SMART ELECTRICITY GRIDS: A VERY SLOW DEPLOYMENT IN THE EU

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EXECUTIVE SUMMARY

The European electricity sector will have to deal with a huge challenge in the decades to come. On the one hand, electrical power is increasingly substituted for other forms of energy. It has been forecast that electricity demand will increase in the future (notably because of new needs in transport and heat sectors), although it is currently stagnant, mainly because of the economic crisis. Unless a major alternative energy source is discovered, electricity will become the central energy pillar in the long term. On the other hand, electricity production remains uncertain and will depend on numerous factors: the growth of renewable energy and decentralized energy, the renewal of old power generation capacities, increased external dependency, CO_2 charges, etc. This increases the demand for electricity networks that are more reliable, more efficient, and more flexible. Europe's current electricity networks are ageing, and, as already indicated by the International Energy Agency, many of them will need to be modernized or replaced in the decades to come. Finally, the growing impact of energy trading also needs to be taken into account.

These considerations explain the need to modernize the electric grid through various ICT means. This modernization alone may allow the grid to become more flexible and interactive, to provide real time feedback, more adaptation to a fluctuating demand, and finally to reduce the global electricity costs.

The paper begins with a description of the EU definition of the term 'smart grid' (§ 1) and of the body in charge of advising the Commission (§ 2). The EU legal framework applicable to smart grids is also detailed (§ 3). It is a rather complex domain, connected to various regulations. The paper then examines three critical factors in the development of smart grids (and smart meters as a precondition). Standardization is quite complex, but absolutely essential (§ 4). Innovation is not easily put into action (§ 5). Finally, as digital insecurity has worsened dramatically in recent years, the security of electricity networks, and especially their multiplied electronic components, will become increasingly important (§ 6). Lastly, the paper provides a concise overview of the progress of smart grids in the EU in recent years (§ 7). In a nutshell, the conclusion is that progress is quite slow, many obstacles remain, and, given the appearance of many new regulatory problems, it would be useful to organize a review of the present EU strategy.

SMART ELECTRICITY GRIDS: A VERY SLOW DEPLOYMENT IN THE EU

The electricity sector in Europe will have to deal with a huge challenge in the decades to come. On the one hand, electrical power is increasingly substituted for other forms of energy. It has been forecast that electricity demand will increase in the future (notably because of new needs in transport and heat sectors), although it is currently stagnant, mainly because of the economic crisis. Unless a major alternative energy is discovered, electricity will become the central energy pillar in the long term. On the other hand, electricity production remains uncertain and will depend on numerous factors: the growth of renewable energy and decentralized energy[1], the renewal of old power generation capacities, increased external dependency, CO_2 charges, etc. This increases the demand for electricity networks that are more reliable, more efficient, and more flexible. Europe's current electricity networks are ageing, and, as already indicated by the International Energy Agency, a good part of them will need to be modernized or replaced in the decades to come. Finally, the growing impact of energy trading also needs to be taken into consideration.

To overcome this huge challenge, one solution has become a central point of attention and has gained considerable support. It concerns the development of *smart grids* which are an *evolution* of electricity networks based on a more intensive use of ICT while reducing the environmental impacts of the electricity supply system overall. The European Commission sees them as the backbone of future decarbonized energy power systems.[2] Combined with changes in consumer behaviour, they are considered indispensable for reaching all the fundamental objectives of EU energy policy – sustainability, security and competitiveness – as well as the creation of the energy single market.

To foster the development of smart grids, the EU has established a framework which combines different instruments. However, despite private and public investments, the deployment of smart grids remains slow and it mainly concerns smart meters (considered an important first step towards smart grids).[3] Even in the case of smart meters, the roll-out generally falls below expectations,[4] despite the fact that an increasing number of Member States support smart metering. Efforts to develop

1 Decentralized energy or distributed energy is generated or stored by a variety of small, grid-connected devices referred to as distributed energy resources (DER) or DER systems. DER systems typically use renewable energy sources. A grid-connected device for electricity storage can also be classified as DER system and is often called a distributed energy storage system (DESS). See http://www.wikipedia.org.

2 EU energy roadmap 2050 – COM (2011) 112 final.

3 The Commission's communication Making the internal energy market work – COM (2012) 663 – underlines the various benefits from the roll-out of smart metering systems.

4 See, for instance, the report by the EEGI Member States Initiative on mapping and gap analysis of current European smart grid projects. A pathway towards functional projects for distribution grids, April 2012.

smart grids and smart meters also vary considerably between European countries (the majority of projects are in EU 15, while much of EU 12 lags behind).[5] It is worth noting, however, that the size of projects is increasing overall, even though the majority of projects are currently small ones.[6]

This paper begins with the EU understanding of the term 'smart grid' (§ 1) and identifies the body which advises the Commission on smart grids (§ 2) and the EU legal framework applicable to smart grids (§ 3). It then briefly examines three critical factors in the development of smart grids (and smart meters as a precondition): standardization (i.e., who is in charge and what has already been done) (§ 4), innovation (§ 5) and security (§ 6). It gives a concise overview of the progress of their development in the EU (§ 7). A short conclusion follows.[7]

5 See the paper of Ruggero Schleicher-Tappeser, *The smart grids debate in Europe. Essential for the transformation of the European energy system, deserving more attention and transparency*. SEFEP Working Paper. November 2012. See also *Smart grid database updated end of 2012*, JRC, 2013, pp. 20-23 as well as *Smart Grid Projects Outlook 2014*, JRC, 2014, pp. 30-32. It is worth noting that the top countries are France and the United Kingdom, followed by Germany, Spain, Italy, Denmark. The latter has the highest investment in smart grids per capita and per national electricity consumption.

6 *Smart grid database updated end of 2012*, JRC, 2013, p. 26 as well as *Smart Grid Projects Outlook 2014*, JRC, 2014, p.30.

7 The relevant documents for this paper stop at the beginning of January 2015.

1. THE EU DEFINITION OF THE TERM 'SMART GRID'

The smart grid is a recent, complex and still evolving concept. It enables many potential new features. It can thus be defined in multiple ways. This probably explains why there has so far been no internationally accepted definition. According to the International Electrotechnical Commission (IEC), 'smart grid' is used as a marketing term rather than a technical definition. For that reason, there is no well-defined and commonly accepted scope of what is 'smart' and what is not. The general understanding is that this concept covers the modernization of the electric grid with various ICT means. This modernization allows the grid to become more flexible and interactive, and to provide real time feedback.

At EU level, there are several definitions of the term 'smart grid'.[8] In its April 2011 communication 'Smart Grids: from innovation to deployment',[9] the Commission indicates that smart grids could be described as 'an upgraded electricity network to which two-way digital communication between supplier and consumer, intelligent metering and monitoring systems have been added. Intelligent metering is usually an inherent part of smart grid.'[10] This demonstrates once more that the concept of smart grid is not easy to apprehend. One thing is sure: it is a concept which stands for the increasing use of new electronic information, communication and control technologies (in one form or another) in the traditional electricity business, and this concept must not be confused with that of smart meters, which are so broadly defined in the EU legislation[11] that there is room for interpretation as to what they really are. This creates potential for country-by-country differences in the required

8 See, for instance, the definition given by the Council of European Energy Regulators (CEER) in its *Status review on European regulatory approaches enabling smart grids solutions* ('smart regulation'), ref. C13-EQS-57-04 – 18 February 2014, p. 10. According to this document 'A smart grid is an electricity network that can efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure an economically efficient, sustainable power system with low losses and high quality and security of supply and safety.' This definition stresses that smart grid deployment should be user-centric and output-focused (the smart grid is a means to an end and not an end in itself). A similar definition is used by the EC Smart Grid Taskforce [http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/expert_group1.pdf] and in article 2 (7) of regulation (EU) No. 347/2013 (OJ L 115/39, 25.04.2013).

9 COM (2011) 202. This document focuses on five objectives: 1) developing technical standards, 2) ensuring data protection, 3) establishing a regulatory framework to provide incentives for smart grid deployment, 4) guaranteeing an open and competitive retail market in the interest of consumers, 5) providing continued support for technology and systems. It has taken into account the 2011 JRC report *Smart grids projects in Europe: lessons learned and current developments*, elaborated at the request of DG ENER.

10 This definition is repeated in recommendation 2012/148/EU (OJEU 2012, L 73/11).

11 See Art. 2 (28) of Directive 2012/27/EU on energy efficiency (JOUE 2012, L 315/1). This article defines the 'smart meter' through the concept of 'smart metering system' or 'intelligent metering system', and according to this article, a 'smart metering system' or 'intelligent metering system' means 'an electronic system that can measure energy consumption, providing more information than a conventional meter, and can transmit and receive data using a form of electronic communication.' See also recommendation 2012/148/EU, Point I, 3. (b), p. 11 (OJ L 73, 13.03.2012).

capabilities of smart meters, although the Commission has tried, as one will see in Recommendation 2012/148/EC, to bypass this inconvenience – without success (see point 7.1 of this paper).

The Commission focuses far more on the expected new services, functionalities and benefits (including impressive business opportunities) that smart grids should provide. They are enumerated in the Commission Staff Working Document[12] accompanying its April 2011 communication. This Staff Working Document also identifies transmission system operators (TSOs) and, above all, distribution system operators (DSOs)[13] as the prime movers for their deployment, though the implementation of the smart grid concept necessitates the participation of a variety of actors.

This said, it is now widely recognized that consumer behavioural changes – i.e., *demand response* – will have a substantial impact on the benefits that smart grids are deemed to bring. These behavioural changes can occur as a result of, for instance, improved usage information (feedback via home displays), tariff differentiation, remote capacity control by the grid operator and customer education.

[12] Commission Staff Working Document – Definition, expected services, functionalities and benefits of smart grids – SEC(2011) 463.

[13] See notably a 2014 Ecofys/ECN report *The role of DSOs in a smart grid environment*, commissioned by the Commission (DG ENER), pp. 145.

2. THE EC SMART GRID TASKFORCE

The Staff Working Document mentioned above is based on the work done by the Smart Grids Task Force (SGTF)[14] established by the Commission in January 2009.

The second mandate[15] granted to the SGTF aims to advise the Commission on policy and regulatory actions at European level for the deployment of smart grids, as well as identifying projects of common interest in the smart grid field under the context of regulation 347/2013 on guidelines for Trans-European Infrastructure (see point 3.6 of this paper). This second mandate seems also to acknowledge – more than the first – that the development of smart grids and increased distributed generation involve a fundamental rethinking of actors' roles, the logic of the technical system and market architectures.

The SGTF consists of five expert groups (EGs). Each focuses on specific issues: EG1, co-chaired by DG ENER and CONNECT, focuses on smart grid standards; EG2 on regulatory recommendations for privacy, data protection and cyber security in the smart grid environment; EG3 on regulatory recommendations for smart grid deployment; EG4 on smart grid infrastructure deployment; and finally, EG5 on industrial aspects of smart grids. The latter was launched in February 2013. The 2012 Deliverables of EG1, EG2, EG3 and EG4 have been published on the Commission's website.[16] EG5 has identified a set of actions requiring attention from an industrial policy perspective and several of them will be launched from 2015, 2016 or 2017.[17]

In practical terms, the activities of the SGTF are guided by a Steering Committee which meets every two months and which is composed of representatives of the different services of the Commission, Agency for the Cooperation of Energy Regulators, industry associations, consumers' representatives. The SGTF also works closely with other related smart-grid projects, such as the Smart Grids European Technology Platform set up in 2005 (see point 5.1. of this paper) and the European Electricity Grids Initiative (EEGI) under the Strategic Energy Technology Plan or SET-Plan (see point 5.2. of this paper). It also works closely with other smart grid standards initia-

[14] There is an ongoing push to register this task force as a Commission Expert Group in conformity with communication C(2010) 7649. After this registration, the SGTF will be publicly open to any stakeholder with a legitimate interest in the smart grid arena. This could potentially have an impact on the composition of the SGTF, bringing in stakeholders who have so far not participated.

[15] [http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/mission_and_workprogramme.pdf].

[16] 2012/2013 deliverables of EG1, EG2, EG3 and EG4 have been published on the Commission's website: [http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm].

[17] The set of actions identified by EG5 can be found here: [http://ec.europa.eu/enterprise/policies/industrial-competitiveness/industrial-policy/task-forces/smart-grids/index_en.htm].

tives in other regions of the world, including with National Institute of Standards and Technology (NIST) in the United States,[18] and activities in China and Japan.

Finally, policy aspects relating to mandate M/490 (smart grids) are dealt with under EG1, which also monitors activities under mandates M/441 (smart meters) and M/468 (electrical vehicles chargers) to the European Standardization Organizations (ESOs) (see § 4 in this paper).

[18] See the 2011 White Paper on standardization of smart grids, published by the US Commerce Department's NIST and the EU's Smart Grid Coordination Group on standardization of smart grids [http://www.nist.gov/smartgrid/upload/eu-us-smartgrids-white-paper.pdf].

3. THE LEGISLATIVE FRAMEWORK

Various legislative texts cover the development of smart grids. The third package (more specifically the electricity directive 2009/72/EC and regulation 714/2009/EC), the climate and energy package (more specifically the renewable directive 2009/28/EC and the revised EU ETS directive) and the energy efficiency directive 2012/27/EU jointly constitute the main existing legal framework on which further proposed action to stimulate the development and deployment of smart grids is built. These texts are accompanied by others that are also of particular importance in this domain.

3.1. The third energy package

Directive 2009/72/EC on electricity contains several provisions concerning smart grids and smart meters.

Firstly, its annex 1 § 2 explicitly requires that Member States conduct a cost-benefit assessment (CBA)[19] for smart metering systems as a key step towards the implementation of smart grids, and that they proceed with the smart metering roll-out to at least 80% of positively assessed cases on their territory by 2020. Moreover, Member States are also required to define an implementation timetable over a period of up to ten years if their CBA is positive. All these elements had to be submitted to the Commission no later than 3 September 2012. This deadline was, however, missed by several Member States.[20] On the basis of the information submitted by Member States, conclusions were presented by the Commission in a benchmarking report which shows important differences in Member States' CBAs.[21] To assist Member States in their preparations for the roll-out of smart metering systems, the Commission also published recommendation 2012/148/EU.[22] This focuses on four main aspects for consideration in preparation for the smart metering system roll-outs:

- Data protection and security considerations. They imply protection of personal data by considering '**data protection by design**' and '**data protection by default settings**' measures. Data protection by design means that data protection safeguards should be built into products and services from the earliest stage of devel-

[19] The methodology to conduct such an assessment has been detailed by the Commission in the following document: *Guidelines for cost benefit analysis of smart metering deployment*, JRC report, EUR25103, 2012.

[20] See, for instance, the report issued in April 2013 by Northeast Group, LLC*: Central & Eastern Europe smart grid: market forecast (2013-2023)*.

[21] See COM(2014) 356 final, accompanied by SWD(2014) 188 final and SWD(2014) 189 final.

[22] Commission's recommendation 2012/148/EU of 9 March 2012 on preparations for the roll-out of smart metering systems (JO L 73/9, 13.03.2012). This recommendation intends to facilitate Member States' task. In its annex, it contains guidelines for Member States for conducting their CBA, and guidelines for elaborating their smart meter implementation plans.

opment.[23] It should be implemented at legislative level (through legislation that has to be compliant with data protection laws), at technical level (by setting appropriate requirements in smart grid standards to ensure that infrastructure is fully consistent with the data protection laws) and organizational level (relating to processing). Data protection by default means that the most data-protection-friendly option is provided to the customer as a default configuration.[24]

- The development of a '**data protection impact assessment template (DPIA template)**'. This template was initially drafted by EG2 of the Commission's SGTF and was issued by the Commission in October 2014.[25] The aim of this template is to provide guidance to data controllers on how to carry out a data protection impact assessment for smart grid and smart metering systems.
- **Ten key common minimum functionalities**[26] that smart metering systems for electricity should have to benefit all stakeholders (customers included). Member States are encouraged to go beyond these ten common minimum functionalities.
- The identification of a set of '**Best Available Techniques (BATs)**'. The work is still ongoing and has also been entrusted to EG2 of the Commission's SGTF. Once established, this set of BATs should pinpoint the potential cyber security risks inherent in each of the ten key common minimal functionalities that smart metering should have, and should identify optimal controls and privacy-enhancing technologies to mitigate each of these risks. The BATs will be issued under the form of a Best Available Technique Reference Document (BREF).

Secondly, article 3 (11) of the same directive 2009/72/EC identifies smart grids as a way for Member States to meet their obligations to promote energy efficiency.

Thirdly, article 41 requires Member States to create well-functioning and transparent retail markets and to facilitate access for new entrants (including energy

[23] For the full definition, see recommendation 2012/148/EU (*op.cit.)*, I, 3. (Definitions), (d), p. 11.

[24] For the full definition, see recommendation 2012/148/EU (*op.cit.)*, I, 3. (Definitions), (e), p. 11.

[25] OJEU, L 300/63, 18.10.2014. The Article 29 Data Protection Working Party has provided two opinions on this template – opinions 04/2013 and 07/2013 on the data protection impact assessment template for smart grid and smart metering systems ('DPIA Template') prepared by EG2 of the Commission's SGTF.

[26] The ten recommended functionalities are: ***Consumer side***: (1) provide readings directly to the customer and any third party designated by the consumer; (2) update the readings referred to in point one frequently enough to allow the information to be used to achieve energy savings. ***Metering operator***: (3) allow remote reading of meters by the operator; (4) provide two-way communication between the smart metering system and external networks for maintenance and control of the metering system; (5) allow readings to be taken frequently enough for the information to be used for network planning. C***ommercial aspects of energy supply***: (6) support advanced tariff systems; (7) allow remote on/off control of the supply and/or flow or power limitation. ***Security and data protection***: (8) provide secure data communications; (9) Fraud prevention and detection; **Distributed generation**: (10) provide import/export and reactive metering. These ten recommended functionalities are consistent with the European Regulators' Group for Electricity and Gas's final guidelines of good practice on regulatory aspects of smart metering for electricity and gas, February 2011, ref.: E10-RMF-29-05. It should be noted, however, that they do not cover the case of pre-payment, as it is specific to certain energy markets and for that reason it could not be considered as 'common'.

service companies and ICT providers) that can provide services to consumers, allowing them to change their behaviour to their own benefit. The directive also imposes obligations on Member States to facilitate switching within strict deadlines, and to ensure consumer access to consumption and billing information.

From this point of view, the roll-out of smart meters introduced by EU legislation as a prerequisite to smart grids, remains the main concern for many EU consumers (but also for a number of energy experts who remain unconvinced). Wide-scale roll-outs of smart meters are expensive and their success depends on numerous factors (notably consumers' behaviour changes) as well as criteria decided largely by Member States. Consumer groups worry that consumer benefits will be negligible or that not all consumers benefit from the technology. This has been stated in a relevant study[27] from the Free University in Brussels (ULB) ordered by the Bureau Européen des Unions de Consommateurs.

In the United Kingdom, questions continue to be asked about whether the implementation of smart meters is good value for money. The National Audit Office (NAO)[28] and the Public Account Committee[29] have highlighted the uncertainties over consumer benefits, compounded by the risk of potential cost escalation, the challenges of delivering a fit-for-purpose and secure system and the risk that suppliers do not pass on all the savings achieved from smart metering to their customers. What is also revealing in the United Kingdom is that many consumers have little, if any, knowledge of the technology.[30] These fears have had consequences. In December 2014, the British authorities decided to delay again by one year the roll-out of smart meters. It seems that mistakes have been made in the way the United Kingdom made the move (an out-dated and over-complicated system, cost escalation and failure to deliver the promised customer benefits).[31] In the United States, too, a 2012 report focusing on electricity grids and economy of energy entitled *Getting Smarter About the Smart Grid*, was published by the National Institute for Science, Law and Public Policy (NISLAPP) in Washington, D.C. This report states that billions of dollars in federal subsidies for 'smart' utility meters have been misspent on meter technology that will not lead to energy sustainability or contribute to the possibility of a more efficient and responsive electricity grid.[32]

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27 F. Klopfert (Ecole Polytechnique de Bruxelles), G. Wallenborn (IGEA – Faculté des Sciences, ULB), *Empowering consumers through smart metering*, 2012. Sciences, Université libre de Bruxelles.

28 See NAO report on Preparations for smart metering of 30 June 2011 [http://www.nao.org.uk/wp-content/uploads/2011/06/10121091.pdf] and its update of 5 June 2014 [http://www.nao.org.uk/wp-content/uploads/2014/06/Update-on-preparations-for-smart-metering.pdf].

29 PAC report 2011 on Preparations for the roll-out of smart meters, sixty-third report [http://www.publications.parliament.uk/pa/cm201012/cmselect/cmpubacc/1617/161702.htm] and PAC report 2014 on Preparations for the roll-out of smart meters, twelfth report [http://www.publications.parliament.uk/pa/cm201415/cmselect/cmpubacc/103/10302.htm].

30 [http://www.thegreenitreview.com/2012/03/smart-meter-roll-out-in-europe-more-talk.html].

31 Nick Hunn, WiFore Consulting, *Smart metering is fcuked*, November 2013, [http://www.nickhunn.com/wp-content/uploads/downloads/2013/11/Smart-Metering-is-FCUKED.pdf].

32 [http://www.gettingsmarteraboutthesmartgrid.org/pdf/SmartGrid_Report_PDF-2012-11-26-Final.pdf]

Until now, as one will see, the potential energy savings seem thus to remain modest. Furthermore, some of the solutions provided are not fully compliant with the set of functionalities recommended by Recommendation 2012/148/EU concerning data privacy and data protection requirements, etc.

Regulation (EC) 714/2009 and the development of network codes by the European Network of Transmission System Operators for Electricity (ENTSO-E) on the basis of framework guidelines adopted by ACER: these codes will contain a number of mandatory requirements. Grid connection codes (in particular the demand connection code in relation to demand side response) as well as system operation codes and market codes (in particular the electricity balancing code) are of particular interest for the SGTF.[33]

3.2. The climate and energy package

***Directive 2009/28/EC* on renewables** views smart grids as an enabler for integration of increasing renewable energy into the grid, and obliges Member States to develop transmission and grid infrastructure towards this aim.

***Directive 2003/87/EC* establishing the EU ETS** in its article 10(a) 8 sets aside 300 million allowances (rights to emit one tonne of carbon dioxide) in the New Entrants' Reserve of the EU Emissions Trading System (ETS) for subsidizing installations of innovative renewable energy technology (RES) and carbon capture and storage (CCS). The money raised from the sale of these 300 million allowances on the carbon market by the European Investment Bank will be made available to innovative projects. With the first call for proposals (covering the sale of 200 million of allowances) under the NER300 funding programme, the Commission awarded in December 2012 over €1.2 billion funding to 23 highly innovative renewable energy demonstration projects. Distributed among them were renewable management projects (smart grids).[34]

The second call for proposals under the NER300 programme was launched on 3 April 2013.[35] It covered the sale of 100 million in allowances together with €288 million unspent in the first round. Smart grid demonstration projects were again called for for funding in this second round. Thirty-three proposed projects[36] (i.e., one CCS and

[33] Each code will become binding under the form of a Regulation, after a comitology procedure driven by the Commission and scrutinized by both the Council and the European Parliament. For more information, see also the annual priority lists for the development of network codes for 2015 and guidelines for 2015 (Commission decision 2014/713/EU of 13 October 2014 – OJ L296/28, 14.10.2014).

[34] See Commission implementing decision of 18.12.2012. Award decision under the first call for proposals of NER300 funding programme – C(2012) 9432, modified by Commission implementing decision of 31.01.2014 – C(2014) 383 final.

[35] OJEU, 3.04.2013, C 94/8. The call for proposals can be found on http://ec.europa.eu/clima/funding/ner300/docs/call_en.pdf.

[36] http://ec.europa.eu/clima/funding/ner300/docs/project_proposals_en.pdf.

32 RES) were submitted by the 3 July deadline. The award decision[37] was issued on 8 July 2014 and two smart-grid projects were selected (The Green+ project[38] to be implemented in rural mountain area in Cyprus for a maximum NER funding of €11.1 million, and Puglia Active Network project,[39] to be implemented in Italy for a maximum NER funding of €85 million).

It should be noted that the European Council at its 23-24 October 2014 meeting decided on a successor to NER300. It will be replaced by NER400, which will be 'initially endowed with 400 million carbon allowances' for the period between 2021 and 2030. The European Council wants NER400 to cover 'low carbon innovation in industrial sectors' as well as CCS and RES. Reference to the eligibility of small projects has also been included.[40] To make NER400 operational, a legal basis has to be created in the EU ETS Directive while further implementation modalities can be set out in secondary legislation. A public consultation (from 19 December 2014 to 16 March 2015) on the revision of the EU ETS Directive is ongoing.[41]

3.3. Directive 2012/27/EC on energy efficiency

Directive 2012/27/EC[42] replaced Directive 2006/32/EC after 5 June 2014. In article 9, § 1 it requires Member States to ensure that customers for electricity, natural gas, district heating, district cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the end customer's actual energy consumption and that provide information on actual time of use, when it is technically possible, financially reasonable and proportionate in relation to the potential energy savings. At the same time, article 15, § 1, line 2 of the same directive requires Member States to ensure that

> national energy regulatory authorities, through the development of network tariffs and regulations, within the framework of Directive 2009/72/EC and taking into account the costs and benefits of each measure, provide incentives for grid operators to make available system services to network users

37 See Commission implementing decision of 8.7.2014. Award decision under the second call for proposals of NER 300 funding programme – C(2014) 4493final. The decision and its annexes can be found on the following website: [http://ec.europa.eu/clima/funding/ner300/index_en.htm].

38 The aim of the project is to convert a region with a traditional grid to a micro-grid concept targeting the challenges that distributed generation imposes onto network operation, such as voltage, frequency, power quality parameters and balancing renewable generation. 25,000 customers are involved.

39 The aim of the project is to demonstrate active large-scale network management at distribution level and to show the extent to which this enhances the capability of the grid to accommodate large quantities of renewables. This includes active control of power flows, facilitation of demand response, ancillary services to control supply quality, reduction of network losses and vehicle-to-grid service from electric vehicle battery storage.

40 See European Council's conclusions on 2030 climate and energy policy framework, point 2.6 [http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145356.pdf#page=3].

41 [http://ec.europa.eu/clima/consultations/articles/0024_en.htm].

42 OJEU L 315/1, 14.11.2012.

permitting them to implement energy efficiency improvement measures in the context of the continuing deployment of smart grids.

It must also be noted that, as measuring devices, smart meters must comply with the Measuring Instrument Directive (Directive 2004/22/EC)[43] in order to be used in the European Union.

3.4. Directive 95/46/EC on the protection of personal data (data privacy rules)

In a smart grid environment, the availability of data provided by metering equipment is crucial. The data can be utilized for commercial actors, e.g., for realizing energy savings by demand response, as well as grid operators for both short-term system management and long-term grid planning.

However, data privacy is an important issue for consumers. Public acceptance of the roll-out of smart grids and smart meters as a first step will depend on adequate protection. Directive 95/46/EC on the protection of personal data[44] covers any sector, including smart grids aspects. Under this legislation, personal data can only be gathered legally under strict conditions, for a legitimate purpose. Furthermore, persons or organizations which collect and manage your personal information must protect it from misuse and must respect certain rights of the data owners which are guaranteed by EU legislation.

The current rules of Directive 95/46/EC were nevertheless introduced a long time ago, and need to be updated and modernized because of new challenges to data protection. Indeed, the scale and way data is collected, accessed, used and transferred have been transformed due to technological changes and globalization. So in 2012, the Commission proposed a major reform of the EU legal framework on the protection of personal data. This reform envisages replacing Directive 95/46/EC with a new draft Regulation[45] containing the following key changes, provided, obviously,

[43] OJ L35/1, 30.04.2004. This Directive has been modified several times.

[44] Directive 95/46/EC of 24 October 1995 of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data, OJEU L 281, 23.11.1995, p. 31. It should be noted that the Article 29 Working Party on the protection of individuals with regard to the processing of personal data (set under Art. 29 of directive 95/46/EC to advise the Commission) is working to highlight the relevant protection issues for smart grids and make recommendations for solutions. See opinion 12/2011 on smart metering, adopted on 4 April 2011 (doc. 00671/11/EN – WP 183). The European Data Protection Supervisor, another data protection authority whose opinion is requested in accordance with article 28(2) of regulation EC 45/2001, also issued on 8 June 2012 an opinion on the same subject (see [http://www.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/Consultation/Opinions/2012/12-06-08_Smart_metering_EN.pdf].

[45] Proposal for a Regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) – COM(2012) 11 final. See on the same subject the Communication from the Commission Safeguarding privacy in a connected world – A European data protection framework for the 21st century, COM(2012) 9 final.

that they are adopted at the end of the legislative process by the EU legislative power:

- establish a 'right to be forgotten'. When individuals no longer want their data to be processed and there are no legitimate grounds for retaining it, the data will be deleted. This is in line with a recent Court of Justice of the EU ruling;[46]
- guarantee easy access to one's own data;
- guarantee the freedom to transfer personal data from one service provider to another ('data portability');
- ensure that whenever consent is required for data processing, it will always be given explicitly (rather than assumed);
- ensure companies and organizations inform without undue delay individuals about data breaches that could adversely affect them. They will also have to notify the relevant data protection authority;
- improve administrative and judicial remedies in case of violation of data protection rights;
- cut red tape and bureaucratic requirements which impose unnecessary costs on businesses;
- ensure a single set of rules on data protection, valid across the EU. Today, companies have to deal with 28 different sets of data protection rules within the EU, resulting in a fragmented legal environment with legal uncertainty and unequal protection for individuals;
- ensure EU rules will apply to companies not established in the EU if they offer goods or services in the EU or monitor the online behaviour of EU citizens. In that context, a streamlined procedure for 'adequacy decisions'[47] that allow free flow of information between the EU and non-member countries is proposed.
- establish a one-stop-shop enforcement: companies will be answerable to just one data protection authority (one-stop-shop) – the data protection authority where they have their main establishment;
- increase responsibility and accountability for those processing personal data – through (1) data protection risk assessments, (2) introduction of data protection officers for companies of a certain size, and (3) integration into business processes of the principles of 'privacy by design' and 'privacy by default'; and
- strengthen national data protection authorities' cooperation so they can better enforce the EU rules at home.

In the meantime, some adaptations might be needed in the specific national legal frameworks in order to accommodate some smart grids functionalities. With regard

[46] OJEU, 13 May 2014, Google Spain SL, Google Inc. vs Agencia Espagñola de Protección de Datos, Mario Costeja González, C-131/12.

[47] An 'adequacy decision' is an acknowledgment that a given non-EU country ensures an adequate level of data protection through its domestic law or international commitments.

to that, in its April 2011 communication, the Commission has expressed its intention to monitor the relevant provisions of national sectoral legislation that take into account the data protection specificities of smart grids.[48] In addition, the ESOs are required to integrate in the standards they are developing a 'privacy by design'[49] approach. On top of this, the Commission continues to bring together the energy and ICT communities within an expert group to assess the network and information security and resilience of smart grids as well as to support related international relations.

The Commission's recommendation 2012/148/EU also provides guidance related to data protection and security considerations.

Incidentally, it should be added that the provisions of Directive 2002/58/EC[50] on privacy and electronic communications are fully applicable to smart metering, which processes personal data.

3.5. Directive 2010/31/EU on the energy performance of buildings

According to article 8(2) of the recast Directive 2010/31/EU,[51] Member States shall encourage the introduction of intelligent metering systems whenever a building is constructed or undergoes major renovation. Additionally, Member States may encourage the installation of active control systems such as automation, control and monitoring systems that aim to save energy. One will notice the very limited constraining character of this provision.

3.6. The energy infrastructure package

Making smart grids a reality will require significant investment in 'intelligent' network infrastructure. According to rough estimates, the investment need in intelligent network infrastructure at both transmission and distribution levels amounts to around €40 billion before 2020. The failure to invest, as a result, could lead to peak demand in electricity – up to 5% higher by 2020 and up to 8% by 2030 – with corresponding needs for investment in expensive peak load and back-up generation assets.[52]

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48 Notably, with the wide deployment of smart grids, the obligation to notify national data protection authorities of the processing of personal data is naturally likely to increase. Member States will have to ensure, when setting up smart grids and particularly when deciding on the division of roles and responsibilities regarding ownership, possession and access to data, that this is done in full compliance with EU and national data legislation.

49 'Privacy by design' approach can be translated into French as: '*une approche de «la prise en compte du respect de la vie privée dès la conception » du réseau intelligent*.' See: [http://www.ipc.on.ca/images/Resources/7foundationalprinciples.pdf].

50 OJ L 201/37, 31.07.2002.

51 OJ L 153/13, 18.06.2010.

52 See, for the figures mentioned, the updated mission and work programme of the SGTF, p. 8.

In the energy infrastructure package, smart grids have been subject to special attention.[53] In particular, Regulation (EU) No. 347/2013[54] on guidelines for trans-European energy infrastructure identifies smart grid deployment across the EU as a priority thematic area for infrastructure investment up to 2020. It also introduces a process and criteria to select concrete projects contributing to the implementation of this priority area. The projects selected this way will carry the label 'Projects of common interest (PCIs)'. PCIs will benefit from facilitated permit granting procedures (e.g., a three-and-a-half year time limit for granting of permits) and improved regulatory treatment. PCIs will also receive, provided a certain number of conditions are fulfilled, financial assistance under the EU financial instrument called the Connecting Europe Facility (CEF), created under Regulation (EU) No. 1316/2013[55] which entered into force in 2014. The CEF has a fund of €33.2 billion (€29.3 billion in constant 2011 prices), of which €5.8 billion (€5.1 billion in constant 2011 prices) is allocated to trans-European energy infrastructure in the period 2014-2020.[56] In addition to its financial envelope, the CEF brings new instruments to encourage investments.

A first list of energy infrastructure projects identified as PCIs that may qualify for a share of the amount of €5.8 billion was unveiled by the Commission on 14 October 2013.[57] The 248 projects on this list were selected by 12 regional groups established by Regulation (EU) No. 347/2013. Surprisingly, only two projects on the list are related to smart grids, despite the fact that they are widely perceived to be among the most promising energy-related technologies. The two smart grid projects selected are: (a) the *Grid integration of Renewable Energy Sources in the North Mediterranean* Project (Green-Me Project) which involves France and Italy, and (b) the *North Atlantic Green Zone* Project, which involves Ireland and the United Kingdom. Initially, four smart grid projects were submitted for selection but apparently two of them did not fulfil the criteria of Regulation (EU) No. 347/2013.[58] Under

[53] Its core elements were presented in a Commission Communication on energy infrastructure priorities for 2020 and beyond – A blueprint for an integrated European energy network, COM (2010) 677.

[54] Regulation (EU) No. 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing decision No 1364/2006/EC and amending regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) 715/2009 (OJEU 2013, L 115/39).

[55] The regulation creating the CEF amends Regulation (EU) No. 913/2010 and repeals the TEN financing Regulation (EC) No 680/2007 and Regulation 67/2010. The CEF was assisted in the area of energy by a 'pilot phase' until the end in 2013 of the Europe 2020 Project Bond Initiative under regulation No 670/2012.

[56] This financial envelope is the result of a compromise reached between the Council and the European Parliament on 10 July 2013, for it depended on the outcome of the negotiations on the 2014-2020 EU budget.

[57] See Commission Delegated Regulation (EU) No. 1391/2013 of 14.10.2013 amending regulation (EU) No. 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure as regards the Union list of projects of common interest (OJEU, L 349/28, 21.12.2013). A document on technical information accompanies the Commission delegated regulation and can be found on the following website: http://ec.europa.eu/energy/infrastructure/pci/doc/com_2013_0711_technical_en.pdf.

[58] See the 2013 JRC report *Evaluation of smart grid projects within the Smart Grid Task Force Expert Group 4 (EG4) – Application of the assessment framework for energy infrastructure projects of common interest in the field of smart grids*, prepared by Vincenzo Giordano et al. The report evaluated the four projects and can be found on the following website: [http://ses.jrc.ec.europa.eu/sites/ses.jrc.ec.europa.eu/files/documents/evaluation_of_smart_grid_projects_within_the_smart_grid_task_force_expert_group_4_eg4.pdf].

the first call for CEF energy, the Commission received 64 eligible proposals requesting a total of €1.37 billion in financial support. The Commission evaluated all the applications and submitted a list of actions to be co-financed to the CEF Coordination Committee (composed of Member State representatives), which approved it on 29 October 2014. On that list,[59] only the North Atlantic Green Zone project has been selected. The next call for CEF energy will be launched in 2015.

3.7. Directive 2014/94/EU (Electro-mobility Directive)

Electric vehicles could contribute to the stability of the electricity system by recharging their batteries from the grid at times of low general electricity demand and feeding power from the batteries back into the grid at times of high general electricity demand. Therefore recharging points should use intelligent metering systems, and the price for electricity at a recharging point should be market based, so that flexible consumption (and storage) of electricity is promoted through dynamic pricing.[60]

[59] [http://ec.europa.eu/energy/infrastructure/pci/doc/2014_cef_energy_lists.pdf].

[60] Directive 2014/94/EU on the deployment of alternative fuel infrastructure (OJEU, L 307/1, 28.10.2014). See in particular Recital 28 and art. 4, point 7 of the Directive.

4. STANDARDIZATION

Standardization is a pivotal issue for smart grids due to the involvement of many different sectors along the value chain of electricity provision (from the generation to the appliances in households). It is also essential for the competitiveness of the European industry. However, because the smart grid's scope is quite broad, the potential landscape is quite complex.[61]

The European Council of February 2011 invited Member States, in liaison with European Standardization Organisations (ESOs)[62] and industry, to 'accelerate work with a view to adopting technical standards for electric vehicle charging systems by mid-2011 and for smart grids and meters by the end of 2012.'[63] On that basis, the standardization mandate M/490 was issued by the Commission and European Free Trade Association in March 2011 and was accepted by the three European ESOs: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Group (ETSI).[64] Mandate M/490 requests them to develop European standards facilitating the implementation of high-level smart grid services and functionalities by the end of 2012. To ensure the timely adoption of standards, a monitoring system has been set up.[65] To perform the work under mandate M/490, the ESOs established in July 2011 a CEN-CENELEC-ETSI Smart Grid Coordination Group (SG-CG)[66]. This SG-CG is responsible for coordinating and managing the whole work process concerning the smart grid mandate M/490 and is structured into four working groups focusing on the main elements of the mandate. In November 2012, the SG-CG produced several reports: (a) on smart grid reference architecture, (b) on a first set of standards, (c) on sustainable processes, and (d) on smart grid information security. A framework document which provides an overview of the activities was also issued.[67] At the end of 2012, the smart grid mandate M/490 was extended

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61 A very good introduction can be found in CEN et al, *Sustainable growth: smart grids and smart meters, ICT environment*, Brussels, 23 May 2014.

62 Through the provisions established by Directive 98/34/EC of the European Parliament and Council (JOUE 1998, L 204/37), CEN and CENELEC (together with their sister organization ETSI) are officially recognized as organizations that can deliver European Standards and other deliverables for use with the European regulatory framework. As this directive has been modified several times, a 2013 consolidated version can be found on the following website: [http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1998L0034:20130101:EN:PDF].

63 Conclusions of the European Council of 4 February 2011.

64 The three ESOs are the organizations listed in annex I of Regulation (EU) No. 1025/2012 (OJ, L 316:12, 14.11.2012).

65 This standardization mandate and the Commission's communication on smart grids [COM(2011) 202] have foreseen the creation of a Reference Group to monitor the implementation of the work programme established under the mandate, with a view to ensuring timely adoption of the smart grids-related standards by the end of 2012. This Reference Group is an advisory group to the Commission.

66 This SG-CG replaces the Joint Working Group on standards for smart grids (May 2010 – June2011). It consists of ESO representatives and associations.

67 All reports can be found on the following website: [http://www.cencenelec.eu/standards/Sectors/SustainableEnergy/SmartGrids/Pages/default.aspx].

until the end of 2014. The deliverables required included firstly a further refinement of the methodology used under mandate M/490, to be provided at the end of 2013, although the final report (and its annexes) was finalized only in November 2014.[68] Secondly, the mandate pushed for a set of consistent standards by the end of 2014 that should complement the first set of standards adopted at the end of 2012. This work will include a prioritization of new gaps. A report (version three) was produced in October 2014.[69] Thirdly, the work of the SG-CG will also investigate three interoperability aspects: (a) a system interoperability testing method to be provided by the end of 2013, (b) a conformance testing map[70] that should be provided by the end of 2013, and (c) an assessment of needed profiles (limiting implementation options given by the standards to achieve interoperability) to be provided by the end of 2014. These three tasks were presented in a single report in October 2014.[71] Finally, continuation of the work on smart grid information security for which a report was produced in December 2014.[72] The content of all these reports was approved by the CEN and CENELEC Technical Boards as well as the ETSI Board in December 2014.

It should be noted that in parallel to Mandate M/490, ICT standards are being discussed with other standards organizations under a new platform created by DG ENTR[73] and DG CNECT[74] named Mirror Group.[75]

The M/490 mandate adds itself to two other pre-existing mandates: mandate M/441 for developing smart meters (March 2009) and mandate M/468 for electric vehicles (June 2010).

A CEN-CENELEC-ETSI Smart Meter Coordinating Group (SM-CG) was established in 2009,[76] in addition to related working groups, as a response to mandate M/441. The general objective of work under M/441 has been to ensure European standards that

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68 SG-CG/ M490/F – Overview of SG-CG Methodologies (version 3.0), 11/2014 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Methodology_Overview.pdf] and annexes: SG-CG/M490/L – Flexibility management, 11/2014 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Methodology_FlexibilityManagement.pdf]; SG-CG/M490/L – General Market Model Development, 11/2014; [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Methodology_GeneralMarketModelDevelopment.pdf]; SG-CG/M490/K – SGAM usage and examples, 11/2014; [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Methodology_SGAMUserManual.pdf].

69 SG-CG/M490/G – Smart Grid set of standards – Version 3.1, 31 October 2014 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Standards_Report.pdf].

70 Conformance tests are tests to evaluate the adherence or 'non-adherence' of a candidate implementation to a standard which provides the user with a guarantee that the considered implementation is not against the standard. A conformance testing map will ensure that each selected standard (from the first set of standards) is provided with conformance testing tools and respective processes.

71 SG-CG/M490/I – Smart Grid Interoperability, 31 October 2014 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Interoperability_Report.pdf].

72 SG-CG/M490/H – Smart Grid Information Security, December 2014 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_SGIS_Report.pdf].

73 DG ENTR means 'Directorate General for Enterprise and Industry'.

74 DG CNECT means 'Directorate General for Communication Networks Content and Technology'.

75 Minutes of the 16th meeting of the Steering Committee of the SGTF dated 17 July 2013, p. 2.

76 The SG-CG produced a technical report in December 2011: *Functional reference architecture for communications in smart metering systems*. (Doc. CEN/CLC/ETSI/TR 50572).

will enable interoperability of utility meters, which can then improve the means by which customer awareness of actual consumption can be raised in order to allow timely adaptation to their demands. Work, when completed, should permit fully integrated solutions, modular and multi-part solutions, and should allow secure data exchange. In addition, the architecture has to be scalable and adaptable to future communications media. SM-CG has thus understood its work to cover the entire Advanced Metering Infrastructure (AMI) and not just the meters.[77]

The first phase of M/441 mandate requested the ESOs (CEN-CENELEC-ETSI) to produce a European standard for communications. In this context, SM-CG produced in December 2011 a technical report entitled *Functional reference architecture for communications in smart metering systems*.[78] The architecture should be applicable across the variety of smart metering deployments in Europe and be able to be implemented in electricity, gas, water and heat. The technical report also provides an overview of the existing standards that are applicable to smart metering and describe a standardization approach to reuse existing standards as much as possible while being open to new proposals. It also determines additional smart metering functionalities.

The second phase of M/441 focuses on the development of European standards containing harmonized solutions for additional functionalities within interoperable frameworks. The SM-CG decided to complete the second phase of M/441 by producing another report in December 2012.[79] The latter summarizes the work undertaken during the period 2009-2012. Currently, the SM-CG is working on the definition of European Use Cases for smart metering. These Use Cases will be used as input for the ESOs to check the completeness of the functionality of their standards.

In response to M/468, a CEN-CENELEC Focus Group on European Electro-Mobility was established in 2010 and produced in October 2011 a report[80] recommending, among other things, the creation of a CEN-CENELEC Coordination Group on e-Mobility (eM-CG) with the aim of supporting coordination of standardization activi-

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77 SM-CG, report of activity at the end of 2012: [http://www.google.be/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=3&ved=0CC4QFjAC&url=http%3A%2F%2Fwww.beama.org.uk%2Fdownload.cfm%2Fdocid%2F8C20C69B-6244-4A58-B6E3AFD1D7CBBDA8&ei=q0XGVPzhAdfiav_LgqgE&usg=AFQjCNEdFzX-7gInBjKBCtH42y112K-S6Ag&bvm=bv.84349003,d.d2s].

78 CEN/CLC/ETSI/TR/50572 of December 2011 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartMeters/CEN-CLC-ETSI-TR50572%7B2011%7De.pdf]. It should be noted that this technical report does not cover smart grid applications or electric vehicles, except to the extent that they involve communications routed via the smart metering system. This technical report also does not cover demand-side management and demand response, which are considered to fall under the smart grid mandate (M/490). Close-coordination between smart grid mandate M/490 and smart meter mandate M/441 has, however, been ensured by designated '*rapporteurs*'.

79 Introduction and guide to the work undertaken under the M/441 mandate, SM-CG, December 2012 [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartMeters/CENCLCETSI_SMCG_end2012.pdf].

80 Standardization for road vehicles and associated infrastructure, version 2, October 2011 [ftp://ftp.cen.eu/CEN/Sectors/List/Transport/Automobile/EV_Report_incl_annexes.pdf].

ties during the critical phase of writing new standards or updating existing standards. The latter held its first meeting in March 2012 and sent a first set of available standards[81] to the Commission in June 2012. A work programme and a list of relevant standards for the charging of electric vehicles was updated in December 2014.[82] CEN-CENELEC technical committees[83] are also actively working on electric vehicles.

In 2013, the European Commission (Directorate General for Mobility and Transport) launched the EU clean fuel strategy, which contains a package of measures to ensure the build up of alternative fuel stations in Europe. The package contains Directive 2014/94/EU[84] on the deployment of alternative fuels infrastructure in Europe. Part of this Directive concerns 'electric recharging points for motor vehicles', a topic which is of particular interest to the eM-CG. CEN and CENELEC should thus receive a standardization mandate in support of the implementation of this Directive early in 2015.

It should be added that where standardization is concerned, there is a new CEN-CENELEC-ETSI Coordination Group on Smart and Sustainable Cities and Communities (SSCC-CG). Its first meeting was foreseen in October 2014. There are liaisons between the SSCC-CG and the other SGs.

To round up the many aspects of standardization, the Commission will continue reviewing European standardization policy by following up its White Paper *Modernising ICT standardization in the EU – The way forward*,[85] as well as the global standardization developments.

This said, there remain marked uncertainties on future standards for smart grids because the concept of a smart grid is not yet well defined, and this is a problem, notably to choose technologies. The industrial and commercial stakes around smart networks are so colossal that companies implement strategies of influence to position themselves on this market.

81 The set of standards can be found at: [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/ElectricVehicles/M468%20Set%20of%20Standards.pdf].

82 These can be found on the following website: [ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/ElectricVehicles/M468%20WorkPorgrammeUpdate2014.pdf].

83 These are CEN/TC 301 'road vehicle'; CLC/TC 69X 'electric systems for electric road vehicles'; CLC/TC 23BX 'switches, boxes, and enclosures for households and similar purposes, plugs and socket oulets for d.c. and for the charging of electrical vehicles including for their connectors'; CLC/TC 64 'electrical installations and protection against electric shock'.

84 Directive 2014/94/EU on the deployment of alternative fuels infrastructure (OJEU, L30/1, 28.10.2014).

85 COM (2009) 324.

5. INNOVATION

The Commission has launched several innovation initiatives for the modernization of energy networks (including small-scale pilot projects to verify and demonstrate the functioning and benefits of smart grids). The most spectacular ones are listed in the next sections.

5.1. Smart Grids European Technology Platform (Smart Grids ETP)

Initiated by DG Research in 2005, the European Technology Platform for electricity networks of the future (also called Smart Grids ETP)[86] is a forum of discussion between a wide range of stakeholders (representatives from industry, transmission and DSOs, research bodies, regulators). Its primary objective is to boost European industrial competitiveness. In view of this, it was asked to formulate and promote a shared vision for the European networks of 2020 and beyond.

The strategy to make this vision a reality was presented in a single document in 2006.[87] A strategic research agenda[88] (SRA) was published in 2007, proposing research areas for investigation in the 2020 perspective in Europe. A key principle in the development of this agenda was that grid users should be the focus of developments. In 2012 came a second SRA, Smart Grids Strategic Research Agenda 2035,[89] emphasizing that a long perspective is needed to envisage the deep transformations required by high shares of renewables (expected to be approximately 34% of the total energy consumption by 2020), highly efficient buildings and a strong role for storage.

This new agenda intends to contribute to the EU's envisioned CO_2 reduction of at least 80% by 2050 and is viewed as a key input to the EU Framework programme for research and innovation, Horizon 2020[90] (which has replaced FP7). This framework began in 2014 – in addition to other smart grids research, development & demonstration (RD&D) initiatives at national and European level. It describes research topics and priorities but also highlights the economical and institutional options, market boundaries, and grid regulations that will be necessary for the smart grids-

[86] See document on the European Technology Platform for the electricity networks of the future SmartGrids ETP – Terms of Reference and Rules of Procedure. This document can be found on the following website: [http://www.smartgrids.eu/documents/ETPSG-20130628TermsofReferenceandRulesSmartGridseETP-SteeringCommittee.pdf].

[87] The document can be found on: [http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf].

[88] This agenda can be found on: [http://www.smartgrids.eu/documents/sra/sra_finalversion.pdf].

[89] This document can be found on: [http://www.smartgrids.eu/documents/sra2035.pdf]. See also on this topic, Thang Vu Van et al, Organic Growth, Towards a Holistic Approach to European Research and Innovation, IEEE Power and Energy Magazine, Jan-Feb. 2015, pp. 34-36.

[90] See Regulation (EU) No. 1291/2013 establishing Horizon 2020 – The framework programme for research and innovation (2014-2020) and repealing Decision 1982/2006/EC (OJ L 347/104, 20.12.2013).

based electricity systems by 2035. One central issue is the nature of the interactions between the transmission and distributions networks. Another is the necessity to clearly define the tasks, obligations and business activities of all actors intervening in the electricity system.[91]

The structure of the ETP Platform is organized around a Steering Committee (which replaces the previous Advisory Council), a secretariat and three working groups: WG1: network operation and assets, WG2: energy storage and grid integration and WG3: demand side, metering and retail. The goal of these three working groups is to provide strategic advice for the European Commission, with two-way communication between the Commission and national initiatives as a goal.

5.2. Initiatives linked to the SET-PLAN

The SET-Plan[92] aims to accelerate the development and wide-scale application of low-carbon technologies for the achievement of the EU energy and climate goals for 2020 and beyond.[93] It also aims to lift European industry into a leading position worldwide.

The implementation of the SET-Plan has led to the establishment of large scale programs, called European Industrial Initiatives (EIIs), which bring together industry, the research community, Member States and the Commission in risk-sharing partnerships aimed at the rapid development of key energy technologies at European level. The EII called The EEGI[94] was launched in 2010. One of the EEGI's

[91] In particular, several studies encourage a rethink of the role, responsibilities, cooperation and the regulation applicable to DSOs. For instance, P. van den Oosterkamp et al., *The role of DSOs in a smart grid environment*, Ecorys/ECN report, 23 April 2014, pp. 146; S. Ruester et al., *From distribution networks to smart distribution systems: rethinking the regulation of European Electricity DSOs*, Think report financed by FP7, June 2013, pp. 86. See also the slides of A. van der Welle (ECN), *Role and activities of DSOs in the future electricity market*, 6th FSR & BNetzA Forum on legal issues of energy regulation, Brussels, 14 February 2014: [http://fsr.eui.eu/Documents/Presentations/Energy/2014/140214BNetzAForumBrussels/140214vanderWelleAdriaan.pdf].

[92] Commission Communication: A European strategic energy technology plan (SET-Plan) – Towards a low carbon future – COM(2007) 723. Since the launch of the SET-plan, major elements have evolved and modified the world energy landscape: the global economic crisis, the energy prices in Europe, the evolution of discussions in relation to the post Kyoto obligations, the post-Fukushima debate on nuclear energy, the competitive edge of various technologies (e.g., low carbon price, the introduction of shale gas into the international energy market) and the competitive pressure of manufactures from outside the EU. For all these reasons, the Commission in its communication on energy technologies and innovation published under reference COM (2013) 253 wishes to reinforce the SET-Plan to respond to the new challenges and to better consolidate research and innovation capacity and resources across Europe, and it proposes several changes. It was preceded by a public consultation (20 December 2012 – 15 March 2013) whose results were published in a Commission report on the public consultation on the communication on energy technologies and innovation dated 29.04.2013. This report can be found on the following website: [http://ec.europa.eu/energy/technology/consultations/doc/20130315_techinnov_results.pdf].

[93] Concerning the EU energy and climate goals, see the recent Green Paper: *A 2030 framework for climate and energy policies* – COM (2013) 169.

[94] The EEIG was founded by network operators. The founding members were seven TSOs (Elia, Red Electrica, Amprion, RTE, TenneT, Vattenfall, Transpower) and seven DSOs (ENEL, CEZ Group, RWE, ERDF, Iberdrola, E.ON, Vattenfall). The EEIG is accompanied by the GRID+ project whose aim is to implement and support the management, planning and networking process of the EEIG over the years 2012-2014, both within and beyond the European borders (see [http://gridplus.eu]).

main goals is to help achieve the 20/20/20 climate package targets: a 20% cut in emissions of greenhouse gases by 2020 (compared with 1990 levels), a 20% increase in renewable energy use by 2020, and a 20% cut in energy consumption by 2020. The EEGI offered a first R&I roadmap prepared by TSOs (ENTSO-E) and DSOs (European Distribution System Operators or EDSO for smart grids) for the period 2010-2018 with a cost estimated at about €2 billion,[95] accompanied by an implementation plan for 2010-2012. In 2012, the EEGI issued a report which undertook a gap analysis of the identified smart grid projects[96] and in January 2013, a second EEGI R&I roadmap was issued for the period 2013-2022.[97] This roadmap, developed within the (post) GRID+ project,[98] is an upgraded version of the first one intended to cover new R&I and knowledge needs in response to EU energy policy evolutions. Based on this second EEGI R&I roadmap, the implementation plan was also updated. It defines priorities for 2014-2016.[99] The following implementation plan for 2015-2017 is already under preparation.

The European Energy Research Alliance (EERA) which also involves the activities and funds of the Member States, is also supporting the efforts of the SET-Plan with a research programme on smart grids.[100] EERA is an initiative which was conceived in 2008 with the close collaboration and support of the Commission.

A more general initiative of the SET-Plan is the information system SETIS, which has an interesting section on electricity grids (*inter alia* smart grids).[101] SETIS has also recently published an overview of the public and private investments in the key technologies addressed by the SET-Plan, and electricity grids technology is obviously relevant to it.[102]

5.3. Others

In parallel, action has been taken at regional and local level in the form of the Covenant of Mayors initiative and the Smart Cities and Communities European Innovation Partnership[103] launched in 2012. It is meant to boost the development of smart technologies in cities – by pooling research resources from energy, transport

95 [http://www.smartgrids.eu/documents/EEGI/EEGI_Implementation_plan_May%202010/pdf].

96 Mapping and gap analysis of current European smart grids projects. Report by the EEGI Member States initiative: a pathway towards functional projects for distribution grids. April 2012. In cooperation with ERA-Net Smart Grids and the Austrian Ministry of Transport, Innovation and Technology.

97 [http://www.gridplus.eu/Documents/20130228_EEGI%20Roadmap%202013-2022_to%20print.pdf].

98 The role of the Grid+ project is to support the development of the EEGI (2012-2014), in a structured and organized fashion. For more information on the role of Grid+ subject, see [http://www.smartgrids.eu/documents/EEGI%207/51_Grid+_role_in_the_EEGI_8_may_2012[1].pdf].

99 [http://www.gridplus.eu/Documents/EEGI%20Implementation%20Plan%202014-2016_definitive.pdf].

100 [http://www.eera-set.eu].

101 [http://www.setis.ec.europa.eu/technologies/smart-grids].

102 See SWD (2013) 157.

103 See the Commission's communication, *Smart cities and communities – European Innovation Partnership*, C(2012) 4701 dated 10.07.2012.

and ICT and concentrating them on a small number of demonstration projects which will be implemented in partnership with cities. For 2013 alone, €365 million in EU funds have been earmarked for the demonstration of these projects for urban technology solutions. Every demonstration project financed under the scheme must combine the three sectors.

When transnational aspects are concerned, ERA-NET SG+ complements the work of EEGI. It also cooperates with other initiatives such as EERA and ETP-SG.

6. SECURITY

Threats to smart grids can be broken into two categories: physical attacks (explosives, projectiles, natural disaster) and cyber (computer-launched) attacks.[104] Whatever the specific nature of the threat, its results can be devastating.

Attacks on smart grids must thus be addressed, particularly when the perception and the approach taken to this topic differ among stakeholders. The European Network and Information Agency (ENISA)[105] issued a technical report[106] at the end of 2012 in view of defining a common approach to smart grid protection in Europe. This report offers guidance to smart grid stakeholders by providing a set of minimum security measures which are considered appropriate for smart grids. Apart from this, ENISA has also developed other important documents. On the one hand, a smart grid threat landscape, issued in December 2013. This document is a significant contribution to the EU cyber security strategy. It comprises a detailed threat assessment in the area of smart grids. This work concludes with a good practice guide, consisting of an overview of smart grid security approaches. On the other hand, a report on "Smart Grid Security Certification in Europe – Challenges and Recommendations", issued in December 2014.[107] This report builds on the findings of the security certification of smart grid components workshop organized in 2012 in Brussels and has been validated by security experts in another workshop held in September 2014 in Heidelberg.

Finally, the Commission has issued a communication on the cyber security strategy of the European Union: An open, safe and secure cyberspace.[108] The strategy clarifies the principles that should guide cyber security policy in the EU and internationally, and proposes priorities and specific actions both for short and long term. The strategy is also accompanied by a proposal for legislation[109] to:

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104 On the subject, see H. Faas, F. Gracceva, G. Fulli and M. Masera, *European Security – A European perspective*, p. 20. See also two Euractiv articles: 'European renewable power grid rocked by cyber-attack', published on 10 December 2012 and updated on 20 December 2012, and 'Smart technology makes energy utilities more vulnerable to hackers', published on 16.07.2014.

105 ENISA was established in 2004 by Regulation (EC) No 460/2004. This 2004 Regulation has been repealed by Regulation (EU) No. 526/2013. The latter strengthens ENISA and modernizes its mandate.

106 Appropriate security measures for smart grids. Guidelines to assess the sophistication of security measures implementation, ENISA, 2012.12.06.

107 file:///C:/Users/FD/Downloads/Smart%20Grid%20Security%20Certification%20in%20%20Europe%20(1).pdf.

108 JOIN(2013) 1 final.

109 Proposal for a Directive concerning measures to ensure a high common level of network and information security across the Union [COM(2013) 48 final]. This proposal is also called 'the proposal for a NIS Directive'. Linked to this proposal, EDSO for Smart Grids prepared a paper 'Network and information security (NIS): Recommendations for information sharing and risk management', September 2014.

1. establish common minimum requirements for Network and Information Security (NIS);[110]
2. set-up coordinated prevention, detection, mitigation, and response mechanisms enabling information sharing and mutual assistance amongst the national NIS competent authorities, and
3. improve preparedness and engagement of the private sector to foster cyber security.

The EG2 report published at the end of December 2013 (in cooperation with ENISA) is linked to this legislative proposal. It proposes 45 available security measures, grouped in 11 domains that might help smart grid providers in improving the level of cyber security of their installations. It should be stressed that the list is a guidance and not a mandatory list.[111]

[110] The Commission has developed a policy on NIS. In 2001, the Commission adopted a Communication on *Network and Information Security: Proposal for A European Policy Approach* [COM(2001)298]; in 2006, it adopted a Strategy for a Secure Information Society [COM(2006)251]. Since 2009, the Commission has also adopted an Action Plan and a Communication on *Critical Information Infrastructure Protection (CIIP)* [COM(2009)149], endorsed by Council Resolution 2009/C 321/01, and COM(2011)163, endorsed by Council Conclusions 10299/11]**.** The European Parliament's resolution of 12 June 2012 on 'critical information infrastructure protection: toward global cyber security' broadly endorsed the 2011 communication and made recommendations to the Commission for the way forward. Many of these recommendations have been taken on board in the cybersecurity strategy and proposal for a network and information security published in 2013.

[111] SGTF, EG2 deliverable, proposal for a list of security measures for smart grids, 9.12.2013 [http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/20140409_enisa.pdf].

7. PROGRESS IN THE DEVELOPMENT OF SMART METERS AND SMART GRIDS IN THE EU

The April 2011 Commission's communication on smart grids announced a number of measures, including monitoring Member States' progress. In that perspective, the Joint Research Center (JRC) which is the Commission's in-house science service launched in 2010 the first comprehensive inventory of smart grid projects in Europe. The latest one was issued in 2014.

7.1. Smart metering

In the EU, national governments play a key role for the introduction of smart meters on their own territory. They also play a key role by choosing policy options for smart metering deployment which allow consumers to reap the full benefits. So between EU Member States, the picture is very varied. Moreover, EU Member States are currently at different stages of the smart meter roll-out.

Roll-outs

Only three countries have already completed a full smart metering roll-out: Italy 2001-2011, Sweden 2003-2009 and Finland 2009-2013. Having begun in 2009, Malta should have completed its smart metering roll-out in the course of 2014. Twelve Member States have decided to proceed with large-scale smart-metering roll-outs by 2020 or earlier (Austria, Denmark, Estonia, France, Greece, Ireland, Luxembourg, the Netherlands, Poland, Romania, Spain, the United Kingdom). Four Member States (Belgium, Czech Republic, Lithuania, Portugal) have decided not to proceed at all with a national roll-out by 2020 while three Member States (Germany, Latvia, Slovakia) have found the roll-out of smart meters economically justified only for particular groups of customers. The remaining Member States (Bulgaria, Cyprus, Hungary and Slovenia) have not yet reached an official decision.

According to Commission estimates, the total investment for the future installation of smart meters in the countries which have already chosen to do so would amount to around €35 billion by 2020 for a total of around 195 million smart meters installed (representing 72% of all European consumers). This level of investment and number of installed meters is, however, bound to grow as other Member States take official steps.

Entity in charge of the roll-outs and regulated vs. competitive smart meter markets

Most of the Member States have chosen to bestow to DSOs the responsibility of installing (and consequently of retaining ownership of) smart metering, which means

that roll-out investment is to be recovered through network tariffs, complemented sometimes – rarely – by DSOs' own resources. In other words, in most of the Member States, DSOs have a leading role in ownership and implementation and the financing of smart metering is mostly secured through an adequate remuneration via network tariffs.

There are two exceptions to be noted, however: Great Britain and Germany. In Great Britain, DSOs do not own and do not install smart meters. Suppliers do. This choice has created problems in Great Britain. In Germany, DSOs only do this if the consumer does not choose a third party as meter operator. In addition, in Germany, the meter ownership can (potentially) be attributed to third parties.

The cases of Finland and France are also worth mentioning. In Finland, DSOs (over 80 DSOs of different size) had the responsibility of installing smart metering but were free to outsource the roll-out projects. In France, slight variations concerning meter ownership can be found. There, DSOs are responsible for the roll-out, but the meter ownership is retained by local municipalities.

Data handling and data protection and security considerations

A handful of Member States (Denmark, Estonia, Poland, the United Kingdom/Great Britain) which decided on a full roll-out have explored the possibility of handling data through an independent central data hub. The central hub entity is responsible for routing (but does not store) data, gathering it from the equipment in consumer's premises and delivering it to energy suppliers, DSOs and other third parties with appropriate access permissions according to privacy legislation. According to the Commission, this choice is guided by the idea that centralized communications, particularly in a competitive electricity market, could lead to improved supplier competition because they make it easier for customers to switch between suppliers. In conclusion, DSOs may be responsible for data handling here, too, in most of the Member States. This may have implications (notably for data handling requirements, for options for specific transactions, and for a competitive market in general).

Moreover, if personal data is to flow freely, customer protection must always be guaranteed. The Commission's recommendation 2012/148/EC has drawn particular attention to that. Consequently, measures for 'data protection by design' and 'data protection by default' need to be carefully considered when rolling out smart metering. But, contrary to what was stated in recommendation 2012/148/EU, only a very limited number of Member States (the Netherlands and United Kingdom) refer their smart metering assessment and respective roll-out programme to a national personal data protection legislation put in place to ensure data privacy and security. Other countries have mentioned explicitly the importance of data privacy and security in their smart metering assessments, but no data protection act is yet in place to cover this matter.

Energy savings results

In many Member States, energy saving potential has been considered a strong driver in the decision to deploy smart metering. But of the countries that have completed roll-outs, Finland and Sweden have indicated energy savings of the order of 1-3%; no data were available for Italy. The other countries which have decided to roll out have estimated energy savings potential to be from 1% to a maximum of 3.8%. Only Malta and Greece are more optimistic and expect 5% energy savings.

Nevertheless the comparison leads to the conclusion that electricity savings or the electricity savings potential of smart meter implementation are of a low percentage.

Ten key recommended functionalities

Regarding smart metering functionalities, only about half of the Member States that are proceeding with large scale roll-out actually deliver the ten recommended functionalities that smart meters should have in order to benefit consumers.

For instance, the functionality related to the frequency at which consumption data are updated and made available to the consumer (and third parties on their behalf) is essential. However, in only a few cases do smart metering systems comply with the 15 minutes recommended. This is regrettable because only with close-to-real-time information about energy consumption and variable prices will interested consumers be able to react to real-time price-signals and demand-response services from energy service companies (ESCOs). Yet as just stated, many smart meters that have been installed are not yet fit for these purposes. So it will thus be difficult to convince customers of the added value of new metering technologies and by extension of the modernization of the European electricity grid if metering data is only of use for operational changes within utilities (to reduce non-technical losses, for remote reading and supplier switching or the simplification of billing procedures, etc.). This is all the more important given that customers are bearing not only the cost of installation of smart meters but also the costs in terms of privacy intervention on non-monetary issues.

This situation could be explained by the fact that, based on available information, prior to the smart metering roll-out, very few Member States have set the functional requirements for the systems to be installed in a clear and descriptive manner (for instance via formal or legal guidelines), thus leaving the analysis, options and protocols to those responsible for the roll-out (in most cases DSOs). Also often absent: the necessity to consider common standards and ensure interoperability in view of creating a market environment conducive to newcomers offering innovative services.

Detection of fraud/theft

At the beginning of 2014, research revealed that in Malta at least 1,000 smart meters had been tampered with in order to record lower electricity consumption, and that this energy theft accounted for roughly 10% of all the electricity generated by Enemalta (Malta's largest utility) in 2012, costing the taxpayer some €30 million that year alone. A former Enemalta technician is now in jail and three others have been suspended. Customers had paid €1,200 euros to have their smart meters hacked. So smart meters do not fully protect the grid operator against theft.

Communication system

Finally, the communication system is a key component of smart metering and the use of wireless technologies in the European smart metering market is increasing rapidly, and electronic communication operators are consequently more frequently requested. This evolution has raised concerns about the potential adverse health effects that long-term low level radio frequency emissions such as those from smart meters could cause. However, uncertainty remains due to a lack of data.

This said, even though smart meters are considered an indispensable prerequisite, they are not sufficient to create really efficient smart grids. Much more effort will need to be expended in parallel on the other components of the electricity network.

7.2. Smart grids

In its 2014 inventory – the latest one – the JRC has identified 459 smart grid R&D and demonstration and deployment projects from EU-28, Switzerland, Norway and 17 other non-EU countries representing a total of €3.15 billion. 48% of these projects are still ongoing, most of them ending by 2017. These 2014 figures from JRC are not easily comparable with those contained in the previous JRC inventory updated at the end of 2012, which included 281 smart grid R&D and demonstration and deployment projects with total funding of €1.8 billion. Indeed, in 2012, the 17 other non-EU countries were not included. This positive trend seems to be reflected by a strong increase in projects, as shown in the JRC's 2014 inventory, but could thus possibly be more cosmetic than real.

The installation of smart grids, as already noted, will also heavily depend on the involvement of stakeholders. These include consumers, who will have a crucial role, not only for smart meters but also for decentralized production or electric vehicles. Indeed, the balance of the electricity system will be far more managed by the final user. In that context, demand/response technologies and services, as already stated, will play a pivotal role.

In 2014, the European regulators underlined the existence of emerging regulatory issues in the development of smart grids. Experience indicates a need in the majority of EU Member States for new regulatory and commercial arrangements to facilitate their development. These arrangements concern specifically: '(a) new routes to market and market processes; (b) benchmarking; (c) the coordination between suppliers and DSOs on the flexibility requested of customers and (d) the definition of the stakeholders' relationships and roles in the value chain.'[112] Additionally, '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.'[113]

Such problems may increase the uncertainty surrounding smart grid investment decisions, and thus complicate the investment process. This "makes conventional cost-benefit analysis techniques difficult to apply, particularly when assessing options over time under uncertain conditions, which may yield misleading results. For example, under a standard cost-benefit analysis, which implicitly assumes perfect foresight, a capital-intensive option might have a higher net present value than an option that has high ongoing costs, but no upfront costs. Once uncertainty over the future outturn scenario is taken into account, the latter approach might look more sensible because of the flexibility associated with it; you can choose not to run it if it turns out not to be needed."[114]

[112] CEER, *CEER Status Review on European regulatory approaches enabling smart grids solutions*, 18 February 2014, p. 15.

[113] Ibid., p. 16.

[114] S. DEASLEY, T. THORNHILL and A. WHITTAKER, Can Smart Grids Reduce the Costs of the Transition to a Low-Carbon Economy?, in A. Estache ed., The next generation of economic issues in energy policy in Europe, CEPR, 2014, p. 102.

CONCLUSIONS

Smart grids respond to the growing need to increase ICT use for communication between the electricity networks' various components. Smart grids are thus directly related to all objectives of the EU energy and climate strategy. First, this can help to increase the efficient use of electricity. Second, it allows the management of more fluctuating streams of renewable energy coming from wind and solar power, and also linked to energy trading. Third, this permits the functioning of an increasingly decentralized model of energy production (a growing number of actors are becoming pro-sumers, meaning both producers and consumers). Smart grids can thus bring more sustainability, more security and more competitiveness. This, however, represents an important challenge for a multitude of actors. It also requires new approaches.

In recent years, smart grid initiatives have grown but large deployment projects are mostly based on smart meter roll-outs. Smart meters today remain thus the most advanced concretization of the smart grids. This constitutes a paradox. Smart meters are largely a national matter. Their transnational aspects remain quite limited. The other aspects of smart grids (smart network management, integration of large scale renewable electricity, or systems of storage for example) are of a more transnational character, but their progress is limited. Moreover, smart grid projects are not uniformly distributed across Europe. Most of the projects and investments remain located in the EU-15 countries while the EU-13 states lag behind. Both smart meters and smart grid projects are surrounded by a certain number of problems which delay their deployment. These problems are various, but some of them can be connected. This said, some progress seems to have been made.

On the regulatory front

As we have seen, European regulators have identified a new set of mounting problems regarding the development of smart grids. The situation is still complicated by the fact that the liberalization of the electricity sector, conceived on the basis of the old energy system, is far from being achieved. These elements maybe indicate that it could possibly be time to change the logic of the system and to operate a clarification and/or a redistribution of the role and responsibilities of the multiple actors implied (in particular, DSOs), as well as a revision of mechanisms for attributing costs and revenues. Among other things, 'DSOs are in a central position in the transition of electricity markets, although acting at local levels. DSOs' primary role lies in local system optimisation allowing for demand response implementation for small customers, in order to reduce congestions and minimise energy losses. The clarification of the role of DSOs in relation to demand response measures is crucial before demand response can potentially develop in a liberalised market, outside of

networks' regulated responsibilities.'[115] Apart from this, however, although a need for regulatory change seems to exist, nothing precise has yet been proposed.

On the standardization front

Standardization is an indispensable step to ensure smart grid deployment. Despite the important work already achieved, the need for European technical standards to achieve a number of objectives such as interoperability, data protection and privacy, protocols to communicate, etc., for smart grids (and smart meters as a first step) remains. This said, the standard landscape is very large and complex, and it still remains difficult to evaluate the impact of standardization on the deployment of smart grids and smart meters.

On the financial front

Investments into "smart grids" – whatever might specifically be meant by this concept – and smart meters are far below expectations. This has been reminded by the European Commission in its communication on Progress towards Completing the Internal Energy Market.[116]

On the consumers front

Concretely, even if the situation is different in Member States, generally the costs and benefits of deployment are not yet really clear. There are strong signs of consumer disinterest (or even hostility) in many places. The costs for consumers are much more evident than the benefits.

In that context, the persistence of the financial crisis risks increasing these difficulties. On the side of demand, the reduction of growth may create an additional incentive for inaction. On the side of supply, the crisis has provoked a strong decrease in investment, especially very long term investment. These evolutions have a profound impact on the energy sector, especially the networks, where the pay-off period is generally quite long. A debate should be opened to examine which reforms could improve a deployment that has remained until now quite slow.

To conclude, the EU has just begun a long smart-grid transition in the electricity sector. Some results have been obtained in the field of smart meters. In other aspects, progress has been slower. There is a clear need for a greater mobilization of the numerous stakeholders, for more analysis about the possible regulatory changes required, and for a clearer demonstration of the benefits for the public.

[115] A. Faure-Schuyer, *The EU Electricity Policy Outlook for the Smart Grid Roll-Out*, IFRI, 2014, p. 11.
[116] COM(2014) 634, p. 9.

In this context, considering the multiple remaining obstacles, and also the numerous new regulatory problems observed, the European Commission would be well inspired to open a reflection in depth, and propose some limited changes in the regulatory framework (and possibly the financial guarantees).