploy a WSN, how to develop WSN, maintenance, etc.
 - To train and teach future professionals.
2. R&D partners: ADVANTIC is an SME which believes strongly in the importance of breaking the limits. That is why it is especially interested in taking part in R&D projects

Markets and competitors

The use of wireless technologies for monitoring and control systems is relatively recent. The main problem has been the absence of a wireless technology using low-cost and low-consume devices. As we have remarked previously the presence of the standard IEEE 802.15.4 and the use of open software for its programming has caused a revolution for the potential use of wireless technologies in market areas such as industry, domotics, remote monitoring, etc.

The commercial use of these new standards is starting now and the apparition of new companies developing these solutions is low. Besides, the knowledge and the technology domain are very little too.

Several studies show that wireless device market implemented with IEEE 802.15.4 and used for monitoring, grows in an exponentially way. ABI Research foresees that sales will increase from 15 million in 2008 to 499 million in 2014, which means a growth of 79.6% per year during the period.

WSNs have applications in different business areas. The principal ones are those who were studied on R&D projects in collaboration with potential clients, other contacts and detected as a good opportunity market for its demand during the last 3 years:

- Energy efficiency in buildings



- Remote monitoring of meters
- Industrial control

Due to the present economic context and the necessity of offering a sustainable consume model, one main goal of European Union is the reduction of the energy consumption. Buildings are responsible of the 40% of energy consumption in Europe, and the same percentage in emissions of toxic gases provoking greenhouse effect. G8 proposed that CO₂ emissions will have to be reduced a 50% in comparison to 2005 and the investment was expected to be about 29 million of euros..

It is though that in Spain a law related to these aspects will take effect soon and ADVANTIC is capable of implementing sensor solutions to measure environmental conditions, lighting control, and climatic systems with the possibility of monitoring the consumption at any time through Internet.

Remote monitoring meters is an emergent area too. Energy, water and gas supplier companies invest every year important amounts of money in getting these data so they are the ones more interested in this technology.

So the main targets are industrial, engineering and building companies which will be interested in adding this technology in its productive processes.

To sum up, the opportunities for ADVANTIC are:

- We are in an optimist moment to introduce in the market because there are few competitors, with lack background and knowledge.
- There are few proprietary designs and they are very poorly developed.

Identified exploitable areas

ADVANTIC has detected clearly its target customers and has very good relations with some of them. ADVANTIC is participating in important R&D projects with big companies related to the market areas already explained and this allows its pole position to launch its products to the market.

So to sum up the main markets WSNs technology can cover, are:

1. Investigation R&D: due to the novelty of all of these technologies, one of the principal markets is the investigation area. Before the commercialization of the standards it is necessary to study and prove them. This is a task that only enterprises of R&D can develop.
2. Universities: apart from investigation market, universities are the other entities which can be involve in the first part of the discovery of new interoperability technologies.
3. Industrial: principal customers or potential real market of WSNs are the industrial companies.

Commercial value

WSN technologies are deployed more and more in industrial processes. Sensor networks technology has a huge application potential and market importance.

The number of intelligent device shipments will grow from 73 million units in 2008 to 430 million units in 2013 according to a recent report by Harbor Research. Total device revenue is expected to exceed \$12 billion by 2013. This growth is caused by the presence of Wireless PAN technology, including ZigBee, other 802.15.4 related technology, and IP, particularly those used in Wireless Sensor Networks (WSNs).

The great challenges are now interoperability and integration. There exist multitudes of communication protocols which make necessary to find standardization. New standards have strong promoting companies which search for an effective technology which enables the support and co-existence of numbers of communication networks.

Below we show some information used previously to study the viability of ADVANTIC as a new SME related to WSNs. We can observe the growth expected to IEEE 802.15.4 devices is very high. Chipsets ZigBee units in 2005 were about 2.5 million which meant 11.2 million US\$ in sales.

1. ABI Research foresees sales will increase from 15 million in 2008 to 499 in 2014 which means a 79.6% of growth during the period.
2. In-Stat expects that ZigBee chipsets will reach 120 million of units in 2011 (which means a change of the 110%).
3. According to Frost & Sullivan, this market will grow exponentially to reach 800 million US\$ in 2009, which means 190% of accumulative growth.

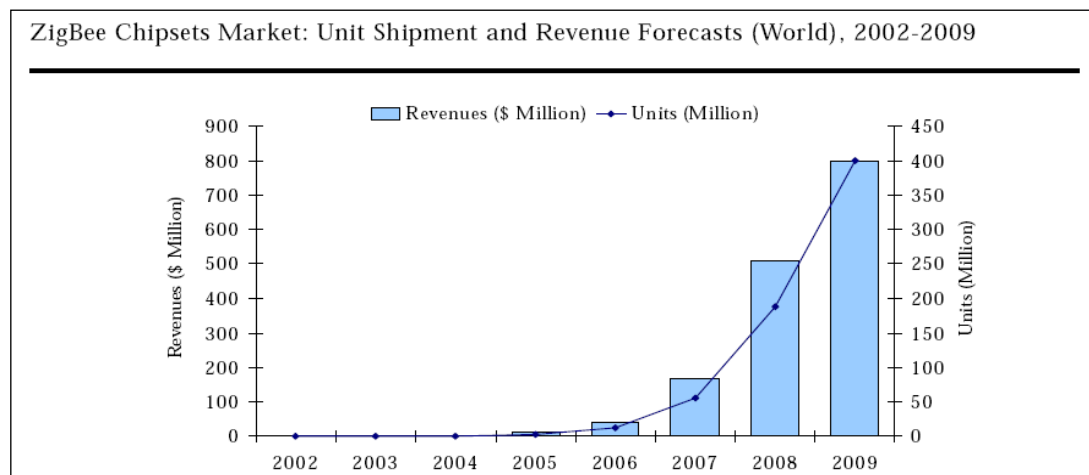


Figure 5. Evolution ZigBee market (Frost & Sullivan)

This high growth in wireless sensor market will launch the increase of IEEE 802.15.4 and ZigBee technologies.

1. On World expects that the number of nodes used in wireless sensor applications will increase to exceed the 500 million in 2010.

2. Harbor Research foresaw that more than 100 million of wireless sensor would be used in 2008.

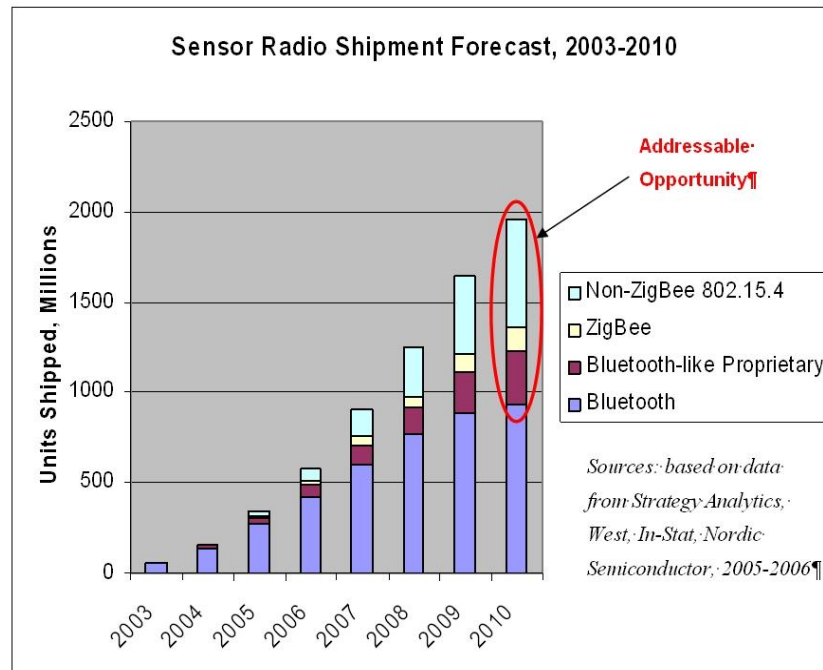


Figure 6. Opportunities for wireless Bluetooth and IEEE 802.15.4 devices with and without ZigBee (In-Stat, Nordic Semiconductor 2005-2006)

Risks

SWOT Analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective. Once this is completed, SWOT analysis determines what may assist the firm in accomplishing its objectives, and what obstacles must be overcome or minimized to achieve desired results.

ADVANTIC has performed the SWOT analysis with regard to the project outcomes:

Strengths

- Wide Technological experience
- Management experience
- Wide knowledge in the ICT sector
- Offering a customer a combination of several new high-tech systems
- Leadership experience on national and international R&D projects.
- High flexibility with regard to fluctuating market conditions.
- Strategic alliances with third parties and partnerships with suppliers of specific technology products or solutions



- A decentralized, flexible, customer oriented organization with well-developed entrepreneurship and relatively low overheads
- The offering of solutions characterized by the best combination of proven technology and innovation
- The quality and skills of employees

Weakness

- Weak market image
- The development of the knowledge potential and management skills fast enough to keep pace with technological developments
- The decentralized business model which sometimes complicates internal co-operation because the autonomous organizational units are rewarded separately for their achievements

Opportunities

- Financial help for new entrepreneurs from local agencies.
- Economical stability
- Big amount of possible clients.
- Quick access to technological knowledge.
- Taking over of responsibility for all non-strategic technical affairs for customers so they can concentrate on their own core activities
- The increasing demand from customers for sustainable technological and socially relevant solutions
- The increased demand for high value ICT within technological solutions, generally at the heart of the customer's core processes
- The growing demand for energy control and management, environment improvement, mobility solutions, water facilities, care & cure and integrated security
- Increased size and the further internationalization of customers.

Threats

- Changing technology
- Competition in the sector
- Increasing competition due to forwards integration by suppliers and the broadening of disciplines and services offered by civil contractors and suppliers of adjacent activities
- The increasing dependence on large suppliers, co-makers and subcontractors
- The growing short and long-term shortfall of well qualified technical specialists.

Roadmap for exploitation

During 2013, ADVANTIC will deploy and test its WSN based solutions for buildings monitoring and control systems. It will be part of the ENCOURAGE Demonstration activities.

It is foreseen to start test and certification activities during 2014 in order to start producing and selling the system by 2015.



3.2.3. ISA-Intelligent Sensing Anywhere

Today's energy problems

As energy costs and demands rise and more renewable energy sources come available, the existing energy infrastructure struggles to keep pace. The aging electricity grid does not efficiently balance supply and demand, resulting in needless waste, expense, threats of blackouts and brownouts, and carbon dioxide emissions.

While the development of a real-time, proactive, and intelligent grid (or smart grid as it is widely known) promises to solve energy problems in the long term, consumers and businesses need effective and affordable solutions today for managing their energy consumption and costs as well as improving the desired levels of comfort and well-being.

Intelligent energy management technologies can provide these immediate solutions. Properly implemented, intelligent energy management cannot only help cut energy use, spending, and emissions, but also provide a solid foundation to build tomorrow's smarter energy infrastructure.

In the past, the electric system has been planned and operated under the assumption that the supply system must meet all customers energy use, and that it is not possible to control the demand. However that supposition is starting to change due to the creation of opportunities for customers to manage their energy use in response to signals (prices or load contracts).

The idea behind DR is that if the marginal peak load price is higher than the value that a consumer gets out of the services derived from the electricity, the user would be willing to modify the demand, if paid the peak price or slightly less instead. A grid operator can obtain an economic benefit paying to a customer to reduce the consumption instead of paying a power producer to supply more output, because in peak periods, the production cost can be very high. Traditionally the DR technologies were typically used to attend to economic concerns. However, nowadays they can be used to improve the system reliability, reducing instantaneously the energy consumption to prevent the most unbalanced situations, such as problems that result from the large space conditioning consumption on days with reduced wind velocity.

Actually Demand Response technologies help to save demanded energy using:

- One-way communications from suppliers to customers.
- Producer integration.

These generation solutions had limitations, they could not predict changes in demand, nor could they provide everyday energy management solutions.

Some of the available systems do not have sub-metering capabilities and thus do not provide users with real-time information about the individual consumption of appliances and about the local generation. The control capabilities provided to the users and the communication services to allow information sharing between users and utilities are also scarce. As a result, such systems do not guarantee the required conditions to operate DR programs. However, DR services are an important



emerging aspect of the Smart Grid, with very good results in terms of energy savings in some case studies, but with only very limited examples, due is not being applied.

Drivers for change

The following issues drive the need for intelligent energy management solutions:

Peak Demand Challenges

Energy use changes from one hour to the next, depending on many influencing factors, like outside temperatures. Because energy needs can change abruptly, the energy infrastructure must always have the capability of meeting the highest – or peak – demand. Though the nation's energy use reaches peak demand levels for fewer than 100 hours every year, we maintain inefficient, pollution causing “peaker” plants for use on these rare occasions.

Intermittent Generation

In a scenario of large scale penetration of renewable production from wind and other intermittent resources, it is fundamental that the electric system has appropriate means to compensate the effects of the variability and randomness of the wind power availability.

Aging Infrastructure

Technologies developed more than 100 years ago compose the current power grid's structure, yet the grid delivers power to countless contemporary digital devices.

The antiquated infrastructure shows signs of stress. Three major blackouts have occurred in US in the past decade. Brownouts across the grid affect more and more people on a regular basis.

Upgrading the grid will only cost more the longer it is left in its current state.

Rising Prices

Consumers will bear a 50% increase in electricity prices over the next seven years, according to projections, because of increased consumption of fossil fuel, climate change initiatives that make carbon-based fuels more expensive and due to the incentives and system requirements increase associated to the renewable generation.

Rising Demand

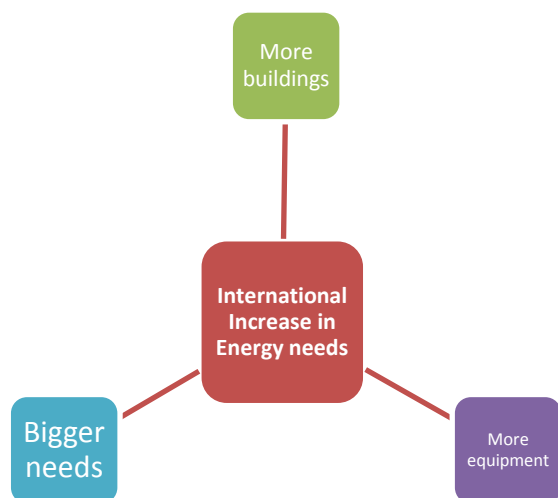


Figure 7

According to the European Commission's Baseline business-as-usual scenario, electricity demand will increase 52% between 2000 and 2030.

Total installed power generation capacity will increase by about 400 GW, from 656 GW in 2000 to 1,118 GW in 2030, and additionally about 365 GW of current power stations are to be retired or decommissioned.

The total new build requirement in Europe to 2030 is 761 GW, more than the entire European power capacity in existence today.

Legislative Impact

The government's regulations will affect future energy supply strategies.

Increased Use of Renewable Energy by stimulus promises to support additional megawatts of renewable energy sources. These types of energy present intermittency challenges: the wind does not always blow and the sun does not always shine. As a result of intermittency, energy management systems must incorporate rapidly accessible response reserves for use during power shortages.

The Coming Age of Plug-In Vehicles

Plug-in hybrid and all-electric cars, promise to help reduce both carbon emissions and dependence on imported oil; however, they also increase demands on power plants and transmission lines.

Eco Positioning

Companies try to develop friendly & positive brands, in order to achieve an Eco-positioning image. On the other hand, there is an increasing implementation of Sustainable Policies.

Barriers

Facility Diversity

- Age of Construction
- Multiple building management and control systems
- Different building insulation behaviour

Facility Users Diversity

- Multiple users – different habits
- Different energy rules and procedures
- Inefficient energy behaviours
- Hard to unify and control energy use

Equipments & System Diversity

- Brands and features
- Energy Consumption
- Age & General Shape
- Facility Management Service on-going

Portugal Energy Profile

- Portugal is one of the EU countries most dependent on fuel imports (76,7% in 2010);
- Share of RES in total primary energy consumption: 22,8% (2010)
- Hydropower is the main renewable energy source;
- Electricity production from biomass capacity is primarily met from thermoelectric plants, using forest biomass

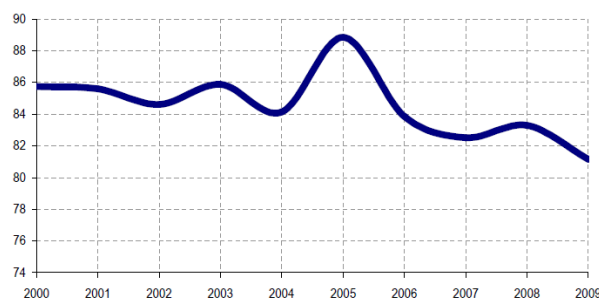


Figure 8. Portugal energetic dependency evolution (%)

Table 1 - Electricity supply, GWh (from DGEG)

	2007	2008	2009	2010
Electricity generation including:				
Coal	12 406	11 196	12 896	7100
Petroleum	4873	4154	3285	3048
Natural gas	13 123	15 202	14 712	14 903
Biomass	2140	2134	2384	2902
Hydric	10 449	7296	9009	16 547
Wind	4037	5757	7577	9189
Geothermal	201	192	184	197
Photovoltaic	24	38	160	214
Total gross production	47 253	45 969	50 207	54 093
Net electricity imports	7488	9431	4776	2623
Electricity consumed in production process	1885	2029	2418	1819
Total electricity available	52 856	53 371	52 565	54 897

Table 2 - Consumption of primary energy resources (thousands tep) – from DGEG/MEID, PORDATA

Energy type	2007	2008	2009	2010 (estimated)
Total consumption* Including	25 349	24 462	24 139	22 902
Coal	2 883	2 526	2 858	1 657
Petroleum products	13 567	12 612	11 765	11 245
Natural gas	3 821	4 157	4 223	4 507
Industrial remains	25	40	40	40
Electricity imports balance	644	811	411	225
Renewable energy	4 409	4 316	4 832	5 229

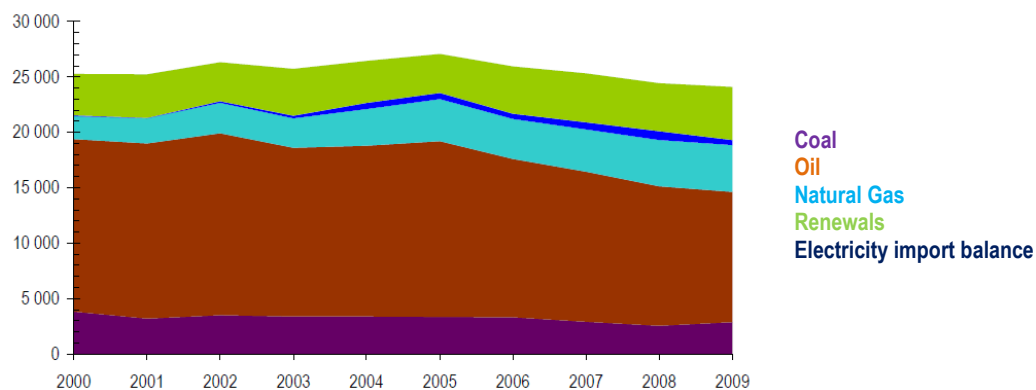


Figure 9. Portugal Primary Energy Consumption (ktep)

Table 3 - Energy consumption by sectors, million kWh (from DGEG)

Sector	2007	2008	2009	2010 (estimated)
Domestic	13.863,09	13.443,52	14.187,92	14.521,78
Non-domestic	11.373,41	11.430,99	11.563,94	11.916,76
Industry	18.687,12	18.452,54	17.142,72	18.193,49
Agriculture	1.022,18	1.014,16	986,29	1.025,17
Illumination of public roads	1.571,27	1.642,51	1.673,48	1.661,70
State's buildings	2.651,63	2.694,92	2.729,26	2.812,12
Others	507,35	508,24	489,34	481,86
TOTAL	49 676,04	49 186,87	48 772,94	50 612,88

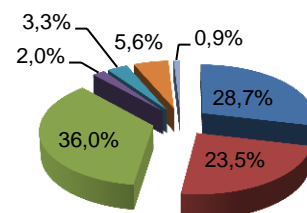
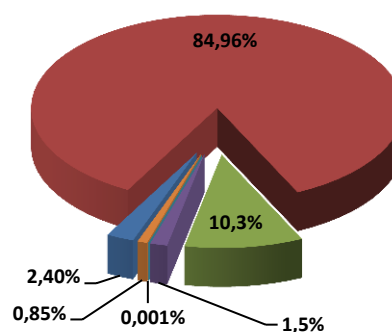


Table 4 - Electrical energy consumers in 2010 (from DGEG)

Consumer type	Number of consumers
Agriculture	153 425
Domestic	5 436 351
Non-domestic	658 423
Industry	95 901
Traction	43
Illumination of public roads	54 582
TOTAL	6 398 725





- Since 2007 over 40% of electricity production is renewable;
- Portugal has one of the highest untapped hydro potentials (only 46% of its potential is currently exploited);
- Portugal has approximately 200 wind farms and 1800 turbines installed.

There are 2 **support mechanisms** for investment and acquisition of renewable energy systems:

- A juridical regimen that establishes a differentiated tariff for the production of electricity from renewable energy resources (feed-in tariffs);
- An incentive system to support the investments in projects of energy production that use new and renewable energy sources, and the rational utilization of energy;
- Increased tax benefits.

Challenges

The biggest challenge will be to create a level of integration between management applications and the physical grid that will enable complex IT components distributed across heterogeneous grids and company borders to communicate with each other.

We need to modernize the grid in order to:

1. Improve reliability, especially as we face new complexities like two-way energy flow and cyber security challenges.
2. Increase the overall efficiency of our generating, transmission and distribution system.
3. Facilitate the growth of renewable energy sources like solar and wind, and enable electric vehicles and dispersed generation.
4. Develop an electricity system that can automatically synchronize intermittent renewable energy sources with fossil energy generation and energy storage.

A modern grid must be able to support both distributed and central generation.

In the specific case of Portugal, the strategy was defined and the targets by 2020 are:

- Reduce the Portuguese energy dependency from the exterior to 74%;
- 60% of the electricity produced in Portugal will be renewable;
- Consumption of final energy will be reduced by 20%;
- 31% share of RES on the final energy consumption;
- At least 10% share of renewable energy in final consumption of energy in transport;
- 20% savings in final energy consumption;
- Improved energy efficiency by 10% by 2015 and by 20% by 2020.

Opportunities

Information and communication technologies will play a key role in the development of a future-oriented energy supply. They form the basis for realizing a future Internet of Energy, an intelligent electronic networking of all components of an energy system. Thanks to this increased networking, generator plants, network components, usage devices, and energy system users will be able to exchange information among each other and align and optimize their processes on their own.



Therefore the current energy grid with its passive, uninformative components and predominantly unidirectional communication will evolve into a market-oriented, service-based, and decentralized integrated system providing potential for interactive optimization and the creation of new energy services. Increased usage of power supply systems that are optimized through home automation and smart metering will give residential customers, public agencies, as well as SMEs the chance to reduce their energy consumption or avoid using energy during peak load times. Improved energy management systems on the transmission and distribution levels will enable the optimal use of decentralized generation and renewable energy sources on a large scale, without affecting the stability and quality of the system.

Electricity is expected to remain the fastest growing form of end-use energy worldwide through 2030, as it has been over the past several decades. The highest demand growth is expected in China and India, plus smaller developing countries in Asia, so should be extremely interesting to do a future market studies in this Countries and try migrate ENCOURAGE architecture.

ENCOURAGE project will provide a platform that allows optimizing in near real time generation and consumption matching in residential, commercial buildings and neighbourhoods, creating a smart energy grid. By developing **remote monitoring and energy efficiency solutions**, ENCOURAGE wants to improve households control spending and awareness of energy efficiency and environmental impacts. In this context, **Utilities** will be the best intermediate to sell the product since they can get consumer satisfaction and loyalty with the solution created.

Target sectors

- Utilities
- Shopping / Retail
- Banks
- Domestic Buildings
- Hotels
- Schools
- Hospitals
- Light industry
- SME
- Smart/Green Communities



3.3. Student and research funding segment

3.3.1. Aalborg University - AAU

Inaugurated in 1974, Aalborg University (AAU) is the youngest Danish University with 14.000 students and a pedagogical structure based on problem-centered, real-life projects of educational and research relevance. The university is a member of The European Consortium of Innovative Universities (ECIU), which consists of 10 innovative European universities whose purposes are the exchange of experience and the development of new projects within education, research and regional development.

The work on ENCOURAGE is coordinated within the Centre for Embedded Software Systems (CISS) which is formed by 10 senior researchers 10 postdocs and 15 PhD students. Its main subjects are models and tools for distributed systems, and their application on industrial cases with particular emphasis on embedded systems. Since 2002, the team has formed the Danish competence

centre for embedded software systems jointly with two research groups from Electrical Engineering (CISS). CISS coordinates the FP7 FET Proactive project on energy saving of embedded systems SENSATION (<http://www.utwente.nl/ctit/research/projects/international/fp7-streps/sensation.doc/>). In addition, CISS is key partner in the VillumKann-Rasmussen centre of excellence MTLAB (www.mt-lab.dk) on formal verification of modern advanced software systems and coordinates the Danish-Chinese basic research centre IDEA4CPS (www.idea4cps.dk) on foundations for cyber-physical systems. In the ENCOURAGE project, CISS contributes with its expertise on middleware for home automation systems as well as its leading expertise on models and tools for analysis and optimization of embedded systems, which is realized through the UPPAAL tool-suite (www.uppaal.org).

AAU exploits the results of ENCOURAGE in the standard way for a scientific university environment: Knowledge and results generated in the ENCOURAGE project will be used to apply for funding of both industrial and more basic research projects. ENCOURAGE also provides the opportunity to update courses and labs within the embedded systems area.

AAU's main market for its candidates is the Danish IT industry. The education's unique profile is based on group project work in combination with industrial relevance, which supports a good reputation when compared to its main competitors among the five other Danish universities. AAU collaborates with its main competitor, DTU, on industrial dissemination in a large innovation project funded by the Danish government.

AAU sees the following possible areas for exploitation of ENCOURAGE results:

- AAU is involved in several national projects on the development and application of middleware for intelligent buildings. Here, ENCOURAGE provides important input with respect to standardization issues as well as relevant case studies.



- In future, the difference between performance- and availability requirements to service oriented systems and to embedded systems will gradually become much smaller. This means that there will be a growing need for IT developers having skills within the embedded systems area. Here, AAU sees an area for dissemination of ENCOURAGE results into lifelong learning activities.

Based on the expectations for activities within lifelong learning and also future project collaborations, it is expected that the ENCOURAGE results will provide a value of more than 100.000 EUR for AAU per year.

Future exploitation roadmap:

- By the end of 2011, funding was achieved for a national project on technologies for the development of a market for energy trade of intelligent buildings. Also, a first version was announced of a lifelong learning course package on model based development of embedded systems.
- During 2011, the lifelong learning package was attended by employees from the embedded systems industry.
- During 2012 and the first half of 2013, a first version of an international master on embedded systems engineering has been announced – including the results as learnt from ENCOURAGE so far. Also, MSc and PhD projects have made important contributions to a future tool chain for developing home automation device controllers.
- During 2012 and the first half of 2013, AAU and has participated in the launch of several new research projects partly based on ENCOURAGE results – both on a national and on a European level.
- By the end of the project, a second version of the lifelong learning course package will be announced. Also, it is expected that AAU together with DTU will be involved in cluster collaboration with other European regions on embedded systems competence development based partially on ENCOURAGE results.

3.3.2. Instituto Superior de Engenharia do Porto

Instituto Superior de Engenharia do Porto (ISEP) is the School of Engineering of the Polytechnic Institute of Porto, working both as a tertiary education facility, as well as a central research hub in Portugal. It offers a wide range of education programmes in different fields of engineering and has a student population in excess of 6000 students.

The CISTER research unit of ISEP, which participates in ENCOURAGE, performs work in real-time embedded computing systems, being the only research unit in electrical engineering and computer science which was ranked excellent by the Portuguese funding agency FCT in the last two evaluations.

As a public tertiary education and research facility, ISEP's goal is primarily to develop research and teaching on the cutting-edge issues addressed by the project, to publish and promote the research



results, and perform potential technology transfers in future joint research activities, in particular in projects that have an integrated perspective of research/innovation and pre-competitive development.

Naturally, ISEP competes nationally and internationally with other research institutions for research funding, direct contract research and talented human resources. Furthermore, the CISTER research unit has a record both in research results in the areas of ENCOURAGE, and also in industry-driven exploitation in which CISTER research results are of interest.

CISTER and ISEP see the following immediate possible areas for exploitation of ENCOURAGE results:

- CISTER is involved in national and international projects on the development and application of middleware for distributed embedded systems. The ENCOURAGE middleware is expected to be explored in this setting.
- The results of the project will be incorporated in the new computer systems profile of the Informatics Engineering Master at ISEP, in particular in the Ubiquitous and Embedded Systems course.



4. Conclusions

In this documented, an intermediate analysis and assessment of the market segments of the ENCOURAGE partners has been presented. Clearly, the markets are dependent to a certain degree, because consumption forecasts to be used in management systems, has to be provided through the use of smart metering building networks. Also, both markets are supposed to be stimulated by the introduction of variable electricity prices for private households and also by the introduction of energy saving requirements from the national authorities.

As for the market of Energy Management Systems, the overall conclusion is that the market has a very high potential – especially with respect to the management of systems for thermal energy but also for the management of general electricity consumption. A major challenge is the lack of standards for home automation Smart-Grid interfaces and also the handling of the huge foreseen number of renewable energy producing devices in a way that assures a well-balanced energy system. Furthermore, the usability of the offered solutions has been recognized as a major challenge for the industrial partners.

As for the market of Smart Metering Networks, it follows the trend of the Energy Management Systems market, and in addition there is also a market for energy visualization for the individual building owner. A major challenge is the lack of interoperability between various types of building networks.

In addition to the technical challenges to be addressed in the ENCOURAGE project, the university partners of ENCOURAGE are also focused on the dissemination of results via student teaching, and here it is expected that ENCOURAGE will provide important input that will attract the market of student enrolment.

In summary, the markets of the ENCOURAGE partners look promising, and also the challenges are among the main issues that the project aim to address. During the second project year, it has been generally recognized that the project has brought the partners closer to their potential markets.



5. References

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