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Smart Grids

Contents

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Editorial

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European Distribution System Operators' Association for Smart Grids Chairman

European energy policies aimed at liberalising, integrating, and decarbonising the energy sector are spurring our electricity networks to undergo dramatic changes and overcome colossal challenges. A more dynamic and distributed system with active consumers in focus is replacing the old and more predictable system based on centralised power generation. The EU renewables target, in particular, is a very strong driver for change to the scope of activities undertaken by the electricity distribution system operator (DSO). The variable nature of this distributed renewable energy generation poses a serious challenge to the DSO's core responsibilities of maintaining security of supply and quality of service.

To add to this, activities evolving in the context of the internal energy market, like aggregation, are not taking grid constraints into account and can lead to local grid congestion and imbalances between supply and demand. There is a pressing need to upgrade our networks with communication and automation, but also to introduce flexibility to local networks, where the DSO depends on immediate access to data from all grid users (distributed generation, demand and storage) and must have the right to make decisions regarding actions from third-parties (transmission system operator (TSO), retailer, aggregator) impacting DSO grid stability. The DSO is, therefore, becoming an active system operator and is adequately placed, as a regulated natural monopoly, to provide access, without bias, to data from essential smart grid components like smart meters (consent permitting), for the development of innovative services on the market.

Regulation must be reformed not only to incentivise innovation, but also to allow the DSO to procure flexibility services from distributed generation, storage and demand response. These challenges are, together with standardisation, data privacy and cyber/system security, essential to tackle now. Also of crucial importance to the urgent development of these smarter networks is the testing of new solutions and technologies on a large scale through demonstrations in real-life environments. The SET-Plan has been a valuable guiding tool for the development of smart technologies, and the coordination work of the European Electricity Grid Initiative (EEGI), set up under the SET-Plan, is playing an essential part in steering and accelerating the development and deployment of these cost-effective solutions at system level. Much is yet to be achieved, as is clear from the EEGI's roadmap to 2022, which has also guided the Integrated Roadmap for Horizon 2020 spending on grids.

In the meantime, important discoveries are being made. Final results are expected from three FP7 smart grid projects: REserviceS (assessing the potential savings of smartening our grids against the costs of reinforcing them in the traditional way), Meter-ON (turning existing smart meter roll-out experience into practical guidance) and GRID+ (providing support to the EEGI).

An important part of the GRID+ work is the development of measures to improve the scaling and replicability of the projects, as well as the development of tools to share knowledge and results, which is vital for an efficient roll-out. This is the reasoning behind the InnoGrid2020+ conference , organised in partnership with the European Network of Transmission System Operators for Electricity (ENTSO-E) and GRID+. The two-day annual event gives smart grid projects a chance to share their results and brings industry and decision makers together to discuss barriers and solutions to grid developments in Europe. Our third edition (March 25-26 2014, Brussels) will be opened by DG Energy Director Dominique Ristori, and we encourage projects to present during our interactive sessions and exhibition. Together we have the potential to meet these challenges in the best way possible for Europe.

MARCH 2014

SET-Plan update Smart Grids

The European Strategic Energy Technology Plan (SET-Plan) aims to transform the way we produce and use energy in the EU with the goal of achieving EU leadership in the development of technological solutions capable of delivering 2020 and 2050 energy and climate targets.

Smart Grids will play a crucial role in integrating the European electricity system, making it truly reactive and giving the consumer an active role in achieving the SET-Plan. The following is a chronological overview of some of the actions taken to promote Smart Grids technology across the EU, in addition to a more general look at actions taken to achieve broader SET-Plan objectives.

- During the first International Conference on the Integration of Renewable Energy Sources and Distributed Energy Resources, held in December 2004, industrial stakeholders and the research community suggested the creation of a **European Technology Platform for the Electricity Networks of the Future (ETP SmartGrids)**. The European Commission's Directorate General for Research developed the initial concept and guiding principles of the ETP SG with the support of an existing FP5+6 research cluster representing over 100 electricity network stakeholders.
- In April **2006**, the ETP SG presented its **Vision and Strategy for Europe´s Electricity Networks of the Future**. The Vision, for both transmission and distribution networks, was driven by the combined effects of market liberalisation, the change in generation technologies to meet environmental targets, and the future use of electricity.
- The ETP SG published its **Strategic Research Agenda (SRA)** in 2007. Since then, these documents have inspired several research and development programmes within the EU and national institutions. The **SRA** was updated in 2012, and the new **SRA 2035** will serve as a key input to Horizon 2020 and other smart grids research, development and demonstration initiatives with the goal of advancing the smart grids-based European energy system.
- In July 2009, the Commission issued a **Directive concerning common rules for the internal market in electricity** (2009/72/EC), in which it establishes common rules for the generation, transmission, distribution and supply of electricity with a view to improving and integrating competitive electricity markets in the EU.
- The **Renewables Grid Initiative (RGI)** was launched in July 2009 by a number of European transmission system operators (TSOs) and non-governmental organisations (NGOs) with financial support from the European Commission. The aim of the initiative is to support the build-up of sufficient grid infrastructure in Europe to rapidly and efficiently transmit electricity from both decentralised and large-scale renewable energy sources.
- In July 2009, six European transmission system organisations (ATSOI, BALTSO, ETSO, NORDEL, UCTE and UKTSOA) were merged into the **European Network of Transmission System Operators for Electricity (ENTSO-E),** with the various committees, working groups and task forces transferring their work to the ENTSO-E structure. ENTSO-E aimed to become the focal point for all European, technical, market and policy issues related to TSOs, interfacing with the power system users, EU institutions, regulators and national governments.
- The **Smart Grids Task Force (SGTF)** was set up by the European Commission at the end of 2009. Since then, the SGTF has reached a consensus on policy and regulatory directions for the deployment of smart grids and has also issued key recommendations for standardisation, consumer data privacy and security.
- In March 2009, the **European Commission** issued a mandate to the **European Standards Organization** for smart meter standards (M/490). This was followed in June 2010 by a mandate for electric vehicle standards (M/468), and a smart grids mandate (M/490) in March 2011.
- The **European Electricity Grid Initiative (EEGI)** was launched in 2010 as one of the European Industrial Initiatives under the SET-Plan. The first **EEGI Roadmap 2010-2018** was approved by the European Commission and the Member States in June 2010. An upgraded version was produced within the GRID+ project in 2013 in response to recent EU energy policy evolutions.
- The **first SmartGrids ERA-Net call** was published on 15 January 2010. The objective of the ERA-NET was to ensure that essential, coordinated research is conducted in preparation for the large-scale integration of smart grids architecture. The second call for proposals opened on 15 January 2011 and the third - on 31 May 2013.
- The **European Distribution System Operators' Association for Smart Grids** (EDSO for Smart Grids) was founded in March 2010, bringing together leading European Distribution System Operators to act as an interface between the DSOs and the European institutions, promoting the development of smart grid technology, new market designs and regulation.
- The **European Energy Research Alliance (EERA) Joint Programme on Smart Grids** was officially launched at the SET-Plan Conference in Madrid in June 2010. The JP aims at addressing one of the most critical areas directly relating to the effective acceleration of smart grid development and deployment - smart grids technology, its application and integration.
- In April 2011, the Commission issued the **Communication Smart Grids: from Innovation to Deployment** (COM(2011) 202 final), setting policy directions to drive forward the deployment of future European electricity networks.

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- The European Commission's in-house science service the **Joint Research Centre (JRC)** presented its first complete catalogue of EU smart grid projects - **Smart Grid projects in Europe: Lessons learned and current developments** - in July 2011. In July 2013, the JRC published the 2012 update of the report, which includes an up-to-date and comprehensive inventory of smart grid and smart metering projects in Europe: it includes 281 smart grid projects and around 90 smart metering pilots and roll-outs from 30 European countries.
- In October 2011, the European Commission issued a **Set of Common Functional Requirements of the Smart Meter**, which is a joint contribution by DG ENER and DG INFSO towards the Digital Agenda for Europe (Action 73 - Member States to agree common additional functionalities for smart meters).
- **GRID+**, a support action of the **European Electricity Grid Initiative (EEGI),** started its work in October 2011. The project aims at designing a set of accompanying activities to ensure that the EEGI passes through the critical 2012-2014 period. The project will continue until October 2014.
- In March 2012, the **European Commission** published a **Recommendation on preparations for the roll-out of smart metering systems** (2012/148/EU). With this Recommendation, the Commission aimed to facilitate the take-up of this technology by providing step-by-step guidelines for Member States on how to conduct cost-benefit analysis.
- European Research and Innovation Commissioner Máire Geoghegan-Quinn launched the new web version of the **JRC's interactive smart grids communication tool** as part of the Euroscience Open Forum (ESOF) in Dublin, Ireland on July 11, 2012. The interactive tool was developed to increase awareness and understanding of smart grids.
- In September 2012, the **JRC-IET** signed a letter of intent with the leading Portuguese electricity utility **EDP Distribuição** to strengthen cooperation on smart grid related topics. The goal is to integrate data and insights from EDP smart grid installations into JRC scientific studies on smart grids.
- The **JRC** and the Brazilian Ministry of Science, Technology and Innovation (MCTI) signed a cooperation arrangement in January 2013 to strengthen scientific and other cooperative activities, with energy topics, including bioenergy and smart grids, earmarked as priority areas.
- The European Commission, with the support of European standardization organizations (CEN, CENELEC and ETSI), organized a high-level conference entitled **Smart Grid Standardization Achievements,** on 28 January 2013. The objective of the conference is to disseminate the results of the work carried out by CEN, CENELEC and ETSI in the context of the Commission's smart grid, smart metering and electric vehicle mandates.

General Set-Plan news

- The development of the **Integrated Roadmap** is one of the key actions in the European Commission's **Communication on Energy Technologies and Innovation**, COM(2013)253; it reached an important milestone in February, when the first compilation of proposed research and innovation actions to address the challenges of the European energy system was produced. The aim of the Integrated Roadmap is to consolidate the updated technology roadmaps of the SET-Plan and propose research and innovation actions designed to facilitate integration along four axes: the innovation chain, covering from basic research to demonstration and support for market roll-out; the value chain, according to the industrial capacities and innovation potential of the various supply chains; the EU space, achieving replication of solutions in different climate and geographic contexts across Europe; and, the energy system, fulfilling the societal needs in a competitive, secure, efficient, climate-friendly, socially-acceptable and sustainable way. Under the guidance of the SET Plan Steering Group, over 100 stakeholders participate in this process, as part of the Coordination Group, supporting the Commission (DG ENER, DG RTD and JRC) in drafting the Integrated Roadmap, and the Working Group, tasked to propose research and innovation actions. The progress in the development of the Integrated Roadmap was discussed during the last Steering Group meeting on February 6th, while the first draft of the Integrated Roadmap will be discussed in the Steering group meeting on the 21st May. Based on the Integrated Roadmap, an Action Plan will be developed together with the Member States for its joint implementation. JRC/SETIS is leading the drafting process of the Integrated Roadmap.
- In December 2013 the JRC published a **Report on Innovative Financial Instruments for the Implementation of the SET Plan, First-Of-A-Kind Projects,** in which it proposes a set of recommended changes to the existing financial instruments and their utilisation. One of these recommendations is to set up a dedicated facility for providing risk financing for the SET-Plan.
- The European Commission launched its research and innovation programme **Horizon 2020** in December 2013. Worth more than EUR 15 billion over the first two years, the funding is intended to boost Europe's knowledge-driven economy. Also in December, the Commission organized an **Energy Information Day** to provide essential information on the calls for proposals under Horizon 2020 that will be open in 2014 and 2015.
- In January 2014, the European Commission published its **Communication on Blue Energy - Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond** (COM(2014) 8 final). The Communication aims to facilitate the further development of the renewable ocean energy sector in Europe.
- In January 2014, the European Commission's Directorate-General for Economic and Financial Affairs published a report on **Energy Economic Developments in Europe,** in which it provides analysis of the economic impact of energy developments in the EU and Member States over the past years.
- The JRC/SETIS will publish its **Technology Map 2013 i**n March 2014. The Technology Roadmap is one of the main regular SETIS deliverables and the 2013 update provides a concise overview of the current state of the art and development potential for the various renewable energy technologies.
- The **Energy Research Knowledge Centre** has released its first **Thematic Research Summary** in February 2014. This TRS is dedicated to Concentrating Solar Power and aims at promoting awareness about the current state of CSP research in Europe.

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Could you please explain what ENTSO-E is, why and when it was set up and its role, for example in the European Electricity Grid Initiative (EEGI)?

K.S.: “The European Network of Transmission System Operators for Electricity (ENTSO-E) was founded in December 2008, as defined in the third EU Internal Energy Market legislative package. Based in Brussels, it is a non-profit association that fosters co-operation of European transmission system operators (TSOs), both on the pan-European and regional level. More importantly, in the third package and in several other EU Regulations since, it is given important legal mandates. For example, we draft network codes which become binding EU regulations through comitology, and which complement the third package with the many detailed operational, connection and market rules that make the Internal Electricity Market a reality. Another important task is the Ten-Year Network Development Plan which we publish every two years to provide market participants and policy makers with complete integrated plans for the Europe-wide transmission system.

Regarding the European Electricity Grid Initiative[1], ENTSO-E is a key member and coordinator of the transmission R&D component of the EEGI Roadmap and Implementation Plan. The huge challenges of market integration and the integration of ever increasing renewable energy sources will require constant innovation in how we design and manage the future electricity system. Within the EEGI, we coordinate with distribution system operators, the Commission, Member States, regulators and stakeholders to identify where R&D is needed, so that we have the solutions in place to meet these challenges as they arise.”

Smart grids are expected to play a key role in achieving EU energy targets and integrating the internal market. What are some of the benefits of smart grids from a TSO perspective?

K.S.: “Smart grids are central to ENTSO-E’s vision for the European electricity system. Deployment of smart grid technology, smart metering and smart homes will enable demand response to bid into pan-European intraday and balancing markets. The availability of flexible demand response is critical in order to manage fluctuating renewable generation, and therefore to ensure that the market continues to function well in the future. System benefits of demand response can include the reduction of peak loads that need to be covered by non-renewable resources, reduced network investments and the ability to integrate more fluctuating generation. We are also defining the procurement markets for ancillary services, so that demand response can contribute through aggregators, for example, in our Electricity Balancing Network Code. ”

What are some of the challenges that need to be overcome, also from a TSO perspective, and how are these being addressed?

K.S.: “ The key challenges facing TSOs are integrating new sources of energy and managing the fluctuations of wind and solar energy as their installed capacities keep increasing. To meet the challenges, TSOs must keep improving their planning and operating methods, contribute to the evolutions of market design, and continue to increase cooperation with the distribution system operators. The TSO-related R&D in the EEGI is largely focused on such improvements. This means that the R&D and the improvements needed are less about inventing new technology and more about putting all the pieces together so that the system can be planned and operated reliably now and in the future. Testing and implementing the technology while ensuring the system remains secure and stable is a challenge that TSOs and distribution system operators (DSOs) are working to overcome. The work that is being carried out through the EEGI is key to overcoming these challenges and finding solutions that will benefit not only the industry but the wider European economy.

How is the work of ENTSO-E coordinated with the work of DSOs and other smart grid stakeholders?

K.S.: “ The European Electricity Grid Initiative (EEGI) provided the industry with a strong mandate to develop coordinated solutions to ensure that an adequate grid is developed both from DSO and TSO perspectives. Together with the European Distribution System Operators' Association for Smart Grids (EDSO for Smart Grids)[2], ENTSO-E is a key contributor to the EEGI Roadmap and Implementation Plan. We are also a consortium partner and a member of the management Board of the Grid+ project which supports and implements the EEGI both within and beyond European borders. The work of the R&D Committee in ENTSO-E complements our membership of these initiatives, with the ENTSO-E R&D Roadmap fully integrated within the EEGI roadmap. In addition, DSOs and other smart grid stakeholders have taken an active part in the consultation process during the drafting of our network codes. Finally, ENTSO-E is an active contributor to the EC Smart Grids Task Force[3] a consensus building initiative on policy and regulatory directions for the deployment of smart grids.

Standardisation and network codes raise critical issues for smart grids. What are some of these issues? Why is standardisation so important?

K.S.: “ TSOs and DSOs as regulated companies need to operate the system in a multi-vendor environment. In order to ensure workable solutions, a high level of interoperability is required. Standards are a key factor in this respect. Network codes are the tools to ensure system security and European market integration in a rapidly changing power system. Standardisation complements network codes in various areas, e.g. compliance, non-cross-border issues, and harmonisation for cost efficiencies. Coordination between network codes and standardisation activities is key to ensure that both tools achieve their objectives, while smart grid standardisation is critical to enable demand response to bid into Europe-wide intraday and balancing markets ”

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What progress has been made so far to achieve the necessary standardisation across Europe? And what more needs to be done?

K.S.: “ The standardisation which is most important for smart grids concerns data exchange. I would like to mention three important examples for this. At the end of last year ENTSO-E approved the Common Grid Model Exchange Standard (CGMES), a critical step towards increased market integration and the integration of growing amounts of fluctuating renewable energy sources in European electricity transmission systems. It will allow TSOs to efficiently combine the data describing their different networks, which is a prerequisite for routine security and capacity calculations on a regional scale.

The M/490 EN standardisation mandate from the Commission to European Standardisation Organisations (ESOs) CEN[4], CENELEC[5] and ETSI[6] to support the deployment of the European smart grid was another major and positive step towards achieving standardisation. While much work has already been achieved, including listing and prioritising the many different standards needed for smooth and successful smart grid rollouts Europe-wide, the scope of the mandate is enormous and much remains to be completed. We strongly advocate that M/490 work proceeds with the highest priority and as soon as possible produces information technology use cases that enable demand response to access intraday and balancing markets. This is a high priority for TSOs. Europe's clear market design, as described in detail in the third IEM package and the network codes, is an advantage for the standardisation of such use cases and for their future implementation. ENTSO-E has increased its resources within the secretariat to work specifically on disseminating the results of this research to TSOs, and also to coordinate TSO participation in CEN, CENELEC and IEC activities.

A third example is ENTSO-E's Electronic Data Interchange (EDI) working group which collaborates with external harmonisation and standardisation organisations, such as the European Federation of Energy Traders (EFET) , the European Forum for Energy Business Information Exchange (ebIX) and the International Electrotechnical Commission (IEC) , to develop detailed business process descriptions and standards in formats that can be easily understood and implemented by the software industry.

Close cooperation between all parties must continue if we are to achieve the necessary standardisation and it was for this reason that last September a memorandum of understanding was signed between CEN (European Committee for Standardisation) and CENELEC (European Committee for Electrotechnical Standardisation) and ENTSO-E. ”

Is the SET-Plan still on track regarding the move towards a low-carbon Europe? Does anything need to be rethought?

K.S.: “ It is still on track; however it is critical that we do not become complacent. The SET-Plan's greatest success thus far has been its foresight in recognising the major challenges facing the industry, for example in the areas of market integration and decarbonisation, and in coordinating and commissioning research to find solutions early enough. However, this is only the first step in the process. The results of this research must be disseminated to the wider industry if it is to be of benefit, and appropriate resources must be dedicated to achieve this. Regulatory frameworks are required in each Member State in order to allow TSOs to allocate resources to R&D projects and implement the results of the projects. With respect to TSO research in the EEGI part of the SET-Plan, ENTSO-E monitors these R&D activities on an ongoing basis to assess progress in respect to the R&D Roadmap, and to disseminate results to the European TSOs ”

1 http://www.gridplus.eu/eegi
2 http://www.edsoforsmartgrids.eu/
3 http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm
4 http://www.cen.eu/CEN/aboutus/Pages/default.aspx
5 http://www.cenelec.eu/
6 http://www.etsi.org/
7 http://www.efet.org/
8 http://www.ebix.org/
9 http://www.iec.ch/

Konstantin Staschus

Konstantin Staschus is Secretary-General of the European Network of Transmission System Operators for Electricity (ENTSO-E), a position he has occupied since February 2009.
Originally from Berlin (Germany) he received a Ph.D. in Operations Research from Virginia Tech (USA) and spent nine years at Pacific Gas and Electric, in the USA. Before taking up his post with ENTSO-E he held management positions in German utility associations, including six years as Managing Director of VDN, the association of German electricity network operators.

Avoiding shocks

– keeping the smart grid safe

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Smart grids are electricity grids in which computer intelligence and networking capacity have been added to a 'dumb' electricity distribution system. This enables greater consumer involvement in managing their consumption patterns, giving them access to the information required to make informed choices. A smart grid also provides the capacity to accommodate intermittent energy from renewable and decentralised sources. However, both of these advantages of the smart grid are not without their inherent risks.

The operation of a smart grid relies on a complex network of computer hardware, software and communications technologies. This leaves the grid vulnerable to malicious attacks that have the potential to cause major disruption, with possibly devastating consequences for both suppliers and consumers alike. The grid flexibility required to accommodate intermittency introduces a level of uncertainty that has implications for security of supply. The challenge of keeping a European smart grid safe should not be underestimated - it is a truly enormous task, involving coordinating the cyber-security of an area with a population of over 500 million people. This task is further complicated by the fact that it should be coordinated between 28 governments with different requirements concerning data protection and privacy.

In its report "Smart Grid projects in Europe: lessons learned and current developments," the Joint Research Centre (JRC), the European Commission's in-house science service, identified five important challenges that need to be addressed with respect to data protection and grid security. These are: the large amount of sensitive customer information the grid will transmit; the greater number of control devices in the smart grid; the poor physical security of a great proportion of these devices; the use of Internet Protocol (IP) as a communication standard; and the number of stakeholders the grid relies on for its smooth operation.[1]

A number of EU projects and initiatives aim to address these issues. In July 2012, the European Union Agency for Network and Information Security (ENISA)[2] published Smart Grid Security: Recommendations for Europe and Member States. The aim of this report was to provide advice aimed at improving current initiatives, enhancing co-operation, raising awareness, developing new measures and good practices and reducing barriers to information sharing. To this end, the report produced a set of recommendations for the European Commission and Member States.

These recommendations include undertaking initiatives to improve the regulatory and policy framework on smart grid cyber security at national and EU level. It is also recommended that the EU, in cooperation with ENISA and the Member States, promotes the creation of a public-private partnership to coordinate smart grid cyber security initiatives and to foster awareness raising and training, along with dissemination and knowledge sharing. Given the range and complexity of equipment required to make the smart grid function, and in recognition of the JRC's concern about the poor physical security of smart grid devices, ENISA also recommends that the competent authorities in the European Commission and the Member States develop security certification schemes for components and products. Furthermore, ENISA recommends that strategies be refined to counter large scale pan-European cyber incidents that affect power grids.[3]

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While cyber security is clearly a critical issue, there are other concerns of a systemic nature that also need to be dealt with to support safe grid operations. Among measures to ensure the stable operation of the European grid, in its Seventh Framework Programme (FP7) the European Commission organized a call for 'innovative tools for the future coordinated and stable operation of the pan-European electricity transmission system'. One of the projects awarded funding under this call was iTesla (Innovative Tools for Electrical System Security within Large Areas) - a project that aims to provide the technical means for European transmission system operators (TSOs) to address challenges arising from the integration of renewable energy. To do this, it will perform accurate security analysis of the energy system to provide a risk-based assessment that takes into account the various uncertainties (particularly those arising from intermittent power generation), the probability of contingencies and the possible failures of corrective actions.

iTesla is expected to cover the actual needs for security analysis expressed by the TSOs, as well as provide additional functionalities. One such functionality is the possibility of working on an ENTSO-e power grid, which will make it possible to carry out studies of coordinated actions. iTesla should provide probabilistic security analysis taking into account uncertainties such as renewable generation (primarily wind and photovoltaic) and other variable parameters. The iTesla toolbox will build on the results of the EC supported Pan European Grid Advanced Simulation and State Estimation (PEGASE) project, which aimed at removing algorithmic barriers related to the monitoring, simulation and optimization of very large power systems. Once the iTesla toolbox has been developed, the project findings will be disseminated to regulatory bodies, European TSOs and other stakeholders in an effort to share the knowledge gained and promote the adoption of the toolbox.

The iTesla project works in tandem with another FP7 project - "Toolbox for Common Forecasting, Risk Assessment, and Operational Optimisation in Grid Security Cooperation of TSOs" (Umbrella). This project, which has been awarded a label by the European Electricity Grid Initiative (EEGI), aims to develop a dedicated innovative toolbox to support the grid security approach of TSOs. This toolbox shall include: simulation of uncertainties due to market activities and integration of renewables on various time scales; optimisation of corrective actions in reaction to simulated risks; and the development of risk-based assessments for anticipated system states, with and without corrective actions. In so doing, it aims to provide a scientifically sound basis to support common TSO rules. The European power grid was designed to operate with fixed, centralised and predictable energy sources. The revolutionary changes that the grid is currently experiencing are necessitated by the changing nature of how we produce and use energy. As the energy system strives to accommodate these adjustments, the measures currently being implemented and the proposed recommendations to enhance grid security will be instrumental in creating a secure foundation for the grid of the future.

For more information:
iTesla project: http://www.itesla-project.eu/
Umbrella project: http://www.e-umbrella.eu/
ENISA: http://tinyurl.com/moett2k
JRC Smart Grid projects in Europe: http://tinyurl.com/kp684rz
PEGASE project: http://fp7-pegase.com/

1 JRC, Smart Grid projects in Europe: lessons learned and current developments, p. 56
2 The European Network and Information Security Agency (ENISA) is a centre of network and information security expertise for the EU, its Member States, the private sector and Europe's citizens.
3 ENISA, Smart Grid Security: Recommendations for Europe and Member States, p. 27.

Medgrid

– interconnecting the Mediterranean

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New interconnectors are needed throughout the Mediterranean region to facilitate large-scale electricity trading between the north and south, in addition to inter-grid trading throughout the region. To address this need, the Medgrid industrial initiative was set up to design and promote a Mediterranean transmission network capable of transporting 5 GW of electricity to Europe and to provide tools to assess infrastructure projects. In so doing, the project will support the Mediterranean Solar Plan (MSP) under which about 20 GW of renewable power capacity, particularly solar power, should be built in the Mediterranean region by 2020. Investment in this infrastructure is forecast to reach between EUR 38 billion and EUR 46 billion, of which EUR 6 billion has been specifically earmarked for building submarine high-voltage direct current interconnectors between generation centres and the rest of Europe. There is currently only one double 1.4 GW AC line linking Africa to Europe across the Straits of Gibraltar.

Meanwhile, according to information from the Mediterranean Energy Observatory (OME), primary energy demand in the Mediterranean region is forecast to increase 50% by 2025, compared to 2006 levels. The 20 GW of additional capacity foreseen in the MSP will only scratch the surface of addressing future needs. The OME forecasts that, to meet the increase in demand, the region will have to build an additional 191 GW of power capacity, of which 106 GW will be in the south and east and 85 GW in the north. The existing grid infrastructure will need to be significantly upgraded to cope with this increase in consumption, to ensure security of energy supply in the region and to facilitate the integration of energy from intermittent sources. Both these objectives will need to be achieved if the Northern Mediterranean region and the Southern and Eastern Mediterranean Countries (SMEC) are to meet the dual challenges of ensuring socio-economic development and decarbonizing their energy sectors.

On 20th November 2009, the French government launched an initiative to study the feasibility of a high-voltage direct current transmission project across the Mediterranean. One of the aims of this initiative was to put together an industrial partnership to implement the project, and so the Medgrid industrial initiative was set up in 2010. The initiative was launched within the framework of the Mediterranean Solar Plan which, in turn, is one of six key initiatives generated by the Union for the Mediterranean (UfM)[1] aimed at meeting the future energy and climate challenges confronting the European Union and the larger Mediterranean region. The UfM Secretariat and Medgrid signed a Memorandum of Understanding (MoU) in January 2012, paving the way for Medgrid to support the UfM in the implementation of the Mediterranean Solar Plan. Under the MoU, the partners share experts and analysts and participate in joint working groups on finance, infrastructure and projects of common interest.

The challenges that the project aims to address vary across the different regions. For the Northern Mediterranean region, specifically the European Union, the principal aim is to provide cost-effective energy while mitigating the negative impact of energy generation and use on the environment. The SMEC region is facing population and economic growth, requiring significant investment in the electricity sector to meet the resulting increase in electricity demand. The scarcity of fresh water in this region is also an issue, and the supply of power to future energy-intensive desalination plants, being built to meet the growing demand for water, will be a priority. However, a common objective across the entire region is to make energy supplies more secure and sustainable. As a first step towards achieving this goal, Medgrid will elaborate a Mediterranean Grid Master Plan, based on the national generation and transmission grid master plans for the countries involved. It will then endeavour to identify opportunities for power exchanges that exploit the different peak load periods for the various countries, and the energy mix based on different production costs and levels of environmental performance (CO_2 emissions). This work will be facilitated by the involvement of more than 20 companies from 8 Mediterranean countries.[2]


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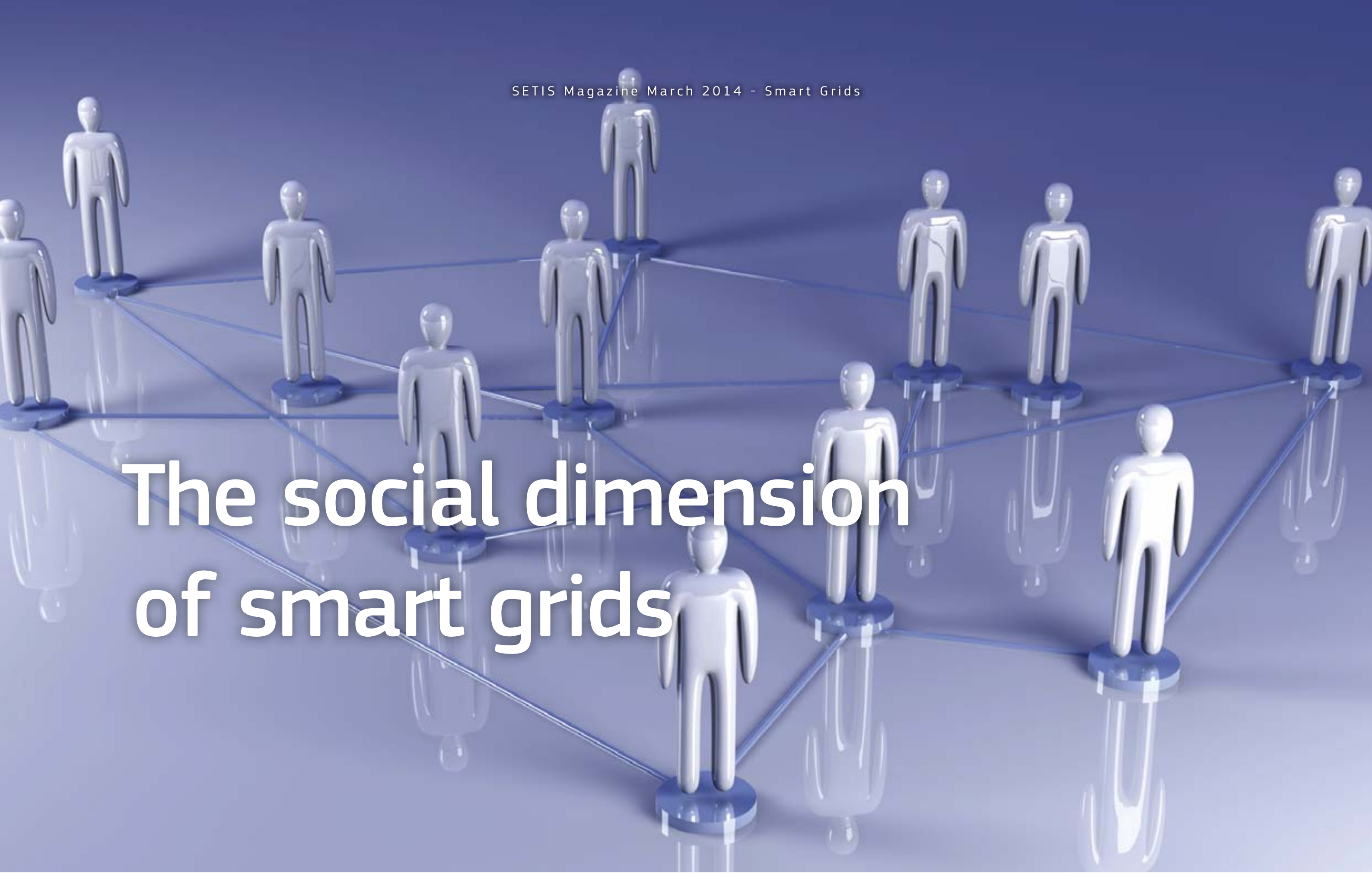
Medgrid works in cooperation with other initiatives being implemented in the region, where a number of regional associations and industrial initiatives[2] have developed a cooperative approach to the development of an energy community of UfM members built around four pillars: energy security; energy sustainability; affordability of energy and competiveness of systems; and the integrated development of the region. In 2011, Medgrid signed an MoU with the Desertec Industry Initiative (Dii) with a view to launching coordinated actions. Medgrid also works closely with public authorities in the countries involved, in addition to the European Commission, the scientific community, development banks and NGOs. These collaborations aim to create an attractive investment environment and assess the benefits of the planned infrastructure investments, and the subsequent trade in electricity, on growth, economic activity and employment.

The uncertainty resulting from the political upheaval in the Mediterranean region in the aftermath of the Arab Spring revolutions has impacted on the Medgrid and other projects in the region. While this uncertainty makes the challenges facing the project more daunting, it also underlines the importance of this and other co-development projects supported by the UfM as a source of stability and socio-economic development in the region.

For more information:
http://www.medgrid-psm.com/en/
http://www.ome.org/
http://ufmsecretariat.org/

1 Launched in 2008, the UfM promotes new co-development policies in the Mediterranean region and brings together 43 Mediterranean and EU countries.
2 Medgrid founding members are: Abengoa, AFD, Alstom grid, Areva Renouvelables, Atos WorldGrid, CDC Infrastructure, EDF, Ineo, Nemo, Nexans, Nur Energie, ONE, Pan Med Trading and Investment, Prysmian, Red Eléctrica, RTE, Siemens, Soitec Concentrix Solar, Taqa Arabia, Terna and Walid Elias Establishment.
3 MEDELEC, MEDENER, OME, RCREEE, IPEMED, Dii, MEDGRID and RES4MED.



The social dimension of smart grids

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Growing concerns over climate change, security of power supply and market competitiveness are challenging the current power system operation and architecture, with the resulting need to integrate increasing shares of renewable energy resources installed close to the consumers' premises. This will enable micro-players like electricity end-users to also operate and behave as producers, thus introducing additional flexibility into the system and increased challenges for macro-players like system operators and regulators. The same will endorse effective engagement of the electricity prosumer (producer-consumer) in the power systems daily operation and the home energy management.

Allowing for such flexibility would bring additional system complexity and thus require an upgraded electricity network with two-way information and power exchange between the suppliers, distribution system operators (DSO) or any third parties and the prosumers through pervasive deployment of information and communication technologies. The adoption of such systems is expected to demand and facilitate new market structures, new services and primarily new social processes.

Having a closer look at the European Inventory of Smart Grid projects, performed by the European Commission's in-house science service – Joint Research Centre (JRC), one may identify an increasing trend of Smart Grid projects to focus on consumer engagement. Notwithstanding the positive trend, the number is still limited in comparison to the total number of projects, and most of the projects explore the smart grid social dimension at a community level, indicating lack of consumer involvement in larger scale smart grid projects.

At this point, one may recognize barriers for the scalability potential of smart grid projects in EU and recommend strategies on how to advance towards large scale adoption of smart grids.

Advances in EU Policy clearly played a significant role in the adoption of smart grids and smart grid technologies at a national scale. The European Commission's Interpretative Note on the Retail Markets for Directives 2009/72/EC and 2009/73/EC provides a description of the Commission's understanding of an intelligent metering system by *"...the ability to provide bi-directional communication between the consumer and the supplier/operator..."* and to *"...promote services that facilitate energy efficiency within the home..."*.

The Recommendation 2012/148/EU on smart metering deployment further clarifies that the smart metering system should be defined through the functionalities it provides. In particular, in the case of electricity, the Commission Recommendation identified ten minimum functional requirements that the smart metering system should provide in order to deliver full benefits to consumers and the energy grid while supporting technical and commercial interoperability and guarantee data privacy and security. The JRC together with DG ENER is currently finalizing an in-depth analysis related to the long-term economic assessment of costs and benefits for national electricity smart metering roll-out, performed by the EU Member States, and their respective deployment plans and strategies.

It is worth noting that Member States such as the UK and the Netherlands strongly focus their analysis on the electricity consumer, thereby addressing smart metering acceptance, effective use and efficient roll-out as policy attention points in the early stage of the system development. In the Netherlands, social acceptance, related to privacy concerns, resulted in an amendment to the legislative proposal by means of an introduction of a voluntary approach for consumers' acceptance of smart metering systems.

To this end, the success of the smart grid deployment will critically depend on the overall functioning of the power system as a socio-economic organisation, and not just on individual technologies. As a consequence, the most important challenge for policy makers over the next decade will likely be the shift away from a supply-driven perspective, to one that recognizes the need for the integration of the different dimensions and actors of the smart grid. Furthermore, the role of communities (neighbourhoods, districts, cities, rural areas, etc.) will highlight the importance of discussing externalities and questioning uncertainties at an early stage in order to strive for a socially sustainable smart grid future.

The uncertainty due to autonomous prosumer behaviours is one of the main arguments for introducing complexities in emerging distribution systems. Thus, the challenge ahead is to understand the prosumer active role in the early stage of smart grid development, including the relation with the suppliers, system operators and other service actors and among and across the community of prosumers. Social scientists argue that for behaviour change to occur, prosumers must have the right information, possess or adopt consonant norms and values (or receive financial incentives), translate those motivations into actions and maintain behaviour change over time.

In this context, and based on the available theories of behavioural change, the JRC is developing a methodological framework based on agent-based modelling, able to provide a comprehensive insight into distinctive behaviours of individual components at micro-level, while observing emergent behaviour of the overall system at macro-level. Such a tool will permit in-depth analysis of the multi-layer complex distribution system with the knowledge of specified rules of the micro-players, which can define the individual behaviour and interaction pattern to some extent. By capturing different prosumers' behaviours in terms of power consumption and generation decisions, while having the same continuously interacting within their social networks and being exposed to different policies and interventions from the macro-players, it is possible to observe and analyse the development of emerging electricity distribution networks, i.e. smart grids.

The provided insights and recommendations, reached based on the proposed assessment framework, should prove useful to better understand the electricity prosumers' own values and goals and the important role of adequate communication from the electricity suppliers, system operators and policy makers. The same should also serve the purpose of defining adequate consumer engagement and electricity network operation strategies central to the electricity prosumer, the community, and the society in general and recognize obstacles and risks as an attention point for sound policy formulation.

For more information:
http://ses.jrc.ec.europa.eu/sites/ses.jrc.ec.europa.eu/files/documents/the_social_dimension_of_smart_grids.pdf
http://ses.jrc.ec.europa.eu/agent-based-modelling-smart-grids
For more information on the activities of the "Smart Electricity Systems and Interoperability" team – please refer to our website: http://ses.jrc.ec.europa.eu/

1 http://ses.jrc.ec.europa.eu/smart-grids-observatory
2 Commission Staff Working Paper: Interpretative Note on Directive 2009/72/EC and Directive 2009/73/EC – Retail Markets, http://ec.europa.eu/energy/gas_electricity/interpretative_notes/doc/implementation_notes/2010_01_21_retail_markets.pdf
3 Commission Recommendation 2012/148/EU, OJ L 73 p.9, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32012H0148:EN:NOT
4 European Commission Energy Directorate

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Just after 4 pm on Thursday 14 August, 2003, a power outage cascaded through the north-east and mid-west of the USA and Ontario (Canada), leaving over 50 million people without electricity. Communications, transport and industry were all disrupted, with power only being restored in some areas two days later. Although the blackout was essentially a result of systems shutting down to protect the grid and its infrastructure, it was a dramatic illustration of what can happen if minimum and common standards of reliability are not in place and enforced.

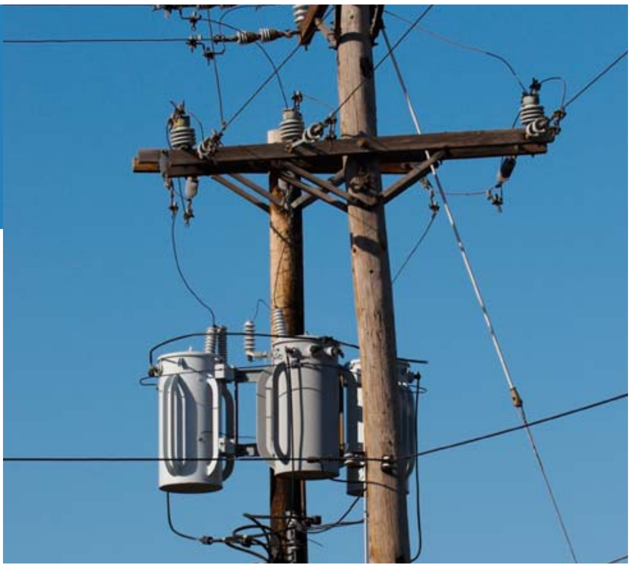
Today, in Europe, as we move towards a new kind of 'smart' electricity grid, a stable framework is essential if we are to integrate energy from conventional, centralised generation sources. This is also necessary to accommodate energy from renewable sources, including large wind farms (mainly offshore) and smaller scale distributed sources, including photovoltaic, wind, biomass and combined heating and cooling. Distributed storage and electric vehicles will also increasingly be connected, both taking electricity from and supplying it to the grid. With just 45 milliseconds to respond to an interruption in supply, common standards on interconnectivity, safety, security and reliability, are imperative.

This is why, in March 2011, the European Commission issued its M/490 mandate to European Standards Organisations (ESOs)[1] on the deployment of smart grids. The mandate comprises a common technical reference architecture, a set of consistent standards "which will support the information exchange [...] and the integration of all users into the electric system operation," and sustainable processes and tools to make sure that stakeholders can continue to work together to identify and fill any gaps. A first set of standards was required by the end of 2012, with annual revisions after that.

The standardisation framework will, says the Mandate, have to be "Comprehensive and integrated enough to embrace the whole variety of smart grid actors and ensure communications between them; In-depth enough to guarantee interoperability of smart grids from basic connectivity to complex distributed business applications, including a unified set of definitions so that all Members States have a common understanding of the various components of the smart grid; Flexible and fast enough to take advantage of the existing telecommunications infrastructure and services as well as the emergence of new technologies while enhancing competitiveness of the markets; and flexible enough to accommodate some differences between EU Member States' approaches to smart grids deployment."

The joint working group set up by three European Standards Organizations – the European Committee for Electrotechnical Standardization (CENELEC), the European Committee for Standardization (CEN) and the European Telecommunications Standards Institute (ICT) – worked quickly, publishing a list of recommendations in mid-2011[2] and its final report in 2013.[3]

Speaking at the European Conference on Smart Grid Standardization Achievements in January 2013,[4] Tore Trondvold, CENELEC President, outlined some of the challenges the ESOs have been faced with. "Standards are voluntary," he explained. "Although the EU legislation can refer to European standards as a means of



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compliance with mandatory requirements, European standards that have been adopted and published also have to be adopted at national level by standards organisations in all 34 member states. Any conflicting national standards have to be redrawn, but without withdrawing them." The trade-off, though, is that Europe-wide standards can provide "barrier-free access to the internal market for over 600 million customers."

At the same conference, Ralph Sporer, Chairman of the CEN/CENELEC/ETSI Smart Grid Coordination Group, explained that, in an effort to seek wide input for their work, they had asked various stakeholders what they expected from a first set of standards. The result was a set of five requirements: that standards should be easy to use, should include all stakeholders, be comprehensive (showing available and future standards), be 'future proof' and have international outreach – in other words, not offer a "Europe-only approach".

Dovetailing European standards with international standards, where possible, also helps to foster the competitiveness of European industry. "Smart grids can have a very positive impact on economic recovery in Europe," said Luis Jorge Romero Saro, ETSI Director General, at last year's EC conference on standardization achievements. "But to ensure interoperability across borders, we need common standards. These will be a key factor in its success." EC Energy Commissioner, Günther Oettinger, gave a concrete example of how this applies to the smart grid. "Electrical equipment can be given remote instructions," he said, "like a washing machine filled with dirty washing that is only switched on when the electricity price has reached a low level. For these machines to work properly we need one information and communication technology (ICT), one electro-technology, where everything is interconnected. Washing machines are no longer national, they are European. There have to be common standards and compatibility." The same reasoning applies to the European electricity grid, he explained. "This is the only way we can guarantee and retain the internal market."

Common standards are also high on the list of considerations for research and development on smart grids beyond 2020 to 2035, as outlined in the Strategic Research Agenda for 2035 of the European Technology Platform, SmartGrids.[5] "Due to the massively changing nature of the grid users," says the Agenda, "with generation becoming less controllable and consumption becoming more controllable, the architecture of the involved transmission and distribution grids and their interaction will need to change. Adapted legal frameworks must go along with this evolution of the electric system and grids. This means that the tasks, obligations and business activities of those actors that will intervene in the electric system must be clearly defined. The existing interfaces between today's unbundled regulated grid monopolies and competitive business activities will be challenged due to the closer technical interactions among all system actors."

The vision to 2020 for industry, says the report, allows for an inevitable degree of incompatibility at component level, as new technologies are developed and proven. But, after 2020, common standards will be increasingly critical. "Until approximately 2020," says the SmartGrids Research Agenda, "solutions for these challenges are mostly component, single-point related. They work, but cannot be integrated with each other or with similar or competitive systems. They are not modular, are not based on standards. There is the danger of technology lock-in, which is not very desirable. For the 2020 SmartGrids based system, the pilots and small-scale rollouts are justified in this phase of 'proof of principle' and 'proof of concept'. But for a large-scale rollout by 2035 these systems must be able to co-operate and be interchangeable."

Pat Rabitte, Minister for Communications, Energy and Natural Resources for the Republic of Ireland, in his keynote speech to the 2013 conference on Standardization Achievements for the Smart Grid summarised the importance of common standards for European industry. "Huge investment is necessary to smarten the grid," he said. "This is resulting in a global business opportunity of huge importance for Europe. But one of the biggest impediments has been the lack of proper standards for the adoption of new technology. The lack of standards adds significant risk to technology selection, leads to increased costs, and the risk of security issues arising. Standards are essential for smart grid interoperability."

1 EC Smart Grid Mandate M/490: ftp://ftp.cen.eu/CEN/Services/Innovation/M490.pdf
2 CEN/CENELEC/ETSI Recommendations on Smart Grid Standardization in Europe: ftp://ftp.cen.eu/PUB/Publications/Brochures/SmartGrids.pdf
3 CEN/CENELEC/ETSI Final Report: ftp://ftp.cencenelec.eu/CENELEC/Smartgrid/SmartGridFinalReport.pdf
4 http://ec.europa.eu/energy/gas_electricity/events/20130128_smartgrids_standardization_en.htm
5 http://www.smartgrids.eu/documents/sra2035.pdf

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The European grid was not designed with intermittent energy sources in mind. What is being done to ensure that the grid becomes sufficiently reactive to accommodate the levels of renewable energy foreseen in the SET-Plan?

L.M.: “The management of electricity networks under stable frequency and voltage conditions implies a continuous exact balance between power generation and load consumption. Any unbalance, if not properly managed, can evolve into unstable conditions, potentially opening the way to blackouts. Up to a few years ago, the only variable in the electricity system was the load. Hence, generators were operated to follow load variations closely in order to maintain equilibrium with the required safety margin to ensure secure operation of the system. More recently, nearly all European countries experienced abrupt growth in renewable energy sources (RES) such as wind and photovoltaic, which are intrinsically variable and, to a certain extent, difficult to predict. This fact has increased the level of complexity of system management and, to avoid dramatic consequences, there is an urgent need for increased system flexibility.

The only way to cope with this new situation is to implement smart grid solutions. The evolution towards smart grids is a must, and represents at the same time a need and an opportunity to evolve towards a more efficient and sustainable electricity system.

Innovative control functions based on extended observability, effective use of storage, and demand response, all enabled by the use of information and communications technology (ICT) at all voltage levels, and the related market and regulatory frameworks, are some of the solutions that need to be applied in the grid, after successful demonstration by dedicated key projects at national and European level. ”

There are a number of grid-related energy calls in Horizon 2020. What do you see as the main RD&D priorities for smart grids under the next framework programme?

L.M.: “In line with the new trends in Horizon 2020 calls, within the European Energy Research Alliance Joint Programme on Smart Grids (EERA JP SG), we have identified a set of research areas that we believe need to be tackled with a coordinated approach at EU level. These research areas represent our vision of the main R&D priorities for smart grids, in a 2035 perspective. We are very conscious about the absolute necessity to address these in a holistic and technologically neutral manner, exactly as in the new Horizon 2020 calls.

On an aggregated level, these research areas are as follows: network operation; energy management; ICT for smart grid control systems and interoperability; electrical storage integration; and transmission networks. These five research areas are deemed to be key for ensuring the current or an even higher level of grid stability in the presence of a very high penetration of distributed generation from RES.

We know perfectly well that several other research aspects need to be addressed to ensure the seamless implementation and deployment of advanced network technologies. Among them, the design of proper market and regulatory frameworks is important, to support the system evolution and hence to allow smart grid technology to be exploited to its full potential. We are teaming with other initiatives (for example the Implementing Agreement for a Co-operative Programme on Smart Grids - ISGAN[1]) to ensure that all aspects are properly covered. ”

What are the main factors hindering the smartening of the European grid, and what needs to be done to overcome these obstacles?

L.M.: “The electricity system as we know it has been operating for many decades. Its evolution towards smart grids is already taking place, but this cannot be fully accomplished in only a few years. In fact, the electricity system is one of the most complex and strategic assets of a country or a continent and hence its evolution is a very costly process that needs to be properly managed. What we also need to take into account that typically new grid infrastructures are intended to stay in operation for very long periods of time (30 years or more). Therefore, as with all radical evolutionary changes, there are several factors hindering the smartening of the European grid and their relevance differs significantly according to the perspective of the various grid stakeholder groups.

For example, current uncertainty about how future energy markets will develop and hence about the related return on investments and business models, is holding grid stakeholders back from large-scale investment in the grid. Standardisation aspects also need to be addressed to ensure an adequate level of interoperability between the different technology providers, thus ensuring the creation of a correct competitive technology framework that is the most effective guarantee of continuous development. Finally, the deployment of smart grid solutions implies very rapid growth in data flows: concerns related to data collection, privacy and security are increasing among all players and, in particular end-users, sometimes resulting in opposition to the change.

Market design, interoperability and data security are three new topics that have been included by the EERA JP SG in its new 4-year R&D activity plan (2014-2017).

In summary, to expedite smart grids deployment, it will be necessary to simultaneously address the various open issues from the viewpoint of the regulatory framework, market design and technology. Development of these issues should be fully aligned to ensure that they are mutually reinforcing rather than work against each other. ”

What are the main challenges currently facing utilities deploying smart grid technologies, and what can be done at a research and/or policy level to help them address these challenges?

L.M.: “Utilities are presently facing several practical challenges in deploying smart grid technologies. As electricity grid infrastructure is a vital asset, all the developments must be made on the system while it is live and functioning. This is why any solution must first be developed and tested in the laboratory, checked in terms of system integration in extended test beds, trial tested in real life on a small scale in demonstrators before being extended and deployed. This process takes time and effort and requires that many activities are carried out in parallel to achieve consistent results in an acceptable time frame.

Much can be done at a policy and regulatory level, and governments should be more aware of the importance of smartening networks to achieve the policy goals they are aiming at: there will be no extended integration of variable renewables, no outstanding electrical mobility, no load flexibility, no possibility for customers to participate in the energy market without smart grids. Regulators need also to act to facilitate and motivate investment in smart technologies and solutions. A transition from “input based” regulation which remunerates the assets and their management, towards an “output based” regulation which takes into account the achievement of targets may be a good way forward in this respect.

In fact, one of the main challenges faced by utilities is related to receiving fair remuneration for their investments in innovation: to be properly compensated for the added value of offered services, while keeping the implementation costs manageable.

Technical barriers are also present on the path toward smart grids: the first one being a profound understanding of the architecture of smart grids themselves. A large effort is therefore needed between stakeholders to develop a common language and a common approach towards smart grid developments. Smart grid technologies for each individual function are mostly available, even if not always off-the-shelf, but interoperability is not yet assured and significant effort is still required at pre-standardisation level.

Applied research has a key role in these developments: independent and public research centres involved in the EERA JP SG can set up solutions, develop algorithms, test integrated systems and study optimisation rules without being influenced by single party interests, while keeping an eye on the common benefits. This must be done in close collaboration with the parties that plan and operate the system, with technology providers, ICT operators, NGOs and end-users. ”

In times of budget constraints, proving the business case for renewable energy technologies has become a key issue. What can be done to create strong business justifications for smart grid applications?

L.M.: “ Incentives for renewable deployment have been instrumental in achieving strategic energy goals in times where the cost of the energy produced by innovative generators was higher than that of conventional generation. This has been valid up to a few years ago and the incentive policies have given a strong stimulus to this type of generation. So-called “grid-parity” is currently almost a reality for many such generators.

The electricity generation system in many European countries has been profoundly influenced by this strong evolution towards de-carbonised generation. This fact has changed the panorama in many countries: high efficiency conventional generation which acted as base production is nowadays operated for less than 2000 hours per year, strong variability must be managed with flexibility, important reverse power flows are seen in the presence of distributed generation etc. This also has an important influence on the financial and economic scenario.

Investing in smart grids is important to achieve national strategic goals: however, each stakeholder must receive a financial return on investment and adequate business plans need to be developed. This is not an easy exercise. While deployment costs can be evaluated based on development scenarios, technology alternatives, learning curves, and economies of scale, the benefits of the smart grids alternatives for the different system stakeholders are more difficult to calculate.

In fact, the relation between the investing stakeholder and the parties receiving the benefits is not always clear and straightforward. Here again, applied research can be of great value and the development of cost and benefit evaluation tools is certainly a subject on which research centres and universities can make a significant contribution.

In conclusion, I think it is very important not to stick to the current framework, but to identify the real cost drivers for end users, thus revealing the true value and remuneration for providing the required system flexibility. ”

How are European initiatives supporting the large-scale roll out of smart grid technology?

L.M.: “ The European regulated network operators have a well-defined approach towards the development, demonstration and roll-out of smart grid technology. In fact, within the European Electricity Grid Initiative (EEGI)[2] a specific roadmap has been developed and implementation plans are being updated yearly, with the assistance of the GRID+[3] project.

European governments are also considering smart grids within the framework of their energy strategies and are investing in smart grid solutions and technologies. In view of the necessity to reduce the time-to-market of the system flexibility enhancers, close collaboration and optimal coordination is needed to avoid duplications, particularly in times of financial crisis. New collaborative schemes capable of bringing together European, national and private funds are desperately needed to ensure timely deployment of technologies, and the European Research Area's ERA-NET[4] co-funding mechanism is considered a promising option to achieve this goal.

As regards more advanced technologies, still at the pre-competitive stage, the EERA JP SG is addressing, in a co-ordinated manner, unresolved problems in a set of targeted smart grid critical research areas across Europe. Through these EU initiatives we will achieve over-critical mass in terms of research capacity, bridge cooperation between Europe's leading research institutes and increase the use of existing research infrastructure. Last and but not least, we also aim to drive the efforts in the EU Member States towards achieving the targets of the SET-Plan.

The interaction and coordination among the different European initiatives and in particular, cooperation with EEGI and with the Smart Grids European Technology Platform (ETP SmartGrids)[5] is of utmost importance for the EERA JP SG and a must for Europe as a whole. ”

What are EERA's priorities for the medium to long-term perspective aimed at accelerating smart grid deployment?

L.M.: “ The main goal of the EERA JP on Smart Grids is to promote the European coordination of smart grid research roadmaps and medium- to long-term research activity, in order to avoid gaps and to avoid excessive overlapping. Hence, one of our main tasks is to align and coordinate with the research effort of the Member States, to elevate the results at European level with the ambition of steering the national smart grid research programmes.

This can be fully accomplished only if the research organisations brought together in the EERA JP SG (at present 19 participants and 14 associate participants, representing 16 EU countries) closely interact and collaborate with the European Commission. Close interaction is also required with organisations representing industrial grid stakeholders such as the EEGI, the European Network of Transmission System Operators for Electricity (ENTSO-E)[6] , the European Distribution System Operators' Association for Smart Grids (EDSO4SG)[7] and the ETP on SmartGrids.

Our EERA JP on Smart Grids is planning its R&D activity for the next 4-year period. One of our main priorities is to define a coherent research programme including all strategic research topics to be addressed in order to promote the development and proof of new concepts that will be needed in the management of the future electricity system. Our R&D activity will span from studies, simulations and analyses, to assessment and validation of the main findings at laboratory scale. This will prompt research institutes involved in the EERA JP SG to contribute to specific complementary areas of R&D, and to consolidate the results of national programmes in direct support of the European strategic energy objectives.

Strong support for this approach will be provided by the newly launched European Liaison on Electricity Committed towards Long-term Research Activities for Smart Grids (ELECTRA)[8] Integrated Research Programme (IRP) on smart grids, which will be instrumental in achieving the EERA JP SG goals and outcomes.

The coordination of smart grid research infrastructure development, in order to stimulate complementary specialization to ensure a more efficient use of future national and European investment in any of these laboratories, is one of our priorities. Another priority is to promote international collaboration in order to exchange research results and to compare R&D topic priorities for research programmes in the area of smart grids. Finally, based on our past cooperation with partners outside of Europe, we see that Europe and European industries are frontrunners in this field and we will have to continue to work hard to strengthen Europe's leading position. ”

1 http://www.iea-isgan.org/
2 http://www.gridplus.eu/eegi
3 http://www.gridplus.eu
4 http://cordis.europa.eu/fp7/coordination/about-era_en.html
5 http://www.smartgrids.eu/
6 https://www.entsoe.eu/
7 http://www.edsoforsmartgrids.eu/
8 http://www.sintef.no/home/SINTEF-Energy-Research/Project-work/ELECTRA/

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He is a member of the steering committee of the ETP SmartGrids and the coordinator of ELECTRA, the recently launched European Integrated Research Programme on smart grids.

Demand response
– empowering the European consumer

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Demand response is the intentional modification of normal consumption patterns by end-use customers in response to incentives from grid operators. It is designed to lower electricity use at times of high wholesale market prices or when system reliability is threatened. Demand response requires consumers to either actively respond to signals from the operator or, in what may be a more appealing option, to make use of automated solutions to enter into contracts with service providers.

Demand response can be either incentive-based, where consumers are offered payments to reduce their power consumption at times of peak demand or when the system is under stress, or it can operate on a time-price principle. This option, which simply involves consumers shifting their consumption to low-cost periods, has a lot of untapped potential for industrial consumers of electricity, as many of these have the flexibility to shift significant consumption loads to off-peak hours.

A number of provisions dealing with demand side participation are stipulated in various EU policy documents, specifically the Electricity Directive (2009/72/EC) and the Energy Efficiency Directive (2012/27/EU). In an effort to increase public engagement with demand response (current estimates suggest that only 10% of demand response potential is being tapped), the Energy Efficiency Directive is calling on Member States to remove incentives in transmission and distribution tariffs that might hamper demand response participation. Member States should also ensure that national energy regulatory authorities encourage the participation of demand side resources, such as demand response, alongside supply in wholesale and retail markets. Furthermore, Member States should ensure that network operators are incentivised to improve efficiency in infrastructure design and operation and that tariffs are put in place that allow suppliers to improve consumer participation in demand response.

There are, however, some barriers that need to be overcome before we can expect to see the wide-scale uptake of demand response solutions. According to a recent report from the Joint Research Centre (JRC), the European Commission's in-house science service, regulatory and market barriers seem to be the main obstacles to the development of commercially viable aggregation applications, e.g. establishing clear rules for the technical validation of flexible demand-response transactions. Another challenge to be overcome is gaining consumer trust and encouraging consumer participation, as consumer resistance to participating in projects is still significant. In this regard, demand response projects are benefiting from the deployment of smart meters, which are key enablers for demand response initiatives. Consequently, an increasing number of demand response projects are moving from research and development to consumer engagement tests. Programmes to lower energy consumption by providing feedback to customers on their consumption patterns are also paving the way for the wider uptake of demand response solutions. The potential benefits to consumers are significant and include energy savings of up to 10-15%, which should help bring the public on board.

To facilitate greater consumer participation, demand side products and programmes are being created within the wholesale market, and an increasing number of aggregators are becoming active. On the supply side, operators and retailers are providing access to services that enable demand side management and micro-generation. The wider uptake of demand response solutions will be further helped by the fact that EU Member States are obliged to transpose the provisions of the Energy Efficiency Directive (EED) into national law by 5 June 2014, and to report on this to the Commission. The European Commission is providing support to the Member States in a number of ways: a seminar has been held with Member States on how to implement Article 15 of the EED (on energy transformation, transmission and distribution), and work is ongoing on a state-of-play report outlining where Member States are in terms of incentive systems.

In its Staff Working Document on incorporating demand side flexibility, the European Commission outlines some actions required to boost the market for demand response. These include creating transparent, market-based incentives for demand response that reward participation through dynamic pricing, while at the same time respecting data privacy laws. The Commission also recommends that the market be opened up to exploit the potential of demand response, treating demand side resources fairly with respect to supply. Finally, the technology needs to be brought into the market through the increased roll-out of smart meters, allowing consumers to become more engaged and to understand the value of demand response.

The time is ripe for an increased demand response role in balancing the markets. Domestically-installed generating devices, particularly solar panels, are becoming more prevalent, giving households increased opportunities to produce their own electricity and to adjust their demand in relation to their own production, and also to supply electricity into the wholesale market. Household appliances are also becoming smarter, and can power-up or switch on in response to signals from the grid, which will encourage greater consumer involvement. With energy prices continuing to rise, the public's engagement with demand response will increase, as consumers are attracted by the financial and efficiency benefits that demand response solutions can offer.

For more information:

JRC Reference Report: http://tinyurl.com/kbbzkfd
JRC Report: http://tinyurl.com/o6pgbex
EC Staff Working Document: http://tinyurl.com/oohxs87
Energy Efficiency Directive: http://tinyurl.com/cqusd9n

1 SWD(2013) 442 final.
2 Directive 2012/27/EU.
3 Smart Grid projects in Europe: Lessons learned and current developments, JRC, 2012.
4 JRC Reference Report, Smart Grid projects in Europe: Lessons learned and current developments, p. 27.

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Meter-ON
- steering the implementation of smart metering solutions in Europe

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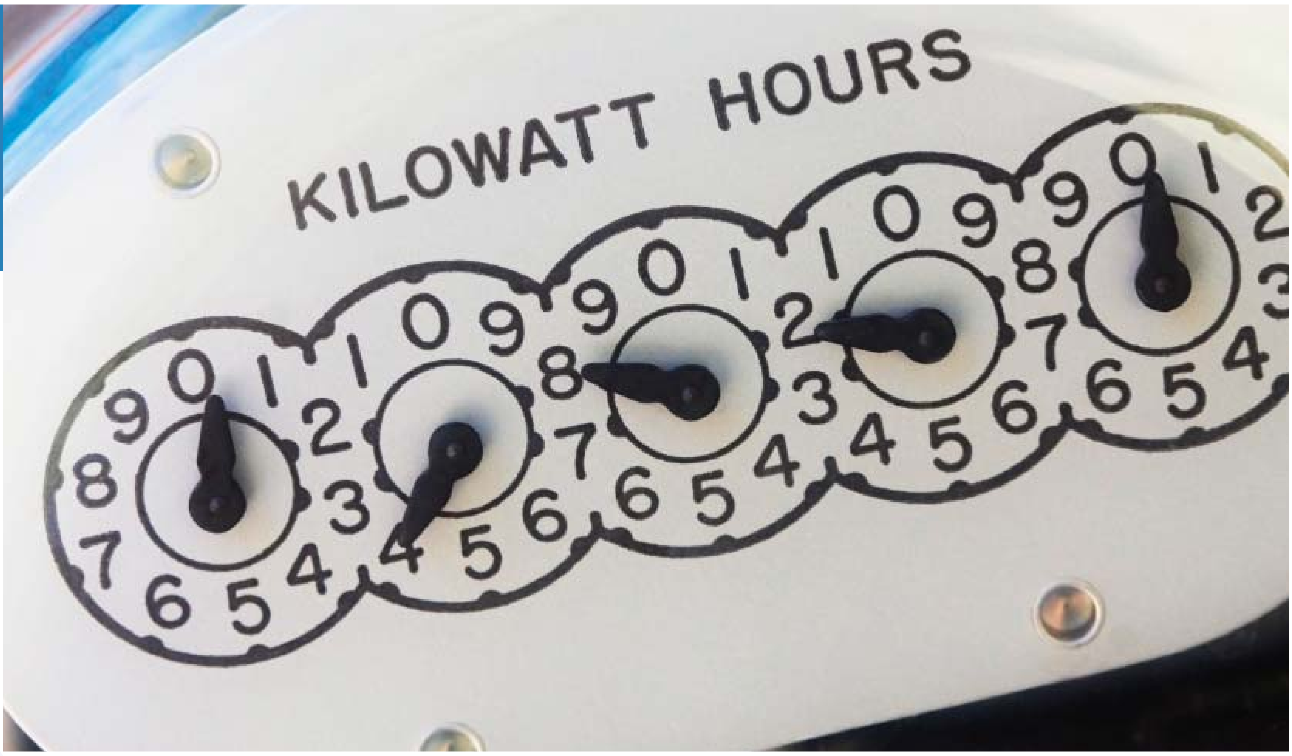
Meter-ON is a project financed under the European Commission's Seventh Framework Programme (FP7) that aims to foster and support the implementation of smart metering solutions throughout Europe. By providing clear recommendations to stakeholders on how to tackle technical barriers and regulatory hurdles, the project aims to overcome obstacles to the widespread uptake of smart metering technology across the European Union.

Generally speaking, smart metering solutions involve the use of advanced meters and integrated communications systems, they provide the possibility of bi-directional communication between the consumer and the supplier and allow consumers to monitor their consumption and make informed choices. Smart meters are gradually being rolled out across Europe and, by giving households greater control and the ability to moderate their consumption, they will help meet the energy efficiency objectives and climate challenges facing the continent. At the same time, by making the grid more reactive they will facilitate the deeper integration of energy from intermittent sources.

In Directive 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity (also known as the 3rd Electricity Directive), the European Commission instructed Member States to strongly recommend that electricity companies optimize the use of electricity through, inter alia, the introduction of intelligent metering systems or smart grids. The Directive noted that it should be possible to base the introduction of intelligent metering systems on an economic assessment of the long-term costs and benefits to the market and the individual customer. By gathering and disseminating information on a comprehensive set of smart-metering projects set under different geographical, technical, regulatory and economic conditions, the Meter-ON project will contribute to the information required for stakeholders in Member States to make informed decisions, in line with the mandate set down in the EC Directive.

To ensure a coordinated approach, Meter-ON collaborates with other projects and European initiative's, such as Grid+ - a support action created to provide operational support for the development of the European Electricity Grids Initiative (EEGI)[1], and OPENmeter[2] - a project funded under FP7 to address knowledge gaps for the adoption of open-standards for smart multi-metering equipment. Meter-ON also collaborates with the Smart Grids European Technology Platform[3], with both initiatives sharing their agendas in order to find common interests. In so doing, the project aims to increase its impact and reach a higher number of interested stakeholders.

The Meter-ON Consortium is led by the European Distribution System Operators for Smart-Grids (EDSO for Smart Grids), and brings together 27 leading DSOs and associations throughout the European Union, representing more than 70% of its electricity metering points. In order to achieve the project's goal of fostering large-scale deployment of smart metering infrastructures, the project is collecting and analysing the most successful experiences in the smart metering field. Based on this analysis, it will exchange information between project stakeholders and produce deliverables that contribute to large-scale deployments.



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To date, 22 projects from 10 different countries have been included in the Meter-ON project, providing a highly representative overview of the current stage of development of smart meter implementation in Europe. One of the main Meter-ON objectives is to recommend feasible technological patterns, business models and policy frameworks to foster smart-meter deployment. To this end, a cross-topic analysis has been carried out to identify the most relevant driving forces and barriers influencing the deployment of smart metering projects. The need for a regulatory requirement for smart metering infrastructure was identified as being the main driver for the uptake of a roll-out programme. Other driving forces behind successful roll-out include a reduction in operational costs and in technical and non-technical losses and the possibility of exploiting economies of scale, not only at the meter level, but at the level of ICT systems. Some of the main barriers include the fact that some technical regulation has not kept up to date with current smart meter developments. In addition, legal and regulatory frameworks need to clarify how operating and investment costs will be accommodated in tariffs. On a social level, it was found that some consumer resistance may be encountered due to concerns over data security or concerns that the consumer will have to bear the cost of the smart meter.

Based on this analysis, a number of recommendations have been made for the European Commission to foster the deployment of smart meters in Europe. The recommendations are grouped under five headings: incentives, cost distribution and market model; data flows and privacy issues; dissemination and customer involvement; support of services and applications beyond pure smart metering; and standardisation activities. Among the main recommendations, the project has identified a need for a fair distribution of costs among all agents in the energy sector and the creation of regulatory incentives to promote solutions that further smart grid development. To address the issue of data security, it is recommended that standards be established to manage information flows and that regulation be compatible with data protection and privacy laws, while at the same time noting that it is necessary to strike the right balance between the need to protect data and the need to provide the minimum functionalities.

Meter-ON has an overall budget of EUR 1 884 418, of which a maximum of EUR 1 622 482 will be financed by the European Commission. Launched in July 2012, the 24-month project is set to finish at the end of June 2014. The project's results will be disseminated among the smart-metering community, involving stakeholders along the entire smart-metering value chain, including distribution system operators, meter operators, meter manufacturers, technology suppliers, system integrators, policymakers and technical bodies. Feedback will be collected from these stakeholders and used to fine-tune the project deliverables, in order to provide a comprehensive guideline for any organization involved in smart metering initiatives.

For more information:
http://www.meter-on.eu/the-meter-on-project/project-overview/
http://www.edsoforsmartgrids.eu/

1 http://www.gridplus.eu/eegi
2 http://openmeter.com/
3 http://www.smartgrids.eu/ETPSmartGrids

EEPR

- connecting the European grid

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In 2006, the European Commission issued guidelines concerning trans-European energy networks (TEN-E)[1] which stated that, for the European internal energy market to operate effectively, it would be essential to build power grid infrastructure to ensure the interconnection and interoperability of electricity networks. In issuing the guidelines, the Commission aimed to ensure that Europe's energy consumers would have access to a higher quality of service and a wider choice, due to the the diversification of energy sources. To make this possible, the guidelines recognized that it would be necessary to establish closer links between national markets and the EU as a whole.

In the context of smart grids, it is frequently the computer technology and networking aspects of the grid that get all the attention, while the traditional cable and pylon infrastructure that underpins the grid is sometimes overlooked. However, it is precisely cables and pylons that are required to strengthen the unity of the European grid and to allow consumers in London, for example, to benefit from a windy day off the west coast of Ireland, or consumers in Paris to respond to price signals from suppliers in Spain. The importance of these networks for the creation of the European internal energy market is reflected in the fact that 12 electricity infrastructure projects were selected to receive a total of EUR 904 million in funding under the European Energy Programme for Recovery (EEPR).

Most of the EEPR interconnector projects had previously been identified as TEN-E projects of European interest and were chosen for EEPR support because of their strategic importance. The projects will help enhance the European grid by strengthening the grid capacity between Spain and France, Portugal and Spain, Austria and Hungary, Ireland and the United Kingdom and also across central Germany. Furthermore, the projects will integrate isolated energy islands by building important new interconnections between Estonia, Latvia and Lithuania and the Nordic electricity market. Interconnectors will also be built between Malta and Italy, and between Sicily and mainland Italy.

The largest project among the 12, in terms of overall investment and of EEPR contribution, involves the construction of an interconnector between France and Spain through a dedicated tunnel passing under the Pyrenees. The construction of a 65-km line between Santa Logaia in Spain and Biaxas in France will see a total investment of EUR 700 million. The project will increase the security of the Spanish electrical system and help to reduce the likelihood of blackouts. Furthermore, it will expand trade between the two countries and allow for the integration of wind, hydro, and solar energy produced in Spain into the European grid. The EEPR is providing EUR 225 million, which is being used to finance technical studies, the procurement of materials, and construction work on the cables, the converter station and the tunnel. Work started in early 2012 with the digging of the tunnel, the construction of converter stations and the laying of the cable on the French and Spanish sides. The project is set to be operational by its scheduled completion date in December 2014.

In second place in terms of EEPR contribution is a project to build the Nordbalt high-voltage direct current connection between Sweden and Lithuania with a transmission capacity of 700 MW. This interconnection will comprise a sub-sea cable of approximately 400 km, as well as converter stations in both countries. The project, which is called Nordbalt 1 (Nordbalt 2 is a separate project that aims to reinforce the grid in Latvia) will transmit electricity between the two countries, contributing to the integration of the energy market in the Baltic Member States and Nord Pool Spot - the power system that unites Finland, Sweden, Denmark and Norway. The new underwater cable will increase the reliability of the Baltic power system while decreasing its dependency on electricity from Russia. By contributing EUR 131 million of the total project cost of EUR 366 million, the EEPR is supporting the construction, installation and commissioning of the sub-sea cable and converter stations. Construction work has begun and the connection is set to start commercial operation in early 2016.


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Five of the other electricity interconnector projects being co-financed by the EEPR, had already been completed as of October 2013: the extension of two 400 kW lines in Portugal; a transmission link between Vienna and the Hungarian city of Györ; construction of a 132 kV distribution center in Kappara in Malta; and finally - the laying of a 500 MW cable connection between the Republic of Ireland and Wales. Work on the remaining projects is ongoing and all actions supported by the EEPR are scheduled to be completed by 2017 at the latest.

The goal of establishing trans-European networks, including in the energy sector, is one of the founding principles of the European Union (the need for these networks is set out in Article 154 of the Treaty establishing the European Community[2]).These networks will play a critical role in ensuring the security and diversification of electricity supplies in the EU, while at the same time allowing interoperability with the energy networks of third countries and reducing the isolation of energy islands. In so doing, they will not only serve to enhance the integration of the European grid, but they will also contribute to the political objective of strengthening territorial cohesion within the EU.

For more information:
http://ec.europa.eu/energy/eepr/projects/index.html
http://eur-lex.europa.eu/en/treaties/dat/12002E/pdf/12002E_EN.pdf

1 Decision No 1364/2006/EC of the European Parliament and of the Council of 6 September 2006 laying down guidelines for trans-European energy networks and repealing Decision 96/391/EC and Decision No 1229/2003/EC.
2 Official Journal of the European Union C 325/33, Consolidated Version of the Treaty on European Union, 24.12.2002

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http://setis.ec.europa.eu