The drive towards Smart Grids

CEER Deputy Secretary General test-driving an electric car, at COP-15, Copenhagen

Electricity grids need to become smarter, more efficient and customer-oriented than ever before

A Fact Sheet by the European Energy Regulators on how the drive towards smarter grids can help meet European policy objectives on energy and climate change and empower customers

National regulators cooperate at EU level through the European Regulators Group for Electricity and Gas (ERGEG) and (also at international level) through the Council of European Energy Regulators (CEER) (see http://www.energy-regulators.eu). CEER/ERGEG work on smart grids and other issues (e.g. sustainable development or customer issues) supports and complements the work of the new EU Agency for the Cooperation of Energy Regulators (ACER) which becomes fully operational from March 2011.

The need for smart grids

Smart grids are about *planning, building, expanding, operating and maintaining the electricity networks of the future* in a way which will help meet the EU's 20/20/20 energy and climate change objectives. These ambitious targets for the year 2020 include 20% reduction in greenhouse gas emissions, 20% EU renewables share and 20% savings in consumption by improving energy efficiency.

The "smartness" of the grid is manifested in making *better use of technologies and solutions* to *intelligently control generation* (including low-carbon), to better *plan and run* existing electricity grids, and to enable *new energy services* and *energy efficiency* improvements.

Smart grids are key to reducing carbon emissions and improving energy efficiency by:

- *facilitating higher penetration of renewable (e.g. wind) and distributed generation*;
- *reducing network power losses;*
- *helping consumers better participate in the market* not only by using their energy more efficiently (e.g. through smart metering) but also by allowing consumers to act also as producers selling back their excess electricity (e.g. CHP or plug-in electrical vehicles).

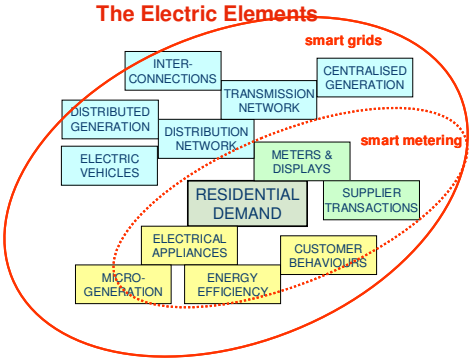
See the section on benefits of smart grids and the two examples on (1) integrating more renewables and (2) driving energy savings.

What is the smart grid?

There is no standard global definition. The European energy regulators define smart grids[1] from a user-centric and technology neutral perspective, by building upon a former proposal by the European technology platform on smart grids: *"Smart grid is an electricity network that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety."*

What the smart grid does not mean?

- Smart grids are not new "super grids". They will *not look significantly different to today's "conventional" electricity grids* which transport and distribute power over "aluminium, copper and iron". However, *smart grids will lead to improved cost-efficiency and effectiveness*.
- The smart grid *is no revolution* but rather an ongoing *evolution* or process within which electricity grids are being continuously improved to meet the needs of current and future customers.
- There *will not (and cannot) be any "roll-out" of smart grids*, since such a "roll-out" is continuously occurring.
- Although the concepts are sometimes confused, the *smart grid is not smart metering*. The smart grid encompasses a much broader set of technologies; solutions are by no means restricted or strictly delimited by the introduction of smart metering (see diagram).
- There are several specific benefits to smart metering. For example, when used with other parameters (such as differential tariffs and customer awareness) smart meters can encourage consumers to reduce their demand (load) when prices are high or when system reliability or power quality is at risk.



Unbundling of network operators should help deploy smart grid solutions

The EU's (2009) 3rd Package of energy laws directly promotes smart grids (and smart metering). It also provides for the unbundling (separation) of the network arm of vertically-integrated utilities from the generation and supply parts of the business. Unbundling should encourage network operators to actively respond to the climate change challenge and to pursue smart grids deployment. Otherwise *vertically-integrated network operators face perverse incentives not to invest in needed grid extensions to connect new generation or in smart grid technologies* e.g. low-losses network elements or energy efficiency measures (since energy efficiency reduces sales, hence profits).

[1] Position paper on smart grids - An ERGEG conclusions paper, (E10-EQS-38-05), 10 June 2010.

Benefits of smart grids

The European energy regulators have identified eight main effects and benefits of smartness:

(1) Increased *sustainability*;
(2) Adequate *capacity of transmission and distribution grids* for "collecting" and bringing electricity to consumers;
(3) Adequate *grid connection and access* for all kinds of grid users;
(4) Satisfactory levels of *security and quality of supply*;
(5) Enhanced *efficiency* and better service in electricity supply and grid operation;
(6) Effective *support of trans-national electricity markets*;
(7) *Coordinated grid development* through common European, regional and local grid planning to optimise transmission grid infrastructure;
(8) Enhanced *consumer awareness* and participation in the market by new players.

Cost of smart grids - regulators require value for consumers and society

Investment in grids needs to be carried out by introducing cost efficient intelligent technologies that will also help to meet the climate change targets.

However, this *should not be a case of regulators writing a blank cheque for network operators*. Regulators (who control network tariffs and hence the revenue stream of network operators) must consider the public interest implications of these investments.

Key regulatory challenges of smart grids

1. Regulators must enable network companies to *identify and prioritise specific smart grid solutions* that can more efficiently meet network users' needs and incentivise them to be deployed. There should be clearly defined and agreed criteria for the selection of projects for network operators and their follow-up.

2. A major challenge for regulators is to find ways of *encouraging an adequate level and scope for more radical innovation* while providing an appropriate degree of protection of customers' interests and economically effective development of the network (given that network operators are monopolies).

Smartness should ultimately result in reduced costs for society as a whole, improved efficiency and customer benefits.

What can regulators do?

Regulators are not the main actors in the development of smart grids – however they have a central role to play as *key facilitators of smart grids.* Regulators are responsible for establishing well-functioning energy markets, which ultimately benefit network users and society as a whole. Regulators have three main priorities:

- *to focus on the outputs* of the regulated network companies, through tailored regulatory mechanisms;
- *to encourage cooperation among stakeholders* so that possible barriers to smart grids deployment are addressed; and
- *to encourage innovation while protecting consumers' interests* through the identification of costs and benefits of smart grid demonstrations and deployed solutions.

Regulators facilitate cooperation on smart grids

Europe's national energy regulators meeting through CEER/ERGEG/ACER share best practices at EU level and are facilitators of smart grids. Activities include public consultations, workshops, providing technical and policy advice to the European Commission and engaging with EU standardisation bodies and consumer associations.

At international level, regulatory cooperation happens through the *International Confederation of Energy Regulators (ICER*), a virtual confederation of the world's energy regulators (11 regional associations representing more than 200 regulatory authorities) which was created in October 2009 (www.icer-regulators.net). ICER is currently chaired by CEER President, Lord Mogg. CEER also heads up ICER's Climate Change Working Group.

You can learn more about the activities of the European Energy Regulators, their external cooperation activities, publications and consultations at the end of this factsheet.

Example 1 – Smart grids can better integrate more renewable energy sources

Goal and means

The integration of low-carbon generation technologies that use renewable energy sources (RES) or that use primary energy more efficiently e.g. combined heat and power (CHP) helps meet sustainability objectives.

These generation units can be divided into *large scale* (connected to the transmission grid e.g. large wind or solar parks and large hydro plants) and *small scale* (connected to distribution grids, e.g. individual wind mills or solar cells and small hydro plants or micro-CHP).

This *small-scale generation, or distributed generation (DG)*, can, depending on its location and penetration level, contribute to energy efficiency by reducing losses in the distribution networks. An increase in DG can also lead to a more active role of consumers, in which they act also as producers (*production-side user participation*).

Problems

With climate change objectives there is much focus on zero/low carbon electricity generation *But today's conventional grids were not built to be able to cope with large scale zero and low-carbon* electricity generation including an effective demand response.

Ageing networks will need to be *replaced or reinforced* to connect new forms of generation.

Without smart grid solutions, there is a real *risk* that the renewal of the grid will result *in "like-for-like" replacement* of copper and iron, based on conventional technologies, *without any efficiency gains*.

Smart grid challenges and solutions

For large scale renewable and distributed generation, cost-effective connection solutions need to be developed, particularly as renewable resources are often distant from the load (demand) centres.

Because of the intermittent character of wind energy (today's most mature RES technology in terms of deployment and installation), *monitoring and balancing* on the transmission level will become more challenging and measures to maintain balance (e.g. management of supply, maximising interconnection capacity by soft measures like coordinated phase-shifters operation, etc.) need to be enhanced. Furthermore, new smart technologies are required in particular to *connect the massive capacity of the additional off-shore wind in the years to come*.

The grid must be able to cope with more *small scale or distributed generation* (DG) e.g. windmill, small hydro plants or micro-CHP.

Energy regulator's role

Smart grids can *effectively integrate renewables* and *dynamically manage the mismatch between intermittent renewables* (e.g. wind) *and consumer demand*.

Regulators have a key role to play in *incentivising network operators* to adopt smart grid solutions and integrate new and best technologies. Regulators too can *change the market rules* such as for balancing systems and markets (e.g. moving from traditional day-ahead electricity bidding closer to a real-time one) to help the network better manage the wind intermittency (which would in turn help renewables better compete with fossil fuels).

Example 2 – Smart grids facilitate energy efficiency, demand response and thus help to save energy

Goal and means

Energy efficiency is one of the most cost-effective ways of reducing greenhouse gas emissions. *Smart grids* can *reduce the need for costly new generation, transmission and distribution capacity* by *cutting energy usage and peak demand* in a number of direct and indirect ways:

- Optimising grid operation and usage will *directly reduce energy consumption by reducing losses,* and will enhance *voltage quality, reliability and operational security*.

- Smart grids (relying here on smart metering solutions) can *help consumers to use energy more efficiently and to have more control over their energy bills*. A more active participation by consumers is not only a goal in itself, but a possible means to integrate renewable and other more energy-efficient sources of energy in the electrical network. Enabling a demand response from customers makes retail and wholesale markets more efficient as well as helping to meet the EU's sustainability goals (e.g. by encouraging a shift in energy consumption away from peak times).

Problems

Energy efficiency cuts demand, hence sales and profits. Energy companies today still focus on supply (i.e. selling more energy) not on demand. They need to be encouraged to sell less (not more) energy, by making energy efficiency a fundamental market design feature.

Smart grid challenges and solutions

Smart meters can have many useful applications such as providing consumers and suppliers with accurate information about actual consumption. *A challenge is to ensure a demand response as smart meters in themselves do not save energy or lead to more active consumers.* However, raising consumer awareness of energy use can help consumers to identify how to better manage and reduce their consumption (see Fact Sheet FS-10-02 on Smarter regulation for energy customers).

A smart grid can also *integrate generation and energy storage at customer sites*. An increase in distributed generation can lead to a *more active role for consumers who may also act as producers*, feeding in the energy they generate whenever it is available. *Electrical cars are an interesting example of making smart grids meaningful for consumers.* They not only have zero local emissions but also offer potential for distribution storage and "leveraging" large portions of demand. Consumers can sell electricity back to the grid (e.g. at peak demand time) when the car is not being used for travelling. But, "smart regulation" is also needed to avoid increases in peak demand.

Energy regulator's role

Regulators control network tariffs and hence the network operators' revenue streams. *Regulators can set targets* against which network operators would be rewarded or fined *to discourage network losses.* Regulators can also encourage grid operators to adopt solutions which *push energy efficiency goals.*

Activities of European Energy Regulators on Smart Grid and Climate Change Issues

The European energy regulators act as key facilitators of smart grids by identifying and removing possible barriers and finding solutions that provide an appropriate balance between all stakeholders' positions. We undertake a number of activities related to smart grids including public consultations, workshops, reports and participation with stakeholders in external initiatives. www.energy-regulators.eu

External Cooperation Activities

Regulators and the European Commission's smart grids task force
Regulators are fully involved in the European Commission's task force on the implementation of Smart Grids (http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm).

Regulators and the European Electricity Grid Initiative (EEGI) of the Strategic Energy Technology Plan (SET) launched by the European Commission
European energy regulators have been involved in the preparation of the Strategic Energy Technology Plan – European Electricity Grid Initiative promoted by the European Commission.

Regulators and the European SmartGrids Technology Platform
Regulators have been involved in the Advisory Council of the smart grids European technology platform since its inception in 2005. CEER is a member of its successor, the EU Smart Grids Forum (www.smartgrids.eu).

Regulators' contribution to Standardisation
CEER works closely with the European standardisation bodies (CEN, CENELEC and ETSI) that are mandated by the European Commission to develop an open architecture for utility meters (water, gas, electricity and heat). CEER also participates in their "focus group on standards for the Smart Grid," which will advise on European requirements relating to smart grids standardisation.

ICER Report on energy efficiency
This report is the first step taken by energy regulators worldwide to gather data on regulatory practices aimed at fostering energy efficiency. It was prepared for the G8 meeting (25-26 June 2010) in Muskoka, Canada (www.icer-regulators.net).

Publications and Public Consultations

ERGEG Public consultation on smart grids
This 2009 consultation paper on Smart Grids (E09-EQS-30-04) and its conclusions paper (E10-EQS-38-05); published in June 2010, explore the drivers and opportunities for 'smarter' networks from the users' perspective. The reports discuss the regulatory challenges and priorities and the Conclusions Paper provides a set of concrete conclusions (7) and recommendations (10) for national and EU decision makers.

ERGEG Public consultation on the regulatory aspects of the integration of wind generation in European electricity markets
This 2009 consultation paper (C09-SDE-TF-14-02a) and its conclusions paper (C10-SDE-16-03), published in July 2010, considers whether the regulatory regime for wind generation facilitates barriers to its deployment and/or distorts incentives in choosing where to locate in the EU. It examines how wind generation should be integrated into the electricity market (e.g. bidding closer to real time and balancing) and network access arrangements.

ERGEG Guidelines of good practice on regulatory aspects of smart metering for electricity and gas
The GGP (Ref. E10-RMF-23-03), which were subject to public consultation in 2010, are intended to serve as guidance for Member States, regulators and industry in their consideration and deployment of smart metering systems. They set out the minimum services that should be provided to customers by smart meters, as well as tips on what should be taken into account in conducting a cost-benefit analysis. They also contain the regulators' recommendations on data security and customer integrity issues.

ERGEG Status review on the regulatory aspects of smart metering
This October 2009 report (E09-RMF-17-03) reviews the state of play (as of May 2009) regarding the introduction of smart meters across Europe, examining the issue from a regulatory perspective: meter value management; roll-out policy; access to data and privacy; and functional and technical aspects.

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