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CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions ("Smart Regulation")

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Council of European Energy Regulators asbl
Cours Saint-Michel 30a, Box F – 1140 Brussels, Belgium
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INFORMATION PAGE

Abstract

This document (C13-EQS-57-04) seeks to provide an update the 2011 CEER Status Review of Regulatory Approaches to Smart Electricity Grids with an overview of the current regulatory approaches in 2013. The 2011 edition sought to follow-up the discussion initiated by European Energy Regulators with the ERGEG public consultation on the 'position paper on smart grids' in 2010. The 2013 CEER Status Review examines the definition of smart grids; regulatory challenges affecting smart grids, national implementation plans for smart grids; innovative solutions in electricity networks; cost benefit analysis for the demonstration and deployment of smart grids and potential performance indicators and incentive schemes.

Target Audience

Consumer representative groups, network users, policy-makers, electricity industry, distribution system operators, transmission system operators, electric and electronic equipment manufacturers, standardisation organisations, energy suppliers, energy services providers, information and communication technology providers, academics, researchers and other interested parties.

If you have any queries relating to this paper please contact:
Ms Natalie McCoy
Tel. +32 (0)2 788 73 30
Email: natalie.mccoy@ceer.eu

Related Documents

CEER documents (cited in the paper):

[1] "European Energy Regulators' 2013 Work Programme", Ref: C12-WPDC-22-06, 3 September 2012

[2] "CEER Status Review of the Regulatory Approaches to Smart Electricity Grids", Ref: C11-EQS-45-04, 6 July 2011

[3] "Position Paper on Smart Grids – An ERGEG Public Consultation Paper", Ref: E09-EQS-30-04, 10 December 2009

[4] "Position Paper on Smart Grids – An ERGEG Public Conclusions Paper", Ref: E10-EQS-38-05, 10 June 2010

[5] "Treatment of Losses by Network Operators - an ERGEG Position Paper for public consultation", Ref: E08-ENM-04-03, 15 July 2008

[6] "Treatment of Losses by Network Operators - an ERGEG Conclusions Paper", Ref: E08-ENM-04-03c, 19 February 2009

[7] "Cross Border Framework for Electricity Transmission Network Infrastructure - An ERGEG Conclusions Paper", Ref: E07-ETN-01-03 18, April 2007

[8] "ERGEG Status Review on Building and Construction Authorisation and Permit Process - Case Examples", Ref: E08-EFG-27-04, 06 February 2008

[9] "5th Benchmarking Report on Electricity Quality of Supply", Ref. C11-EQS-47-03, 2 December 2011

CEER documents (not directly cited, but of interest):

"Status Review of Regulatory Aspects of Smart Metering", Ref: C13-RMF-54-05, 12 September 2013

"Benchmarking Report on Meter Data Management - Case Studies", Ref. C12-RMF-46-05, 7 November 2012

External documents

[10] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Smart Grids: from innovation to deployment", COM (2011) 202 final, Brussels, 12 April 2011
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0202:FIN:EN:PDF

[11] EU Commission Task Force for Smart Grids, "Expert Group 3: Roles and Responsibilities of Actors involved in the Smart Grids Deployment", 4 April 2011
http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/expert_group3.pdf

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Executive Summary

Background

This Status Review of Regulatory Approaches to Smart Grid serves as a follow-up to the previous CEER Status Review of Regulatory Approaches to Smart Electricity Grids, published in 2011 [2].

Objectives and contents of the document

The objective of this present paper is to gather evidence and analyse information about regulatory approaches to the demonstration and deployment of smart grids. Input for the paper was supported by an internal questionnaire among CEER member and observers countries (27 respondents out of 32). The main topics considered are:

1. The definition of smart grids;
2. The regulatory and commercial challenges related to smart grids;
3. Plans for the implementation of smart grids;
4. Encouraging innovative solutions in electricity networks;
5. Cost benefit analysis for the demonstration and deployment of smart grids; and
6. Potential performance indicators.

A brief summary of each topic is provided below.

The definition of smart grids

The 2013 Status Review Report decided to maintain the definition first published by European Energy Regulators in 2009.

The regulatory and commercial challenges related to smart grids

As smart grids become an increasingly relevant topic across Europe, regulators are considering possible implementation challenges more thoroughly. Such an analysis has already occurred in many countries, due to its importance for enabling regulators to take appropriate action at the national level. Using an internal questionnaire among CEER members, a range of possible challenges has been analysed. Taken overall, the feedback suggests differences in the importance attached to possible challenges at national level. In particular, stakeholder involvement in demand side response, incentivising demand side response, the regulatory barriers to the development of smart grids and the regulatory instruments to facilitate smart grid development generated substantial reaction from National Regulatory Authorities (NRAs).

Plans for the implementation of smart grids

Of the countries who responded, 42% already have a strategic roadmap in place for the implementation of smart grids; while 58% do not. Nevertheless, some form of implementation plan has been created at a national level by 38% of countries. In the majority of countries, the most common stakeholders involved in implementation plans are the national Government and the distribution system operators (DSOs); whilst the NRA is responsible for monitoring these plans. There was no clear convergence across countries with regard to the timeframe for implementation plans, although progress has been made towards completing these plans in the majority of countries.

Encouraging innovative solutions in electricity networks

The 2009 Position Paper on Smart Grids [3] included recommendations that relate to smart grid demonstration projects. CEER continues to recommend encouraging the deployment of smart grid solutions where they are a:

'Cost-efficient alternative to existing solutions, and as a first step in this direction, finding ways of incentivising network companies to pursue innovative solutions where this can be considered beneficial from the view point of society as a whole.'

Based on responses to our internal questionnaire, there are several approaches taken for encouraging innovation through different regulatory regimes and a varying status of smart grids development in different countries. Different incentive mechanisms to encourage network companies to pursue innovation/demonstration projects are either already in place or planned to be introduced.

CEER also recommends ensuring dissemination of the results and lessons learned from demonstration projects. In 50% of the respondent countries, the dissemination of information and lessons learned is on a voluntary basis; however, this may be due to not all smart grid demonstration projects being undertaken by regulated entities or financed by tariffs, and so, rules regarding dissemination may be different for these projects. In 21% of countries, (Great Britain, Norway and Italy), dissemination of demonstration project results is on a mandatory basis.

Cost benefit analysis for the demonstration and deployment of smart grids

European Energy Regulators recommend evaluating the breakdown of costs and benefits of possible demonstration projects for each network stakeholder and taking decisions or giving advice to decision-makers based on a societal cost-benefit analysis (CBA). One of the priorities for regulation (identified in related documents [3] and [4]) refers to the identification of costs and benefits of smart grid demonstrations and deployed solutions.

The results of the 2013 survey found that 39% of countries have undertaken a cost benefit analysis of a full smart grid or specific value streams. In one country, project applicants are obliged to demonstrate the benefits for society as a whole. In two countries, a CBA has been partially undertaken or is under discussion; however, a CBA has not been undertaken at all in 44% of the respondent countries.

Potential performance indicators

Regulators are highly aware of the importance of performance indicators across Europe. The nine performance indicators that this report focuses on are:

1. Hosting capacity for distributed energy resources in distribution grids;
2. Allowable maximum injection of power without congestion risks in transmission networks;
3. Energy not withdrawn from renewable sources due to congestion and/or security risks;
4. Measured satisfaction of grid users for the "grid" services they receive;
5. Level of losses in transmission and distribution networks;
6. Actual availability of network capacity (e.g. Distributed Energy Resources (DER) hosting capacity) with respect to its standard value;
7. Ratio between interconnection capacity of one country/region and its electricity demand;
8. Exploitation of interconnection capacity (particularly related to maximisation of capacity according to the Regulation on electricity cross-border exchanges[1] and the congestion management guidelines[2]); and
9. Time for licensing/authorisation of a new electricity transmission infrastructure.

The move towards quality and efficiency in networks, which was encouraged by the European Commission in its Communication [10], is already being undertaken by many NRAs. A significant number of countries indicated that they use some of the indicators proposed in the previous Smart Grids Conclusions Paper [4], either for monitoring purposes or as a revenue driver.

[1] Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity

[2] ACER Framework Guidelines on Capacity Allocation and Congestion Management for Electricity

Introduction

The 2013 CEER Work Programme envisages a 'CEER Status Review on European regulatory approaches enabling smart grid solutions ("smart regulation")'. The work programme [1] describes the paper as follows:

'In the future, smart distribution systems will become more and more important. Therefore, CEER will analyse current national smart grid models. In particular, smart grid technology aspects which make electricity grids more cost effective will be studied.'

The present report follows on from the 2011 Status Review of Regulatory Approaches to Smart Electricity Grids, and the 2010 Position and Conclusion Papers on Smart Grids [3] [4]. The 2010 paper identified three main priorities for regulators:

1. To concentrate on outputs of the regulated entity, by tailored regulatory mechanisms;
2. To favour cooperation among stakeholders, with emphasis on standardisation, also in order to identify the possible barriers to smart grid development; and
3. To encourage an adequate level of innovation, while protecting consumers by the identification of costs and benefits of smart grid demonstrations and deployed solutions.

Objective and main topics of the status review paper

The objective of this paper is to gather and analyse information about regulatory approaches to the demonstration and deployment of smart electricity networks. The main topics addressed are:

1. The definition of smart grids;
2. The regulatory and commercial challenges related to smart grids;
3. Plans for implementation of smart grids;
4. Encouraging innovative solutions in electricity networks;
5. Cost benefit analysis for the demonstration and deployment of smart grids; and
6. Potential performance indicators.

The report was supported by an internal questionnaire among CEER member countries, with 27 out of 32 members contributing to some or all of the questions.

1 The definition of smart grids

The term “smart grids” is defined in a variety of ways. The following definition is used in the European Energy Regulators papers on smart grids [3] [4]:

‘A 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 systems with low losses and high levels of quality and security of supply and safety.’

The European Commission made use of the European Energy Regulators definition in accompanying documents (SEC (2011) 463 final) to the European Commission Communication “Smart Grids: from innovation to deployment” [10].

The 2011 Status Review concluded that while other definitions[3] are also used (including those that define smart grids by the kind of technology used), these small differences were not considered as a barrier to the development of smart grids. It was not considered that the recent developments in smart grids affect the original definition.

Therefore, the 2011 Status Review decided to maintain the definition first published in 2009 [3] and CEER upholds this definition in the present report; we consider that this definition remains accurate and relevant in the framework of recent developments in smart grids.

[3] See Annex 3: Smart grid definitions

2 The Regulatory Challenges Related to Smart Grids

In their 2010 Conclusions Paper, European Energy Regulators observed that while high-level principles for smart grids can be applied across Europe, detailed implementation will vary from country to country. The results from the 2011 Status Review showed that smart grids are at different stages of development in Europe, and as a consequence, the regulatory activity for smart grids within Member States is evolving in different phases.

As smart grids progressively become a more significant topic of discussion in Europe, the challenges to their implementation are increasingly examined in more detail by energy regulators. This investigation is important for regulators in order for them to identify challenges and to ensure mitigation through appropriate action at the national level.

This paper analyses a range of possible issues that will help to identify challenges to smart grid regulation, according to the following categories:

- Stakeholder involvement in the development of smart grids (e.g. demand side response, demand side response for domestic customers, incentivising demand side response);
- Regulatory challenges to the development of smart grids (e.g. technical and commercial arrangements, barriers, regulatory instruments); and
- Emerging regulatory issues for the development of smart grids (e.g. new arrangements, electrical storage, and smart meter data).

The following sections provide an overview of the findings. More detailed information is provided in Annex 4 of this report.

2.1 Stakeholder involvement in the development of smart grids

The first stage of CEER's analysis sought to identify the different stakeholders involved in the development of smart grids in each member state. This information is useful for regulators when considering the roles that stakeholders play, or will need to play, in the development of smart grids, as well as the relationships between them. The results of the 2013 questionnaire have shown that while the role of stakeholders in smart grid development varies widely from country to country, some broad trends can be identified. These trends are set out overleaf.

In the majority of countries (84%[4]), the distribution system operator (DSO) plays a major role in smart grid development. In addition, a smaller number of countries identified that NRAs (44%) and transmission system operators (TSOs) (40%) play a major role, with suppliers (52%), the Government (56%) and technology providers (56%) all noted as playing a supporting role. Other stakeholders that were identified include local authorities, generators, technical universities, research institutes and external consultants.

[4] Percentages are taken from the number of countries that answered each specific question, not the number of countries that answered the survey as a whole.

The areas that NRAs are predominately involved in for smart grid development are incentivising (58%) and information provision (58%). The NRA was also identified as being involved in promoting research and development and demonstration trials, but in a lower number of countries.

Other key roles for NRAs were noted as providing input for legislation, consultation, mediation and defining the goals of smart grids. The responsibilities for smart grid development in Austria, Germany, Estonia, Luxemburg, Romania and the Netherlands are mainly left to the market, without an explicit role for NRAs. In Lithuania, the NRA is involved in the CBA for smart grid development for the gas sector, but it has no specific role in smart grids in the electricity sector.

Stakeholder involvement in demand side response

For 83% of the respondent countries, the DSO is involved in demand side management (DSM) and it will play a role in this respect for smart grids in 81% of countries. Other stakeholders that are involved in demand side response were identified as the NRA, customers, customer associations, research centres, municipalities, Governmental agencies and Energy Service Companies (ESCOs), amongst others.

DSOs (91%), suppliers (86%) and aggregators (57%) will be involved in DSM for domestic customers in smart grids in the majority of countries. However some countries, like Austria, Lithuania, Portugal and the Netherlands, have not defined what form the role of the DSO will be in DSM for domestic customers with the deployment of smart grids.

Incentivising demand side response

In the majority of countries, static time of use tariffs (71%) and load control through remote means (58%) are used to incentivise demand side response. Load control at premises is used to a lesser extent; in 33% of the countries that responded to the survey.

In France, demand response operators will receive an additional payment that takes into account the benefits demand response has provided. In Italy, load control is currently limited to very large industrial customers through remote means, while in the Netherlands, 95% of energy for balancing is provided through short-term activation (less than 15 minutes) with near real-time pricing.

2.2 Regulatory challenges to the development of smart grids

The next section of this chapter concerns the regulatory challenges to the development of smart grids. It is important to identify any potential barriers and challenges to the development of smart grids in order to put processes in place to overcome them.

Regulatory and commercial barriers to the development of smart grids

There was no clear consensus between NRAs on the existence of regulatory and commercial barriers to the development of smart grids, but the majority of respondents did not consider barriers to be evident.

Norway noted that it will be necessary to continually develop regulation as thinking on smart grids evolves. Several NRAs (Belgium, Cyprus, Czech Republic, France, Great Britain, Italy, Poland, Portugal and the Netherlands) identified a number of different barriers. Examples of these barriers relate to the following areas:

- Encouraging system operators to play a more active role in addressing future challenges;
- High electricity prices and limited network development funds;
- Uncertainty around the direction of planned national action plans;
- The integration of Electric Vehicles (EV), storage, demand response and renewable energy strategies (RES) into the market;
- Charging methodologies and current settlement processes;
- Data protection laws;
- The lack of clear responsibilities for the role of stakeholders; and
- Standardisation.

Technical and commercial arrangements

The questionnaire circulated to CEER members sought to identify the technical and commercial arrangements in place at the national level.

In the majority of countries (52%), net metering[5] is either in use already (the Netherlands, Sweden, Italy, Hungary, Great Britain, Finland and Denmark), or is planned to be introduced (Croatia, Cyprus, Estonia, Greece and Romania).

In 78% of countries, smart grids are not limited to certain networks or voltage levels. In Greece, smart grids are limited to low-voltage (LV) networks while in Italy and Portugal, smart grids are limited to LV and medium-voltage (MV) networks. In Italy, almost all high-voltage (HV) networks are included in the transmission grid that is already "smart grid" functional.
The boundary between regulated and non-regulated activities will be affected by the development of smart grids in most countries (38%). Others noted that storage and the integration of electric vehicles will affect this boundary.

In general, NRAs stated that existing rules for unbundling are not expected to hinder smart grid development and provided individual statements from their national view, listed in Annex 4.

[5] Net metering is an electricity policy for consumers who own (generally small) renewable energy generation facilities (such as wind, solar power or home fuel cells) or V2G electric vehicles. "Net", in this context, is used in the sense of meaning "what remains after deductions" — in this case, the deduction of any energy outflows from metered energy inflows. Under net metering, a system owner receives retail credit for at least a portion of the electricity they generate.

Regulatory instruments to facilitate smart grid development

79% of countries use tools for price regulation to facilitate smart grid development, while performance indicators are used in 63% of countries; tools to regulate information provision, charges and licensing are used to a lesser extent. In the majority of countries (76%), regulatory instruments will need to be adapted for smart grid development. Notably:

- Belgium: tariffs will need to be adapted to reflect the market value and network costs of smart grids.
- Great Britain: investment incentives will need to reflect the true value of demand side response to the system.
- Lithuania: current regulation will need to be adapted to fully exploit smart grid benefits and to control data privacy issues.
- Italy: "input-based" incentive regulation is already in place for transmissions, and has been used for promoting demonstration projects of smart grid at distribution level;
- Poland: two new performance indicators were introduced to measure the benefits to consumers arising from smart metering.
- Spain: the low voltage code has been proposed to be changed and a new discriminatory tariff that promotes charging of EV at low demand times has been established.

Across the range of issues, investment incentives and performance indicators were cited most prominently as areas that would be affected by the need to adapt regulatory instruments. However, it should be noted that for these two issues a large number of NRAs (61%) believe that the existing regime already enables the deployment of smart grids.

Other important issues for smart grid development

CEER asked its members to rank a series of issues with regards to their importance for smart grid development:

- **Incentives to encourage network operators to choose investment options that offer the most cost effective solutions** was rated as '*very important'* by the majority of countries (61%);
- **Incentives to encourage network operators to choose innovative solutions/ incentives for network operators to encourage efficient use of electricity and renewable electricity production** was rated as *'important'* by most countries (52%), as was **active participation in the development of smart grids by stakeholders** (48%), **the roles and relationships of relevant stakeholders to encourage the introduction of new services or markets** (44%), and **the introduction of new tariffs to incentivise more efficient network use** (52%);
- A number of countries (35%) rated **standards on smart technologies** as of *'medium importance'*;

NRAs were asked to consider whether there was a differentiation between conventional grids and smart grids for the issues listed above. On the whole, NRAs stated that there is no differentiation between smart grids and conventional grids for:

- Incentives to encourage network operators to choose investment solutions that offer the most cost-effective solutions;
- New tariffs to incentivise more efficient network use; and
- The effective implementation of unbundling (however, it is important to note the comments recorded in Table 2 in Annex 4).

There was no clear consensus on differentiation for the remaining issues.

2.3 Emerging regulatory issues in the development of smart grids

This section explores emerging regulatory issues in the development of smart grids.

The need for new regulatory and commercial arrangements to facilitate smart grid development

In the majority of countries (73%), new commercial and regulatory arrangements will be necessary in order to facilitate the development of smart grids. The new commercial and regulatory arrangements relate specifically to:

- New routes to market and market processes;
- Benchmarking;
- The coordination between suppliers and DSOs on the flexibility requested of customers; and
- Defining the relationships and roles of stakeholders in the value chain.

New arrangements will not be needed in Austria, Cyprus, Estonia, Finland, Latvia, Slovenia and Sweden.

Electrical storage connected to the network

This section of the questionnaire aimed to identify the ownership and operation of storage connected directly to the network. It is important to note that the answers in this section reflected the use of storage in demonstration projects in some cases. The results are varied but show that in the majority of countries, large scale generators and DSOs own storage, while large scale generators, DSOs, TSOs and end use customers (distributed generators and electric vehicles) operate storage.

The use and access of smart meter data for smart grids[6]

In 70% of countries, smart grids will use smart meter data; not all countries were certain that this would be the case. In most countries, consumers (71%), and DSOs (67%) will have access to smart meter data, and to a lesser extent, suppliers (58%). However, many countries noted that this decision was yet to be taken (see Annex 4 for more information).

[6] While smart metering issues are considered out of the scope of this particular review, they are of course connected to smart grid issues and hence briefly analysed here. While smart meters are considered as enablers for smart grids in some countries, European Energy Regulators [4] concluded that it is technically possible to develop smart grid and smart meter infrastructure independently of each other.

In the majority of countries, consumers and suppliers will have access to consumption and pricing data, while in a smaller number of countries, consumers will also have access to power quality and technical data. NRAs will mostly have access to power quality and consumption data, but DSOs, and to some extent TSOs, will have access to power quality data, technical data and consumption data (but not pricing data). Furthermore, ESCOs will also have access to consumption data in Cyprus, Germany, Great Britain, Luxembourg, Portugal and Slovenia. In France, ESCOs will have access to this data, but only if the customer gives their consent. This present study did not analyse if the exchange of data is based on an opt-in or opt-out method.

There was no clear consensus on whether the NRA will be involved in data security regulation for smart meter data, nevertheless in Belgium, data security will form part of the DSOs core duties, which the NRA will oversee the compliance of. In the Czech Republic, data security will be the responsibility of the Office for Personal Data Protection, as in France, where there is also a separate and dedicated agency in charge of data security. In Germany, this is the responsibility of the Federal Office for Information Security. In the UK, the NRA will approve data aggregation plans from the DNO, and data privacy requirements are covered under licence conditions. In Slovenia, the NRA will conduct a CBA for smart metering which will include security issues. Finally, in the Netherlands, the NRA and the Data Protection Authority operate in conjunction with each other on data security matters.

Other emerging issues impacting the development of smart grids

In the majority of countries, standards and investment risks were noted as emerging issues that could impact on the development of smart grids. The lack of market mechanisms, information collection and handling, interoperability and technology risks were also noted as emerging issues.

In Poland for example, laws concerning smart grids and smart metering have not yet been passed. Some provisions of the law on personal data protection could severely hinder the development of certain functionalities of smart meter infrastructure. As a consequence, some companies consider the situation as being too uncertain to invest in metering on a large scale.

3 Plans for the Implementation of Smart Grids

The European Commission's Smart Grids Task Force (Expert Group 3) called for and recommended greater commitment by European countries towards establishing/implementing national models for the deployment of smart grids. It is proposed that EU Member States define national models and/or platforms, ensuring in particular the dissemination, and exchange of experiences and lesson learned. This part of the Status Review outlines NRAs responses with regard to their national models/roadmaps and on-going or planned implementation steps. Please see Annex 5 for further information and detail on the publication of national plans.

3.1 The creation at local or national level of a smart grid implementation plan

Currently, national plans for the implementation of smart grids have not been outlined in a significant number of countries (42%); 10 countries noted that such plans had been created, while 14 indicated that they had not. Austria, Cyprus Denmark, Finland, France, Greece, Luxembourg and Norway have already published their national implementation plans. In 9 of the 10 countries, these implementation plans were established at the national level; while in Belgium, this plan is under development at both national and local levels. In the Czech Republic and Slovenia, an implementation plan has not been developed. In Great Britain, although an implementation plan has not been created, a high level route-map has been developed, which is the responsibility of the national GB Smart Grid Forum[7].

Responsibility for implementing smart grid plans

The second part of this section relates to the responsibility for implementing these plans. In the majority of countries (71%), the two most common stakeholders involved in implementing plans are the Government and DSOs. In Austria, the Austrian Smart Grid Technology Platform[8] is also involved in implementing these plans alongside the Government, the DSO and suppliers; the Platform is also liable for deployment of the plan.

In Finland, Greece and Luxembourg, the NRA is also responsible for implementation. In Belgium, the recommendations are mostly addressed to DSOs, but other stakeholders are involved too. In Great Britain, the NRA, Government, DSOs and the Smart Grid Forum are responsible for monitoring the route-map. There is no decision yet regarding who will be the responsible party in Romania and Switzerland.

[7] http://www.smartgridgb.org/

[8] http://www.smartgrids.at/

3.2 Monitoring implementation plans

In many cases (50%), NRAs are responsible for monitoring implementation plans but the responsibility is shared between the NRA and other stakeholders in three particular cases. In four countries, there is more than one responsible party for monitoring. As mentioned in Austria, the Smart Grid Technology Platform has a large role to play and this also extends to monitoring responsibilities. In the Netherlands, the Agentschap NL (a quasi-autonomous non-governmental organisation)[9] is the party responsible. It has not yet been decided who the responsible party is yet in Great Britain, Romania and Switzerland, as implementation plans have not yet been developed.

Timeframe of the implementation plan

There was no clear consensus among respondents with regard to the timeframe for implementation. Three countries have time frames of between 0-5 years, six have time frames of between 5-10 years and three noted that time frames have not yet been determined. The French implementation plan is set over a period of 10 years. In Austria, a new version of the roadmap is currently being developed. The Action Plan for Smart Grids in the Czech Republic should be prepared before the end of 2015. There are two route-maps in Great Britain, an integrated route map out to 2020 and a high level route map out to 2050. Norway are due to implement their national plan before 2019, however, there is currently no implementation plan for smart grids in place. Hungary, Romania and Slovenia have no timeframe for the implementation plan.

Progress of the implementation plan

The last question in CEER's internal questionnaire sought to find out whether progress is being made in line with the respective national implementation plan. Generally most countries indicated that progress has been made in accordance with the execution plan, with the exception of Hungary and Romania.

In the Czech Republic, the National Action Plan for Smart Grids is still under discussion with regard to the specific content and detail. In France, three calls for projects have so far been launched by the Energy Agency and many demonstration projects have already received funding. While no implementation plan exists in the Great Britain, progress has been made with regards to the route-map. In Italy, there is currently a one-year delay regarding the implementation of demonstration projects and analysis of critical issues is now under consideration. In Luxembourg and Sweden, progress has been made with regards smart meter implementation, and in the Netherlands, research on evaluating the implementation of smart grids is on-going.

[9] http://english.rvo.nl/

4 Encouraging Innovative Solutions in Electricity Networks

The Smart Grids Conclusions Paper [4] recommended that NRAs should ensure the dissemination of learning and results arising from smart grid demonstration projects. The 2011 CEER Status Review stated that the first priority towards realising this goal is to ensure that such projects are made visible to interested parties in order to facilitate the sharing of knowledge and experience; furthermore, it should help to mitigate trial duplication.

The 2011 Status Review defined active innovation/demonstration projects as:

'A project that involves the trialling on a distribution or transmission system of at least one of the following:

- *A specific piece of new (i.e. unproven) equipment (including control and communication systems and software) that has a direct impact on the distribution or transmission system;*
- *A novel arrangement or application of existing distribution/transmission system equipment (including control and communications systems software);*
- *A novel operational practice directly related to the operation of the distribution/transmission system; or*
- *A novel commercial arrangement.'*

The 2013 internal questionnaire sought to establish and identify:

- The level of funding for demonstration projects;
- The mechanisms for monitoring progress;
- The mechanisms and processes to ensure the dissemination of lessons learnt;
- The specific incentives to encourage DSOs to pursue smart grid innovation projects;
- General incentives for smart grid innovation; and
- How incentives to encourage DSO innovation are funded.

19 out of the 22 (86%) respondents that answered this part of the questionnaire stated that demonstration projects had already started in their respective country. This represents an increase in demonstration projects as compared with the data received in the 2011 Status Review which indicated that 14 countries had started demonstration projects. As in the previous paper, the results do not offer a fully comprehensive account of the level of smart grid demonstration projects in Europe, but instead offer a snap-shot of the situation from those NRAs that responded to the questionnaire.

4.1 Demonstration projects

This section investigates demonstration projects for smart grids, as well as the funding of these projects, and the monitoring and dissemination of learning.

Funding for demonstration projects

In a majority of countries (61%), a combination of sources are used to fund demonstration projects. In 56% of these countries, funding for demonstration projects has been through sources of finance such as industry funding, public funding institutions, the European Commission and integrated municipal energy suppliers. Further information can be found in Annex 6.

Efficiency targets for demonstration projects are in place in four countries; Cyprus, Italy, Poland and Finland. In Finland, costs are passed through up to a certain limit, but are also included in efficiency targets. In Italy, a cost-benefit indicator is used during the selection stage. In Austria, demonstration projects are funded by industry, public institutions and national budgets; the Climate and Energy Fund (Klima- und Energiefonds - KLIEN) was created by the Federal Government with the aim of supporting the implementation of the climate strategy, and remaining costs (if adequate) are audited and covered by network charges. The remaining investment costs are checked and considered as pass-through costs during the regulatory period, with efficiency targets applied in the following period. Demonstration projects are not subject to efficiency targets in Great Britain, however, a key criterion for awarding funding is the value for consumers that the project can provide and the overall efficiency of the project in the long-term.

In many countries (61%), the decision maker on granting funding for demonstration projects is the Government or 'other' (see Annex 6 for further detail). In Belgium, the Government is advised by the NRA during the decision-making process In Great Britain, the Government is only the decision maker for small amount of projects, while the NRA is responsible for the majority of these decisions. In Austria, the funding institution (KLIEN) is the responsible party for granting (or not) most demonstration projects funding. In Luxembourg and the Czech Republic, it is the DSO (or the largest DSO in the case of Czech Republic), whereas in Finland, DSOs and research institutions are jointly responsible. In Spain, the DSOs and Local Authorities who undertake these projects are the decision makers, and in the Netherlands, Agentschap NL is the responsible party.

Monitoring progress of demonstration projects

In the majority of countries (88%), the progress of demonstration projects is monitored. Finland and the Czech Republic do not monitor demonstration projects but the project consortium does continually inform the NRA of progress in the latter.

The responsibility for monitoring these demonstration projects falls to a mixture of NRA, Government, DSOs, funding institutions and 'others'. In Norway, the Norwegian Smart Grid Centre[10] is responsible for monitoring these projects. In Belgium and Germany, the particular stakeholder who initiated the project is responsible monitoring its progress; in the case of Belgium, monitoring could be undertaken by universities.

There is no consensus on the mechanism through which demonstration projects are monitored but further information can be found in Annex 6.

Processes and mechanisms to ensure lessons learnt and the dissemination of learning

In 50% of the countries with demonstration projects in place, learning is disseminated to interested parties on a voluntary basis. This is through information that is made publicly available (Czech Republic, France), or through workshops and seminars (France, Spain, the Netherlands). In Great Britain, Italy and Norway, the dissemination of demonstration projects' results is on a mandatory basis; in fact, in Great Britain, knowledge dissemination events, annual conferences and a sharing portal are mandatory for demonstration projects. In Italy,

[10] http://smartgrids.no/en/

dissemination of knowledge is considered as a main objective for these projects. There are no mechanisms for the dissemination of information in Cyprus. For further information, please see Annex 6.

For the majority of projects (67%), the party who initiated and undertook the demonstration projects are themselves responsible for ensuring the dissemination of results and lessons learned.

4.2 Innovation and incentives

The following section examines incentives to encourage innovation projects and how these incentives are funded.

Specific incentives to encourage DSOs to pursue smart grid innovation projects

Regulatory mechanisms, Government initiatives and European initiatives are all in place to encourage DSOs to pursue smart grid innovation projects in the majority of countries. For examples:

- In Austria, the regulatory system provides incentives for cost reductions as companies have to follow a regulatory/efficiency path. This results in companies choosing smart solutions whenever they are more cost efficient than other solutions. These incentives are explicit investment incentives which do not differentiate between traditional and smart incentives.
- In Belgium, incentives are still to be defined.
- In Cyprus, there are currently no incentives in place.

In 63% of countries, general incentives (not specific to smart grids) are used for smart grid development.

How incentives to encourage DSOs to innovate are funded

Incentives to encourage DSO innovation are mostly funded through network charges (in 75% of countries). National government funding and European funding is also used to a great extent, while many countries use a combination of funding sources:

- Network charges, national government funding and European funding are used by **Austria, Finland , Italy and France**;
- Network charges and national government funding are used by the **Netherlands, Poland and Norway;**
- Network charges and European funding are used by **Lithuania and Slovenia**; and
- European funding and national government funding is used by **Spain**.

5 Cost-benefit Analysis for the Demonstration and Deployment of Smart Grids

In the 2009-2010 papers [3 & 4], regulators supported the following recommendation:

'Recommendation 6 - To evaluate the breakdown of costs and benefits of possible demonstration projects for each network stakeholder and to take decisions or give advice to decision makers based on societal cost-benefit assessment which takes into account costs and benefits for each stakeholder and for society as a whole.'

This chapter assesses the status of cost-benefit analysis (CBA) on smart grids in those CEER member countries who responded to the internal questionnaire. It should be noted that CBA on smart metering projects is not addressed in this document. Additional information can be found in Annex 7.

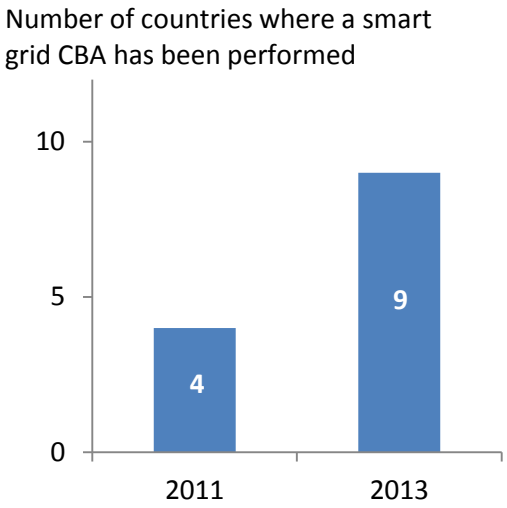
For this status review, NRAs were asked:

- Whether a cost benefit analysis has been undertaken for smart grids;
- The geographical scope of the analysis (national, regional, demonstration project);
- The focus of the analysis;
- The status and the main results of the CBA if completed; and
- The responsibility for conducting the CBA.

An increasing number of NRAs indicated that a CBA has already been carried out in their country: (9 countries in 2013, versus 4 in 2011)

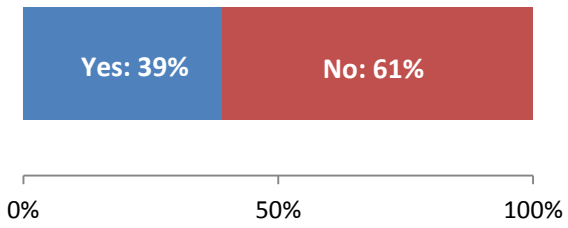
- A CBA on both deployment and demonstration has been undertaken in 3 countries;
- A CBA on smart grid deployment has been conducted in 4 countries;
- One CBA has been undertaken on demonstration; and
- One country has not defined whether their CBA relates to deployment or demonstration.

14 countries (61%) answered that no CBA has been undertaken. However, in Austria, while no CBA has been undertaken at a national level, project applicants must demonstrate the effects and impacts of the project for society as a whole. In Belgium, a CBA has been partially undertaken, while it is under discussion in the Czech Republic. In Switzerland, Lithuania and Luxembourg, CBAs have only been undertaken on smart meters.



Evolution between 2011 and 2013 of the number of countries where a CBA has been performed

NRA answers to the question "Has a CBA been undertaken for Smart grids?" (23 NRAs answered this question)



Proportion of countries where a CBA has been performed (status in 2013)

5.1 Detailed results

Geographical scope of the analysis

In nearly all countries (91%), the CBA is performed at national level. A CBA has been undertaken at regional level in Belgium and at demonstration level in Italy, Denmark, France and the Netherlands. In Great Britain and Denmark, CBAs have been undertaken at both regional and national level.

Geographical level	**% of countries where a CBA is performed** (among the 8 countries which answered the question)	Countries
National level	88 %	Denmark, Finland, France, Great Britain, Italy, Norway, The Netherlands
Regional level	38 %	Belgium, Denmark, Great Britain
Demonstration project	50 %	Denmark, France, Italy, The Netherlands

Focus of the analysis

In most countries, the CBA aims to identify the net benefits of smart grids compared to business as usual. Three countries also performed an analysis at the level of the demonstration projects.

Focus of the CBA	% of countries where a CBA is performed (among the 8 countries which answered the question)	Countries
Net benefits of smart grids compared to business as usual	88 %	Belgium, Denmark, Finland, France, Great Britain, Norway, The Netherlands
Demonstration projects	38 %	France, Italy, The Netherlands

Responsibility for conducting the CBA

There was no clear consensus on the different market players that conducted these CBAs and the results were varied among the respondent countries. Governments, NRAs, TSOs, DSOs, national competition authorities, and in some cases a dedicated work streams gathering various market players, were listed as being responsible for conducting the CBAs.

6 Performance indicators and incentive schemes for regulating network outputs

In its 2010 Smart Grids Conclusions Paper [4], European energy regulators identified a number (34) of performance indicators for regulating network outputs. These indicators can contribute to regulators' work to quantify the effects/benefits of the "smartness" of a network.

Furthermore, the recent European Commission Communication on Smart Grids [10] states that "regulatory incentives should encourage a network operator to earn revenue in ways that are not linked to additional sales, but are rather based on efficiency gains and lower peak investment needs, i.e. moving from a 'volume-based' business model to a quality- and efficiency-based model".

As part of this present status review, NRAs were asked about their experience with the aforementioned indicators mentioned. The results of that exercise are presented in Annex 8, and partly in the forthcoming sections. The list of indicators found in the Annex corresponds to that presented in 2010 [5]. In addition, more detailed information was on those indicators which are currently in use or under consideration at the national level. The information obtained from fourteen countries is presented in the forthcoming sections for nine selected indicators.

6.1 The indicators selected for the detailed analysis

From the 34 indicators proposed in the 2010 Smart Grids Conclusions Paper, nine were selected for further analysis in this report. The selection was based on the number of countries actually using the indicators and the extent to which these indicators fulfilled the following criteria:

i. The variation (improvement) of the indicator would determine a quantifiable benefit to grid users and, in general, society as a whole[11].
ii. It is possible to determine (measure or calculate) the value of the index in a sufficiently accurate and objective way[12].
iii. The value of the index can be influenced (even if to a limited extent) by the network operator or the system operator; this includes metering[13].
iv. The index should be as far as possible, technology neutral[14].

[11] 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" - Smart Grid Conclusions Paper [4], page 11.

[12] Clear and transparent measurement rules are very important to make it possible to observe, quantify and verify such targets -Smart Grid Conclusions Paper [4], page 26.

[13] Performance targets should be cleansed of external effects outside the control of network operators - Smart Grid Conclusions Paper [4], page 26.

[14] It is also of paramount importance that no regulatory scheme or requirement represents an (unintended) barrier for necessary development in technology and applied solutions in the grid - Smart Grid Consultation Paper [4], page 31.

European Energy Regulators already stated in their consultation paper on smart grids that:

'A good regulatory model, which could be used as the basis for a regulatory approach to smart grids, are the incentive regulation mechanisms adopted to promote other aspects of network business, e.g. quality of supply.'

There is significant experience in performance-based regulation in the field of quality of supply, covering:

- Commercial quality (which includes indicator 3.4 "time to connect a new user").
- Continuity of supply (group of indicators classified under 4.5 "Duration and frequency of interruptions per customer").
- Voltage quality (group of indicators classified under 4.6 "Voltage quality performance of the electricity grid").

For example, in half of the responding NRAs, continuity of supply indicators are used as a revenue driver for network operators while in the other half, continuity of supply is monitored.

CEER has ten years of experience in benchmarking the indicators and regulations for quality of supply across Europe [9] and [4]; these topics are not covered in this status review.

In the framework of the present paper, CEER chose to investigate the following nine indicators more closely. The numbers refer to the full list of indicators in the Smart Grids Conclusions Paper [3] and as presented in Annex 6:

a) 2.1. Hosting capacity for distributed energy resources in distribution grids;
b) 2.2. Allowable maximum injection of power without congestion risks in transmission networks;
c) 2.3. Energy not withdrawn from renewable sources due to congestion and/or security risks;
d) 4.3. Measured satisfaction of grid users for the "grid" services they receive;
e) 5.1. Level of losses in transmission and distribution networks;
f) 5.5. Actual availability of network capacity (e.g. DER hosting capacity) with respect to its standard value;
g) 6.1. Ratio between interconnection capacity of one country/region and its electricity demand;
h) 6.2. Exploitation of interconnection capacity (particularly related to maximization of capacity according to the Regulation on electricity cross-border exchanges and the congestion management guidelines); and
i) 7.4 Time for licensing/authorisation of a new electricity transmission infrastructure.

In the forthcoming sections, these selected indicators are discussed in more detail and grouped according to four headings.

6.2 Indicators of adequate grid capacity

Hosting capacity for distributed energy resources in distribution grids

This indicator is used in two countries (Italy and Norway) as a revenue driver and used or under consideration for monitoring in nine countries (Austria, Belgium, Finland, Denmark, Norway, Portugal, Slovenia, Spain and Netherlands). This indicator is specifically referred to as a distribution indicator in the aforementioned Smart Grids Conclusions Paper.

Hosting capacity is the amount of electricity production that can be connected to the distribution network without endangering the voltage quality and reliability for other grid users. To calculate the hosting capacity, it is important that performance requirements for voltage quality and reliability are agreed upon. This could also depend on the type of electricity production; again this means that it is important to define clearly how the hosting capacity is calculated. Incorrect definition or calculation of the index could result in new technology increasing the actual hosting capacity, but not the index.

When the hosting capacity indicator is used as a revenue driver, it should not incentivise the network operator to excessive unnecessary investments in the grid. The indicator should also give the right incentive towards the use of cost-effective technology.

Allowable maximum injection of power without congestion risks in transmission networks

This indicator is either used in or under consideration when monitoring in eight countries (Belgium, Germany, Italy, Lithuania, Portugal, Slovenia, Spain and Netherlands), but no country uses this indicator as a revenue driver.

This index can be considered as the transmission system equivalent of the hosting capacity. It can also be seen as the net transfer capacity from a (hypothetical) production unit to the rest of the grid. The condition “without congestion risks” should be interpreted as obeying the prescribed rules on operational security.

This indicator can be calculated on an hourly basis, considering the actual availability of network components and the actual power flows through the network. This would result in an indicator whose value changes with time. The indicator can also be calculated as a fixed value under pre-defined worst-case power flows and a pre-defined outage level (e.g. n-1). The resulting value would give the largest size of production unit that can be connected without risking curtailment.

When using this indicator as a revenue driver, the same care should be taken as with the hosting capacity, as well as with the net transfer capacity. The incentive mechanism should not result in excessive unnecessary investments and the method for calculating the index should not favour one technology above another.

Energy not withdrawn from renewable sources due to congestion and/or security risks

This indicator is used or under consideration in seven countries (Germany, Belgium, Finland, Italy, Portugal, Spain, Netherlands) for monitoring and in one country (Great Britain) as a revenue driver.

This indicator quantifies the ability of the network to host renewable electricity production. In that sense, it is similar to indicators such as hosting capacity and allowable maximum injection of power. However, whilst these two indicators only quantify the actual limits posed by the network, the energy not withdrawn quantifies the extent to which the limits are exceeded. The value of this index is determined afterwards, so that there are fewer approximations and assumptions needed than for the other two indicators. In fact, the calculation is rather similar to the calculation of energy not delivered, an indicator that is commonly used for continuity of supply. The main assumption to be made will be the energy that would have been produced during curtailment or disconnection of the production unit.

Another advantage of using actual energy not withdrawn as an indicator, especially when used as a revenue driver, is that there is no risk of the network operator investing heavily in a network to be prepared for production capacity that never arrives. The associated disadvantage is that this indicator will give less incentive to invest before renewable electricity production is in place. This could result in the network being insufficiently prepared for a sudden increase in the amount of renewable electricity production.

6.3 Indicators of enhanced efficiency and better service

Measured satisfaction of grid users for the grid services they receive

This indicator is used in one country (Great Britain) as a revenue driver and in four countries (Finland, Portugal, Slovenia and Netherlands) is used or is under consideration for monitoring purposes.

This indicator would in principle be the ultimate indicator; after all, the grid is there for its users. However, it is not straightforward to quantify satisfaction of grid users in an objective way. Some of the customer-quality indicators presented in the CEER Benchmarking Reports on quality of electricity supply [9] are strongly related to this.

Level of losses in transmission and distribution networks

The transport of electrical energy through the distribution or transmission network is associated with a certain amount of losses. Therefore, the amount of energy being produced has to be a few percentage points higher than consumption levels. When the marginal electricity production is based on fossil fuel, as is the case most of the time in most European countries, the losses result in additional carbon-dioxide emissions[15].

This indicator is used in nine countries (Austria, Great Britain, Italy, Lithuania, Norway, Poland, Portugal, Slovenia and Spain) as a revenue driver and in ten countries (Belgium, Germany, France, Finland, Italy, Lithuania, Norway, Slovenia, Spain and Netherlands) for monitoring. This indicator can be determined for both distribution and transmission networks.

[15] The impact of renewable penetration on losses can be two-fold. Depending upon localisation and time profile of renewable energy injection, losses can decrease for lower levels of RES penetration or even increase for higher levels of RES penetration.

Losses in the distribution and transmission networks are reported in the majority of countries. As a result, there is a significant amount of experience in the use of this indicator. However, the indicator is likely to be calculated in different ways in different countries. It is not clear to what extent this will have an impact on the results and the level of comparability. An overview of methods for calculating losses as used in different countries is included in a consultation paper on losses [5] and its associated conclusions paper [6]. The reader is referred to those papers for more details on methods in use for calculating losses.

Losses depend on the current and resistance of the network component, of which only the latter can be impacted by the network operator. There are also differences in network structure, like typical length of lines and cables, which may make comparison between countries and even between network operators in the same country difficult.

The costs associated with the losses occurring during the transport of power through a network are in principle recovered by the network operator through tariffs. When the losses are fully recovered through the tariffs, this removes any economic incentive for the network operator to reduce the losses. Putting a maximum amount on the costs associated with losses that can be recovered from the tariffs will create an incentive to prevent high losses. A fixed compensation for losses per network operator per year gives a direct incentive to reduce losses. However, losses are not fully controllable by the network operator and can put it at risk.

Actual availability of network capacity with respect to its standard value

There are two possible interpretations of this type of indicator:

- The availability of network capacity compared to a reference value at national or local level; or
- The actual availability of network capacity in selected lines or network cross-sections compared to their normal capacity (e.g. winter peak net transfer capacity), due to unavailability of some network components or actual operational conditions.

This type of indicator is used for monitoring in six countries (Austria, Finland, Great Britain, Lithuania, Norway and Spain) and in one country (Spain) as a revenue driver.

Calculating the network capacity (the term “net transfer capacity” (NTC) is often used) is not obvious and several variables need to be considered, including the thermal capacity of network elements (at both transmission and distribution level), the need for operating reserve and stability reasons (especially at transmission level) and permissible voltage variations (especially at distribution level).

It is also important to realise that network capacity varies with time, again especially at transmission level. This is not of concern when the indicator is used for monitoring only but when used as a revenue driver, an appropriate annual index should be calculated.

Another important aspect to consider is that network capacity is only of concern when it becomes less than the required network capacity or when such a situation is expected to occur in the future. The choice of the standard value to which the network capacity is compared is important in that context. This is again especially important when network capacity is used as a revenue driver. Such a revenue scheme should not incentivise network operators towards investing in network capacity that is not needed for many years to come. None of the responding countries uses network capacity as a direct revenue driver, but some relations between network capacity and revenue can still be identified.

In order to handle grid congestion, the Nordic exchange area is geographically divided into bidding areas or trade zones. Bidding areas are generally consistent with the geographical area of each of the TSOs and Finland (FI), Estonia (EE), Latvia (LV) and Lithuania (LT) have single bidding areas. Denmark, however, constitutes two areas (DK1 west of the Great Belt and DK2 east of the Great Belt), whereas the Norwegian grid is divided into five bidding areas (NO1 through NO5) and Sweden into four areas (SE1 through SE4). For the hours in which there is adequate transmission capacity, the electricity price in all the areas will be the same but in case of grid congestion (insufficient network capacity), adequate market splitting is used. Internal grid congestion within a bidding area is handled by the TSOs using other methods such as counter-trading or export capacity reductions. The costs are carried at first by the TSO, who transfers these to its network users through the grid tariffs. Congestion will thus not directly impact the TSO's financial result, but the TSO is in a position to minimise societal costs by balancing counter-trading costs and investments aimed at increasing the network capacity.

The use of the indicator as a revenue driver could be subject to drawbacks, including the impact on the calculation of standard NTCs and reduction of planned maintenance of transmission elements.

6.4 Indicators of effective support to trans-national markets

Ratio between interconnection capacity of one country/region and its electricity demand

This indicator is used in five countries (Austria, Norway Slovenia, Spain and Netherlands) for monitoring and no country uses the indicator as a revenue driver.

The limited capacity of international connections is often a serious barrier to having an open trans-national (pan-European) market. Although international connections can be treated in the same way as other connections using the network capacity indicators, there are good reasons for introducing a dedicated indicator for international connections. Calculating the interconnection capacity suffers from the same limitations as the network capacity; in particular, operational security rules have to be considered.

Exploitation of interconnection capacity (particularly related to maximisation of capacity according to the Regulation on electricity cross-border exchanges and the congestion management guidelines)

This indicator is used in seven countries (Austria, Finland, Norway, Portugal, Slovenia, Spain, the Netherlands) for monitoring purposes, but no country uses the indicator as a revenue driver.

The basic elements of the indicators in this and the previous section (i.e. net transfer capacity, national electricity demand, mono-directional energy transfers) are currently monitored by the each country's TSO and reported by ENTSO-E on a European level in their statistical yearbooks.

6.5 Indicators of grid development

Time for licensing/authorisation of a new electricity transmission infrastructure

There are two possible understandings of this type of indicator. It can be interpreted and used referring to:

- The licensing/approval of the new transmission project by the NRA and/or the competent authority; and
- The permitting/authorisation process for the construction of the new transmission infrastructure.

The latter issue was discussed by European Energy Regulators in 2007-2008 by means of the European Energy Regulators papers "Cross-Border Framework for Electricity Transmission Network Infrastructure" [7] and "Status Review on Building and Construction Authorisation and Permit Process - Case Examples"[8].

More recently, the European Commission's Energy Infrastructure Communication[16] identified the importance of faster and more transparent permit granting procedures. Also based on the common recommendations by all European stakeholders in [11], the Commission's Smart Grids Communication [10] reiterated that permitting procedures for the construction and renewal of energy grids have to be streamlined and optimised and regional regulatory barriers and resistances must be tackled.

This indicator is used in two countries (Finland and Spain) for monitoring; no country uses the indicator as a revenue driver.

[16] http://ec.europa.eu/energy/infrastructure/strategy/2020_en.htm

7 Conclusions

7.1 The Definition of Smart Grids

In recent years, European Regulators (and later the Commission in its accompanying document (SEC2011) 463 final) to its Smart Grids Communication [10]) have adopted a definition of smart grids which is technology-neutral and focused on what smart grids can deliver. CEER confirms to retain this definition, as originally stated in 2009.as it was not considered that the recent developments in smart grids affect the original definition.

7.2 The Regulatory Challenges Related to Smart Grids

In its 2010 Smart Grids Conclusions Paper [4], European energy regulators identified the need to address the main barriers to smart grids by encouraging cooperation amongst stakeholders as one of the main priorities. It was agreed that while high-level principles can be applied across Europe, detailed implementation processes will vary from country to country.

As smart grids become an increasingly relevant topic in Europe, regulators are considering possible implementation challenges more thoroughly. Such an analysis has already occurred in many countries, due to its importance for enabling regulators to take appropriate action at the national level. An internal questionnaire helped CEER to analyse a range of possible challenges. The feedback suggests differences in the importance given to possible challenges at national level.

The following issues generated the most reaction from NRAs:

- Stakeholder involvement in demand side response;
- Incentivising demand side response;
- The regulatory barriers to the development of smart grids; and,
- The regulatory instruments to facilitate smart grid development.

7.3 Plans for the Implementation of Smart Grids

From the overall results in this part of the questionnaire, it is quite obvious that deployment of smart grids in many countries across Europe is a serious issue. Compared with the results of the previous work from 2011[17], there has been a huge increase in countries with implementation plans in place.

In four countries that currently have no implementation plan in place, some variation of plan or route map is being prepared or is under discussion.

The involvement of relevant stakeholders differs between countries however; for example, there is only one stakeholder (the Government) responsible for implementation in two

[17] http://www.energyregulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Electricity/2011/C11-EQS-45-04_SmartGridsApproach_6%20July%202011.pdf

countries. In the majority of answers, the NRA was responsible for monitoring the implementation of plans.

In the majority of countries, there is a set time frame for implementation. Almost all countries who have adopted implementation plans have made some progress in line with their proposals. However, in three cases, this progress refers to the deployment of smart metering.

7.4 Encouraging Innovative Solutions in Electricity Networks

This status review represents a cross-section of smart grid demonstration projects in Europe. CEER considers that there are very significant benefits to the efficient communication of the results of demonstration projects to all interested stakeholders. CEER recommends encouraging the deployment of smart grid solutions where they are a cost-efficient alternative to existing solutions and, as a first step in this direction, finding ways of incentivising network companies to pursue innovative solutions where this can be considered beneficial from a societal viewpoint.

Based on responses to the internal questionnaire, demonstration projects have been launched in the majority of countries. This represents an increase in demonstration projects as compared with the data received in the 2011 CEER Status Review. The progress of demonstration projects is monitored in most countries and the responsibility for monitoring falls to a mixture of NRA, Government and DSOs. The dissemination of learning to interested parties is generally conducted on a voluntary basis.

7.5 Cost benefit Analysis for the Demonstration and Deployment of Smart Grids

CEER found that 9 countries have undertaken a cost benefit analysis (CBA) for a fully implemented smart grid. In three countries, this CBA is on both deployment and demonstration, while in four countries this CBA is only on smart grid deployment. In one country, a CBA has been undertaken on demonstration only. One country has not defined whether this CBA relates to deployment or demonstration.

7.6 Potential Performance Indicators

Regulators across Europe are highly aware of the importance of performance indicators. The same awareness appears in the European Commission's Communication on Smart Grids [9] which states that 'regulatory incentives should encourage a network operator to earn revenue in ways that are not linked to additional sales, but are rather based on efficiency gains and lower peak investment needs'.

This move towards quality and efficiency is already being encouraged by many NRAs. A significant number of countries indicated that they use some of the indicators proposed in the Smart Grids Conclusions Paper [4]. This can be either for monitoring or as a revenue driver.

Annex 1: CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national regulators of electricity and gas at EU and international level. Through CEER, a not-for-profit association, the national regulators cooperate and exchange best practice. A key objective of CEER is to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest.

CEER works closely with (and supports) the Agency for the Cooperation of Energy Regulators (ACER). ACER, which has its seat in Ljubljana, is an EU Agency with its own staff and resources. CEER, based in Brussels, deals with many complementary (and not overlapping) issues to ACER's work such as international issues, smart grids, sustainability and customer issues.

The work of CEER is structured according to a number of working groups and task forces, composed of staff members of the national energy regulatory authorities, and supported by the CEER Secretariat.

This report was prepared by the Electricity Quality of Supply Task Force of CEER's Electricity Working Group.

CEER wishes to thank in particular the following regulatory experts for their work in preparing this report: Werner Friedl, Veli-Pekka Saajo, Keavy Larkin, Lukáš Křivanec, Herlita Bobadilla-Robles, and Gregory Jarry.

Annex 2 : List of abbreviations

Term	Definition
CBA	Cost Benefit Analysis
CEER	Council of European Energy Regulators
DNO	Distribution Network Operator
DSM	Demand-Side Management
DSO	Distribution System Operator
EV	Electric Vehicles
HV	High-Voltage
LV	Low-Voltage
MV	Medium-Voltage
NRA	National Regulatory Authority for Energy
R&D	Research and Development
RES	Renewable Energy Strategies
SO	System Operator
TOU	Time of use
TSO	Transmission System Operator

Annex 3: The definition of smart grids as presented by CEER countries in the 2011 Status Review

Of the twenty four NRAs who took part in the internal questionnaire in 2011, four (Austria, Great Britain, Poland and Sweden) indicated that their country has adopted a definition for smart grids. The definitions adopted in these countries do not differ significantly from the CEER definition of smart grids.

Austria

Austria[18] uses the definition that was adopted by the National Technology Platform Smart Grids Austria in 2008. This definition is similar to that adopted by the Smart Grids European Technology Platform. The NRA was not involved in the definition process.

Great Britain

The definition from Great Britain[19] has been adopted by the Electricity Networks Strategy Group and is very close to the definition adopted by the European Energy Regulators. The NRA was involved in the definition process.

Poland

Poland adopted the definition from the ERGEG position paper in June 2011 and published this definition in an NRA position paper on minimum requirements for AMI Smart Grid Ready.

Sweden

The Swedish definition[20] has been published by the NRA and contains some of the Smart Grids objectives.

[18] Smart grids are power grids, with a coordinated management, based on bi-directional communication, between: grid components, generators, energy storages and consumers; to enable an energy-efficient and cost-efficient system operation that is ready for future challenges of the energy system.

[19] A smart grid as part of an electricity power system can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

[20] Intelligent or smart grids is the synthesis of technologies, functions, and regulatory frameworks that in a cost effective manner facilitate the introduction and use of renewable electricity generation, the reduction of overall energy consumption, the reduction of load peaks, and the creation of an environment where electricity consumers can become more active.

Annex 4: The regulatory challenges related to smart grids

4.1 Regulatory challenges to the development of smart grids

Technical and Commercial Arrangements

Table 1: Technical and Commercial Arrangements[21]	
Meshed network	15
Real time thermal ratings	7
Fault current limiters	13
Enhanced automatic voltage control	14
Dynamic network reconfiguration	11
Distribution – flexible AC transmission systems	5
Electrical energy storage	9
Other forms of storage of energy balancing	11
Generator providing network support	14
Demand side response	14
Demand reduction	13
Other	3

Unbundling rules and smart grid development

In general, NRAs stated that existing rules for unbundling do not hinder smart grid development but a number of NRAs made individual statements in this context and those comments are noted below:

Table 2: Do existing unbundling rules in your country have the potential to hinder smart grid development?	
Belgium	The unbundling rules created different actors with different goals to pursue and strong commercial interests. It is the NRA's task to ensure that those rules can be fulfilled while delivering cost efficient solutions for society through smart grid capabilities. As a logical consequence, the DSO will have to (re)develop a stronger relationship with their customers.
Finland	Current rules do not allow a significant participation to the competitive market for the DSOs. DSOs have to unbundle their market related activities at very early stage

[21] Table 1 lists certain technical arrangements and represents the number of countries that have these arrangements in place.

Table 2: Do existing unbundling rules in your country have the potential to hinder smart grid development?	
France	Existing unbundling rules may obstruct or delay the progress of the deployment of smart grids equipment. In particular, business cases are difficult to elaborate as most of the costs are located at DSO level while benefits are spread all over the value chain. CRE is currently working on regulatory arrangements which could facilitate smart grids development.
Great Britain	It is yet to be seen whether unbundling rules will affect smart grid development but it is something that we are currently investigating. There are situations where it could become harmful for smart grid development, for instance where storage is sponsored by the DSO for network reinforcement. This would separate consumer involvement in the smart grid and make it harder for customers to be involved.
Portugal	DSO unbundling is not a problem. The separation between distribution and supply activities introduce new challenges, as some of the potential new services made available by the development of smart grids will be a combination of DSOs and suppliers solutions. New regulatory tools must be developed to overcome those challenges.

Other important issues for smart grid development

- **Incentives to encourage network operators to choose investment solutions that offer the most cost-effective solutions**: In Austria, DSOs will choose smart grid solutions where they are most cost effective due to incentives for cost reduction. In Great Britain, capital efficiency requires that the DNOs employ the most cost-effective network development strategies.
- **Incentives to encourage network operators to choose innovative solutions/incentives for network operators to encourage efficient use of electricity and renewable electricity production**: In Austria, there is no differentiation as DSOs must consider energy efficiency, demand management measures and/or distributed generation when planning the network. In Great Britain, incentives are provided for the best innovation projects that help all network operators understand the measures needed to provide environmental benefits and security of supply for value for money. In Italy, the index used for selecting demonstration projects considers the benefits of increasing the renewable electricity supply and the reduction of losses.
- **Standards on smart grid stakeholders**: In Germany, there is a differentiation between smart and conventional grids. There are special requirements for technical protection and communication between market partners using smart meters. Likewise in Great Britain, standards on smart grid technology are important for interoperability within a smart grid.
- **Active participation in the development of smart grids by stakeholders**: In Spain, manufacturers will need to provide appropriate equipment and so will need to be more actively involved in a smart grid. Similarly, in Portugal, hardware and software developers will need to innovate as new services are offered to customers.

In Italy, the level of stakeholder involvement will increase alongside smart grid development.

- **The roles and relationships of relevant stakeholders to encourage the introduction of new services or markets**: In Germany, incentives must be created for some roles, for example aggregators and consumers. In Great Britain, new stakeholder roles and relationships must be defined as new services are introduced in a smart grid.
- **The introduction of new tariffs to incentivise more efficient network use**: In Finland and France, new tariffs are being developed with the advent of smart grids.
- **Effective implementation of unbundling**: In Portugal, unbundling activities introduce new regulatory challenges since potential new services for smart grids will be provided by a combination of DSOs and suppliers.

4.2 Emerging regulatory issues for the development of smart grids

The use and access of smart meter data for smart grids

In Austria, while new stakeholders may have access to smart meter data, currently an independent operator, the Clearing and Settlement Agency, operates the switching platform for supplier switching.

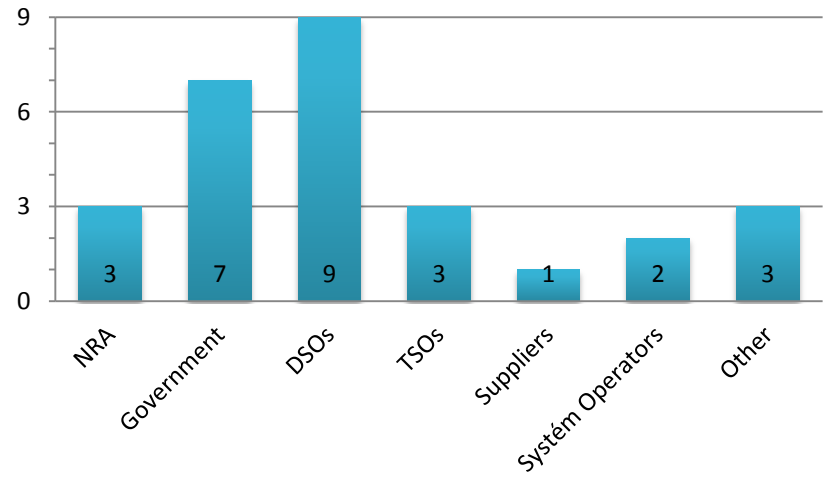
In Belgium, the consumer and DSOs have access to smart meter data by default; depending on consumer reaction and support, future more parties may have access to this data in future.

In Portugal, the customer is the owner of the data and access will depend on customer authorisation, as is the case in the Netherlands too.

Annex 5: Plans for the implementation of Smart Grids

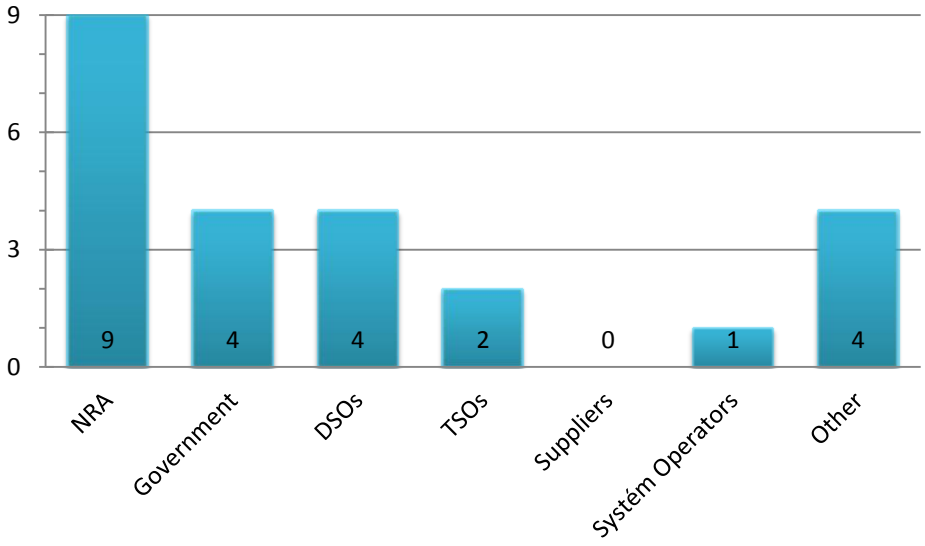
Responsibility for implementing

The chart below represents the parties responsible for implementing national or local plans by number of countries.



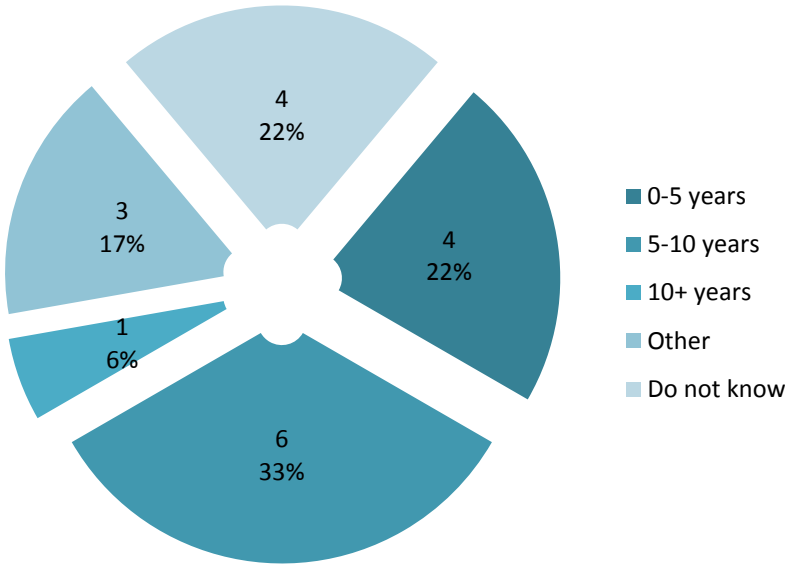
Responsibility for monitoring

The chart below represents the parties responsible for monitoring implementing plans by number of countries.



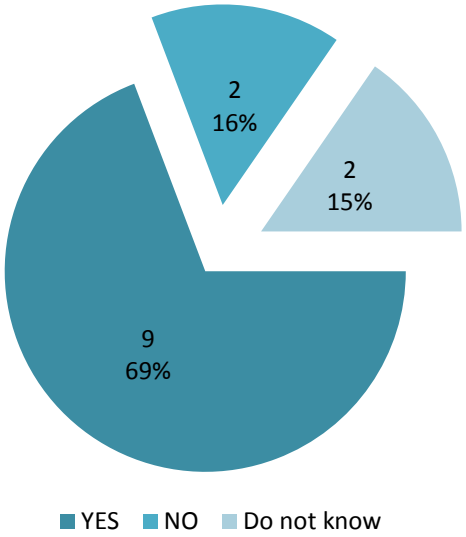
Time-frame of implementation plans

The pie-chart below represents the time frame for implementation, by number of countries and percentage.



Progression against implementation plans

The pie-chart below shows the number and percentage of countries where progression in the development of smart grids is being made against implementation plans.



Development of implementation plan and links to published documents

Member State	National or local level	Details
Austria	National level	National Smart Grids Technology Platform (www.smartgrids.at), published roadmap in 2010
Belgium	National and local level	Roadmap is currently under construction but the Rapport final du groupe de réflexion REDI can be found at: http://www.cwape.be/?dir=4&news=122
Croatia	No	
Cyprus	National level	
Czech Republic	No	Under construction.
Denmark	National level	http://www.kebmin.dk/sites/kebmin.dk/files/klima-energi-bygningspolitik/dansk-klima-energi-bygningspolitik/energiforsyning-effektivitet/smart/smart%20grid-strategi%20web%20opslag.pdf
Finland	National level	http://energia.fi/sites/default/files/haasteista_mahdollisuuksia___ja__hiilineutraali_visio_vuodelle_2050_20091112.pdf and http://www.emvi.fi/files/Tiekartta%202020%20-%20hankkeen%20loppuraportti_15_11_2011%20(2).pdf
France	National level	Published by the Energy Agency (ADEME), current version is available at: current one is available here : http://www2.ademe.fr/servlet/getDoc?sort=-1&cid=96&m=3&id=84680&ref=&nocache=yes&p1=111
Germany	No	
Great Britain	No	High-level route map has been developed.
Greece	National level	
Hungary	No	
Italy	National level	http://www.autorita.energia.it/it/docs/10/039-10arg.htm
Lithuania	No	
Luxembourg	National level	For smart meters: http://www.eco.public.lu/documentation/etudes/2012/Etude_ComptageIntelligent.pdf

Member State	National or local level	Details
Norway	National level	www.nve.no/ams
Poland	No	
Portugal	No	
Romania	No	
Slovenia	No	Under construction.
Spain	No	
Sweden	National	A roadmap with recommendations on how to stimulate the deployment of smart grids for the years 2015 to 2030 is currently under construction by the Swedish Coordination Council for Smart Grid (http://www.swedishsmartgrid.se). Due date December 2014.
Switzerland	No	
The Netherlands	No	There is a vision document from the Taskforce Smart Grids established by the Ministry of Economic Affairs http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2010/09/02/op-weg-naar-intelligente-netten-in-nederland.html

Annex 6: Encouraging Innovative Solutions in Electricity Networks

6.1 Demonstration projects

Funding for demonstration projects

Member State	Funding arrangements
Austria	Financing is from industry funding, public funding institutions and budgets, and remaining costs (if adequate), are audited and covered by network charges. The Climate and Energy Fund (Klima- und Energiefonds - KLIEN) was created in 2007 by the federal government with the aim to support the implementation of the climate strategy. From 2007 to 2012, €730 million was budgeted, and in 2013 another €140 million was allocated. Since inception, this fund has supported approximately 57,000 projects. Public funded projects must be self-financed in part, which in the case of DNOs, this means that projects are also funded by network tariffs.
Cyprus	Demonstration projects are funded from the DSOs' budget.
Czech Republic	Demonstration projects are funded from the DSOs' budget and from European Commission funds.
Germany	Integrated municipal energy suppliers and several federations provide funding.
Hungary	Demonstration projects are funded from European Commission funds and are augmented from the Government budget.
Italy	The projects under NRA regulation are financed by electricity tariffs and monitored by AEEG. Other projects have been launched by the government through EC funding which is not monitored by AEEG.
Poland	Investment in smart grids by distribution companies and other entities is supported by a Smart Grid programme led by the National Fund for Environmental Protection and Water Management.
Slovenia	EU funds are also used in Slovenia along with the capital of stakeholders.
Spain	Subsidies are provided by Local Authorities and some Government institutions.

Member State	Funding arrangements
The Netherlands	Pilot projects are a combination of non-regulated and regulated stakeholders.

Monitoring the progress of demonstration projects

Member State	Action
Austria	The NRA does not have detailed information on the rules of monitoring.
Belgium	Monitoring is through public consultation and submission of mid-term reports.
Czech Republic	The NRA is continuously informed through a private initiative, Grid4EU.
Finland	Monitoring is through DSOs and funding institutions. The NRA collects the annual costs of the projects.
France	Projects are monitored through project steering committees. CRE plans to define indicators with DSOs and TSOs.
Germany	As part of the process for selecting which projects are funded, companies' approaches on progress reporting and disseminating learning are evaluated. High quality learning dissemination activities that either build on best practice from other demonstration projects or incorporate innovative approaches is expected.
Great Britain	All companies running projects must produce progress reports every six months. These reports must include the progress they have made against their project plan and the learning that the project has delivered in the previous six months. The company must also explain the activities that it has undertaken to disseminate the learning. All companies must also produce a comprehensive report following the conclusion of the project. These reports must explain how other parties can replicate the implementation and outcomes of the project. The consultation on the structure of these reports has recently been issued which is available at: http://www.ofgem.gov.uk/Networks/ElecDist/lcnf/Documents1/Consultation_LCNF_closedown_reports_180613.pdf Companies must present the progress and learning from their projects at an annual conference. The next conference will be held in October 2013. Details are available at: http://www.energynetworks.org/news/events/ena-events/2013/november/lcnf-conference-2013.html

Member State	Action
Hungary	Projects are not yet monitored by the NRA.
Italy	For AEEG projects, a work progress report has to be sent by the involved DSOs to the NRA every six months. Thereafter, monitoring is through ad-hoc meetings and result dissemination.
Luxembourg	Reporting is to the smart meter implementation group.
Slovenia	Ex-post monitoring of particular projects is performed by the NRA. On-the-fly monitoring is performed by investors/funding institutions.
Spain	The NRA has limited information about demonstration projects, as it is not NRA´s responsibility to monitor third party projects and agreements in which CNE is not an active member of the project.
The Netherlands	Project leaders of the funding institution (Agentschap NL) organise an evaluation and monitoring day each year.

Processes and mechanisms to ensure lessons learnt and the dissemination of learning

Member State	Mechanisms in place to disseminate learning
Cyprus	No mechanism in place.
Czech Republic	Mechanisms are in place on a voluntary basis, basic information is publicly available.
Finland	Mechanisms are in place on a voluntary basis.
France	Mechanisms are in place on a voluntary basis, workshops are organized by CRE and there is a dedicated website on smart grids managed by CRE : www.smartgrids-cre.fr
Great Britain	Mechanisms are in place on a mandatory basis. Learning is a key deliverable of the LCNF and there are a range of measures to ensure the corresponding benefits are realised, including knowledge dissemination events, an annual conference, a knowledge sharing portal and rules around DNOs having access to intellectual property generated through the projects. Under the smaller First Tier projects, a

Member State	Mechanisms in place to disseminate learning
	DNO must report the required details for its projects as set out in Standard Licence Condition (SLC) 44C and the LCN Fund reporting instructions and guidance (RIGs). The DNO must provide a Close-Down Report for each First Tier LCN Fund Project that it registers. It needs to provide sufficient information for third parties to understand what has been learnt from the Project and should be sufficient to minimise the likelihood that other DNOs will unnecessarily duplicate the Project using the First Tier Funding Mechanism in future. The DNO must work collectively with such other DNOs that are subject to the LCNF fund to organise an annual conference that will be held for the DNOs, External Collaborators and interested third parties. The DNO must deliver presentations and answer questions on all First Tier LCN Projects that have been completed since the previous annual conference as well as provide updates on those First Tier LCN Projects that are still ongoing. The dissemination process for Second Tier projects is similar, progress reports must be produced every six months. These reports must include the progress they have made against their project plan and the learning that the project has delivered in the previous six months. The company must also explain the activities that it has undertaken to disseminate the learning. All companies must also produce a comprehensive report following the conclusion of the project. These reports must explain how other parties can replicate the implementation and outcomes of the project. They must also present on the progress and learning from their projects at an annual conference. The next conference will be held in October 2013.
Italy	Mechanisms are in place on a mandatory basis. Analysis and dissemination are considered one of the main objectives of the demonstration process.
Luxembourg	Mechanisms are in place on a voluntary basis.
Norway	Mechanisms are in place on a mandatory basis.
Poland	Mechanisms are in place on a voluntary basis.
Slovenia	Mechanisms are in place on a voluntary basis.
Spain	Mechanisms are in place on a voluntary basis, Using information provided by DSO´s, public seminars and workshops have been completed.
The Netherlands	Mechanisms are in place on a voluntary basis. A one day congress is held, with a speaker of each demonstration project, platform for knowledge exchange and expertise and future-headed speakers. The information from this event is shared through an online document: http://www.agentschapnl.nl/sites/default/files/Innovators%20aan%20het%20woord%20thema%20Smart%20Grids%20juni%202013.pdf

Annex 7: Cost Benefit Analysis

The table below shows additional information on the status of CBAs and intermediate results.

Country	Status of CBA and details
Finland	http://www.emvi.fi/files/Lahde_45_Poyry_Tuntimittaus_2010.pdf
Great Britain	Through the Smart Grids Forum, we have undertaken extensive work in conjunction with the Department of Energy and Climate Change (DECC), DNOs and other industry parties to help understand the role which smart grids can play. Through this work low carbon scenarios produced by DECC have been combined with the smart grid solutions evaluation framework, initiated by Ofgem and taken forward by the DNOs. This has been captured in the work stream 3 model, also known as the transform model.
	This has indicated that the deployment of smart grid solutions has potential benefits over conventional reinforcement under some scenarios. The take up of low carbon technologies is predicted to increase significantly during RIIO ED2 and RIIO ED3, the modeling indicated that, over time, a more integrated 'top down' smart grid is likely to have benefits over traditional methods.
	Phase 1 of this project indicated that the significant number of separate parties involved in delivering effective smart grid solutions for the UK will require concerted project co-ordination. A broad plan is needed that identifies critical 'intervention points', for example windows of opportunity linked to DECC or Ofgem developments and RIIO work programmes. Innovative solutions commonly span the traditional boundaries of voltage level and distribution/transmission classifications, and extend to third parties. A number of challenging issues can be expected for both technical and management agendas which will require sustained attention over a number of years.
	Work on this model is ongoing, Phase 2 will establish a quantitative assessment of solution sets and the extent of their application considering regional and economic variations, urban/rural applications and the effects of clusters in new demand and generation types.
Italy	Result is the evaluation of demonstration projects.
	Details of the methodology are in http://www.autorita.energia.it/allegati/docs/10/007-10dtrfallb.pdf
	Results of the application of the methodology are in http://www.autorita.energia.it/allegati/docs/11/012-11argalla.pdf
Lithuania	CBA showed negative national smart grid coverage results. It is beneficial to install smart meters for larger business consumers, but not beneficial install smart grid at national level for all consumers Additional information on 17/10/2013: CBA was undertaken only for smart metering
The	http://www.ce.nl/publicatie/maatschappelijke_kosten_en_baten_van_intelligente_nett

Country	Status of CBA and details
Netherlands	en/1236

Annex 8: Performance indicators and incentive schemes for regulating network outputs

8.1 Performance indicators

Potential performance indicator	Used for monitoring	Used as a revenue driver
1. Increased sustainability		
1.1 Quantified reduction of carbon emissions	FI; PT; NL	GB
1.2 Environmental impact of electrical grid infrastructure	GB; IT; NO; PT; NL	GB
2. Adequate capacity of transmission and distribution grids for "collecting" and bringing electricity to consumers		
2.1 Hosting capacity for distributed energy resources in distribution grids	AT; BE; FI; DE; NO; PT; SI; ES; NL	IT; NO
2.2 Allowable maximum injection of power without congestion risks in transmission networks	BE; DE; IT; LT; PT; SI; ES; NL	
2.3 Energy not withdrawn from renewable sources due to congestion and/or security risks	BE; FI; DE; PT; ES; NL	GB
3. Adequate grid connection and access for all kind of grid users		
3.1 First connection charges for generators, consumers and those that do both	FI; LT; NO; SI; ES	AT; DE; LT; NL
3.2 Grid tariffs for generators, consumers and those that do both	FI; DE; LT; NO; SI; ES	AT; DE; LT; SI; NL
3.3 Methods adopted to calculate charges and tariffs	LT; NO; SI; ES	AT; FI; LT
3.4 Time to connect a new user	AT; BE; FI; GB; LT; SI; ES	SI
4. Satisfactory levels of security and quality of supply		
4.1 Ratio of reliably available generation capacity and peak supply	AT; FI; GB; IT; LT; NO; PT; ES; NL	
4.2 Share of electrical energy produced by renewable sources	AT; BE; FI; DE; GB; IT; LT; NO; PT; SI; ES; NL	
4.3 Measured satisfaction of grid users for the "grid" services they receive	FI; PT; SI; NL	GB
4.4 Power system stability performance	AT; FI; LT; NO; PT; SI; ES; NL	
4.5 Duration and frequency of interruptions per customer	AT; BE; DE; LT; NO; PL; SI; ES; NL; SE	FI; GB; IT; LT; NO; SI; ES; NL; SE; PT
4.6 Voltage quality performance of electricity grids	AT; BE; IT; LT; PT; SI; ES; NL	ES
5. Enhanced efficiency and better service in electricity supply and grid operation		
5.1 Level of losses in transmission and in distribution networks (absolute or percentage)	BE; FI; DE; IT; LT;	AT; GB; IT; LT; NO; PL; PT; SI;

Potential performance indicator	Used for monitoring	Used as a revenue driver
	NO; SI; ES; NL; SE	ES
5.2 Ratio between minimum and maximum electricity demand within a defined time period	FI; LT; ES; NL	
5.3 Percentage utilisation (i.e. average loading) of electricity grid elements	GB; LT; ES, NL	
5.4 Availability of network components (related to planned and unplanned maintenance) and its impact on network performances	AT; FI; GB; LT; NO; PT; ES; NL	ES
5.5 Actual availability of network capacity with respect to its standard value	AT; FI; GB; LT; NO; ES	ES
6. Effective support of trans-national electricity markets		
6.1 Ratio between interconnection capacity of one country/region and its electricity demand	AT; NO; SI; ES; NL	
6.2 Exploration of interconnection capacity	AT; FI; NO; PT; SI; ES; NL	
6.3 Congestion rents across interconnectors	AT; FI; LT; NO; PT; SI; ES; NL	NO
7. Coordinated grid development through common European, regional and local grid planning to optimise transmission grid infrastructure		
7.1 Impact of congestion on outcomes and prices of national/regional markets	AT; FI; GB; NO; PT; SI; ES; NL	
7.2 Societal benefit/cost ratio of a proposed infrastructure investment	GB; LT; NO; NL	NL
7.3 Overall welfare increase (i.e. always running the cheapest generators to supply the actual demand)	NO; ES	
7.4 Time for licensing/authorisation of a new electricity transmission infrastructure	ES	
7.5 Time for construction of new electricity transmission infrastructure	LT; ES; NL	
8. Enhanced consumer awareness and participation in the market by new players		
8.1 Demand side participation in electricity markets and in energy efficiency measures	FI; IT; SI	
8.2 Percentage of consumers on time-of-use/critical peak/real-time dynamic pricing	BE; FI; LT	
8.3 Measured modifications of electricity consumption patterns after new pricing schemes	LT; ES	
8.4 Percentage of users available to behave as interruptible load	AT; BE; NO; ES	ES
8.5 Percentage of load demand participating in market-like schemes for demand flexibility	IT; NO	
8.6 Percentage participation of users connected to lower voltage levels to ancillary services	IT; ES	ES

8.2 Other performance indicators

Country	Comment/ performance indicator
Austria	Peak load and network connection density are relevant benchmarking parameters.
France	Indicators are currently being defined in France.
Germany	Grid tariffs for generators, consumers and those that do both are only for consumers.
Hungary	Not decided yet.
Norway	When we have chosen "monitoring" it means that the NRA have the data but it is not specifically related to smart grid.
Poland	reduction of the costs of manual meter reading
Sweden	Currently none are used for purposes of incentivising smart grids but planned for the next regulatory period.
The Netherlands	The performance indicators as mentioned in 5.1- 5.3 do influence the costs, but not the revenues. DSO's Time for construction of new electricity transmission infrastructure as a revenue driver, but strictly it is not.