EUROPEAN ENERGY REGULATORS’ POSITION ON SMART GRIDS

François-Annet de FERRIERES
CRE – France
francois-annet.de-ferrieres@cre.fr

ABSTRACT
The European Energy Regulators’ Group for Electricity and Gas (ERGEG, www.energy-regulators.eu) launched, on the 17th of December 2009, a public consultation on its position on Smart Grids. The consultation period ended on the 1st of March 2010, and ERGEG is now in the process of preparing a conclusions paper including an evaluation of comments received. This CIRED paper introduces the content of the consultation paper and highlights its most important items.

INTRODUCTION
The ERGEG consultation aimed to collect views from all stakeholders in order to assist regulators in understanding how smart grids can benefit network users. Moreover, assuming that cost effective benefits can be identified, the consultation aimed to contribute to exploring ways in which Smart Grids deployment can be encouraged.

Key objectives of the European Union (EU) for the year 2020, with regard to energy, are to increase renewable energy supply to 20% of total demand, reduce energy consumption by 20% with respect to 2020 forecasts and reduce greenhouse gas emissions by 20% with respect to 1990 levels. More ambitious objectives are currently being developed for 2050. The electricity supply sector will make a major contribution to achieving these targets and the engagement and support of all stakeholders will be essential.

As well as helping meet the 2020 targets, “smarter” grids may bring many improvements to grid operation, asset management, network engineering and planning. The Smart Grids implementation will certainly influence network operators’ mission and should show a positive impact on the efficiency as well as on the quality of supply to the end users. The issues mentioned here are just some of the many elements which will characterise Smart Grids in the future.

SMART GRIDS
The outputs expected from a smart grid (efficient electricity supply, low costs, satisfactory quality and security of supply, etc.), coincide with the outputs already expected from today’s “conventional” grid. Though elements of ‘smartness’ exist in many parts of existing grids, the difference between today’s grid and a smart grid of the future is mainly its capability to handle more complexity than today in an efficient and effective way. ERGEG’s definition and understanding of a smart grid are based on the services that they will offer to users, i.e. what challenges they are intended to address, and what kind of functions and output values they can provide for the users of the transmission and distribution grids. ERGEG relates smart grids to a future grid that is needed for reaching the EU targets for the year 2020. Smart grid solutions are applicable to both distribution and transmission networks.

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.

Figure 1: The electric elements of smart grids and smart metering

1 Source: P. Nabuurs, KEMA, presentation at CEER Workshop on Smart Grids 29th June 2009.
Smart metering enables and enhances a number of smart grid functions. Nevertheless, smart grids encompass a much wider area of technologies and solutions and are by no means restricted or dependent on the introduction of smart metering.

**DRIVERS**

There exist two different but directly related drivers for the evolution of electricity networks and the innovation which is needed for that. First, legislation is the primary external driver, albeit an indirect one. Of specific relevance here is the European legislation relating to electricity supply and the political targets for the year 2020, as already mentioned. Member States have to put in place their own legislation and policies to meet the environmental targets that they have committed to deliver. These legislative targets do not in themselves directly determine future network performance requirements. However, they do encourage or require the adoption of particular generation and other technologies. These *means* lead to the drivers for smart grids from a technical perspective, which include:

1. Large-scale renewable energy sources including intermittent generation;
2. Distributed generation including small-scale renewable energy sources;
3. Active end-user participation;
4. Market integration and market accessibility;
5. Improved operational security.

**SMART GRID OPPORTUNITIES AND REGULATORY CHALLENGES**

Regulators are responsible for establishing well-functioning energy markets, which ultimately benefit network users. Therefore, the regulators approach the potential of smart grids from the perspective of the benefit they can bring to network users – a user-centric approach.

It is important to be clear about the roles that different stakeholder groups will play in the development of smart grids. Network companies will be the prime movers in smart grid deployments and will be the major direct beneficiaries. As these companies are monopoly businesses, the role of the regulator is vital in ensuring that the benefits of smart grids are delivered to network users. Other key stakeholders including research institutions, manufacturers and all network users, including new entities such as energy services companies, will need to actively engage with the network companies to deliver successful smart grid outcomes.

**What new services do network users need?**

It is proposed that the fundamental services that network users will need in the future are not radically different from those they require today. The core services are the ability to provide connections to the network and the opportunity to use the network without unnecessary constraints, all in a cost efficient way. In addition, network users expect a system operator to co-ordinate the use of the network so that it operates safely and within specified quality limits. These limits apply to frequency, voltage quality and continuity of supply.

Smarter network solutions are expected to offer the most efficient way forward because a low carbon infrastructure can be expected to be a more complex system than the one in place today. In particular, the primary sources of electricity production are expected to be less controllable and more widely dispersed making system balancing, voltage control and power flow management more significant challenges. One way of helping to address these challenges will be to encourage all network users, including electricity consumers, to become actively engaged in the control of the system.

The new or extended services that network users will need; include:

1. Connection services for a greater range of devices at all voltage levels;
2. Network access for these devices taking account of their operating characteristics and the particular value they can bring to a low carbon system;
3. Operating services that will provide all network users with the opportunity, or perhaps requirement, to participate in the overall control of the system;
4. Information services that will allow network users to make choices about the way they consume and/or produce electricity.

**Smart grid solutions**

There is a general consensus that all of the component parts of a smarter grid are available today. The challenge is to prove that they can be deployed successfully and that they will, in the near future, offer the most cost-efficient options for future network development.

It is envisaged that, where necessary, future networks are likely to be designed using more sophisticated probabilistic techniques to better deal with operational uncertainties. It is expected that the level of system monitoring and control, that is already a feature of transmission systems, will migrate down to lower voltage systems. More sophisticated power electronic technologies and direct current devices could be more commonly deployed. More information on network assets can help to improve network utilisation. Improved automation in distribution grids could allow the optimal use of grid reconfiguration after faults. These are just a few examples of smart solutions that are expected to be deployed.

**Encouraging innovation**

Fundamental to the successful development of smarter grids is the need for some network companies to place a greater emphasis on innovation. For decades, network companies have been considered to be low risk businesses offering secure returns. If these companies are to venture
into higher risk activities then appropriate incentives will need to be put in place. Further; the reasons why some network operators do not apply innovation need to be explored and understood. A number of such incentive schemes have now been adopted in particular Member States.

POSSIBLE REGULATORY APPROACHES FAVOURING SMART SOLUTIONS

A key principle of good regulation is to concentrate on the outputs of the regulated entity and the effects of a given activity or service, instead of trying to influence internal processes and activities of the regulated company. Regulation of outputs can be done by direct regulation, i.e. specifying minimum requirements for certain parameters, and/or by performance-based incentive regulation, providing penalties and rewards related to certain criteria and performance indicators. A good regulatory model, which could be used as the basis for a regulatory approach to smart grids, is the incentive regulation mechanism adopted to promote other aspects of network business, e.g. the quality of supply in electricity distribution [2].

Regulation of outputs, either by incentives or by minimum requirements, relies on predefined performance targets and indicators. Clear and transparent measurement rules are very important to make it possible to observe, quantify and verify such targets. Performance targets must be strictly related to the pursued objectives and should therefore be cleansed of external effects outside the control of network operators.

A regulatory scheme for promoting improvements in the performance of electricity networks requires the quantification, through appropriate indicators, of the effects and benefits of “smartness”. In order to be able to use such an approach in practice, the key effects and parameters will have to be precisely identified according to defined metrics. Defining metrics for quantification of effects and benefits of smart grids – including as the most important part, the evaluation of efficiency, effectiveness and comparative cost analysis in relation to a conventional “non-smart” approach – is a challenging but necessary task. In order to be able to perform the cost and benefit analysis, before cost recovery and eventual introduction of incentives for the deployment of smart grids. This is a high priority and complex issue for regulators. Further, it is of paramount importance that no regulatory scheme or requirement represents an (unintended) barrier for necessary development in technology and applied solutions in the grid. One example of a barrier (to achieving 2020 energy efficiency target) is when an increase in the energy delivered is equal to automatic increases in the companies’ profits. The volume of energy delivered should be decoupled from companies’ profits in regulatory models.

Effects and benefits of smart grids

Seven effects and benefits of “smartness” are identified in [1]:

1. Increased sustainability;
2. Adequate capacity of transmission and distribution grids for “collecting” and bringing electricity to consumers;
3. Uniform grid connection and access for all kinds of grid users;
4. Higher 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 by load-flow control to alleviate loop-flows and increased interconnection capacities;
7. Coordinated grid development through common European, regional and local grid planning to optimise transmission grid infrastructure.

Potential performance indicators

A selection of potential performance indicators is presented below. A larger list is identified in [1]:

1. Quantified reduction of carbon emissions;
2. Hosting capacity for distributed energy resources (‘DER hosting capacity’) in distribution grids;
3. First connection charges and grid tariffs for generators, consumers and those that do both;
4. Duration and frequency of interruptions per customer;
5. Level of losses in transmission and in distribution networks (absolute or percentage);
6. Ratio between interconnection capacity of one country/region and its electricity demand;
7. Societal benefit/cost ratio of a proposed infrastructure investment.

Some of these indicators are already in force in some countries today.

ROLE OF REGULATORS FAVOURING COOPERATION

In addition to the aforementioned priority of output regulation, a second priority for regulators should be to have an active role in favouring cooperation among stakeholders, to achieve national and European targets by the various smart grid concepts, innovations and solutions.

The role for regulators is to facilitate ‘smart grids’ discussions, definition of common views, and cooperation among all stakeholders (operators, network users, customers and generation companies, governments, suppliers, standardisation organisations, electric and electronic equipment manufacturers, new energy service providers, information and communication technology providers, academia and research). Such cooperation should be especially devoted to agreeing which smart grid concepts will provide clear and greater net benefits (i.e. the benefits minus the possible additional costs) to
network users, to identifying the possible presence of barriers to such smart grid concepts and to finding the best solutions to eliminate them.

Cooperation among stakeholders is of special importance in the field of standardisation. European Energy Regulators and some national regulatory authorities are already active in cooperation with European and national standardisation bodies, grid operators and manufacturers. This cooperation should further improve open protocols and standards for information management and data exchange, in order to achieve interoperability of smart grid devices and systems and to avoid standards becoming a barrier to their deployment.

**ROLE OF REGULATORS CONCERNING RESEARCH AND INNOVATION**

A third priority for regulators is to find ways of encouraging an adequate level and scope of more radical innovation while providing an appropriate degree of protection of customer interests and economically-effective development of the network. Regulators will critically assess the incentivisation of less innovative network companies to invest in innovative solutions to the benefit of consumers. This challenge could be one of the characteristics of a monopoly business like electricity grid operation, where instead of competition or a technology “revolution” (which are the major forces driving innovation in market businesses), additional regulatory support is needed.

Regulators should further support the increasing efforts and international cooperation in research and development in the field of electricity grids and smart solutions and promote their effectiveness. Regulators, acting as observers in such activities, should favour an approach targeted to define performance indicators for specific smart solutions, and later identify their costs and the benefits to customers. Regulators should also support the link between research & development (R&D) projects and demonstration and initial deployment of selected promising solutions. Supporting the transition process from R&D to demonstration and finally to full deployment of smart solutions, when it is profitable from the point of view of the whole society, while incentivising only economically and technologically efficient technologies, should also be one of the future tasks for the national regulatory authorities. The participation of regulators in this process could reduce the risk of having duplication of costs and financial burden for the final customers.

**CONCLUSIONS**

Smart Grids is about how the network of the future shall be designed, planned, built, operated and maintained including *inter alia* much larger share of intermittent generation and active end-user participation, without compromising on the quality, security or safety and still achieve a reasonable level of costs. Regulators focus on the interests and needs of network users and society. Although different national implementations of the European Directive exist, there is a common objective of efficient, sustainable and secure supply of electricity, in a competitive market environment.

By adopting this user-centric approach, European Energy Regulators have established a common position on Smart Grids which pointed out the services needed by users, the smart grid solutions and the regulatory challenges for satisfying such needs. This common position identified three priorities for regulators: i) identify the effects and benefits of smart grids and concentrate on the output performance of regulated companies by the potential use of performance indicators; ii) facilitate ‘smart grids’ discussions, definition of common views, and cooperation among all stakeholders; iii) find ways of encouraging innovation and supporting the transition process from research and development to demonstration and finally to full deployment.

This position was under public consultation 17th December 2009 till 1 March 2010, and a conclusions paper is expected during summer 2010.

**ACKNOWLEDGEMENT**

This paper contains highlights and a summary of the ERGEG Position Paper on Smart Grids submitted for consultation last December 2009 [1]. The authors of this CIRED paper have been involved in preparing the ERGEG paper, but the contributions from many others are gratefully acknowledged, especially from the other members of the CEER/ERGEG Electricity Quality of Supply Task Force. This paper represents the personal interpretation by the authors of the material presented, and the opinions and recommendations represented in this paper do not necessarily correspond with the opinions of CEER/ERGEG or of their national regulatory authorities.

**REFERENCES**
