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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 3: Incorporating Incentive Mechanism into Tariff Structure to Enhance Innovation Capabilities of Regulated Entities Training

Electricity Transmission

2 September 2020, Ankara

This project is funded by the European Union

Agenda

- ENTSO-E Innovation and R&D Activities
  - ENTSO-E Vision on Electricity Transmission Innovation
  - General description of ENTSO-E approach on cross-continental innovation activities
  - ENTSO-E Recommendations for Innovation Framework
- International Benchmark, Best Practices and Regulatory Approaches about Incentivizing Innovation
  - Different regulatory approaches on incentivizing innovation efforts Selected country practices (UK, Italy, France, Norway, Finland) for regulation of transmission innovation activities
- Roles, Responsibilities, Strategies and Actions of Regulated Entities and Public Institutions in Incentivizing Country-Specific Targets
  - Grid Operation and Safety
  - Power Electronics
  - Data Management and Digitalization
  - Sector Coupling
  - Relation between TSOs and DSOs
- Gap Analysis and Recommendations
  - Summary of Recommendations

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ENTSO-E Innovation and R&D Activities

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ENTSO-E Vision on Electricity Transmission Innovation (1/7)

- According to ENTSO-E, TSOs, having key role as system integrators for new services and Technologies, are at the centre of the transition to a low-carbon energy system.
- In this context, ENTSO-E mainly recommends the followings to TSOs:
  - Being prepared to face game-changing modifications, and
  - Ensuring the three dimensions of innovation, technology, process and business model.
- In order to enhance cooperation between TSOs, and support their engagement in R&I activities, ENTSO-E has published a Research, Development & Innovation Roadmap 2017-2026.
  - ENTSO-E has also developed a Research, Development, and Innovation (RDI) Roadmap for 2020–2030 which is under on-going process for public consultation and ACER opinion.

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ENTSO-E Vision on Electricity Transmission Innovation (2/7)

- In the roadmap, cooperation is intended to be promoted in two dimensional:
  - **Vertical cooperation,** it is targeted that TSOs have to collaboratively work with universities, research institutes, industrial manufacturers, DSOs, generation companies, market actors and consumers due to the fact that no single TSO is able to succeed alone.
  - On the other hand, it will be possible to enhance synergies among TSOs to avoid overlaps and to work on common goals, which can be achieved with a strong, uniform and possibly joint approach to R&I activities with the help of **horizontal cooperation**.
- In line with the overarching R&I framework set by the European Commission and the R&I roadmap 2017-2026 prepared by ENTSO-E, main responsibility of TSOs includes to perform R&I activities as per a challenge-based approach rather than technology-driven approach.
- ENTSO-E and its Members (TSOs) have created a public platform for communication and exchange of best practices applied at national level.

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ENTSO-E Vision on Electricity Transmission Innovation (3/7)

- R&I roadmap 2017-2026 covers the following clusters;
  - **Power System Modernization:** The development of an optimal grid design by using the most cost-effective technologies/solution enabling flexibility.
  - **Security and System Stability:** The improvement of the observability and controllability of the transmission system.
  - **Power System Flexibility:** The deployment of existing and new system flexibility options.
  - **Power System Economics & Efficiency:** The achievement of a more efficient market with an optimized energy mix and security of supply through integration of market and grid operations
  - **ICT & Digitalization of Power System:** The achievement of a more efficient market with an optimized energy mix and security of supply through integration of market and grid operations

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ENTSO-E Vision on Electricity Transmission Innovation (4/7)

- R&I Roadmap Electricity Transmission innovation projects are classified under each of the following topics:

Innovation Area	Brief Description	Functional Objectives
C1 Power System Modernisation	This cluster aims at developing an optimal grid design, based on the use of the most cost-effective technologies/solution, which should enable more flexibility (through the use of demand response, storage, or interface with other energy networks). It also looks at smart asset management models and methodologies, and the improvement of public awareness and acceptance.	• T1 Optimal grid design: Planning, adequacy, tools • T2 Smart Asset Management: Predictive and on-condition maintenance; CAPEX optimization • T3 New materials & technologies: Use of new materials and power technologies; new construction and maintenance methods • T4 Environmental challenges & Stakeholders: Environmental impact, public acceptance, stakeholder's participation
C2 Security and System Stability	This cluster addresses the improvement of the observability and controllability of the transmission system. This will be carried out through the development of methods, technologies and tools able to handle, process and interchange measured and forecasted data in real time across TSOs but also with DSOs. Network modelling and dynamic security tools are part of this cluster. It aims at improving defense and restoration plans for the pan-European grid. The operation of the power system will be based on the development of new procedures, strategies and models for ancillary services coming from different sources: RES, DSOs, energy storage, etc.	• T5 Grid observability: Observability of the grid: PMUs, WAM, Sensors, DSO information exchange • T6 Grid controllability: Controllability of the grid; frequency and voltage stability, power quality, synthetic inertia • T7 Expert systems and tools: Decision support tools, automatic control and expert systems • T8 Reliability and resilience: Défense and restauration plans, probabilistic approach, risk assessment, self-healing • T9 Enhanced ancillary services: For network operation; cross-border supply of services

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ENTSO-E Vision on Electricity Transmission Innovation (5/7)

➢ R&I Roadmap Electricity Transmission innovation projects are classified under each of the following topics:

Innovation Area	Brief Description	Functional Objectives
C3 Power System Flexibility	This cluster supports the deployment of existing and new system flexibility options such as: • Storage solutions for fast-responding power (time dimension) and energy (less capacity needed) as well as for novel solutions for system services. Technical requirements, economic, market and environmental aspects must be evaluated. • Demand response encompassing the development of tools and specifications for the control of such resources. It will also address the integration of electric vehicles and the modelling of customer behavior and quantify the degree of flexibility provided by the distribution networks. • ICT and enhanced RES forecast techniques would support the optimal capacity operation of the power system while maintaining the quality and security of the supply. • The enhanced use of the transmission assets.	• T10 Storage integration: Definition and use of storage services; system added value from storage • T11 Demand Response: Tools to use DSR, Load profile, EV impact • T12 RES forecast: Improved RES forecast and optimal capacity operation • T13 Flexible grid use: Dynamic rating equipment, power electronic devices; use of interconnectors • T14 Interaction with non-electrical energy networks: Interaction/coordination with other energy networks (gas, heat, transport)

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ENTSO-E Vision on Electricity Transmission Innovation (6/7)

➢ R&I Roadmap Electricity Transmission innovation projects are classified under each of the following topics:

Innovation Area	Brief Description	Functional Objectives
C4 Power System Economics & Efficiency	This cluster aims to propose ways and means to facilitate interactions between the European electricity markets and the pan-European transmission system. The objective is to achieve a more efficient market with an optimized energy mix and security of supply through integration of market and grid operations. All time horizons are treated in this cluster. On the one hand, tools and methods will be proposed to enhance the optimization of the energy flows at short-term horizons in the pan-European system, considering the intermittency generated by RES. On the other hand, the cluster aims to make proposals to coordinate investments in a context where the quality of the market prices to generate the correct signals for investment is regularly questioned.	• T15 Market – grid integration: Integration of market and grid operation across timeframes (up to real time) • T16 Business models: For storage, grid extension, distributed generation for optimal investments in the network • T17 Flexible market design: Market design for adequacy, flexibility use, cross border exchanges, rationale use of RES, demand management
C5 ICT & Digitalization of Power System	This cluster aims at considering Big Data management through data-mining tools and the development of interfaces with neutral and transparent data access. The cluster will also consider recommendations for standardization activities and protocols for communications and data exchanges, the use of new technologies such as the Internet of Things and cyber security issues. ICT is an enabling technology for managing the flexible energy system described in C3.	• T18 Big data: Big data analytics, data mining, data management • T19 Standardization & data exchange: Standardization, protocols for communications and data exchange with DSOs and other grid operators • T20 Internet of Things: New communication technologies, Internet of Things • T21 Cybersecurity

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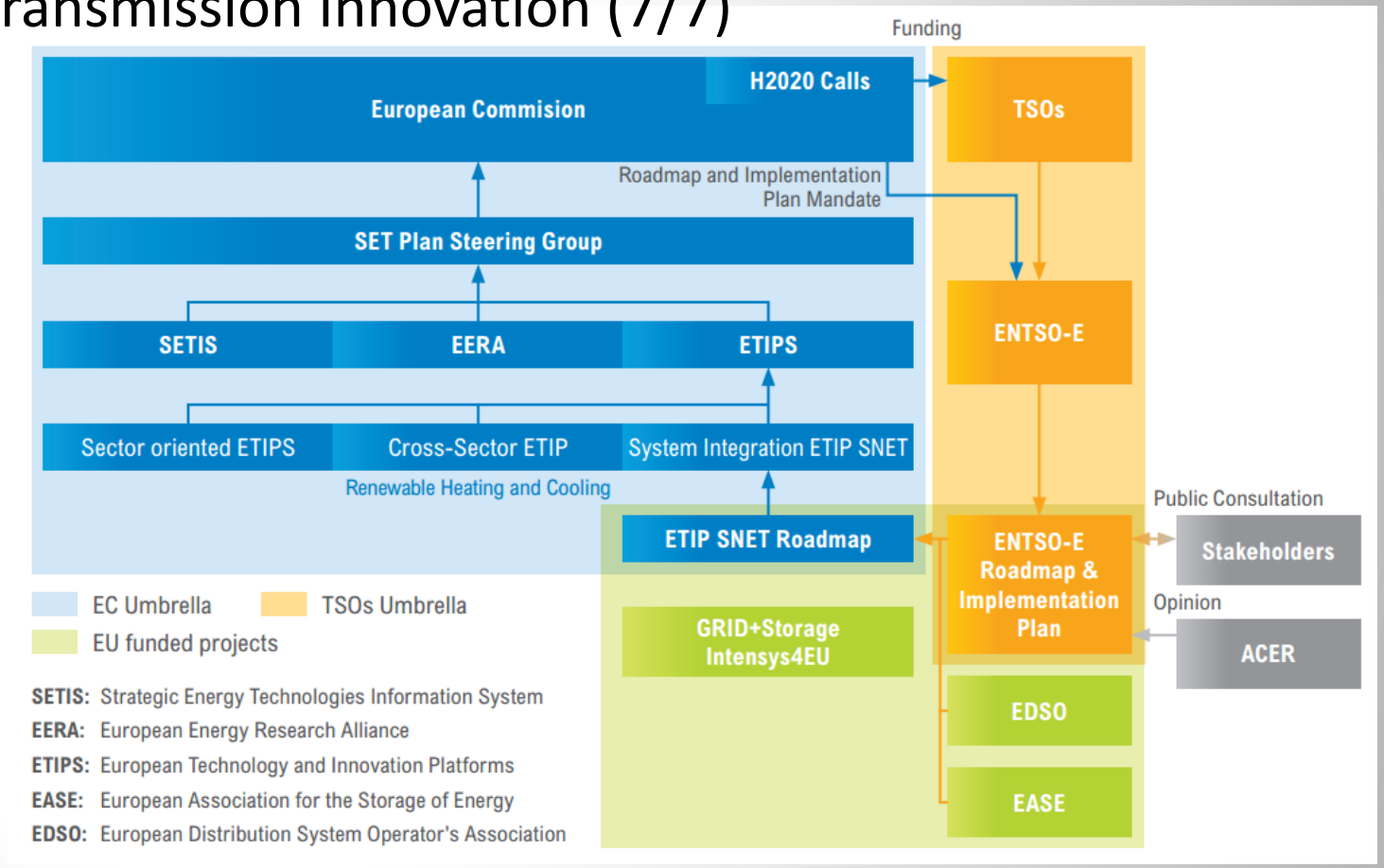
ENTSO-E Vision on Electricity Transmission Innovation (7/7)

- ENTSO-E has close collaborations with other EU institutes to harmonize the research and innovation efforts.



Source: ENTSO-E R&I Implementation Plan 2017-2019

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ENTSO-E approach on cross-continental innovation activities (1/2)

- ENTSO-E approach is to use new technologies and solutions to deal with the challenges of variable RES increasing, empowering customers and active participation of households and businesses consumers/prosumers to the European energy market in compliance with the Energy Union Strategy.

- Following processes are performed by ENTSO-E in close cooperation with relevant stakeholders to govern the R&I Roadmap:

  - Designing and approval of the R & I Roadmap;
  - Support to the EC for defining priorities and R & I programs;
  - Encouraging TSOs to pool efforts and resources to perform R & I projects;
  - Monitoring the achievements of the performed R & I projects;
  - Disseminating, facilitating, replication and implementation of results by the entire ENTSO-E community.

2020	2030	2050
-20% GHG	≤ -40% GHG	≤ -85% GHG
20% RES	≥ 27% RES	≥ ?% RES
20% Energy Efficiency	≥ 27% Energy Efficiency	≥ ?% Energy Efficiency
10% Interconnections	15% Interconnections	?% Interconnections

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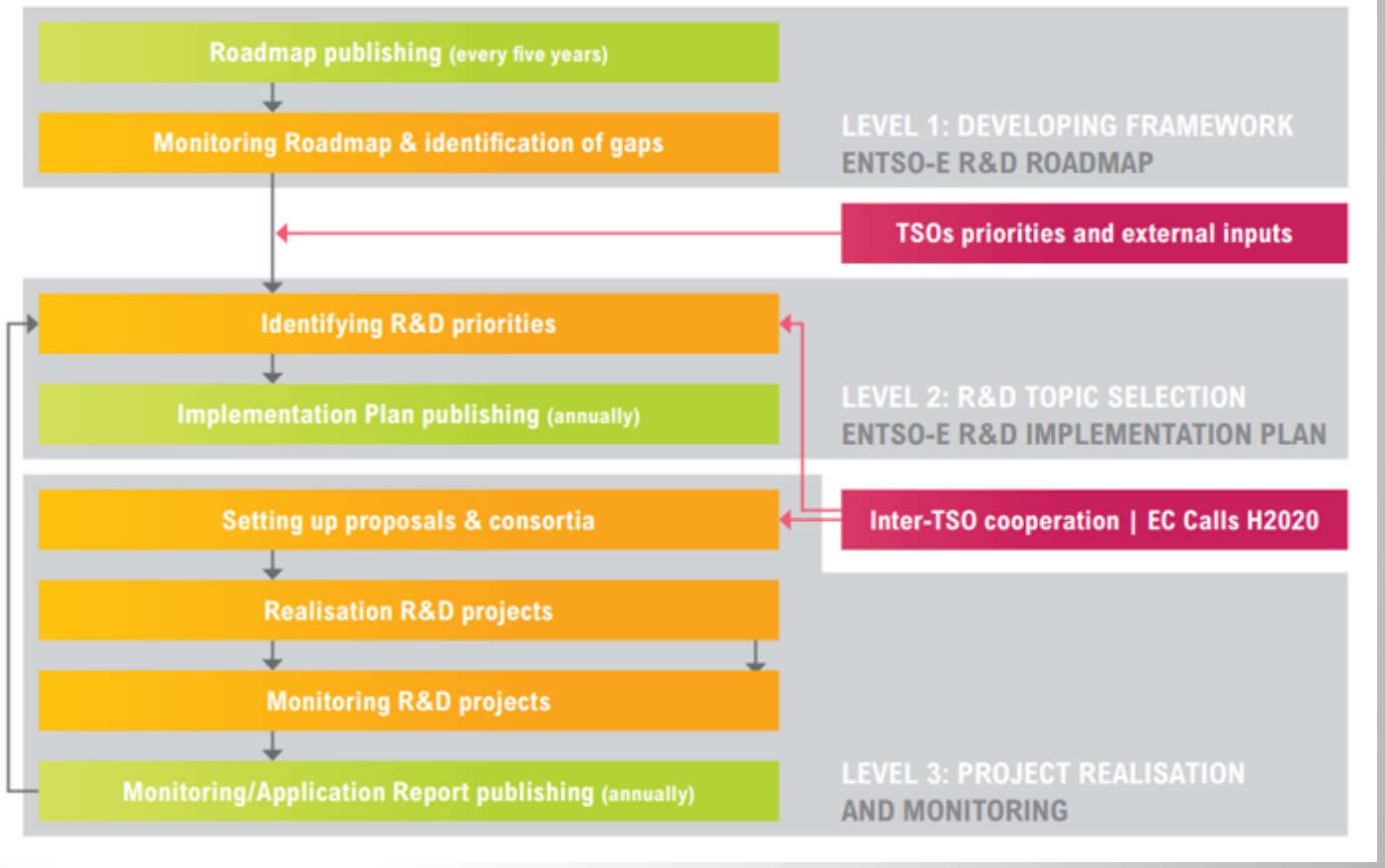
ENTSO-E approach on cross-continental innovation activities (2/2)

- R&I Roadmaps
  - EEGI R&I Roadmap 2013-2022
  - RD&I Roadmap 2017-2026
- R&I Implementation Plans
  - R&D Implementation Plan 2014-2016
  - R&D Implementation Plan 2015-2017
  - R&D Implementation Plan 2016-2018
  - R&I Implementation Plan 2017-2019
- R&I Monitoring/Application Reports
  - R&D Monitoring Report 2013
  - R&D Application Report 2014
  - R&D Monitoring Report 2015
  - RD&I Application Report 2016
  - RD&I Monitoring Report 2018



Source: ENTSO-E RD&I Roadmap 2017-2026

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R&I Implementation Plans

Implementation Plans

- The R&I activities of all stakeholders are coordinated
- The R&I topics based on existing state of art and evolution of the technology and business for the next years are identified

Selection Criteria for R&I Topics

- Innovation level based on TRL (Technology Readiness Level)
- Applicability/replicability of the expected outputs
- Added value for economic extent and carbon footprint of European

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Monitoring/Application Reports

Monitoring Reports

- Include assessment of the progress of R&I activities
- Based on R&I project surveys
- Include highlights of the survey and key recommendations
- The results of **gap analysis** carried out in detail for each functional objective are used to assign action priorities for updating roadmap
- The deployment and short-term application of results, through the identification **KER (Key Exploitable Results)** have taken an important role in forward-looking approach

Application Reports

- Include the assessment of the concrete impact of TSOs' EU-funded RD&I projects together with monitoring reports
- More focus on;
  - the effectiveness of RD&I
  - On gauging the benefits of RD&I projects' results

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ENTSO-E Recommendations for Innovation Framework (1/2)

- ENTSO-E recommendations to overcome barriers and limitations are about regulatory framework and policies by national institutes:
  - Reduce disincentives for efficient innovation. A “least-regret” solution could be, for example, to make European R&I support schemes and regulatory treatments more complementary. In general, an incremental improvement of R & I support schemes, incentives for innovation, and updated TSO regulations might enable less costly adaptation of innovation.
  - Ensure that TSOs, NRAs and policy makers recognise and integrate the value of radical innovation into their strategies and frameworks. While anticipatory transformation comes at a cost that not all NRAs and TSOs can cope with, a solution based on coordination, awareness and dissemination of results would reduce the misalignment between all positions.
  - Respond to the economic objectives of regulation. Regulation should ensure the selection and implementation of innovation with the highest value for society. It should also set conditions for the efficiency and effectiveness of the implemented innovation.

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ENTSO-E Recommendations for Innovation Framework (2/2)

- ENTSO-E recommendations to overcome barriers and limitations are about regulatory framework and policies by national institutes:
  - Take into account the specificities of TSOs and the nature of their innovations. The long-term nature of their innovations and investments, the risk of contestability of their monopoly, and the necessity for global finance ability should be taken into account. The value of their investments and innovation activities for the system and for society should be taken into account.
  - Assess the value of innovation with regard to the European electricity system as a whole, in order to integrate the consequences of system and market integration as well as European policy objectives.
  - Recognise the risks associated with the transformation of regulators and TSOs. Transformation of the electricity system and its anticipation by stakeholders induces new risks for TSOs, NRAs and policy makers when they modernise their strategies and frameworks. Those stakeholders indeed face uncertainties about the approaches followed to implement the chosen remedies. Experimental and reflexive modernisation should, however, enable the reduction of these risks by ensuring dynamic improvement of frameworks and governance.

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International Benchmark, Best Practices and Regulatory Approaches about Incentivizing Innovation

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Different regulatory approaches on incentivizing innovation efforts Selected country practices

- The analysis of international experiences aims to extract relevant information necessary to know how innovation incentives are implemented in selected European countries. We have analysed not only the regulatory innovation incentives in use in each country, but also the application of these incentives by each TSO.

- The following countries are considered in the analysis:
  - United Kingdom,
  - Italy,
  - France,
  - Norway and
  - Finland.

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Classified regulatory approaches on incentivizing innovation (1/3)

EU countries are classified under four categories according to their regulatory approach to investments in innovation as given below*;

Category 1.1: Countries in this category explicitly include innovation or related concepts such as R&D, technological change, smart grids in their **hi-level regulatory framework** like legislation.

Examples: Belgium, Bulgaria, Denmark, France, Lithuania, Romania, Sweden.

- In Belgium, in order to incentivize innovative investments, the tariff methodology is allowed to contain favorable provisions based on the legislation. As long as the innovative projects are cost-effective and provide social benefits, the NRA approves innovative projects included in ten-year investment plan. In addition, for especially risky/special projects like the modular offshore wind project, an extra remuneration is covered by the NRA.
- In France, RTE has a statutory objective to perform innovation activities for the new technological solutions and development of intelligent networks. Regulatory framework provides support for innovative projects as long as a reasonable relationship exists between monetary expenditure and economic/technical benefits.
- In Sweden, the Swedish Energy Agency promotes R&I activities and makes the TSO develop R&I plan.

* "Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?" report prepared for EC

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Classified regulatory approaches on incentivizing innovation (2/3)

Category 1.2: Countries in this category explicitly include innovation or related concepts such as R&D, technological change, smart grids at their lower regulatory level instruments like **tariff methodologies/incentives**.

Examples: Austria, Finland, Germany, Ireland, Italy, Luxembourg, Slovenia, UK.

- In Finland, deduction up to 1% of specific R&D costs are allowed in the tariff methodology
- In Germany, limited costs of R&D are approved within the revenue cap.
- In UK, thanks to Innovation Link established by the NRA, innovative solutions not included in regulatory model can be proposed for trial. In addition, revenue adjustment for the innovative projects can be realized by the NRA.

* "Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?" report prepared for EC

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Classified regulatory approaches on incentivizing innovation (3/3)

Category 1.3: Innovation related references are included in the NDP (National Development Plan)
Examples: Croatia, Hungary, Poland.

- In these countries, there is no specific treatment to innovative investments, and they are included in network development plans

Category 2: Countries with no evidence of support for innovative investments in the regulatory framework
Examples: Czechia, Estonia, Greece, Latvia, Netherlands, Portugal, Slovakia, Spain.

- Although no reference exists in the regulatory framework of Czechia, Latvia, Netherlands and Spain, as an example, there are 76 technology innovation projects that aims efficiency increment and facilitation of the integration of renewables in Spain.

* "Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?" report prepared for EC

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Introduce incentivizing innovation in legislation (1/2)

Despite the lack of explicit incentives, several countries have taken steps to try and introduce it in legislation. Some example practices of these countries can be listed as follows:

- Cost-plus elements, e.g. in Greece, Belgium, Czechia, Denmark, and Luxembourg, preclude that the regulator distinguishes between conventional technological solutions and innovative investments. The TSO can invest in innovative projects or projects with innovative elements, if they are approved.
- Direct support to innovation within the regulatory framework, e.g. innovation allowances in the UK. The TSO in the UK can apply for revenue adjustment for innovation projects, there is a Network Innovation Allowance and a Network Innovation Competition fostering smaller trials and projects, and the NRA has established the Innovation Link, allowing solutions from outside the regulatory model to be proposed for trial. It is not surprising that the NRF is given a high overall rating by the stakeholders and that many innovative projects are being implemented in the UK.
- The possibility to propose new innovative categories of investments remunerated based on audited costs in a system of reference unit costs, e.g. in Spain, or external cost assessment, such as in France.

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Introduce incentivizing innovation in legislation (2/2)

- The Slovenian TSO has established a unit for innovation. The TSO is pretty active in smart grids, leading the first smart grid PCI. The TSO has a “budget under coordination” of 130 million Euro for innovation, within which the main focus is on R&D, demonstration projects and pilot projects which range from core-business practices to international collaboration and cross-border market projects. Also, a micro grid project is conducted for the city of Ljubljana and are involved in a large consortium led by the French RTE working on OSMOSE, a project on storage at a cross-border level and including multiuse of storage. In contrast to the UK, there are few (innovation) incentives in the regulation (e.g. for smart grids). Generally large-scale deployment projects testing the use cases are preferred.

- Estonia is a frontrunner in innovation in which the Regulator and TSO closely collaborate to actualize innovation activities yielding a social advantage for the community. Any project, whether it is considered innovative or not, should be advocated by a socio-economic evaluation by the TSO. In spite of the reality that the regulatory framework does not straightforwardly incentivise innovation expenditures, the Regulator is willing to tune in to the TSO’s proposals with respect to contributing in R&D and innovation. The eagerness to contribute to advancement in R&D is illustrated by government-supported project “Data Exchange Platform” and “Smart Metering” projects for which, costs have been completely recognized and included within the RAB.

- Finland is a case of regulatory framework that allows incentives for innovation and R&D projects that are designed to create new knowledge, technology, products or methods of operation in network operations, or to the planning work of such projects. As per the regulatory approach, the Regulator aims at encouraging R&D by allowing for the deduction of up to 1% of R&D costs when calculating realised adjusted profits.

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Decrease the risk of innovative projects

In some countries, provisions are in place, which decrease the risk of innovative projects. Examples are:

- In the current regulatory period in the Czechia, the electricity TSO receives a WACC premium, which supports the investment in risky or innovative projects
- In Belgium, the electricity TSO can receive a WACC premium for risky projects; however, it has not been widely applied and only been recently used for offshore projects
- Ex-ante approval of CAPEX costs and minimizing the time lag for remuneration can reduce the perceived risk, as is the case in Germany and in Austria (for electricity)
- In Germany, investment projects that are stipulated in the national network development plan are eligible for so-called investment measures ("IMA"). When the German NRA BNetzA approves an investment measure, the related costs are considered so-called permanently non-influenceable costs, which are not subject to individual efficiency targets and thus can be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period. After the commissioning of an investment measure, the costs are integrated in the regulatory asset base and regarded as influenceable (potentially inefficient) costs at the end of the regulatory period after the commissioning.

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The good practices for innovative projects

The good practices that could be mentioned for regulatory framework supporting both efficiency and reducing the risk of innovation activities:

- WACC-premium for different projects as the WACC should be in line with the risk of the project
- Provide ex-ante approval of CAPEX/costs (e.g. for specific categories of projects that are relatively risky)
- Allow flexible project implementation deadlines (elimination of deadline penalties related for selected R&D projects)

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Comparison of the regulatory practices in different EU countries (1/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Austria	51% state owned	Rate-of-Return (Cost based)	1 Year	✓			Legislation states that costs arising from the efficient implementation of new technologies may be included in the network charges		
Belgium	No	Revenue Cap + cost control incentives + quality related incentives (Hybrid)	4 years	✓		The legislation requires that the tariff methodology must incentivise the TSO to ensure security of supply – this is applied to existing and new infrastructure of national or European interest and offshore infrastructure. Whilst it refers to the objective of security of supply and not to innovation per se, it allows the tariff methodology to contain more favourable provisions in order to incentivise innovative investments	In light of the statutory requirement, within the tariff methodology, the NRA incentivises the TSO to implement R&D necessary for its activities by allowing recovery of costs incurred with a cap of (i) 50% of total of subsidies received in that year; and (ii) a maximum of € 1m per year		
Bulgaria	Yes (Private company, but parent company is ultimately State owned	Rate-of-Return (combined with cap on prices)	1 Year	✓		The general statutory roles of the NRA include performing assessments regarding introducing smart metering systems.			

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Comparison of the regulatory practices in different EU countries (2/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Croatia	No	Cost Plus (Cost based)	1 Year	✓				Investments in NDP include application of new technologies particularly if innovation leads to efficiency saving	
Czechia	Yes	Revenue Cap	3 years		✓				Innovative projects are being financed using Operational Programme Enterprise and Innovations for Competitiveness. Significant for the TSO is priority axis 3, where subsidies can be drawn under the chapter Smart Grids II – Transmission Grids
Denmark	Yes	Annual break-even process (Other)	No Defined Period	✓		there is an explicit statutory duty on TSO to ensure R&D activities required for environmentally friendly and energy efficient network are carried out. One example of this in practice is Kriegers Flak - combining offshore wind with power exchange between two countries which is a world first			

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Comparison of the regulatory practices in different EU countries (3/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Estonia	Yes	Rate-of-Return (Cost based)	No Defined Period		✓				No reference.
Finland	53.1% state owned	Revenue Cap	4 years	✓			the tariff methodology allows the TSO to deduct up to 1% of specific R&D costs when calculating realised adjusted profits, reducing the likelihood of the TSO being required to lower tariffs set for the next year		
France	No	Revenue Cap, incentive based	4 years	✓		there is a statutory objective imposed on the TSOs to develop research in the field of energy. The TSO is required (through public service contract) to offer new technological solutions and develop a methodology for optimization and development of intelligent networks			
Germany	No	Revenue Cap (Incentive based)	5 years	✓			the NRA can approve limited scope of R&D costs within the revenue cap. Relates to R&D costs under publicly managed and funded schemes, only 50% of costs not publicly funded and cannot otherwise be financed by the TSO		

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Comparison of the regulatory practices in different EU countries (4/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Greece	No	Revenue Cap	4 years		✓				No reference
Hungary	No	Combined model of Incentive based Regulation and Cost plus (Hybrid)	4 years	✓				NDP include duty to examine possibility of introducing new technological solutions. Also, tariffs motivate TSO to develop smart grid methods	
Ireland	Yes	Revenue Cap based on Rate of-Return with Incentive based Regulation (Hybrid)	5 years	✓			the NRA has provided for an innovation allowance to support and trial specific new and emerging technologies. Further revenues can also be provided on case-by-case basis where TSO makes submissions to the NRA including a business case		
Italy	No	Combined model of Price Cap (OPEX) and Rate-of-Return (CAPEX) (Cost based)	6 years	✓			Support of innovative projects through approved State Aid particularly in the area of smart grids		

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Comparison of the regulatory practices in different EU countries (5/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Lithuania	Yes	50/50 Price/Revenue Cap – Hybrid Cap (Hybrid)	5 years	✓		There is a statutory requirement on the TSO to develop innovative pricing formulas and to consider development of smart energy grids and smart energy accounting systems			
Luxembourg	No	Revenue Cap	4 years	✓			There is a strong modernization agenda targeting introduction of smart grid and new technologies. Tariff methodology includes pass through of R&D costs related to TSOs activities and may be included in tariff up to 1% of maximum allowed income		
Netherlands	Yes	Revenue Cap	No Defined Period (3-5 years)		✓				Duty to develop the transmission system in an economic and efficient manner requires the TSO to innovate. There was also a specific Netherlands Enterprise Agency smart grid experimental playing field (ended in 2016) and the TSO block chain initiative
Poland	Yes	Cost of service (with elements of Revenue Cap)	3 years	✓				Via NDP, TSO includes budget for innovative investments	

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Comparison of the regulatory practices in different EU countries (6/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Portugal	No	Combined model of Price Cap (OPEX), standard costs in new investments and Rate-of Return (CAPEX)	3 years		✓				No reference
Romania	58.69% state owned	Price Cap	5 years	✓		National energy strategy includes moving to a smart transmission network and encouraging investments in R&D and this is embedded in the primary legislationin the primary legislationin the primary legislation			
Slovakia	Yes	Cost-plus / Rate-of-Return	5 years		✓				No reference
Slovenia	Yes	Revenue Cap	3 years	✓			Some incentives exist that appear to favor innovation, e.g. investments in smart meters and smart grid projects and in pilot stage		

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Comparison of the regulatory practices in different EU countries (7/7)

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Period	Regulatory Approach to Innovative Investments		Category 1: Reference to innovation in the regulatory framework			Category 2: No reference to innovation in the regulatory framework
				Category 1	Category 2	1.1 References in the high-level regulatory framework	1.2 References in the tariff methodologies/incentives	1.3 References in NDP	
Spain	No	Rate-of-Return (Cost based)	6 years		✓				Evidence provided of 76 technology innovation projects aimed at increasing the efficiency of system and facilitating the integration of renewables.
Sweden	Yes	Revenue Cap	4 years	✓		Swedish Energy Agency (government body, not NRA) has the authority to promote R&D in the sector. This translates into a TSO duty to promote R&D and produce an R&D plan			
UK	No	Revenue Cap based on Rate of-Return with Incentive based Regulation (Hybrid)	8 years (will be 5 years in 2021)	✓			The TSO can apply for revenue adjustment for innovation projects if they can demonstrate cost efficient, low carbon or environmental benefits; Network Innovation Allowance and Network Innovation Competition foster smaller innovative trials and projects; The NRA has established Innovation Link which allows solutions outside of regulatory model to be proposed for trial.		

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Roles, Responsibilities, Strategies and Actions of Regulated Entities and Public Institutions in Incentivizing Country-Specific Targets

This project is funded by the European Union

Roles and Responsibilities (1/3)

Roles and Responsibilities of key stakeholders based on European experiences:

- **National Regulatory Authority (NRA):** In general, the duties of the NRAs include licensing of TSOs as well as fixing or approving network tariffs or their methodologies and supervising the TSOs' performance. With respect to innovation, in most of the countries studied, the NRA is responsible for the design and implementation of the innovation incentives mechanism.
- **The Government:** In general, its role is to set the overall energy strategy at policy level and to promote the required legislation which provides the overall scope and structure for the regulatory framework through the relevant legislature. In some European countries the government holds additional powers in connection with monitoring of market players and with approval of major capital investments. EU governments drive national energy and market policy influencing which innovative solutions for the electricity sector are considered priorities. Some governments have also put in place support mechanisms such as tax incentives of special funds devoted to innovation activities.
- **Transmission System Operator (TSO):** Overall, its main responsibilities are operating, maintaining and developing the transmission network in an efficient, safe, reliable, economic and environmentally sustainable manner guaranteeing third party access on a non-discriminatory basis. TSOs also contribute to security of supply through long term network planning to meet reasonable demands. In some countries the TSO has the legal commitment (e.g. in the licenses) to undertake R&D efforts. With an innovation incentive mechanism in place, the TSO is the main responsible to implement the R&D strategy and invest in pilot projects, R&D studies, etc.
- **Customers:** End users should also be considered as relevant stakeholders since it the end they are funding innovation activities (via network tariffs) and should benefit from potential R&D activities' output: QoS improvements, efficiency gains, cost reduction, etc.

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Roles and Responsibilities (2/3)

There are other agents involved in the innovation activities:

- **Distribution System Operators (DSOs):** It is key for the national innovation strategy of the electricity sector to guarantee that DSOs and TSOs innovation efforts are aligned. In some countries (e.g. UK) the innovation incentive mechanisms are same for TSOs and DSOs. TSOs shall be encouraged to collaborate, as far as possible, with DSOs in some R&D projects to take advantage of synergies and guarantee the knowledge transfer of R&D studies' output among all market players.
- **R&D Entities (Such as universities, R&D centres, advisors):** These entities play different roles in the innovation strategy of European countries. In some countries such as France or UK they support the NRA during the evaluation process of R&D candidate projects. TSOs may also externalise R&D activities and engage external entities via tenders, subcontracts or partnerships.
- **International Agencies:** Some international institutions such as the European Union devote special funds to R&D projects. We have already presented several initiatives at EU level promoting knowledge transfer and partnership between TSOs of European countries. Turkish TSO (TEIAS) may take advantage (already being supported through several international projects) of some of these initiatives and partner with European TSOs for specific projects

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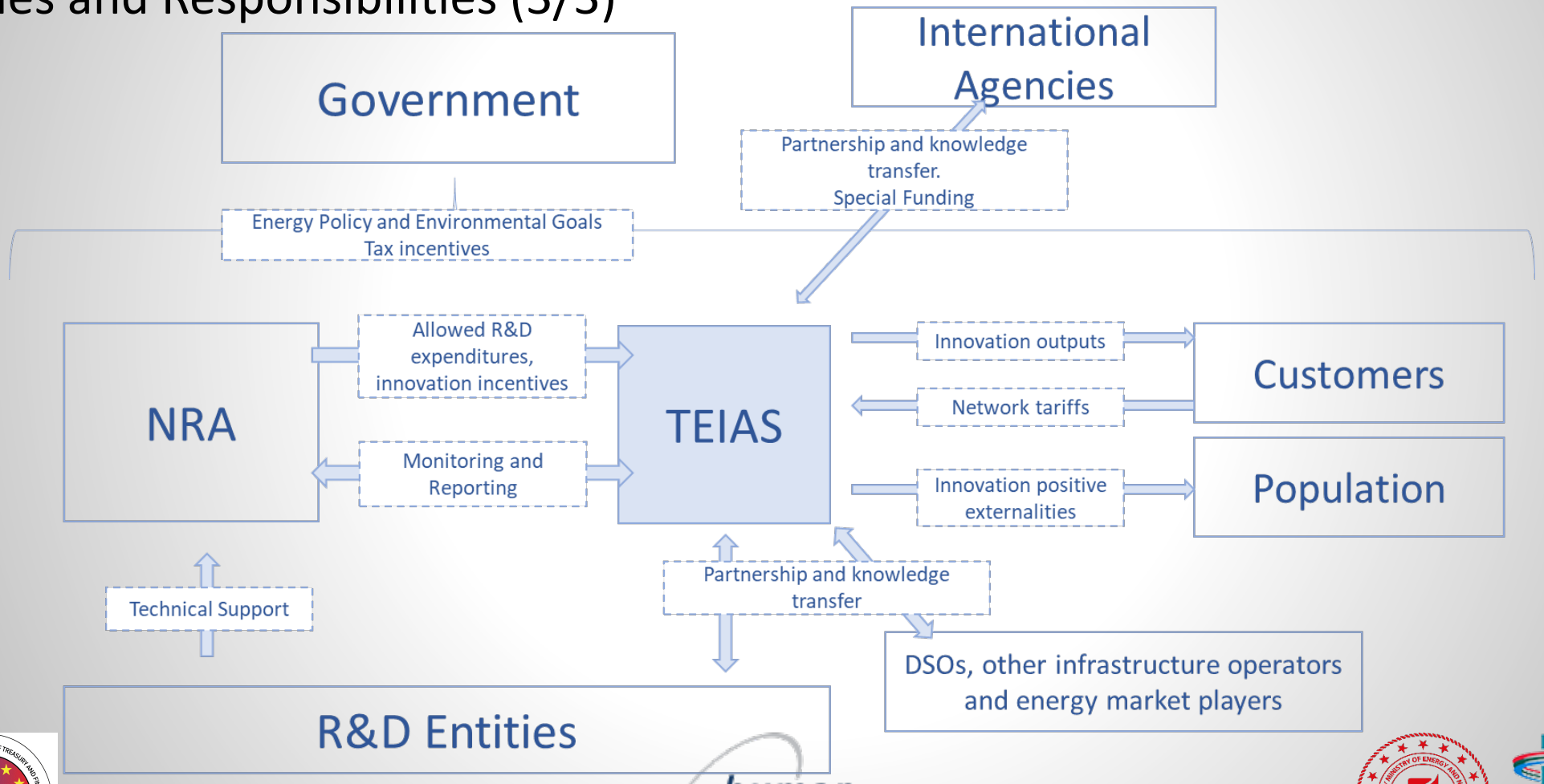
Roles and Responsibilities (3/3)



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Grid Operation and Safety (1/2)

- To operate the transmission network in an efficient and reliable manner is still the core responsibility of the TSO. TSO should be operating, maintaining and developing the transmission network in an efficient, safe, reliable, economic and environmentally sustainable manner, providing third party access on a non-discriminatory basis. Also, security of supply through long-term network planning in order to meet reasonable demands and development of the network is another key function of TSOs.
- The duties of the NRAs include licensing of TSOs as well as fixing or approving transmission tariffs and methodologies and supervising the TSOs' performance NRAs need to design the revenue methodology to guarantee that the TSO has enough resources to operate the network in a safe and efficient manner.
- There are some innovative solutions related to grid operation and maintenance (O&M) that are hard to deploy without previous know-how and IT capabilities. For example, European TSOs are using more and more remote inspections technologies e.g. drone inspections and artificial intelligence (AI). Usually it is necessary to develop pilot projects before the TSO is capable to take advantage of these new technologies. These pilot projects do not generate additional revenues for the TSO until they are deployed on an industrial scale.

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Grid Operation and Safety (2/2)

- UK, France and Ireland NRAs allow TSOs to recover as operating expenses all the cost related to the testing and implementation of new O&M technologies. For example, many projects have been approved under the Network Innovation Allowance to study the application of drones for network inspection.
- In principle, the government in EU countries has not a relevant role in grid operation innovation related matters.
- However, some non-energy governmental regulations that could conditionate the implementation of innovative technology solutions in the operations of Turkish transmission network.
  - Local R&D funds for the industry could be prioritized to cover required technologies for TSO.
  - Provide flexibilities in the regulations (non-energy) for TSO to:
    - Own and operate telecommunication technologies.
    - Use unmanned aerial vehicles for operations and maintenance.
    - Get benefit of national/international cloud services for ICT usage.

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Power Electronics

- Further penetration of renewable and distributed generation will have a significant impact on the interconnected system dynamic profile. Transition from a power system based on conventional synchronous generators to one with Power Electronics raises different challenges related to system Dynamics; decrease of system inertia, the reduced short circuit contributions from these new generators and the emergence of new types of interaction phenomena (i.e. control interactions).
- HVDC systems could enhance the AC transmission system performance, transforming it to an AC-DC transmission system which exhibits enhanced controllability, flexibility and resilience.
- TEIAS should develop a plan towards the successful realisation of power electronics solutions, focusing on system stability, observability and controllability, and integration of technology solutions in meshed systems. The common understanding of roles, the development of new technologies, the assurance of system interoperability, the analysis tools, harmonised standards with ENTSO-E members and procedures are key factors for successful realisation of future AC-DC networks. To achieve these goals, TEIAS will especially need to strengthen their technical cooperation with other TSO, power generators and HVDC manufacturers.

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Data Management and Digitalization

Entity	Main responsibility	Specific duties
National Government	Set national goals for IT upgrading	
National Regulatory Authority	Monitoring and allowed revenues setting	- Active encouragement of digitalization (optional) - Allowed digitalization expenditures in the revenue cap as part of the innovation incentives.
Electricity TSO	Data management	- Design and implementation of digitalization strategy - Upgrade data management and information system.

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Sector Coupling

- Sector Coupling term is generally used for the holistic and integrated approach by all energy sectors (electricity, gas, heat, transport, etc.) to use energy in a sector being generated in another sector, with an total increase in efficiency.
- Furthermore, the use of distributed flexibilities can also be considered as the coupling of distribution and transmission sectors. It is clear that in the future a significant part of the means to operate the system will be located in the distribution networks.
- Together with assessing a power system's flexibility level by looking into traditional supply-side flexibility sources, the Agency's approach integrates equally demand-side flexibility, grid reinforcements, storage and sector coupling as additional flexibility sources and potential game changers

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Sector Coupling

- The electricity sector is already linked to all other energy sectors. Further expansion is possible and TSOs could fulfil the role of systems integrators, obviously sufficiently liaising with all relevant stakeholders. According to ENTSO-E's vision for the future, namely "One System of Systems", there are three main challenges to cope for sector coupling:
  - Managing and coping with threats to the power system
  - Automation and decision support
  - Complex forecasting
- These three areas do not cover all the challenges TSOs will face in the future, but they are considered as the most important drivers and TSOs have a clear plan to meet the challenges through innovation and cooperation.

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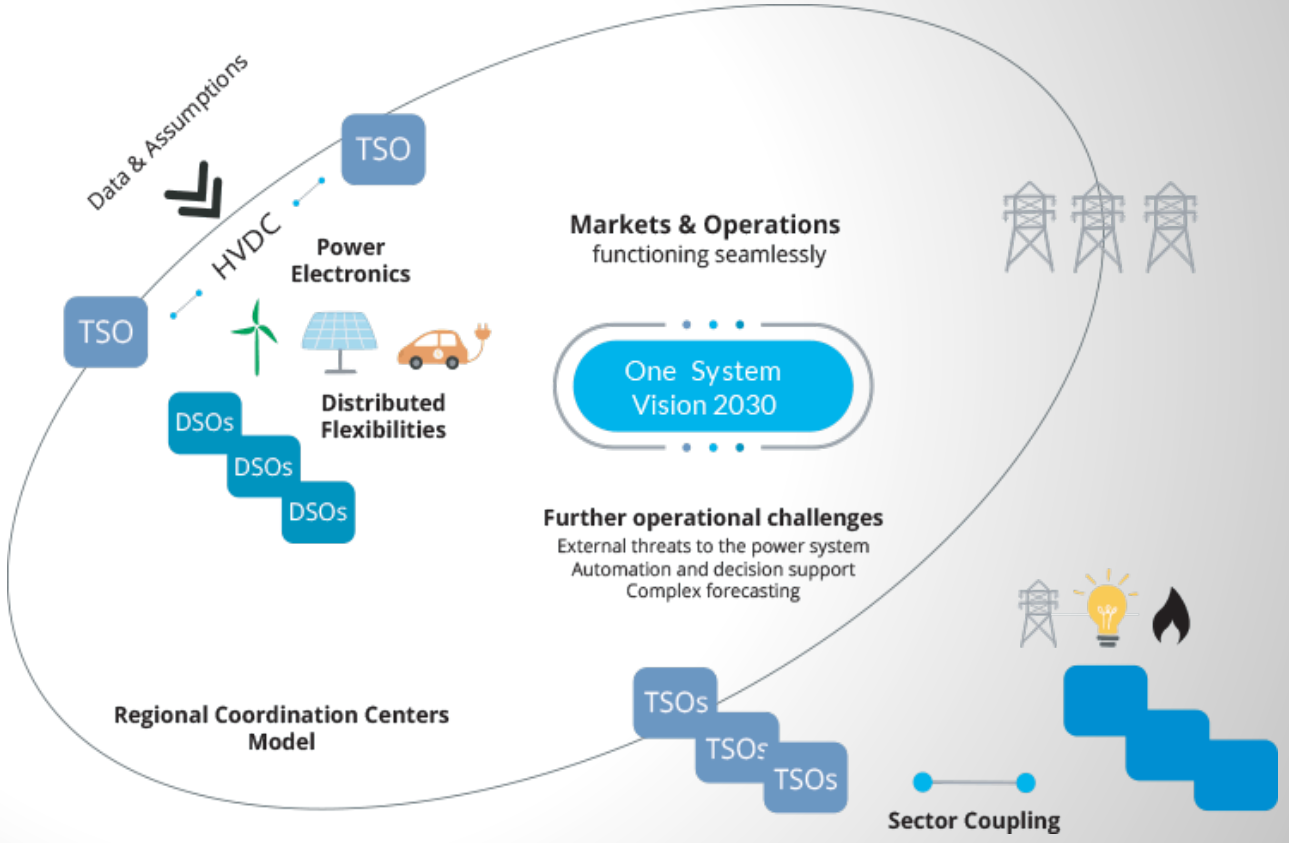
Sector Coupling

ENTSO-E's vision for the future operation of the power system



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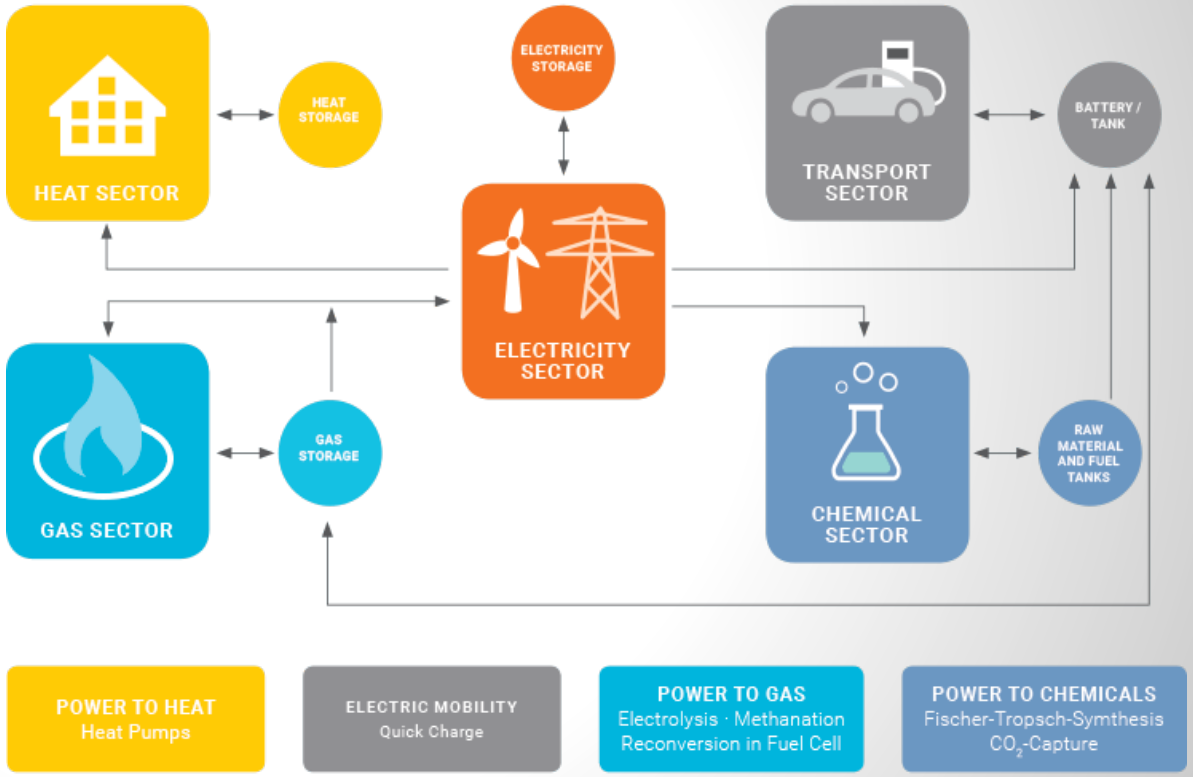
Sector Coupling

Components of Sector Coupling Blueprint



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Relation between TSOs and DSOs

A cross collaboration between TSOs and DSOs is fundamental for electricity sector innovation strategy. To maintain a functional, efficiency and reliable electricity network is important to encourage an active collaboration between TSOs and DSOs for at least the following features:

- Information system upgrading and digitalization with a compatible interface.
- Automatic data exchange mechanisms (e.g. SCADA ICCP link for network management systems)
- Smart meters at transmission – distribution connection points.
- Flexibility: close coordination and strong cooperation of TSOs and DSOs (Ancillary Services from distributed connected resources; distributed generation, power storage and demand side response, etc.) will require a flexible approach from all system operators The initial objective for using DER flexibility resources could be congestion management and its link with balancing, mainly based on coordinated active system management practices.
- Critical infrastructure security: To safeguard the cyber and physical security of the national system

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Relation between TSOs and DSOs

Entity	Main responsibility	Specific duties
National Government	Not relevant in European countries	
National Regulatory Authority	Monitoring, arbitration and allowed revenue setting	- Supervision and disputes resolution. - Incentivise TSO-DSO collaboration in innovation activities. - Implementation and monitoring of innovation regulatory incentives.
Electricity TSO	Operate and upgrade the electricity system in cooperation with DSOs	- Undertake R&D expenditures in cooperation with DSOs: pilot projects

This project is funded by the European Union

Gap Analysis and Recommendations

This project is funded by the European Union

Proposed Innovation Incentive Mechanism for Turkey (1/3)

Feature	Recommendation	Explanation	Justification	Key Stakeholders
R&I KPIs	Development of R&I related KPIs in the relevant legislation	There are already identified research areas and priorities for innovation activities in TEIAS.Specific KPIs for R&D and innovation activities shall be defined and aligned with national energy planning goals. EMRA shall also be allowed to propose KPIs for innovation.	For most of TSOs, the KPIs related to innovation activities are defined both for the entire portfolio of R&D and for each individual projects. Furthermore, ENTSO-E monitors the R&I activities of member TSOs periodically and revisit the KPIs according to the development of needs and technologies.	Government, EMRA TEIAS and R&D institutes.
Funding innovation incentives	Include innovation incentives as part of the allowed OPEX Allowed innovation OPEX will be set by EMRA upon proposal of TEIAS. The amount of allowed R&D OPEX should not be fixed in advance but our recommendation is to target a yearly allowed R&D expenditure around 1% of total revenue.	For each regulatory period, TEIAS shall propose a trajectory for R&D and Innovation expenditures. This trajectory should include indicative values for: • Project description and budget of specific R&D projects. • General R&D expenditure allocated by research area EMRA will assess the proposed budget and accept/reduce the proposed costs to set final allowed revenues. The evaluation criteria are presented in the next points and our recommendations is to evaluate the proposal with external support (e.g. advisors). We recommend targeting a yearly R&D budget of around 2% of total TSO OPEX. (Not explicitly defined as of today) At the end of each regulatory period a financial settlement will take place if some allowed R&D budget has not been spent by TEIAS. Unspent amounts shall be reconciliate in the revenue determination of the next tariff period.	We think OPEX based solutions for funding R&D expenditures are the best alternative. In most countries analysed, innovation incentives are included as allowed OPEX of the TSOs CAPEX based alternatives lead to problems related to RAB and depreciation policy that may be hard to overcome. OPEX based solutions for innovation incentives are the alternative identified as best practice in a recent report of the European Commission (2019). 1% of total revenue for R&D expenditures is an international benchmark (which roughly corresponds to 2% of OPEX)	EMRA and TEIAS

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Proposed Innovation Incentive Mechanism for Turkey (2/3)

Feature	Recommendation	Explanation	Justification	Key Stakeholders
Procurement and project implementation rules	Special treatment to critical innovative projects like exemptions from the regulation	In TEIAS' R&D Directive Type C projects are defined as: Projects undertaken by local and/or foreign natural and legal persons through the tender of consultancy or service under the Public Procurement Law. We recommend to accelerate R&D and innovation activities in TEIAS, Type-C projects can be treated as Type-A and B projects, which will also attract more technology/solution provider and private sector R&D firms for TEIAS projects. Also, the exemption from public procurement rules will encourage TEIAS departments to catalyse new innovation activities, not pursuing a timid approach anymore.	In order to achieve R&D objectives, the need to identify which procurement policies could stimulate R&D activities is crucial. While public procurement rules usually are designed for off-the-shelf products and services without requesting any additional R&D, in the future accelerated technical change and the growing social demand for improved quality will result in more and more innovative solutions. This will invite additional R&D efforts by the suppliers. In such cases "the best value for money" will largely be determined by the extent to which really new innovations become part of the process. This expectation strengthens further the importance of flexible public procurement rules as a key innovation measure.	Public Procurement Institution, Ministry of Finance, TEIAS, EMRA
R&D Project Monitoring Requirements (post-project)	Yearly reporting of R&D expenditures	Each year, TEIAS shall send to EMRA a report presenting: • Status of ongoing R&D projects and investigations: objective, budget, partners, expected output, etc. • Review of finished projects: objective, budget, partners, project results, etc. These reports will help EMRA in two ways: • Monitoring TEIAS R&D expenditures. • Knowledge dissemination. These reports must be published in both TEIAS and EMRA website.	In all countries analyzed, TSOs must comply with reporting obligations related to innovation incentives. Usually innovation reports are publicly available to facilitate knowledge transfer.	EMRA and TEIAS

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Proposed Innovation Incentive Mechanism for Turkey (3/3)

Feature	Recommendation	Explanation	Justification	Key Stakeholders
Public Access to Innovation Process and Projects	The results of the innovation projects can be publicly available to promote transparency.	EMRA should foster dissemination activities of the projects; results, impact and lessons learnt.	It's a common practice to provide public access to the projects that are funded via tariffs: • Dissemination of R&D projects and innovation activities is also a key requirement by the European Commission, especially for projects funded under the Horizon 2020 framework. According to this framework program, grant beneficiaries is required to provide open access to publications and research data stemming out of Horizon 2020-funded projects. Opt-outs are possible in some cases. • Ofgem expect innovation activities and R&D project stakeholders to collaborate with each other on many of the projects supported by the NIA. Moreover, the facilitation of knowledge transfer is of paramount importance of the NIC, mainly due to the fact that customers are funding the relevant work and it is a requirement of the NIC that the learning generated be disseminated as effectively as possible. This way, project stakeholder, and therefore all customers, are able to benefit from the NIC projects and innovation activities. This facilitation is fostered through the Learning Portal. The Learning Portal is an area on the ENA website through which external parties can access the learning generated as a result of innovative Projects.	EMRA, TEIAS
Amendments to Secondary Legislation	In principle the proposed innovation incentive (via OPEX allowance) does not require specific modifications of the legislation. Only Revenue Requirement Methodology must be modified	Revenue Requirement Methodology must be modified to include R&D expenditures in the allowed OPEX. It is recommendable to include also the following aspects: • Eligibility criteria for R&D allowed expenditures. • Evaluation criteria. • Monitoring and reporting obligations of TEIAS.	In most of the countries analysed there is not specific legislation for the innovation incentive. Innovation incentive regulation is included in the overall Revenue Requirement Model regulation.	EMRA

Thank You / Teşekkürler

2 September 2020, EMRA, Ankara