Digital Single Market

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Smart ICT for energy efficiency

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Energy efficiency is the catchphrase of the early 21st century. Amid rising demand around the world, concerns about traditional sources and increasing environmental awareness, saving energy, improving transmission and distribution and generating power from renewable sources have become priorities for Europe.

[1]

Changing the way we generate, transmit, distribute and use energy will have a major impact on every segment of European society, from big industry to household consumers. Improving energy efficiency will save money, help protect the environment, create new jobs, spur economic growth and improve security of supply by reducing Europe's dependency on imported fossil fuels.

With those goals in mind, and aiming at reducing energy consumption across the EU-27 by 20% by 2020, the European Commission's Communication 'Energy 2020 - A strategy for competitive, sustainable and secure energy' [2], adopted in 2010, called for action in energy efficiency, infrastructure and technology, as well as choice and security for consumers. In the envisioned energy efficient Europe of the future, new technologies will have a big role to play. 'Dumb energy', squandered carelessly at the flick of a light switch or the rev of a car engine, will be replaced by 'smart energy', enabled by 'information and communication technologies' (ICTs) that allow consumers to closely monitor their consumption and energy suppliers to more efficiently meet demand. In a nutshell: less waste, more gain.

'ICT can also give us a smarter two-directional power grid', Neelie Kroes, Vice-President of the European Commission responsible for the Digital Agenda, has said 'especially at the retail level: getting real-time information on time and quantity of energy consumption; and allowing households to become energy suppliers to the grid.'

Already being rolled out in many countries, smart metering systems for electricity are a big step in that direction and have been shown to cut annual household energy consumption by up to 10%. Estimates(1) also suggest that smart electricity grids, currently at the pilot project stage, could reduce CO2 emissions in the EU by between 9 and 15% and reduce primary consumption by the EU energy sector by almost 9% by 2020.

By giving consumers the ability to monitor their electricity consumption in real time, they offer a big incentive to save energy. Combined with ambient intelligence technologies, smart metering will enable smart homes to adjust energy use dynamically, for example turning down the heating when no one is in or automatically adjusting the lighting depending on the activities taking place in a room.

For electricity suppliers, smart grids ensure energy gets where it is needed when it is needed by accurately matching supply with demand thereby reducing the need for wasteful excess capacity, while enhancing the integration of renewable energy sources such as wind and solar that are prone to erratic spikes and dips in generation.

'We will have to address the issues that stand in the way of full implementation of smart grids right now. We cannot afford to miss out on the opportunities an upgraded electricity system would offer in terms of decarbonising our economy and providing real added value for consumers,' noted Günther Oettinger, European Commissioner responsible for Energy.

However, there are several challenges to upgrading Europe's electricity grids, which were considered state of the art when they were deployed in the middle of the last century but will be obsolete in the smart energy world of the future.

The SmartGrids ERA-Net [3] project is addressing those challenges, developing transnational research activities to speed up the development of a 'Smart European Electrical Infrastructure' with the support of a wide spectrum of stakeholders including energy suppliers, technology companies, regulators and end users.

They are studying the many issues facing the roll out of smart grid infrastructure, from methods to improve electrical transport and distribution systems in order to facilitate the integration of renewable energy sources and improve the sustainability of supply to addressing regulatory issues and the development of effective energy markets. The project's end goal is to lay the groundwork for the development of a smart, robust and effective pan-European grid that is capable of meeting future demands.

Information and energy: a smart marriage

In meeting that goal, the Internet will have a crucial role to play, given that in the smart grids of the future information will need to be distributed alongside energy.

The 'Future Internet for Smart Energy' (FINSENY [4]) project is specifically tackling this energy-information integration, bringing together key actors from the energy and ICT sectors to identify the ICT requirements of smart energy systems. The researchers are planning a trial of how a future ICT-enabled smart grid might work.

'The FINSENY consortium brings together the best expertise in the field of ICT, energy, research and the world of academia to create innovative solutions in the energy field in order to optimise the delivery of energy to homes, buildings, industries and cars. This approach will not only change the way we live, but will also offer new business opportunities and will allow new competitors to enter the energy market and, at the same time, reduce CO2 emissions and improve the environment in which we live,' explains Werner Mohr, the FINSENY project coordinator at Nokia Siemens Networks in Germany.

In a similar vein, the 'Internet of Energy for Electric Mobility' (IoE [5]) project is developing hardware, software and middleware for seamless, secure connectivity and interoperability by connecting the internet with energy grids, primarily with the aim of enabling the widespread use of electric vehicles.

The benefits of this approach are two-fold. On the one hand, IoE is supporting the development of the future electric grid by using data communication to move electricity more efficiently, reliably and affordably and, on the other, the project is contributing to the development of the future internet by using the electric grid to facilitate and speed-up the communication among the various energy nodes and domains.

Using power lines to transmit data as well as electricity for smart grid applications is also the focus of the 'Intelligent Electrical Grid Sensor Communications' (INTEGRIS [6]) project. The pan-European consortium is developing a novel and flexible ICT infrastructure based on a hybrid of 'Power-line communications' and wireless technologies to efficiently fulfil the communications requirements of future smart grids. The team's approach, which will be tested in a series of field trials, covers applications such as monitoring, customer integration, demand-side management, voltage control, quality of service control, control of distributed energy resources and asset management for power suppliers.

Thinking locally, saving globally

At a more local level, the 'ICT Roadmap for Energy Efficient Neighbourhoods' (IREEN [7]) project is investigating strategies to create energy efficient neighbourhoods and communities. Working with a wide range of stakeholders including technology, energy and construction companies, local authorities, building managers and owners, the IREEN team hopes to extend the concept of energy positive homes (i.e. homes that generate more energy than they consume) to larger areas, laying the foundations for highly energy efficient smart cities.

Other projects are working even further down the energy chain on ways to save energy within individual homes and buildings.

The researchers behind the 'Self-Learning Energy-Efficient Buildings and Open Spaces' (SEEDS [8]) initiative, for example, are using advances in self-learning methods, wireless sensor technology and building technology to develop a novel energy management system that will allow buildings to continuously learn to maintain user comfort while minimising energy consumption and CO2 emissions. The technology is to be tested at offices and car parks in Spain and on a university campus in Norway.

Meanwhile, in the 'Sounds for Energy Efficient Buildings' (S4EeB [9]) project, researchers are innovatively using sound sensors to determine occupancy in a building so heating, air conditioning, ventilation, lighting and other systems can be automatically adjusted.

Besides buildings, big gains in energy efficiency are also possible through the implementation of ICT

solutions in many sectors from industry and commerce to transport.

The 'Energy Efficiency in the Supply Chain through Collaboration, Advanced Decision Support and Automatic Sensing' (E-SAVE [10]) project, for example, is contributing to the development of energy-efficient supply chains by providing tools to help companies monitor, manage and share energy use and carbon footprint data in order to support supply chain design decisions.

And in the automotive sector, the 'Engine Waste Heat Recovery and Re-Use' (NoWaste [11]) project is developing an engine waste heat recovery and re-use system that promises to improve energy use by as much as 15%.

Individually, these EU-funded initiatives and many like them promise to have a big impact on energy efficiency. Combined, these emerging technologies will help Europe reduce energy demand, integrate more renewable sources, lower costs for consumers, create new jobs and new markets, and improve the security and sustainability of energy supplies.

The projects featured in this article have been supported by the Seventh Framework Programme (FP7) for research.

(1) Communication, 'Smart Grids: from innovation to deployment', COM:2011 202 final [12]

Useful links:

- FP7 on CORDIS [13]
- Energy efficiency on EUROPA [14]
- SMART-GRIDS project factsheet on CORDIS [15]
- IOE project factsheet on CORDIS [16]
- FINSENY project factsheet on CORDIS [17]
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