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Technical Assistance for Improvement of Performance-Based Tariff Regulation of EMRA For Turkish Energy Markets Through Introducing an Enhanced Monitoring System

Task 4.2 Workshop

Preparation of Smart Grid Road Map and Required Methodological Tariff Approaches for Electricity and Natural Gas Markets

Electricity Distribution

15 September 2020, Online

This project is funded by the European Union

Workshop Program

AGENDA 15 September 2020 – Electricity focused workshop		
Time	**Agenda item**	**Presenter/Moderator**
10:00 – 10:10	Opening and Task summary	Wietze Lise, Team Leader Gökhan Tosun, senior NKE
10:10 – 10:30	Overview of Smart Grid Regulations and Efforts of Regulatory Bodies in EU	Gökhan Tosun, senior NKE
10:30 – 11:00	International Benchmarks: Smart Grid Regulations in Electricity Distribution	Gökhan Tosun, senior NKE
11:00 – 11:30	Regulatory Approaches for Selected Smart Grid Components in EU	Gökhan Tosun, senior NKE
11:30 – 11:50	Gap Analysis and Regulatory Recommendations (Electricity Distribution)	Gökhan Tosun, senior NKE
11:50 – 12:30	Smart Grid Roadmap for Turkish Electricity DSOs	Gökhan Tosun, senior NKE

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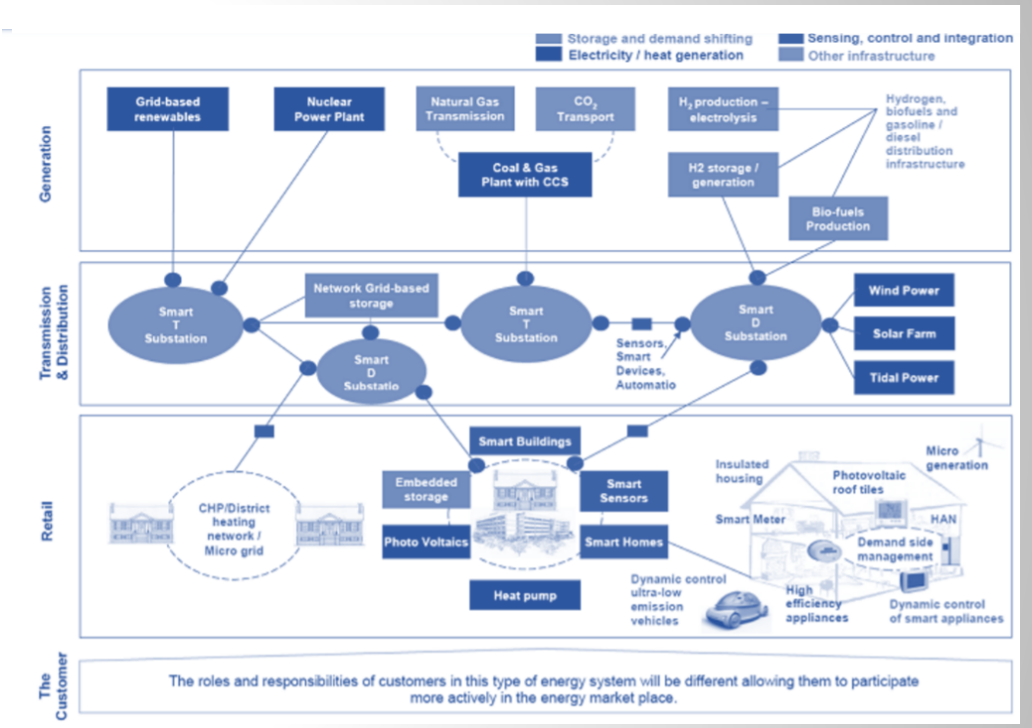
Introduction – What is "*Smart Grid*"

- ✓ According to the European Regulators' Group for Electric and Gas (ERGEG) Public Conclusions Pape;

"Smart Grid is an electricity grid with low loss and high-quality economic features that can integrate the behaviours and actions of all users (manufacturers, consumers and those assume the both roles) in a cost-effective way to ensure sustainable power systems and supply security and safety"

and both The Council of European Energy Regulators (CEER) and European Commission (EC) use this same definition. Some of the European countries such as Austria, England, Poland and Switzerland have also adapted this definition.

An alternative definition proposed is as follows;



$$\text{Smart Grids} = \int_{t \to 0}^{ICT} (\text{Producers} + \text{Transmission} + \text{Distribution} + \text{Storage} + \text{Consumers})$$

$i \to \infty$

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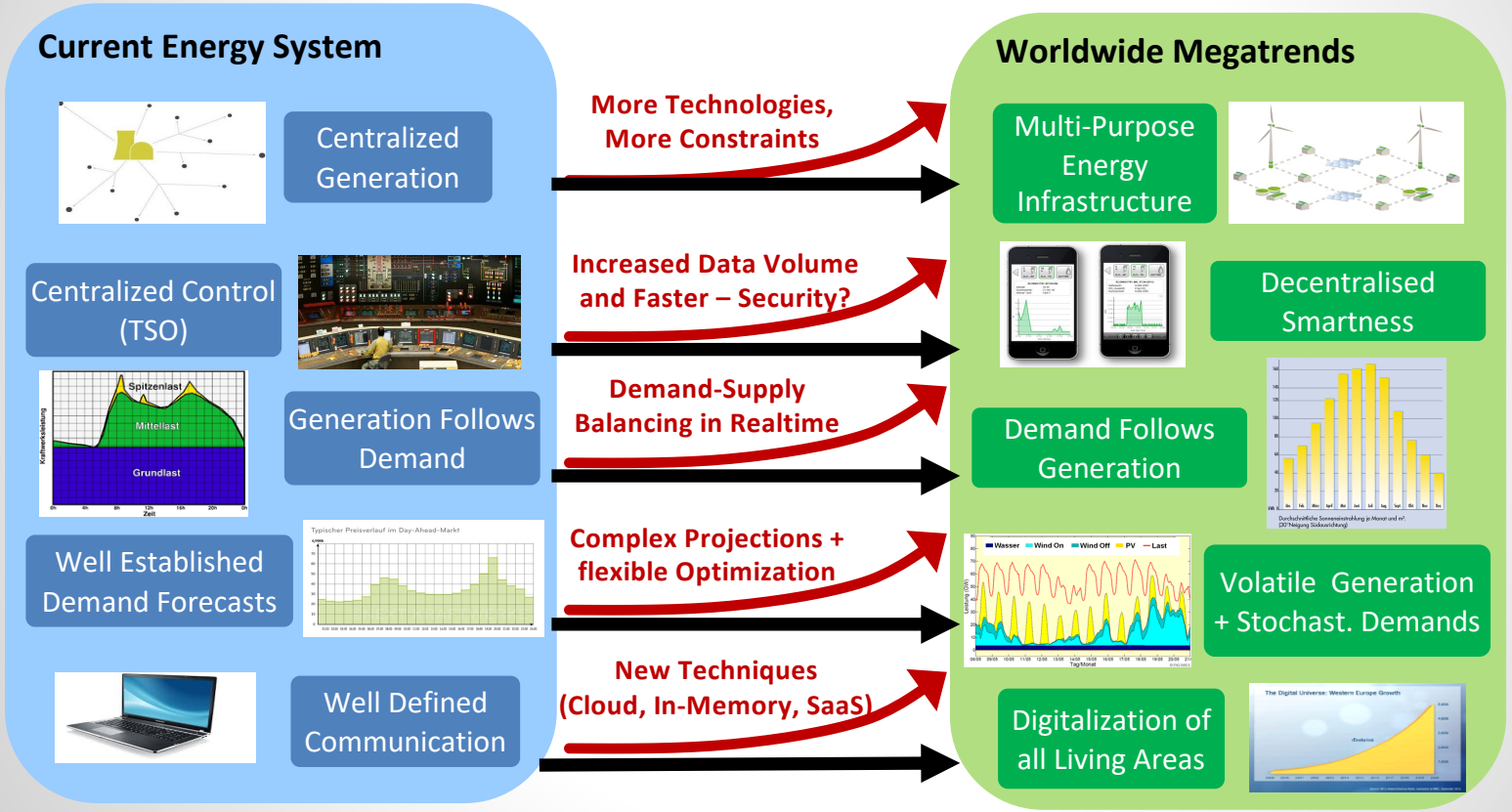
Smart Grids Mega Trends



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Smart Grid Roadmap for Turkish Electricity DSOs

- Smart Grid is an emerging concept in electrical networks along with the developments on advanced measurement, intelligent monitoring, automatic control, information and communication technologies.

- Smart Grids are basically considered as a global imperative that triggers change and transformation to help efforts to tackle energy and environmental issues and improve service quality worldwide.

- Energy markets in all developed countries are working hard to keep up with the paradigm shift they face. The main dynamics of this change can be listed as follows:

    - Reducing the carbon footprint as quickly as possible
    - To meet the market participation demands of the consumers
    - Keeping up with rapidly developing renewable energy, IT and analytics, telecommunication and cyber security technologies
    - Designing and commissioning transmission and distribution grids that can meet these developments
    - To meet the financial and regulatory requirements needed on time

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Smart Grid Roadmap for Turkish Electricity DSOs

In the transformation of smart grid, the future of electricity distribution systems can be defined very basically by the following three characteristics:

- **Millions of manageable active endpoint equipment:** Substations (distribution centres, circuit breakers, etc.), distribution transformers, lines and feeders, distributed generation facilities, storage units, electric vehicles, micro-networks, etc. and sensor networks, relays, smart electronic devices, communication switches, meters and communication equipment installed in many different points; a grid management, characterized by creating value for all stakeholders.
- **Hundreds of thousands of market stakeholders:** Operating the electricity system and the market supported by ICT while having stakeholder participation (consumers, supply companies, generators, prosumers.
- **Flexibility management:** System capacity management that will be required in a flexible and distributed structure, which will be needed due to the increase in the share of renewable energy sources (solar, wind, etc.) connected to the electricity grid, and inclusion of new load types with different characteristics such as electric vehicles, heat pumps, manageable loads.

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Agenda

Overview of Smart Grid Regulations and Efforts of Regulatory Bodies in EU

- Regulations in EU Related to Smart Grid
- Smart Grid Investment and Regulatory Factors for 30 European Countries (EU-28, Norway and Switzerland)
- Smart Grid Efforts of EU Regulatory Bodies
- Overview of Smart Grid Projects in EU

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Overview of Smart Grid Regulations in the EU (1/4)

Directive / Regulations	Definition
Parliament and Council Directive 2004/22/EC, On Measuring Instruments, 2004 O.J. (L 135)	Establishes the requirements for the deployment and use of instruments for measuring electricity
Energy Efficiency Directive 2006/32/EC	Defines the use of cost-effective technological innovations such as “electronic metering” in order to reach the energy saving targets of EU.
Third Energy Package (Parliament and Council Directive 2009/72/EC) Concerning Common Rules for the Internal Market in Electricity	Although it is not an obligation, Directive is a legal foundation on which Member States can facilitate the development and deployment of smart grids. According to the Directive a CBA shall be done to prepare a timetable regarding roll-out of smart meters. In addition, it provides a supranational legal foundation for the development of demand response in Europe.
COM (2011)202 on Smart Grids	Proposes a variety of actions aimed at smart, sustainable and inclusive growth and at developing Smart Grids to effectively contribute to the European Union's Europe 2020 Strategy.
Energy Efficiency Directive 2012/27/EC	Provides additional instructions on the deployment and the minimum common features of smart metering systems as well as on data protection and privacy of final customers. It requires Member States to ensure that network operators are incentivized to improve efficiency in infrastructure design and operation, and, within the framework of Directive 2009/72/EC, that tariffs allow suppliers to improve consumer participation in system efficiency, including demand response, depending on national circumstances. Member States shall ensure that national regulatory authorities encourage demand side resources, such as demand response, to participate alongside supply in wholesale and retail markets.

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Overview of Smart Grid Regulations in the EU (2/4)

Directive / Regulations	Definition
Recommendation 2012/148/EU on smart metering	Provides guidance to Member States (MS) on the design of smart metering systems to ensure the protection of personal data and recommend MS to include a data protection impact assessment in the design of smart grids and smart metering systems. Also provides guidelines on the methodology for the economic assessment of the roll-out of smart metering.
COM (2012)663 on the Internal Energy Market	With the growing need for flexibility and energy efficiency and to accommodate distributed generation and demand-side participation, coordinated action is needed with a view to the deployment of smart grids at European, regional and municipal levels. Smart grids rely on digital infrastructure. The Commission tabled a proposal for a Regulation on "Guidelines for trans-European telecommunications networks" identifying inter alia digital services infrastructure as priorities
Energy Infrastructure Regulation (EU) 347/2013	States that smart grid is among the 12 strategic trans-European energy infrastructure priorities, the implementation of which by 2020 is essential for the achievement of the Union's energy and climate policy objectives. Smart grids deployment: adoption of smart grid technologies across the Union to efficiently integrate the behaviour and actions of all users connected to the electricity network, in particular the generation of large amounts of electricity from renewable or distributed energy sources and demand response by consumers
Electro-mobility Alternative Fuels Directive AFID; COM (2013)	The Directive requires Member States to set targets for recharging points accessible to the public, to ensure that electric vehicles can circulate at least in urban and suburban agglomerations by 31 December 2020 as well as on the TEN-T core network by December 2025.

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Overview of Smart Grid Regulations in the EU (3/4)

Directive / Regulations	Definition
COM (2013)7243 on IEM and public intervention	To promote demand response deployment, Member States should accelerate the roll out of smart grids and smart metering, which will go in parallel to the Commission's work to create better conditions for smart appliances and energy management systems to develop. European standardization organizations will develop a complete set of standards for smart grids, including for demand response, by the end of 2014.
SWD (2013)442 on Demand Side Flexibility	Demand response programs should be able to rely on standardized technological solutions integrating smart metering, storage facilities. Bringing the technology into the market through the roll-out of smart metering with the appropriate functionalities
the Commission Guidelines on State aid for environmental protection and energy 2014-2020	In clarifying the conditions under which Member States are allowed to introduce capacity remuneration mechanisms, the Guideline requests Member States to consider alternatives such as demand response. The measure should be open and provide adequate incentives to both existing and future generators and to operators using substitutable technologies, such as demand-side response or storage solutions.
Recommendation 2014/724/EU Data Privacy Impact Assessment	Introduces measures for the promotion of the use of a Data Protection Impact Assessment Template (called the "DPIA Template"), developed at EU-level, with the aim of helping ensure the fundamental rights to protection of personal data and to privacy in the deployment of smart grid applications and systems and smart metering roll-out
Directive 2014/32/EU32 Measuring Instruments Directive	Harmonizes the national laws for making available measuring instruments on the market. Directive repeal the earlier Directive 2004/22/EC3.

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Overview of Smart Grid Regulations in the EU (4/4)

Directive / Regulations	Definition
Directive 2014/94/EU36 deployment of alternative fuels infrastructures	States that the recharging of electric vehicles at recharging points accessible to the public shall, if technically feasible and economically reasonable, make use of intelligent metering systems as defined in point (28) of Article 2 of Directive 2012/27/EU and shall comply with the requirements laid down in Article 9(2) of that Directive.
COM (2015) 339 on delivering a 'new deal' for energy consumers	States one of the targets as strengthening the link between research, innovation and industry for developing international competitiveness in smart home and smart grid technologies, in cooperation with all market players.
2016/679 General Data Protection Regulation (GDPR)	The operation of smart meters entails the processing of 'personal data' and needs to be in line with the EU's General Data Protection Regulation (GDPR).
2019/944/EU New Electricity Directive	Updates and puts forward provisions that are of direct relevance to smart metering and its use as a tool for demand-side management and flexibility.
Directive 2014/94/EU36 deployment of alternative fuels infrastructures	States that the recharging of electric vehicles at recharging points accessible to the public shall, if technically feasible and economically reasonable, make use of intelligent metering systems as defined in point (28) of Article 2 of Directive 2012/27/EU and shall comply with the requirements laid down in Article 9(2) of that Directive.

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Communication Document - Smart Grids: From Innovation to Installation

Being one of the most important documents related to development of smart grids, “Communication Document Smart Grids: From Innovation to Installation” was published in 2011, proposing a variety of actions aimed at smart, sustainable and inclusive growth and developing smart grids to effectively contribute to EU-wide strategies.

Goals for the development and dissemination of smart grids were defined as follows:

- Goal 1: Develop Common European Smart Grid Standards
- Goal 2: Guarantee Data Protection and Security
- Goal 3: To Promote the Dissemination of the Smart Grid
- Goal 4: Develop Smart Grids in a Competitive Retail Market that will Attract Consumers
- Goal 5: Support Innovation

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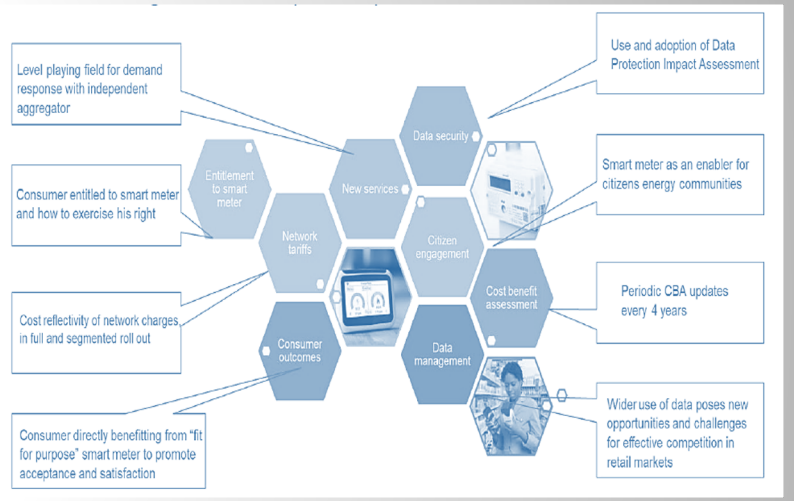
New Electricity Directive (2019/944/EU)

Recently in 2019, new Electricity Directive (2019/944/EU) was published, updating and putting forward some provisions that are of direct relevance to smart metering and its use as a tool for demand-side management and flexibility:

According to the Directive,

- The deployment of smart metering systems may be subject to a cost-benefit assessment, which shall be undertaken in accordance with the Commission Recommendation 2012/148/EU;
- Member States should publish the minimum functional and technical requirement for these systems which should be in accordance with those mandated in the Directive and in the spirit of the Commission Recommendation 2012/148/EU;
- Member States should ensure the interoperability of the smart metering systems and their ability to provide output for consumer energy management systems;
- Final customers should contribute to the associated cost of deployment of smart metering systems, in a transparent and non-discriminatory manner, while taking into account the long-term benefits to the whole value chain;



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New Electricity Directive (2019/944/EU)

- When the deployment of **smart metering systems is negatively assessed**, Member States should revise this assessment at least **every four years**;
- Smart metering systems should be in accordance with applicable **Union data protection rules**;
- Network tariffs: as a general principle of network charges, tariffs paid by customers should fairly reflect the cost they impose on the network operator. This should also be reflected on **network charges related to smart metering deployment (full or segmented roll out);**
- Customers **should be entitled to a smart meter in cases where the deployment has been neither negatively assessed nor systematically pursued.** Then, customers should bear the associated costs of deployment, under fair, reasonable and cost-effective conditions.
- Functionalities that smart metering systems should support in order to fit their purpose and deliver benefits for the consumers and the energy system as a whole are set. It furthermore provides that Member States should ensure that the deployed smart metering systems are in accordance with **European standards**, the spirit of the measures under the Commission Recommendation 2012/148/EU, and in line with other specific requirements coming from Article 9 of the Energy Efficiency Directive 2012/27/EU (**the type of data provided to customers, security of data and data communications, the availability of these data for the customers, the appropriate advice and information that should be given to final customers prior to or at the time of installation of smart meters**.)

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Smart Grid Regulations

- In addition to EU-wise regulations related to smart grid, most of the member states developed their **own national regulation about deployment of smart meters and other components of smart grids**. We'll have a closer look on the country practices.
- An important and recent issue is about consumer **data protection**. EU has taken a series of measures to uphold data protection rules since smart grids and meters may have an **impact on personal data and privacy**, which is why the Smart Grids Task Force updated the impact assessment template in September 2018, and which serves as guidance on data protection and privacy for data controllers and investors in smart grids.
- In addition to data protection and privacy, **cybersecurity** has increasingly become an issue related to smart grids and meters. The Commission is committed to **mitigating any risks** and **enhancing resilience towards cybersecurity.**

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Market and Regulatory Factors Influencing Smart Grid Investment in Europe*

- In Europe, the level of smart grid investments has been low until 2007, most probably due to **uncertainty related to the returns on such capital expenditures**. However, following most of the NRA's introducing incentives after 2008, the investments started to increase. The smart grid investments are not uniformly distributed across Europe and the great majority of the spending is in central European countries.
- We'll present in the next slides a study from 2016, summarizing smart grid investments of EU countries and three regulatory features:
  - **Distribution-sector concentration** reflects the level of market concentration in the electric power distribution sector
  - Regulatory mechanisms reflect the capacity of the regulatory scheme to provide **incentives to DSOs for increasing cost efficiency or productivity**
  - Innovation-stimulus mechanisms refers to the mechanisms designed by regulatory authorities to **stimulate the implementation of pilot projects**

*Source: Cambini C., Meletiou A., Bompard E., Masera M., 2016, Market and regulatory factors influencing smart-grid investment in Europe: Evidence from pilot projects and implications for reform

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Normalized SG Investments and the Three Analysed Regulatory Factors for 30 European Countries (EU-28, Norway and Switzerland*

Country	Country Code	Investment (€/M€ of GDP)	Investments (€/capita)	Distribution-Sector Concentration	Regulatory-Mechanisms	Innovation-Stimulus Mechanisms
Austria	AT	193.8	7.03	Low	Incentive	Adj. Rev.
Belgium	BE	228.46	7.77	Low	Cost	None
Bulgaria	BG	56.77	0.3	Medium	Incentive	None
Switzerland	CH	26.19	1.53	Low	Cost	None
Czechia	CZ	219.48	3.31	Medium	Hybrid	None
Germany	DE	109.19	3.54	Low	Incentive	None
Denmark	DK	566.12	24.89	Low	Hybrid	Adj. Rev.
Estonia	EE	64.73	0.8	Medium	Hybrid	None
Greece	EL	76.2	1.49	High	Cost	None
Spain	ES	174.56	4.06	Medium	Hybrid	None
Finland	FI	243.26	8.77	Low	Hybrid	Adj. Rev.
France	FR	191.15	6.18	Medium	Incentive	None
Croatia	HR	42.64	0.45	High	Cost	None
Hungary	HU	82.83	0.83	Medium	Incentive	None
Ireland	IE	88.99	3.35	High	Incentive	Adj. Rev.

*Source: Cambini C., Meletiou A., Bompard E., Masera M., 2016, Market and regulatory factors influencing smart-grid investment in Europe: Evidence from pilot projects and implications for reform

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Normalized SG Investments and the Three Analysed Regulatory Factors for 30 European Countries (EU-28, Norway and Switzerland*

Country	Country Code	Investment (€/M€ of GDP)	Investments (€/capita)	Distribution-Sector Concentration	Regulatory-Mechanisms	Innovation-Stimulus Mechanisms
Italy	IT	136.73	3.72	Medium	Hybrid	Extra WACC
Lithuania	LT	84.32	0.85	High	Incentive	None
Luxembourg	LU	68.33	5.47	Medium	Incentive	None
Latvia	LV	26.77	0.27	Medium	Hybrid	None
Malta	MT	42.8	0.7	High	Cost	None
Netherlands	NL	155.37	5.93	Medium	Incentive	None
Norway	NO	47.08	3.27	Low	Incentive	None
Poland	PL	19.21	0.18	Medium	Hybrid	None
Portugal	PT	306.46	5.11	Medium	Hybrid	Extra WACC
Romania	RO	27.55	0.18	Medium	Incentive	None
Sweden	SE	234.89	9.59	Low	Incentive	None
Slovenia	SI	337.71	6.05	High	Incentive	Adj. Rev.
Slovakia	SK	68.75	0.88	Medium	Incentive	None
UK	UK	203.18	6.1	Medium	Incentive	Adj. Rev.
Italy	IT	136.73	3.72	Medium	Hybrid	Extra WACC

*Source: Cambini C., Meletiou A., Bompard E., Masera M., 2016, Market and regulatory factors influencing smart-grid investment in Europe: Evidence from pilot projects and implications for reform

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Incentives for Smart Grids Innovation

- Smart grids demonstration and innovation expenses are still treated like any other cost in most of the countries; i.e. there is no specific compensation for the risks involved in testing new technologies and processes (Eurelectric, 2014). Since 2014, six Member States – France, Greece, Ireland, Italy, Portugal and Slovenia – have implemented a new specific regulatory mechanism to promote R&D and/or pilot projects.

Country	Country regulations
Austria	The regulatory system provides incentives for cost reductions as companies must follow a regulatory efficient path (CEER, 2014). Additionally, E-Control (the Austrian NRA) applies an **incentive factor to stimulate investments in innovation**. The **investment factor constitutes a cost-based element in the incentive-based regulatory system.**
Denmark	Regulator applies a public service obligation-financed mechanism (ForskEL). The **ForskEL mechanism is dedicated to support R&D and demonstration of environmentally friendly technologies** and provides annual funding of DKK 130 million.
Greece	From 2017 onwards, the approved **budget for R&D and pilot projects** added to the annual allowed revenues in Greece.
Finland	DSOs can cover some of their investment costs through the innovation incentive system. As part of the innovation incentive system, the EMV can approve R**&D related expenditures up to a maximum of 0.5% of a DSO's annual turnover** (NordREG, 2011).
France	A new instrument that includes **a dedicated amount for R&D and pilots** was issued at the end of 2013. If the DSO spends less than the projected allowance, the remaining amount is returned to the customers benefit, while if the company overspends is at its own risk. In the current French regulatory period, **R&D and pilot projects' operating costs are covered by a specific part of the distribution network tariff**. These costs are **excluded from efficiency requirements.**

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Incentives for Smart Grids Innovation

Country	Country regulations
Ireland	The Commission for Energy Regulation (CER) introduced **an extra-allowance mechanism for incentivizing DSO to carry out research and development and sustainability activities**. The total amount of the projected fund equals €18.2 million and will allow DSOs to explore technological advances **in areas such as smart grids, generation integration, and adaptation of new network devices** to support the integration of renewable generation into the network and improve the reliability of service.
Italy	In Italy, in 2012, NRA introduced a **competition-based procedure providing specific incentives for innovative demonstration projects** related to the active distribution network. To generate interest by DSOs, these pilot programs allowed for a **2% premium over the cost of capital** for a limited time period of 12 years. At present, output-based incentives are used.
Norway	Since 2013, the Norwegian NRA has been providing **extra income of up to 0.3% (book value * 1.01) on some innovative projects**, that is expenditures for R&D and pilot projects are added to the allowed revenues (max. 0.3% of regulated assed base)
Portugal	The DSO will **receive the minimum between a higher regulatory RoR and 50% of the system benefits.** The extra rate is 0.25% in the first year and rises 0.1% each year, until it reaches 0.75% in the sixth year. Hence, **projects should allow for an OPEX reduction**, which will be accounted as part of the system benefits; otherwise the DSO may receive a lower incentive
Slovenia	Regulatory framework acknowledges **3% of the book value for smart grid investments**
United Kingdom	Ofgem announced a funding mechanism (Low Carbon Network Funds-LCNF) of £500 million over the period 2010 to 2015 **to support competitive tenders for "large-scale trials of advanced technology including smart grids",** as part of DPCR5. In 2015, with the introduction of RIIO-ED1, the LCNF was replaced **by a new funding scheme, called Network Innovation Competition (NIC)**. DSOs can now **recover money for pilot projects through an innovation stimulus** under the RIIO model and are incentivised to roll out innovative projects through the regulatory framework.

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Incentives for Smart Grids Innovation

On the other hand, the vast majority of Member States **have no mechanism that takes OPEX into account**. Only Finland, France, Ireland and United Kingdom have an incentive mechanism for smart grid related OPEX.

- In Finland, there are only incentives for OPEX. CAPEX for R&D and pilot projects are treated as any other costs. OPEX incentives for R&D are approved if they do not exceed 1% of the allowed revenues.
- In France, costs for R&D and pilot projects are covered within the distribution network tariff. These costs are excluded from the benchmarking.
- In Ireland, the Regulator can provide OPEX allowances for R&D projects. Separately, there is also an “Innovation OPEX Fund” for projects. If they succeed, they will strategically innovate and change how the DSO operates.
- The RIIO model in the UK does not differentiate between CAPEX and OPEX. OPEX for funded pilot projects will be recognised in the allowed revenues as well.

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Overview of Smart Grid Efforts of EU Regulatory Bodies
CEER

Within the scope of CEER Smart Grid Position Paper, it is stated that; innovation solutions (demonstration pilots) shall be incentivized, open protocols and standards for interoperability shall be adopted, the results and lessons earned from the demonstration projects shall be disseminated, societal cost-benefit assessment shall be performed and output regulation: value for money of users shall be introduced.

In 2011, CEER published CEER Status Review on European Regulatory Approaches Enabling Smart Grids Solutions (“Smart Regulation”) and updated it on 18 February 2014. Objectives and contents of the document are to gather evidence and analyse information about regulatory approaches to the demonstration and deployment of smart grids. CEER applies an internal questionnaire among CEER members and observer countries (27 respondents out of 32) to gather information.

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Overview of Smart Grid Efforts of EU Regulatory Bodies
EC - Smart Grid Task Force

The Smart Grid Working Group was established by the European Commission in 2009 to advise on issues related to the installation and development of a smart grid. It consists of five Expert Groups that focus on specific areas. The work of these expert groups helps to shape the EU's smart grid policies.

Although the task force was much more active between 2009-2015, they are still producing guiding and consultation documents for hot topics under smart grid ecosystem.

Some of the expert groups are as follows:

- Expert group 1 – Smart grid standards
- Expert group 2 – Regulatory recommendations for privacy, data protection and cyber-security in the smart grid environment
- Expert group 3 – Regulatory recommendations for smart grid deployment
- Expert group 4 – Smart grid infrastructure deployment
- Expert group 5 – Implementation of smart grid industrial policy

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Overview of Smart Grid Efforts of EU Regulatory Bodies ERGEG/ACER

In December 2009, ERGEG launched its “Position Paper on Smart Grids” for public consultation with the purpose of assisting regulators in understanding how smart grids can benefit network users and, potentially, other stakeholders in the European electricity supply system and exploring ways in which the development of smart grids can be encouraged, where cost effective. Together with the 50 responses gathered, on June 2010, Conclusions Paper was published to evaluate the responses received by the stakeholders and to state the final views and recommendations of ERGEG after the consultation process.

Also in 2014 (and updated in 2019), ACER has published a public consultation document on “Energy Regulation: A Bridge to 2025” which focuses on the following aspects:

- Decarbonize Europe’s energy sector while maintaining security of supply,
- Increase affordability for consumers
- Competitiveness for businesses.
- Sector coupling

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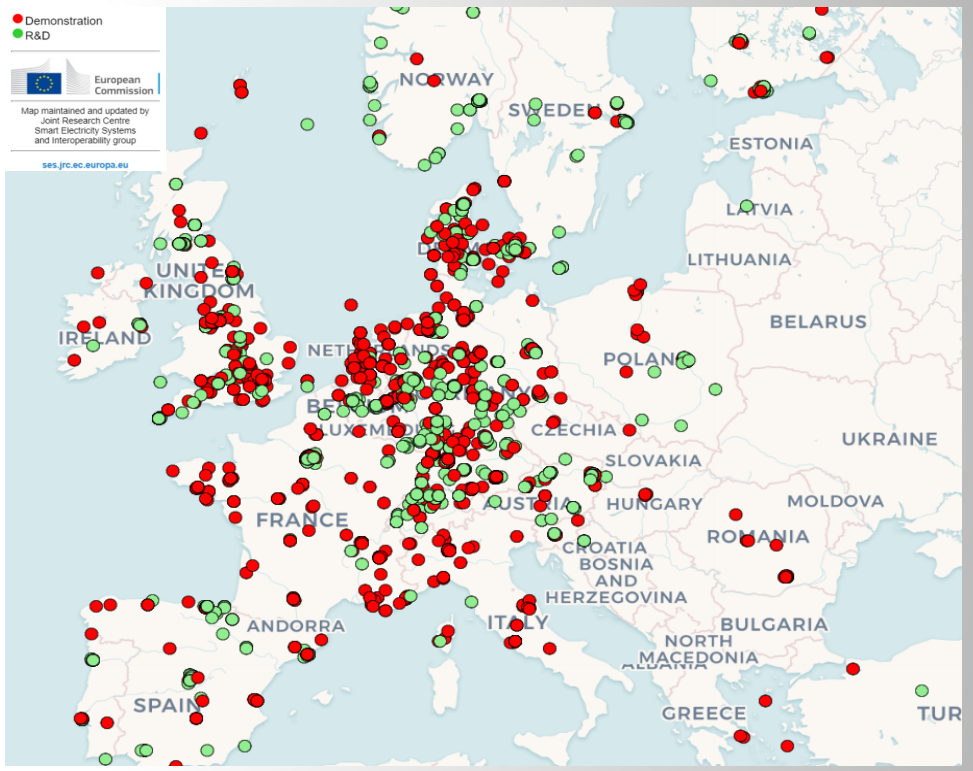
Overview of Smart Grid Projects in EU

- In Europe investments related to smart grids are concentrated in 10 Member States together with Switzerland and Norway. Among them, Germany, UK, Denmark and Spain are the countries with the most initiatives. It is known that organizations in these countries are very active and have decided to start a large number of initiatives in their own countries as well as in other Member States.

- Especially United Kingdom, Germany and Denmark have high share of international and national projects. These countries are remarkable in terms of the positive national or regulatory environment that they create for the development of smart grids. In United Kingdom, the interaction between the national regulatory authority, Ofgem and DSOs has been a driver and funding for innovation at the heart of smart grid developments has been created. Acting as the developer of smart grid projects, DSOs have become the main source for technology transfer and sub-financing for the development of an innovative supply chain, and have created opportunities for other organizations to test, learn, implement and grow new business models.



Map of Smart Grid Projects (as of August 2020) since 1994, Source: JRC

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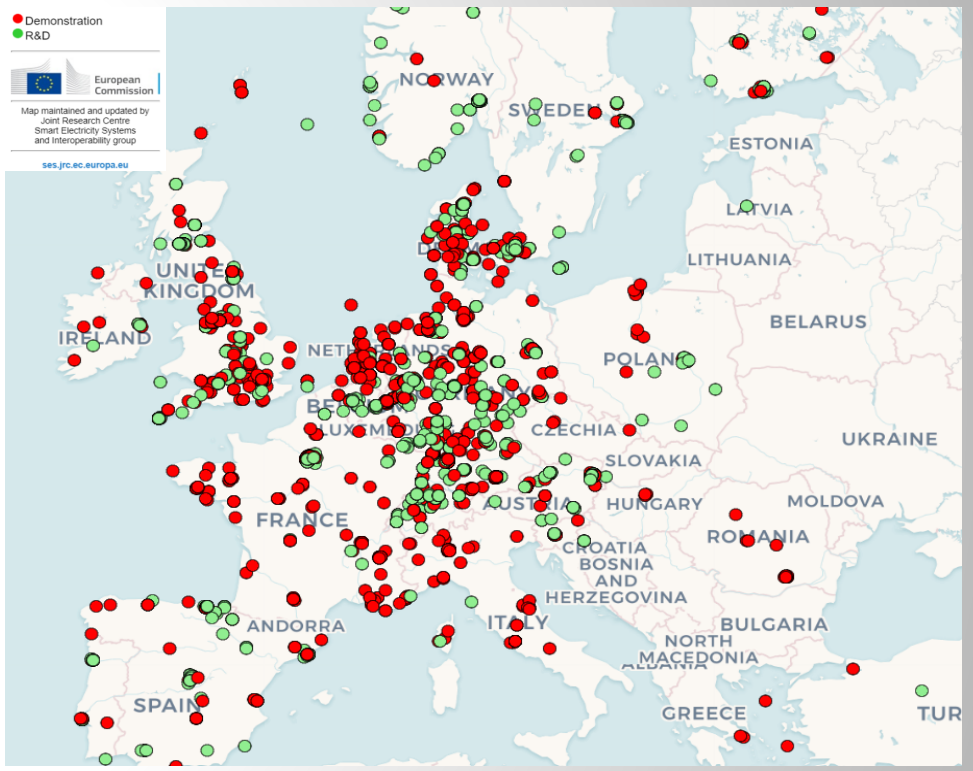
Overview of Smart Grid Projects in EU

- The region located in the south of Belgium, Netherlands and west of Germany shows the highest density in smart grid projects in terms of both number and total investment.
- However, Madrid and the Basque region of Spain are seen among other EU capitals, such as London, Copenhagen, Rome and Paris, and regions such as eastern Denmark and northern Italy where such organizations are condensed.
- R&D projects are much more spread over many countries than pilot projects, with notable exceptions in France, Italy, Luxembourg and UK. The number of pilot implementation projects in the UK, together with France, Italy and Luxembourg, is higher than the R&D projects, due to the national policy priorities and regulatory framework that encourage the adoption of pilot implementation initiatives in different areas.



Map of Smart Grid Projects (as of August 2020) since 1994, Source: JRC

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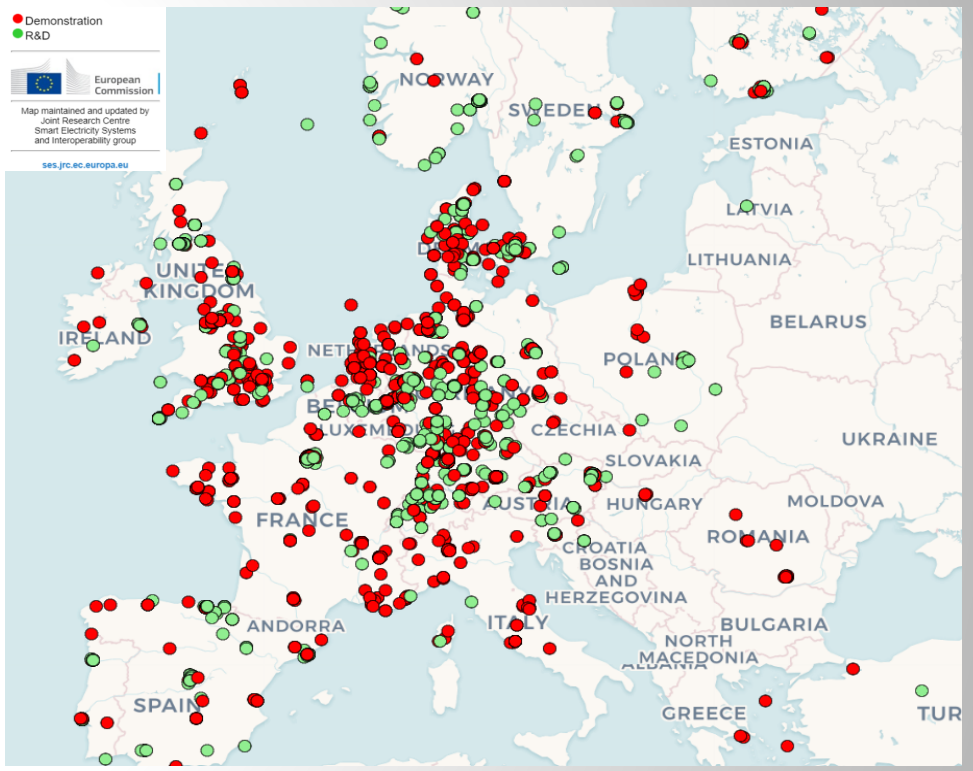
Overview of Smart Grid Projects in EU

- In addition to strengthening the national export potential, a positive national policy and regulatory framework are also important to make a country attractive for foreign smart grid investments.
- In particular, the adoption of smart grid roadmaps is a clear sign that smart grids are at high priority on the national agenda, thus attracting foreign investors to seek partnerships with local stakeholders to enter the national market.
- To date, several Member States, including the UK and Denmark, Germany, Ireland, France, Austria, Slovenia, Sweden, have adopted roadmaps for the rapid development of smart grids.



Map of Smart Grid Projects (as of August 2020) since 1994, Source: JRC

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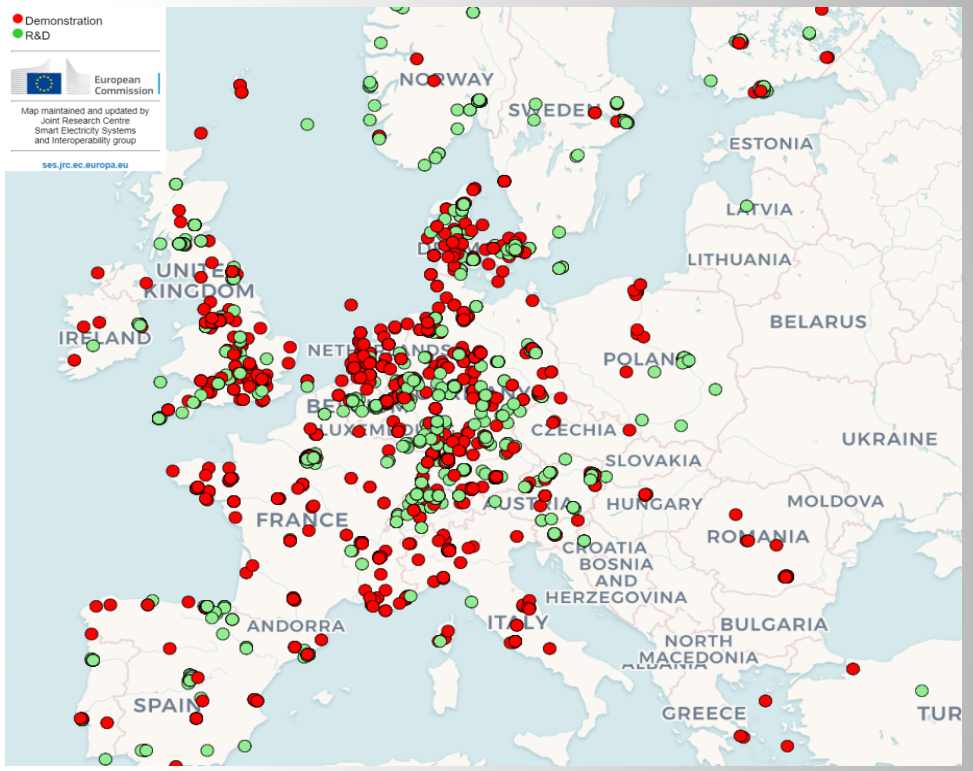
Overview of Smart Grid Projects in EU

- A clear sign that smart grids are of high importance in the national and international agenda is the establishment of smart grid platforms. Smart network platforms were first established in Spain, Slovenia, Austria, Czechia, Ireland, Flandre Regions, Norway, Poland, Switzerland, Netherlands, Germany (Baden- Württemberg), Italy, Greece, Denmark, Latvia and France.



Map of Smart Grid Projects (as of August 2020) since 1994, Source: JRC

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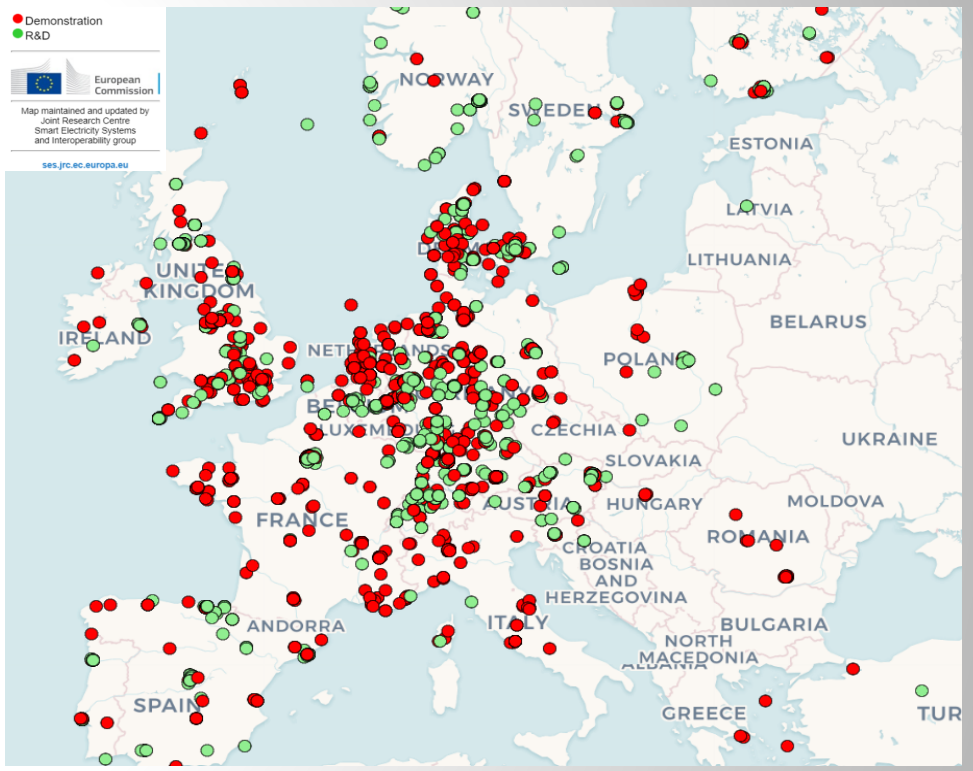
Overview of Smart Grid Projects in EU

According to a study* performed in 2020 :

- Close to 225 million smart meters for electricity and 51 million for gas will be rolled out in the EU by 2024. This represents a potential investment of €47 billion.
- By 2024, it is expected that almost 77% of European consumers will have a smart meter for electricity. About 44% will have one for gas.
- The cost of installing a smart meter in the EU is on average between €180 and €200.
- On average, smart meters provide savings of €230 for gas and €270 for electricity per metering point (distributed amongst consumers, suppliers, distribution system operators, etc.) as well as an average energy saving of at least 2% and as high as 10% based on data coming from pilot projects.



Map of Smart Grid Projects (as of August 2020) since 1994, Source: JRC

* Alaton, Clément; Tounquet, Frédéric, 18 March 2020, Benchmarking smart metering deployment in the EU-28 Final Report

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Technical Assistance for Improvement of Performance-Based Tariff Regulation of EMRA For Turkish Energy Markets Through Introducing an Enhanced Monitoring System

Task 4.2 Workshop

International Benchmarks: Smart Grid Regulations in Electricity Distribution

15 September 2020, Online

This project is funded by the European Union

Agenda

International Benchmarks: Smart Grid Regulations in Electricity Distribution

- Different regulatory approaches on smart grid regulations
- Selected country practices (UK, Italy, Germany, Spain, Sweden) for regulation of smart grids roll-out
- Comparative review of regulatory practices

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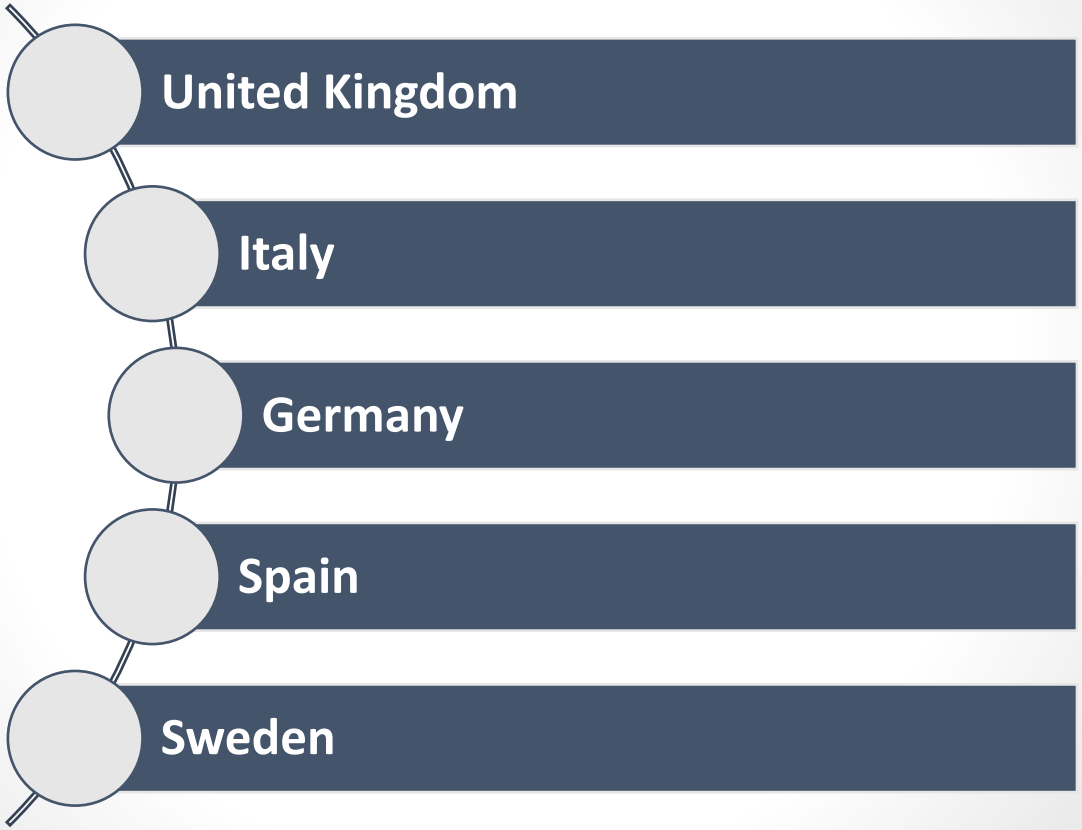
International Benchmarks



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United Kingdom

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Smart Grid Regulations and Efforts in UK

- Similar to many other countries, United Kingdom is also seeing the impacts of the transition to a low carbon economy. Electricity generation mix is changing with the **increasing level of RES and other low carbon generation**. Share of distributed generation including **solar PV and onshore wind farms** are increasing while creating **technical challenges such as variations in system voltages** in some parts of Britain particularly overnight and creating operational challenges in managing T&D network.

- On the other hand, due to the increasing **electrification of heat and transport**, electrical demand increases too. In this regard, continued development of a smart grid seems essential.

- At distribution level, Distribution Network Operators (DNOs) in local electricity networks are transitioning to a Distribution System Operator (DSO) role, which involves **more active management of networks**, including procurement of market solutions to network issues and greater coordination between the transmission and distribution boundary. DNOs have started to open up the delivery of network requirements to market-based smart solutions (storage and DSR, for example), to reduce network cost and deliver savings for consumers.

- Ofgem and the DECC established the **Smart Grid Forum** in 2011 in order to support the UK's transition to a secure, safe, low carbon, affordable energy system through considering the full range of technical, commercial and regulatory issues associated with developing smart grids.

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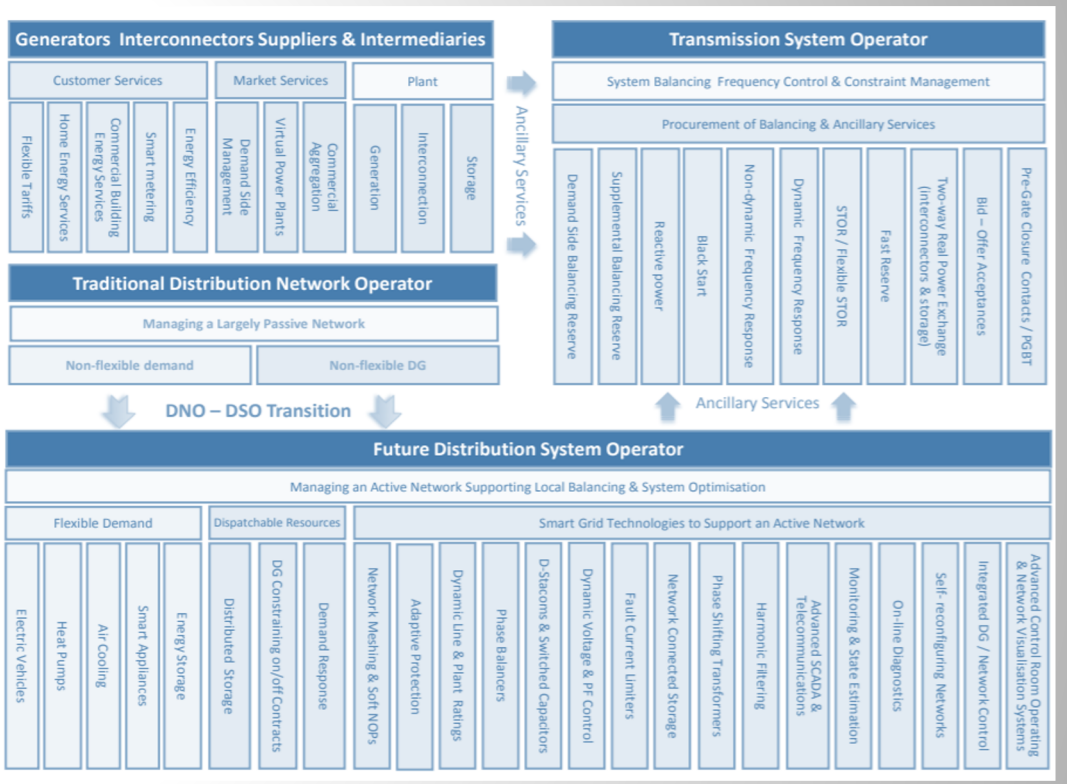
Smart Grid Blueprint

Together with the development of smart grids, new roles, and relationships for all the stakeholders acting in the electricity system such as suppliers, consumers, generators and network operators were defined as stated by UK Power Networks is shown in the figure. As it can be seen, the traditional network operators will evolve from their current role to operating as a DSO supporting local balancing and system optimization. In UK;

- Suppliers will be responsible for installing smart meters across and they may introduce new ToU tariffs that reward consumers for shifting demand away from peak times
- Distributed generators will play more active role in meeting local energy demand.
- Consumers, through demand management, will play a more active role in helping to balance supply and demand.



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Policy and Regulatory Efforts (1/5)

In UK, various papers, reports and strategy documents have been published related to the development of smart grid systems:

- The **Innovation Funding Incentive** and **Registered Power Zone** incentives introduced in 2005 by Ofgem have been instrumental in catalysing innovation in the management of electricity distribution networks and development of smart solutions.
- **UK Carbon Plan (2011)** outlined different pathways (scenarios) to meet the 4th Carbon Budget and 2050 emissions target. This has provided a starting point to assess the potential impact of the low carbon transition on electricity distribution networks.
- As part of the electricity distribution price control arrangements, the **Low Carbon Networks Fund (LCNF)** was established between April 1, 2010 and March 31, 2015. The LCNF has provided £500 million to cover the costs of projects supported by distribution network operators (DNO). The projects covered new technology, business and trade arrangements.
- According to the **Electricity System Assessment of Future Challenges document** published in 2012, balancing technologies and smarter networks will be crucial to the cost-effective matching of electricity supply and demand. In this document, it is also stated that the Government will have a key role to ensure that market frameworks and networks develop in a way that is fit for purpose, and in removing barriers to widespread deployment of balancing technologies.
- **Community Energy Strategy (2014**) recognizes that as the country move towards smarter energy management, communities can help pilot new approaches to balancing supply and demand, providing valuable learning that can be applied elsewhere.
- The **Smart Energy Code** is the legal framework which sets out the day-to-day rules, rights and obligations regarding smart metering equipment and the information it provides. Given the key role of smart metering in enabling the development of a smart grid, network operators are working closely with the Government in the development of preparations for the smart meter roll-out.

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Policy and Regulatory Efforts (2/5)

- **Future of Heating: A strategic framework for low carbon heating in the UK (2012)** set out the challenge of decarbonizing the UK's heat demand and identified key enabling activities DECC will undertake in order to deliver the step-change in heating necessary to meet it. This includes looking at the most effective ways to bring about a large-scale transition to low carbon heating over the coming decades, to meet the country's carbon budgets whilst putting them on a pathway to achieve their2050 carbon targets.

- Ofgem has developed the new **RIIO Regulatory Framework** in order to incentivize network operators to rise to the challenge of delivering a low carbon UK. RIIO is a significant departure from the previous regulatory approach to regulation (RPI-X), which was largely aimed at reducing costs and getting efficiencies out of the existing assets. RIIO requires companies to plan earlier for different scenarios and to engage more with stakeholders when preparing business plans and throughout the price control period. RIIO will be explained in more detail in the next paragraphs.

- The Smart Grid Forum developed a parametric model, the **Transform Model** to assess the costs and benefits of smart grid deployment in terms of deferred or avoided reinforcement costs under different low carbon transition pathways and investment strategies. The Transform Model provides DNOs with a robust evidence base for assessing the investment needs of accommodating low carbon technologies across any scenario for the next price control period. These estimates have informed the DNO investment proposals set out in their RIIO-ED1 Business Plans.

- **The Smart Cities' initiative** was launched by the Department for Business Innovation and Skills.

- In 2014**, Smart Energy UK** was launched and the public-facing campaign to communicate the benefits of smart meters began.

- DECC introduced in 2014, **Electricity Market Reforms (EMR),** that consist of Contracts for Difference as the central means for incentivizing the deployment of large-scale low carbon electricity generation and a Capacity Market, which will ensure sufficient capacity margin exists in the UK power market through a series of capacity auctions.

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Policy and Regulatory Efforts (3/5)

- DECC has commissioned Frontier Economics, with support from Sustainability First, to review the potential for demand side response (DSR) in the electricity sector to 2035. In 2015, **Future Potential for DSR in UK** was published with the aim of creating an initial framework to capture which drivers affect the capacity and costs of all types of DSR in the long-run.
- In 2016 DECC published a **Guideline on Smart Meters and Demand Side Response** to explain how the smart metering system can support load control mechanisms to facilitate domestic demand side response.
- In February 2017, BEIS published a **toolkit and factsheets on energy efficiency** to enable meter installers to give tailored energy efficiency advice during smart meter installation visits, making it easier for householders to adopt energy efficient behaviours.
- **Smart Systems and Flexibility Plan of July 2017** sets out the policy direction to guide innovation and the wider smart transition. Three key areas of focus are mentioned in the plan that are to deliver a smarter and more flexible energy system, removing barriers to smart technologies including storage, enabling smart homes and businesses and making markets work for flexibility.
- In October 2018 Government and Ofgem published a **progress update to the plan**, announcing that half of the original actions had now been implemented and identifying nine new actions they are undertaking.
- The transition to second-generation smart meters began in 2018 and in May 2019, over 1 million of these meters were connected to the national smart metering communications infrastructure. In May 2018, the **Smart Meters Act 2018** received Royal Assent, extending the Government's right to exercise powers over the roll-out to November 2023.

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Policy and Regulatory Efforts (4/5)

- In June 2019, the **New and Replacement Obligation** was activated, mandating energy suppliers to take all reasonable steps to install a compliant smart meter where a meter is installed for the first time (for example in new-build properties) or where a meter is replaced.
- Energy Networks Association (ENA) made studies on the benefits and development of new data management and analytics technologies, consistent with security and privacy requirements. In 2019, ENA published **a manifesto for a net zero energy system**, where it is stated that transformation to a smarter energy system shall continue. In this regard, more green energy needs to be connected to the grid to achieve net zero and support shall be provided for emerging local energy markets, the use of new forms of flexibility to manage the grid and the shift to 'distribution system operators' – to manage local electricity networks more actively than ever before.
- The Government offers grants to support the wider use of electric and hybrid vehicles via the Office of Low Emission Vehicles (OLEV). The schemes offered are
  - Electric Vehicle Home-Charge Scheme
  - Workplace Charging Scheme
  - ChargePoint Authorization
  - On-street Residential ChargePoint Scheme
  - Ultra-Low Emission Taxi Infrastructure Scheme

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Policy and Regulatory Efforts (5/5)

The RIIO model includes incentives to drive the innovation needed for a smarter energy network at value for money for existing and future energy customers. Under this model, network companies are expected to adopt smart solutions where they are cost-effective in comparison to conventional solutions.

The package of incentives contained in RIIO-ED1 is designed to ensure that network companies consider these solutions upfront, while also delivering these during the RIIO-ED1 period. The interruptions incentive puts a strong motivation on companies to anticipate the increased loads from low carbon technologies and ensure that they do not overload network assets. The efficiency incentive ensures that the DNOs do not over-invest to avoid interruptions. It incentivizes the companies to look for the most cost-efficient solution, which will drive the DNOs to adopt smart solutions, including Demand Side Response, in many cases.

The package of connections incentives (time to connect incentive, customer satisfaction and connection engagement) are designed to encourage the DNOs to consider the needs of customers connecting low carbon technologies and distributed generation. Network companies are also expected to maximize the benefits they can achieve from all forms of data, including but not limited to, data from smart meters.

The innovation incentive in RIIO-ED1 consists of three components:

- Network Innovation Competition (NIC) - Applies to electricity transmission and distribution companies. For the first two years of ED1, the NIC fund for electricity has been £90M annually (adding £60m to £30m previously processed in RIIO-T1).
- Network Innovation Allowance (NIA) - aims to fund small-scale innovation projects. Its values are set by default, 0.5% of allowed income as good thinking is showed with an innovation plan of 1% of allowed income
- Innovation Roll-out Mechanisms (IRM) - a mechanism that allows companies to apply for additional funding to deliver a proven innovation that meets defined criteria.

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Smart Grid Planning of DSOs

Distribution Network Operators submit their Business Plans as part of the RIIO-ED1 process, where they consider their smart grid related investments too. For ED1, Ofgem requested DNOs to include smart grid solutions in their business plans, as well as the roll-out of innovation trailed in the current price control, and the impacts of the roll-out of smart meters.

Western Power Distribution (WPD) is a DNO and distributes electricity to 7.8 million customers. In Supplementary Annex of the Business Plan (SA-03) Innovation, Smart Grids, Smart Meters, Losses and Climate Change Adaptation topics are planned. The section of the business plan describes WPD's approach to smart grids innovation and describes how they continue to innovate within their business to improve efficiency and set the foundations for smart grids. The following 5 topics are included in SA-03 of the plan:

- Innovation Strategy: A description of WPD's Innovation Strategy, including the initiatives they have already adopted, their plans for adoption of LCNF project outputs and steps they could take to prepare for the Carbon Plan
- Smart Grid Strategy: An explanation of how WPD's network will evolve into a Smart Grid, and the interactions that they will have with customers to make more flexible use of capacity.
- Smart Meters: A description of WPD's involvement in the smart meter roll out and an explanation of how they will make use of smart meter data to manage our network.
- Losses Strategy: An explanation of how losses occur and the actions that they can take to reduce losses on their network in the future.
- Climate Change Adaptation: A description of the effects that Climate Change will have on WPD, an assessment of the key priorities for them and the work they are undertaking to prepare for changes to climate

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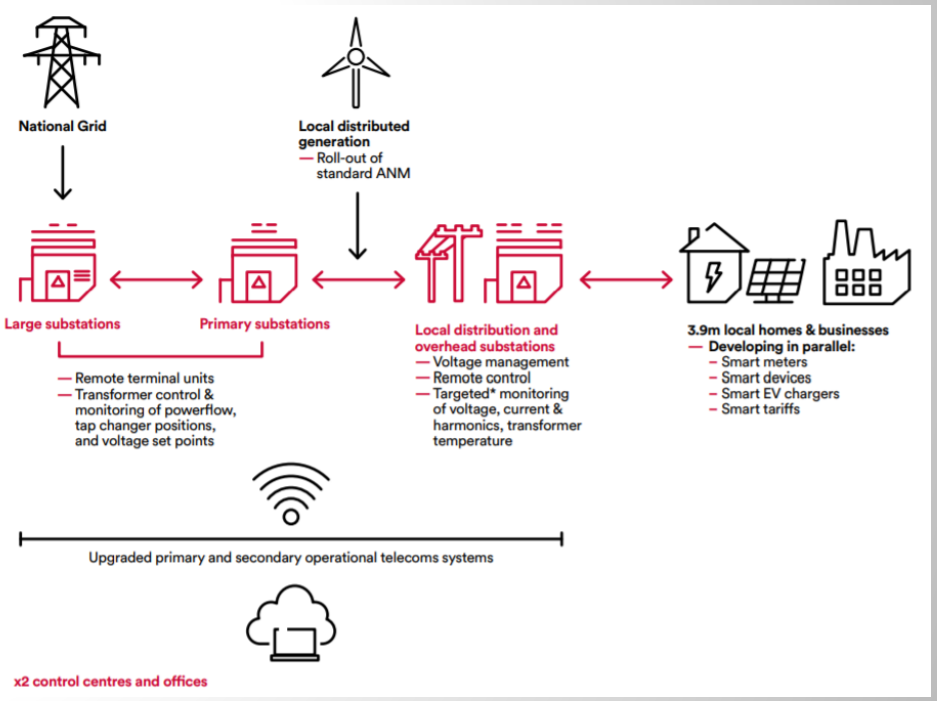
Smart Grid Planning of DSOs

As the second example; **Northern Power Grid** has Customer-Led Distribution System programme that explores the future potential for their network to operate a more flexible energy system and avoid unnecessary investment in their infrastructure or new generation. They are now rolling out the initial phase of customer flexibility, using commercial solutions to resolve network issues.

Primary Network	Local Network
Self-healing networks	Time-of-use demand data
Real-time capacity management	Remote monitoring of LV circuit power flow
Two-way power flow monitoring	Automated control of voltage
Advanced substation control devices	Fault prediction and smart ‘fuses’
Wideband flexible communications (IP-based)	Wideband communications
	Harvesting network data from existing HV devices



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Italy

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Smart Grid Regulations in Italy

- **ARERA Resolution No. ARG/elt 39/10 and the consultation paper No. 255/2015/R/eel** paved the way for **smart-grid pilot projects carried out by several operators** in Italy since 2011. The Resolution introduced incentives to support investments related to the development of smart grids and the installation of smart meters by electricity distributors. Temporary enhanced Return on Revenue (RoR) for demonstration projects with capital expenditure (CAPEX) has been provided in Italy under this resolution. On the basis of a competitive process, the resolution provides an **additional 2% extra on Weighted Average Cost of Capital (WACC)** remuneration for a period of 12 years on the part of the distribution RAB associated with investments needed for the demonstration project. However, it has to be noted that it only covers capital expenditure and not operation costs, which in the case of R&D projects can be substantial.

- With **Resolution ARG\elt 198/11**, the Autorità per l'energia elettrica e il gas (AEEG) maintained **incentives for smart grid projects** granted under the aforementioned Resolution 39/2010 for the regulatory period 2012–2015.

- The Italian Energy Authority also supported pilot projects aimed at testing different market models for electric vehicle charging services under **Resolution ARG\elt 242/10.** Five new pilot projects have been allowed, with an annual contribution of EUR 728/year per charging point up to 2015 for the construction and operation of charging infrastructure, according to three market models: Distribution model, competitive service provider model, sole service provider model.

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Smart Grid Regulations in Italy

- AEEG has initiated a process for the **identification of regulatory tools and criteria** that could be used to incentivize DSOs to orient their own investment plans towards smart grids. Then, the regulatory authority launched a selection process for smart grid demonstration projects, focused on active **Medium Voltage (MV) networks**. This process has been based on a comparative assessment of different proposals presented by DSOs, according to a key-performance indicator scheme that takes into account the costs and benefits.
- **Italian Energy Efficiency Action Plan** of 2014 introduced smart meters in detail within the scope of the Policy measures implementing the Energy Efficiency Directive.
- Together with the **Ministerial Decree dated 19 October 2016,** the Ministry of Economic Development has established a state-aid program dedicated to investments for the construction of intelligent electricity distribution networks, where the programme is valid until 31 December 2020. The relevant ministerial decree provides a common legal and economic framework for public administrations to launch calls for tenders, in order to promote the upgrading and optimization of the electrical network in specific areas of the country. In 2017–2018, the Ministry itself launched and concluded a tender procedure for the construction of smart grids in Basilicata, Calabria, Campania, Apulia and Sicily.
- **ARERA Resolutions No. 646/2016/R/eel of 10 November 2016 and No. 222/2017/R/eel of 6 April 2017** includes the detailed rules on the recognition of costs for low-voltage electricity metering as for second generation smart metering (i.e., the remote reading and control of power consumption) with the purpose of encouraging and compelling distribution undertakings to upgrade their assets to meet the ongoing technological developments.

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Smart Grid Regulations in Italy

- **Directorial Decree 20 March 2017** – (Call for electricity distribution networks Pon I&C 2014-2020) concerns the Call for electricity infrastructures for the construction of smart energy distribution networks (smart grid) in the territories of the less developed Regions. The decree was registered by the Court of Auditors on April 4, 2017.
- In 2017, **the National Energy Strategy (SEN),** the ten-year plan was published by MiSE introducing the national energy targets to drive the energy transition toward the policy targets. The SEN is closely coordinated with the European Strategic Energy Technology Plan (SET Plan) and is complemented by the Integrated **National Energy and Climate Plan (PNIEC).**
- PINEC's final draft has been submitted by MiSE to the European Commission in December 2018. The plan sets the energy scenario towards 2030, fostering a wide-ranging transformation in which the combination of decarbonisation, circular economy, efficiency and rational and fair use of natural resources represent objectives and instruments for the future of the economy.

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Germany

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Smart Grid Regulations in Germany

- The **Digitizing the Energy Transition-Act** (Gesetz zur Digitalisierung der Energiewende) also from summer 2016 sets the start signal for smart grids, smart meter and smart home in Germany. Most important elements of the new act are the obligation for the smart meter rollout with a pre-defined pricing model according to consumption and regulation as regards data communication and security (see below).
- In addition, Federal Government introduced the vision called **Power 2030 (Strom 2030)** with the goals of a more flexible system, well expanded modern grids, integration and making the European markets further flexible, bringing production and consumption cost-efficient together and reliability of supply, digital solutions help to use decentral consumers like electric cars or heat pumps with a benefit for the system.
- Smart grids are considered as integral part for the achievement of Germany's climate goals 2050. In this regard, single actors published roadmaps.
- Moreover, the federal state **BadenWürttemberg** has a **Roadmap** that defines own climate goals for the state with the help of smart grids.
- In 2018 the Federal Ministry for Economic Affairs and Energy presented the **Electricity Grid Action Plan** that follows a two-pronged approach: to optimise existing grids using new technologies and operating strategies, and to speed up grid expansion by simplifying planning procedures and utilising forward-looking controlling.
- The **2019-2030 Grid Development Plan** was endorsed by the Bundesnetzagentur in December 2019. The plan outlines the grid expansion and optimisation that is necessary up to 2030 to reach the climate targets in Germany.

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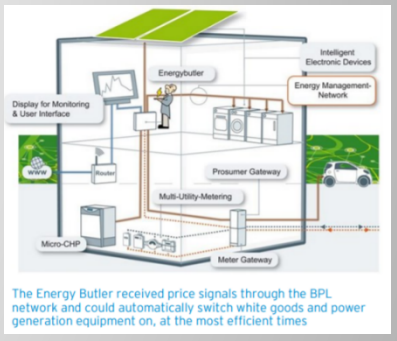
Smart Grid Regulations in Germany

- Germany forecast to invest $23.6 billion in smart grid infrastructure including 44 million smart meters by 2026. The smart metering legislation passed in July 2016 is regarded as an important next step in the country's broader transition to a low-carbon and energy efficient energy economy known as the **'Energiewende**'. According to the reports, Germany has failed to keep pace with its neighbours in terms of meeting smart metering targets.
- The **Act on the Digitization of the Energy Transition** calls for the deployment of smart meters. Germany aims for full deployment of smart meters by 2032. In addition to smart metering, Germany will also invest in other smart grid infrastructure segments. Over the next decade, the country is expected to invest $14.1billion in advanced sensors, communications and software for its distribution grid and in battery storage. Investment will be undertaken by the country's four largest utilities: RWE, E. On, EnBW, and Vattenfall, as well as the numerous Stadtwerke, or municipal utilities. Rollouts should be rapid due to an efficient power sector and popular support for Energiewende.
- The gained results and insight from smart grid trial projects are continued in a follow-up programme "**Smart Energy Showcases - Digital Agenda for the Energy Transition" (SINTEG)** that aims to develop and demonstrate in showcase regions new approaches to ensure reliable and secure grid operation with high shares of RES generation on the basis of wind and solar energy. The programme places a clear focus on building smart networks linking up the energy supply and demand sides, and on the use of innovative grid technology and operating strategies. It thus addresses key challenges of the energy transition including the integration of renewables into the system, flexibility, digitisation, system security, energy efficiency and the establishment of smart energy systems and market structures. The project makes an important contribution to moving forward the digital transformation and the energy transition.



The Energy Butler received price signals through the BPL network and could automatically switch white goods and power generation equipment on, at the most efficient times

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Smart Grid Regulations in Germany

- As in the free market economies, the Federal Republic of Germany is working on competition to ensure that prices are affordable. There exists a balance between supply and demand, and companies are encouraged to constantly look for new products and low-cost production technologies. However, several sectors of a national economy may emerge as an exception.
- Since the operation of energy networks is a capital-intensive business, Energiewende examines the investments from network operators accurately. The power and gas lines required for Energiewende cost billions of dollars. **German network operators need a long-term planning horizon** and reliable economic framework conditions for such investments. Consumers and third parties (i.e., suppliers) seeking network access are of great interest in accessing the electricity grid and the gas grid and fair calculation of prices. This legal duty is carried out by Bundesnetzagentur by a specific regulatory approach known as incentive regulation.
- There is no ideal regulatory approach for regulated industries. Bundesnetzagentur **constantly evaluates the incentive regulation with industry associations, network operators, network users and political representatives**. Moreover, Bundesnetzagentur adapts administrative procedures to new developments and proposes changes to the framework.
- For consumers and commercial enterprises, fair calculation of the price of access to the electricity grid is carried out by Bundesnetzagentur with the regulation of incentive regulation.

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Spain

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Smart Grid Regulations in Spain

- In Spain, until 2007, Red Eléctrica Española and the main energy suppliers joined their efforts to transform the currently grid system to a smart grid. There was not any specific law available that regulates smart grid systems. On the other hand, there were laws that regulate the **grid conditions and the energy meters specifications**.
- **Order ITC/3860/2007,** adopted on 28 December 2007, required utility service providers to progressively replace electricity meters under 15 kW with smart meters. During each of the four replacement periods starting from 2008 through 2018, energy distribution companies must install smart meters to replace a certain percentage of the firm's total electricity meter stock. Customers have the option of buying or renting the equipment. As result of the meter replacement plan at the end of December 2017, 91% of new meters were already installed.
- Smart Meter's Replacement Plan was amended in 2012 with the **ORDEN IET/290/2012** publication which modifies the previous order to adjust the Replacement Plan to the current deployment status.
- **Royal Decree 647/2011**, of 9 May, regulating activity for charging point managers (companies allowed to buy and resell electric energy exclusively for electric vehicle charging) defined specific low access tariffs for night / off-peak recharging.
- Benchmarking smart metering deployment in the EU-27 with a focus on electricity was performed with **COM (2014)** on 17th June 2014.
- **Royal Decree 216/2014**, of 28 March, set final prices for electricity consumers according to real metering in hourly basis.

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Smart Grid Regulations in Spain

- **The Resolution of 2nd June 2015** of the Secretary of State for Energy approved the Operational Procedures necessary to start issuing bills to customers equipped with smart meters based on hourly consumption and hourly prices. The first bills of this kind were issued in October 2015. This model provides a dynamic price signal to small customers and consequently, a way to implicitly participate in the market by shifting consumption to the hours of the day where energy is cheaper.

- In Spain, there is no specific public programme to fund smart grid pilot projects. Although some basic R&D projects are partially financed with the national and European R&D programs, most of the pilots has been **fully funded by the companies** which are developing them and **additional costs were not taken into account in the reference grid model**. There are varying shares of national funding, especially mainly the Basque region area. On the other hand, being not similar to many other countries, in Spain, there is an exception for EU funding incentivising the DSO, **which amounts to 10% of the regulated asset base**. Investment financed by third parties don't add to RAB, but if DSOs get EU fund, 10% is added into the RAB

- The Spanish **smart grids platform FutuRed** was established in October 2015, for the purpose of integrating all of the stakeholders involved in the electricity sector behind a set of common goals. FutuRed brings together smart grid stakeholders; utilities, companies, universities, research institutions, organizations and public administration – with a total of 127 entities as members. This in order to define and promote strategies at national level to allow the realization of a more advanced power network – one capable of responding to the challenges of the future.

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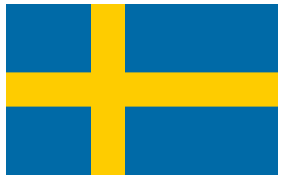
Sweden



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Smart Grid Regulations in Sweden

- One of the key policies related to smart grid is energy research programmes' supporting extensive research and innovation that have applications in society and the energy research grant's constituting an important means of influence and control for transforming the energy system.
- By 2030, Sweden plan to have a vehicle stock that is independent of fossil fuels and, according to a broad Parliamentary 5 party agreement in 2016.
- In May 2012**,** the Swedish Government appointed a **Coordination Council and National Information Platform** for Smart Grids (2012:48). The role of the Coordination Council includes **promoting dialogue and cooperation by developing a national information platform** and a **national action plan** for the development of smart grids in Sweden from 2015 to 2030. To highlight long-term results and the need for measures, the Coordination Council has extended its **future scenarios** to **2050** for the development of smart grids in Sweden. The Council defined some challenges related to smart grids as communication for smart grids, system architecture, energy efficiency, power quality, managing low-cal generation, study of active demand, customer benefits of smart meters, vulnerability for IT threads in smart grids, and characteristic of loads.

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Smart Grid Regulations in Sweden

- Sweden is one of the leader companies in the development, implementation and dissemination of smart grids. Within the Country, there is close cooperation between universities, industry, institutes, institutions, non-Governmental organizations and the education, research and innovation-information triangle initiative.
- **The Swedish Smart Grid Forum** was appointed in 2013 by the **Swedish Ministry of the Environment and Energy** and has 18 members. These members represent central agencies, businesses and organizations and have a wide range of skills in smart networks. The Forum is established as a result of the recommendations from the Swedish Coordination Council for Smart Grid (active 2012–2014). The mission is to implement the action plan, set up by the Council, to further develop a store of knowledge on the website and to support Swedish export within smart grids. The goals of the Swedish Smart Grid Forum are;
    - An electricity market with active customers, as well as the robust and effective integration of 100 percent renewable electricity.
    - Sweden is a hub for smart grids, with internationally recognized expertise and a natural test bed for smart grids.
    - Growing the number and variety of exporting smart grid companies, services and products in Sweden.
- The **Swedish Energy Agency** distributes almost all state funding for energy research, and it provides funding for both major research at universities and large-scale demonstration projects in cooperation with industry. **The agency also supports the development from technical solution to commercial product.** It also promotes energy efficiency and smarter energy usage by conducting information campaigns, making technical purchases, executing business intelligence, and testing and labelling products. The agency also provides financial support to Sweden's municipalities for energy and climate consulting services.

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Smart Grid Regulations in Sweden

- Smart Grids the action plan that has been developed by Swedish Coordination Council for Smart Grid includes a discussion on long-term measures that are not directly linked to the recommendations in the action plan. In this plan, how to revise and develop the tools that are in use today in order to cope up with **longer term expectations of changing conditions** of the market is discussed. An important condition is the rules that govern the European market, which will cause changes in the Swedish market. Even economic instruments such as green electricity certificates and energy taxes should be reviewed from a long-term perspective. Finally, opportunities in the public sector are highlighted, e.g. **public procurement, tenders, and procurement of innovation.**
- In 2019, According to Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, Ministry of the Environment and Energy published Sweden's **draft Integrated National Energy and Climate Plan**. The plan consists of description of Sweden's integrated national energy and climate policies including smart grids.

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Smart Grid Regulations in Sweden

- Regarding smart meters, NRA determines a revenue cap for each DSO for a period of four years at a time. The minimum functional requirements may increase the cost for smart meters. Therefore, it is important to consider how costs related to meters are handled in the revenue-cap regulation to facilitate the roll-out of the next generation smart meters. There are both operating expenses (OPEX) and capital expenses (CAPEX) connected to meters.

- With the new legislative amendment in 2017, all electricity consumers can now request **hourly metering** without extra cost. In Sweden, the DSO is responsible for the registration and reporting of values. The DSO is obliged to report values in the common standard electronic data interchange format, upon request from the customer. If the customer has opted for hourly metering, the DSO must make the metering data available online.

- The revenue cap regulation includes incentive schemes based on several indicators for continuity of supply, losses and for having a more even load. Smart meters can have indirect impact to help the DSO improve such indicators in a longer perspective.

- In Sweden there are already incentives in the regulation model for **quality/security of supply and for efficient utilization of the power grid**. The later one focus on reducing network losses and improving the load factor. These kinds of bonus/malus system are a good ambition but need to be developed to really give us the incentives wanted. There is an ongoing project at the Regulator to develop these incentives

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Comparative Review of Smart Grid & Regulatory Practices

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Recap of EU Countries for Electricity Distribution

Practices	UK	Germany	Italy	Spain	Sweden
Specific mechanisms to incentivize smart grids innovation	Yes (adjusted within regulatory period)	Treated like other costs	Yes (adjusted within regulatory period)	Treated like other costs	Treated like other costs
Regulatory incentives to smart grids innovation	Low Carbon Network Fund (LCNF) included funds for trialling smart technologies in previous years. It was replaced with Network Innovation Competition (NIC), and Network Innovation Allowance (NIA), which are limited amounts. DNOs present their smart grid solutions in their business plans. There are incentives in RIIO for smart solutions including DSR for efficiency and managing network loads and demands.	DSOs can apply for the cost recognition of R&D projects, and NRA is allowed to approve revenue adjustment in case projects receive public finance and DSO carries 50 % of the cost. Additional cost for SG is not approved by the NRA for the majority of projects.	Investment made in SG pilots selected by the NRA was treated in the same way as other investment but receiving a premium on the WACC (+2%) for 12 years. After 2015, output-based deployment projects started to be implemented.	Additional costs were not taken into account in the reference grid model. However, if DSOs get EU fund, 10% is added into the RAB. There is not any specific program /mechanism to fund SG pilots. Some basic R&D projects are partially financed in the national and European R&D programs. Current projects are fully funded by the companies developing them.	All assets that are used and needed in the network business are included in the RAB (for instance smart meters as CAPEX). Large scale projects with a character of a pilot project and financed partly by EU-funds might be classified as non-regulated business.
Any platform for smart grid	Smart Grid Forum	SmartGrids Baden-Württemberg	Smart Grids italia	FutuRed	Swedish Smart Grid Forum

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Recap of EU Countries for Electricity Distribution

Practices	UK	Germany	Italy	Spain	Sweden
Monitoring demonstration projects and roadmaps	All companies running projects must produce progress reports every six months. These reports must include the progress they have made against their project plan and the learning that the project has delivered in the previous six months. The company must also explain the activities that it has undertaken to disseminate the learning. All companies must also produce a comprehensive report following the conclusion of the project. These reports must explain how other parties can replicate the implementation and outcomes of the project. The consultation on the structure of these reports has recently been issued. Ofgem, Government, DSOs and the Smart Grid Forum are responsible for monitoring the route-map.	As part of the process for selecting which projects are funded, companies' approaches on progress reporting and disseminating learning are evaluated. High quality learning dissemination activities that either build on best practice from other demonstration projects or incorporate innovative approaches is expected.	For AEEG projects, a work progress report has to be sent by the involved DSOs to the NRA every six months. Thereafter, monitoring is through ad-hoc meetings and result dissemination	The NRA has limited information about demonstration projects, as it is not NRA´s responsibility to monitor third party projects and agreements in which CNE is not an active member of the project.	Swedish Smart Grid Forum (established with the Government decision) follow up the implementation of the action plan for smart grids developed by the Coordinating Council for Smart Grids.(http://swedishsmartgrid.se/)

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Recap of EU Countries for Electricity Distribution

Practices	UK	Germany	Italy	Spain	Sweden
Implementation of energy policies	DECC: responsible for high level policy making Ofgem: independent body, operating within the legal framework determined by the UK Government and the European Union. Incentives are introduced by Ofgem. DECC and Ofgem works in cooperation and established Smart Grid Forum in 2011. Smart Metering Implementation Programme is led by Department for Business, Energy & Industrial Strategy (BEIS), regulated by Ofgem, and smart meter delivered by energy suppliers. The Government's role includes developing smart metering policy and strategy, providing the right framework against which energy suppliers and network operators can plan, and ensuring benefits are delivered to consumers	There are 16 federal states with their own Governments. They have their own budget and they are independent to initiate their own projects and can prioritize different focus areas such as smart grids.	Ministry of Economic Development (MISE) defines the strategic lines and sets out general principles AEEG (NRA) has a significant role in development of smart grids, launched a competition-based procedure to incentivize smart grid/demand response projects	Ministry of Industry, Energy and Tourism develops legislative proposal and prepares national action/strategy plans in the process of developing Smart City in Spain, also approves the distributors' smart meter equipment and replacement protocols. CNMC (NRA) monitors development of smart grids.	Coordination Council and National Information Platform for Smart Grids, appointed by the Government promotes dialogue and cooperation by developing a national information platform and a national action plan for the development of smart grids in Sweden from 2015 to 2030. In January 2020, the Government commissioned the Swedish Energy Agency and the Energy Market Inspectorate (EI) to produce proposals on how the Forum's work can be taken further. In addition, EI has also monitors the compliance with the regulations

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Recap of EU Countries for Electricity Distribution

Practices	UK	Germany	Italy	Spain	Sweden
Incentives for OPEX related to smart grid innovation	Yes	No	No	No	No
CBA (for smart meters)	Positive	Negative	Positive	No CBA	Positive
Meter ownership and installation belongs to	Energy supplier	DSO or 3rd party meter operator	DSO	DSO	DSO
Considered market actors in smart meters rollout	Supplier Consumer State/Society	Supplier Consumer State/Society TSO Balance Responsible BRP Producer Independent aggregator	DSO Supplier NRA Consumer State/Society TSO BRP Telecom service provider	No CBA	DSO Supplier NRA Consumer State/Society

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Recap of EU Countries for Electricity Distribution

Practices	UK	Germany	Italy	Spain	Sweden
Market drivers for smart meter roll-out	Digitalize retail market to foster innovation and new services by private actors Support actions tackling fuel poverty	Enable dynamic tariffs for households and SMEs Digitalize distribution grid and optimize network operations Digitalize retail market to foster innovation and new services by private actors Integrate decentralized energy resources with flexible access (load shedding, infeed curtailment) Support actions tackling fuel poverty Support energy efficiency	Enable dynamic tariffs for households and SMEs Digitalize distribution grid and optimize network operations Digitalize retail market to foster innovation and new services by private actors Support actions tackling fuel poverty Support energy efficiency	Digitalize distribution grid and optimize network operations Digitalize retail market to foster innovation and new services by private actors Support energy efficiency	Enable dynamic tariffs for households and SMEs Digitalize distribution grid and optimize network operations Digitalize retail market to foster innovation and new services by private actors
Total smart meter penetration rate	19.9% (as of 2018)	Not available	98.5% (as of 2018)	93.1% (as of 2018)	100%

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Other Key Topics

- Incentives to force network operators **to choose investment solutions that offer the most cost-effective solutions** (e.g. In United Kingdom, capital efficiency requires that the DNOs employ the most cost-effective network development strategies.)
- Incentives to encourage network operators to choose **innovative solutions/incentives for network operators to encourage efficient use of electricity and renewable electricity production** (e.g. In United Kingdom, incentives are provided for the best innovation projects that help all network operators understand the measures needed to provide environmental benefits and security of supply for value for money. In Italy, the index used for selecting demonstration projects considers the benefits of increasing the renewable electricity supply and the reduction of losses.)
- **Standards on smart grid stakeholders** (e.g. In Germany, there is a differentiation between smart and conventional grids. There are special requirements for technical protection and communication between market partners using smart meters. Likewise, in United Kingdom, standards on smart grid technology are important for interoperability within a smart grid.)
- **Active participation in the development of smart grids by stakeholders** (e.g. In Spain, manufacturers will need to provide appropriate equipment and so will need to be more actively involved in a smart grid. Similarly, in Portugal, hardware and software developers will need to innovate as new services are offered to customers. In Italy, the level of stakeholder involvement will increase alongside smart grid development.)

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Other Key Topics

- The **roles and relationships of relevant stakeholders to encourage the introduction of new services or markets** (In Germany, incentives must be created for some roles, for example aggregators and consumers. In United Kingdom, new stakeholder roles and relationships must be defined as new services are introduced in a smart grid.)
- The introduction of **new tariffs to incentivize more efficient network use** (e.g. In Finland and France, new tariffs are being developed with the advent of smart grids.)
- Unbundling that cause **uncertainty about the responsibility regarding the smart grid investments** (e.g. In Portugal, unbundling activities introduce new regulatory challenges since potential new services for smart grids will be provided by a combination of DSOs and suppliers.)
- **Data protection, security** (e.g. in Germany, there are strict data protection laws, which is a very sensitive area, especially for the end consumer and standardization and here above all compatibility of ICT and appropriate processes for interfaces are barriers)

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Other Key Topics

- Lack of clear regulatory framework and existing **complex regulation** (e.g. in Germany after coming into force of the digitisation act legal, uncertainty relating to load management and dynamic pricing, 3rd Energy packages being mostly related with smart meters but not with other smart grid components, unclear incentive methods)
- Lack of **customer demand and applications** (e.g. in Germany, although technology is not a problem, there are not many electric vehicles or smart home applications are not common etc. This goes hand in hand with the fact that **business cases are still lacking**. In addition, there is lack of awareness and limited understanding in EU, related to smart grids)
- Lack of **EU-wise technical standards** (e.g. different utilities might use different interoperability standards and specifications)

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Task 4.2 Workshop

Regulatory Approaches for Selected Smart Grid Components in EU

Electricity Distribution

15 September 2020, Online Training

This project is funded by the European Union

Agenda

Regulatory Approaches for Selected Smart Grid Components in EU

- Key Performance Indicators Used by Regulatory Organizations
- Regulations Regarding Smart Metering
- Legislation on Energy Storage Solutions
- Demand Side Management (DSM) Regulations
- Interoperability and Standardization
- Regulations on Communication Infrastructures for Smart Grids
- Smart Grids Cyber Security and Data Ownership Regulations
- Regulations on Renewable Energy Sources Integration
- Relationships Between Distribution and Transmission System Operators

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Key Performance Indicators Used by Regulatory Organizations

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KPIs Used by Regulatory Organizations

- In order to measure and evaluate the effects of smart grids, some key performance indicators have been defined.
- In Europe, the *EU Working Group for Smart Grids* identified the outcomes of ideal smart grids and ideal smart grid applications, and measured the benefits achieved through some key performance indicators.
- European Electricity Grid Initiative (EEGI) followed a different method and divided the ideal smart grid into thematic areas. The contribution of projects to progress in each thematic area and system level is analysed.

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EU Smart Grid KPIs

Benefits and KPIs published by the EU Smart Grid Working Group

- **Increased Sustainability**
  - Quantitative reduction of carbon emissions
  - Environmental impact of the electricity network infrastructure
  - Reduction of accidents and risks related to production technologies
- **Adequate Capacity in Transmission and Distribution Networks to Reach Electricity to Consumers**
  - Capacity for distributed energy sources in distribution networks
  - Maximum power that can be delivered to transmission networks without the risk of constraints
  - Energy that cannot be withdrawn from renewable energy sources due to constraint and/or security risk
  - Optimized use of capital and assets
- **Adequate Network Connection and Access for All Network Users**
  - Initial connection fees for producers, consumers, and both
  - Network tariffs for producers, consumers, and both
  - Methods used to calculate tariffs and prices
  - Connection time for the new user
  - Optimization of new equipment design that gives the best benefit / cost ratio
  - Faster innovation with clear / open standards

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EU Smart Grid KPIs

Benefits and KPIs published by the EU Smart Grid Working Group

- **Adequate Level of Security and Supply Quality**
  - The ratio of reliable available production capacity to peak demand
  - Electrical energy rate produced from renewable energy sources
  - Measured satisfaction of network users regarding the network service they have received
  - Power system stability
  - Frequency and duration of downtime per customer
  - Voltage quality performance of electrical networks (e.g. voltage and frequency deviations)
- **Increased Efficiency and Better Service in Electricity Supply and Network Operations**
  - The level of transmission and distribution network losses. Storage reduces losses but active flow control increases losses
  - The ratio between minimum and maximum electricity demand in a given time period
  - % Use of electrical network components (e.g. average load)
  - Demand side participation and energy efficiency criteria in the electricity market
  - Availability of network components (planned and unplanned maintenance) and their impact on network performance
  - Actual availability of grid capacity according to standard values (e.g. distributed energy sources, net transfer capacity in transmission networks)

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EU Smart Grid KPIs

Benefits and KPIs published by the EU Smart Grid Working Group

- **Effective Support of International Electricity Markets and Increased Interconnection Capacity with Load Flow Control**
  - The ratio of interconnection capacity of a country / region to electricity demand
  - Maximization and utilization of interconnection capacities, particularly in accordance with electricity cross-border trade regulations and constraint management guidelines
  - Constraint leases between interconnections
- **Coordinated Network Development with Common European, Regional and Local Network Planning for Optimization of Transmission Network Infrastructure**
  - The impact of constraints on outputs and prices in national / regional markets
  - Social benefit-cost ratio of proposed infrastructure investments
  - Total welfare increase (e.g. always running the longest production facilities to meet actual demand)
  - Time required for licensing / authorization of the new electricity transmission infrastructure
  - Time required for the construction of the new electricity transmission infrastructure

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EU Smart Grid KPIs

Benefits and KPIs published by the EU Smart Grid Working Group

- **Increased Consumer Awareness and New Players' Participation in the Market**
  - Demand side participation in the electricity markets and energy efficiency
  - Percentage of customers using timed usage / critical peak / real-time dynamic pricing
  - Change of electricity consumption patterns after new pricing mechanisms
  - % ratio of users with intermittent load behaviour
  - Percentage of demand participation in market-based designs for demand flexibility
  - Percentage of participation in ancillary services at low voltage level
- **Informing Consumers in Decisions to Meet EU Energy Efficiency Targets**
  - Base / Peak Load Rate
  - The relationship between energy demand and electricity market price
  - Understanding of actual energy consumption and freely requesting of data by customers
  - Consumers can request past energy consumption information free of charge and in a way that can compare between options in the market.
  - To be able to participate in the relevant energy market for the purchase and sale of electricity
  - Establishing an easily understandable link between energy prices and consumer behaviour

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EU Smart Grid KPIs

Benefits and KPIs published by the EU Smart Grid Working Group

- **Establishing Market Mechanisms for New Energy Services such as Energy Efficiency or Energy Consultancy to Customers**
  - Simple and / or automatic changes in consumers' energy consumption with the formation of demand / response signals
  - Clear identification of data ownership and determination of data processes
  - Accessibility of data related to physical network
  - Physical connection authorization, requirements and fees being transparent
  - Effective handling of customer complaints
- **Decreasing Pressure on Decreasing or Increasing of amount on Consumer Invoices**
  - Transparent and healthy processes for evaluating the benefits of application exceeding costs in the regions where the installation takes place
  - Regulatory mechanisms reflecting benefits to consumer invoices
  - New smart tariffs that provide tangible benefits to the customer or community
  - The market design is compatible with consumers' network usage

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Regulations Regarding Smart Metering

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Regulations Regarding Smart Metering

- Various Directives and smart meter regulations were published by EU:

  - **The Third Energy Package (2009/72/EC): I**mplementation of smart metering systems for the long-term benefit of consumers of Member States.
  - **The Commission Recommendation 2012/148/EU23:** Guidance to Member States on the design of smart metering systems to ensure the protection of personal data.
  - **Directive 2012/27/EU24 on energy efficiency:** Energy saving target was updated to 20% by 2020. Additional instructions on the deployment, minimum common smart metering features, data protection and end-user privacy.
  - **Directive 2014/32/EU26:** Harmonization of national laws
  - **Commission Recommendation 2014/724/EU29:** Data protection impact assessment template
  - **Directive 2014/94/EU30:** Link between public EV charging stations and smart metering systems

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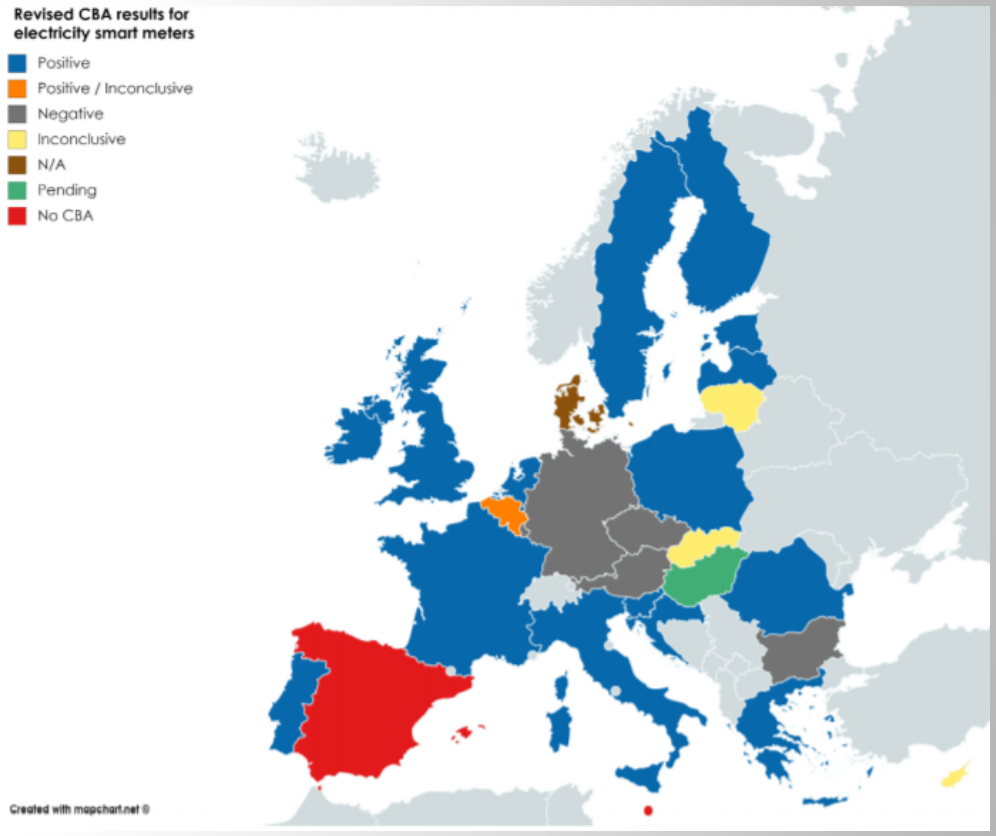
Regulations Regarding Smart Metering

- In 2014, a first benchmarking report was presented by the European Commission, presenting the CBAs' outcome.
- As of July 2018, **all but two Member States have conducted at least one CBA** for a largescale rollout of electricity smart meters to at least 80% by 2020, with the results for most of these being positive.
- As of 2018, **33.83% of all electricity metering points** were equipped with a smart meter (ca. ***99,080,000 smart meters***).
- Taken separately, households' electricity metering points and SMEs metering points were equipped at 34.5% and 27.52%, respectively.



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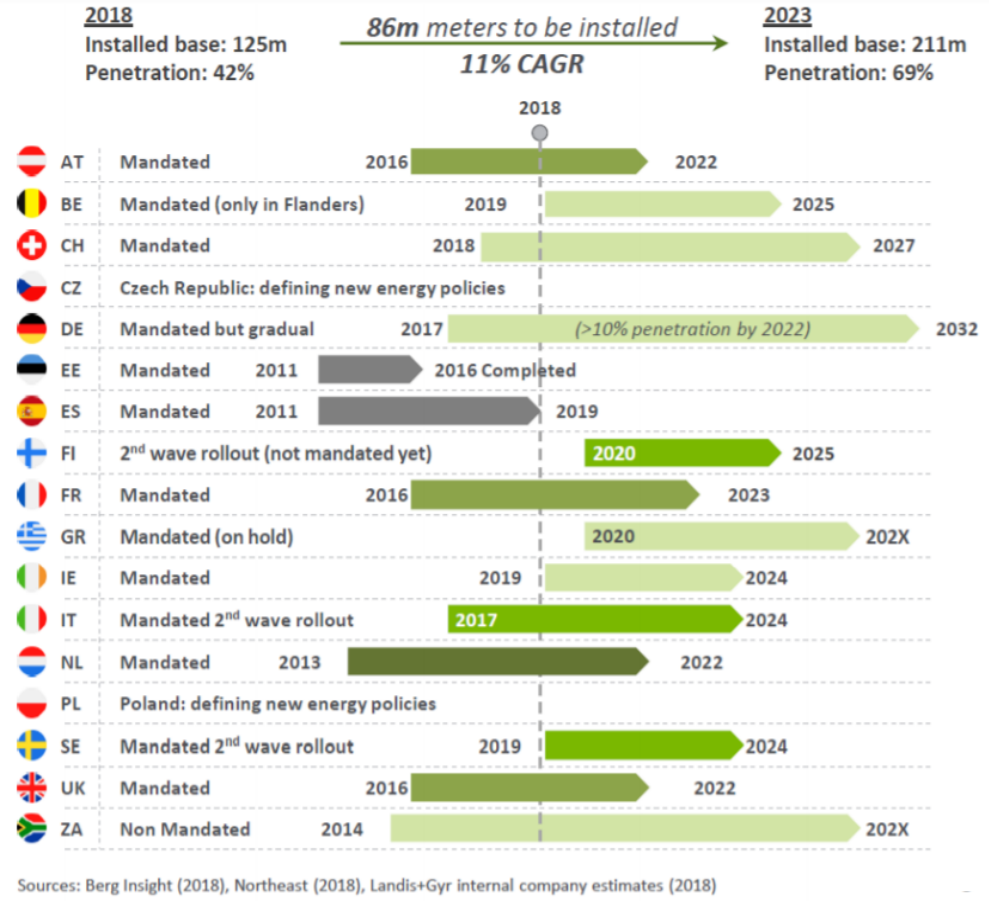
Regulations Regarding Smart Metering



Progress in EU:

- **Sweden, Finland, Italy, Estonia, Malta, Spain and Denmark** have already a wide-scale roll-out for electricity in place today.
- About **one third of the Member States will roll-out smart meters by 2030 or later**, as their latest CBA is still negative.
- According to the recast Electricity Directive, these Member States will have to **perform a CBA every 4 years**.
- **Once the result of the CBA is positive, at least 80 % of the end users shall be equipped** with smart metering systems within 7 years from the date of the positive assessment.

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Legislation on Energy Storage Systems

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Legislations on Energy Storage Systems

The European Commission and regulatory agencies have recognized that many regulatory problems hinder the development of the energy storage area, and the most important are:

- Unclear rules for ownership
- Unclear rules for accessing the network
- Energy storage, which is not taken into account in network planning due to the lack of incentives for TSOs and DSOs to do so
- Uncertainty about network fees and charges
- Lack of markets for services provided to the network

Regarding ownership, all participants agreed that primarily energy storage is a market activity, but network operators should not be prohibited from owning and using storage facilities under exceptional conditions strictly defined by national regulatory agencies.

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Legislations on Energy Storage Systems

As an output of the work focused on energy storage solutions, The European Commission published two working papers on the subject matter: (i) "***Definitions and principles***" (June 2016) and (ii) ***'Energy storage - its role in electricity***' (Feb. 2017)

Development and financing of energy storage can be based on the following principles:

- Energy storage should be developed to the extent that the total cost of the energy system with new storage capacity is lower than that of the non-storage system.
- Energy storage should be rewarded for peer-based services which are provided through demand-side management or flexible production by alternative suppliers.
- Contribution of energy storage as a supportive tool for the integration of variable renewable energy, electricity grid or other economic sectors to increase energy security and de-carbonization.
- When a generator or consumer chooses to integrate a storage plant in its place, this should not lead to less positive treatment in terms of obligations.

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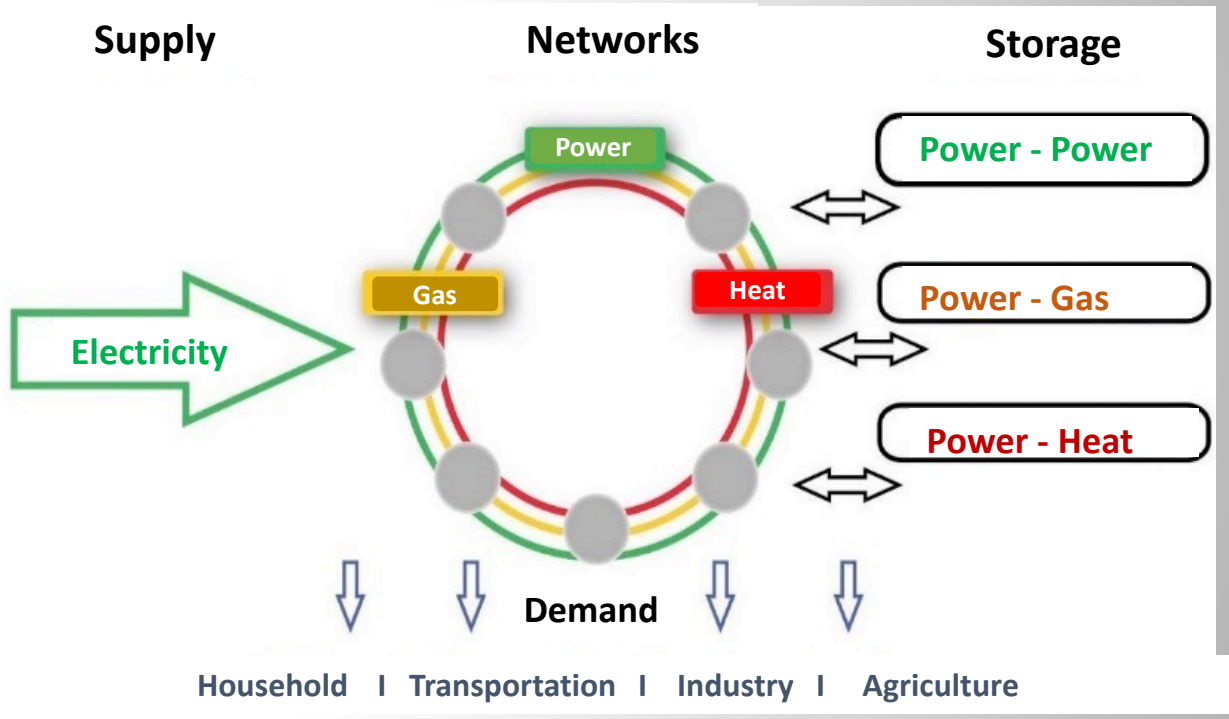
Legislations on Energy Storage Systems

Role of Energy Storage in Electricity:

- Energy storage is an important component in providing flexibility and supporting renewable energy integration in the energy system. It can balance central and distributed electricity generation, but also contributes to supply security.
- Energy storage will have a complementary effect on demand side management, flexible generation and network development.
- Energy storage can also contribute to de-carbonization of other economic sectors and support increased share of the integration of variable renewable energy in transportation, buildings or industries.



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Demand Side Management (DSM) Regulations

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Demand Side Management Regulations

- Recently, demand-side management programs started to be implemented EU-wise. Regulatory developments create a momentum that needs to be sustained, to provide wider demand-side management and greater potential benefits for consumers.

- Existing provisions in EU legislation (3rd Energy Package Electricity Directive and Energy Efficiency Directive) enable demand side management. This framework sets out the requirements and responsibilities that shall be implemented by Member States, National Energy Regulators, TSOs and DSOs to ensure and improve demand-side management, and to allow further development of market and consumer satisfaction.

- In order to activate the demand-side management market, one must specifically acknowledge that a company can fulfil more than one role, and roles and responsibilities must be clear. For demand-side use, there is a need to strike an appropriate balance among consumers and their BRPs, TSOs, DSOs and aggregators who are encouraged to participate in demand-side management.

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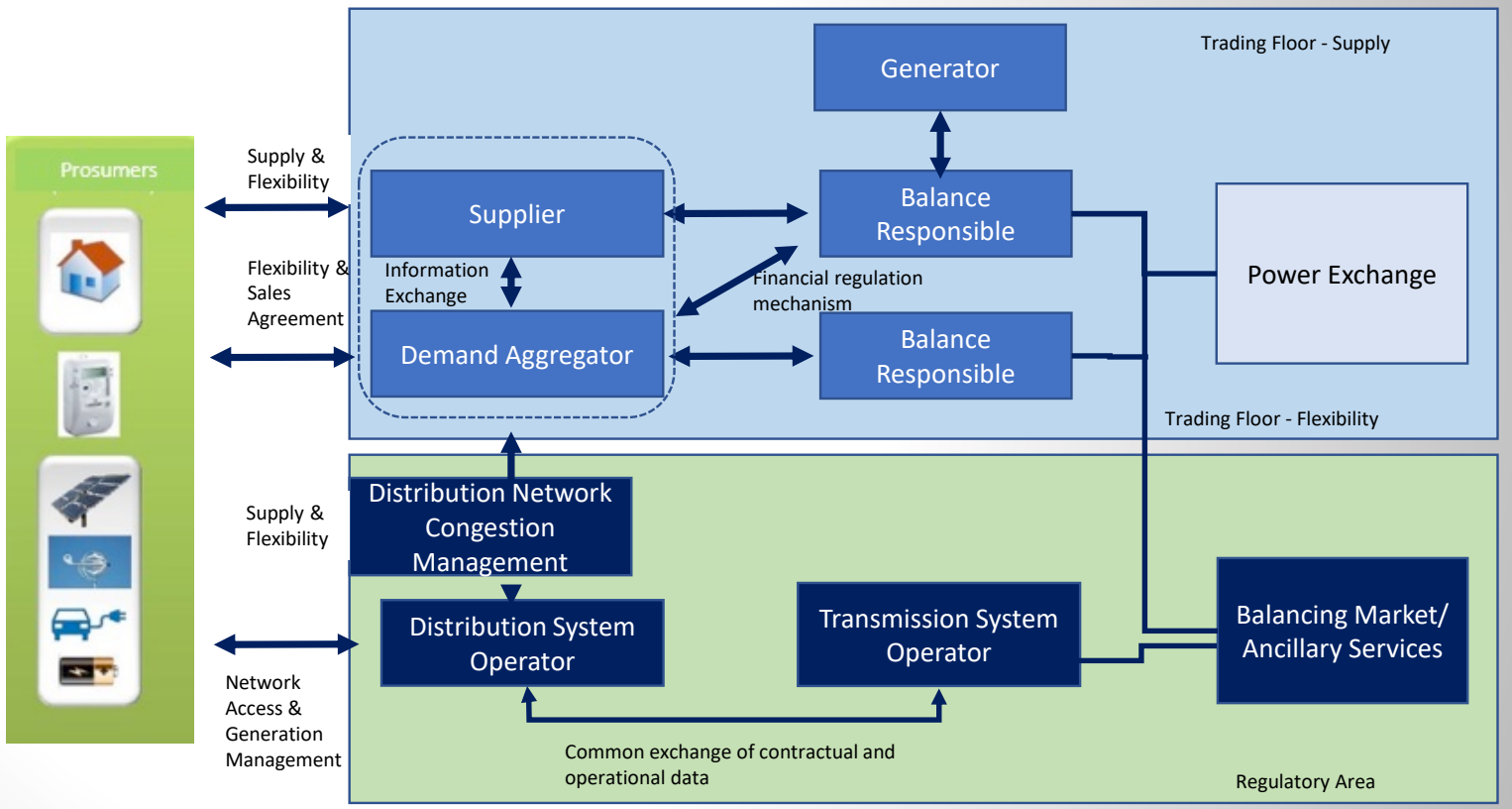
Demand Side Management Regulations

Role and responsibilities, incentives, infrastructure requirements and necessary arrangements for the activation of demand-side management are included in the regulatory recommendations report, "***Regulatory recommendations for the deployment of the smart grid***" of the Smart Networks Working Group established by the European Commission.



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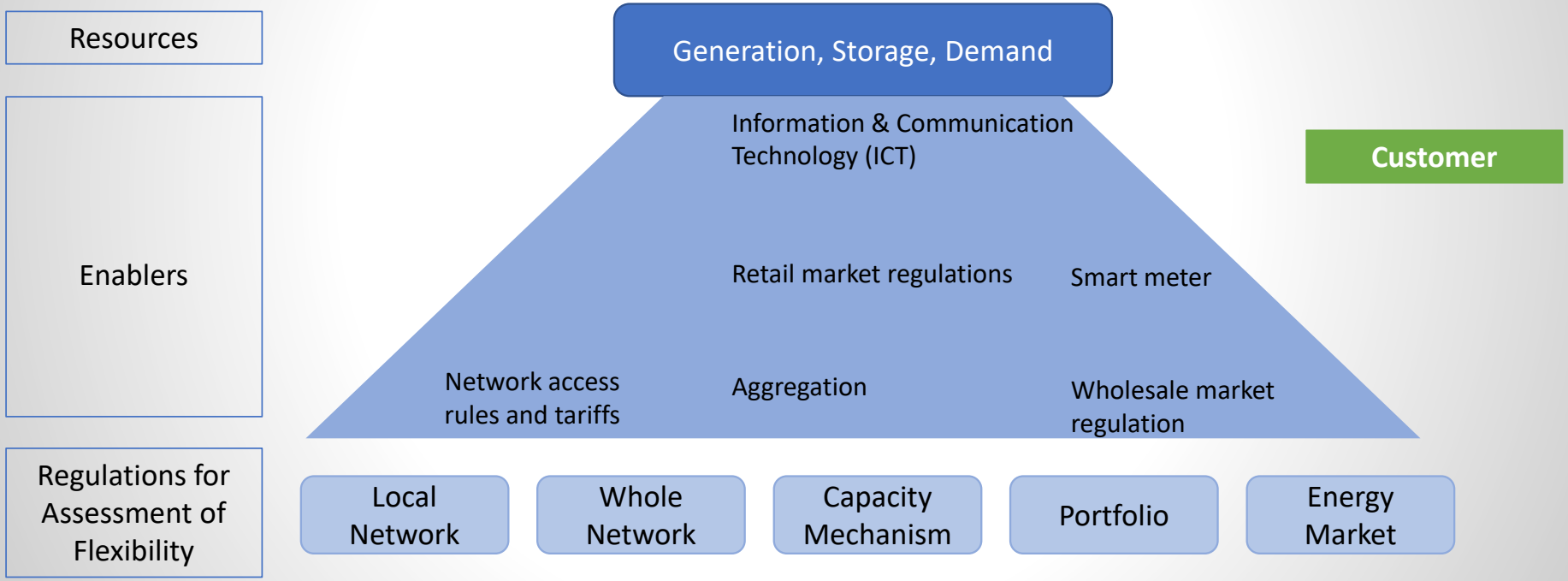
Demand Side Management Regulations

Predicted Structure of Flexibility System



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Interoperability and Standardization

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Interoperability and Standardization

- Interoperability and Standardization was studied by the Expert Group 1 (EG 1), which focuses on the Smart Grid Standards of the Smart Grids Working Group established by the European Commission.
- EG 1 published its final report on methodologies and definitions to facilitate the interoperability of smart grids. This final report revealed that simply choosing communication standards is not enough to guarantee interoperability.
- The study conducted by EG1 in 2015 showed that the various Member States of the EU did not take the additional measures necessary to ensure interoperability, and there are several risk areas, especially in terms of interoperability.
    - **Some smart metering / smart grid standards were not available** when existing smart meters and smart grids were planned to be expanded,
    - **EU Member States did not always provide specific information** about the standards or technical specifications to be used in their responses to the survey.
    - **Additional features** (use cases, data definitions, and complementary standards) **are not defined** in the majority of EU Member States.

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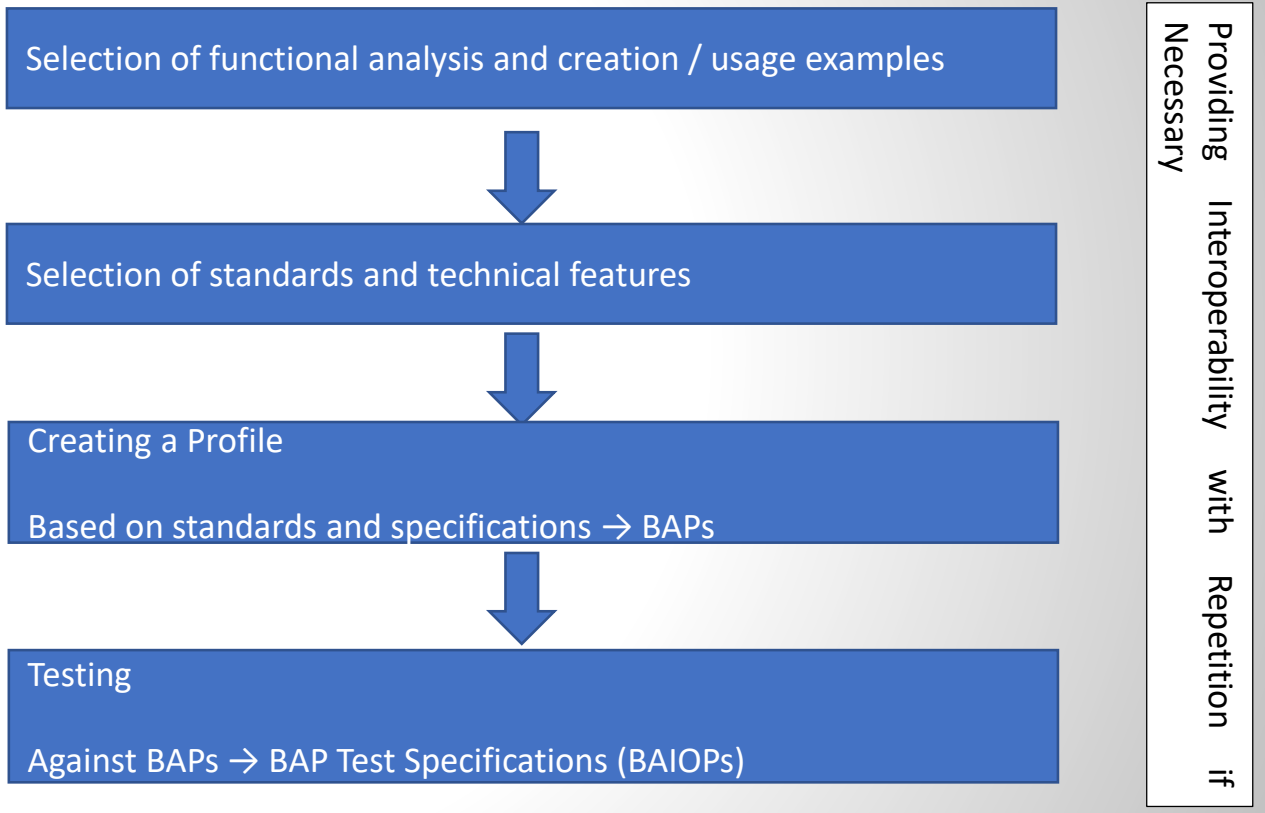
Interoperability and Standardization

- For this reason, the use of additional or accompanying specifications called Basic Application Profiles (BAPs) was encouraged.
- BAP is a document that explains how standards or technical specifications are applied to support the needs of a particular national infrastructure.
- In addition, the Basic Application Interoperability Test Profiles (BAIOPs) were used to check that the selected profile meets the technical requirements. BAIOPs can also be called BAP Test Specifications.



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Regulations on Communication Infrastructures for Smart Grids

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Regulations on Communication Infrastructures for Smart Grids

- The communication **solution is not processed in a separate standard or structure for smart grids**. All communication structures can be used, provided that they validate energy-oriented factors of countries or the Unions.

- **Communication solutions are supervised by the relevant communication Regulator**. E.g. FCC in USA, CER and DCENR in cooperation in EU, etc. energy companies cooperate with communication regulators. The main goal is to support development without hampering the standards.

- Therefore, a **separate smart grid communication structure or standard is not used**. CEN-CENELEC-ETSI, IEC, IEEE etc. used in the EU based on the work of international standard institutions, address the desired energy delays and capacities according to their applications. **Regulation of communication side is left to the communication regulators, but the restrictions are made without delaying the essence of the work.**

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Regulations on Communication Infrastructures for Smart Grids

- Energy companies are deciding on the communication infrastructures they will use according to their flexibility and forward-looking activities.

- Decisions are made by **assessing the advantages, present communication infrastructure in the country, future expectations, current regulations** and **possibilities for application** in the field. The communication practices that are in place in the countries with smart grids are in line with the grid ownership.

- In Continental Europe, strong companies specialized in the market, which were former public owned monopolies are dominant. E.g. EDF in France, ENEL in Italy, Iberdrola in Spain, etc. can be examples. The competitive environment remains in a city or in regional basis and the grid is owned by the investor.

- Since almost all of the solutions are required to be of **future-oriented, interoperability or transitive nature** they are closely inspected by regulators (Energy and Communication), and in inconsistent cases, the regulations are followed, and penalties are imposed.

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Smart Grids Cyber Security and Data Ownership Regulations

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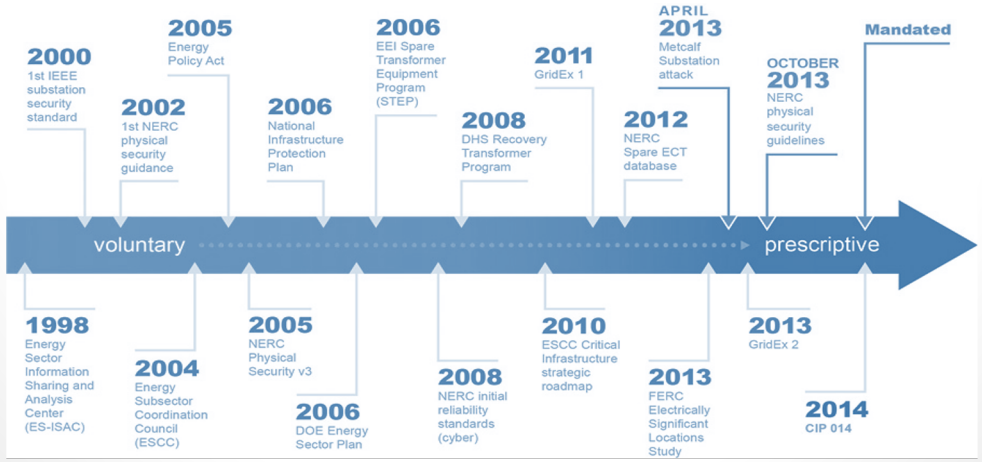
Smart Grids Cyber Security and Data Ownership Regulations

- The concept of cyber security for smart grids begins with understanding the fact that smart grids are actually an ICT solution. Since smart grid market is developing rapidly especially in North America, almost all of the standards and regulations regarding the market are of North American origin. In the European Union, some activities have started basing on NIST.



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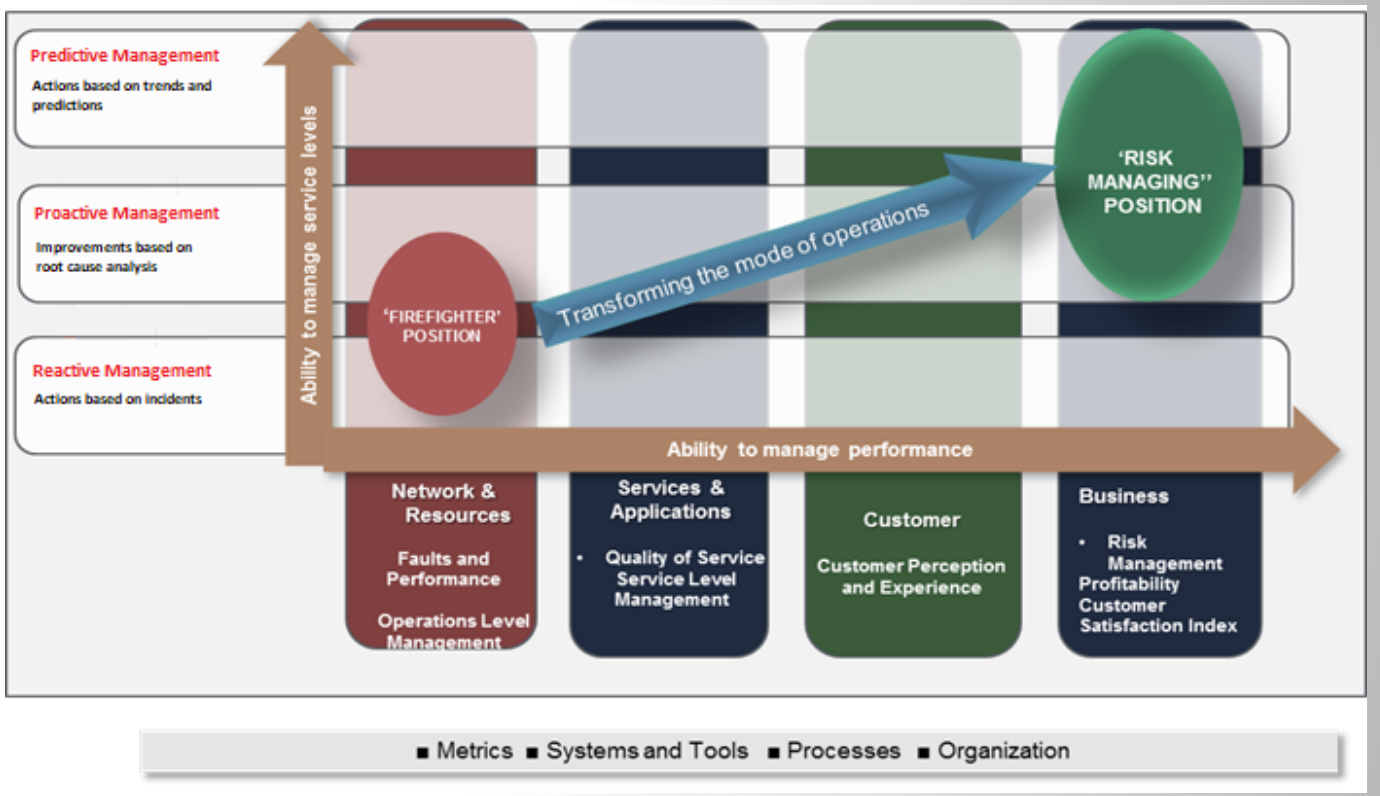
Smart Grids Cyber Security and Data Ownership Regulations

- Over time, there is a clear transition from firefighting approach to preventive, risk-eliminating flow to security activities.
- The main key issue is to ensure the security of ICT services. The security of the entire process from generation to consumption is addressed, especially since almost all of the energy is managed over ICT.



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Regulations on Renewable Energy Sources Integration

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Regulations on RES Integration

- By 2030, 50% of generated electricity in EU is expected to be based on renewable energy sources.
- It is more important than ever to increase the share of renewable energies in electricity and to develop flexible demand, generation and storage solutions, with the increasing use of electricity in traditionally fossil fuelled sectors such as transportation, heating and cooling.
- A new regulatory framework is needed to address these challenges and opportunities. For this reason, with the revised Renewable Energy Directive and new recommendations for a new market design, it is aimed to deepen the integration of the internal energy market, strengthen consumers, increase regional and EU-wide cooperation and provide the right signals for investment, thus ensuring safe, sustainable and competitive electrical systems.

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Regulations on RES Integration

Distribution Grid Connection

- Strengthening sustainable electricity supply through the improvement of the distribution network (DG-GRID) regulatory framework for distributed generation was carried out in 2005 and repeated in 2010.

- DG-Grid focused on four main objectives:
  - Review existing EU economic and regulatory frameworks for electricity networks and markets and identify how to remove barriers to renewable energy sources (RES) and combined heat and electricity (CHP),
  - To analyse the interaction between regulations, the capacity of RES and CHP installed, and innovative grids,
  - To evaluate the impact of market penetration of RES and CHP by inspecting changes in income and expenditure flows, to develop business models for an economically viable grid system and to evaluate cost / benefit analysis of different regulatory designs,
  - To develop guidelines for better integration of grid planning, regulations and distributed generation.

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Regulations on RES Integration

Distribution Grid Connection

Lessons learned;

- **The regulatory framework should include incentives for DSOs to integrate distributed generation**. Operational and capital expenditures and pricing plans for preliminary assessments should take into account the connectivity and management of distributed generation. Additional incentives should be considered to encourage innovation and R&D activities of DSOs.
- **Deep connection charges which include grid retrofit costs should be avoided**. Any shallow approach grid connection policy can be adopted, or the system pricing methodology can be reorganized to financially cover the contribution of distributed generation to network costs.
- If the market rules agree to bring together small individual generators, **the participation of distributed generation in ancillary services and balancing markets can be increased.** In balancing regulations, the time interval to submit the estimated generation should be reduced.

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Regulations on RES Integration

Renewable Energy Support Schemes

- The CEER report '***Case Study of Renewable Energy Support Schemes in Europe***' covering 28 EU Member States highlights the amount of RES support, the type of support scheme, and the expenditures (technology) of RES support.
  - The weighted average paid in 2015 for renewable generation is about 110 €/MWh above the wholesale price.
  - RES support schemes are an important cost for electricity consumers.
  - The types of RES support schemes vary in Europe: (i) Direct tariff support such as FITs (21 countries); (ii) Green Certificate support (7 countries); (iii) Removal of balancing responsibility for balancing services (14 countries)
  - The amount and cost of RES support differ in terms of countries and technology.
  - The cost of RES support is financed either by taxes or non-tax payments such as the consumer bill.
  - The proportion of RES generation in gross electricity production differs too much among countries.
  - Photovoltaic, hydro and bioenergy are supported the most.

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Regulations on RES Integration

Standards and Secondary Legislation

- Increasing the penetration of renewable energy requires changes in standards and secondary legislation, grid codes in order to ensure that energy systems remain reliable and robust.

- **Standards:**
  - The European Electrotechnical Standardization Committee CENELEC is working on CLC / TS 50549-2, a technical specification designed for plants connected to medium voltage distribution power grids.
  - Institute of Electrical and Electronics Engineers, IEEE Standard 519-2014, has published a revision for IEEE Recommended Practice and Electric Power Systems Harmonic Control Requirements, as a result, IEEE Standard 519-1992 has been overridden.
  - The Chinese National Energy Administration (NEA) has issued a statement to speed up testing and certification efforts to guarantee the quality of wind power equipment.

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Relationships between Distribution and Transmission System Operators

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Relationships between TSO & DSOs

- Today, ancillary services such as congestion management are mostly provided by large synchronous power plants connected to the transmission grid. In the future, due to the transformation in energy generation, generation capacities will shift from transmission to distribution level. Thus, the role of the operators of the transmission and distribution system will change, especially with regard to the provision of ancillary services.

- Therefore, distribution system operators are questioned about how system stability and total system responsibility can be assumed by distribution system operators and therefore they can actively contribute to the transmission system.

- A stronger collaboration between system operators has positive effects for both players and significant cost savings can be achieved.

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Relationships between TSO & DSOs

- It may be necessary to **develop the relationship and regulatory legislation between DSOs and TSOs** to provide effective system solutions that meet the needs of a sustainable energy system. Principles that CEER believe that should determine the path of future DSO-TSO relationship and related regulatory legislation:

  - **Comprehensive Principles**: It sets the framework in which more specific principles and approaches on governance, network planning and system operation are developed. At the centre of this framework, DSOs and TSOs need to build a constructive and collaborative relationship and leadership with mutual respect.
  - **Roles and Responsibilities**: The increased need for governance and coordination should not create any confusion in allocating relevant roles and responsibilities. It is essential that in this process, DSOs and TSOs' revenue regulations create incentives to optimize the results of the system, rather than focusing on minimizing the costs of DSOs and TSOs.
  - **Grid Planning**: In a rapidly changing environment, transparency of state of the grid and shared convictions are crucial in defining the minimal cost solutions and creating the opportunity for innovative products and services.
  - **System Operation**: The changing system will make the task of overall system security increasingly difficult. However, there are also important opportunities for the DSO-TSO collaboration to gain greater effectiveness in the entire system operation.

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Technical Assistance for Improvement of Performance-Based Tariff Regulation of EMRA For Turkish Energy Markets Through Introducing an Enhanced Monitoring System

Task 4.2 Workshop

Gap Analysis and Regulatory Recommendations

Electricity Distribution

15 September 2020, Online

This project is funded by the European Union

Agenda

Gap Analysis and Regulatory Recommendations (Electricity Distribution)

- As-is Regulations
- Challenges for Smart Grids Roll-out
- Overarching Principles
- Regulatory Recommendations
  - Tariff Methodologies and Incentives
  - Smart Grid Planning
  - Monitoring Requirements
  - Standardization and Interoperability
  - New Services and Business
  - Other Recommendations

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As-is Regulations Related to Smart Grids

Electricity Market Customer Services Regulation was published in May 2018 and replaced the old Regulation that was published on 8 May 2014. Consumer Services Regulation includes minimum standards, principles and procedures for the transactions between consumers, suppliers and/or distribution companies for electrical energy and/or capacity sale and those providing services regarding the same. The Consumer Services Regulation categorizes eligible consumers based on their consumption amounts as eligible consumers with high consumption amounts (more than 100,000 kWh) and eligible consumers with low consumption amounts (less than 100,000 kWh).

Service Quality Directive covers the regulations for DSOs, RetCos and end-users in terms of supply continuity, commercial and technical quality of electrical energy provided through the electricity distribution grids. This regulation aims to ensure that electrical energy is supplied in an economic optimum, with minimum duration and frequency of interruptions, in alignment with standardized commercial agreements and within acceptable technical power quality parameters. This regulation also indicates the cases of exemption for DSOs as well as the monetary penalties and compensations in breach of the regulation.

EDVARS (Electricity Distribution Data Warehouse and Reporting System) Regulation aims to determine the rules and procedures in order to enable EMRA to have remote access to DSO IT/OT systems so that EMRA can have the capability of real-time monitoring of data that DSOs are mandated to report.

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As-is Regulations Related to Smart Grids

Quality Factor Regulation introduces the 'quality factor' parameter that is used as an overall indicator of DSO performance with respect to regulations. Quality factor score, that is calculated through a series of provided formulas, is used to determine the impact of distribution activities to the DSO revenue cap. In calculations of quality factor scores, several factors are taken into account; focusing on the continuity of supply (establishment of outage recording systems, reporting requirements, performance realizations and improvements), technical quality parameters (measurement, data and reporting requirements, performance improvements), customer satisfaction performance and HSE-related performance.

Investment Regulation covers the rules and procedures for determination and monitoring of capital investment expenditures (CAPEX) by DSOs within the scope of distribution system revenue regulations. Investment planning process, including the preparation, acceptance and revision of investment plans, and the principles of investment plans and master plans are regulated under this document. Distinction of investment characteristics are recognized and rules of acceptance by EMRA are determined. Monitoring and reporting requirements for grid investments are also stated within the scope of this regulation.

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As-is Regulations Related to Smart Grids

A draft regulation is published by EMRA in Q3 of 2020 in order to revise and enhance the existing investment rules and procedures and is expected to become effective in the coming period. Notable changes that are revised or included within the scope of draft regulation are as follows:

- Allocation of CAPEX for R&D Dissemination Investments (Allocation of an amount of capped with 0.2% Network CAPEX for R&D Dissemination Investments)
- 'Smart Grid Planning' is included and obliged as part of DSO Master Plans, including cost-benefit analysis for related investment projects.
- Flexibility in the cap for Technological Investments (Grid Management Systems CAPEX) based on DSO's application to EMRA and justification of increase in smart grid investments
- Non-project ('Other') IT investments are considered in Technological Investments category, which amounts to 5% of network CAPEX.

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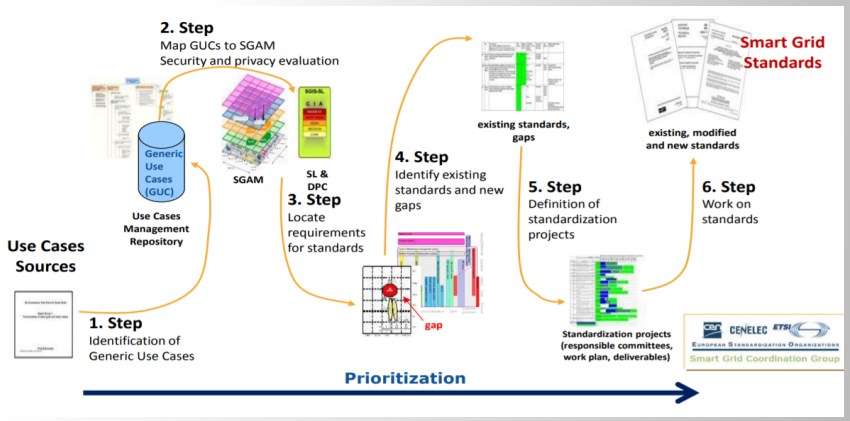
Challenges for Smart Grids Roll-out

- The main problems with smart grid legislation in many countries include **lack of published and accepted legislation** on this issue, the evaluation of smart grid solutions within **unchanged market mechanisms**, **social pressure on electricity prices** and **limited investment revenues**, uncertainty about how the prepared **national action plans** will be directed, settlement process and payment methodologies, **data protection laws**, **lack of clarity regarding the roles and responsibilities of stakeholders**, **lack of standardization and different implementation practices**.

- According to research by CEER, 79% of EU Member States use **price regulation mechanisms to promote smart grid**, and 63% use **performance indicators**. In addition, it has emerged that 76% of countries **lack and need to develop regulatory tools for smart grid development.** The smart grid legislation arrangements recently made or foreseen in some European countries can be summarized as follows:

Improved System Operations	Increased Economic Efficiency	Increased Resources for Customers
•More effective and efficient usage of network •Improved customer service, reduced cost	•Creation of situational awareness: more information on system usage and costs •Increased confidence in dynamic pricing	•End-use efficiency •Distributed generation and active end-user system



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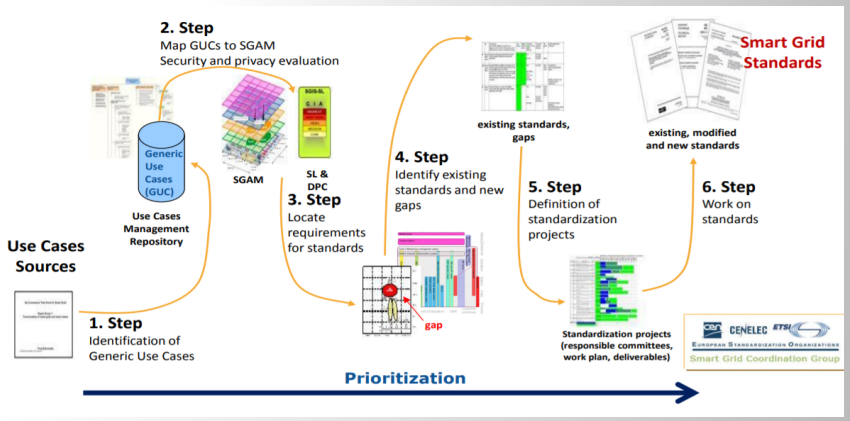
Challenges for Smart Grids Roll-out

- Lack of EU-wise technical standards for individual technologies, as well as for the interoperability of smart grid solutions for electricity distribution,
- Smart grid deployments in electricity distribution networks are wide in EU, in this context considerable lessons learnt is available that can serve as best practices for the deployment of smart grid solutions for DSOs,
- Lack of active participation of electricity distribution companies in the development of smart grid technologies,
- Strict data protection laws and the new General Data Protection Regulation (GDPR) can be, in some cases, a barrier for the exploitation of the full potential of the deployment of smart grid solution (e.g. In the case of smart meters for electricity),

Improved System Operations	Increased Economic Efficiency	Increased Resources for Customers
•More effective and efficient usage of network •Improved customer service, reduced cost	•Creation of situational awareness: more information on system usage and costs •Increased confidence in dynamic pricing	•End-use efficiency •Distributed generation and active end-user system



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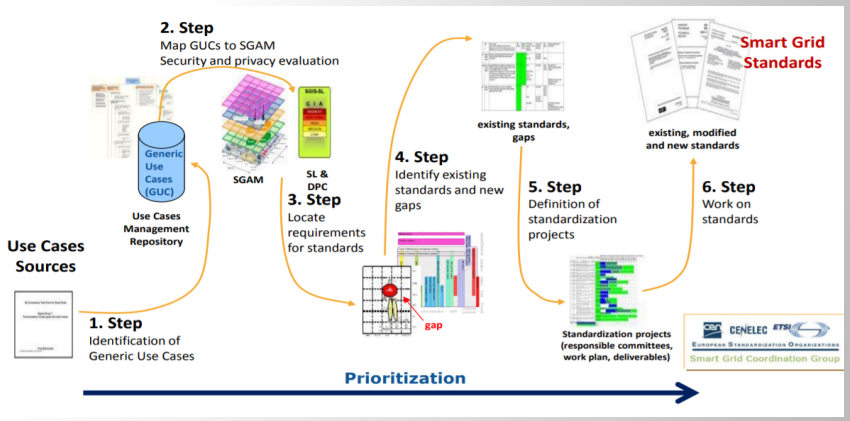
Challenges for Smart Grids Roll-out

- Lack of clear regulatory framework and/or existing complex regulation constitutes a barrier for the fast deployment of smart grid solutions for electricity distribution,
- The existing regulatory framework does not provide the necessary incentives to electricity DSOs to invest in innovative smart grid technologies that will generate benefits for the end-customer in the long run,
- Lack of a performance-based regulatory framework that will encourage electricity distribution companies to increase the efficiency of their networks via the deployment of smart grids solution, and
- Lack of clear roles and responsibilities for the regulated entities to encourage the introduction of new services or markets.

Improved System Operations	Increased Economic Efficiency	Increased Resources for Customers
•More effective and efficient usage of network •Improved customer service, reduced cost	•Creation of situational awareness: more information on system usage and costs •Increased confidence in dynamic pricing	•End-use efficiency •Distributed generation and active end-user system



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Overarching Principles for Smart Grids Related Regulations

OP1: Output and input regulation
EMRA should focus on outputs in their regulation of distribution companies, by designing the regulatory framework taking into account both the economic and technical aspects, as well as the fact that developing a smart grid is not a goal in itself, but is a means to an end, i.e. a regulatory approach towards smart grids alone, is not envisaged. However, since the deployment of a smart grid is a heavy technical endeavour, input regulations cannot be neglected. Input regulations may be related to the preparation and approval of the network codes, as well as to standardization issues which fall under the input regulation.
OP2: Effects and benefits expected by smart grids
The application of smart grid technologies and services for the distribution companies, should have clear effects and benefits towards both the DSOs, as well as towards the consumers. Such benefits may include: • Increased sustainability, • Adequate capacity of distribution grids for providing to consumers and adequate grid connection and access for all kinds of grid users, • Satisfactory levels of security and quality of supply, • Enhanced efficiency and better service in supply and grid operation, • Coordinated grid development through regional and local grid planning to optimize distribution grid infrastructure; and Enhanced consumer awareness and participation in the market by new players.

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Overarching Principles for Smart Grids Related Regulations

OP3: Performance indicators and output measures for smart grids
EMRA should have in place a clear and straightforward approach for the evaluation of smart grid projects, based on performance indicators and output measures. The evaluation framework should be based upon transparent Key Performance Indicators (KPIs), so that all targets are measured and evaluated in an observable, quantifiable, and verifiable manner. Moreover, these indicators should be supported by a complete regulatory framework and a long-term reasonable rate of return to avoid the sub-optimization for some of the indicators. Additionally, wherever the performance targets and the corresponding indicators are associated with economic effects, they should be decoupled from external effects outside the control of the DSOs. Finally, the evaluation process should be implemented in a form of reward/penalty compensation mechanism based on the best output measures.

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Overarching Principles for Smart Grids Related Regulations

OP4: Encouraging innovation along research, development, demonstration chain

NRA should foster innovation and research and development (R&D) activities related to smart grids for distribution. KPIs for innovation and demonstration projects should differ from the performance indicators for large-scale and/or rollout projects. This differentiation is justified by the fact that the innovation and R&D activities include also additional elements, such as the dissemination of the results and the required training, as well as they should also take into account the replicability of the projects.

Smart grid technologies for distribution networks, as well as potential demonstration and large-scale projects, should be evaluated according to a nation strategic roadmap for smart grids for energy networks to be developed by EMRA in collaboration with the energy network operators. This evaluation needs to take into considerations the following aspects:

- Identification of what it is research, development, demonstration and deployment,
- Ex ante and ex post assessment of benefits,
- Replicability and openness of projects,
- Transparent validation procedures,
- Well-defined and transparent criteria for monitoring of demonstration projects,
- Evaluation of project indicators tailored to each demonstration allowing to measure projects' results; and
- Ensure proper coordination among research projects, including avoidance of overlapping and duplication.

It remains at NRA's responsibility to assess the benefits and the costs of the possible large-scale or demonstration projects for smart grids, according to national priorities and in coherence with the applicable national regulation systems.

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Overarching Principles for Smart Grids Related Regulations

OP5: Standardization, harmonization and interoperability
Interoperability is a key requirement for smart grid projects. It should be mentioned that even though some technological domains are already covered by a sufficient number of standards, there are cases where interoperability standard are missing. Moreover, there technical domains where a large number of standards are available, thus making the selection of the appropriate standards by the DSOs a complicated process. It is highly recommended that EMRA establishes a task force for the implementation of smart grids in the internal energy market. The purpose of this task force is to deal with inter alia services and functionalities for smart grids and smart meters, as well as a standardisation strategy for smart grids.

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Regulatory Recommendations related to Smart Grids

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R1	**Tariff Methodologies and Incentives**	**Incentivizing Strategic Smart Grid Projects**	Additional premium might be added to CAPEX in case electricity DSO makes expenses for strategic smart grid projects. EMRA may select a few projects for each tariff period that will receive pre-defined incentives. This selection can be performed through an application/competition process and the incentive is recommended to be approved based on a systematic evaluation of KPI-realization for individual projects.	Incentivization of a selected number of Smart Grid projects that go through a competitive stage will catalyse the Smart Grid transformation in the distribution industry. Competitive process for additional incentives will result in strategic project concepts with higher quality and more ambitious goals, and a transparent competition process will motivate DSOs to improve quality of their project applications. KPI monitoring of incentivized projects will ensure stricter monitoring, higher regulatory engagement and increased possibility of high-impact project results for the industry. A good example can be found in Italy, based on ARERA Resolution No. ARG/elt 39/10. On the basis of a competitive process, the resolution provides an additional 2% extra on Weighted Average Cost of Capital (WACC) remuneration for a period of 12 years on the part of the distribution RAB associated with investments needed for the demonstration project.	This methodology is not applied by EMRA for Smart Grid CAPEX or R&D projects. Application/evaluation stages exist for biannual R&D project applications.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R2	**Tariff Methodologies and Incentives**	**Allocated CAPEX for Smart Grid and Technology Investments**	10% of the Network CAPEX + ad-hoc application to EMRA for further budget with strict justification of additional projects	Following the initial phases of Smart Grid system investments, an enhanced Smart Grid management requires implementation and integration of several systems and components within a single framework. Increase in the number and scope of Smart Grid systems require a higher portion of overall CAPEX as the investment scope should slide towards high technology system deployments. Turkish DSOs' smart grid roll-out/maturity level is relatively lower than EU standards, so it is recommended that to be encouraged via increased allocated smart grid/technological budgets. This allocation will increase focus of DSO managements on the technology investments and provide leverage for Smart Grid transition.	5% of the network CAPEX is allocated for Smart Grid and Technology Investments, with ad-hoc application to EMRA for further budget	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R3	**Tariff Methodologies and Incentives**	**Allocated CAPEX for R&D Dissemination Investments**	2% of the network CAPEX + ad-hoc application to EMRA for further budget	Although only R&D projects may successfully result in ready-to-use outcomes, a certain ratio will deliver usable products and solutions that can have direct positive impact on real-life operations and business processes and practices. Allocation of a significant R&D dissemination budget will allow focus and create initiatives for widespread usage of R&D outputs and speed up the financial returns for DSOs and the funding mechanisms. Dissemination of Smart Grid R&D solutions is also strongly recommended by ERGEG/CEER in their Smart Grid position papers and regulatory reviews.	0.2% of network CAPEX is allocated for R&D dissemination investments in the draft legislation for investments (as of August 2020)	EMRA, DSOs
R4	**Tariff Methodologies and Incentives**	**Incentives for Extension of Network Assets Lifetime**	Development of indirect incentive methodologies to increase network asset performance and extend operational lifetime through advanced asset management practices.	Practices for extension of asset lifetime require lower budget amounts in comparison with costly grid reinforcement and renewal projects. Incentives for advanced asset management practices will provide flexibility in investment planning and create a culture of advanced and pro-active maintenance on existing network components. Smart Grid monitoring capabilities and management practices such as using data analytics for predictive maintenance have significant potential for avoiding failures, increasing savings on OPEX and CAPEX and extending asset lifetimes.	Indirect incentive mechanisms for network assets' lifetime extension is not included in existing practices.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R5	**Tariff Methodologies and Incentives**	**IT/OT System Licenses and After Sales Services to be Considered as Uncontrollable Component of OPEX**	• Yearly license fees regarding database, operating system and other related software solutions • Maintenance agreements for all the technological systems and infrastructure that complete their warranty periods • Expenses in this category are not expenses that are directly controlled by the DSOs and mainly dependent on vendor pricing policies, thus vendor dependency exists. (Competitive environment is very limited or non-existent) • It will be useful to specify these expenses as 'Uncontrollable OPEX' component and provide income allocation with respect to realized expenses (through invoices) of DSOs within the Tariff Period. • Certain conditions may be defined in order to ensure that invoices regarding the license and maintenance agreements are provided directly by the related system supplier or re-seller company. • A estimated budget can be determined before the Tariff Period with respect to this cost item and can later be revised according to realized figures.	Deployment and operation of IT and OT systems are dependent on after-sales vendor support as the software component in these systems requires fixes, improvements and upgrades to remain effective in operation. Majority of IT/OT system vendors place additional pricing on periodic software licenses regarding database, operating system or other features/components. Pricing policy behind these items are not controlled by DSOs and are difficult to precisely estimate for upcoming years of system usage. Thus, this expense item is 'uncontrollable' by its definition and should be registered as an 'Uncontrollable Component' in OPEX considerations.	These OPEX items are not considered as Uncontrollable Component	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R6	**Tariff Methodologies and Incentives**	**Methodology to Define OPEX Requirement for IT/OT Hardware**	• Expenses related to all hardware (RTU, IED, modem, smart meter, backbone router, server, etc.) which do not complete their useful lifetime but require partial or complete replacement due to malfunctions or similar reasons. • There may be several approaches for OPEX budget calculations. Each IT/OT hardware type's repair/replacement need can be evaluated through their MTBF values, assuming that certain percentage of all hardware will be annually replaced or repaired (using spent and planned CAPEX values for same hardware categories).	IT and OT hardware are critical components in daily grid operations, especially when DSOs are adapting the transition to Smart Grid management philosophies and deploying technologies with IT/OT components. Unexpected problems with IT/OT hardware require fast solutions in terms of repair or replacements in order to avoid any negative impacts and potential economic losses in grid operations. Definition of an OPEX allocation for this purpose will ensure proper responsiveness for sustaining IT and OT systems.	No as-is methodology.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R7	**Tariff Methodologies and Incentives**	**Economic Lifetime of IT/OT Assets & Systems**	It is recommended that the minimum period of time for acceptance of technology infrastructure renewal investments as CAPEX should be accounted in accordance with the useful lifetime periods as stated in Tax Procedure Law, instead of accepting it as 10 years. For example; - Server: 4 years - Software: 3 years - Network Router: 5 years - Tele-control systems: 5 years - Etc.	Technological equipment that can be considered as IT/OT assets are generally used as subcomponents of a larger, more complex system or solution. Depending on asset type, function and capacity, expected/estimated lifetimes of such equipment are various. Manufacturers of these components are also delivering warranty periods of much shorter times in comparison to accepted 10 years interval. It is therefore necessary to acknowledge this situation and evaluate renewal periods according to asset types and expected lifetimes in CAPEX. EURELECTRIC acknowledges this situation and recommends that smart grid investments such as ICT investments should be accepted with shorter lifetime periods.	In effective legislation, minimum period of time for acceptance of technology infrastructure renewal investments as CAPEX is accepted as 10 years. However, in the recent draft legislation for 'Rules and Procedures for Determination of Electric Market Distribution System Investments', this period is revised as 5 years for computers/PCs, tablets, indexer devices, mobile phones ve printers under the scope of Technological Systems'.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R8	**Tariff Methodologies and Incentives**	**CAPEX Category for IT Expenditures without a Project**	It is suggested that all technological investments such as PCs, server/network hardware, tablets, etc. and all software and hardware components that are required for testing technological infrastructure should be evaluated under the scope of 'Grid Management Systems' and not under the scope of 'Other Expenses In Form of Investment Expense' (%1).	Due to the increased level of technology components and usage in transition to Smart Grid, IT systems are a major part in reliable grid management activities. IT expense items such as PCs, servers, network hardware, tablets and other IT equipment that are in direct use for grid management purposes by central or field teams. It is beneficial to evaluate IT expenditures in the same context with 'Grid Management Systems' and allow DSOs to manage that budget according to operational requirements and priorities.	In effective legislation, IT expenditures are considered under the scope of 'Other Expenses in Form of Investment Expense'. Recommended change is in alignment with the Draft legislation, which foresees inclusion of IT expenditures (computers/PCs, tablets, indexer devices, mobile phones, monitors, printers and similar assets) under 'Technological Systems'.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R9	**Smart Grid Planning**	**Identification of Targets of Achievements for DSOs about Smart Grid Roll-out**	EMRA is advised to determine the principle guidelines, targets, achievement targets and evaluation criteria for DSOs about Smart Grid roll-out projects, digitalization, technology deployment and practices within the IV. Implementation Period	Introduction of identified achievement targets and KPIs for Smart Grid roll-out projects will ensure performance-based monitoring of DSO activities by EMRA. As part of common regulatory processes and project management practices, KPIs are widely used in notable Smart Grid programs in EU. In some European examples such as the UK, NRAs request business plans, including smart grid targets and achievements, from DSOs and monitors the progress according to the statements given in these plans.	Relevant performance objectives and indicators for Smart Grid projects have not been particularly identified but widely discussed in preparatory projects such as TAŞ2023.	EMRA, DSOs
R10	**Smart Grid Planning**	**Smart Grid Master Plan**	Include Smart Grid Planning in DSO Master Plans as a Regulatory Requirement	Inclusion of Smart Grid Planning as a component within DSO Master Plans for each regulatory period will ensure harmonization between the regular network planning and related Smart Grid projects. This will also allow scope and KPI standardization for DSO targets in the tariff period. Several EU countries develop smart grid and smart meter roll-out plans and NRAs encourage DSOs to comply with the national roadmaps in their planning efforts. In the UK, DSOs present their smart grid roll-out plans embedded within their business plans.	Already in draft "Rules and Procedures for Distribution Investments"	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R11	**Smart Grid Planning**	**Minimum Requirements for Smart Grid Master Plan**	- Plan must contain information on the as-is status of Smart Grids. - Improvement actions for more effective usage of functionalities in existing systems must be included in the planning. - Smart Grid Master Plan must have details in 'Project' granularity - There must be CBA studies for each key projects and a prioritization - Minimum requirements for the project definition in planning phase must be: project name, scope, objectives, targets, qualitative and quantitative benefits, related technologies, anticipation of hardware and software components, as-is status related to project concept, project period, anticipated calendar and budget requirements - Section covering regulatory recommendations must be included in the Master Plan, including new business models, new service definitions and market re-structuring plans	A multi-year Smart Grid Master Plan is the core strategic document (or a set of documents) that will guide the transition process for DSOs and ensure alignment of Smart Grid projects while tracking the progress. This roadmap plan is especially useful in the beginning phase of a widescale Smart Grid portfolio investment, but also continue with updates throughout the transition management. Many national or regional examples can be found such as UK (DSO Business plans) Ireland (SEAI - Smart Grid Roadmap), Germany (BDEW-Eurelectric SG Roadmap) etc.	Our recommendation is in line with the amendments in draft "Rules and Procedures for Distribution Investments"	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R12	**Smart Grid Planning**	**CBA as a Complementary Tool of Decision Making in Planning**	Inclusion of cost-benefit analysis (CBA) with respect to smart meter and grid monitoring/control/automation roll-out planning; prioritization of all projects that are included in the planning with respect to CBA outcomes.	Usage of CBA as a complementary decision-making tool is useful in objectively evaluating a large number of Smart Grid projects with various sizes and complexity levels. This method is embedded in decision making processes for Smart Grid projects and many guideline documents have been published by key institutions such as EU JRC, CEER and IRENA as well as academic and industrial papers. Deployment of smart metering systems are recommended to be subject to cost-benefit analysis in EU Directive in accordance with the Commission Recommendation 2012/148/EU. CEER recommends that (Smart Grid) projects shall be disseminated, societal cost-benefit assessment shall be performed and output regulation (value for money of users) shall be introduced. In the UK, business plans presented by DSOs to NRA includes CBAs for Smart Grid projects.	CBA is selectively used in evaluating significant Smart Grid investments or used in evaluation discussions for future projects but is not a common practice applied by all DSOs yet. Draft "Rules and Procedures for Distribution Investments" require DSOs to implement CBA in their smart grid planning activities.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R13	**Smart Grid Planning**	**Smart Meter Roll-out Planning**	Roll-out planning with a detailed design and selection of smart meter locations in the resolution of neighbourhood and implementation of DSO-specific CBA studies	Smart meter roll-out projects are highly complex and large in scale due to large number of metering points, variety in grid and geographical topology, customer types and distribution. Roll-out planning is essential in order to handle a cost-effective procurement, logistics and installation phase without unexpected technical or administrative problems. Due to level of common characteristics, technical constraints and ease of implementation; roll-out planning is suggested to proceed at a resolution of neighbourhood. Roll-out planning had been done with all large-scale smart meter projects in leading countries such as Italy, Sweden etc. Inclusion of CBA is recommended as supported by EU Directives, CEER and as practices by multiple European NRAs for Smart Grid projects including smart-metering roll-out projects.	Nationwide decision for full-scale smart meter roll-out has not been given yet and there is no regulation for planning activities of a roll-out project. Existing AMR metering projects ('OSOS') are limited in terms of metering points and has been implemented for high-consumption customers with scattered nature. The concept of roll-out planning has been discussed in 'Smart Metering' part of one of the key projects such as 'TAŞ2023' but no further action is taken by EMRA yet. A project that spinned off from the results of TAŞ2023 project that is related to AMI is named 'MASS (National Smart Metering Systems) Project'. This project aims to develop technical requirements and roadmap for implementation of smart metering solution nationwide. All DSOs and ELDER (Industrial Association of Electricity DSOs) are stakeholders in this project.	EMRA, TEDAS, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R14	**Smart Grid Planning**	**Harmonization of Smart Grid Planning Activities of Different Energy Sectors**	Harmonization of electricity distribution smart grid planning with electricity transmission and gas distribution	Electricity distribution has points of connections or overlaps with electricity transmission (TSO-DSO interconnections) and gas distribution networks (customer interface). Harmonization in deployment of Smart Grid systems will provide benefits for TSO, Electricity DSO and Gas DSO in leveraging their grid management capabilities. For TSO-DSO interconnection, provision of grid services and monitoring/control capabilities can be enhanced through harmonized investments. For Electricity-Gas DSOs, harmonized efforts in smart metering and customer engagement can reduce project expenses and create mutual benefits. There are R&D projects and guideline studies for TSO-DSO interoperability in Smart Grid domain in EU, under EC, EDSO and H2020 projects.	Technical criteria for TSO-DSO interaction exist in conventional grid operations but Smart Grid harmonization is not within discussion scope due to lack of clarity and consensus in Smart Grid visions of state-owned TSO, 21 private DSOs and EMRA. Gas DSOs are privatized at a later period then electricity DSOs and many of them are not developing their Smart Grid visions and investment plans in alignment with electricity DSOs. There does not exist a comprehensive platform that brings all parties under a unified Smart Grid vision.	EMRA, TEİAŞ, Electricity DSOs, Gas DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R15	**Smart Grid Planning**	**Harmonization of Smart Grid and Smart City Efforts**	Harmonization with other urban infrastructure operations such as telecommunication, water, municipal services, etc.	Urban infrastructure management is comprised of multiple services and layers, including electricity, gas, telecommunication, water and municipal services. Harmonization of Smart Grid and Smart City efforts for certain urban environments is essential to renovate and modernize the overall perspective on the urban infrastructure and the intelligence level of urban services. Many benefits are expected at urban level, such as reductions in CAPEX or OPEX requirements, increased revenue streams, increased service level quality, increased data/information sharing and development of city-level intelligence for continuous monitoring and control. There are several R&D projects and academic studies in development of urban innovation for urban infrastructure management.	There is no regulation with respect to urban infrastructure management in Smart City context and harmonization among relevant urban infrastructure operators. Municipalities are primary authorities in local level whereas many infrastructure operators are regional or national service providers. Smart City vision is discussed in different contexts and no comprehensive legislation is present.	MENR, MEU, MTI, EMRA, ICTA, Electricity DSOs, Gas DSOs, Telecommunication Operators, Municipalities

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R16	**Monitoring Requirements**	**Yearly Reporting Requirement of Smart Grid Realizations**	Monitoring of realization percentage of DSO plans on Smart Grid roll-out. Specific report template may be identified by EMRA for this reporting item.	In order to keep track of project-based and overall progress of Smart Grid Master Plan, reporting on an annual basis to EMRA is recommended, similar to annual reporting for annual CAPEX and OPEX realizations. This is a common practice for countries following Smart Grid programs and several EU NRAs monitor the progress of DSO investments through their business plans which also include Smart Grid projects.	Yearly reporting is within current practice in terms of CAPEX and OPEX realizations within each Implementation Period. Smart Grid Master Plan is advised to align with this reporting practice.	EMRA, DSOs
R17	**Monitoring Requirements**	**Identification of KPIs for Monitoring the Success of Smart Grid Projects**	Implementation of concrete methodologies for evaluating, monitoring and auditing Smart Grid projects and their benefits	Determination of KPIs is necessary to provide objective assessments of Smart Grid goals and achievements. Studies for common frameworks of Smart Grid KPIs have been conducted by EU initiatives, such as EU JRC. EU JRC recommends definition of suitable metrics and KPIs in order to measure impact of services and benefits of Smart Grid projects to ideal Smart Grid vision. All Smart Grid programs in leading countries are monitored within objective KPIs, in alignment with expected benefits such as revenue generation, lowering CAPEX or OPEX or increasing system performance.	Distribution business is regulated by EMRA through KPIs, but no Smart Grid related KPI has been set yet. Some Smart Grid components like OMS, EDVARS, GIS, etc. are included in the obligatory implementations by DSOs.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R18	**Standardization and Interoperability**	**AMI Interoperability**	- Minimum technical requirements of smart meters - Standard OBIS codes - Communication protocol interoperability	Due to privatized nature of Turkish electricity distribution sector (21 DSOs) and large number of metering points, smart meter roll-out throughout the nation will result in various smart metering products and solutions deployed in field and in back-office applications. Identification of minimum technical requirements, standardization guidelines and interoperability requirements are significantly required to align smart metering projects by different DSOs. This has been a common practice for large-scale smart meter roll-out projects, in countries such as Italy, Denmark, Sweden etc.	MASS (National Smart Meter) project is ongoing for this purpose.	EMRA, DSOs, Meter Manufacturers
R19	**Standardization and Interoperability**	**Cyber Security Standardization**	Adaptation and implementation of cyber security measures in compliance with the information security management guidelines of ISO/IEC 27002 and SO/IEC TR 27019	Effective management of cyber security measures require company-wide and industry-wide attention and practices according to latest standards and guidelines. It is recommended that DSOs must adapt to existing set of guidelines in globally accepted cyber security / information security standards.	ISO27001 standard certification is mandated for all DSOs.	EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R20	**Standardization and Interoperability**	**Identification of Minimum Requirements for Certain Smart Grid Systems**	Recommended at minimum for; - Asset Management Systems - Smart Meters - Meter Data Management - Network Management Systems (SCADA, DMS, DERMS, etc.) - Reporting and Data Management (EDVARS)	Smart Grid systems have different purposes, scales and complexity that require specific attention for achieving seamless integration and flawless operation. Minimum acceptable criteria must be identified for each specific system type in order to gain a standardized Smart Grid system portfolio within each DSO and throughout the electricity distribution industry. This issue is generally addressed in standardization efforts by IEC, ETSI etc. or national authorities; and a similar standardization roadmap can be developed with TSE (Turkish Standards Institute).	Available for; - GIS - AMR - OMS (TSKS)	EMRA, DSOs, TSE
R21	**Standardization and Interoperability**	**EV Charging Points - Requirements for Grid Integration**	Technical requirements for grid integration	Due to presence of multiple technical standards (CCS, ChaDeMo, Tesla Supercharger, Guobiao) and difference in charging power requirements of different EV charging station equipment, it is highly important to provide nationally accepted technical requirements for grid integration of EV charging points. In general, countries opt for a certain standard and aim to set criteria for connection points. Many European countries (France, Germany, Netherlands, Norway etc.) have standardized preferences of technology and require grid compliance for accessible charging stations in their domestic markets.	No criteria are determined for EV charging point integration to distribution grids.	EMRA, DSOs, EV Charing Equipment Providers, Potential EV Charging Operators

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R22	**Standardization and Interoperability**	**Grid Integration Requirements for Energy Storage**	Technical requirements for grid integration	Energy storage systems have the capability to act as an enabling tool in active distribution grid management due to their controllable design for energy flow management. Either as isolated or aggregated, many services (flexibility, grid support, voltage/frequency regulation etc) can be extracted via intelligent and coordinated usage of energy storage systems; but integration criteria to the distribution grid must be in place and audited accordingly in order to enable such services and maintain grid operations without issues. Countries such as Germany have initiated regulations for energy storage integration according to local targets and constraints, such as renewable-coupling or grid reliability.	Legislation for facility acceptance procedures of electrical energy storage facilities was drafted in October 2019 and published in February 2020. However, legislation does not cover any issues related to grid integration criteria and operational regulations.	EMRA, DSOs, DG Plant Owners, Aggregators
R23	**New Services and Business**	**EV Charging Infrastructure**	Definition of roles, responsibilities and revenue streams for regulated entities (DSOs)	DSOs have a key role in enabling EV charging infrastructure and definition of roles and business models is key to the discussion. There are multiple studies and publications (EDSO for Smart Grids, EURELECTRIC, IEA etc.) that focus on DSO role in EV business value chain, such as smart charging services, V2G implementations, infrastructure operations etc.	Draft regulations have been released in 2017, but not become effective yet.	EMRA, DSOs, EV owners, 3rd party charging operators, ESCOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R24	**New Services and Business**	**Distribution Ancillary Service**	Definition of roles, responsibilities and revenue streams for regulated entities (DSOs)	Provision of innovative ancillary services that depend on Smart Grid management by DSOs is an upcoming issue that needs regulations on technical and commercial aspects for the DSOs and energy markets in general. Renewable-energy or battery oriented ancillary service provision has been allowed at TSO level in countries such as Germany, the UK and Ireland; and DSO-level service provision is under consideration in parallel with adoption of aggregator roles in energy markets.	Ancillary services are only provided at TSO level. EMRA-supported pilot R&D projects are ongoing for inclusion of renewable-energy based DG units at DSO-level ancillary service provision.	EMRA, DSOs, Energy Storage System Owners/ Operators, DG Plant Owners, Aggregators
R25	**New Services and Business**	**Power Storage**	Definition of roles, responsibilities and revenue streams for regulated entities (DSOs)	DSOs are expected to handle energy storage integration at LV or MV levels, especially in combination with renewable-based distributed generation units. Effective management and integration of energy storage for creation of new service definitions must be defined in regulatory legislations. Leading EU examples can be found in Germany and Denmark where the regulation defines new responsibilities and business models for DSOs.	No regulation on energy storage integration to electricity distribution grids and related business models/services for DSOs (Draft regulation has not yet become effective).	EMRA, DSOs, ESCOs, Aggregators, DG Plant Owners

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R26	**New Services and Business**	**Demand Response**	Definition of roles, responsibilities and revenue streams for regulated entities (DSOs)	Demand response services at MV or LV (aggregated) level (including smart meter flexibility services) can be a critical tool for managing local or grid-wide flexibility requirements of the DSO. Regulations are required to define the allowed business models, interactions, contract conditions, execution principles and energy market integration. Leading examples for DR regulations for distribution grids can be found in Europe, by organizations such as European Commission (EC Smart Grid Task Force) or countries such as France, Belgium, Ireland and the UK. Countries such as Germany, Netherlands, Austria are also in regulatory reviews for DR and aggregation services.	Pilot projects and studies are conducted in EMRA-supported R&D projects. No draft or approved regulation regarding demand response services in Turkey. Potential role of DSOs is unclear.	EMRA, DSOs, DSO Customers
R27	**New Services and Business**	**Energy Efficiency Services**	Definition of roles, responsibilities and revenue streams for regulated entities (DSOs)	Improving and maintaining nationwide energy efficiency measures is critical for effective usage of country's energy resources. DSOs with Smart Grid capabilities are expected to be in the centre of managing or supporting energy efficiency services in built environment, electric mobility and industrial uses. There are multiple examples within of energy efficiency regulations within Europe that DSOs play a key role in, such as Denmark, Belgium (Flanders region)	A recent regulation has been published in Turkey, focusing on 'Energy Performance Contracts for Public Buildings/Facilities', but the role of DSOs is not significantly included and an ESCO role perspective is strengthened. Energy efficiency targets for DSOs are evaluated in reduction of technical & non-technical energy losses and grid investments	EMRA, DSOs, ESCOs, Aggregators, Facility Owners as Grid Customers (Household, Industrial or Commercial)

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R28	**New Services and Business**	**Enabling Construction of DSO's Own Telecommunication Infrastructure**	- Special provision of radio frequency allocation for electricity DSO smart grid applications - Definition of possible revenue streams for allowing joint use of the infrastructure amongst different sectors	This is a cross-regulatory issue that both energy market and telecommunication regulatory authorities are concerned. Increasing telecommunication requirements due to Smart Grid systems require reliable, isolated telecommunication infrastructure that are exclusive to the DSO operations. Collaborative usage of telecom infrastructure is under discussion in both domains, especially in countries such as Germany, UK, Finland etc.	Allowed RF communication in 169.4-169.475 MHz frequency range. There are several DSOs that use RF communication (proximity of 444 MHz) and fibre optics for SCADA backbone communication, but through acquiring services from approved RF service providers or existing national telecommunication operators.	ICTA, EMRA, DSOs
R29	**Other Recommendations**	**Identify High-Priority Technology Areas for Domestic Industry**	Supporting target areas for technology development and export (storage, IoT, data analytics, network management software, smart meters, solar panels, etc.)	Development of domestic Smart Grid ecosystem is important in order to develop and maintain a sustainable business environment and enhance economic value. Identification and prioritization according to industry requirements and capabilities is essential to initiate ecosystem planning.	An ecosystem of equipment manufacturers, software and hardware developers, service providers and re-sellers (local branches of international companies) exist in the industry. However, this ecosystem needs significant growth in size and technological capabilities to enrich and sustain Smart Grids in Turkey. New generation technology providers must be identified, supported and aligned with other industrial partners through Smart Grid projects and other related incentive mechanisms.	MENR, EMRA, ICTA, MIT

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R30	Other Recommendations	Public Awareness and Consumer Acceptance	EMRA and the DSOs should promote mechanisms for improved consumer awareness of technology use and market opportunities.	In order to reach success for Smart Grid projects, awareness and acceptance levels of energy consumers must be high so that the Smart Grid transition can continue successfully, and benefits can be created through better consumer engagement processes. This is one of the key topics that is suggested by European (EDSO, EURELECTRIC) authorities for Smart Grid projects through events, publications and strategy papers. Many countries such as France, Netherlands etc. have developed consumer engagement strategies according to local conditions and requirements in this perspective.	Consumer engagement and awareness for Smart Grid transition is very limited and not initiated by DSOs or public authorities. Recent disseminations of industry-wide projects such as TAŞ2023 and triggering events in electric mobility and renewable energy has started to attract consumers' attention to a certain level and presents an opportunity for more structured planning for higher engagement.	MENR, EMRA, ICTA
R31	Other Recommendations	Regulations for Disaster Recovery Plans	Establishment of advanced emergency and system restoration plans using smart grid technologies to ensure network resilience in case of disasters and large disruptions	Smart Grid technologies and management philosophy has significant potential to contribute to disaster recovery actions, especially in natural disasters such as earthquakes that are frequent in Turkey, due to capabilities of continuous real-time monitoring and control over the grid segments. Regulations must be revised in the light of Smart Grid capabilities of DSOs, especially in potential disaster zones, to enhance disaster recovery plans and give DSOs certain responsibilities to act in case of disasters. Smart Grid concepts such as smart metering and micro grids are crucial in this context. Countries outside Europe such as Japan and Canada are progressive in implementation of such concepts with disaster awareness.	Disaster recovery plans are made according to existing capabilities and expected role of DSO is mainly to re-organize its central and field teams to energize disaster region to a possible extent via grid or via temporary solutions (such as diesel generators). SCADA systems are also available for disaster recovery purposes but not included in the disaster recovery regulations as a mandated system.	AFAD, MENR, EMRA, DSOs

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R32	Other Recommendations	**Revised Rules for More Efficient Reactive Energy Regulation**	Revision of existing rules and regulations on reactive energy management in alignment with new concepts and technologies in reactive energy management and flexibility services	Existing set of rules and regulations for reactive energy management are not completely sufficient to capture and organize Smart Grid capabilities and flexibility potential that can be reached by DSOs. New or revised regulations are recommended to include concepts like aggregated flexibility services, reactive energy support from distributed generation etc. to provide better grid management.	Existing reactive energy management regulations are mainly focusing on ancillary services market at larger scale and they are not related to DSOs and distribution grid management. EMRA-supported pilot R&D projects are ongoing to analyse benefits of distribution level flexibility services and to provide regulatory suggestions to EMRA.	EMRA, DSOs, DG Plant Owners, Aggregators
R33	Other Recommendations	**Encourage Establishment of Sector Smart Grid Platform**	Establishment of Smart Grid Information Exchange Platform and active working groups under the platform for industry-wide standardization and exchange of Smart Grid experiences	A Smart Grid platform with active working groups per focus area is recommended to form a collaborative structure among the DSOs and other key stakeholders in sharing Smart Grid experiences, benefit from lessons learned by other entities and contribute to industry-wide standardization efforts for Smart Grid transition.	There had been several attempts at initiating a Smart Grid platform or working group, but lack of definitions and regulations for roles, responsibilities and benefits caused discontinuation. DSOs have limited amount of information exchange on Smart Grid projects through R&D collaboration (mutual projects), dissemination events (fairs etc.) or direct communication in formal or informal platforms.	ELDER, EMRA, DSOs, Smart Grid Vendor Ecosystem, Academia

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Regulatory Recommendations related to Smart Grids

ID	Feature	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
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Technical Assistance for Improvement of Performance-Based Tariff Regulation of EMRA For Turkish Energy Markets Through Introducing an Enhanced Monitoring System

Task 4.2 Workshop

Smart Grid Roadmap for Turkish Electricity Distribution System Operators

15 September 2020, Online Training

This project is funded by the European Union

Agenda

Smart Grid Roadmap for Turkish Electricity DSOs

- As-is Status of Smart Grids in DSOs
- Needs Assessment
- Smart Grid Roadmap for DSOs
- Recommendations on Implementations, Roles and Responsibilities

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As-is Status of Smart Grids in DSOs

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As-is Status of Smart Grids in DSOs

- After the privatizations, the operators of the electrical distribution companies have been obliged to undertake the necessary investments and improvements in the networks. Primarily, distribution companies were expected to perform network master plan studies for 5- and 10-years horizon. EMRA also started to update loss & theft target values for each distribution region for every year; to reduce technical and non-technical losses.

- In addition to the initiation of implementation Smart Grid systems (including SCADA, distribution automation, OMS, AMR, GIS, etc.) which started mainly with the 2nd Tariff Period (2010-2015) of the sector, R&D and pilot projects have also been initiated on topics such as advanced measurement infrastructures, demand side management, smart meters, and communication within the scope of R&D activities that intensified after 2014.

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As-is Status of Smart Grids in DSOs

There are a number of findings related to Smart Grid development status in Turkish electricity DSOs:

- Different Smart Grid maturity and technology deployment levels amongst 21 electricity distribution companies
- Lack of a systematic approach to track the results, lessons learned and real-life experience for SG projects
- Functionalities that have been implemented but not used
- Insufficient pilot implementation and trials on the field for new technologies
- Lack of cross-sectoral know-how sharing platform
- HR requirements that can harmonize power system and ICT technologies
- Challenges to realize IT-OT convergence
- Problems with transforming data asset to value and lack of analytics-based decision making
- Solutions that do not comply interoperability requirements
- Overdependency to public infrastructure for SG communication needs

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Needs Assessment

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Needs Assessment

- For Turkey, there are a number of main expectations from smart grids.
- In order to realize all these high expectations, the operation of a well-designed transition and transformation process for smart grids is critical.
- Planning and implementation efforts must be extensive and must involve a large number of parameters and approaches.

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Needs Assessment

Smart Grid roadmap developed for Turkey in this task considers the following needs and achievement targets as basis and project recommendations have been developed on top of these considerations:

- Smart Grid Planning
  - Implementation planning for smart grid and digital transformation
  - Adaptation of organization and business processes for IT-OT convergence
  - Strong engagement of academia for development of Smart Grid-ready HR
  - Collaborations for new business models, lessons learned exchange

- Advanced Grid Monitoring, Control and Management
  - Start network management utilizing SCADA/ADMS/OMS and DERMS systems
  - Proper capture and management of network data, data-driven decision making in network management, advanced grid analytics
  - Roll-out of grid automation systems to improve situational awareness and remote control & management capabilities, automation work-force management
  - Large-scale pilot projects for concepts including self-healing networks, (ANM), D-ancillary services, closed-loop networks, WAM for distribution and DC networks.

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Needs Assessment

- Asset Management and GIS
  - Properly capture and manage network, customer, and geospatial data in GIS
  - Asset performance and life-cycle management via IoT and IT
  - Risk and reliability-based maintenance plans
  - Long-term asset management and strategical investment decisions based on APM

- Enterprise IT & Analytics
  - Enhance customer interactions enabling enterprise applications, mobile apps, social media integration and next generation analytics
  - Develop enterprise IT architecture and properly manage
  - Digitalization roadmap, plan to deploy advanced analytical capabilities and platforms
  - Implement data quality control & assurance systematics and tools
  - Automate regulatory reporting
  - Accurate short-term load forecasting
  - Include OT and telemetry data in enterprise analytics

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Needs Assessment

- Enterprise Application Integration
  - Realtime synchronization of network model and telemetry data
  - Design integration architecture and develop the implementation plan
  - Complete all major integration work for IT and OT systems for key data exchange
  - Start implementation of interoperability standards (CIM/IEC 61968)

- Integration of Distributed Energy Resources
  - Real time monitoring and remote control of DGs
  - Initiate distribution ancillary services capabilities for voltage/reactive and congestion management support from DGs
  - Standardize and automate DG connection permission processes
  - Large-scale pilot projects to evaluate the effects of hybrid rooftop PV and ESS
  - Pilot projects for implementation of utility-scale storage systems
  - New network components (voltage regulators, OLTC DTRs, etc.) to increase connection capacity of RES
  - Integration with aggregator Systems for better utilization of DSM
  - Adapt network expansion planning processes considering DERs

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Needs Assessment

- Integration of Electric Vehicles and Charging Infrastructure
  - Enabler role to proliferate of EVs via standardization/automation of connection process
  - Implementation of systematics for smart management of LV&MV network capacity
  - Explore potential use of EVs for grid services (V2G) via pilot projects
  - Cross-regional interoperability and plug & play practices for EV charging

- Smart Grid Communication
  - Design, plan and implementation of own communication infrastructure
  - Collaborate with telecommunication operators for better network utilizations
  - Interoperable environment for SCADA, AMI and IoT
  - New capabilities for tighter communication capabilities with field crew
  - Pilot implementations for testing and adaptation of new generation communication technologies for smart grid components
  - Start to manage smart grid telecommunication networks and nodes

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Needs Assessment

- AMI / Smart Meters
  - 80-80 principle for deployment of smart meters: 80% of total consumption by 2025 and 80% of the estimated 50 million customers by 2035
  - Develop minimum standard requirements for smart meters and relevant standards
  - Large-scale smart meter pilot projects
  - Develop deployment plans for AMI and communication infrastructure
  - Implementation of MDM (Meter Data Management) systems and meter analytics
  - Advanced invoicing applications for energy efficiency
  - Trial studies for blockchain technologies in energy trade

- Cyber Security
  - Cyber security audits for compliance check of IT and OT environment
  - Action plans to mitigate vulnerabilities and risks
  - Track CS maturity level and progress
  - Establish of cyber security operation centre
  - Implement cyber security test laboratories
  - Nationwide cybersecurity certification program for smart grid components

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Smart Grid Roadmap for DSOs

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Smart Grid Roadmap for DSOs

Building on the assessment of current situation and requirements, a successful transition to a ‘Smart Grid’ framework requires certain steps in certain directions within the relevant technical domains.

In this perspective, a total number of 30+ concrete recommendations are presented in this section with conceptual framework and relevant sub-topics that can be handled as projects within the context.

Technical domains that are considered for enlisting project recommendations can be listed as below:

- **Smart Grid Planning**
- **Advanced Network Monitoring, Control and Management Systems**
- **Asset Management and GIS**
- **Enterprise IT and Data Analytics**
- **Integration of Distributed Generation and Energy Storage**
- **Electric Vehicles**
- **Telecommunication Infrastructure**
- **Advanced Metering Infrastructure**
- **Enterprise Application Integration**
- **Cyber Security**

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Smart Grid Roadmap for DSOs

Recommendation 1	**Smart Grid Planning Activities**

Planning the deployment of smart grid technologies is a challenging process due to highly complex environment of information (IT) and operational technologies (OT). The first step towards realization of Smart Grids is the initial planning activities that will lay out the conceptual foundation for future projects. Therefore, it is essential for DSOs to start with developing their Smart Grid Master Plans and build up their entire Smart Grid project portfolios and implementation strategies according to the basis provided in the Master Plans. Certain steps recommended for successful progress are as follows:

1. Smart Grid Master Plan

2. Smart Grid R&D and Pilot Implementation Planning

3. Harmonization/Revision of Grid Master Plans with the Smart Grid Master Plan

As-is Status in Turkey: Turkish electricity distribution sector has developed a detailed smart grid roadmap defining the achievement targets and implementation recommendations until 2025. EMRA has recently added a clause in the draft version of "Procedures and Principles for the Determination of Investments in Electricity Distribution" to oblige DSOs to include Smart Grid planning as part of their 5 and 10-years Master Plan studies.

Prioritization: Short-term	**Technical Domain:** Smart Grid Planning

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Smart Grid Roadmap for DSOs

Recommendation 2	**Establishment of a PMO Organization for Managing Smart Grid Roll-out**

Due to the wide-scale technical and administrative complexity of Smart Grid implementations, it is recommended for DSOs to establish a 'Project Management Office (PMO)' structure within their organizational frameworks.

Main function of a PMO will be to handle the strategic project management; continuously track progress of Smart Grid roll-outs in multiple technical domain, coordinate projects and resources, provide coaching and training for Smart Grid Project Managers and ensure that certain project management methodologies are put into standardized, high-quality use across the organization.

As-is Status in Turkey: Most of Turkish DSOs have not yet implemented a PMO structure to properly monitor and manage their progress in smart grid domains. In general, alignment of company organization and business processes are in good shape but triggered via establishment of new systems and infrastructure, the approach is generally reactive. On the other hand, there is still room to improve about IT-OT convergence from business process and organizational perspectives.

Prioritization: Short-term	**Technical Domain:** Smart Grid Planning

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Smart Grid Roadmap for DSOs

Recommendation 3	**New Services, Business Models and Market Blueprints**

Transition to Smart Grids provides new perspectives and business opportunities for DSOs that had not been available with the conventional grid management philosophies and systems. It is recommended for DSOs to develop and execute a project on market-oriented transformation around Smart Grid technologies and their value chain. Each factor driving the Smart Grid transition also holds various business opportunities that will benefit all the involved stakeholders, but extraction of the added value requires elaborate assessments of business value chain, consumer orientation, market models and mechanisms.

1. Comparing Different Models and Establishing Market Structure for Ancillary Services Market.
2. Evaluation of Different Market Models for Demand Side Participation
3. Establishment of Market Mechanisms for Sustainable Expansion of User-Sized Renewable Energy Generation.
4. Comparison of Different Market Balancing Mechanisms
5. Transformation Studies of Grid and User Oriented Open Market Structure for the Expansion of Electric Vehicles
6. Evaluation of Different Market Mechanisms for Blockchain and Peer-to-peer (P2P) Energy Trade.

As-is Status in Turkey: Turkish DSOs are executing (or completed) numerous R&D projects for trials of different smart grid components including Distribution Ancillary Services, Demand Response, EV Charging, etc. R&D and Innovation mechanisms of EMRA is quite encouraging for this kind of studies.

Prioritization: Medium-term	**Technical Domain**: Smart Grid Planning

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 4	**SCADA/ADMS and Network Management Systems**

An ADMS platform contains software modules that automate grid re-energization processes and optimize grid performance in the event of downtime. ADMS developed for electricity distribution companies includes functions such as fault location detection, isolation and restoration, Volt/VAr reactive optimization, voltage management, peak load management, micro-grid operation and grid integration of electric vehicles and embedded production.

As-is Status in Turkey: In general, Turkish electricity DSOs have robust progress and maturity in terms of SCADA systems.

DSOs supplying the western parts of the country are in higher maturity level since the total demand and quality expectation of the customers in these areas are higher than the rest of the country. Several utilities have been investing in centralized SCADA/DMS solutions, besides some utilities preferred to meet current operational needs by providing limited monitoring and control capabilities.

There are also problems about the functionalities that have been implemented but not used in real operations in Network Management Systems.

Almost all utilities have a connection model of their MV networks in different platforms.

Prioritization: Medium-term	**Technical Domain:** Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 5	**Roll-out of Grid Automation Systems**

Modern grid control and automation technologies include applications based on advanced mathematical algorithms. For example, performing failure analysis with the data received from smart devices in the grid and determining the location of the fault, isolating the defective region, re-feeding the remaining network regions, returning the network to its normal operating state after the fault is eliminated, and making advanced analysis for maintenance and investment processes after failure are the competences provided by modern grid control technologies.

Investments in monitoring and automation systems should be designed in the light of the difficulties encountered in the relevant grid section (regional conditions such as accessibility, grid topology, meteorology, critical loads). This planning should be based on service quality requirements of the grid, reliable assessments of distributed energy roll out, and modular concepts for automation.

Due to differentiating characteristics of medium and low-voltage grid portions, roll-out of grid automation systems within this project recommendations are clustered under two segments, namely 'MV Grid Monitoring / Control' and 'LV Grid Measurement / Monitoring' in order to provide a clearer view of required tasks.

As-is Status in Turkey: Remote-control function is mostly supported on primary substations in MV networks while generally not being provided in secondary MV and LV level.

Prioritization: Short-to-Medium Term	**Technical Domain:** Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 6	**Advanced Grid Analytics**

Existing ADMS solutions provide advanced reporting and post-event analysis capability, integrated with commercial BI (business intelligence) systems. This allows distribution grid operators to perform analyses for improving different business processes with high yields. However, some ADMS solutions have included data analytics functionality and complex event handling into the operational environment, in order to meet exclusive real-time analytical needs for business operations. In the coming period, advanced analytical functionality can be expected to be implemented (including in-memory processing and in memory database technologies) within ADMS solutions. Grid data and connection models are essential to establish a fully functioning "advanced grid analytics" systems which also requires a sound plan for pilot implementations and dissemination activities.

In this context, a series of projects are recommended in order to develop, sustain and benefit from advanced grid analytics to full extent in real-life operational processes.

1. Grid Data Model Design; 2. Improvement/Verification of Grid Connection Model; 3. Grid Data Management and QA&QC Management System Design;

4. Implementation of Grid Data Management and QA&QC Management System; 5. Grid Analytics Concept Proof and Pilot Application Project;

6. Grid Analytics Application and Dissemination Project

As-is Status in Turkey: In most of the DSOs, efforts to realize the business transformation of "analytics-driven decision making" have either not started or at very preliminary stages.

Prioritization: Medium Term	**Technical Domain**: Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 7	**Adaptation to New Operational Philosophies**

Emergence of new generation energy technologies are significantly challenging and changing the conventional grid structure and pushing the grid operation towards a 'Smart Grid' philosophy, that is not necessarily limited to planning and deployment of several systems that enable DSOs to tackle the challenge. Transition to smart grids require an important change in perspectives and philosophies so that DSOs are completely able and aware of the new possibilities and limitations of Smart Grid systems that they deploy and use.

Integration of distributed generation units, electric vehicles, energy storage units and inclusion of demand side practices (such as demand response) mandate a bi-directional grid management due to the fact that not only energy but the information and communication requirements in the Smart Grid are also bi-directional. Active grid management philosophy becomes highly important and there are several steps to consider and execute in order to successfully change grid management philosophies into a data-oriented, pro-active and comprehensive nature.

As-is Status in Turkey: There are several conceptual and small-scale trial studies for the advanced solutions, technologies and operational practices, especially through R&D funding of DSOs.

Prioritization: Medium-to-Long Term	**Technical Domain:** Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 8	**New Grid & Automation Technologies**

Together with the increased usage of consumer electronics in the last decades, a significant portion of end-user electricity consumption has started to become direct current (DC) appliances, due to the fact that DC applications are standard in consumer electronics. In addition to DC consumption requirements, all the new generation Smart Grid components, such as solar photovoltaic panels and batteries (whether in energy storage units or electric vehicles) are integrated in the LV grid through AC/DC inverters. DC applications are also gaining attention in high-voltage applications, especially in establishment of long-distance transmission lines due to lower technical loss rates and operational economy.

A number of projects are recommended in this context:

1. Feasibility Study and Roadmap for LV DC Distribution Grids; 2. Pilot Applications Related to LV DC Distribution Grids; 3. 'Augmented Reality' Pilot Applications in Electricity Distribution Grids; 4. Wide Area Monitoring Pilot Application in Distribution; 5. MV Innovative Distribution Automation Field Solutions Pilot Application; 6. LV Innovative Distribution Automation Field Solutions Pilot Application; 7. Amorphous Transformer and Super Conductor Pilot Application Studies; 8. Pilot Application Study of Switching Equipment Based on Semi-Conductor and Power Electronics Technologies; 9. Pilot Applications of LED in Street Lighting

As-is Status in Turkey: There are several conceptual and small-scale trial studies for the new grid and automation technologies, especially through R&D funding of DSOs.

Prioritization: Medium-to Long Term **Technical Domain**: Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 9	**Outage and Workforce Management**

Outage management functionality is one of the critical components in management of Smart Grid infrastructure and systems. Outages are the primary reflection of grid failures and have significant impact on social and economic activities of end-users at various scales. Improved handling and mitigation of outages is therefore one of the key aspects that DSOs must focus on in their Smart Grid roadmaps and investments.

An outage management system is required to perform critical tasks; such as fault localization, resource prioritization for grid restoration after outage incidents, outage impact assessment, restoration time assessment and assistance to field crew organization for restoration activities.

Although some of the DSOs have already implemented an OMS within their SCADA systems, several other DSOs do not have any capability of outage management due to a lack of OMS. Thus, a major Smart Grid functionality remains inactive and prevents these DSOs to provide reliable and uninterrupted energy delivery to their customers in MV and LV grids. Tasks below are recommended for DSOs without any OMS implementation within their Smart Grid framework and operational capabilities.

1. Outage Management System Design and Construction Studies; 2. Establishment of Outage Management System; 3. Outage Management System - Social Media Integration; 4. Launching the Outage Notification Mobile Application; 5. Mobile OMS (Field) Project; 6. Pilot Project for Integration of Telecom Service Outage Data to Outage Management System; 7. Dissemination Project for Integration of Telecom Service Outage Data to Outage Management System; 8. Work Force Management (WFM) Business Rules Definition and Construction Studies; 9. Establishment Project of Advanced Workforce Management System (WFM); 10. Mobile WFM Design and Construction Studies; 11. Establishment Project of Mobile Workforce Management System

As-is Status in Turkey: Per regulatory obligations, all DSOs have implemented continuity of supply recording and basic outage management systems. Furthermore, many DSOs have implemented basic work order management systems. There are also a few DSOs that have implemented some of the aforementioned advanced OMS and WFM functionalities.

Prioritization: Short to mid-term	**Technical Domain**: Advanced Network Monitoring, Control and Management Systems

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 10	**Data Management and GIS Improvement**

Management of asset data through geographical information systems (GIS) is one of the key topics that enables the DSO to possess extensive knowledge of its asset status and the grid topology. The quality of data and the functional capabilities of implemented GIS solutions becomes important in this manner.

Action steps and tasks recommended with respect to asset management and GIS solutions are given as below.

1. Establishment of/Improving GIS Solutions
2. Mobile Field Data Collection and Establishment of GIS Access Solutions
3. GIS Data Model Design Update Studies Based on Smart Grid Requirements
4. Collecting Smart Grid GIS Data Needs from the Field
5. GIS Landscape Update Project and Landscape Integration with Other Related Smart Grid Systems

As-is Status in Turkey: Majority of DSOs have early implementations of GIS solutions, with data quality problems due to lack of proper execution of data update, management and QA&QC processes.

Prioritization: Short-term	**Technical Domain:** Asset Management and GIS

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 11	**Advanced Asset Management**

Advanced asset management is a concept that requires an asset management philosophy focusing on data analytics and in-depth analysis of asset performances. For successful realization of Advanced Asset Management system, it is necessary to carry out development, improvement, implementation and dissemination activities for asset performance management in order to correctly evaluate the performance of distribution network assets, to provide maintenance requirements with systematic, data-based and predictive approaches, and thus to increase the performance of the distribution system.

Tasks related to development of an 'Advanced Asset Management' system are recommended as below.

1. Grid Asset Management Design and Planning Studies; 2. Development of Grid Components Operational Status/Performance and Useful Life Models; 3. Pilot Application Project of Asset Operational Status and Performance Tracking Field Solutions; 4. Establishment of Asset Management and Performance Tracking System; 5. DSO Technological System Elements (IT & OT) Asset Management Application; 6. Asset Performance Analytics Design and Concept Proof Studies ; 7. Asset Analytics Application and Dissemination

As-is Status in Turkey: Asset management practices implemented in DSOs so far are at basic level. New tariff period will require more advanced functionalities**.**

Prioritization: Short and Medium-term	**Technical Domain:** Asset Management and GIS

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 12	**Situational Awareness of Asset Performance**

It is essential for DSOs to have situational awareness of their existing assets in order to efficiently manage their complex grid structure. To handle this requirement, a DSO must have reliable and capable field monitoring solutions that will provide data and intelligence in order to observe field status of assets on a continuous basis. Predicting the status of critical assets in short, medium and long term becomes a critical issue for DSOs to be able to take failure preventive actions to increase grid resilience and performance.

Studies and actions below are recommended for DSOs to increase their level of situational awareness with respect to their asset performances and status throughout their grid.

1. Dissemination of Field Monitoring Solutions (IoT, Sensor Network) to Grid Components for Asset Operational Status and Performance Monitoring
2. Development of Risk Based and Reliability Based Maintenance Planning Methodologies
3. Dissemination Studies for Reliability Based Maintenance Planning Application
4. Development of Asset Management Systems for Operational Life Estimation
5. Aerial Photographing of OHL Assets and Thermographic Analysis Applications

As-is Status in Turkey: Asset management practices implemented in DSOs so far are at basic level. New tariff period will require more advanced functionalities**.**

Prioritization: Short-to-Medium Term	**Technical Domain:** Asset Management and GIS

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 13	**Digitalization Planning and Roadmap**

Digitalization requires substantial planning efforts in complex operational frameworks and corporate IT architectures such as in the case of DSOs. Establishing the vision for digitalization of enterprise IT systems and infrastructures therefore must start with elaborate studies of existing situation and future requirements in alignment with the Smart Grid vision that the DSOs will follow in short, medium and long term. Since this new vision needs DSOs to be data-oriented organizations in all aspects, efforts in data analytics must also be planned within the context of digitalization efforts.

A series of roadmap studies and analytical works are highly recommended in the beginning phase of Smart Grid digitalization efforts for enterprise IT infrastructure and data analytics; as presented below.

1. Corporate IT Infrastructures Digitalization Roadmap Study
2. Corporate IT Systems Requirement Determination Studies and Implementation Planning
3. Data Analytics Corporate Roadmap Study
4. Analytical Uses Development Project
5. Construction of Data Management Processes for Big Data Analytics

As-is Status in Turkey: Most of the DSOs in Turkey do not have a comprehensive digitalization planning**.**

Prioritization: Short-term	**Technical Domain**: Enterprise IT and Data Analytics

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 14	**Digitalization of Business Processes and Enterprise IT**

Based on digitalization roadmap studies and implementation plans, a DSO needs to review, adapt or completely revise its existing business processes according to the requirements of digitalized Smart Grid IT infrastructures. This project is recommended to focus on development and establishment of advanced IT applications on enterprise level, using the insight gained from the assessments and analyses from the roadmap studies and use case development efforts.

The initial action listed below should be interpreted as an umbrella structure or a project portfolio that will eventually incorporate several development efforts in enterprise IT architecture. The latter task recommendation focuses on a specific part of enterprise IT applications that is related to the externality of DSO operations, namely the customer interaction through call-centre operations and other customer interaction channels. Digitalization in this segment is evaluated to be highly important to effectively manage the customer relations for a DSO and requires a distinct emphasis.

1. Implementation of Advanced Corporate Applications

2. Call Centre and Customer Relations Management System Improvement/Development Studies

As-is Status in Turkey: Heterogeneous steps through several projects in call-centre automation, field management processes (metering, work force management etc.); lacking industry-wide homogeneity and alignment in all business processes.

Prioritization: Medium-to-Long Term	**Technical Domain:** Enterprise IT and Data Analytics

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 15	**Big Data Management and Analytics Platform**

The IT software components of smart grid systems both need serious hardware infrastructures, allocation for huge investment budgets for their installation, and collect data in a geometrically increasing volume, making the distribution companies data-intensive companies.

Due to the developing technology, changing business manners and customer needs, companies have started to use the data kept in their corporate systems and systems not only for basic reporting purposes, but also for creating high value services, products, and processes by using different analytical techniques and business intelligence infrastructures.

It is among the first objectives of the “Big Data” concept to reuse each data together by evaluating the large volumes of data collected for different purposes, and to reach the necessary data with data mining for the processes in order to maximize efficiency from field studies to top management.

Tasks below are required and recommended for a DSO to establish a firm management of big data generated from its Smart Grid systems.

1. Process Analytics Concept Proof and Pilot Application; 2. Process Analytics Application and Dissemination Project; 3. Big Data Analytics Software Platform Establishment Project; 4. Application of Advanced Load Estimation Algorithms and Integration of MDM Data; 5. Establishment of Advanced and Integrated Load Estimation Systems in Distribution; 6. Development of Common Model, Exchange Methods and Protocol/Standards for EDVARS

As-is Status in Turkey: There are initial efforts by several DSOs to implement Big Data Analytics functionalities.

Prioritization: Medium to Long-Term	**Technical Domain**: Enterprise IT and Data Analytics

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 16	**DERMS**

Distributed Energy Resources Management Systems (DERMS) are grid management tools that provide coordinated management of distributed energy resources, energy storage units and controllable that are connected to grid and aims to enhance and deliver value from the integrated architecture.

A number of expected benefits from a typical DERMS can be listed as active load shifting / shedding, load factor improvement through load curve shaping, minimization of grid losses through phase balancing, voltage profile management, congestion management and provision of ancillary services. Improved and active energy management through DERMS is completely aligned with Smart Grid philosophies and operational requirements, making DERMS an essential component of Smart Grid architecture with significant DG penetration rates.

Successful realization of DERMS for DSOs require certain steps and tasks, that are recommended below:

1. Distributed Energy Resources Management System (DERMS) Establishment Project; 2. Integration of Aggregator (Aggregator) and DSO DERMS Systems;

3. Distributed Energy Resources Coordinated Management Applications in Distribution Grids; 4. Establishment and Integration of Distributed Generation Real Time Monitoring Systems; 5. Medium- and Long-Term Forecasting and Action Planning Study for DGFs to Integrate MV and LV Grid;

6. Distributed Generation Real Time Control/Command Systems Establishment and Integration Project; 7. Application of Distributed Generation Estimation Solutions

As-is Status in Turkey: There is not any DSO that established their DERMS, despite the fact that several DSOs experience significant DG penetration in their distribution grids.

Prioritization: Short- to Medium-Term	**Technical Domain:** Integration of Distributed Generation and Energy Storage

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 17	**Integration of Distributed Generation**

Grid integration of distributed generation requires significant changes for DSOs in terms of planning and implementation. Long-term expansion plans should be made for all electricity distribution companies regions including rooftop solar, sub-1MW solar power plants, river-type hydro, geothermal, wind and specific road maps should be prepared for electricity distribution companies.

Energy storage systems have an important share in the establishment of distributed energy systems. Investment activities are expected to significantly decrease if the network integration is done properly. For now, high cost storage facilities and units can be expected to take place in all networks in the near future.

In this recommendation, it is advised that grid connection criteria, connection and permit procedures and grid management approaches must be analysed in detail through extensive studies, evaluating future scenarios in addition to existing framework and market trends. Projects related to this recommendation can be listed as follows:

1. Creating Minimum/Common Grid Connection Criteria for Different Distributed Generation Resources; 2. DG Facilities Energy Permits Over Grid Connection Tracking and Evaluation System; 3. Distributed Generation Integration Pilot Application in LV Grids and Impact Analysis; 4. Solution Development Project for Increasing Connectable Distributed Generation Capacity; 5. Analysis of Grid Effect of Hybrid LV Plants with Roof Type Solar and Storage Components on Real Systems

As-is Status in Turkey: There are a few DSOs that have executed R&D projects covering some of topics mentioned in this recommendation.

Prioritization: Short-Term	**Technical Domain**: Integration of Distributed Generation and Energy Storage

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 18	**DER Flexibility Services**

Increasingly higher penetration rates of renewable energy based distributed generation units possess a challenge for DSOs in terms of flexibility requirements, especially in the grid sections where generation significantly exceeds energy consumption rates frequently. This requirement of flexibility can be arranged at local or aggregated levels within the grid, in order to provide services based on modifications of generated or consumed power patterns for a specific time interval and/or power rates for certain locations or grid portions. Mitigation of such problems allows DSOs to prevent undesired situations of high imbalance and enables them to maintain their grid efficiently and effectively.

In this context, extensive work is required for DSOs to understand, analyse and effectively use distributed generation and energy storage systems within their operational framework to unlock their benefits in provision of flexibility services in Smart Grid architectures. Tasks and actions below are suggested in scope of this project recommendation, which can be viewed as below:

1. Analysing the Effects of Distributed Energy Resources and Flexibility Management Models on Electricity Distribution Grids; 2. Comparative Analysis of Different Energy Storage Technologies in Line with the Requirements of Electricity Distribution Grids and Development of Design Criteria; 3. Pilot Applications of Large-Scale Energy Storage System in Distribution Grids; 4. Pilot Application of Hydro Power Plant with Reservoir Pump in Distribution Companies with Shore to the Sea (Pumped-Storage); 5. PoC Project for intense energy storage system usage in LV distribution grid; 6. Usage of Behind-the-Meter Storage systems and PoC project; 7. Storage system and DSO system interoperability PoC Project; 8. Creating Advanced Connection Criteria and Rules for Energy Storage Systems; 9. Medium- and Long-Term Forecasting and Action Planning Study for Energy Storage Systems to be Connected to the Grid

As-is Status in Turkey: Flexibility from distributed energy resources are evaluated under R&D projects scope on theoretical base. There is no pilot energy storage system installed and commissioned by Turkish DSOs.

Prioritization: Medium- and Long-Term	**Technical Domain:** Integration of Distributed Generation and Energy Storage

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 19	**EV Charging Characterization and Grid Integration**

Main point of interaction between the electric vehicles and the distribution grid are the EV charging stations. As the primary energy outlet that will enable the EV's to charge their in-car batteries, charging stations are directly fed from the distribution grid. Therefore, it is crucial for DSOs to be able to characterize the charging habits of end users, standardize EV charging station connections and continuously monitor the charging infrastructure for a seamless grid integration of electric mobility.

A series of tasks and actions are recommended below for DSOs, that will assist and enable them to have deeper insight on grid integration of electric mobility and management of EV charging infrastructure.

1. Creating Minimum Requirements for EV Charging Stations and Grid Integration; 2. EVs Load Characterization Studies; 3. Analysis of EV Usage Habits and Impacts of EV Charging - Grid Integration; 4. Medium- and Long-Term Forecasting and Action Planning Study for Electric Vehicles and Charging Stations to be Integrated to MV and LV Grid; 5. Creation of EV Charging Station Grid Connection Criteria Document

As-is Status in Turkey: Technical and pilot studies on user profiling and widespread EV charging infrastructure management have been completed by DSOs. EV market is slowly growing its customer base. No active legislation is in place to regulate EV charging infrastructure management

Prioritization: Short- to Medium-Term	**Technical Domain**: Electric Vehicles

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 20	**Operational Management for EV Charging Infrastructure**

In connection and alignment with the previous project recommendation, it is also highly recommended for DSOs to use their insights and operational know-hows on developing operational management frameworks and strategies for effective management of EV charging infrastructure.

Inclusion of a widespread EV charging infrastructure, consisting of various types and scales of EV charging stations scattered around urban zones or transport corridors, is an important complexity that requires utmost attention for DSOs to maintain grid stability and reliability without any outages and losses. Thus, it is recommended that advanced methodologies and tools should be developed and put into operational use in order to continuously manage EV charging infrastructure and enhance true value of electric mobility without compromising operational standards and targets. Projects below are two concrete suggestions for DSOs to proceed in this subject.

1. Establishment of EV Charging Stations Monitoring, Measurement and Control Platform and Integration into Grid Management Systems
2. Autonomous EV Charge/Discharge Control

As-is Status in Turkey: No DSO has established an EV charging infrastructure management system.

Prioritization: Medium Term **Technical Domain**: Electric Vehicles

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 21	**Vehicle to Grid Applications**

Vehicle-to-Grid (V2G) applications indicate the technical concept that incorporate electric vehicles and their respective batteries into the energy management schemes in Smart Grid management scenarios. Private or public EV's are generally under-utilized within 24 hours of a day, a situation which allows batteries to be used as temporary energy storage units that can be controlled by DSOs in favour of their local grid management strategies and energy requirements.

Due to the observed and expected increase of EV's in number, especially in congested areas such as urban zones, V2G concept is seen as a highly promising Smart Grid application that increases grid efficiency and vehicle utilization in multiple aspects and creates value on both sides of the equation.

DSOs are recommended to familiarize themselves with this concept with practical implementations and prepare their strategic and operational perspectives according to the random availability of electric vehicle batteries as parked vehicles in public urban spaces or built environment.

Pilot applications of Electric Vehicle to Grid (V2G) and Electric Vehicle to Building (V2B) technologies are recommended.

As-is Status in Turkey: There is no pilot application or active infrastructure for V2G pilot implementations. There is no legislation for V2G implementation by DSOs.

Prioritization: Long-Term	**Technical Domain:** Electric Vehicles

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 22	**Interoperability Compliance**

Smart devices, which have communication, control and data processing capabilities, form a significant part of the Smart Grid communications and control architecture. Therefore, it is highly important that these devices are up to the international standards and compliant with the rest of Smart Grid components in order to establish a healthy communication flow.

These smart devices, such as smart meters or smart automation equipment, are key for enabling Smart Grid services and their capabilities are determining factors in defining the extent of Smart Grid capabilities in general. Two projects are recommended in this manner, one focusing on the smart meter interoperability and the other focusing on technological status of field automation equipment.

1. Establishment of Smart Meter Interoperability and Field Conditions Test Laboratory

2. Conversion of Field Automation Equipment Not Supporting Existing International Standards

As-is Status in Turkey: Smart meter interoperability is handled partially in different conceptual R&D studies and no test laboratory is available for smart meter interoperability. Field automation equipment, on the other hand, are generally deployed within SCADA or other infrastructure projects and they are partially up to international standards but require an overall review for standardized alignment**.**

Prioritization: Short- to Medium-Term	**Technical Domain:** Telecommunication Infrastructure

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 23	**Infrastructure Modernization**

One of the first and basic criteria for smart grid investments and projects to be successful is a well-designed telecommunication network and a suitable system architecture. Choosing the right communication technologies is the main component of this success. Technological status of the telecommunication infrastructure is playing a key role for determining how the Smart Grid components can be integrated and operated under a single communications framework.

Testing and adaptation of suitable new generation technologies is important and must always remain in focus of infrastructure management while operating the Smart Grids. Similarly, management of field activities must be tasked with capable teams and sustained continuously in order to eliminate the risks associated with infrastructure failures and operational bottlenecks due to poor maintenance. Overall assessment of existing IT and OT systems is one of the key issues and the whole communication system must be operated in an integrated fashion.

Tasks and actions related to 'Infrastructure Modernization' can be listed as below, in this context.

1. Pilot Application of New Generation LPWAN Communication Technologies in Smart Meter Infrastructures; 2. Establishment of Field Teams Communication Infrastructures; 3. Assessment and Optimization of the Current Communication Structure for IT/OT; 4. Establishment and Integration of Communication Network Monitoring and Management Systems

As-is Status in Turkey: Modernization efforts for telecommunication infrastructure are under progress in several DSOs, without an industry-wide standardization or alignment.

Prioritization: Medium-Term	**Technical Domain**: Telecommunication Infrastructure

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 24	**Smart Meter Roll-out Planning and Implementation**

Initial step towards establishment of a grid-wide AMI is the deployment of smart meters in the field. However, this step is not very straightforward due to the size and complexity of widespread implementation. Planning efforts are required to be extensive and highly detailed to avoid any shortcomings in terms of product requirements, roll-out progress or system integration efforts.

Analysis of grid requirements, customer expectations, communication technology options, interoperability issues, data requirements are all important factors in planning phase of the smart meter roll-out projects. Implementation plans are generally scaled into a few steps of roll-out expansion and field operations are scheduled according to a certain field implementation plan that evaluates factors such as field crew efficiency, customer accumulations, grid topology and communication infrastructure availability.

Certain tasks and action items that require attention in smart meter roll-out planning and implementation are given below as recommendations.

1. Definition of Minimum Smart Meter Requirements and Interoperability Standards; 2. Creation of Common OBIS Code Structure and Object Model for Smart Meters;

3. Smart Meter Dissemination Planning and DSO-Specific CBA Studies ; 4. Advanced Metering Infrastructures (AMI) Design and Planning Studies;

5. Smart Meter Large Scale Pilot Application Project; 6. Roll-out of Smart Meter Infrastructures

As-is Status in Turkey: Smart-meter roll-out plans have been identified as a primary action item in regulatory projects but there are no regulatory targets so far for large scale deployment of smart meters.

Prioritization: Short-term	**Technical Domain:** Advanced Metering Infrastructure

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 25	**Meter Data Management and Analytics**

The meter data management system generates the necessary reports by processing the meter readings according to the interruption time verification as well as the essential functions such as the management of the readout values subject to settlement. Smart meters can report alarm, configuration and connection problems. Such communications include diagnostic alarms, mix alarms and other abnormal conditions. All this data is processed by MDM and necessary reports are created. Meters can perform periodic software/firmware updates in meter data management system management.

Smart meters can collect information about grid events such as instant interruption, continuous interruption, low/ high voltage and high distortion, and send reports to the meter data management system. This information can be used for downtime analysis, maintenance schedule or capacity planning. It can also support other advanced applications such as getting pricing information, prepaid services and supporting customer exchanges between suppliers, that different types of meters will work integrated with the meter data management system.

Tasks related to MDM and meter data analytics are briefly presented as below.

1. Establishment of Meter Data Management System (MDM); 2. Meter Analytics Concept Proof and Pilot Project; 3. Meter Analytics Application and Dissemination

As-is Status in Turkey: Although a widespread AMI is not present in Turkish distribution sector, there are basic MDM systems installed and used by DSOs, mainly to fulfil the needs for old-generation AMR (‘OSOS’) systems that provide one-way communication from field to DSO.

Prioritization: Short-term	**Technical Domain**: Advanced Metering Infrastructure

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 26	**Customer Interaction and Demand Response**

One of the main benefits of transition to Smart Grids for DSOs is the capability of increased monitoring and control at the end-nodes of the distribution grid. This means that DSOs can have a much higher level of engagement with their customers and begin to use this capability to create and enhance added value for the grid operations that benefits both the DSO and the customers at the same time.

On top of direct benefits, such as continuous monitoring of smart meters and improve intervention methodologies for handling end-node grid failures or problematic situations; DSOs also have the capability to design and run advanced mechanisms such as 'Demand Response'. This means that DSOs have an active operational tool to manage the demand side continuously and bring higher efficiency and reliability to the distribution grid.

Certain tasks are suggested below to enable and improve customer interaction and demand response mechanisms.

1. SMI - Customer Interaction Applications; 2. Providing a Comparable and Detailed Invoice Information to the Consumer, Establishing an Energy Data Platform for Smart Management of Metering Information; 3. Comparative Implementation of Different Market and Tariff Models for Demand Side Participation; 4. Establishment of the necessary DSO Infrastructure for Managing Heating and Cooling Peak Load; 5. Comparative Technological Solution Application for Advanced Demand Side Management Applications over Customers' Smart Meters

As-is Status in Turkey: Customer interaction processes are not integrated to a smart metering framework. Demand response concept is tried in few pilot projects in various scales, but no legislation or active practice is currently held by the DSOs.

Prioritization: Medium- to Long-Term	**Technical Domain**: Advanced Metering Infrastructure

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 27	**Integration Architecture**

For an effective integration of enterprise applications in Smart Grids, determination of the integration architecture is the key issue to address. Each DSO may have different system topology despite being regulated entities and a specific integration architecture is required with selection of a suitable topology and set of technologies for the integration processes.

In addition to the integration of systems that are already existing or that are planned to be deployed in near term, the enterprise application integration framework must also take future systems into account as well. This requires that the DSOs are consistent with their IT and integration architecture for the future and the enterprise integration plans are future proof.

Tasks below are recommended for establishing the correct 'Integration Architecture' for DSOs.

1. Designing DSO Enterprise IT Integration Architecture by Evaluating Different Integration Topology and Technologies

2. Implementation Project for Enterprise Service Bus Based Integration

3. Identification of Technical Criteria for Compliance of New Systems with the Company's IT Architecture

As-is Status in Turkey: Although several DSOs have already comprehensive Enterprise Application Integration plans and implementation, numerous DSOs still lack these activities.

Prioritization: Medium-Term	**Technical Domain**: Enterprise Application Integration

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Smart Grid Roadmap for DSOs

Recommendation 28	**IT/OT Convergence and Integrations**

In line with the digitalization and integration of DSOs' enterprise applications, two technology domains that are present in the Smart Grid architecture require healthy integration. Information technologies (IT) and operational technologies (OT) are essential in their own functionalities, but the DSO needs a fully-integrated system structure to be able to operate and govern the whole distribution grid without any shortcomings or problems.

It is recommended that DSOs pay significant attention to IT/OT convergence and integration efforts and divide the work into a structured breakdown in order to address all the relevant Smart Grid systems and components within the system architecture. Related tasks are suggested below.

As-is Status in Turkey: Although several DSOs have already comprehensive Enterprise Application Integration plans and implementation, numerous DSO still lack these activities.

Prioritization: Medium-Term	**Technical Domain**: Enterprise Application Integration

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 29	**Common Information Model**

IEC 61970 (Common Information Model / Energy Management) and IEC 61968 (Application Integration at Electric Utilities) standards define a common information model (CIM) for data exchange, application integration, application programming interface (API) for XML messaging, and standards for electrical power systems.

CIM is a data model that enables direct data exchange between different systems operating under the same roof. The fact that it supports not only vertical but also horizontal data exchange enables communication between systems in different hierarchies. CIM allows additional applications to be integrated with minimal effort. The most obvious misconception about CIM is that CIM defines a physical data model or physical data store. CIM is the logical information model used in the definition of messages between different systems. Also, different systems and applications do not have to store their data in CIM format to connect to other systems and applications externally via CIM. In other words, it is not mandatory for an application connected to CIM to use a database draft using CIM.

There is no definitive definition that indicates that a system or application is CIM compliant. The most important bases of CIM practitioners regarding CIM compliance are interoperability tests and these tests should be taken into consideration in CIM compliance.

It is advised for DSOs to design, pilot and disseminate a CIM based grid model and data flow models in the light of the integration architecture and IT/OT integration frameworks.

As-is Status in Turkey: Although international OT products used in several DSOs have compliance with CIM standards, there are no integration implementation using CIM data exchange services in the sector yet.

Prioritization: Long-Term	**Technical Domain**: Enterprise Application Integration

This project is funded by the European Union

Smart Grid Roadmap for DSOs

Recommendation 30	**Cyber Security Maturity Assessment, Planning and Standardization**

In order to develop a sound strategy and establish mechanisms against cyber security threats, existing situation of each DSO must be addressed properly in terms of existing systems, practices and enterprise know-how. Determination and development of adequate cyber security measures needs thorough assessments of existing situation in alignment with existing maturity models and standards, and a cyber security roadmap must be developed to enlighten the continuous process to protect the DSO operations.

In addition to planning and standardization efforts, it is also important that the technological infrastructure for the testing and simulation purposes is also established. Smart Grid systems and subcomponents are various in scale, complexity, technology, and functionality. This requires a cyber security laboratory in order to test and address potential weaknesses in Smart Grid components and develop strategies for prevention of cyber-attacks through these components before any threat exists in real. Projects below are suggested under this recommendation.

1. Cyber Security Maturity Model, Determination of Current & Target Maturity Levels, and Roadmap Studies; 2. Compliance and Adaptation to IT and OT Cyber Security Standards Project; 3. Creating Cyber Security Requirements and Implementing the Required Solutions; 4. Establishing Cyber Security Simulation Laboratory in Smart Grids

As-is Status in Turkey: DSOs in Turkey have received ISO 27001 accreditation as the first step. However, there are not satisfactory studies for maturity models and standardizations.

Prioritization: Short-Term	**Technical Domain**: Cyber Security

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Smart Grid Roadmap for DSOs

Recommendation 31	**Operational Cyber Security Solutions and Business Adaptation**

Operational aspect of cyber security is at the centre of dealing with external threats. This can only be managed through the establishment of a central operational unit with adequate resources and necessary technological tools in order to run day-to-day cyber security operations to protect Smart Grid operations and enhance cyber security measures over time with accumulated know-how and operational capabilities.

In addition, integrated IT and OT systems within the Smart Grid architecture and their relevant business practices must be adapted to the necessary cyber security measures according to international standards and maturity assessments. Projects below present suggested items to implement in this perspective.

1. Establishing the Cyber Security Operation Centre; 2. IT and OT Communication Infrastructures Cyber Security Solutions Application Project; 3. Cyber security solutions applications in data exchange services between IT/OT systems; 4. OT Systems Server and Local Network Infrastructures Cyber Security Solutions Application Project;

5. IT Systems Server and Local Network Infrastructures Cyber Security Solutions Application Project

As-is Status in Turkey: There are cyber security solutions implemented for IT/OT systems. For the next tariff period, more sophisticated solutions are planned to be implemented.

Prioritization: Short- to Medium-Term	**Technical Domain**: Cyber Security

This project is funded by the European Union

Recommendations on Implementations, Roles and Responsibilities

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Recommendations on Implementations, Roles and Responsibilities

Distribution System Operator

Distribution System Operators (DSOs) play a fundamental role in the operation of networks since they are responsible for the operation, maintenance, and development of the portion of the network that links the transmission system and the end customer.

- To integrate new generation and consumption management models into the grid operations,
- To support the expansion of small-scale, variable and intermittent generation resources (solar, wind) to be connected to the grid at different voltage levels,
- To provide necessary management infrastructures to support demand side participation,
- To start the transformation of grid infrastructures by clarifying the requirements of new electric users such as electric vehicle charging stations, heat pumps,
- To provide the necessary infrastructure to implement new business opportunities and innovative solutions for market players,
- To facilitate Ancillary Services mechanisms through its flexibility sources,
- To realize continuous efficiency (all losses, operational activities, grid usage rates, etc.) in grid operations,
- To ensure its resilience against attacks that may occur on electrical infrastructures or natural disasters, in electricity systems of near future, which should possess user-oriented, interactive, flexible, reliable and sustainable grid, IT and communications infrastructure.
- To collaborate with gas DSOs in data collection, exchange and handling, in case smart metering data is collected and provided to the market.

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Recommendations on Implementations, Roles and Responsibilities

National Regulatory Authority

National Regulatory Authorities (NRAs) are responsible, among other things, about regulating network tariffs and their methodologies, as well as supervising the performance of DSOs. With regards to smart grid projects for distribution, NRAs are also responsible for setting the framework for incentivizing the smart grid-related activities.

According to CEER, NRAs should not decide on the technologies and/or solutions to be used in order to carry out the DSO's distribution task, but their role is rather to set the framework so that the DSO to decide on suitable solutions according to the incentives set by each NRA. Specifically, in the case of smart meters, NRAs should be responsible of overseeing the conducting of the CBA and evaluate the outcome, both related to associated costs, as well as to expected benefits. Moreover, issues related to data handling and exchange, and ownership and management of metering equipment, should be treated by the NRAs regarding allocation of roles and responsibilities in the private and the regulated domain. Finally, the NRA should request from DSOs to perform a Societal Cost-Benefit Analysis (SCBA), to evaluate the necessity of the deployment of flexibility services via analysing whether the benefits of a procurement model outweigh the resulting administrative burdens.

Other key recommendations about roles of the NRA can be listed as follows:

- Shift the allocated revenues from traditional investments to technological investments through incentives
- Develop smart grid promoting regulations
- Develop asset aging and conditional assessment approach
- Implement a concrete methodology to assess, monitor and audit the Smart Grid projects

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Recommendations on Implementations, Roles and Responsibilities

Academia and Research Institutions

Academia, such as universities and R&D centres play an important role in smart grid activities in the European setting. Moreover, DSOs often collaborate with the academia and research institutions for their smart grid-related activities. CEER[195] proposes that incentives for innovation may also be anchored outside the regulatory system and therewith beyond the scope of the NRA. This may include public innovation funds for smart grid projects, national funding programs or European Framework Programs for Research and Innovation.

International Entities

Several international entities provide financing for smart grid projects. Apart from funding available from the European Commission for innovation and smart grid activities, via several funding mechanisms, such as the Horizon 2020 and the Horizon Europe framework program, the LIFE program, the Connecting Europe Facility, as well as other funding schemes, funding is also available from financial institutions and entities, such as the European Bank for Reconstruction and Development (EBRD), the EuropeAid, and others.

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Thank You / Teşekkürler

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