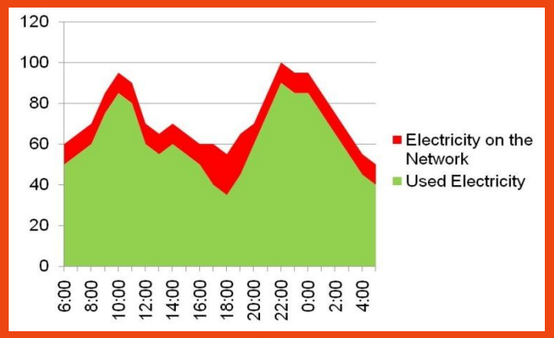
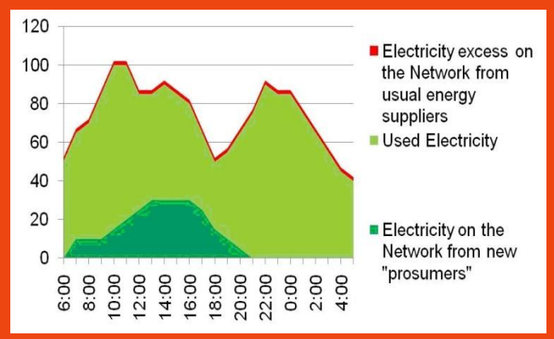
AN INNOVATIVE INTEGRATED ENERGY MANAGEMENT SYSTEM





The ultimate objective is to achieve higher energy efficiency and optimise its usage. This will be achieved by **analysing and continuously monitoring the components in the distribution network**, gathering the appropriate data and, finally, identifying on-the-fly situations where energy can be saved. This will allow NOBEL to create a highly dynamic system where the amount of electricity in the network follows the current demand. Excess energy is monitored and managed to make the energy available in other parts of the network (see previous figures) or to intelligently make use of it via demand side controlling. To achieve this goal, the energy that comes from the local network operator as well as the prosumers will have to be monitored, analysed, and decisions will need to be made in a timely manner. The objectives of the NOBEL project are in-line with the vision and the strategic deployment agenda set by the SmartGrids European Technology Platform.

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PARTNERS

ETRA Investigación y Desarrollo, S.A. (ETRA I+D) is the hi-tech unit within ETRA Group, one of the leading industrial groups in Spain. Its mission is putting in the market the most advanced solutions and services either directly or through the 10 companies of the Group. The main market areas of ETRA Group are Spain, South-Central America, South East Asia and the EU.

SAP has grown to become the world's leading provider of e-business software solutions. With 12 million users, 96400 installations, and more than 1500 partners, SAP is the world's largest inter-enterprise software company and the world's third-largest independent software supplier, overall. SAP solutions help enterprises of all sizes around the world to improve customer relationships, enhance partner collaboration and create efficiencies across their supply chains and business operations.

Swedish Institute of Computer Science (SICS) is a part of Swedish ICT Research AB, a non-profit research organization owned by the Swedish government (60%) and industry (40%). SICS' mission is to contribute to the competitive strength of Swedish industry by conducting advanced and focused research in strategic areas of computer science, and actively promoting uptake of new research ideas and results in industry and society at large. SICS works in a close collaboration with industry and the national and international research community.

Cooperativa Electrica de Alginet (Electrical Cooperative of Alginet) is an electrical energy supplier installed in Alginet (Valencia – Spain) in the year 1930. Nowadays, it supplies 45 million Kilowatts per year (5.700 users) with 18.000 Kilowatts installed power capacity thanks to 35 transformation centres. A new electrical energy substation will be build this year, with 40Megawatts to guarantee the current and future energy demand in the whole town.

The Centre for Research and Technology Hellas (CERTH) is a legal, non-profit entity organized under private law, under the auspices of the General Secretariat for Research and Technology (GSRT), of the Greek Ministry of Development. CERTH was founded in March 2000, with the mission to carry out basic and applied research with special emphasis in exploiting research results and developing new products and services with industrial, economic and social impact. CERTH is housed in its own building facilities at the Technology Park of Thermi, Thessaloniki.

The **"Networked Embedded Systems**" (NES) group was founded in 2009 with the change in position of Pedro Marrón, the head of the group, from the University of Bonn to the **University of Duisburg-Essen**. Scientists at NES have worked on research and development projects for government agencies, associations and industry (Siemens, ...) during their work at the University of Bonn and Fraunhofer IAIS. Examples of European projects, where current members of NES have worked on, are the Embedded WiSeNts coordination action and the CarTALK research project.

NOBEL
NEIGHBOURHOOD ORIENTED BROKERAGE ELECTRICITY AND MONITORING SYSTEM

An innovative energy brokerage system

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Date of publication
April 5, 2011

SEVENTH FRAMEWORK PROGRAMME
EUROPEAN COMMISION

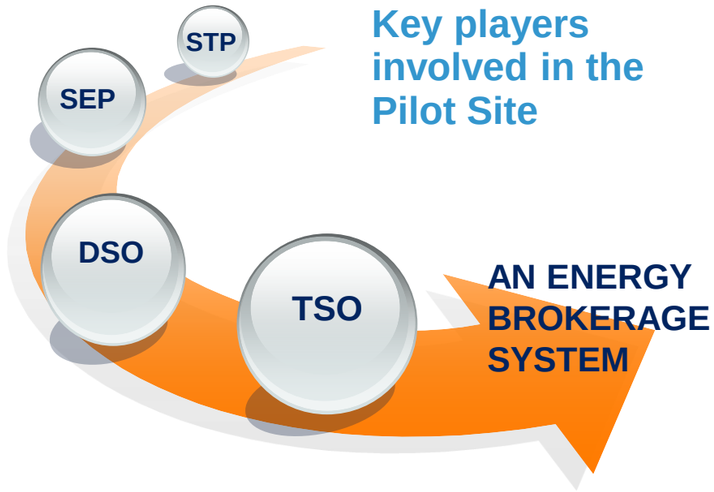
Why NOBEL project?

Europe and the rest of the world share common goals towards energy efficiency and sustainability. European leaders committed themselves to reduce primary energy consumption by 20% compared to projections for 2020. Energy efficiency is the most cost-effective way of achieving such goal. Furthermore, improving energy efficiency also addresses the key energy challenges of climate change, energy security and competitiveness.

Distributed generation of energy coming from various vendors, even private homes, is a big challenge for tomorrow's power management systems that, unlike today, will not dispatch energy centrally or under central control. On the contrary, the production, distribution and management of energy will be treated and optimized using local data.

The NOBEL project will build an energy brokerage system with which individual energy consumers can communicate their energy needs directly with both large-scale and small-scale energy producers, thereby making energy use more efficient. The brokerage system will use a middleware system to communicate energy consumption data and will use IPv6 technology to interconnect the middleware with sensors and energy meters on individual devices.

Even today, parts of the power system are highly nonlinear with fast changing dynamics. It is hard to predict disturbances and undertake counter measures on time. In existing approaches electricity is distributed to the final users according to its expected estimated demand. Such non-dynamic approaches, are difficult to evolve and can not accommodate changes in the system. By having a cross-layer and open information flow among the different actors involved we can make better and more timely predictions, and inject new dynamics in the system that will lead to better energy management and achieve better energy savings.



Key players involved in the Pilot Site

A **STandard Prosumer (STP)** is a basic end user, like for instance a citizen.

A **SEnior Prosumer (SEP)** is a STP that requires internal energy management processes, as a public lighting system.

A **TDistribution System Operator (DSO)** provides the last mile for the final users, as well as the adaption of the electricity from the high voltage used by GNOs.

A **Transmission System Operator (TSO)** provides the network to distribute the energy coming from major producers. Its clients are not the final users, but other secondary distributors.

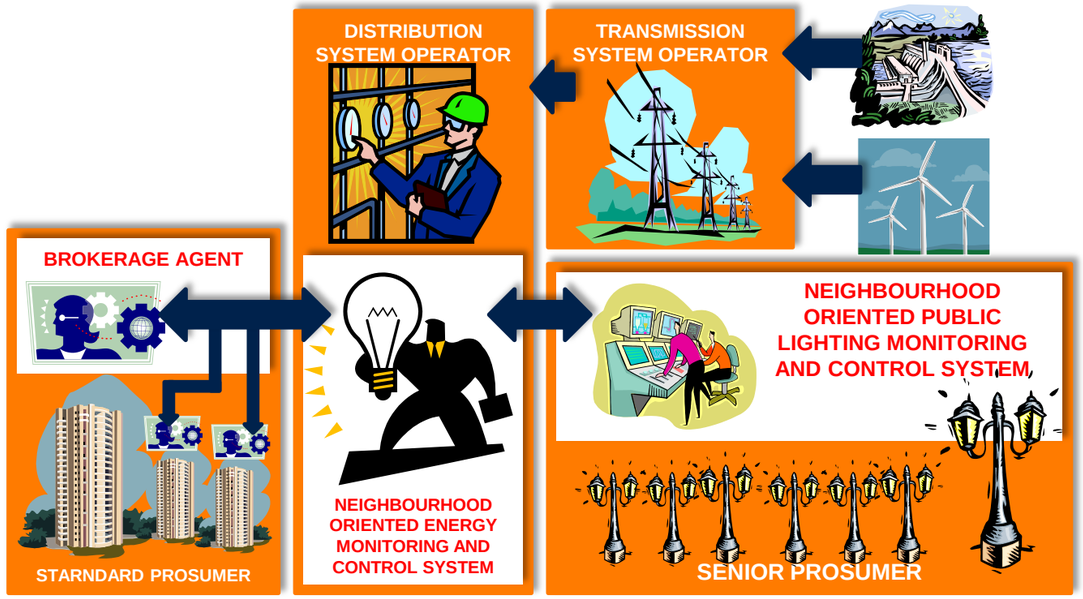
The key to NOBEL's efficiency improvement is that prosumers become sources of both energy and information. The information allows the energy system to better adapt the amount of electricity in the network to the real time demand.

The performance of the entire system is enhanced by exploiting the locality of the processes in monitoring and control that normally do not consider the detailed behaviour of the actual consumers.

IPv6-based communication

NOBEL's real-time monitoring and optimization of energy consumption requires information from a large number of different embedded devices. These devices need to be able to communicate using a common communication standard. In the area of sensor networking, the adoption of IP as the layer 3 protocol to connect wireless sensors has been slowed down by the common belief that IP is too large to fit on a memory constrained device. SICS uIP embedded IP stack previously showed that IP was lightweight enough to be used even on the most memory constrained devices. uIP was later extended with fully certified IPv6 support, making it the smallest IPv6 Ready stack available. uIPv6 has a code size of 11.5 Kbytes and requires less than 2 Kbytes of RAM.

Before mainstream adoption of IPv6 for resource-constrained embedded devices some issues remain to be solved: the definition, implementation and standardization of suitable routing protocols as well as a suitable MAC layer.



Scientific and Technical objectives

• Information retrieval. NOBEL uses state of the art technologies to dynamically obtain and process information from current available installed equipment. This will be achieved by implementing bidirectional communication with all involved entities, process the information with respect to consumption and production and automate decisions to be made network-wide.

• Information distribution. NOBEL develops a service oriented framework that will allow easy flow of information among the prosumers and the enterprise systems in order to foster more energy efficient processes. This implies the development/extension of a middleware – i.e. a set of application independent services – that enable the distributed capturing, filtering and processing of the energy related data. The same services will ease enterprise wide inclusion and allow for better cross-layer collaboration which will lead to holistic optimisation strategies.

• A cooperative system. NOBEL develops cooperation approaches for all entities involved. This assumes cooperating objects at device level, at the energy brokerage system, at service level etc. We plan to tackle interoperability in heterogeneous environments and use the Internet Protocol for communication e.g. at smart meters, etc- in order to reach unprecedented levels of granularity. The system will include:

  a. The development of a core platform to assist local network operators in the monitoring and control of energy.
  b. The development of a brokerage system and usage of brokerage agents that act on behalf of a prosumer – to distribute fine-grained knowledge and gather information through the network.

• End-user applications. NOBEL develops a number of end user applications:

  a. A Neighbourhood Oriented Energy Monitoring and Control System
  b. A Brokerage Agent Front-End
  c. A Neighbourhood Oriented Public Lighting Monitoring and Control System

  Applications are expected to be strongly integrated with the Enterprise Services

• Real-world evaluation. NOBEL validates and assesses the NOBEL approach in a real world Pilot Site, where customers reside and use it in their daily lives.