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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 Natural Gas Markets

Electricity Distribution

15 September 2020, EMRA, Ankara

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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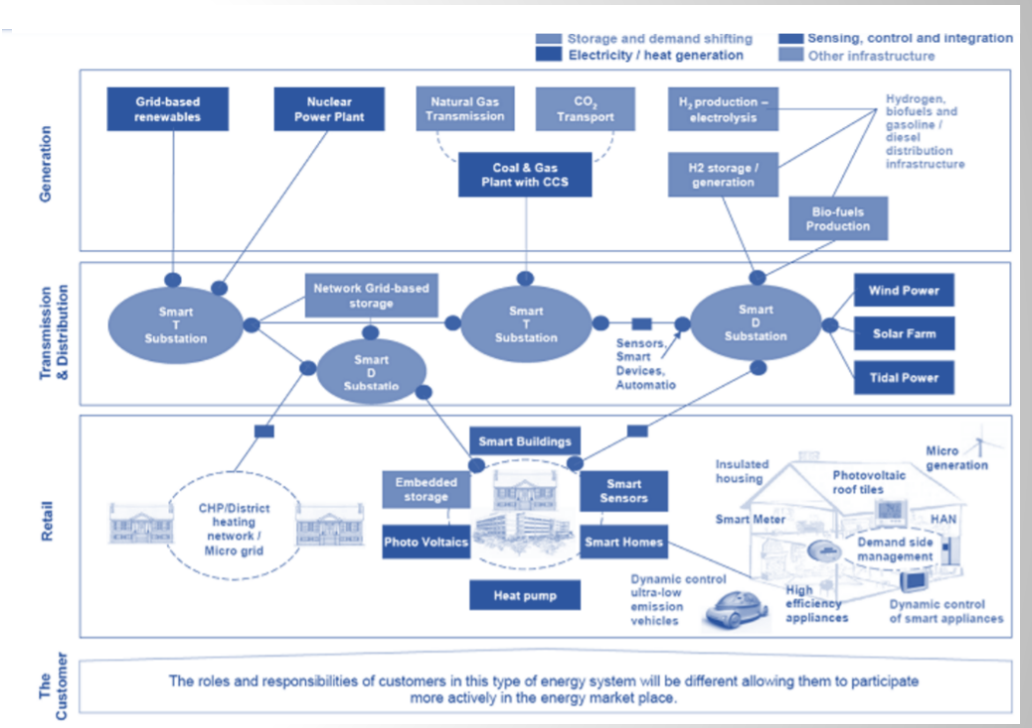
Introduction – What is "*Smart Grids*"

- ✓ 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.



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

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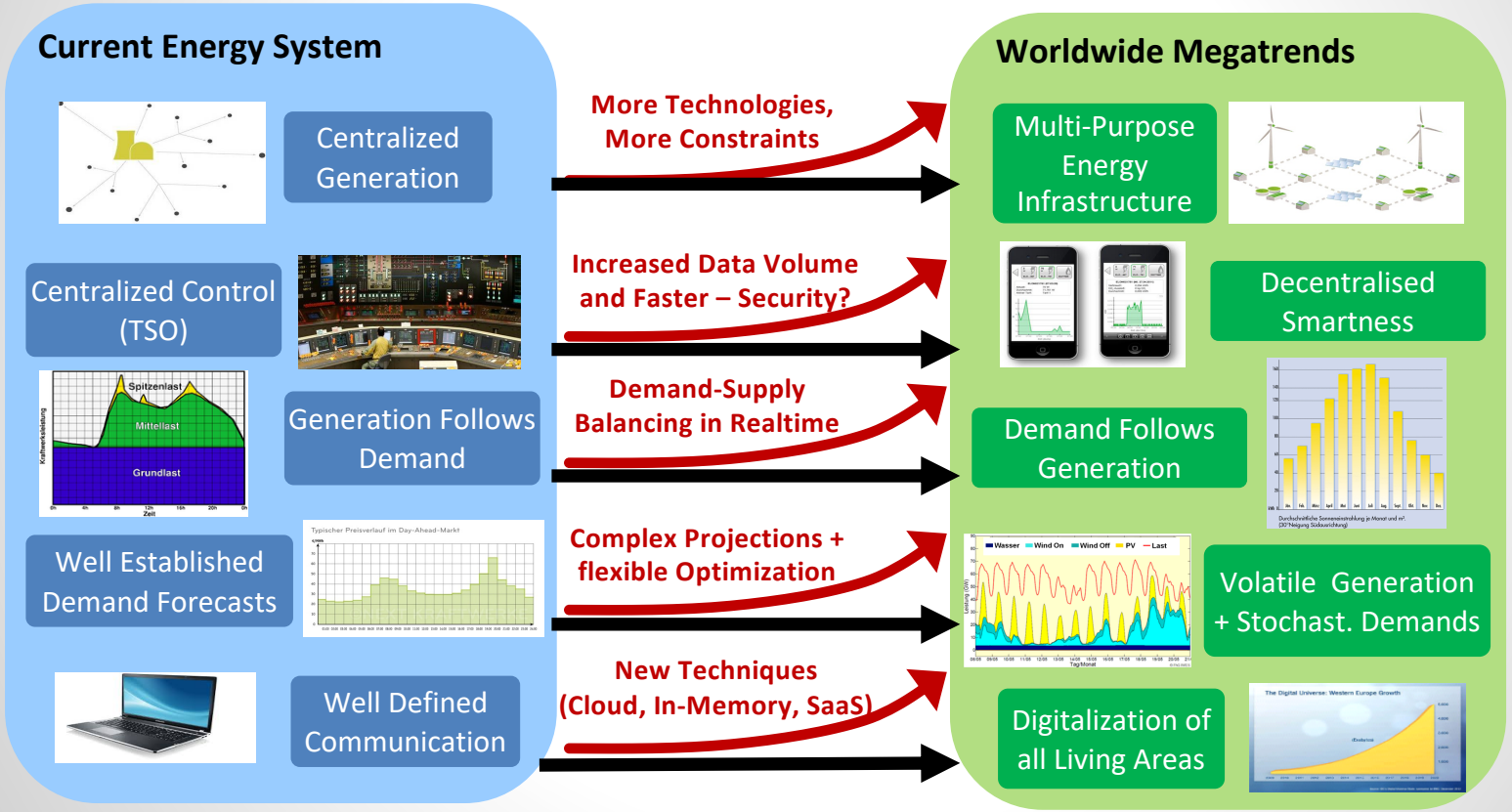
Smart Grids Mega Trends



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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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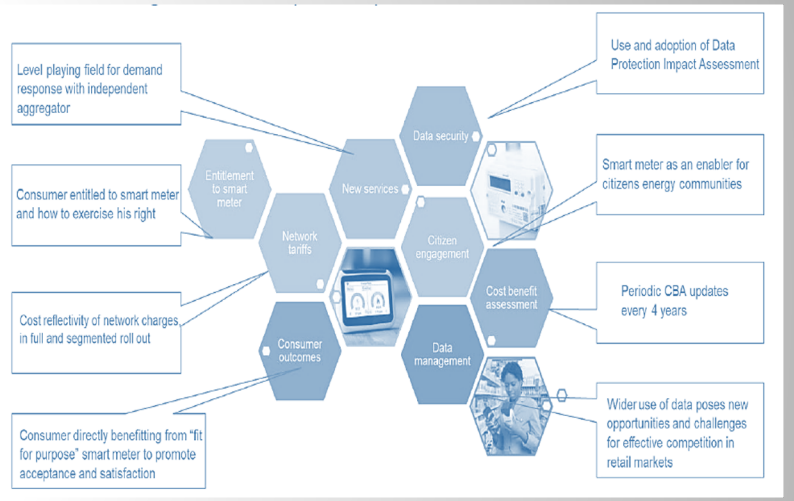
New Electricity Directive (2019/944/EU)

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 MS 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 (Frontier-Economics, 2012).
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 (Energinet.dk, 2015).
Greece	From 2017 onwards, the approved budget for R&D and pilot projects will be added to the annual allowed revenues in Greece (Eurelectric, 2016)
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. (Eurelectric, 2014). 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 (Eurelectric, 2016)

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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 (CER, 2010).
Italy	In Italy, AEEG 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 NER 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) (Eurelectric, 2016)
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 (Eurelectric, 2016)
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, and only applicable to electricity distribution companies (Crispim et al., 2014). 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 (Eurelectric, 2016).

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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 Ra&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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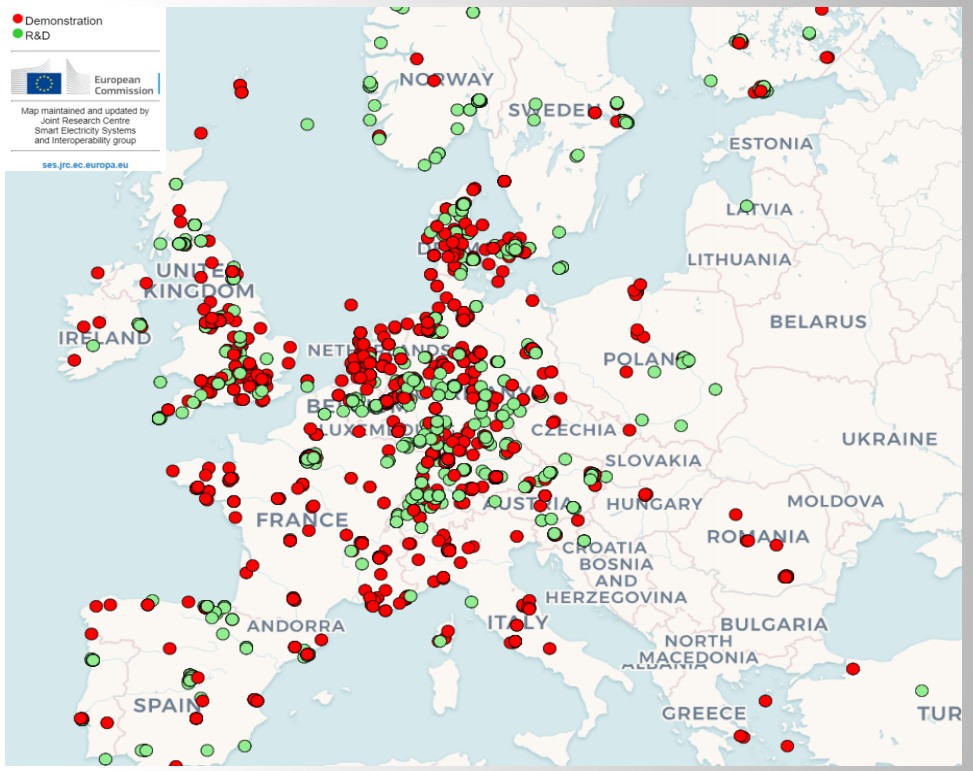
Overview of Smart Grid Projects in EU

- 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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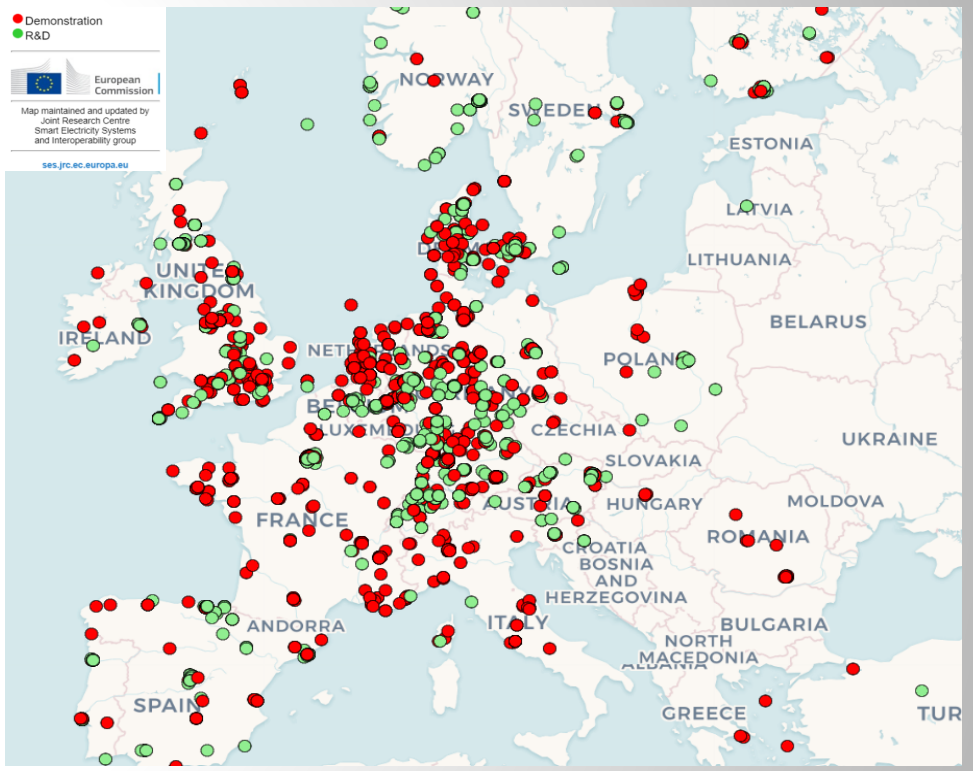
Overview of Smart Grid Projects in EU

- 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 the capital city of Spain 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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Task 4.2 Workshop

European Legislative Framework Related to Smart Grids

Gas Distribution

16 September 2020, EMRA, Ankara

This project is funded by the European Union

Agenda

Session-2: European Legislative Framework Related to Smart Grids

- European Legislative Framework Related to Smart Grids
- Legal and Regulatory Framework at Energy Community Level

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European Legislative Framework Related to Smart Grids

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European Legislative Framework Related to Smart Grids

Directive/Regulation	Description
Directive 2009/73/EC	Directive 2009/73/EC sets that in order to promote energy efficiency, Member States or the National Regulatory Authority (NRA) shall strongly recommend that natural gas undertakings optimize the use of gas, for example by providing energy management services, developing innovative pricing formulas or introducing intelligent metering systems or smart grids where appropriate.
Directive 2012/27/EC	This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy and provides for the establishment of indicative national energy efficiency targets for 2020. The requirements laid down in this Directive are minimum requirements and shall not prevent any Member State from maintaining or introducing more stringent measures. Such measures shall be compatible with Union law. Where national legislation provides for more stringent measures, the Member State shall notify such legislation to the Commission.
Recommendation 2012/148/EU	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.
Recommendation 2014/724/EU	Commission Recommendation 2014/724/EU on Data Protection Impact Assessment Template (DPIA) for smart grids and smart metering systems provides guidance to Member States on measures to be taken for the positive and wide-ranging dissemination, recognition and use of the Data Protection Impact Assessment Template for Smart Grid and Smart is also applicable to natural gas metering systems.
Directive 2019/944/EU	The Directive EU 2019/944 updates the common rules for the generation, transmission, distribution, energy storage and supply of electricity. Specific provisions related to smart metering systems are included from Article 19 to Article 21, and Annex II.

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Directive 2012/27/EC

- Provisions of Directive 2012/27/EC on energy efficiency are also applicable to natural gas meters. Article 9 of Directive 2012/27/EC reads:
  - *"Where, and to the extent that, Member States implement intelligent metering systems and roll out smart meters for natural gas [..]:*
    - *(a) they shall ensure that the metering systems provide to final customers information on actual time of use and that the objectives of energy efficiency and benefits for final customers are fully taken into account when establishing the minimum functionalities of the meters and the obligations imposed on market participants;*
    - *(b) they shall ensure the security of the smart meters and data communication, and the privacy of final customers, in compliance with relevant Union data protection and privacy legislation; […]*
    - *(e) they shall require that appropriate advice and information be given to customers at the time of installation of smart meters, in particular about their full potential with regard to meter reading management and the monitoring of energy consumption."*

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Recommendation 2014/724/EU

- Commission Recommendation 2014/724/EU on Data Protection Impact Assessment Template (DPIA) for smart grids and smart metering systems provides guidance to Member States on measures to be taken for the positive and wide-ranging dissemination, recognition and use of the Data Protection Impact Assessment Template for Smart Grid and Smart is also applicable to natural gas metering systems. In summary, for natural gas systems we see an effort made by the European Commission for alignment of the relevant provisions for gas smart metering to those offered for electricity meters. Nevertheless, such efforts and relevant recommendations are to a grant extend much lighter than those for natural gas.

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Directive 2009/73/EC

- Directive 2009/73/EC sets that in order to promote energy efficiency, Member States or the National Regulatory Authority (NRA) shall strongly recommend that natural gas undertakings optimize the use of gas, for example by providing energy management services, developing innovative pricing formulas or introducing intelligent metering systems or smart grids where appropriate (Article 4).

- Further, Annex I of the Directive lists measures on consumer protection. In paragraph (2) of Annex I, Member States are called to ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas supply market. The Directive provides that the implementation of those metering systems may be subject to an economic assessment of long-term costs and benefits (CBA) to the market and the individual consumer. The form of intelligent metering which is economically reasonable and cost-effective must be considered together with a relevant feasible timeframe. Such assessment should take place by 3 September 2012.

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Directive 2009/73/EC

- The Directive specifies that subject to the CBA assessment above, Member States or the NRA, shall prepare a timetable for the implementation of intelligent metering systems, ensure the interoperability of those metering systems to be implemented and shall have due regard to the use of appropriate standards and best practices and the importance of the development of the internal market in natural gas. No obligation for a specific target exists as is the case with electricity. The respective Electricity Directive (2009/72/EC) sets a target of up to 10 years for the implementation of intelligent metering systems and for at least 80% of consumers to be equipped with intelligent metering systems by 2020 in case of a positive CBA assessment. No such explicit provisions are found in Directive 2009/73/EC for gas. Thus, provisions for natural gas smart metering are clearly, and by substance, lighter than the ones provided for electricity.

This project is funded by the European Union

Recommendation 2012/148/EU

- The definition of smart metering has been provided by the Commission Recommendation 2012/148/EU on the preparation for the roll-out of smart metering systems:

  "'smart metering system' means an electronic system that measure energy consumption, adding more information than a conventional meter, and can transmit and receive data using a form of electronic communication. ".

- In accordance with Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC and Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, Member States are required to ensure the implementation of smart metering systems that assist the active participation of consumers in the electricity supply and gas supply markets and implementation of those metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of smart metering is economically reasonable and cost-effective and which timeframe is feasible for their deployment.

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Directive 2019/944/EU

- The Directive EU 2019/944 updates the common rules for the generation, transmission, distribution, energy storage and supply of electricity. Specific provisions related to smart metering systems are included from Article 19 to Article 21, and Annex II.

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Directive 2019/944/EU

- Article 19

  - Article 19 recalls the provision under which Member States shall recommend energy market undertakings to implement smart metering systems. Although the Article 19 mentions “electricity markets”, the stipulated provisions are also applicable for the gas market as well. Specifically, Article 19 states the following:

    - Member States shall ensure the deployment of smart metering systems to foster the active participation of customers in the energy market, subject to a cost-benefit analysis (CBA) according to what is stipulated in Annex II of the Directive, as well as in Recommendation 2012/148/EU,

    - Member States shall adopt and publish the minimum functional and technical requirements for the smart metering systems to be deployed in their territories, in accordance with Article 20 and Annex II of the Directive

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Directive 2019/944/EU

- Article 19

  - Member States shall ensure the interoperability of the smart metering systems, as well as their ability to provide output for consumer energy management systems, by ensuring compliance of the said systems with the relevant available standards, including those enabling interoperability, to best practices and to the importance of the development of smart grids,

  - Member States shall ensure that final customers contribute to the associated costs of the deployment in a transparent and non-discriminatory manner, while taking into account the long-term benefits to the whole value chain, and

  - Member States at which the smart metering systems have been negatively assessed via the CBA, shall ensure that this assessment is revised at least every four years, or more frequently, in response to significant changes in the underlying assumptions and in response to technological and market developments.

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Directive 2019/944/EU

- Article 20
  - Moreover, according to Article 20 in case of Member States where the deployment of the smart metering systems has been positively assessed via the CBA, smart metering systems should be in accordance with European standards, the Commission Recommendation 2012/148/EU, and with other specific requirements as per Article 9 of the Energy Efficiency Directive 2012/27/EU, such as:
    - The information that metering systems provide to final customers on actual time of use,
    - The security of the smart meters and data communication, and the privacy of final customers,
    - The availability of these data for the customers; and
    - The appropriate advice and information be given to customers at the time of installation of smart meters

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Directive 2019/944/EU

- Article 21
  - Article 21 states that customers are entitled to a smart meter, even where the deployment of smart metering systems has been negatively assessed. In such case, customers should bear the associated costs of deployment, under fair, reasonable and cost-effective conditions.

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Directive 2019/944/EU

- Article 23

  - Article 23, is related to data management of smart metering data. The processing of personal data within the framework of this Directive shall be carried out in accordance with Regulation (EU) 2016/679. Moreover, Article 23 stipulates that:
    - Member States shall specify the rules on the access to data of the final customer by eligible parties in accordance with this article and the applicable union legal framework,
    - Member States shall organize the management of data in order to ensure efficient and secure data access and exchange, as well as data protection and data security,
    - The rules on access to data and data storage for the purpose of this directive shall comply with the relevant union law,
    - Member States shall authorize and certify or, where applicable, supervise the parties responsible for the data management, in order to ensure that they comply with the requirements of this directive, and
    - No additional costs shall be charged to final customers for access to their data or for a request to make their data available.

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Directive 2019/944/EU

- Article 24

  - Article 24, which is related to the interoperability requirements and procedures for access to data from smart metering systems, lays down the following:

    - Member States shall facilitate the full interoperability of energy services within the Union, and

    - the Commission shall adopt, by means of implementing acts, interoperability requirements and non-discriminatory and transparent procedures for access to data.

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Directive 2019/944/EU

- Annex II

  - Annex II “Smart Metering systems” of the recast Electricity Directive states, with respect to the aforementioned CBA, that:

    “Subject to that assessment, Member States or, where a Member State has so provided, the designated competent authority, shall prepare a timetable with a target of up to ten years for the deployment of smart metering systems.

    Where the deployment of smart metering systems is assessed positively, at least 80% of final customers shall be equipped with smart meters either within seven years of the date of the positive assessment or by 2024 for those Member States that have initiated the systematic deployment of smart metering systems before the date of entry into force of this Directive”.

This project is funded by the European Union

Legal and Regulatory Framework at Energy Community Level

This project is funded by the European Union

Legal and Regulatory Framework at Energy Community Level

- The core Energy Community Acquis Communautaire includes the following legal acts with provisions for smart metering:
  - Directive 2009/73/EC concerning common rules for the internal market on natural gas
  - Directive 2010/31/EC on the energy performance of buildings
  - Directive 2012/27/EC on energy efficiency

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Legal and Regulatory Framework at Energy Community Level

- Commission Recommendations 2012/148/EU on the preparations for the roll-out of the smart metering systems and 2014/724/EU on Data Protection Impact Assessment Template (DPIA) for smart grids and smart metering systems have not been transposed in the Energy Community, nevertheless they provide relevant guidance to also Energy Community Contracting Parties. The only difference between the Directive 2009/73/EC as Incorporated and adapted by Ministerial Council Decision 2011/02/MC- Energy Community for the Energy Community and the European original legal document is the deadline for the CBA assessment set in Annex I.

- In the Energy Community legal framework the respective deadline for the economic assessment of all the long-term costs and benefits to the market and the individual consumer (or the assessment on which form of intelligent metering is economically reasonable and cost-effective) and which timeframe is feasible for their distribution is the 1st January 2014 as opposed to 1st January 2012 for EU Member States.

This project is funded by the European Union

Task 3.4 Training

International Benchmarks: Smart Grid Regulations in Gas Distribution

Gas Distribution

16 September 2020, EMRA, Ankara

This project is funded by the European Union

International Benchmarks

- United Kingdom
- Ireland
- France
- Italy
- Finland

This project is funded by the European Union

United Kingdom

This project is funded by the European Union

Innovation Funding and Mechanisms in EU

- United Kingdom
  - The UK's **RIIO** framework stands for **Revenue = Incentives + Innovation + Outputs** and is considered as one of the most comprehensive performance-based regulatory frameworks.
  - The RIIO has been developed in such a way so that it **rewards utilities for achieving desired outcomes**.
  - The primary objective of the RIIO model is to **foster the development of the electricity and gas networks in an efficient manner towards sustainable energy markets**.
  - The first RIIO control for gas distribution was introduced in **2013**.

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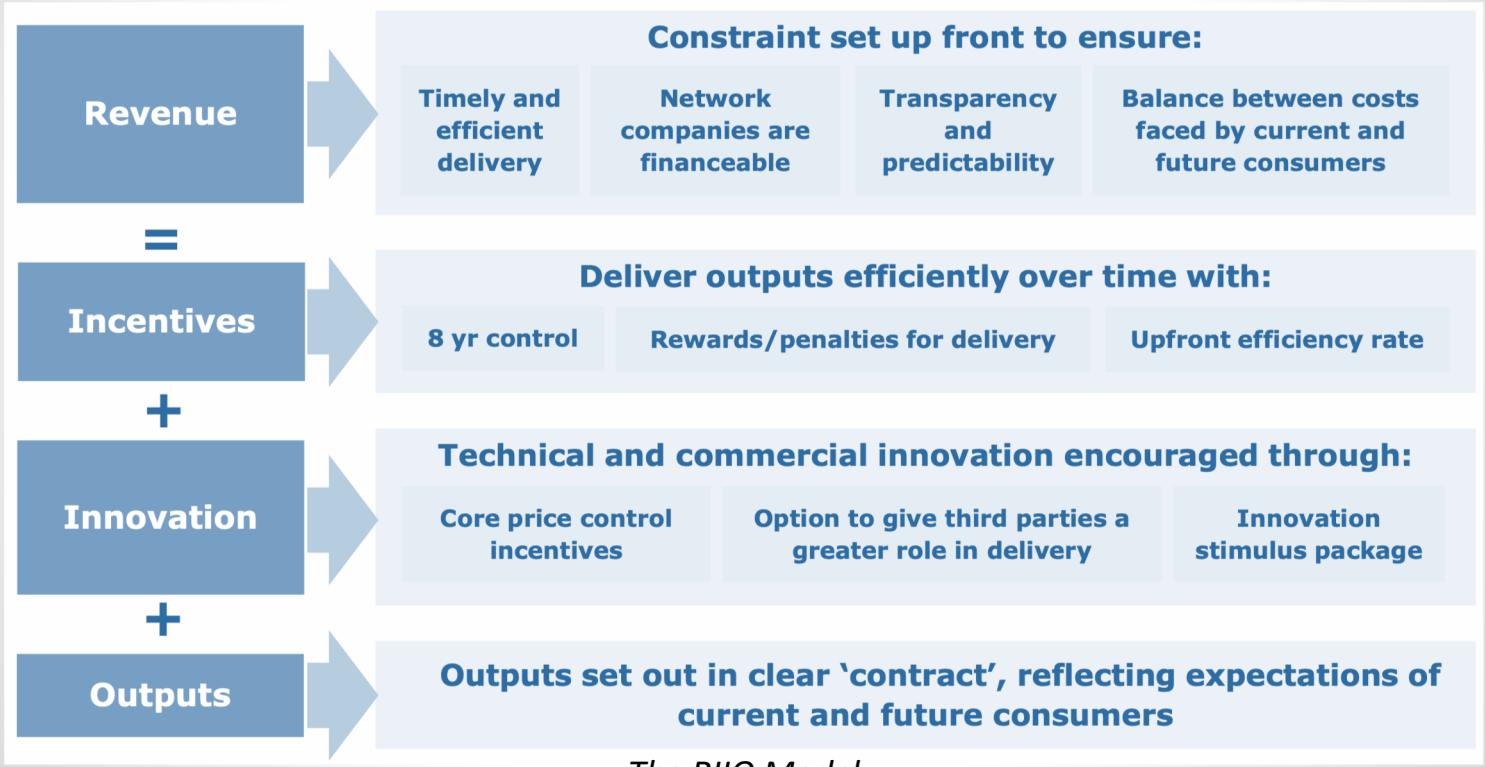
Innovation Funding and Mechanisms in EU

- United Kingdom



The RIIO Model

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Innovation Funding and Mechanisms in EU

- United Kingdom
  - The RIIO model consists of four (4) main features, selected in such a way to **encourage utilities to innovate and achieve favorable outputs**:
    - a multi-year rate plan,
    - the total expenditure (TOTEX) approach,
    - performance incentives, and
    - an innovation fund

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Innovation Funding and Mechanisms in EU

- United Kingdom

Multi-Year Rate Plan
The baseline revenues that utilities can collect are set by Ofgem over an eight-year rate period. Depending on utilities' performance against a predefined set of targets, the revenues are adjusted accordingly, while adjustment mechanisms for managing uncertainties caused by unpredictable incurred costs or events are also included. The purpose of the **multi-year rate plan is to provide incentives for utilities to undertake the long-term investments that are important for the transition from the traditional to the modern grid**. Finally, utilities are incentivized to spend prudently since for projects delivered under budget utilities are allowed to keep a portion of the cost-savings as profit, while the remaining portion is retained by the customers. In an analogous manner, in the case of cost overruns, these are also split between the utility and its customers.

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Innovation Funding and Mechanisms in EU

- United Kingdom

TOTEX
The **TOTEX** approach involves the combination into one regulatory asset of both the capital expenditures (CAPEX) and the operational expenditures (OPEX). This approach allows, **based on a pre-defined ratio, a rate of return on both, while at the same time makes much less attractive to utilities to invest in CAPEX (traditionally earning a rate of return) over OPEX (traditionally passed through without a return)**. Moreover, the TOTEX approach is coupled with a revenue cap that fosters the selection of the most cost-effective solutions by the utilities, as well as the cooperation with third parties that can optimize project-related costs, thus delivering benefits for both utilities, third parties, and customers.

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Innovation Funding and Mechanisms in EU

- United Kingdom

Performance Incentives

Apart from the incentivization of utilities via the multi-year rate plan and revenue cap, Ofgem specify a set of **predefined targets** for utilities that are tied to the following **performance categories**:

- reliability and availability,
- environment,
- connections,
- customer service,
- social obligations and
- safety.

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Innovation Funding and Mechanisms in EU

- United Kingdom

Innovation Fund

To foster innovation activities and R&D projects, Ofgem set up an **innovation fund for new technologies and operating and commercial agreements**. Moreover, an **Innovation Rollout Mechanism** (IRM) is also introduced to reduce risks that are associated with new projects that generate environmental benefits. As parts of the innovation fund, the **Network Innovation Allowance** makes available £20 million per year for gas networks, while the **Network Innovation Competition** offers £61 million per year to fund projects in the gas and electricity sectors. Finally, an important aspect of the innovation fund is the dissemination of results and lessons learnt from innovation activities among the various stakeholders.

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Innovation Funding and Mechanisms in EU

- United Kingdom

Gas Network Innovation Competition

The gas **Network Innovation Competition (NIC)**, which is part of Ofgem's RIIO price controls, is an **annual** opportunity for gas network companies to compete for getting funding to **develop and demonstrate new technologies, as well as operating and commercial agreements**. The requested funding will be awarded to the best innovation projects that foster the understanding of gas network operators on what needs to be done to provide environmental benefits, as well as to reduce costs and maintain security of supply as UK moves towards a low carbon economy. The available funding under the gas NIC is up to **£20 million per annum**.

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Innovation Funding and Mechanisms in EU

- United Kingdom

Gas Network Innovation Allowance

The **Network Innovation Alliance (NIA)**, which is also part of the RIIO-GD1 price control of Ofgem, is a **set allowance** that is received by each RIIO network licensee as part of their price control allowance.

Funding under NIA is limited and can be used for:

- funding **smaller technical, commercial, or operational projects** directly related to the licensees' network that have the potential to deliver financial benefits to the licensee and its customers; and/or
- funding the **preparation of submissions** to the Network Innovation Competition (NIC) which meet the criteria set out in the NIC Governance Document.

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Innovation Funding and Mechanisms in EU

- United Kingdom

Innovation Roll-out Mechanism

Ofgem's innovation stimulus, apart from the NIA and NIC measures, also includes an Innovation Roll-out Mechanism (IRM). The purpose of IRM is to **fund the roll-out of proven innovations which will contribute to the development of a low-carbon energy sector in UK and provision of broader environmental benefits.** The IRM provides funding also to transition proven innovative technologies to business as usual (BAU) if the roll-out of these technologies cannot be funded under the TOTEX allowance of the gas DSO. During RIIO-1, there are two application windows for gas distribution companies to apply for funding.

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Ireland

This project is funded by the European Union

Innovation Funding and Mechanisms in EU

- Ireland

  - The purpose of Gas Innovation Fund is to encourage creativity and foster innovation in the gas sector, by supporting solutions that meet the needs of the gas industry, thus making innovation part of the GNI and the gas industry. The establishment of the Innovation Fund was approved by the Commission of Regulation of Utilities (CRU) under PC3. The purpose of this fund is to support innovation in the gas industry. Under GNI's fourth price control (PC4) a new gas innovation fund was allowed.

  - In the context of CRU's decision PC4 an OPEX allowance was provided to support innovation funding for the PC4 period ranging from October 2017 to September 2022. In making its decision the CRU was "mindful that ongoing utilization of the gas network is important so as to ensure that gas remains competitive as a fuel and that tariffs are contained for customers". It should be mentioned that gas innovation funding has been provided for the Causeway Study, governance and program management, Research and Strategic Projects.

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Innovation Funding and Mechanisms in EU

- Ireland

  - The Causeway Study is a jointly funded project by EU and CRU that its main focus is to study the impact that the installation of 14 CNG stations in Ireland will have on the gas network. A grant of €6.5m was provided by the EU, while CRU has approved an additional €12.83m for the study to be completed. The allowance for the Causeway Study makes up the majority of the €17.5m that was approved by the regulator for innovation.

  - CRU indicated that an additional €2.5m might be available at a later date in PC4 for innovation funding and that he decision about the additional €2.5m will be informed by the outcomes and outputs of the innovation fund throughout PC4. Finally, CRU has provided an allowance of €0.5m for the PC4 period to GNI to maintain the innovation framework developed during PC3, as well as for purposes of program management.

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France

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Innovation Funding and Mechanisms in EU

- France

  - An incentive scheme for R&D costs has been introduced by the French Energy Regulatory Commission (Commission de regulation de l'énergie – CRE) in the current price control started in 2017. CRE uses a **revenue cap with a four-year regulatory period**. For each year, the **revenues are set ex-ante, serving as an estimation of OPEX and a return on the RAB**.

  - **OPEX and CAPEX are treated differently**, thus forming a hybrid system in which **OPEX are subject to incentive regulation while CAPEX is subject to rate of return regulation and can thus create incentive bias**. CRE also introduced a further differentiation between network and non-network expenses.

  - While network expenditures are treated as before, **for non-network expenditures OPEX and CAPEX are subject to the same incentives**.

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Innovation Funding and Mechanisms in EU

- France

  - CRE defines as an R&D budget **all the amounts that will be used for R&D, as well as for performing the necessary innovation activities.**

  - Provides GRDF the means to carry out the R&D projects required for the construction of the networks of the future by guaranteeing in particular that tariff matters do not hinder R&D projects.

  - GRDF has also set up a mechanism for monitoring gas-related projects, in order to provide gas market stakeholders with visibility into the innovation projects fostered and funder by GRDF.

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Innovation Funding and Mechanisms in EU

- France
  - R&D **forecasted** expenditure presented by GRDF for smart grid projects is included in the incentive-based regulation mechanism.
  - These expenses exclude R&D activities focused on increasing the number of customers connected to the gas networks and, as such, they are not taken into account in the regulation mechanism, but rather they fall within a specific incentive-based regulation.
  - R&D costs related to smart grid projects that were consider in the ATRD5 tariff, represent an average €10.7 M per year over the 2016-2019 period.

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Innovation Funding and Mechanisms in EU

- France
  - Actual R&D OPEX incurred by GRDF are **reviewed by CRE at the end of the tariff period**.
  - Any **positive difference** between the forecasted and actual trajectories will be returned to the customers. For the reviewing purposes, GRDF submits to CRE a review of the previous year. This review is submitted before the end of the first quarter of each calendar year.
  - Any recorded **annual differences** between the forecasted and actual trajectories need to be justified by GRDF within the annual report that is submitted to CRE.
  - CRE publishes a **biannual report** with the R&D actions performed by GRDF that provides visibility into the innovation projects led by GRDF and funded under the ATRD tariff.

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Italy

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Innovation Funding and Mechanisms in EU

- Italy

  - The Italian NRA, follows a **six-year period for gas distribution**, where **revenues are being established ex-ante with a RAB-based approach** and with deviations from forecast expenses being treated differently according to whether they are operational (incentive regulation) or capital (cost of service).

  - Starting from 2020, a **TOTEX approach** will be adopted for both electricity and gas to **cope with the distortion that may be posed by the current regulatory approach.** Under the TOTEX approach CAPEX and OPEX are treated in the same way by the regulatory authority.

  - The implementation of smart grid and innovation projects are **incentivized by a 2% increase in the WACC for twelve (12) years.**

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Finland

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Innovation Funding and Mechanisms in EU

- Finland

  - The aim of incentivizing innovation is to **foster the development and use of innovative technical and operational solutions** by the network operators in their operations.

  - Gas distribution network operator **may incur research and development costs before the new technologies are in full use and utilizable.**

  - The Finnish NRA **deducts reasonable R&D costs during the calculation of realized adjusted profit for network operators**, in order to foster the active innovation and R&D efforts.

  - **Acceptable R&D and innovation activities costs must be recorded as expenses in the unbundled profit and loss account** since capitalized R&D costs are not accepted to be included in the calculation of the innovation incentive.

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Innovation Funding and Mechanisms in EU

- Finland

  - The acceptable R&D costs need to be **directly related to new knowledge creation**, as well as **use of new technologies** and the **development of products or network operation methods** for the gas distribution sector.

  - The impact of the innovation incentive is **deducted when calculating realized adjusted profit**.

  - The impact of the innovation incentive is calculated so that **a share corresponding to a maximum of 1% of the DSO's total turnover from network operations in the unbundled profit and loss accounts in the regulatory period are treated as reasonable research and development costs.**

  - The incentive is applied to **all network operators**.

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Comparative review of regulatory practices

This project is funded by the European Union

Recap of EU Countries for Gas Distribution

Smart Grid for Gas Distribution	United Kingdom	Ireland	Italy	France	Finland
Smart Grid and Innovation Regulatory Incentives in use	Two funding mechanisms in place for innovation projects: The Network Innovation Alliance (NIA) and the Network Innovation Competition (NIC).	For the price control period ranging from 2013-2017 an allowance of €0.8 million was available for gas distribution innovation OPEX funding.	Starting from 2020, a TOTEX approach will be adopted for both electricity and gas to cope with the distortion that may be posed by the current regulatory approach.	For each year, the revenues are set ex-ante, serving as an estimation of OPEX and a return on the RAB. OPEX and CAPEX are treated differently. OPEX are subject to incentive regulation, while CAPEX is subject to rate of return regulation and can thus create incentive bias.	Innovation incentive is calculated so that a share corresponding to a maximum of 1% of the DSO's total turnover from network operations.
Financing Innovation Incentives	Innovation incentives are included as part of the RIIO model.	Innovation funding is treated as a pass-through cost item and is not part of the efficiency requirement.	Under the TOTEX approach CAPEX and OPEX are treated in the same way by the regulatory authority. he implementation of smart grid and innovation projects are incentivized by a 12% increase in the WACC for twelve (12) years	CRE introduces further differentiation between network and non-network expenses. Non-network expenditures OPEX and CAPEX are subject to the same incentives.	Allowed innovation incentive is recovered from end-users through tariffs.

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Recap of EU Countries for Gas Distribution

Smart Grid for Gas Distribution	United Kingdom	Ireland	Italy	France	Finland
Implementation, Monitoring, Reporting Obligations and Audit	For projects funded under the NIC of Ofgem, the beneficiary has to report, during the project proposal application submission project-specific financial information. A Close Down Report is also submitted for each project that has received NIC funding.	The Gas Innovation Fund requires applicants to provide a detailed budget for any proposal submitted, along with information on budget justification and other co-funding sources.	Information not available.	GRDF submits to CRE a review of the previous year. This review is submitted before the end of the first quarter of each calendar year.	R&D costs should be recorder separately in the unbundled financial statements.
CBA for Smart Meters	Positive	Negative	Positive	Positive	Negative
Considered Market Actors in CBA for Smart Meters	Supplier Consumer State/Society	DSO Supplier Consumer State/Society	DSO Supplier NRA Consumer State/Society BRP Telecom Service Provider	DSO Consumer State/Society	Information not available

This project is funded by the European Union

Recap of EU Countries for Gas Distribution

Smart Grid for Gas Distribution	United Kingdom	Ireland	Italy	France	Finland
Considered Costs in CBA for Smart Meters	CAPEX • Investment in smart meter • Investment in IT • Investment in Telecom • Investment in in-home display • Sunk cost of conventional meters OPEX • IT maintenance • Network management and front end • Telecom • Change management • Unplanned renewal and failures of smart meter • Revenue reduction • Meter reading • Consumer engagement program	CAPEX • Investment in smart meter • Investment in IT • Investment in Telecom • Investment in in-home display • Sunk cost of conventional meters OPEX • IT maintenance • Network management and front end • Telecom • Change management • Unplanned renewal and failures of smart meter • Revenue reduction • Meter reading • Call centre and customer service	CAPEX • Investment in smart meter • Investment in IT • Investment in Telecom • Investment in in-home display • Sunk cost of conventional meters OPEX • Network management and front end • Meter reading • Call centre and customer service • Consumer engagement program	CAPEX • Investment in smart meter • Investment in IT • Investment in Telecom • Sunk cost of conventional meters OPEX • IT maintenance • Network management and front end • Telecom • Change management • Unplanned renewal and failures of smart meter • Revenue reduction • Meter reading • Call centre and customer service • Consumer engagement program	Information not available

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Recap of EU Countries for Gas Distribution

Smart Grid for Gas Distribution	United Kingdom	Ireland	Italy	France	Finland
Considered Benefits in CBA for Smart Meters	• Bill reduction due to energy efficiency • Increased competition in retail market • Meter reading & operation savings • Air pollution (particulate matters, NO_x, SO_2)	• Bill reduction due to energy efficiency • Meter reading & operation savings • Non-technical (administrative, including fraud) losses	• Bill reduction due to energy efficiency • Increased competition in retail market • Meter reading & operation savings • Operation & maintenance of assets • Technical losses reduction • Non-technical (administrative, including fraud) losses • Outage management (based on reduced customer indemnification) • CO_2 • Air pollution (particulate matters, NO_x, SO_2)	• Bill reduction due to energy efficiency • Meter reading & operation savings • Operation & maintenance of assets • Technical losses reduction	Information not available

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Recap of EU Countries for Gas Distribution

Smart Grid for Gas Distribution	United Kingdom	Ireland	Italy	France	Finland
Number of CNG Stations	7	0	1,010	37	23
Number of LNG/LCNG Stations	13	0	2	3	1
Number of Gas-Driven Vehicles	718	3	885,300	13,550	1,689

This project is funded by the European Union

Task 4.2 Workshop

Smart Grid Roadmap for Turkish Gas DSOs

Gas Distribution

16 September 2020, EMRA, Ankara

This project is funded by the European Union

Agenda

Session-4: Smart Grid Roadmap for Turkish Gas DSOs

- Identified Barriers
- Overarching Principles
- Recommendations on Detailed Topics that are Related to Smart Grids
- Digitalization and Smart Grid Master Plan

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Identified Barriers

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Identified Barriers

- Some of the barriers identified by ERGEG are: uncertainty, lack of clear roles and responsibilities, data management, security and privacy issues, political will, regulatory structures and alignment of incentives, market requirements, ineffective implementation of unbundling, insufficient supporting schemes for RES, lack of definition of smart grids functionalities, safety and more.

- ERGEG believes that some of these tentative barriers can be solved through the European Commission's task force for the implementation of smart grids in the internal energy market, as this task force plans also to deal with definition of roles and responsibilities and issues related to data handling, data protection and data safety.

- ERGEG agrees that possible barriers should be identified and considered. Their impact will differ across Europe; however, ERGEG still considers that there are no fundamental barriers to the deployment of smarter distribution and transmission systems where necessary and cost-efficient.

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Identified Barriers

- One other barrier, not mentioned in the Consultation Paper, referred to the availability of skilled workforce (especially with reference to the knowledge of innovative solutions). Indeed, one respondent mentioned as a possible performance indicator the percentage of time / human resources devoted to training activities. ERGEG agrees that sufficient trained, educated and available personnel are necessary now and, in the future, however, the means to achieve this need to be further elaborated and discussed by relevant parties, mainly at national level.

- Engagement of grid operators with their network users was mentioned as an important item for the deployment of smart grids. In addition, the need for the engagement of suppliers (and more generally, players acting in competitive markets) with their customers was mentioned. ERGEG believes that this is an important issue for an effective user-centric deployment of smart grids. ERGEG believes that a possible regulatory approach to promote user and customer engagement is carefully to address the regulation of commercial quality (i.e. information, customer treatments, etc. provided by regulated parties to their users and customers).

This project is funded by the European Union

Identified Barriers

- The research/consultant group see that cross-subsidies can happen, but the risk can be reduced by regulatory measures, inter alia a more efficient unbundling also of distribution system operators. One of the respondents in this group answers clearly that there are no risks of cross-subsidies, another one that intelligent regulatory rules can prevent any cross- subsidizing between stakeholders.

- ERGEG believes that TSOs and DSOs are the prime movers for the deployment of smart grids, also by allowing new marketplaces and opportunities for suppliers and energy service companies. With respect to the latter, it is evident that grid tariffs do not pay expenses by actors in competitive markets.

- In addition to a careful implementation of unbundling provisions, a thorough evaluation of the distribution of costs and benefits related to smart grids across the whole supply chain and a clear identification of roles and responsibilities of the different stakeholders were mentioned as instruments to avoid future cross-subsidies. With respect to the latter, the ongoing activities within the task force on smart grids promoted by the European Commission focus on roles and responsibilities and can contribute regarding these matters.

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Identified Barriers

- Lack of EU-wise technical standards for individual technologies, as well as for the interoperability of smart grid solutions for gas distribution,
- Smart grid deployments in gas distribution networks are limited in EU, as well as in other contrived worldwide, therefore there are no lessons learnt available that can serve as best practices for the deployment of smart grid solutions for gas distribution companies,
- Not active participation of gas 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 gas)

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Identified Barriers

- Due to the limited potential of flexibility services in the gas grids, there is limited interest to deploy innovative smart grid solutions compared to electricity networks,
- Lack of clear regulatory framework and/or existing complex regulation constitutes a barrier for the fast deployment of smart grid solution for gas distribution,
- The existing regulatory framework does not provide the necessary incentives to gas 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 gas 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.

This project is funded by the European Union

Overarching Principles

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Overarching Principles

OP1: Output and input regulation
EMRA should focus on outputs in their regulation of gas 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 gas 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 gas grid is a heavy technical endeavour, input regulations cannot be neglected. Input regulations may be related to the preparation and approval of the gas 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 gas distribution companies, should have clear effects and benefits towards both the gas DSOs, as well as towards the consumers. Such benefits may include[6]: • Increased sustainability, • Adequate capacity of distribution grids for providing gas to consumers, • 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 gas 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

OP3: Performance indicators and output measures for smart gas grids
EMRA should have in place a clear and straightforward approach for the evaluation of smart gas 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 gas 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

OP4: Encouraging innovation along research, development, demonstration chain

EMRA should foster innovation and research and development (R&D) activities related to smart grids for gas 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. Moreover, according to ERGEG[6], KPIs for demonstration will also depend a lot on what is actually being trialled. It was remarked, and ERGEG fully agrees, that the performance-based approach could fit well the deployment phase, whereas different approaches for incentivizing the demonstration phase might be opportune.

Smart grid technologies for gas distribution networks, as well as potential demonstration and large-scale projects, should be evaluated according to a nation strategic roadmap for smart girds 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,
- Ensure market participants as point of contact to the customers assuring that independent market operators are involved in measuring 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 EMRA's responsibility to assess the benefits and the costs of the possible large-scale or demonstration projects for smart gas grids, according to national priorities and in coherence with the applicable national regulation systems.

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Overarching Principles

OP5: Standardization, harmonization and interoperability
Interoperability is a key requirement for smart gas 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 gas DSOs a complicated process. It is highly recommended that EMRA establishes a task force for the implementation of smart gas grids in the internal energy market. The purpose of this task force is to deal with inter alia services and functionalities for smart gas grids and smart gas meters, as well as a standardisation strategy for smart gas grids.

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Recommendations on Detailed Topics that are Related to Smart Grids

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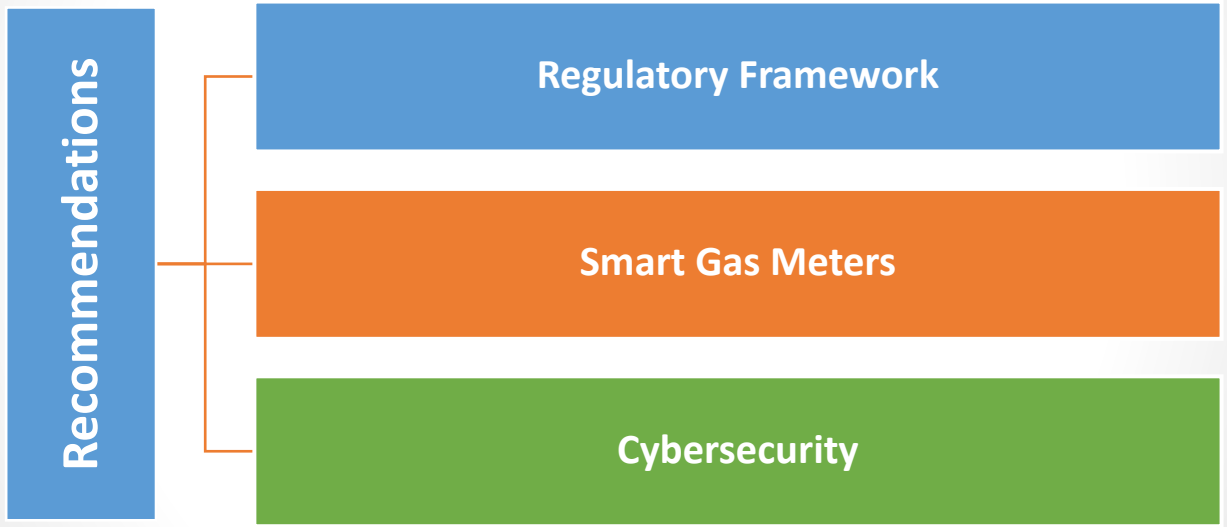
Regulatory Recommendations for Smart Grids for Gas Distribution



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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R1	Stable Regulatory Framework	EMRA should make sure that a long-term stable regulatory framework and a reasonable rate of return for cost-efficient smart grid investments is in place.	Since the majority of the smart grids projects for gas distribution require a long period of time to be deployed to their full extent, a stable regulatory framework is required to attract investors and minimize the project-related risks.	EMRA
R2	Performance-Based Incentive Regulation	EMRA should consider performance-based incentives for smart grids projects.	Smart grid investments should be incentivized based on performance criteria and decoupling should be considered between gas DSO's profits and the volumes of gas they deliver.	EMRA, Gas DSOs
R3	Regulation of Outputs	EMRA should pursue regulation of outputs as a mechanism to ensure value for money paid by network users.	EMRA will be able to assess the metrics for the quantification of the most important output effects and benefits at national level.	EMRA

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R4	Improve User Awareness	EMRA and the gas DSOs should promote mechanisms for improved consumer awareness of gas use and market opportunities.	Promotion should be performed via actions of suppliers and other market participants, as well as through an improved engagement of network operators with their network users.	EMRA, Gas DSOs
R5	Incentivization of Smart Gird Solutions	EMRA should encourage the deployment of smart grid solutions in the gas distribution sector.	EMRA should incentivize gas DSOs to pursue innovative solutions where this can be considered beneficial from the viewpoint of the society.	EMRA, Gas DSOs
R6	Cost-Benefit Analysis	Gas DSOs should perform a cost-benefit analysis for possible demonstration smart grid projects.	The CBA allows gas distribution stakeholders to breakdown the associated costs and benefits and take the necessary decisions based on societal cost-benefit assessment.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R7	Communication and Dissemination Activities	Gas DSOs should make sure that results and lessons learned from smart grid demonstration projects are disseminated.	In case of smart grid demonstration projects for gas distribution, financed or co-financed by additional grid tariffs or from public funds, gas DSOs should ensure the dissemination of the results and lessons learned to all interested parties, including other network operators, market participants, etc.	EMRA, Gas DSOs
R8	Participation in Standardization Organizations	Gas DSOs should participate in standardization organizations.	The purpose of the participation and cooperation is for gas DSO to adopt or to participate in the development of protocols and standards related to information management and data exchange to ensure the interoperability in current and future deployment of smart grid projects for gas distribution.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R9	New Market Opportunities	EMRA should clarify the difference between regulated grid activities and market opportunities.	EMRA should clarify the difference between regulated grid activities and market opportunities for new services under a competitive regime and to carefully monitor the possible presence of cross-subsidies between network activities by TSOs or DSOs and market-based activities.	EMRA
R10	Incentives for Investments in Conventional Network Reinforcements	EMRA should allow for adequate incentives for investments in conventional reinforcements in gas distribution networks.	The conventional reinforcements should be justified by means of a societal cost benefit analysis (SCBA) that will take into account the robustness of the network investment for different scenarios. The gas DSO may be obliged through regulation to perform an integrated investment assessment via the SCBA.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R11	Balanced Investments in Conventional Network Reinforcements and Smart Grids	Gas DSOs should consider balanced investments in conventional network reinforcements and smart grids.	Since innovative smart grid solutions for gas DSOs bear a higher risk compared to conventional network reinforcements, EMRA should make sure that these higher risks are properly accounted for in regulatory assessments for allowing smart grids solutions to be considered as a viable network planning option for gas distribution.	EMRA, Gas DSOs
R12	Monitor of Cybersecurity Related Expenditure	EMRA should require gas DSOs to monitor cybersecurity related expenditure.	EMRA need to be prepared to monitor and evaluate cybersecurity expenditure of certain regulated entities.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Regulatory Framework				
R13	Flexibility Services	Gas DSOs should evaluate the procurement model for flexibility services using a cost-benefit analysis approach.	Due to the limited potential of flexibility services in the gas grids, a cost-benefit analysis (CBA) should be performed by the gas DSOs to evaluate whether the benefits of a procurement model outweigh the resulting administrative burdens.	EMRA, Gas DSOs
R14	Gas DSOs in the Provision of Energy Efficiency Services	Gas DSOs should play an informative and facilitating role in the provision of energy efficiency services.	To prevent market distortion, it is recommended that gas DSOs focus on non-discriminatory information provision.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R15	Flexibility Services	Gas DSOs should evaluate the procurement model for flexibility services using a cost-benefit analysis approach.	Due to the limited potential of flexibility services in the gas grids, a cost-benefit analysis (CBA) should be performed by the gas DSOs to evaluate whether the benefits of a procurement model outweigh the resulting administrative burdens.	EMRA, Gas DSOs
R16	Gas DSOs in the Provision of Energy Efficiency Services	Gas DSOs should play an informative and facilitating role in the provision of energy efficiency services.	To prevent market distortion, it is recommended that gas DSOs focus on non-discriminatory information provision.	EMRA, Gas DSOs
R17	Access to Information on Consumption Data on Customer Demand	Customers should be able to access on demand information related to their gas consumption data and related costs.	The data provider should offer to the customer different communication channels for providing the gas consumption data.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R18	Supplier Switching	Supplier switching should be facilitated for customers leveraging the smart metering infrastructure.	Due to interval metering, all metering data are considered to be accurate, thus facilitating the supplier switching processes, moving or change of contract.	Gas DSOs
R19	Bills Based on Actual Consumption	Bills issued to the customers should be reflect actual gas consumption.	As a result of remote reading, bills issued to the customers should be reflect actual gas consumption.	Gas DSOs
R20	Remote Activation and De-activation of Supply	Smart gas meter should allow the remote activation and re-activation of supply.	Based on the bidirectional communication offered by smart gas meters, the remote activation and de-activation of supply for a customer should be possible.	Gas DSOs
R21	Alert in case of Exceptional Energy Consumption	Customers should be informed in case of exceptional gas consumption.	Upon customer request, up-to-date information on exceptional gas consumption should be communicated to the customer.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R22	Remote Configuration of Smart Gas Meters	Smart gas meters should support remote configuration.	The gas DSOs should make sure that the smart metering system will allow for the program software to be upgraded remotely.	Gas DSOs
R23	Whole System Approach Cost-Benefit Analysis	The cost-benefit analysis for smart gas meter should take into account the whole value chain of gas distribution.	The CBA should take into account, not only the customer benefits, but also the whole gas value chain including gas DSOs, suppliers, etc. Cybersecurity and data privacy related costs should also be part of the CBA.	Gas DSOs
R24	All Customers should Benefit from Smart Metering	All customers should be eligible to obtain a smart gas meter.	In the case of wide geographical spread of gas customers, or any other special circumstances, gas DSOs could exclude customers or group of customers from the smart meter rollout.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R25	No Discrimination when Rolling out Smart Meters	Gas DSOs should avoid discriminatory behaviour during the smart gas meters rollout.	Discrimination based on distinguishing between customers served by suppliers other than the vertically integrated supplier or distinguishing between customers served under regulated prices in relation to customers served on the free market should be avoided.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R26	Improve the Regulatory and Policy Framework	EMRA should develop specific policy documents and regulations regarding cybersecurity and privacy for the smart gas distribution, grid in order to improve the current regulatory and policy framework.	The existing regulatory framework should be extended to also include policies and regulations related to cybersecurity and data privacy for smart grids in the gas distribution sector.	EMRA
R27	Coordinate Smart Grid Cyber Security Initiatives	EMRA should foster the creation of a public-private partnership to coordinate smart grid cybersecurity initiatives for gas distribution.	The public-private partnership (PPP) should act as a central coordinating entity at the national level with a global vision of all European and international initiatives dealing with cybersecurity and data privacy issues.	EMRA
R28	Foster Awareness Raising and Training Initiatives	EMRA and gas DSOs should foster the creation of initiatives targeting awareness-raising of C-level in relation to the importance of the cybersecurity and data privacy in the smart grid for gas distribution.	Part of the awareness raising and training initiatives, EMRA and gas DSOs should also promote training initiatives focused on how to use security-by-design principles for the gas distribution sector.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R29	Foster Dissemination and Knowledge Sharing Initiatives	EMRA and gas DSOs should foster the dissemination activities on smart gird cybersecurity issues between the stakeholders of the gas sectors and the R&D institutions.	Knowledge sharing initiatives, related to cybersecurity for smart grids for gas distribution, should include both gas DSOs and TSOs, as well as other gas stakeholders, with EMRA playing a key role as a unified point for information exchange among smart grid stakeholders.	EMRA, Gas DSOs
R30	Development of a Minimum Set of Reference Standards and Guidelines	Gas DSOs should develop a minimum set of reference standards and guidelines for cybersecurity for the smart grid, leveraging existing initiatives such as Common Criteria, ISA99, and ISO 27000.	Standardization for cybersecurity is of high importance for gas DSOs since it allows for unified and interoperable cybersecurity and data privacy framework for smart grids for gas distribution.	Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R31	Development of Cybersecurity Certification Schemes	EMRA and gas DSO should promote the development of security certification schemes for products and organizational security, leveraging existing initiatives such as Common Criteria, ISA99, and ISO 27000.	The purpose of the promotion of cybersecurity certification schemes for product and organizational security is to harmonize cybersecurity and resiliency requirements across the various gas network stakeholders.	EMRA, Gas DSOs
R32	Creation of Test Beds and Security Assessments	Gas DSOs should create the required test beds to assess if products are secure according to basic cybersecurity principles, such as those defined by the requirements for vendors.	The purpose of this testing is to reveal and identify security flaws at the organizational level. It should be mentioned that these actions should be considered as an intermediate step to fill the gap while certification schemes are being developed.	EMRA, Gas DSOs
R33	Refine Strategies to Coordinate Large Scale Cyber Incidents	Gas DSOs should develop strategies to respond to large-scale cyber incidents that may by affecting multiple gas DSOs and TSOs.	The strategies should also cover aspects related to alarm scalation, political decisions (e.g. isolating a TSO) and pre-established incident handling procedures.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R34	Foster Research in Smart Grid Cybersecurity	EMRA should foster and promote the R&D activities related to smart grid cybersecurity between the gas DSOs and the academia and research institutes in the context of national, European, and/or international research programs.	Research areas may include protection of monitoring functionalities, robust, secure and resilient architectures, trust and assurance and end-to-end, and security in dependable systems.	EMRA, Gas DSOs
R35	Operators of Essential Services	EMRA should request from gas DSOs to develop and apply cybersecurity standards and measures.	The development and application of cybersecurity standards and measures by all OESs will create a homogenous and secure ecosystem that will allow the development of a secure culture for further innovation and digitalization in the gas distribution sector.	EMRA, Gas DSOs

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Regulatory Recommendations for Smart Grids for Gas Distribution

ID	Recommendation	Explanation	Supportive Arguments	Key Stakeholders Involved
Smart Gas Meters				
R36	Compliance with NIS Directive	EMRA should encourage the gas DSOs to adopt, as much as possible, the NIS Directive and provide the necessary support to transport horizontal regulation into best practices for the gas distribution sector.	The compliance with the NIS Directive, will allow gas DSOs to comply with the security requirements in place for the European Member States.	EMRA, Gas DSOs
R37	Guidance on Cybersecurity Governance	EMRA should provide clear guidance to gas DSOs on cybersecurity governance and define the role and responsibility of the Chief Information Security Officer within the organization.	The CISO should be provided with independence, resources, and a proper mandate from top executive management, in order to have an impact in the cybersecurity landscape for gas distribution.	EMRA, Gas DSOs
R38	Cybersecurity Strategy	Gas DSOs should develop a cybersecurity strategy that will include all the necessary security measures prior implementing cloud-based technologies and smart grid solutions that could potentially create security holes in their IT infrastructure.	Developing a cybersecurity strategy will allow the further development of a cybersecurity culture within the gas distribution sector.	EMRA, Gas DSOs

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Digitalization and Smart Grid Master Plan

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Digitalization and Smart Grid Master Plan

- With regards to the plans for smart grid activities of the gas distribution companies, gas DSOs will prepare and submit to EMRA their “Digitalization and Smart Grid” master plans.

- A guideline is provided with best practice recommendations related to the sections and subsections of the “Digitalization and Smart Grid Planning” master plan in terms of their scope and contents. The proposed structure for the “Digitalization and Smart Grid Planning” to be prepared by the gas DSOs is shown below, where [Gas DSO] should be replace with the name of the particular gas distribution company responsible for the preparation of the plan.

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Title

"Digitalization and Smart Grid Planning" Master Plan
1. Background
1.1. Introduction to [Gas DSO]
1.2. Overview of Digitalization and Smart Grid Strategy
2. Introduction
2.1. Digitalization and Smart Grid Planning Process
2.2. Stakeholder Involvement
2.3. Assessment of Effective Regulatory Framework for Smart Grids

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Title

"Digitalization and Smart Grid Planning" Master Plan

3. Innovation for [Gas DSO]

3.1. Scope of Digitalization and Smart Grid

3.2. Stages of Digitalization and Smart Grid

3.3. Digitalization and Smart Grid Objectives

3.4. Funding Digitalization and Smart Grid Projects

3.5. Approach to Innovation

3.6. Selecting and Prioritizing Smart Grid Areas

3.7. Developing Plans for Digitalization and Smart Grid

3.8. Stakeholder Engagement

3.9. Collaboration Between DSO and TSO

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Title

"Digitalization and Smart Grid Planning" Master Plan
4. Digitalization and Smart Grid Progress
4.1. Performance to Date
4.2. Planned Activities
5. Governance Arrangements
5.1. Partners and Supplier Arrangements
5.2. Managing Risk and Future Uncertainty
5.3. Tracking Benefits
5.4. Keeping the Strategy Up to Date
6. Delivering Benefits from Digitalization and Smart Grid

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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

Gas Distribution

16 September 2020, EMRA, Ankara

This project is funded by the European Union

Agenda

Session-5: Gap Analysis and Regulatory Recommendations (Gas Distribution)

- As-is Status of Smart Grids in DSOs
- Recommended Smart Solutions for DSOs
- Prioritization and Roadmap
- Recommendations on Implementation Roles and Responsibilities

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As-is Status of Smart Grids in DSOs

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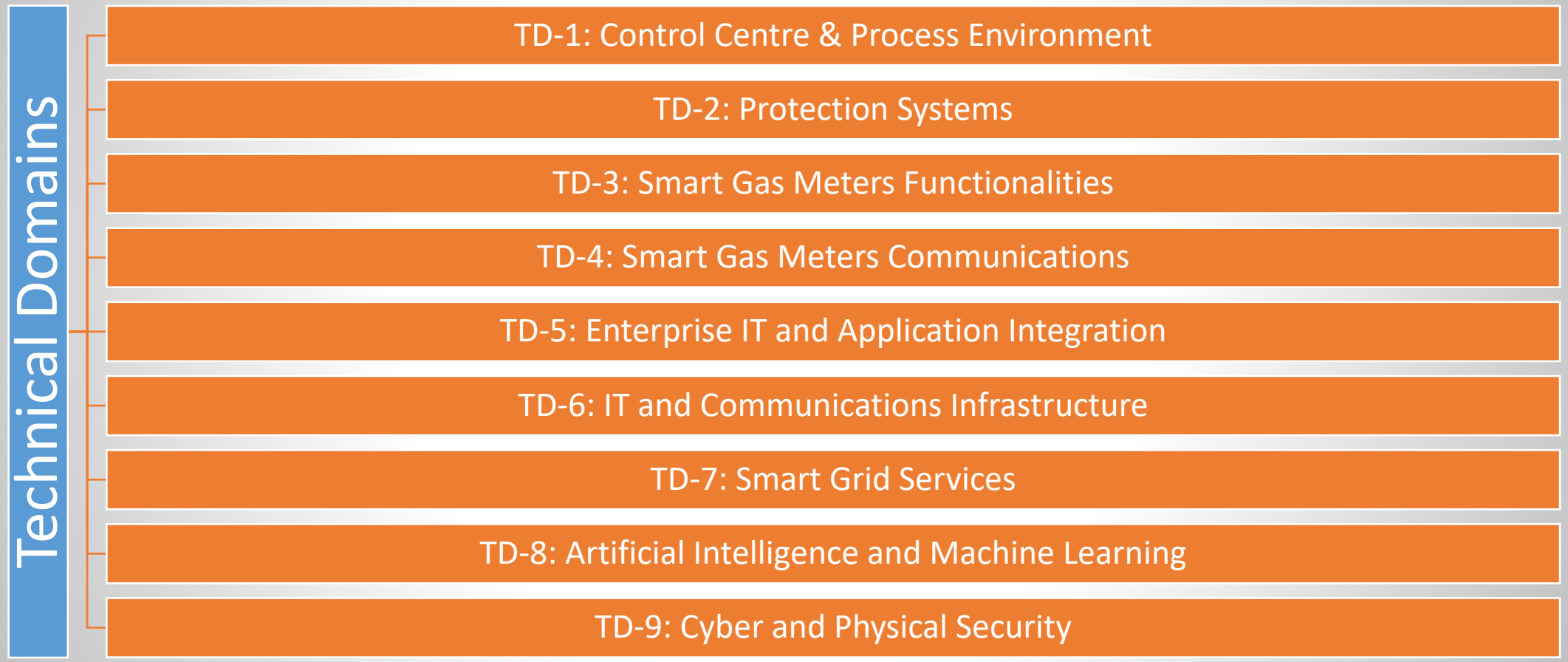
Technical Domains for Smart Gas Distribution Grids



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As-is Status of Smart Grids in DSOs

- For the sake of assessment of the as-is status of smart grids in Gas DSOs, the following questionnaire has been prepared and the responses have been completed based on public information published by EMRA or Gas DSOs. The following table summarized the as-is status of majority of Gas DSOs in the sector.

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As-is Status of Smart Grids in DSOs

Advanced Network Management	As-is Status of Majority of Gas DSOs in Turkey
TD-1: Control Center & Process Environment	
1. Do Gas DSOs have a SCADA system?	Yes, for all Dispatch Control Centres, as well as local SCADA in the relevant stations.
2. Do Gas DSOs have the ability of performing remote fault identification and localization?	Yes, for DSOs with advanced SCADA functionalities
3. Do Gas DSOs operate their own weather forecast service?	No, generally received as a outsourced service if required
4. Do Gas DSOs operate their own demand forecast studies?	Yes.
5. Do Gas DSOs have any other gas specific applications in operation (integrated ones or stand-alone), such as Day Planning, Peak Determination, Schedule Balancing, Missing Data Estimation, Operator Training Simulator, etc.?	Yes, for some of the DSOs
6. Do Gas DSOs have in operation substation automation systems?	Yes.
7. Does gas distribution network have (at least partially) telecontrol and self-healing capabilities?	Yes, telecontrol capabilities are used.
8. Do Gas DSOs have in place and leakage detection system?	Several R&D projects have been executed for this purpose.

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As-is Status of Smart Grids in DSOs

Advanced Network Management	As-is Status of Majority of Gas DSOs in Turkey
TD-2: Protection Systems	
9. Do Gas DSOs have in place a Protection Information System?	Cathodic protection schemes are implemented, with ad-hoc recording of the relevant system parameters.
Smart Gas Meters	**As-is Status of Majority of Gas DSOs in Turkey**
10. Do Gas DSOs have smart gas meters already deployed to customers?	No, only a few R&D projects are being executed
11. Have Gas DSOs already carried out a pilot involving smart gas meters?	Several R&D projects for smart gas metering have been approved by EMRA. Also, some DSOs have initial thoughts for deployment of smart gas meters.
12. Are there any plans to start the rollout of smart meters?	Some DSOs have willingness for deployment of smart gas meters, but no robust rollout planning yet.
○ If yes, what is the time horizon?	Not Applicable.
13. Is there discussion with electricity DSOs in order to jointly rollout smart meters to reduce installation costs?	No. However, it's mentioned in related electricity secondary legislation (Procedures and Principles for AMR Systems).

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As-is Status of Smart Grids in DSOs

Smart Gas Meters	As-is Status of Majority of Gas DSOs in Turkey
TD-3: Smart Gas Meters Functionalities	
14. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they allow end-customers to have full or partial control over their data?	Not Applicable. However, several DSOs provide web platform for customers to access their invoice and other data.
15. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they provide information on actual consumption and cost, on a monthly basis, free of charge to the end-customers?	Not Applicable as of today. However, it can be implemented.
16. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they provide information on consumption data to the end-customers on demand?	Not Applicable as of today. However, it can be implemented.
17. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they support easier supplier switching, move or change contract?	Not Applicable as of today.
18. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they support issue bills based on actual consumption?	Not Applicable as of today. However, it can be implemented.
19. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they support remote activation and deactivation of supply for gas smart meters?	Not Applicable as of today. However, it can be implemented.

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As-is Status of Smart Grids in DSOs

Smart Gas Meters	As-is Status of Majority of Gas DSOs in Turkey
TD-3: Smart Gas Meters Functionalities	
20. In case Gas DSOs have deployed or planning to deploy smart gas meters, do they support triggering of alarms in case of exception energy consumption?	Not Applicable as of today. However, it can be implemented.
21. In case Gas DSO have deployed or planning to deploy smart gas meters, do their meters support over-the-air (OTA) firmware upgrades?	Not Applicable as of today. However, it can be implemented.
22. Do Gas DSOs consider carrying out a cost-benefit analysis (CBA) prior to a smart meter rollout for gas distribution?	Yes, there are initial ideas towards implementation of CBA for smart meters.
23. Do Gas DSOs consider rolling out smart gas meters only for a specific group of customers?	So far, no regulatory obligation is over there. It will depend on relevant legislation once it is defined. However, it might be expected to use consumption level of customers as main criteria to install smart gas meters to customers.

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As-is Status of Smart Grids in DSOs

Smart Gas Meters	As-is Status of Majority of Gas DSOs in Turkey
TD-4: Smart Gas Meters Communications	
24. What type of technology are Gas DSOs considering for smart gas meters communication? Multiple Choice [4G/GPRS, NB-IoT, LTE-Cat3M, LoRa, Zigbee, RF (proprietary), other]	In R&D projects, different wireless solutions are considered.
Digitalization and Communication	**As-is Status of Majority of Gas DSOs in Turkey**
TD-5: Asset & Data Management, Analytics, Enterprise IT, Application Integration	
25. Do Gas DSOs operate a workforce management (WFM) system?	Yes, many DSOs have implemented relevant Enterprise IT system.
26. Do Gas DSO use an Enterprise Resource Planning (ERP) system?	Yes, many DSOs have implemented relevant Enterprise IT system.
27. Do Gas DSOs use an Asset Performance Management System (APMS)?	No, only asset recording is available in GIS.
28. Do Gas DSOs have a detailed description of their distribution network and assets using a Geographic Information Systems (GIS)?	Yes. And GIS improvement investments and studies are on-going in many DSOs
29. Do Gas DSOs have the IT infrastructure to store and analyse big data for the improving the operational process and asset performance?	Several DSOs have plans to implement big data platforms.

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As-is Status of Smart Grids in DSOs

Digitalization and Communication	As-is Status of Majority of Gas DSOs in Turkey
TD-5: Asset & Data Management, Analytics, Enterprise IT, Application Integration	
30. Do Gas DSOs apply Machine Learning (ML) and Artificial Intelligence (AI) algorithms for forecasting and preventive maintenance tasks?	No.
31. Is there a common platform for data exchange between IT and OT systems with BOTAŞ?	In order to develop the smart grid applications in the natural gas market, it was ensured that all distribution companies installed Dispatch Control Centres (SKM) in the first place. Data transfer is made to the Electronic Bulletin Table managed by BOTAŞ through these centres.
32. Is there provision for data exchange with external parties (e.g. via ICCP, web services, etc.)?	Yes, as required.
33. Does Gas DSOs have an Enterprise Service Bus (ESB) architecture for the integration of the IT and OT systems?	Mainly SAP applications are integrated via ESB architecture (SAP PI, etc.)
34. Have Gas DSOs planned to be developing/using extensions of the Common Information Model (CIM), defined for electricity, for gas?	No.
35. Do Gas DSOs have a data model specifically customized for the needs of the organization?	Yes, in GIS and Enterprise Applications, as well as SCADA system.

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As-is Status of Smart Grids in DSOs

Digitalization and Communication	As-is Status of Majority of Gas DSOs in Turkey
TD-6: IT and Communication Infrastructure	
36. Do Gas DSOs use cloud-based solutions/applications?	Depending on the holding company's IT strategy, that's an option if the data centre is located within Turkey.
37. Do Gas DSOs rely on new IT models (e.g. Platform-as-a-Service, Software-as-a-Service, etc.)?	Yes, for several IT needs.
38. For the communication with field and substation devices, what type of telecommunication infrastructure do Gas DSOs use? Multiple Choice: [public, private, hybrid]	Mainly public. Tunnelling, encryption and other cyber security measures are implemented.
39. Do Gas DSOs consider new telecommunication technologies (e.g. 5G) for the communication with field and substation devices?	No. Only within R&D projects.
40. Do Gas DSOs have plans for deploying their own telecommunication network?	No.

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As-is Status of Smart Grids in DSOs

Cross-cutting Topics	As-is Status of Majority of Gas DSOs in Turkey
TD-8: Artificial Intelligence and Machine Learning Applications	
41. Do Gas DSOs use AI- and/or ML-based advanced analytics applications?	No.
42. Do Gas DSOs consider/use Internet of Things based applications within the organization?	Yes, through R&D projects.
TD-9: Cyber and Physical Security Systems	
43. Do Gas DSOs implement (or did they already deploy) cybersecurity measures in the organization?	Yes.
44. Is there a cybersecurity framework imposed by EMRA for gas DSOs?	Yes, both through ISO certification and through detailed rules and principles defined in special legislation for Cyber Security Industrial Control Systems.
45. Do Gas DSOs consider privacy and cybersecurity as two intrinsically interdependent topics within the organization?	Yes, GDPR and ICS processes are handled separately. The related effective regulations are also different.
46. Do Gas DSOs consider cybersecurity measures for current or future smart grids deployments (e.g. smart meters)?	Not yet.

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As-is Status of Smart Grids in DSOs

Cross-cutting Topics	As-is Status of Majority of Gas DSOs in Turkey
TD-9: Cyber and Physical Security Systems	
47. Are Gas DSOs obliged by EMRA to perform a risk assessment?	Yes.
48. Do Gas DSOs request that manufacturers, integrators, services providers comply with specific cybersecurity certifications?	Ad-hoc practices in different DSOs. Some of them have detailed definition in their procurement documents/ technical specifications.
49. Are there any regulatory penalties for not complying with specific cybersecurity standards?	Yes.
50. Are there any dissemination and knowledge-sharing activities within DSOs' organization to raise awareness related to cybersecurity issues?	Yes.
51. Is there a minimum set of reference standards and guidelines related to cybersecurity that is applied within DSO organization?	Yes.
52. Do Gas DSOs have testbeds and/or labs for performing cybersecurity assessments for hardware and software?	No.
53. Apart from cybersecurity, do Gas DSOs also implement measures related to physical security?	Yes.

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Recommended Smart Solutions for DSOs

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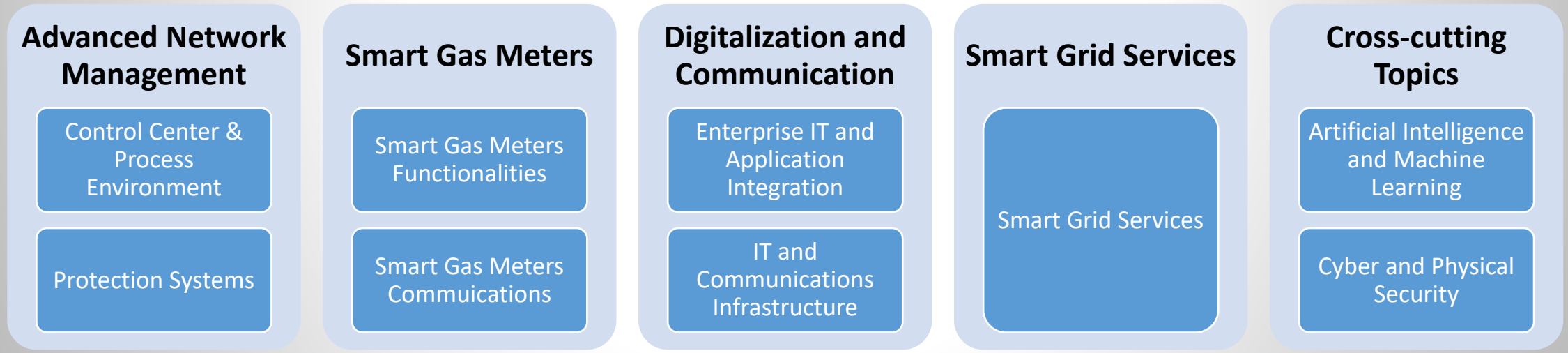
Smart Grid Technological Domains

Category	Technical Domains
Advanced Network Management	TD-1, TD-2
Smart Gas Meters	TD-3, TD-4
Digitalization and Communication	TD-5, TD-6
Smart Grid Services	TD-7
Cross-cutting Topics	TD-8, TD-9



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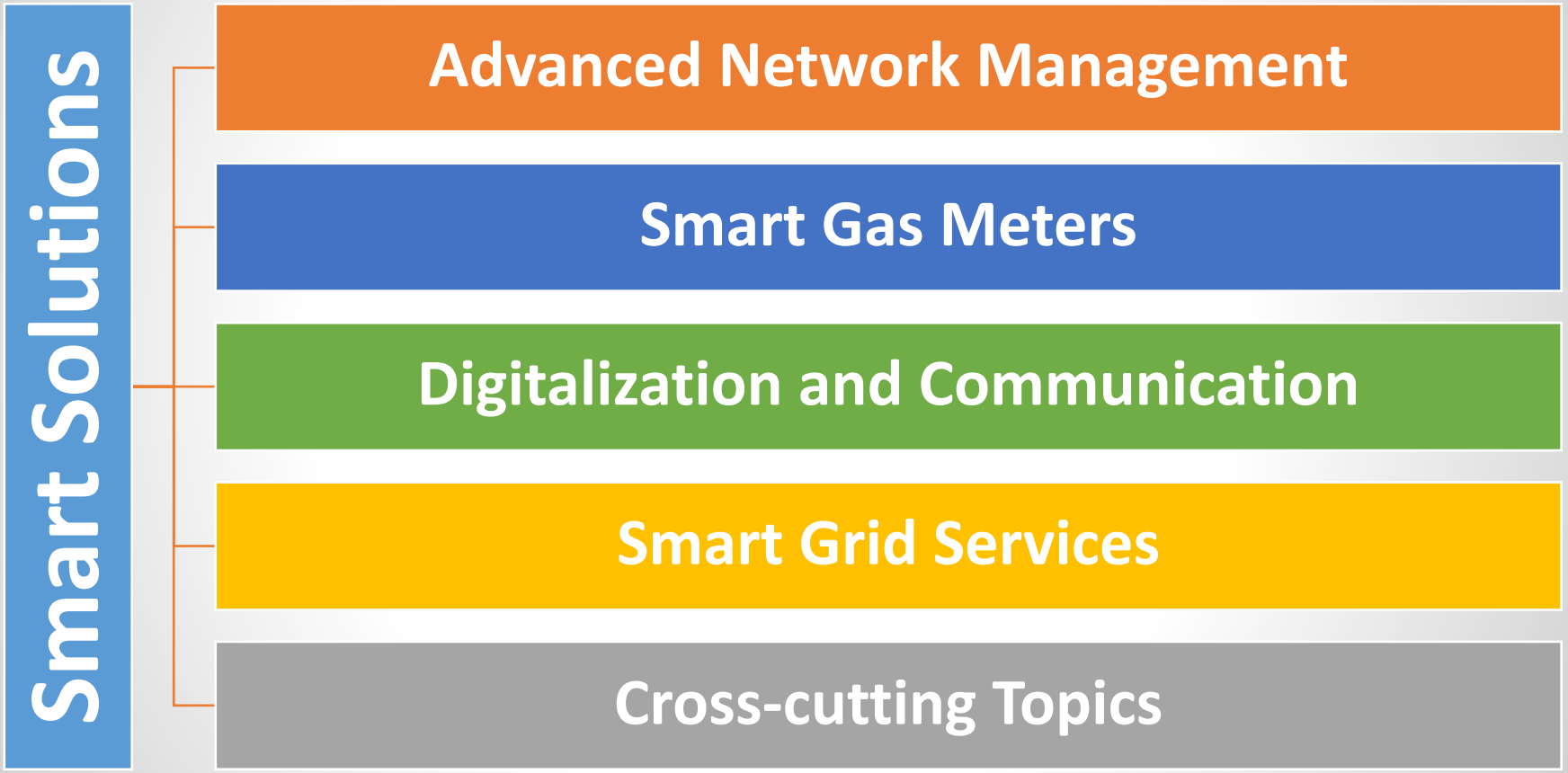
Recommended Smart Solutions for Gas DSOs



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Recommended Smart Solutions for Gas DSOs

Advanced Network Management

Recommendation 1	Gas Distribution SCADA
Gas DSO are strongly recommended to integrate into their Supervisory Control and Data Acquisition (SCADA) system all substation and field devices in order to increase the situational awareness over their gas distribution network. Gas DSOs should also consider during the procurement of SCADA systems, as well as other Operation Technology (OT) systems, that these systems provide all the required interfaces for the integration and exchange of information with existing and future IT and OT systems. Moreover, field devices should also provide the necessary hardware interfaces and support the required telecommunication protocols for their integration with SCADA systems.	
Prioritization: Short-term	**Technical Domain:** Control Centre & Process Environment

Recommendation 2	Remote Fault Identification and Localization
The ability to perform remote detection and localization of faults in the gas distribution network will allow gas DSOs to increase the quality of supply to their customers, to operate their network in a more efficient way, as well increase the safety associated with the distribution networks. Gas pipeline leakage detection aims to identify the nearest sensor to the fault that indicates the faulty pipe segment in the distribution network.	
Prioritization: Medium-term	**Technical Domain:** Control Centre & Process Environment

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Recommended Smart Solutions for Gas DSOs

Advanced Network Management

Recommendation 3	Forecasting Services
Gas demand forecasting is an important service for gas DSO, since it allows gas distribution companies in the calculation of safety monitors, which are used to ensure sufficient gas is held in storage to underpin the safe operation. Moreover, demand forecasts are a key element of security of supply analyses. Advanced approaches to demand forecast that include neural networks and deep learning technique, decrease the forecasting error, thus providing more accurate predictions for gas demand to the gas DSOs.	
Prioritization: Short-term	**Technical Domain:** Control Centre & Process Environment

Recommendation 4	Distribution Automation
Distribution automation and substation automation solutions offer gas DSO the ability to remotely monitor and control the or gas distribution assets. Control functionality includes intelligent control over gas distribution network functions and is considered one of the keys enabling technologies for the realization of the smart grid for gas distribution.	
Prioritization: Medium-term	**Technical Domain:** Control Centre & Process Environment

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Recommended Smart Solutions for Gas DSOs

Advanced Network Management

Recommendation 5	Protection Information System
It is highly recommended that gas DSOs deploy in their distribution networks the required smart grid infrastructure for the remote monitoring and control of aspects related to pressure regulation, traceability, internal pipe inspection, odorization, and cathodic protection towards improving the integrity of the network. It should be mentioned that a protection information system is expected to optimize the operation of all distribution assets and improve the efficiency of the energy networks through enhanced automation, monitoring, protection and real time operation.	
Prioritization: Medium-term	**Technical Domain:** Protection Systems

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Recommended Smart Solutions for Gas DSOs

Smart Gas Meters

Recommendation 6	Smart Gas Meters
Smart gas meters are a key component of the realization of a smart grid for the gas distribution. A smart meter is characterized by the ability to provide bidirectional communication between the meter and the Meter Dara Management System (MDMS). Apart from the ability for the remote monitoring of the gas consumption, the information collected from smart gas meter can be used to offer insights on the distribution network of gas DSOs. A study from December 2019 on the deployment of smart meters in the EU found that 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. Gas DSOs should also consider synergies with electricity DSOs during the pilot and rollout phases of the smart gas meters deployment in order to significantly reduced installation costs.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Functionalities

Recommendation 7	Meter Data Management System
The Meter Data Management System (MDMS) ingests, stores, cleans, and analyses data retrieved from smart metering systems. Data from the MDMS can be used for billing purposes, as well as to provide insights regarding gas demand and consumption, as well their forecasted values. By applying data analytics and data mining methods, smart gas metering data can be used to leakage detection and localization.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Functionalities

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Recommended Smart Solutions for Gas DSOs

Smart Gas Meters

Recommendation 8	Remote Activation and Deactivation
The bidirectional communication capabilities offer by smart gas meters, allow also for the remote activation and deactivation of the gas supply to the end-customers. This functionality can be used to disconnect gas customers due to dept, but also to deactivate the supply for safety reasons, for example in case a gas leakage has been detected.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Functionalities

Recommendation 9	Alarms on Energy Consumption
The analysis of the smart gas meter readings collected in the MDMS can reveal possible abnormal gas consumption profiles that might be attributed to gas leakage or unintended large consumption of gas by end-customers. In such a scenario, an alarm should be triggered in the MDMS or the SCADA systems to alert the gas DSO for the related incidents.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Functionalities

Recommendation 10	Smart Meter Firmware Upgrades
Smart gas meters should be support Over The Air (OTA) firmware updates to allow gas DSO to perform the necessary firmware updates, either in the case of upgrading the functionality of installed meters or when a malfunction of the meter has been identified. Moreover, remote configuration of smart gas meters should be possible, to allow gas DSOs to change the configuration of already installed meters, without the need of a field visit by the gas DSO's personnel, thus reducing the time needed, as well minimizing the associated costs.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Functionalities

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Recommended Smart Solutions for Gas DSOs

Smart Gas Meters

Recommendation 11	Smart Gas Meters Communications
Gas DSOs should properly evaluate the possible technologies available for the communication of the smart gas meters with the MDMS. It is recommended that all available telecommunication technologies for smart gas meters should be assessed during the pilot phase before the smart meters' rollout. The mixture of the tested technologies should be based on state-of-the-art technology evaluations, always taking into account the specific requirements imposed by the gas DSOs. If deemed appropriate, more than one telecommunication technologies can be used during the rollout of the smart meters. Gas DSOs should also consider synergies with electricity DSOs during the pilot and rollout phases of the smart gas meters deployment.	
Prioritization: Medium-term	**Technical Domain:** Smart Gas Meters Communications

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 12	Workforce Management System

Workforce management (WFM) solutions consists of the desktop and mobile applications that allow gas DSOs to manage efficiently staff scheduling, thus enabling the optimization of field resource distribution and streamlines field operations. WFM solutions generally include the following modules:

- labour scheduling: manages manage employees' skills and compliance requirements more effectively,
- time and work data collection: captures and reports detailed information about labour use,
- leave management: processes paid time-off requests with visibility into the staffing and liability implications,
- task and activity management: delivers a detailed view of labour management requirements to help with the sophisticated decision making required for activity-based management; and
- time and attendance: receive input from the other modules and apply rules against the reported times, based on the company's requirements.

Prioritization: Medium-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 13	Enterprise Resource Planning
Enterprise Resource Planning (ERP) systems refer to the collection of integrated applications that an organization can uses to collect, store, manage, and interpret data from many business activities. Based on the fact that the smart gas grid will enable interaction with the various cross-sector business actors, it is recommended that gas DSOs operate an ERP system to cope with the processing of multidisciplinary data. Gas DSOs should also ensure that the ERP system provides all the required interfaces for the integration and exchange of information with existing and future IT and OT systems of the gas DSO.	
Prioritization: Medium-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 14	Asset Performance Management System

It is recommended that gas DSOs implement and operate an Asset Performance Management System (APMS) to manage in an efficient and systematic manner the gas distribution assets and forecast their expected times to failure, thus promoting the efficient operation of the gas distribution network. An APMS has to keep updated information on the equipment deployed by taking into account:

- commissioning and decommissioning of the devices,
- historical information of the device operations, and
- aging of the devices due to time and weather conditions.

Gas DSOs should also consider during the procurement of an APMS that the system provides all the required interfaces for the integration and exchange of information with existing and future IT and OT systems.

Prioritization: Medium-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 15	Geographic Information System
It is highly recommended that gas DSOs should always operate an updated Geographic Information System (GIS), containing all latest information regarding the assets and their geographical location. It is deemed important that an integration with the existing and future IT and OT systems of the gas DSO should be in place, especial with SCADA and the APMS. Moreover, it is also recommended that the exchange of topological data between the GIS and the SCADA system should be supported, so that changes in one of the systems to be reflected on the second system. DSOs should also consider during the procurement of a GIS that the system provides all the required interfaces for the integration and exchange of information with existing and future IT and OT systems.	
Prioritization: Short-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 16	Big Data Analytics

With the deployment of smart grid solutions for the gas distribution grid, gas DSO will have at their disposal a large volume of data. Big data are characterized by the 5Vs: volume, velocity, variety, veracity and value. Although Information and Communication Technologies (ICT) have been already incorporated within the gas DSOs, recent advances in technologies, telecommunications and data analytics are progressively changing the data landscape, by introducing the notion of big data. Via the digitalization of the gas distribution sector, data is becoming more granular and new tools are being developed to better tailor communication, increase transparency and, most importantly, develop more personalized offers and services. It should be mentioned that although digitalization holds a lot of promise, it also comes with new challenges for the consumers and the regulated entities, such as the exchange and handling of big data in a safe and regulatory-compliant way. ENISA recommends several measures for treating big data, such as:

- privacy by design,
- decentralized versus centralized data analytics,
- transparency and control,
- user awareness and promotion of Privacy Enhancing Technologies, and
- a coherent approach towards privacy and big data.

More information on cybersecurity and big data can be found in Recommendation 29.

Prioritization: Short-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 17	Information Management System
Within the gas DSO environment, an Information Management System (IMS) refers to collection of applications and tools that allow the integration of the Information Technology (IT) and Operation Technology (OT) systems of the gas DSO. In the modern utility environment, an Enterprise Service Bus (ESB) architecture is used to enable the integration of the various systems, tools, and services. Compared to the traditional point-to-point architecture for system integrations, where the addition of a new system would require the development of the necessary interfaces with each one of the existing systems, the ESB permits, via the use of a data information bus based on a common data model, the seamless integration of any new IT or OT system via the development of the required interfaces for the said system with the ESB.	
Prioritization: Medium-term	**Technical Domain:** Enterprise IT and Application Integration

Recommendation 18	Common Information Model
The Common Information Model (CIM) is a suite of open international standards addressing energy management, asset management, and market systems. Even though CIM is focused on electricity, it can be extended to gas, thus giving the ability to gas DSO to develop their own customized data model that would be compatible with the CIM. It is recommended that EMRA fosters the use of the CIM not only within the gas DSOs, but also throughout the system operators for both gas and electricity as the common data model that will allow the seamless data exchange and coordination of all involved energy actors.	
Prioritization: Short-term	**Technical Domain:** Enterprise IT and Application Integration

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Recommended Smart Solutions for Gas DSOs

Digitalization and Communication

Recommendation 19	Cloud Solutions
Smart grids highly depend on the coordination between the various energy actors, as well as on the coupling with other sectors. This interaction with the various cross-sector business actors can be supported by creating open cloud solutions that support open Application Programming Interfaces (APIs). To this extents, it is recommended that gas DSO should explore the proper combination of cloud solutions, as well as open source and proprietary solutions to support the synergies between the gas actors, as well as the interaction with the actors of the electricity sector. Such cloud solution may also include new IT models, such as Platform-as-a-Service and/or Software-as-a-Service solutions. It should be mentioned that specific care for cybersecurity issues related to cloud and open source solutions should be taken.	
Prioritization: Medium-term	**Technical Domain:** IT and Communication Infrastructure

Recommendation 20	Telecommunications Infrastructure
Gas DSOs should perform the required technical studies and CBA to define the technologies to be used for the communication with substations and field devices. The technical studies should take into account not only technical requirements for telecommunication, such as Quality of Service (QoS), data rates, and latency, but also assess the reliability of the various telecommunication solutions based on the criticality of the services and processes to be deployed using the specific telecommunication technology. Moreover, EMRA should encourage gas DOS to carry out studies for evaluating the feasibility of deploying and operating their own private telecommunication networks or use existing telecommunication infrastructure from other system operators, such as electricity DSOs and TSOs. The possibility of gas DSOs deploying and operating a telecommunications network together with electricity DSOs and TSOs should also be promoted by EMRA.	
Prioritization: Short-term	**Technical Domain:** IT and Communication Infrastructure

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Recommended Smart Solutions for Gas DSOs

Smart Grid Services

Recommendation 21	Flexibility Services
Gas technologies are capable of providing flexibility solutions to the electricity grids either through power-to-gas solutions, by storing the excess of electricity supply, or via Combined Heat and Power (CHP) solutions, by lowering electricity demands. To meet the energy and climate goals of European Union and foster the energy transition, it is important that the regulations and policies adapt to the new and future roles, related to flexibility, of the gas DSOs. This can be achieved by: • fostering R&D of gas technologies that provide flexibility to the energy system, such as technologies related to biomethane, hydrogen, micro-CHP, reverse flows and others, • encouraging renewable and smart gas producers to become flexibility providers via power-to-grid and micro- and mini-CHP solutions and • considering the active role of gas DSOs in managing flexibility on their grids.	
Prioritization: Long-term	**Technical Domain:** Smart Grid Services

Recommendation 22	Energy Efficiency Services
According to CEER, it is highly recommended that gas DSO should me incentivized by EMRA to promote energy efficiency awareness for their customers as a way to optimize network investment or reduce energy losses (which are capital concerns of network operators). Gas DSOs should actively engage customers in energy efficiency services, since general information sharing about energy use cannot be considered as a direct service offered by the gas DSOs, in the sense that it cannot be charged to an individual consumer that contracts the service. Finally, energy audits and other energy efficiency service offered directly to the customers should not be within the scope of services offered by the gas DSOs.	
Prioritization: Medium-term	**Technical Domain:** Smart Grid Services

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Recommended Smart Solutions for Gas DSOs

Smart Grid Services

Recommendation 23	Power-to-Gas

Gas DSOs are encouraged to explore power-to-gas solutions as the one of the most important aspects of gas technologies that can provide flexibility to the electricity system. Especially power-to-gas system offer innovative and efficient solutions for transforming surplus supplies of electricity from renewable sources into synthesized gas that can then be injected into the gas network. Power–to-gas technologies provide a number of benefits, some of which are listed below.

- The transformation of electric power into hydrogen or SNG allows to use the energy at any time and locations by using the gas networks.
- The transformed electric power into hydrogen or SNG can be stored in the gas grid and made available when and where needed.
- The produces methane and hydrogen from power-to-gas can be used in a variety of industrial application applications leveraging the existing gas infrastructure.
- Peaks in renewable energy production can be efficiently managed by transforming renewable energy into SNG and hydrogen, thus reducing RES curtailment.
- Troughs in power production can also be balanced by generating electric power from power-to-gas plants.

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

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Recommended Smart Solutions for Gas DSOs

Smart Grid Services

Recommendation 24	LNG/CNG Transportation
Gas becomes increasingly important in the transportation sector, in both Liquefied Natural Gas (LNG) and Compressed Natural gas (CNG) forms. The use of gas for maritime transportation is not negligible in Europe while the gas fuelled private vehicles are getting more and more competitive especially due to environmental standards of the EU. The CO_2 emissions from natural gas vehicles (NGVs) can be further reduced by using biomethane as a fuel. Biomethane has a significant market share in Finland, Germany, the Netherlands and Sweden. It is recommended that gas DSOs should perform a feasibility study and a CBA for the deployment of NGV filling station infrastructure.	
Prioritization: Medium-term	**Technical Domain:** Smart Grid Services

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Recommended Smart Solutions for Gas DSOs

Smart Grid Services

Recommendation 25	Combined Heat and Power

Combined Heat and Power (CHP) systems produce simultaneously electricity and useful heat and can achieve energy efficiency levels of around 90%. According to the European Cogeneration Directive (2004/8/EC) a small-scale CHP unit is defined as the unit with an electrical capacity: micro-CHP is below 50kW and mini-CHP is below 1MW. The micro-CHP systems are currently powered by natural gas, biogas, biomethane, biofuels or liquefied petroleum gas (LPG).

- Provide the ability for load shifting between the electricity and the gas network using heat storage, thus maximizing the efficient utilization of electricity and gas grids.
- Provide fuel savings by avoiding exhaust heat losses in many large power generation stations, thus leading to significant reductions of CO emissions (some 3 to 6 tons of CO emissions annually), as well as reductions in NO_x and CO_2.
- Micro-CHP reduce transmission and distribution losses of electricity from power stations to end-users.
- Allow electricity DSOs/TSOs to avoid investments in cross border-flows, as well as investments related to the reinforcement of the electricity grid of infrastructure.
- Low need for additional investment in the gas network since gas grid infrastructure is as already in place.
- Micro-CHP systems and the electricity smart meters, for both consumption and generation of electricity, and supplier services, provide the necessary link between the gas and electricity networks, thus providing high interoperability.

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

This project is funded by the European Union

Recommended Smart Solutions for Gas DSOs

Cross-cutting Topics

Recommendation 26	Machine Learning and Artificial Intelligence
According to CEER conclusion paper on dynamic regulation to enable digitalisation of the energy system, analytics, such as Machine Learning (ML) and Artificial Intelligence (AI), are among the key drivers of digitalization along with data and connectivity. It is recommended that gas DSOs to employ ML/AI algorithms for performing data mining from the available IT- and OT-related data. These algorithms will allow gas DSOs to develop applications for increasing the operational efficiency and safety of gas distribution networks. Such applications may include predictive and preventive maintenance of pipelines and related equipment, more accurate forecasting tools, leakage detection, and others.	
Prioritization: Long-term	**Technical Domain:** Artificial Intelligence and Machine Learning

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Recommended Smart Solutions for Gas DSOs

Cross-cutting Topics

Recommendation 27	Internet of Things
The European Parliament refers to the Internet of Things (IoT) as a "*distributed network connecting physical objects that are capable of sensing or acting on their environment and able to communicate with each other, other machines or computers*". According to CEER, IoT is an integrated part of smart homes, since it provides customers with the ability to manage appliances, devices and sensors, which can communicate with each other and be controlled remotely, as well as to give to customers access to gas consumption data. It is recommended that gas DSOs should prepare their IT infrastructure and systems in such a way that they can cope with the large volume of incoming data from the various IoT devices. The IT systems should be able to perform processing, sorting, cleaning, analysis and visualization of IoT data and to integrate the data with the IT and OT systems of the gas DSO. The analysis of the big data generated by the IoT devices will enable gas DSOS to realize automation, control, management, problem detection and prediction applications in the smart gas grid. It should be mentioned that all customer related IoT device data should be in compliance with data protection laws and the new General Data Protection Regulation (GDPR), which came into force in May 2018.	
Prioritization: Short-term	**Technical Domain:** Artificial Intelligence and Machine Learning

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Recommended Smart Solutions for Gas DSOs

Cross-cutting Topics

Recommendation 28	Cybersecurity Testbeds and Security Assessments
It is highly recommended that EMRA promotes the creation of cybersecurity testbeds that will allow, via agile testing methodologies, the assessment of the security of smart grid solutions and products according to a pre-defined set of security principles. EMRA should also incentivize the participation of third-party companies and organizations in these cybersecurity testbeds that will carry out the required penetration tests to the IT and OT systems of the gas DSOs, as well as other smart grids actors. Cybersecurity testbeds, could also serve as independent evaluators, accredited by National Certification Authorities, for future certifications schemes, as well as they could take the responsibility of knowledge sharing, dissemination, and training.	
Prioritization: Short-term	**Technical Domain:** Cyber and Physical Security

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Recommended Smart Solutions for Gas DSOs

Cross-cutting Topics

Recommendation 29	Cybersecurity for Big Data

According to ENISA, it is highly recommended that the following measure should be taken for treating big data:

- Privacy by Design Applied (Anonymization in Big Data): Data Protection Authorities, data controllers and the big data analytics industry need to actively interact in order to define how privacy by design can be practically implemented (and demonstrated) in the area of Big Data analytics, including relevant support processes and tools.
- Decentralized versus centralized data analytics: The research community and the big data analytics industry need to continue their efforts in combination towards decentralized privacy-preserving analytics models. Policy makers need to encourage and promote such efforts, both at research and at implementation levels.
- Transparency and control: The big data analytics industry and the data controllers need to work on new transparency and control measures, putting the individuals in charge of the processing of their data. Data Protection Authorities need to support these efforts, encouraging the implementation of practical use cases and effective examples of transparency and control mechanisms that are compatible with legal obligations.
- User awareness and promotion of Privacy Enhancing Technologies (PETs): The research community needs to adequately address aspects related to the reliability and usability of online PETs. The role of the Data Protection Authorities is central in user awareness and promotion of privacy preserving processes and tools in online and mobile applications.
- A coherent approach towards privacy and big data: Policy makers need to approach privacy and data protection principles (and technologies) as a core aspect of big data projects and relevant decision-making processes.

Prioritization: Short-term	**Technical Domain:** Cyber and Physical Security

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Recommended Smart Solutions for Gas DSOs

Cross-cutting Topics

Recommendation 30	Physical Security
It is highly recommended that gas DSO should take all the necessary precautions to enforce the required physical security measures in parallel with the cyber ones. Physical security for gas DSO becomes of paramount importance given the increasing number of connected Intelligent Electronic Devices (IEDs) that provide information and control to the IT and OT systems of the gas DSOs. Since field devices, including devices located in substation, are highly susceptible to attacks, the physical perimeter of these devices should be secured. In case of installed smart gas meters, it is recommended that the meters have a tamper detection mechanism that will trigger an alarm in the MDMS upon access attempts from unauthorized personnel.	
Prioritization: Short-term	**Technical Domain:** Cyber and Physical Security

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Prioritization and Roadmap

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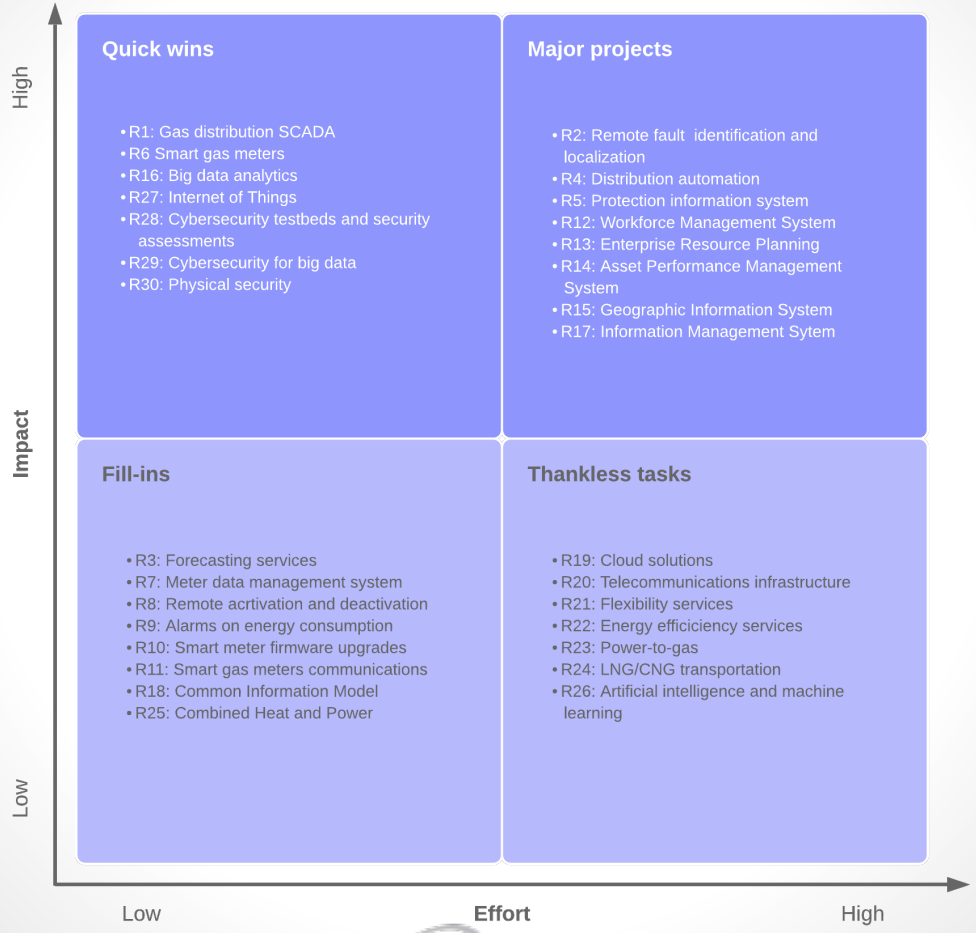
Prioritization and Roadmap



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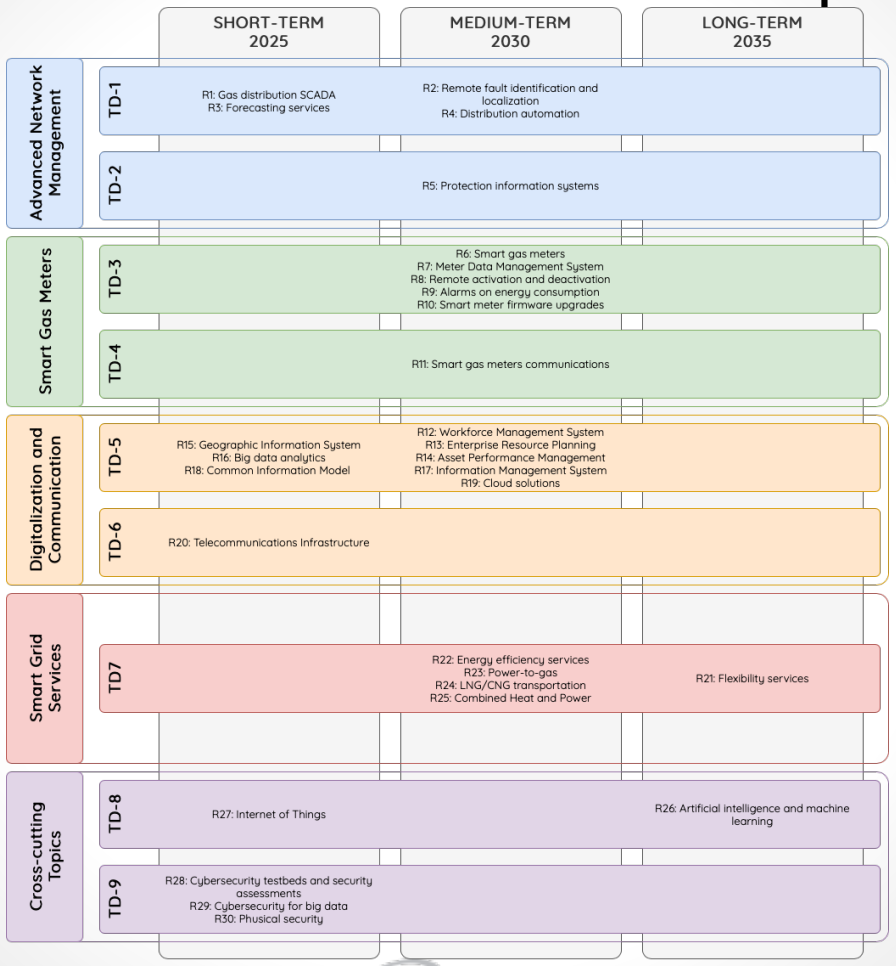
Prioritization and Roadmap



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Recommendations on Implementation Roles and Responsibilities

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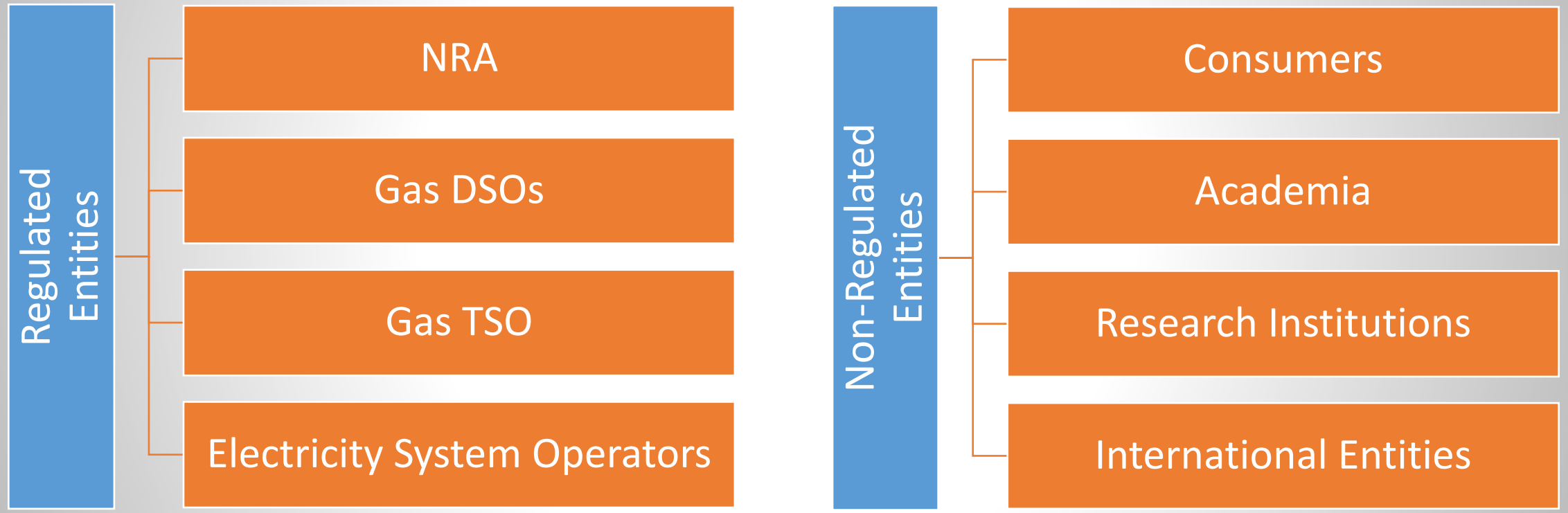
Key Stakeholders in Smart Grid Projetcs



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Recommendations on Implementation 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 gas 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 gas 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, since the potential of flexibility services in the gas grid are limited, the NRAs should request from gas DSOs to perform a Societal Cost-Benefit Analysis (SCBA), to evaluate the necessity of the deployment of such services via analysing whether the benefits of a procurement model outweigh the resulting administrative burdens.

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Recommendations on Implementation Roles and Responsibilities

Gas Distribution System Operator

Gas Distribution System Operators (DSOs) play a fundamental role in the operation of gas networks since they are responsible for the operation, maintenance, and development of the portion of the gas network that links the transmission system and the end customer. Moreover, gas DSOs play an important role as market facilitators for gas suppliers by making sure that the gas is transported in a safe and efficient manner. CEER acknowledges also the importance of gas DSOs to decide on the suitable innovation solutions to be applied in their networks, according to according to the individual needs of the gas DSOs. With regards to smart grids for gas distribution, in case gas DSOs decide to participate active in the development of NGV infrastructure, it is recommended that a clear exit strategy for the gas DSOs should be formulated and executed when the market is able to take over the infrastructure provision, preventing market distortion. Finally, gas DSOs should explore efficiencies of collaboration between electricity and gas DSOs in data collection, transmission and handling, in case smart metering data is collected and provided to the market.

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Recommendations on Implementation Roles and Responsibilities

Gas Transmission System Operator

Gas Transmission System Operators (TSOs) are responsible for the operation and maintenance of the gas transmission network, as well as its development. Moreover, one of the main roles of gas TSOs is to guarantee the security of supply to the increasing energy demands. Since the roles of gas TSOs and DSOs are by nature closely coupled, close collaboration and development of joint strategic plans for smart gas grid investments should be carried out in specific areas selected based on the prioritization of the smart grid activities between the gas system operators. Finally, dissemination of the results of the joint smart grid efforts with the relevant stakeholders of the energy system should be fostered.

Electricity System Operator

The electricity TSOs and DSOs play an important role in modern energy systems. Gas technologies are capable of providing flexibility solutions to the electricity networks either through power-to-gas solutions, by storing the excess of electricity supply, or via CHP solutions, by lowering electricity demands. Electricity and gas DSOs should also explore the potential of flexibility services provided by the gas grid to the electricity grid and vice versa. Finally, if smart electricity meters are rolled out, efficiencies resulting from a combined roll-out with smart gas meters should be further explored, e.g. by conducting a SCBA.

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Recommendations on Implementation Roles and Responsibilities

Consumers

Consumers are a key stakeholder in the energy chain, since according to CEER the regulation focuses to innovation should be related to the whole system, but with a view on benefits for the welfare of consumers in general. Moreover, it is the consumers that they also fund smart grid projects through network tariffs. Finally, for gas DSOs, consumers paly also an additional role, that of the energy producer, via micro- and mini-CHP systems.

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, gas DSOs often collaborate with the academia and research institutions for their smart grid-related activities. CEER21 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.

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Recommendations on Implementation Roles and Responsibilities

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.

Thank You / Teşekkürler

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