Digital Single Market

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Energy aware means energy efficient

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'Smart Grids' are the future of electricity supply, allowing consumers to become interactive participants in a supply network that includes decentralised as well as centralised power generation.

[1]

'Information and communication technologies' (ICT) will help consumers manage and minimise their energy consumption - and allow electricity suppliers to match supply with demand. An EU-funded project has developed ways to collect and analyse the real-time information on energy consumption and generation which will be needed.

Thanks to government incentive programmes and the growing demand for renewable energy the sight of photovoltaic panels and small wind turbines on the roofs of homes and buildings is now a common sight across Europe. With the help of smart electricity grids, consumers could use their domestic generation capacity to shift from being passive receivers of electricity to become interactive participants in the energy supply chain - potentially reducing CO2 emissions in the EU by 9 % and household energy consumption by 10 %.

But for this to happen, consumers need to be able to monitor their electricity consumption in real time - helping them to manage their usage so as to save energy and money. And grid operators need to be able to match electricity supply, from both centralised power-generation plants and a growing number of these smaller generation sources, with demand.

The EU-funded 'Energy-saving information platform for generation and consumption networks' (ENERSIP) project has developed a way to improve these monitoring and matching processes. By providing energy suppliers and consumers with real-time and forecast information about energy consumption, electricity supply and demand could be made to match each other more closely - reducing waste and improving reliability.

'For a utility company the ideal scenario is that you produce just enough electricity to meet demand,' explains Dr Leire Bastida, ENERSIP's project coordinator. 'Sometimes this means forecasting the estimated demand and defining necessary actions when demand peaks, but equally it may be better to try and reduce demand instead. We wanted to develop tools which would help suppliers and consumers to make the best choices to keep supply and demand in balance.'

Match making

The ENERSIP partners have therefore collaborated on developing an open platform that provides a suite of energy monitoring and control services designed to improve the flexibility and responsiveness of the electricity grid.

'Our platform and services were designed to pave the way for near real-time generation and consumption matching in residential and commercial buildings and across whole neighbourhoods,' says Dr Bastida. 'ENERSIP required the development and implementation of many different technologies, like sensors and wireless communication devices that monitor the electricity consumption of home appliances, algorithms to predict energy demand, plus control systems that can switch off appliances and switch on generation systems.'

'We also wanted to change consumer behaviour,' says Dr Bastida. 'The power of internet and social networking is key to educating consumers and encouraging them to change their energy habits.'

As Dr Bastida explains, the project's strategy was simple: getting high energy efficiency through a mix of coordination, conveniently managing resources on the grid and altering users' behaviour by giving them accurate feedback and advice. If users can use this to reduce energy consumption it could in turn reduce the burden on energy generation and supply.

From monitoring to prediction

The secret to ENERSIP lies in the communication between every device in the house - and, ideally, for every house in a whole neighbourhood. The project developed a set of smart plugs, used to connect appliances to power sockets, in order to monitor electricity consumption. This data is sent wirelessly in real-time to a concentrator, which then collates the data and sends the information via the internet to the local energy provider or distributor.

'This consumption data is absolutely key to our ideas,' Dr Bastida explains. 'Once you have this level of data - particularly at the scale of a neighbourhood or larger commercial site - you can begin to analyse it, spot patterns and, most importantly, begin to make predictions. If you can anticipate peaks in demand, you can begin to balance supply and demand, increasing generation more efficiently or switching off unnecessary devices until demand drops again.'

These smart plugs have been used with different types of appliances, from simple lights and electrical heaters to smart devices like TVs and computers. The ENERSIP research also tested how these appliances should communicate with each other and other networks within buildings to create an 'in-building' smart infrastructure which could be controlled remotely or automatically. The ENERSIP team also looked at how such a system could be deployed across an entire neighbourhood.

'We made sure our wireless communication with sites across a neighbourhood had some built-in redundancy, because once you begin to rely on this data flow to manage the electricity grid, you could end up with chaos if the network were to go down,' Dr Bastida remarks. 'We combined mobile-phone networks, public wireless networks and wired broadband networks to create the

neighbourhood-wide communications network. Even though the main thrust of the project is about optimising energy supply and demand, on the technical side, the development of the secure and efficient data communications was a big challenge.'

Changing behaviour - armed with information

Perhaps the biggest challenge for the project, however, was its 'full circle' approach to putting information back into the hands of the consumers and empowering them to take action. ENERSIP built a web platform so households could visualise their consumption and optimise their electricity usage against supply and unit costs.

'You can build a system with clever algorithms to predict peaks, anticipate demand and control generation in intelligent ways. But our emissions will never go down until people begin to change their habits and behaviour,' says Dr Bastida. 'We believe that people will make sustainable choices and be part of the optimisation process if we give them information and help them make decisions.'

The ENERSIP web platform provides users with advice (based on its neighbourhood knowledge and predictive capabilities) on how to reduce or optimise their consumption, for example, by letting them programme the washing machine (via that microchip in the plug) to run at 03:00 rather than during peak demand at 20:00.

The ENERSIP system was tested in two pilot trials that validated the technology developed, while the project team demonstrated through simulations a theoretical energy savings potential of up to 30 %.

'This reveals the level of inefficiency which exists today when you don't balance supply and demand,' says Dr Bastida. 'However, perhaps most surprising was our finding that as much of half of this energy saving was achieved through the ENERSIP users' web tool and the resulting greater awareness of energy efficiency among our volunteer consumers.'

Taking it further

The ENERSIP project partners continue to develop the project's prototype technologies and concepts, including in-plug sensors and actuators for remote and automated control of devices and appliances, online energy-management tools and mobile apps. The optimisation algorithms developed in the project are also being applied to business intelligence tools and decision management systems.

'We have no doubt that people are the key to our energy crisis,' emphasises Dr Bastida. 'We can only make significant energy savings when people change their behaviour. Systems like ENERSIP can begin to make this difference.'

The ENERSIP technologies - monitoring and predicting energy usage, and providing feedback to the consumer - have the potential to start making these energy savings a reality, and putting us on the path to smart electricity grids in the near future.

Link to project on CORDIS:

- FP7 on CORDIS [2]
- ENERSIP project factsheet on CORDIS [3]

Link to project's website:

- 'Energy-saving information platform for generation and consumption networks' website [4]

Link to related video:

- ENERSIP project videos [5]

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