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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

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## Task-3: Incorporating Incentive Mechanism into Tariff Structure to Enhance Innovation Capabilities of Regulated Entities

Activity 3.2 - Incentive Mechanism and Innovation Report  
for Electricity Sectors (Volume II)

Prepared: May 2020





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## Abbreviations

ACER	Agency for the Cooperation of Energy Regulators
ACM	The Netherlands Authority for Consumers and Markets
AMI	Advanced Manufacturing Infrastructure
AMS	Advanced Metering Systems
APL	Acoustic Pipe Locator
ARERA	The Italian Regulatory Authority for Energy, Networks and Environment
ATEX	Equipment for potentially explosive atmospheres
BMWi	Federal Ministry for Economic Affairs and Energy
BOTAS	The Turkish Petroleum Pipeline Company
BRP	Balancing Responsible Parties
BSP	Balancing Services Parties
BTE	Special Low Voltage
BTN	Normal Low Voltage
CAPEX	Capital Expenditures
CBA	Cost-Benefit Analysis
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilization and Storage
CEDEC	The European Federation of Local Energy Companies
CEER	Council of European Energy Regulators
CEF	Connecting Europe Facility
CEN	European Committee for Standardization
CENS	Cost of Energy not Supplied
CEP	Clean Energy Package
CER	Commission for Energy Regulation
CERA	Cyprus Energy Regulatory Authority
CHP	Combined Heat and Power
CI	Customer Interruptions
CML	Customer Minutes Lost
CNG	Compressed Natural Gas
CNMC	The Spanish National Commission on Markets and Competition
CPO	Charging Point Operator
CRE	The French Energy Regulatory Commission
CRU	The Commission for Regulation of Utilities
DDS	Demand Derivation System
DEA	Data Envelopment Analysis
DER	Distributed Energy Resources
DNO	Electricity Distribution Network Operators
DPCR5	The British Distribution Price Control Review 5 (2010-2015)
DSM	Demand Side Management
DSO	Distribution System Operator
DSP	Digital Signal Processing





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DTR	Dynamic Thermal Rating
EA	Energy Authority
EASME	Executive Agency for Small and Medium-sized Enterprises
EBIT	Earnings Before Interest and Taxes
EC	European Commission
EDSO	European Distribution System Operators
EIB	European Investment Bank
ELDER	the Association of Distribution System Operators of Turkey
EML	Electricity Market Law
EMPIR	European Metrology Programme for Innovation and Research
EMRA	Energy Market Regulatory Authority
ENA	The British Energy Networks Association
ENTSO-E	European Network of Transmission System Operators for Electricity
ENTSO-G	European Network of Transmission System Operators for Gas
EnWG	German Energy Industry Act
ERA-NET	The Network of European Funding
ERC	European Research Council
ERDF	The European Regional Development Fund
ERGAR	The European Renewable Gas Registry
ERSE	the Portuguese NRA
ESCO	Energy Service Company
ESS	Energy Storage System
EU	European Union
EUR	Euro
EV	Electric Vehicle
FCA	Financial Conduct Authority
FCO	First Call Operatives
GAZBIR	Natural Gas Distribution Companies Association of Turkey
GB	Great Britain
GDN	Gas Distribution Networks
GERG	The European Gas Research Group
GHG	Greenhouse Gas
GIAG	Gas Innovation Advisory Group
GNI	Gas Networks Ireland
GO	Guarantees of Origin
GoO	Guarantees of Origin
GRDF	Gas Network Distribution France
GRHYD	Management of Networks by Injecting Hydrogen to Decarbonize (French)
GWG2011	German Gas Industry Law
GWh	1 Billion-Watt Hours
HVDC	High Voltage Direct Current
HPP	Hydro Power Plant
ICT	Information and Communication Technology
IFI	Innovation Funding Incentive





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IHD	In-Home Devices
IIS	Interruptions Incentive Scheme
INC	Interoperability Network Code
INEA	Innovation and Network Agency
IPR	Intellectual Property Rights
IRM	Innovation Rollout Mechanism
ISP	Initial Screening Process
IT	Information Technologies
JRC	Joint Research Centre
KPI	Key Performance Indicator
kV	1 thousand volts
LCNF	Low Carbon Network Fund
LCNG	Liquid to Compressed Natural Gas
LNG	Liquified Natural Gas
LV	Low Voltage
MAT	Very High Voltage
MENR	Ministry of Energy and Natural Resources
MT	Medium Voltage
MV	Medium Voltage
MVA	1 million Volt-Ampere
MW	1 million watts
MWh	1 million watt-hours
NCG	Non-condensable Gas
NFR	Norwegian Research Council
NG	Natural Gas
NGG	National Grid Gas
NGGT	National Grid Gas Transmission
NGO	Non-Governmental Organization
NIA	Network Innovation Allowance
NIC	Network Innovation Competition
NPAM	Network Performance Assessment Model
NRA	National Regulatory Authority
NTS	National Transmission System
NVE	Norwegian Water Resources and Energy Directorate
O&M	Operational and Maintenance
OIZ	Organized Industrial Zones
OMS	Outage Management System
OPEX	Operational Expenses
OSOS	Automatic Meter Reading System
P2G	Power-to-Gas
PE	Polyethylene Pipe
PEA	Project Eligibility Assessment
PtG	Power-to-Gas
QoS	Quality of Service





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R&D	Research and Development
R&I	Research and Innovation
RAB	Regulatory Asset Base
RDD	Research, Development & Demonstration
RES	Renewable Energy Source
RIIO	Revenue=Incentive + Innovation + Output
RNG	Renewable Natural Gas
RoR	Rate of Return
RoRE	Return on Regulatory Equity
RQS	Quality of Service Regulation
RRC	Electricity Commercial Relations Regulation-Portugal
RT	Regulatory Targets
RTE	The French TSO in the electricity network
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SET	Strategic Energy Technology
SG	Smart Grid
SGN	Scotia Gas Networks
SME	Small and Medium Sized Enterprises
SNG	Synthetic Natural Gas
SNM	Smart Network Management
SoLR	Supplier of Last Resort
STR	The Second Tier Reward
T&D	Transmission and Distribution
TDI	Transmission & Distribution Interface
TEIAS	Turkish Electricity Transmission Co.
TEK	Norwegian Weighting System for Regional Networks
TEN-T	Trans-European Transport Network
TEYDEB	TechnologyandInnovationFundingProgramsDirectorate
THD	Total Harmonic Distortion
TIGF	Total Infrastructure Gaz France
TIM	TOTEX Incentive Mechanism
TOTEX	Total Expenditure
TPA	Third Party Access
TRL	Turkish Lira
TSO	Transmission System Operator
TTC	Time to Connect
TTQ	Time to Quote
TUBITAK	TheScientificandTechnologicalResearchCouncilofTurkey
UK	United Kingdom
USLA	Norwegian Pay-out for Very Long-term Interruptions
Val	Value of Loss Load
VNF	Virtual Network Function





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WACC	Weighted Average Cost of Capital
WHD	Government's Warm Home Discount
WPD	Western Power Distribution
WWU	Wales & West Utilities





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## 1 Introduction to Entire Report

As part of the Tariff project's Task 3, “*Incorporating Incentive Mechanism into Tariff Structure to Enhance Innovation Capabilities of Regulated Entities in Electricity and Natural Gas Markets*”, one of the deliverables is to review and assess EU and Turkey practices regarding innovation, and deliver a report on the review and recommendations for electricity and natural gas sectors.

The main objective of Task 3.2 report is the elaboration of a comparative desktop analysis, so to assist to the Beneficiary to identify amendment options for secondary legislation.

Task 3.2 report has been organized in 2 separate volumes:

- Volume-I: Incentive Mechanism and Innovation Report for Natural Gas Sectors
- Volume-II: Incentive Mechanism and Innovation Report for Electricity Sectors

The scope of this report (Volume-II<sup>1</sup>) consists of the following elements:

- Electricity Distribution Sector Innovation Report
- Electricity Transmission Sector Innovation Report

Within the individual sections, some practices, adopted by some selected European Countries, were examined in depth to realize a gap analysis with the practices adopted by the beneficiary country and to elaborate the needed recommendations.

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<sup>1</sup> Relevant chapters for Natural Gas Distribution and Transmission are presented in Volume-I.



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## 2 Innovation Funding and Mechanisms in EU

Beginning with a short summary of the EU-specific funding schemes and respective frameworks supposed to foster innovative R&D activities regarding virtually all system-relevant sectors and market segments, the subsequent part of this section does present the status of innovation for the utilities within the European Union.

Within the European Union exist several funding schemes and frameworks, in the context of which innovation and R&D activities for the electricity sector may be supported. Among them, the following programs and funds are the most widely used:

- Horizon 2020 Framework Program,
- Horizon Europe Framework Program,
- ERA-NET Smart Grids Plus,
- ERA-NET Cofound Action Electric Mobility Europe,
- Connecting Europe Facility,
- European Investment Bank,
- InnovFin,
- Life Program,
- NER 300,
- EUROGIA 2020 and
- Innovation Fund

### 2.1 Horizon 2020 Framework Program<sup>2</sup>

Horizon 2020 is the biggest EU Research and Innovation program ever with nearly €80 billion of funding available over 7 years between 2014 and 2020. This EU Research and Innovation program was kicked off back in 2014. The overall funding budget adds up to nearly 80 billion Euro to be provided/ granted within a time period of 7 years for a great deal of sector and/or technology specific calls/projects. The motivation for setting up that program, which has been backed up by all European political leaders and the members of the EU Parliament, is manifold. It is reaching from the general objective to sustainably ensure Europe's global competitiveness in organizational, technological, environmental, regulatory respects and hence support economic growth, a healthy labour market and wealth in the EU, to underlying targets such as fostering inventions and minimize their time-to-market, facilitating cooperation between industrial, public and private sectors, as well as creating a knowledge pool to be alimented and used by all European countries.

Three priorities of the program are excellent science, industrial leadership and societal challenges. Within the scope of societal challenges, €6,339 million was proposed to be funded for smart, green and integrated transport and €3,081 million was proposed to be funded for climate action, environment, resource efficiency and raw materials.

Application stages for the calls are as follows:

<sup>2</sup> <https://ec.europa.eu/programmes/horizon2020/en>



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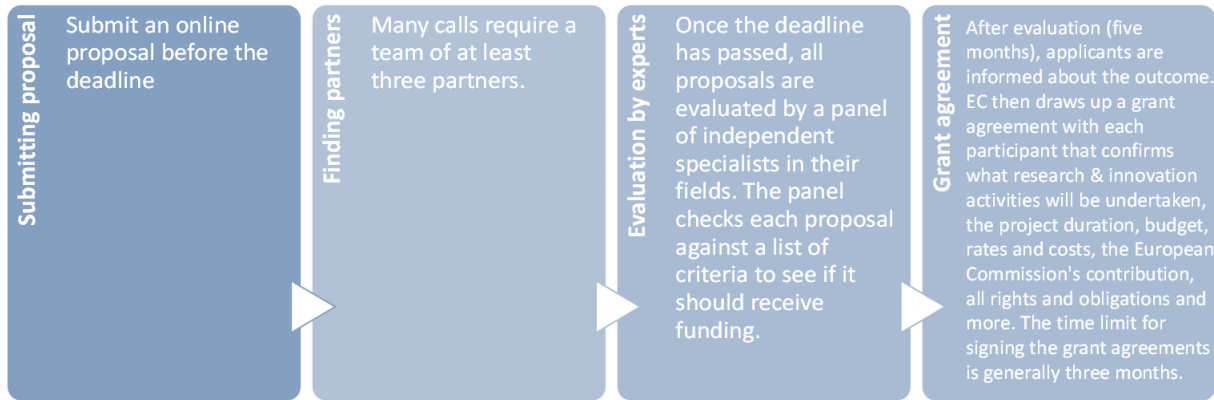


Figure 1: Project Application Procedure

All of the applications to European Commission (EC) are done via the online portal. In order to apply a project, legal entities or real persons shall register themselves and get a PIN number.

EU Commission has determined different support rates for different project types. These project types and support rates are as follows:

- Grants for R&D) Projects: 100%
- Grants for Innovation Projects: 70% (non-profit organizations: 100%)
- Coordination & Support Actions: 100%
- European Research Council (ERC) Projects: 100%
- Marie Skłodowska-Curie Projects: %100 (except Marie Skłodowska-Curie Co-Fund Projects)
- Co-Funding Actions: at most 70%
- SME Instrument: 3 Phased
  - Phase 1: Lump sum - 50.000 €
  - Phase 2: 70%
  - Phase 3: No direct support

Some projects (including companies from Turkey) supported within the scope of Horizon 2020 are as follows:





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Table 1: Horizon 2020 Funded Projects

Project Name	Participant Countries	Participant Company from Turkey	Project Duration	Total Budget/Funding
<b>Smart Cities and Communities solutions integrating energy, transport, ICT sectors through lighthouse (large scale demonstration - first of the kind) projects</b>	Spain, UK, Italy, Germany, Sweden, Turkey	BURSA NILUFER BELEDIYESI HESAP ISLERI MUDURLUGU	2016/02/01 - 2021/01/31	€29,250,563 / €24,965,263
<b>ERA-Net Smart Grids Plus: support deep knowledge sharing between regional and European Smart Grids initiatives</b>	21 EU countries	TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU	2015/01/30 - 2020/01/29	€44,563,055 / €13,511,432
<b>Accelerating CCS technologies as a new low-carbon energy vector</b>	Germany, Switzerland, Romania, Turkey, Norway, UK, Greece	TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU	2016/02/01 - 2021/01/31	€42,831,250 / €12,814,312
<b>Supporting Joint Actions on demonstration and validation of innovative energy solutions</b>	Germany, Switzerland, Sweden, Netherlands, Turkey, Cyprus, UK, Poland, Austria, France	TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU	2016/11/01 - 2021/10/31	€19,670,150 / €5,930,149
<b>European Common Research and Innovation Agendas (ECRIAs) in support of the implementation of the SET Action Plan</b>	Germany, Switzerland, Turkey, Cyprus, UK, Portugal, Austria, France, Spain, Italy, Belgium, Greece	MIDDLE EAST TECHNICAL UNIVERSITY	2017/01/01 - 2020/12/31	€2,858,798 / €2,498,661
<b>Empowering SG Market Actors through Information and Communication Technologies</b>	UK, Greece, Portugal, Denmark, UK, Turkey, Italy	AYDEM ELEKTRIK DAGITIM ANONIM SIRKETI, ELEKTRIK DAGITIM HIZMETLERI DERNEGI BASKANLIGI	2015-01-01 to 2017-12-31	€3,751,891 / €3,072,655





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## 2.2 Horizon Europe Framework Program<sup>3</sup>

The Horizon Europe Framework is expected to become the successor program of/to Horizon 2020. It is designed as a research and innovation program with an overall funding budget of 100 billion EURO. The respective strategic planning process with an initial time horizon of 4 years has been kicked-off by the European Commission as responsible stakeholder and patron of the program. Based on the preliminary structure of the program, which is depicted in Figure 2, the planning process will detail the first phase of the program by scheduling work programs and calls for proposals with the general objectives to widening the participation in the program as well as evolutionarily amending the European R&I system, while the initial specific focus shall be on the challenges belonging to various sectors (see pillar 2 in Figure 2).

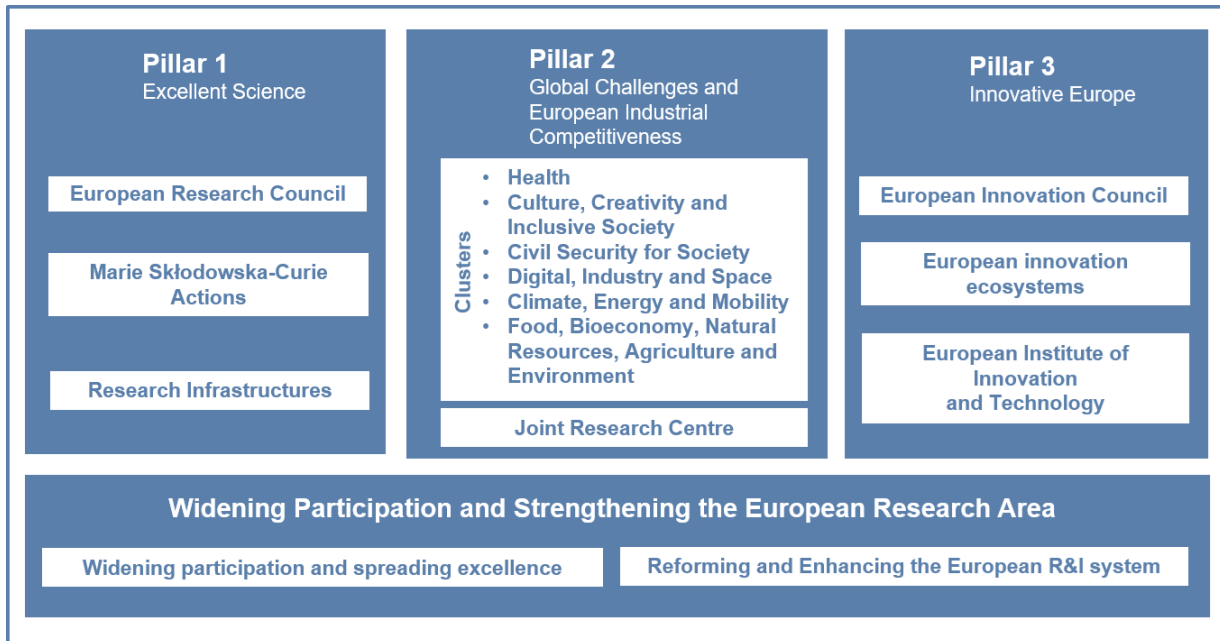


Figure 2: Preliminary Structure of Horizon Europe

## 2.3 ERA-NET Smart Grids Plus<sup>4 5</sup>

ERA-Net Smart Grids Plus is the initiative that aims to support deep knowledge sharing between regional and European Smart Grids initiatives by financing 15-20 transnational projects on applied research, piloting and demonstration in the field of Smart Grids, taking a next step in Smart Grids development building on the knowledge base, R&D initiatives as well as research and demonstration facilities already in place at regional, national and European level. 21 EU Member countries are part of the initiative.

<sup>3</sup> [https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme\\_en](https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en)

<sup>4</sup> Source: <https://www.eranet-smartenergysystems.eu/>

<sup>5</sup> Source: <http://www.tubitak.gov.tr/>





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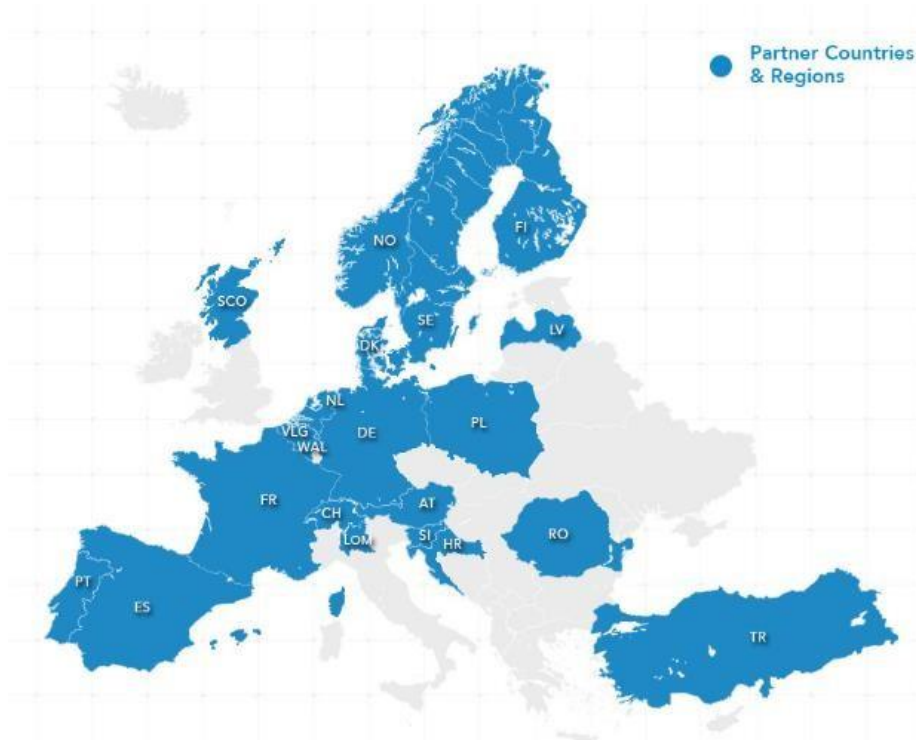


Figure 3: ERA-NET Member Countries and Regions

Representative of ERA-NET in Turkey is TÜBİTAK and companies in Turkey are supported through TEYDEB's 1509-TÜBİTAK International Industry R&D Projects Support Program.

ERA-Net Smart Grids Plus is supported by Horizon 2020 Research and Innovation Program and it;

- is furthering the integration of smart grids system technologies, stakeholder adoption and market processes to help Europe make progress towards achieving its short-term 2020, medium-term 2035 and long-term 2050 energy targets. For such progress cross sectoral and interdisciplinary system innovation is needed,
- promotes applied research, piloting and demonstration in the field of smart grids, with a focus on validation, scaling-up and replication, integrating the layers "technology", "marketplace" and "adoption", aiming at pushing solutions meeting TRL 5-6 to TRL 6-7,
- coordinates national and regional RDD (Research, Development & Demonstration) budgets according to the implementation of the relevant European RDD agendas,
- builds on the already existing, national and regional key pilots, demo projects and facilities as well as the related investments by industry and the public, by facilitating deep knowledge sharing in new transnational RDD projects and taking the next step in Smart Grids development while building on the existing demos,
- organizes both horizontal and vertical learning, where horizontal learning is among Smart Grids RDD projects on the regional/national and transnational level and vertical learning is between these projects and the programming and European initiative level.

The requirements for application include the following:





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- Independent companies from at least two different member countries shall apply together
- Project must be international, and companies shall submit proposals that meet both national/regional funding agencies and ERA-NET Smart Grid Plus Initiative.

Funded projects that includes Turkish companies are listed below:

Table 2: ERA-NET Funded Projects<sup>6</sup>

Project Acronym	Project Name	Participant Countries	Participant Company from Turkey	Project Duration	Total Budget/Funding
<b>Callia - Open Inter-DSO electricity markets for RES integration</b>	Interactions DSO-TSO, cross border DSO coordination, standards, agent-based RES components	Germany, Austria, Turkey, Belgium	Boğaziçi EDAS	01/07/2016 - 31/03/2019	€ 4.891.805 / €3.314.847
<b>EPR</b>	European Pattern Recognition Project	Norway, Turkey, Sweden	EnerjiSA	01/03/2016 - 28/02/2018	€1,600,000 / €1,000,000
<b>GReSBAS</b>	Grid Responsive Society Through Building Automation Systems	Turkey, Portugal	İTÜ, Makel Companies Group	01/04/2016 - 01/04/2019	€665,058 / €570,587
<b>MIDAS</b>	Distribution Automation, Renewable Energy, Forecasting, Volt/VAr/Demand Control, Distributed Resource Integration, ICT	Turkey, Austria, Sweden	T4E Energy and Automation Technologies Ltd.Co., Akdeniz EDAS	01/02/2016 - 30/06/2018	€ 1,187,076 / €712,245
<b>Smart MLA</b>	Multi-Layer Aggregator Solutions to Facilitate Optimum Demand Response and Grid Flexibility	Turkey, Denmark, Sweden, Romania, Norway	EPRA (Coordinator), AKEDAS DSO	01/11/2019- 31/10/2021	€2,012,359 / €1,398,449
<b>SIES 2022</b>	Smart Integrated Energy Systems 2022: Enhanced Virtual Power Plant VPP+ EnergyPool Integration for Local and Regional Resilience	Scotland, Spain, Turkey	TUBITAK	-	-

<sup>6</sup> Source: <http://www.eranet-smartgridplus.eu/research-calls/1st-joint-call-2015/>





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In 2019 a Joint Call 2019 ("MICall19") was announced for transnational Research, Development and Innovation projects on integrated energy storage solutions. The total available budget is above €22 million, and the Joint Call 2019 has been launched on 18 September 2019.

## 2.4 ERA-NET Cofund Action Electric Mobility Europe (EMEurope)<sup>7</sup>

Building on the achievements, experiences, networks and results of the ERA-NET Plus initiative Electromobility+, 19 European national and regional government-related organizations with a strong interest in electric mobility set up an ERA-NET Cofund to further advance electric mobility in Europe: the Electric Mobility Europe. This initiative is designed to take transnational e-mobility research and policy exchange towards deployable solutions.

EMEurope funds research and innovation projects focusing on the application and implementation of e-mobility with the objective of advancing the mainstreaming of the electrification of mobility in European urban and suburban areas. It aims at the achievement of a stronger alignment of strategy and policy among the relevant stakeholders and provides a platform for cooperation and exchange of information and experiences between the governmental organizations of the participating countries while also involving regions and other stakeholders.

On 2 November 2016, the initiative launched a transnational call for Research and Innovation project proposals addressing system integration (transport, (sub)urban areas), urban freight and city logistics, smart mobility concepts and ICT applications, public transport and consumer behaviour and societal trends. Participating countries has been Turkey, Germany, Austria, Belarus, Denmark, the Netherlands, Spain, Israel, Poland, Sweden, Hungary and Italy. Participation conditions were announced as follows:

- At least 3 partners from at least 3 countries/regions shall apply as a consortium,
- Total share of the 2 participating companies cannot exceed 85% of the project budget,
- At most 70% of the project budget can be delegated to a country.

In 2018 a total of 13 research and innovation projects representing all key areas selected for this call started executing their proposed activities. Co-funded by the European Commission around €17 million were provided for these projects.

## 2.5 Connecting Europe Facility (CEF)<sup>8</sup>

The Connecting Europe Facility (CEF) represents an EU funding instrument used to financially support (by granting project funding, project bonds and/or other guaranties) the evolutionary further development of interconnected European networks in the areas of energy, transport and IT/telecommunication with the general aim to maintain and continuously improve their availability, stability, performance and efficiency. Consequently, CEF is principally available for the three sectors Energy, Transport and Telecom, whereof the respective circumstances regarding CEF Energy are addressed in the following in more detail due to their potential relevance for the electricity sector.

Virtually all programs and projects supported by CEF are granted and managed by the Innovation and Network Agency (INEA), which is acting since January 2014 as successor of the Trans-European Transport Network Executive Agency (TEN-T EA). As far as the CEF Energy is concerned, INEA is responsible<sup>7</sup> for deploying the respective commercial instruments and funding as well as for efficiently managing the technical & financial implementation of

<sup>7</sup> Source: <https://www.electricmobilityeurope.eu/>

<sup>8</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility>





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its TEN-T programs/projects, which are supposed to prepare the European energy infrastructure for future requirements. Dealing with an increasing energy demand, fostering the energy transition towards renewable energy sources, striving to improve the synergies not only between different segments of the energy sector (electricity, gas, heat supply) but also with the other sectors transport & telecom, facilitating cross-country interaction between industries, public administrations and private sectors, are only a few examples for the various challenges, which the aging European energy infrastructures are confronted with.

The upgrading of existing, and development of new energy transmission infrastructures of European importance will require investments of about €140 billion in electricity. A budget of 5.35 billion EURO has been made available for energy related infrastructure projects, (whereof an amount of approximately 4.6 billion EURO has been granted by INEA thru CEF Energy).

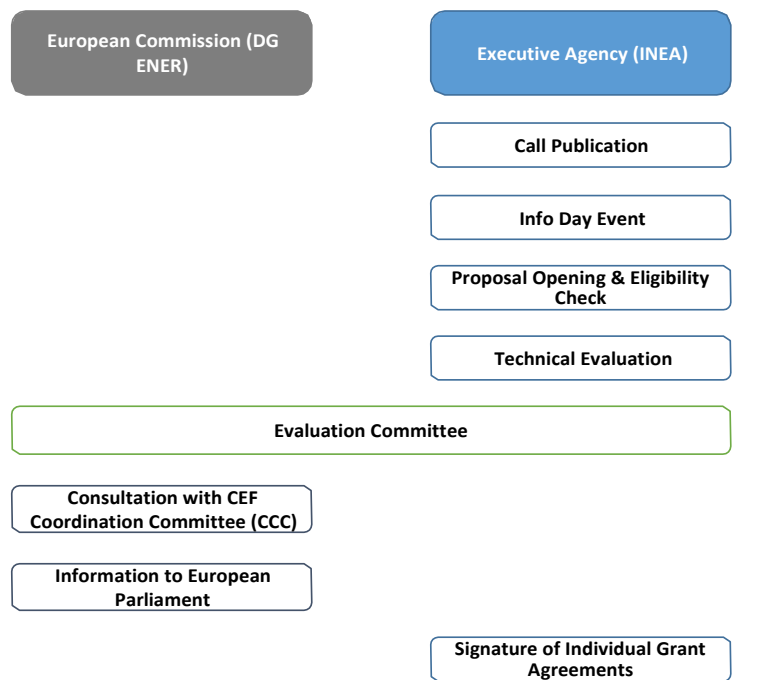


Figure 4: Call Process for Proposals

## 2.6 European Investment Bank (EIB)<sup>9</sup>

The European Investment Bank is the lending arm of the European Union and is one of the largest providers of climate finance. The EIB Group has two parts that are the European Investment Bank and the European Investment Fund. The EIF specializes in finance for small businesses and mid-caps. Although 90% of its activities are focused in Europe, it also supports EU’s external development policies. Some of the projects financed by EIB are as follows:

<sup>9</sup> Source: <https://www.eib.org/>





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Table 3: Some Projects Financed by EIB

Project	Country	Signature Date	Amount Financed
PPC HIGH VOLTAGE SUBSTATIONS & SMART METERING	Greece	21/12/2016	€40,000,000
BELFIUS SMART CITIES CLIMATE & CIRCULAR ECONOMY	Belgium	05/12/2016	€7,000,000
ITALGAS GAS SMART METERING	Italy	29/11/2016	€300,000,000
CALVIN Smart Metering Installation	UK	08/06/2016	€51,891,144
2I RETE GAS Smart Meters	Italy	18/12/2015	€200,000,000
Smart Meters- PROJECT SPARK	UK	02/12/2015	€477,774,076
Smart Meters - PROJECT SPARK	UK	02/12/2015	€35,415,781
IBERDROLA Network Modernization and Smart Meters	Spain	25/06/2015	€325,000,000
GRDF- Gas Smart Meters	France	06/10/2014	€200,000,000
FORTUM WTE and Smart Meters	Finland	21/03/2011	€54,000,000
FORTUM WTE and Smart Meters	Sweden	21/03/2011	€66,000,000

## 2.7 InnovFin<sup>10</sup>

Many potentially revolutionary or evolutionary innovations of products, components, processes, services, etc. are not supported by profit-oriented companies due to the fact/perception that a reasonable return on investment is not deemed as secured. In order to mitigate the respective commercial risks for involved stakeholders, the European Bank (EIB) is providing (under the umbrella of the InnovFin program) loans and/or respective guarantees and/or asset-related financing for innovative demonstration projects belonging to the energy sector. The respective financing instruments are potentially granted to small and medium sized enterprises (SME), large companies and research institutions, provided that the proposed project complies with certain pre-requisites in terms of:

- **Scope:** Related to energy transition towards eco-friendly, resources-preserving and efficient generation, transmission and distribution systems; (respective keywords: renewables, SmartGen/SmartGrid, storage components, etc.)! Expected results: demonstration of technical & commercial viability.

<sup>10</sup> <https://www.eib.org/en/products/blending/innovfin/index.htm>





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- **Innovativeness:** Specific technology, process, products, services or combination of those shall be innovative or new to the market, respectively. The innovative aspect may consist of the innovative combination or innovative application of existing technologies.
- **Readiness for demonstration at scale:** Project components to be developed/implemented shall be at pre-commercial level or early commercialisation stages and the viability of their market introduction shall be assessable by ascertaining a sufficient maturity level for final demonstration at the proposed commercial scale.
- **Bankability:** Providing evidence regarding the prospects of satisfactory project performance and agreed loan repayment.
- **Commitment:** Promoters, sponsors and/or operators must be willing to substantially co-fund the project.
- **Replicability:** Potential to be replicated elsewhere with convincing market opportunities and prospects for future cost reductions.

## 2.8 LIFE Program<sup>11</sup>

The LIFE program with a budget of 3.4 billion EURO expected to be allocated within the funding period 2014-2020 to activities and projects related to the EU environment and climate action created in 1992. The most recent LIFE multiannual work program for the years 2018-2020 details the funding priorities by specifying what kind of projects may be supported in the frame of the sub-programs for environment and climate action. As per the available information, an amount of 243.81 million EURO is allocated for works on nature conservation and environmental protection, and further 413.25 million EURO for climate action.

The program is managed by the European Commission through its services Directorate-General for Environment and Directorate-General for Climate Action and its Executive Agency for Small and Medium-sized Enterprises (EASME). The general objectives of the current LIFE program can be summarized as follows:

- Help move towards a resource-efficient, low carbon and climate resilient economy, improve the quality of the environment and halt and reverse biodiversity loss,
- Improve the development, implementation and enforcement of EU environmental and climate policy and legislation, and act as a catalyst for, and promote, the mainstreaming of environmental and climate objectives into other policies and practices,
- Support better environmental and climate governance at all levels, including better involvement of civil society, NGOs and local actors,
- Support the implementation of the 7th environmental action plan.

## 2.9 NER 300<sup>12</sup>

NER 300 is a funding program pooling together about €2 billion for innovative low-carbon technology, focusing on the demonstration of environmentally safe Carbon Capture and Storage (CCS) and innovative renewable energy technologies on a commercial scale within the EU. Under the first call for proposals in 2012, the European Commission awarded grants totalling €1.1 billion to 20 renewable energy projects. Under the second call for

<sup>11</sup> <https://ec.europa.eu/easme/en/life>

<sup>12</sup> Source: [https://ec.europa.eu/clima/policies/innovation-fund/ner300\\_en](https://ec.europa.eu/clima/policies/innovation-fund/ner300_en)





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proposals in 2014, the European Commission awarded a total of €1 billion in funding to 18 renewable energy projects and one CCS project. Further NER 300 calls for proposals are not planned. The Commission now focuses on the projects already selected for funding and on preparing the first call under the new Innovation Fund.

Due to the challenging global and EU economic environment, some of the 20 projects found it difficult to raise sufficient equity or to attract additional financial support and had to be withdrawn. The unspent funds, amounting currently to some €623 million, are reinvested through existing EU financial instruments managed by the European Investment Bank: InnovFin Energy Demo Projects (EDP) and Connecting Europe Facility (CEF) Debt Instrument.

The InnovFin EDP can finance projects in innovative renewable energy, CCS, smart energy systems and storage. Support is provided to eligible projects on a first come, first served basis. On the other hand, the CEF Debt Instrument can finance innovative projects using renewable energy in the transport sector such as clean vehicles, fuels, charging infrastructure or transport networks.

## 2.10 EUROGIA2020<sup>13</sup>

EUROGIA2020 is a bottom-up, industry driven, market-oriented program which addresses all areas of the energy mix, from renewable energy to efficiency, energy storage and reduction of carbon footprint of fossil fuels. It is supported by 20 countries. The application process for a Eurogia2020 project has two stages:

- Submit a Project Outline: The first phase is to complete and submit a Project Outline. The project coordinator is invited to present it through an oral presentation in front of the Technical Committee.
- A Full Project Proposal: In the second phase, the applicants are invited to fill in and submit a Full Project Proposal. Following the evaluation, the Technical Committee gives its recommendations to the EUROGIA Board, who in turn will decide to label the project. With this label, project participants can apply for funding in their respective countries.

Projects' participants must be organizations from the EUREKA Member and Associated Countries that are Austria, Canada, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Iceland, Israel, Monaco, Netherlands, Norway, Poland, Portugal, Spain, South Africa, Turkey and the UK in collaboration with other EUREKA Member Countries.

As a consortium of partners, participants submit a project proposal to EUROGIA2020 for technical evaluation. The consortium must comprise at least two industrial companies - Large, Small or Medium sized enterprises - from two different EUREKA member and associated countries. The active participation of research institutes or universities is strongly encouraged when not made mandatory. EUROGIA2020 projects must clearly show technical innovation in the future product/process or service (either through using new devices or in the utilization of existing devices in a new application) and the project must have a strong market and exploitation orientation.

The contribution from any given country must not exceed 66% of the total budget. In parallel, the contribution from any one partner (affiliated organizations count as one partner) must not exceed 66% of the total budget either.

As for Turkey, all eligible costs of Turkish participants of EUREKA partners are provided to companies as a grant throughout project duration. (For SMEs 75%, for LEs 65 % of total cost are granted through TEYDEB (Technology and Innovation Funding Programs Directorate) 1509 Program). Only Turkish companies with foreign partners from

<sup>13</sup> Source: <http://www.eurogia.com/>





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EUREKA member countries can apply for this program. There is no specific application deadline or cut-off date for project applications.

## 2.11 Innovation Fund

The Innovation Fund<sup>14</sup> is one of the world’s largest funding programmes for demonstration of innovative low-carbon technologies.

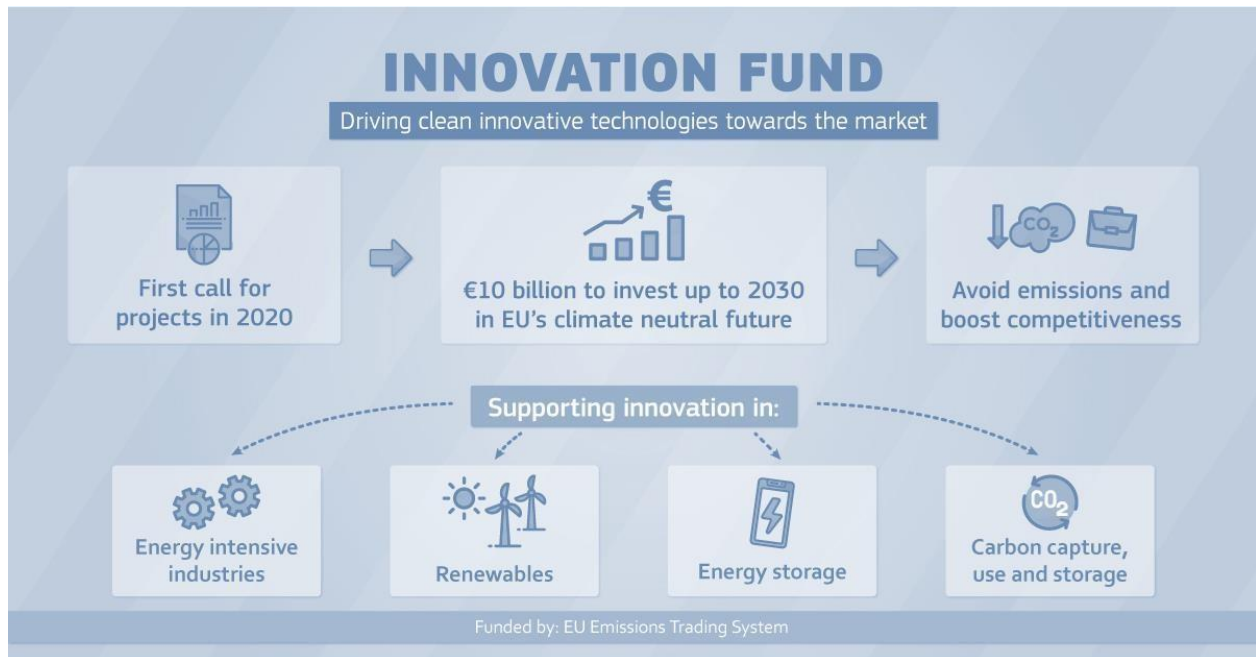


Figure 5: Innovation Fund

The Innovation Fund as one of the world’s largest funding programs for supporting demonstration projects, in the frame of which innovative technological concepts & processes shall be invented and implemented/ deployed, with the general objectives to replace carbon intensive generation plants & production lines by low-carbon technologies or to optimally deal with currently indispensable carbon-based installations, respectively. Important drivers in this respect are e.g. the intelligent planning, integration and usage of renewable energy generation resources, incentive-oriented concepts and innovative components regarding carbon capture, storage, usage and emission trading, or the adoption of smart energy storage concepts/components.

Further information concerning the detailed objectives and technical focus of Innovation Fund, as well as summaries as to how organizations can be applying for project funding under the program, what the selection process and financial conditions look like and which requirements are to be complied with during project implementation, may be looked up on the respective website<sup>15</sup>.

The Innovation Fund support up to 60% of the additional capital and operational costs linked to innovation.

<sup>14</sup> [https://ec.europa.eu/clima/policies/innovation-fund\\_en](https://ec.europa.eu/clima/policies/innovation-fund_en)

<sup>15</sup> [https://ec.europa.eu/clima/policies/innovation-fund\\_en](https://ec.europa.eu/clima/policies/innovation-fund_en)





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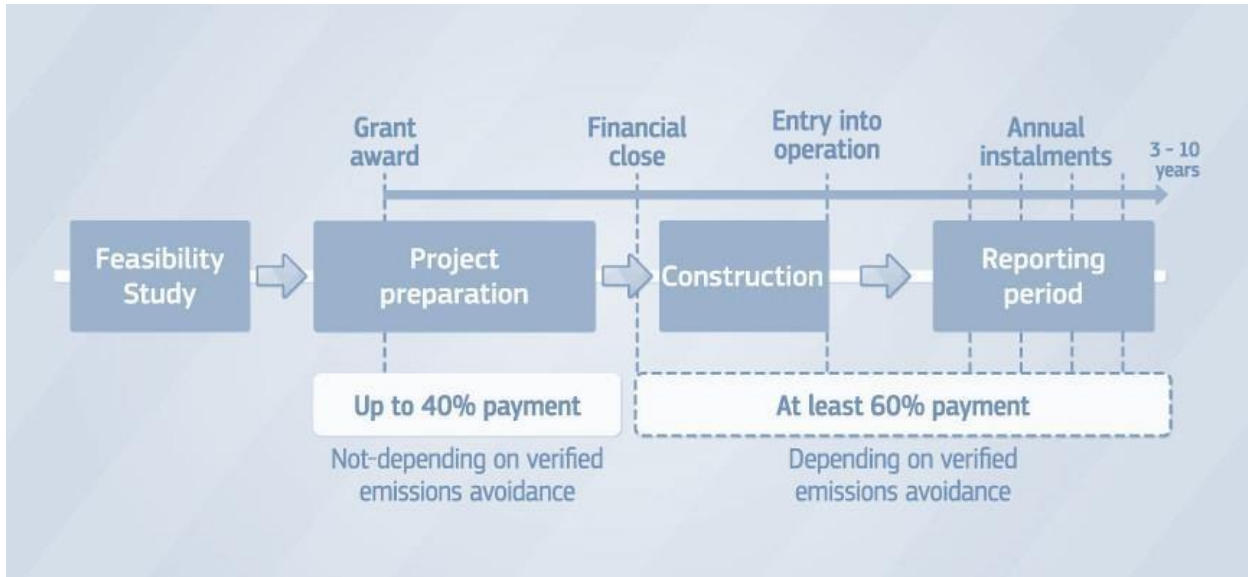


Figure 6: Grant Financing

The grants will be disbursed in a flexible way based on project needs, taking into account the milestones achieved during the project lifetime. Up to 40% of the grants can be given based on pre-defined milestones before the whole project is fully up and running.

### Stakeholder Workshops

As part of the preparation of the first call for proposals under the Innovation Fund, the Commission has invited sector associations and Member States to organise sectoral workshops. In these workshops, the Commission presents the Innovation Fund and the essential elements to be developed for the first call for proposals in 2020, while companies can come forward with their project ideas and to discuss key sector-specific issues.

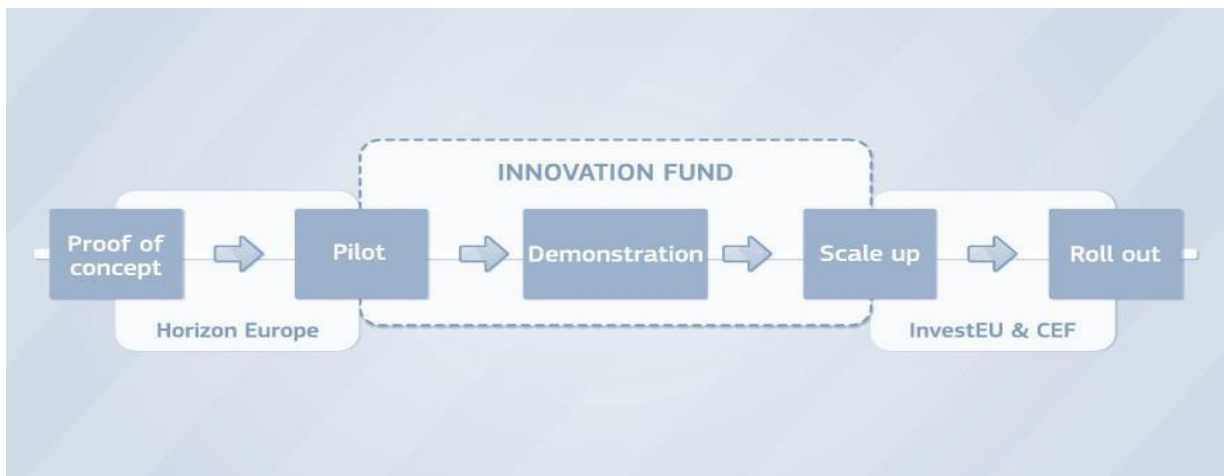


Figure 7: Innovation Fund Structure





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### 3 Electricity Distribution Sector Report

#### 3.1 Introduction of Electricity Distribution Part

Electricity distribution companies worldwide undergo a significant shift from their traditional role of being solely network operator towards the more active role of providing innovative services to their customers, as well as to foster energy market participation. The primary responsibility of Distribution System Operators (DSOs) is to distribute electricity to their consumers in an efficient and safe manner. To achieve this task, the existence of secure and reliable networks is of primary importance.

It is therefore evident that in order for DSOs to face effectively the challenges from the undergoing transformation of the grids, the development of a smart grid equipped with technologies, such as enhanced automation systems for real-time information, monitoring and control mechanisms, as well as other systems are needed.

There is an increasing need for innovation by DSOs to contribute to long-term efficiency and performance of the distribution networks; as well getting ready for future business and market models. Innovation activities and smart grids will create benefits for end-users (increase renewable hosting capacity, EV, etc.), however the major investment has to be realized by DSOs. DSOs will be responsible for the deployment of smart grids, contributing to the development of smart energy systems. This requires increasingly innovative solutions, which should be stimulated by regulatory frameworks.

To achieve the aforementioned goals, research and development (R&D) projects and innovation activities arise more as a necessity rather than a luxury for the DSOs. Therefore, promoting funds for R&D and providing regulatory incentives to support new technologies needs to be of high on the priority list of the National Regulatory Authorities (NRAs) by ensuring that sufficient investments in distribution network take place to meet the challenges of the current and future rules of DSOs.

In this chapter we present several regulatory approaches in incentivizing innovation activities of electricity DSOs. The most common practice applied by European countries is to include a special allowance in the revenue cap linked to innovation and R&D costs. We have compared best practices in use paying special attention to overarching principles, eligibility criteria of R&D allowed expenditures, evaluation and monitoring obligations. We outline the roles and responsibilities of each key stakeholder for the most critical areas of innovation in the electricity transmission sector. Based on international best practices and taking into consideration the current situation in Turkey we develop a set of recommendations to be considered by EMRA in the design and implementation of the innovation regulatory support mechanisms.

#### 3.2 International Benchmarks

This section serves as a benchmark on international practices related to regulations and tariff methodologies for innovation activities in the electricity distribution sector. The following countries are considered in the analysis:

- United Kingdom,
- Italy,
- France,
- Norway,





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- Portugal,
- Netherlands and
- Finland.

### 3.2.1 United Kingdom

RIIO (Revenue = Incentives + Innovation + Outputs) model is used for network regulation companies in UK for setting price controls. The mechanism is based on a performance-based approach where revenues and investments are linked to different output targets. The regulatory period consists of 8 years from 1 April 2015 to 31 March 2023 and includes provision for a mid-period review of the outputs that companies are required to deliver.

Innovation is a key element within this model and the RIIO framework provides strong incentives for Network Licensees to innovate as part of normal business. Alongside the TOTEX Incentive Mechanism (TIM), there are specific RIIO schemes that encourage DNOs to use innovation in the transition to a low carbon economy. As part of the RIIO price controls Ofgem introduced a Network Innovation Stimulus, where there are two main schemes: Network Innovation Allowance (NIA), and Network Innovation Competition (NIC).

Ofgem has played a central role in fostering innovation within the energy sector and turning the benefits of innovation into business-as-usual practice. In addition, Ofgem introduced the concept of Regulatory Sandbox in the energy in 2017 to enable innovative testing of new technologies, goods, services and business models in favour of consumers in a real environment; during the testing period, the regulator can grant waivers to some of existing regulations. The implementation of experiments based on this concept has become of great interest at European and worldwide level, as it is seen as a tool to accelerate the ongoing energy transition.

#### 3.2.1.1 Innovation Stimulus Package

Ofgem have introduced the stimulus package in order to provide an additional incentive to companies and to facilitate innovation as part of business as usual. The innovation stimulus comprises of three components:

##### 3.2.1.1.1 The Network Innovation Competition (NIC)

The NICs are designed to stimulate innovation by network operators. NIC is primarily focused on funding large scale, complex innovative projects, however there is no restriction on the size. All types of innovation, including commercial, operational and technical are eligible for funding so long as the project has the potential to deliver benefits to network consumers.

Electricity network companies compete between themselves for funding for the development and demonstration of new technologies, operating and commercial arrangements in annual basis. For NIC projects, network companies submit and deliver projects in partnership with the wider energy industry, such as energy suppliers, universities or technology providers. The final decision about which projects are rewarded funding is made by Ofgem, supported by independent expert panels.

Up to £90 million (€107.4 million) per annum is available across electricity distribution and transmission. Close to £500 million (€596.7 million) of funding has been awarded since 2010.

Funding is recovered through the price control and by network tariffs. Since the learning from projects is valuable to all UK consumers, each consumer pays an equal share and it is not a loan.





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Each successful project must meet specific criteria to ensure it benefits network consumers. These specific criteria are that a project must:

- Generate new knowledge that can be shared among all network operators.
- Be cost-effective and provide value for money to network customers.
- Accelerate the move to a low carbon energy sector and/or deliver environmental benefits, and potentially bring net financial benefits to network customers now and in the future.

Each submission must also demonstrate that the project:

- Is innovative.
- Is robust and ready to implement.
- Involves appropriate partners and external funding.
- Is relevant and timely.

Some project examples in 2018 are as follows:

Project	Black Start from Distributed Energy Resources (DER)	Charge	Optimise Prime
Company Name	National Grid Electricity Transmission (Electricity System Operator)	SP Manweb Plc (SP Energy Networks)	London Power Networks Plc (UKPN)
The Concept	Trialling the organisational, commercial and technical arrangements required to deliver black start services from DER.	Overlaying transport planning and network mapping to give visibility of network capacity for electric vehicle (EV) charging points, including conducting trials of on street residential and destination charging in preparation for the delivery of flexible connections.	Conducting trials and gathering data on the charging patterns of different commercial electric vehicle (EV) fleets and their network impact.
NIC Funding Awarded	£10.27 m	£6.85m	£16.40m
Additional Company Contribution / External Funding	£879.6k from NGET with additional funding of £411.9k from project partners.	£1.022m from SP Manweb with additional funding of £571k from project partners.	£1.85m from LPN with additional funding of 16.24m from project partners.
Period of Project	3 years, 4 months	3 years	3 years
Aim of the Project	<ul style="list-style-type: none"> <li>• develop and demonstrate the ability of DER to restart an electricity system following blackout</li> <li>• develop and demonstrate the coordination and control solutions, including restoration times and defines roles and responsibilities for black start services from DER</li> <li>• develop and demonstrate the procurement and regulatory frameworks required to deliver black start from DER.</li> </ul>	<ul style="list-style-type: none"> <li>• produce a geographic plot of the location of likely charge points and network headroom down to EHV</li> <li>• define the solutions to enable lower cost connections for destination and on-street residential charging</li> <li>• produce an interactive software tool for customers, to display network headroom down to LV and connection cost estimates.</li> </ul>	<ul style="list-style-type: none"> <li>• develop and demonstrate smart demand response for commercial EV charging on domestic connections, depot energy optimisation and planning tools for profiled connections, and gather data on the mixed charging and journeys of electric private-hire vehicles</li> <li>• gather and analyse data from trials on Hitachi common platform to determine alternative solutions to unnecessary reinforcement as a result of commercial EV charging.</li> </ul>





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Figure 8: Example Projects in Electricity Distribution Sector in 2018<sup>16</sup>

### 3.2.1.1.2 The Network Innovation Allowance (NIA)<sup>17</sup>

The purpose of the NIA is to provide a consistent level of funding to Network Licensees to allow them to carry out smaller innovative projects. Unlike the NIC, where companies compete for funding, the NIA is a set allowance that each network company receives as part of their price control allowance. Network companies submit their innovation strategy to Ofgem alongside their business plans at the beginning of RIIO-ED1. The NIA is set based on the quality and content of the innovation strategy. It aims to fund small-scale innovation projects and companies are required to publish their Project Registration Information and regular updates on all projects on the ENA portal: Smarter Networks Portal.

Value of the NIA awarded to each DSO defaults to 0.5% of allowed revenues, unless companies excel in demonstrating a well thought through innovation plan and then it is up to a maximum size 1% of allowed revenue.

The allowance provides limited funding to network companies to use for two purposes:

- Fund smaller technical, commercial or operational projects directly related to the network companies that have the potential to deliver financial benefits to the network company and its customers; and or
- Fund the preparation of submissions to the NIC.

Limited funding is provided to Network Licensees that meet the criteria set out in the Governance Document. The amount of funding available to each Network Licensee under the NIA can be calculated using the formula in the NIA License Condition. In 2017-18, the DSOs registered 197 NIA projects worth £21.9m (83% of annual allowances), an increase on last year's £20.3m (65% of annual allowances). If successful, these projects will bring a variety of financial, operational, environmental and safety benefits.

An important feature of the NIA is the requirement that learning gained through Projects is disseminated in order that Customers gain satisfactory return on their funding through the broad roll-out of successful Projects and the network cost savings. Even where Projects are deemed unsuccessful, Network Licensees will gain valuable knowledge that could result in future network cost savings. In this regard, Network Licensees shall work collaboratively to maintain a Collaboration and Learning Portal for this purpose at all times. This portal shall be kept updated. From 30 September 2017, Network Licensees must also have in place a publicly available data sharing policy setting out the terms on which data will be provided.

The sets of Specific Requirements that a Project must meet in order to qualify as a NIA Project are as follows:

<sup>16</sup> Source: OFGEM, 2018 NIC Projects, Making Britain's Energy Networks Better

<sup>17</sup> Source: OFGEM, 18 July 2017, Electricity Network Innovation Allowance Governance Document





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Specific Set of Requirements 1	Specific Set of Requirements 2
<ul style="list-style-type: none"> <li>• NIA Project must have the potential to have a Direct Impact on a Network Licensee’s network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following:               <ul style="list-style-type: none"> <li>• A specific piece of new (ie unproven in GB, or where a Method has been trialed outside GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and software);</li> <li>• A specific novel arrangement or application of existing electricity transmission and/or electricity distribution equipment (including control and/or communications systems and/or software);</li> <li>• A specific novel operational practice directly related to the operation of the GB Transmission System and/or the GB Distribution System; or</li> <li>• A specific novel commercial arrangement.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• A NIA Project must also meet the following requirements:               <ul style="list-style-type: none"> <li>• Has the potential to develop learning that can be applied by Relevant Network Licensees</li> <li>• Has the potential to deliver net financial benefits to network Customers.</li> <li>• Is innovative (ie not business as usual) and has an unproven business case where the risks warrant a limited Research, Development or Demonstration Project to demonstrate its effectiveness</li> <li>• Does not lead to unnecessary duplication (other IFI, LCN Fund, NIA or NIC projects already registered, being carried out, or completed)</li> </ul> </li> </ul>

Figure 9: Specific Set of Requirements for NIA Projects

Documents required during the registration period are:

- **Project Eligibility Assessment (PEA)**, demonstrating that abovementioned specific set of requirements are met and why the Funding Licensee is not implementing the Project as part of its normal business activity. This assessment should be signed by the senior person responsible for implementing NIA Projects and published on the Project Registration Page of the Learning Portal.
- **Project Benefits Guide**, which is developed and maintained by the Network Licensees together for converting different types of benefit into financial terms.

The process for registration of projects is as follows:

- In order for a Project to be eligible for funding, it must be registered on the Learning Portal. The Funding Licensee must notify Ofgem by sending an email each time it registers a Project.
- For the avoidance of doubt, there should only be one Project Registration Page for each Project, even where there are multiple Funding Licensees and only one email is required to be sent to Ofgem. However, all Funding Licensees are responsible for ensuring they comply with this Governance Document.
- The Registration process does not generally involve Ofgem approving Projects except following two circumstances; where the Network Licensee is requesting an exemption from the default conditions for IPR or Electricity Network Innovation Allowance Governance Document and the Network Licensee intends to make payments to itself or to Related Undertakings. In these cases, network operator makes a written submission to Ofgem before the Network Licensee registers the project.
- Ofgem review the submission and only provides approval where it considers that a satisfactory justification has been supplied.





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- Ofgem undertake this review and respond to the request within 20 working days of receipt of the submission. If, during the 20 working day evaluation period following the submission of the request, Ofgem considers that additional information will be needed to assess whether approval should be given then in these circumstances the Authority may extend the deadline for its decision by up to 20 working days, from the day when the further information was provided.
- If the Network Licensee is not seeking approval to register a project for one of the reasons identified, the Project will be registered when the Network Licensee publishes information required for the Registration of NIA Projects on the Learning Portal.
- A project can be registered at any time during the relevant year. Projects must start in the same Relevant Year in which they are registered, except where Registration has taken place within 20 Working Days of the end of the Relevant Year, in which case the Project may start in that Relevant Year or in the subsequent Relevant Year.
- Projects must not be started until registration has taken place and Ofgem has been notified. Where the Network Licensee has sought permission from Ofgem to register a project, it cannot be started until the Network Licensee has received permission from Ofgem to register the Project.

Table 4: Information Required for the Registration of NIA Projects

Information required	Description
<b>Project title</b>	
<b>Funding Licensee(s)</b>	The Network Licensee(s) which register(s) the Project and recover(s) the Allowable NIA Expenditure from Customers.
<b>Eligibility</b>	This section should explain why the Project meets the Specific Requirements
<b>Problem(s)</b>	This section should outline the Problem(s) which is being addressed by the Project.
<b>Method(s)</b>	This section should set out the Method(s) that will be used in order to solve or investigate the Problem. The type of Method should be identified where possible, e.g. technical or commercial.
<b>Scope and Objectives</b>	The scope and objectives of the Project should be clearly defined including the benefits (e.g. financial, environmental, etc.) which would directly accrue to the GB Transmission System/GB Distribution System.
<b>Success criteria</b>	Details of how the Funding Licensee will evaluate whether the Project has been successful.
<b>Project Partners and external funding</b>	Details of actual or potential Project Partners and External Funding support as appropriate
<b>Potential for new learning</b>	Details of what the parties expect to learn and how the learning will be disseminated.
<b>Scale of Project</b>	The Funding Licensee should justify the scale of the Project - including the scale of the investment relative to the potential benefits. In particular, it should explain why there would be less potential for new learning if the Project were of a smaller scale.
<b>Geographical area</b>	Details of where the Project will take place. If the Project is a collaboration Project, the Funding Licensee area(s) in which the Project will take place should be identified.
<b>Revenue allowed for in the RIIO- T1 settlement or RIIOED1 settlement</b>	An indication of the expenditure allowed for within the RIIO-T1 or RIIO-ED1 settlements 7 that is likely to be saved as a result of the Project





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Information required	Description
<b>Indicative total NIA Project Expenditure</b>	An indication of the total Allowable NIA Expenditure that the Funding Licensee expects to reclaim for the whole of the Project

**Low Carbon Network Fund (LCNF)<sup>18</sup>:** As well as the NIC and NIA, the Low Carbon Networks Fund (LCNF), which was a DPCR517 mechanism, continues to drive innovative activities. It was designed by Ofgem as part of the electricity distribution price control arrangements that ran from 1 April 2010 to 31 March 2015 and it enables DSOs to explore and implement innovative and cost-effective methods of facilitating the low carbon transition.

The objective of the fund was to help all DSOs understand what needs to be done to provide security of supply whilst achieving value for money and also what role the DSOs could play in facilitating low-carbon and energy saving initiatives to tackle climate change. The fund aimed to support projects sponsored by the DSOs to try out new technology and new operating and commercial arrangements.

The first tier was designed to enable DSOs to recover a proportion of expenditure incurred in small-scale projects. The Second Tier Reward (STR) element of this seeks to imitate the commercial benefits of innovation by rewarding DSOs for exceptional performance in delivering innovation projects which started in DPCR5. These projects were meant to explore how networks can facilitate the take up of low-carbon and energy-saving initiatives such as electric vehicles, heat pumps, micro and local generation and distributed system management, as well as investigating the opportunities that smart meter roll-out provide to network companies. Ofgem received nine applications in May 2018 for the STR and awarded £0.34m (in 2012-13 prices) for one of the nine projects.

#### Differences between the NIC and the NIA

- The NIA is a set annual allowance that each Network Licensee will receive to fund small-scale innovative Projects as part of its price control settlement. The NIA will fund smaller scale Research, Development, and Demonstration Projects, and can cover all types of innovation, including commercial, technological and operational. Unlike the NIC, the NIA is not focused solely on innovative projects with potential low carbon and environmental benefits.
- Compared to the NIA, the NIC is focused on funding larger scale and more complex, innovative projects, therefore, funding is awarded through an annual competitive process. All types of innovation including commercial, operational and technical are eligible for NIC funding so long as the project has the potential to deliver low carbon and/or environmental benefits to customers.
- The scope of Network Licensee involvement in the NIC is also broader than in the NIA. The NIA is only available to Network Licensees as part of their price control settlement, whereas non-RIIO network licensees may lead bids for funding under the NIC.

#### 3.2.1.1.3 The Innovation Roll-out Mechanism (IRM)

The IRM is a Revenue Adjustment Mechanism that enables network companies to apply for additional funding within their price control period for the roll-out of initiatives with longer term benefits. The DSO must submit a business case to Ofgem showing how the benefits of these initiatives outweigh additional costs of implementing for

<sup>18</sup> Source: JRC, 2017, Smart Grid Projects Outlook 2017, Facts, Figures and Trends in Europe





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customers. The funding is awarded ex-ante. The IRM is intended to facilitate the roll-out of proven innovations, which will provide long term value for money to customers, in advance of the next price control period. To qualify roll outs must demonstrate cost savings or deliver carbon and/or environmental benefits.

### 3.2.1.2 Innovation with the Price Control Package

Ofgem sets specific targets to companies, which is based on historic performance. If they miss this target (e.g. customer minutes lost) and exceed the target, they are penalized for every unit exceeded. However, if they beat the given target, they receive an amount for every unit reduced. This influences a company’s investment decisions and can make it worth their while to invest in new technology. In this regard, companies decide whether it is worth investing in a new technology or not.

With the TOTEX approach, companies are incentivized to try and find innovative solutions to problems rather than spending capital as they get to keep a proportion of the savings, with the rest passed on to consumers. Instead of having debates on what is classed as CAPEX and OPEX with different treatment in the price control, it is assumed that regardless of whatever they spend, a fixed percentage is CAPEX and the remainder is OPEX. This removes the disincentive to innovate. For example, a company may decide to implement demand side response to reduce congestion on the grid instead of expensive grid reinforcement.

In UK, together with the TOTEX Incentive Mechanism (TIM)<sup>19</sup>, DSOs are incentivized to outperform their TOTEX allowances, receiving in return around 60% of the savings. Therefore, TIM encourages companies to use innovation to decrease their costs, with the remainder being shared with consumers. TIM applies adjustments to the TOTEX figure. DSOs that submit better forecasts of the costs they expect to incur during the price control in their business plans receive a higher TOTEX efficiency incentive rate, meaning they get to keep more of any underspend. Therefore, efficient spending leads to better returns for investors and lower network charges for customers.

### 3.2.1.3 Next Steps

- Ofgem decided to retain the innovation stimulus package (which was set until 2023 previously), in RII0-2 period, limited to innovation projects that might not otherwise be delivered under the core RII0-2 Framework. In this regard, they will work on three broad areas of reform:
  - Increased alignment to energy transition challenges,
  - Greater coordination with wider public funding,
  - Increased third party engagement (including potential direct access to available funding).
- Ofgem want to explore whether there are ways to encourage greater third-party participation in their innovation program, either by providing innovation funding directly to third parties, or indirectly through network-led innovation projects. Ofgem will focus on innovation relating to price-controlled network activities<sup>20</sup>.
- Ofgem also plans to work more on what the innovation stimulus package should look like, including the balance of direct allowance versus competition, and the level of funding. This will consider the impact of the design of the core incentives package and potential differences across the different sectors.

<sup>19</sup> Source: Ofgem, March 2019, RII0-ED1 Annual Report 2017-18

<sup>20</sup> Source: Ofgem, 2018, RII02 Framework Decision





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### 3.2.2 Italy<sup>21 22 23</sup>

Italy has a long experience regarding incentive regulation in areas like quality of service and productive efficiency. The most recent measures in these fields, which were introduced in 2016 and 2018, respectively, has been related to a new remuneration scheme with a capital incentive scheme for the metering activity, which is operated by DSOs. In addition, a new output-based scheme for resilience of the distribution system was defined.

The Italian Regulatory Authority (ARERA, former AEEGSI) pays particular attention to the development and widespread application of innovative technologies to support the active management of the distribution networks and to the control of the production of electricity from renewable sources, also by encouraging and promoting demonstration projects on the networks. ARERA started in 2010 to focus on incentive schemes for smart grids investments performed by DSOs and in line with the objectives set by the European Union, the Authority has defined the procedure and criteria for selecting some pilot projects on the distribution networks.

The initial approach, based on an input regulation, was to test smart grids functionalities on pilot projects, with the aim to define specific incentive regulation taking into account the results of pilot projects. In this regard, ARERA selected eight smart grids pilot projects and incentivized them with an increase of 2% WACC remuneration for 12 years. Project Carpinone (Isernia region) was selected for Enel Distribuzione.

Also, for specific storage pilots both on TSO and DSO network, the ARERA extended this kind of incentive to pilot projects to be selected from a Commission appointed by the Italian Regulator jointly with the Ministry of Economic Development. However, these pilots were never selected for DSOs.

After the completion of the pilots, and based on their results, in 2016 the ARERA shifted its approach to an output-based incentive regulation. Based on the results of tests conducted in smart grid pilot projects which were initiated in Italy since 2010, the new regulation overpasses the input based incentive mechanism (extra-WACC) and the attention to the smart grid, focusing on output and the system concept, trying to identify the net benefit that innovation may bring at system level and not just at the network level. The incentive mechanism aims at stimulating DSOs to deploy innovative functionalities where these are mostly needed (areas with huge RES penetration) and where, without such an incentive and with the current tariff system, the DSO could have no interest in developing such innovative solutions.

This new bonus mechanisms is implemented on a selection of investments to incentivize, based on the benefits deriving from them, to be shared between the distributor and the system. The Resolution 646/2015 contained also proposals to incentivize further smart city pilot projects specifically focused on demand response, customer awareness, and innovative solutions for low voltage networks. These projects were selected taking into account the costs and the benefits for the whole system and the replicability level and they were incentivized through a lump sum forfeit contribution and an annual contribution for two years.

The first application of the new output-based regulation has been limited to two specific technologies:

<sup>21</sup> Source: ISGAN, May 2019, Innovative Regulatory Approaches with Focus on Experimental Sandboxes

<sup>22</sup> Source: <https://www.arera.it>

<sup>23</sup> Source: CEER, January 2017, Incentives Schemes for regulating DSOs, including for Innovation Consultation Paper





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- **Network observability:** that aims at improving the management of the distribution network with reference to Distributed Generation and voltage regulation; this will first be realized through a data exchange between the TSO and the DSO, and then providing accurate estimation of generation and consumption.
- **Voltage control on MV networks:** enabling the increase of the hosting capacity of the distribution network to connect new DG units without the need of grid reinforcement.

Although a combined model of Price Cap (OPEX) and Rate-of-Return (CAPEX) (Cost based) is implemented, the Italian Regulator also evaluates whether to introduce, from 2020, a TOTEX approach in order to balance incentives and benefits provided by each innovative investment to the system.

### Regulatory Experiments

The complete overview of the different regulatory experiments fostered by ARERA is sketched as follows:

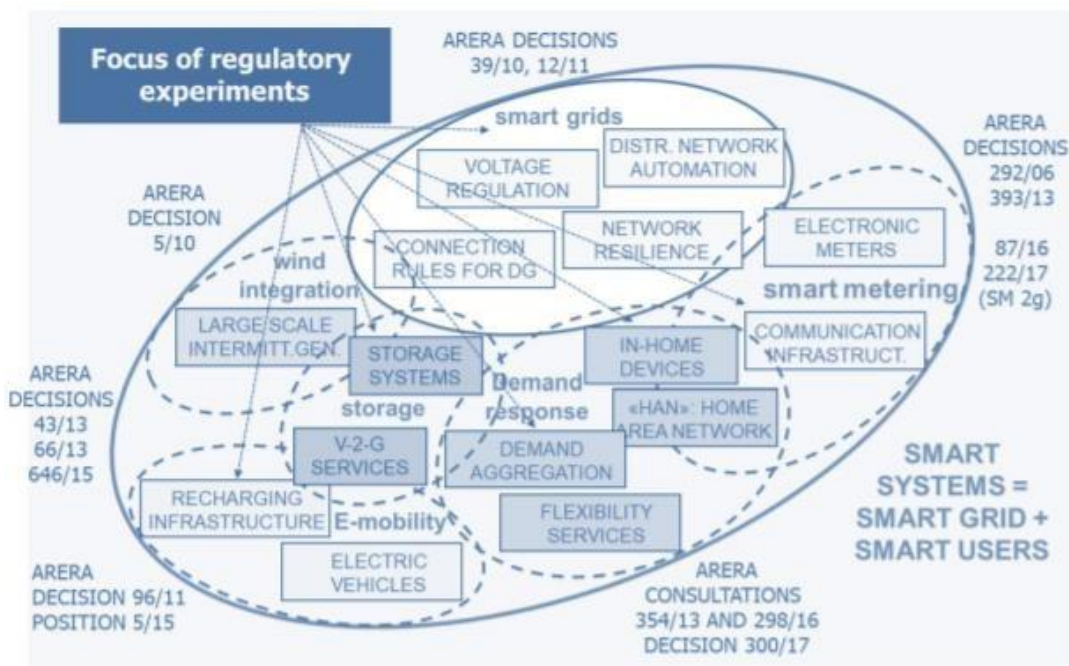


Figure 10: ARERA Overall Framework for Innovation in The Power System

Italian Regulator aims that innovation must go beyond lab experiments and it must be demonstrated in field, in real operating systems. ARERA has taken some initiatives as a part of a comprehensive program, whose general objectives are rooted in the recommendations of the Council of European Energy Regulators (CEER). Italy is one of the few countries that has already implemented sandbox programs for energy and is in the position to foster innovation. The whole program of regulatory experiments has been legally grounded upon regulatory decisions and all provisions described have been set out by ARERA autonomously, always after wide consultation of all stakeholders. In each initiative, a specific regulatory exemption/derogation has been allowed to participants.

The Italian experience has been divided in three steps for smart network innovation that are research, demonstration and deployment of involved smart network technologies / services. As for research, in Italy a general-interest research program for the energy system is funded through levies on the electricity bills (Ricerca di Sistema,





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RdS) and is carried out by RSE. Ricerca sul Sistema Energetico, ENEA, CNR and other research bodies, including private companies and academics.

The Regulatory Authority implemented a two-phase approach for the experiments. In a first phase, the regulatory focus was on the selection of pilot projects in given critical spots of the network, which were selected for their criticality, and an approach focused on critical zones was adopted, in order to experiment in real field conditions smart grids, large-size storage units and EV charging stations.

The Regulator launched several initiatives and for each initiative selected a few demonstration projects among the proposals, identifying the most promising ones according to an assessment of benefits and costs. For each initiative, a special remuneration was granted to selected projects (as a derogation of ordinary WACC for DSO and TSO, and via a direct grant for CPOs) and in turn public dissemination of results was mandatory.

In the second phase, the Regulator moved towards innovation at system level. This approach proved to be necessary for involving market parties, in a fully non-discriminatory manner. The two cases included the introduction of interoperable In-Home Devices (IHDs) and the introduction of aggregation of dispersed resources, including renewables and active demand, for enhancing flexibility services within the Ancillary Service Market.

As mentioned, within the scope of the program 5 initiatives that cover scopes/ dimensions and different innovation goals were determined for regulatory experiments.

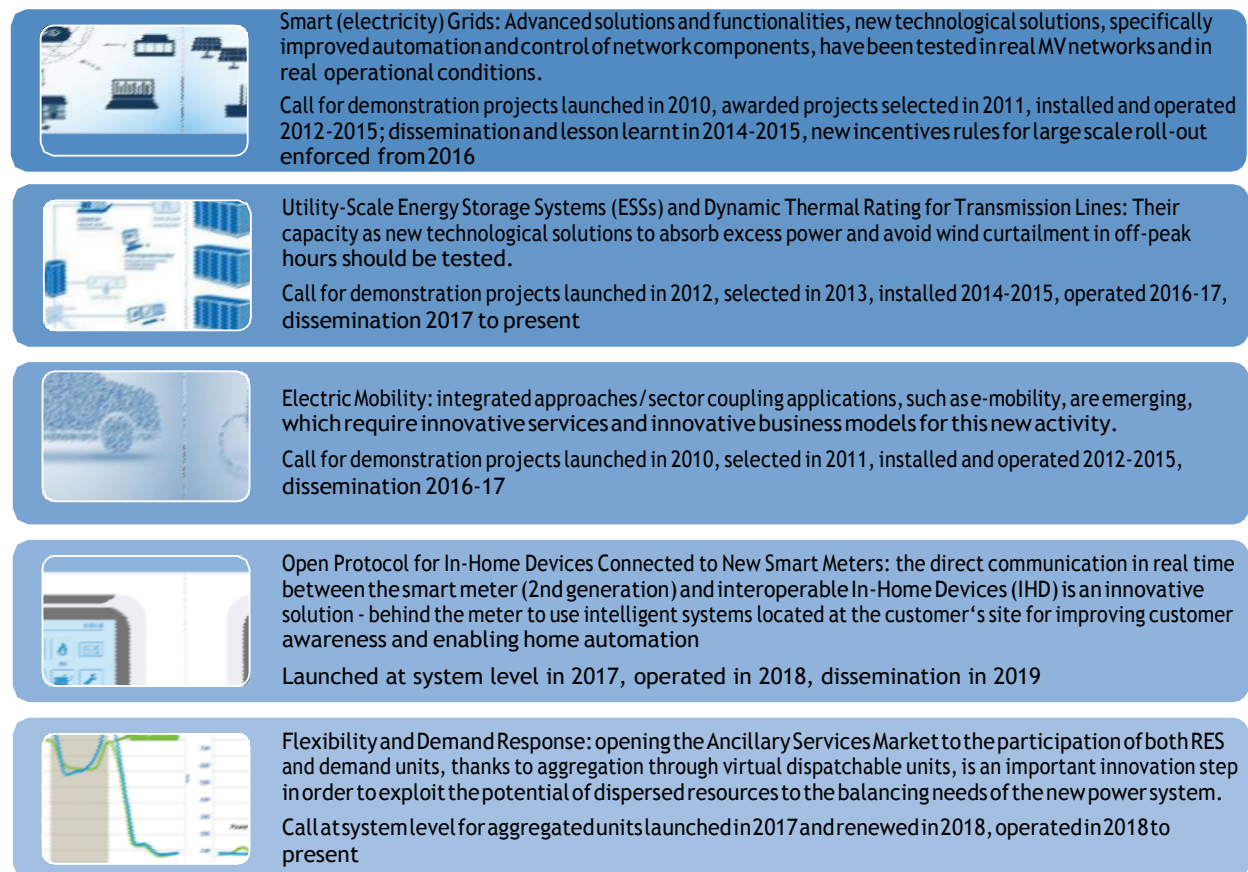


Figure 11: Five Initiatives for Innovation





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The main stakeholder has been the Italian Regulatory Authority which can autonomously proceed to set up regulatory experiments, following the due public procedures. In the different initiatives, responsibility for innovation is with main stakeholders: DSOs, TSO, EV Charging Point Operators (CPOs), market players (RES generation, suppliers and final customers with active demand), aggregators and IHD providers.

The main exemptions/derogations to the ordinary regulation that have been allowed for regulatory experiments are the following:

- **Smart (electricity) grids demonstration projects:** DSOs were allowed to gain an extra-remuneration on their capital investment for the higher risk embedded in the experiment. On the reverse side, DSOs had to propose demonstration projects with given requirements.
- **Energy Storage and Dynamic Thermal Rating (DTR) initiative:** A derogation to the unbundling rules was conceded to the TSO in order to own and operate Energy Storage Systems (ESSs), within the size limits of the demonstration projects (210 MWh / 35 MW for energy-intensive storage located in Southern regions with extremely high wind penetration; 15 MW power-intensive storage in the two major islands for system security issues). On the reverse side, the TSO was mandated to install also DTR applications in the same critical HV network zone where energy-intensive ESSs were built - in order to test the most effective solution to wind congestions. Further, an extra-remuneration on capital investments was envisaged only for storage units able to reach a target level of wind curtailment avoided.
- **Electro-mobility demonstration projects:** As a derogation from the ordinary tariff system, a special network tariff structure has been introduced, without fixed costs, applicable only to network points of delivery dedicated to EV recharge in public places. Further, a tariff-funded contribute was awarded to selected demonstration projects, in a non-discriminatory manner between DSOs and independent service providers. On the reverse side, DSOs participating with their own projects should keep separate accounting of recharging assets from distribution assets and should test in field the multivendor requirement.
- **Interoperable IHD initiatives:** No derogation was requested, but only a manual anticipation of the future automated procedure for the initial handshaking between electricity (LV) smart meters of 2nd generation and interoperable IHDs. The installation of SM-2G is currently ongoing over the whole country by DSOs.
- **Flexibility and Demand Response:** Important derogations to ordinary regulation of dispatching have been introduced. The minimum threshold for participating in the Ancillary Service Market was relaxed from 10 MVA to 1 MW; renewable-sourced generation units and demand units, so far excluded from the Ancillary Service Market, were allowed, even for sizes smaller than 1 MW, provided that the –virtual aggregated unit reaches this threshold as a whole; technical requirements were reviewed in order to avoid any barrier, in a fully technology-neutral approach to dispatching products. Market parties can exploit these derogations and participate in the Ancillary Service Market according to ordinary market rules, at their risk.

In general, after the ten-year experience in regulatory experiments, it can be concluded that the approach of the Italian Regulator has been successful until now in promoting innovation in the power system. More detailed information about the initiatives are defined in the following Table.





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	Smart (electricity) grids	Utility-scale Energy Storage Systems and Dynamic Thermal Rating	EV Recharge pilot projects	Interoperable IHD initiatives	Flexibility and Demand Response
<b>Applications submitted</b>	8 DSOs applied proposing 9 pilot projects		10 proposals were submitted and evaluated		The Italian TSO Terna has already launched different calls, after approval of regulatory exemptions and obligations for each call
<b>Number of projects funded</b>	8 projects (from 7 DSOs) passed the selection phase, but 1 was aborted during the early stage, so 7 projects completed the demonstration phase	Energy-intensive storage sites (each with 2 twin units) in critical HV network zones; moreover, 2 –power-intensive storage sites in major islands	5 projects were selected and 4 were carried out.	1 nation-wide trial, open to several providers of IHDs and associated services	
<b>Types of project</b>	6 main innovative functionalities have been trialled (among all demonstration projects): 1) observability of active resources connected to MV networks; 2) advanced voltage regulation; 3) active power modulation; 4) anti-islanding; 5) fast fault isolation in MV networks; 6) electricity storage at MV level.	Energy intensive storage units, corresponding to installed power of 35 MW / 210 MWh (charge/discharge duration: 7 hours), all using the same storage technology, i.e. NaS batteries. Power intensive storage units: several technologies, charge/discharge duration up to 1 hours	Main aim of the demonstration projects was the in-field test of different business models for EV charging activity: 1 project was based on the business model of DSO, 2 on the model of Charging Service Provider (CSP) in competition, 1 on the model of competitive CSP	Monitoring of the performance of –Chain 2 communication in second generation (2G) Smart Meters	





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	Smart (electricity) grids	Utility-scale Energy Storage Systems and Dynamic Thermal Rating	EV Recharge pilot projects	Interoperable IHD initiatives	Flexibility and Demand Response
<b>Types of key actors/organizations</b>	DSOs	TERNA (Italian TSO). Manufacturers of Battery Energy Storage Systems	Charging Service Providers (CSPs); DSOs	DSOs and IHD manufacturers	TERNA, Balancing Services Parties BSPs, Balancing Responsible Parties BRPs.
<b>Funding volume</b>	DSOs investment around 15.5 million Euro (recovered through network tariff)	TSO investment around 160 million Euro (recovered through network tariff)	Investment in charging stations amount to around 2 Million euro, covered through a special grant. Typically, mono-technology AC 3 kW and 22 kW charging stations, with a single socket or two sockets (and two standards) were installed, while no high-power dual technology (AC or DC) station was installed	No funding has been necessary; each party covered its own costs without any extra funding. No extra funding was required on top of ordinary tariff for DSOs nor payment towards IHDs manufacturers	UVACs and UVAMs have been allowed for a specific capacity remuneration (30 k€/MW), in addition to remunerating the effectively delivered resource; these costs are under evaluation and are covered through the final dispatching tariff (uplift).





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	Smart (electricity) grids	Utility-scale Energy Storage Systems and Dynamic Thermal Rating	EV Recharge pilot projects	Interoperable IHD initiatives	Flexibility and Demand Response
<b>Derogations</b>	Extra remuneration of capital cost (a +2% in addition to the ordinary return rate) for a period of 12 years	The TSO was exceptionally allowed to own and operate storage units; extra remuneration of capital cost (a +2% in addition to the ordinary return rate) is foreseen for a period of 12 years, under condition that a given target of wind curtailment is avoided	Special network tariff, with no fixed part, has been introduced for points of delivery dedicated to EV recharge in public places	No derogation was requested, but only a manual anticipation of the future automated procedure for initial handshaking between electricity (LV) smart meters of 2nd generation and interoperable IHDs	The most important derogations allowed by the Regulator are: the minimum threshold for participating in the Ancillary Service Market was relaxed from 10 MVA to 1 MW; renewable-sourced generation units and demand units, so far excluded from Ancillary Service markets, were allowed, even for size smaller than 1 MW, provided that the virtual aggregated unit reaches this threshold as a whole; some technical requirements were reviewed in order to avoid any barrier, in a fully technology-neutral approach to dispatching products; a capacity remuneration mechanism has been introduced; the possibility that the BSP is a different entity than the BRP is foreseen.





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	Smart (electricity) grids	Utility-scale Energy Storage Systems and Dynamic Thermal Rating	EV Recharge pilot projects	Interoperable IHD initiatives	Flexibility and Demand Response
<b>Obligations for grid operators</b>	Demonstration projects had to be realized in critical MV network zone, with RPT >1% on a yearly basis; only open communication protocols could be used for communication between DSOs and network users	Demonstration projects had to be carried out in critical HV network zones, with wind curtailment in action. Installation of Dynamic Thermal Rating in the same HV network zone was mandatory, in order to test the most effective solution to cope with HV line congestion	DSOs participated to this initiative under an unbundling constraint and with a multi-vendor requirement	Each market party participating in the survey had to collect automatically data on messages received by IHDs from smart meters; DSOs had to collect data on messages sent by each smart meter coupled with IHD; a platform has been implemented and managed by RSE as independent party to assess actual performance level of Chain 2	Aggregators have the same obligations of real time monitoring as ordinary dispatchable units on the whole aggregate
<b>Main results</b>	A relevant increase in hosting capacity has been demonstrated, even at the first level of complexity tested (i.e., only through automatic regulation of MV setpoint at PS busbars, without direct communication with DG)	Although storage units have several capabilities, the operation of TSO owned storage was aimed for a specific network service (i.e. avoiding curtailment of wind-sourced generation units). Considering only time-shift effects the benefit/cost ratio was very low. For other services, storage units should be operated by market players, in a competitive framework	The multi-vendor requirement proved to be too complex. Localization of charging points confirmed to be most crucial decision		Under evaluation, so far the reliability of aggregated resources is around 80%





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	Smart (electricity) grids	Utility-scale Energy Storage Systems and Dynamic Thermal Rating	EV Recharge pilot projects	Interoperable IHD initiatives	Flexibility and Demand Response
<b>Outcomes</b>	Two out of the six smart functionalities trialed (observability of distribution systems, i.e., power flows and state of distributed resources, and ability to regulate the voltage profile of MV networks) were identified after consultation as the most promising in the short term and worth of specific output based regulatory incentives for roll-out on a large scale	The TSO is no longer allowed to own and install storage units. DTR proved to be much more effective for the purpose of reducing wind curtailment than storage	The DSO-based business model is no longer available. The special tariff for points of delivery dedicated to EV recharge in public places is still enforced in order to favour the kick-off of electro-mobility	The communication has been implemented through Power Line Carrier (PLC, band CCenelec) and extremely satisfying results have been achieved. The initiative has allowed to confirm the effectiveness of the open communication protocol, which can be used by market parties to enrich their offers. Therefore, since 2019 the innovation has been released to all customers equipped with 2G electricity meters (roll-out is ongoing).	The expected outcome of the whole initiative is to review the whole regulatory framework for dispatching, enlarging the participation of DERs to Ancillary Service Market, after regulatory experiments.





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**Electric Mobility:** In the field of system research various projects relating to electric mobility have been developed and they are financed through a component of the electricity tariff (A5RIM).

RSE, Energy System Research, has also provided scientific support for the drafting of the document "Elements for a Roadmap of Mobility" which was presented in May 2017 with the participation of the main stakeholders in the mobility sector, environmental and consumer associations, representatives of central and local public administrations and research institutions.

As for the mobility, a competition was launched for the selection of experimental projects for the public charging service of electric vehicles and the Authority made the selection of the pilot projects admitted to the facilitation for five years on the basis of the results of the Evaluation Report prepared by its Offices with the technical support of the company RSE.

### 3.2.3 France<sup>24</sup>

TURPE stands for tariffs d'utilisation des réseaux publics d'électricité (tariffs for using public electricity networks). They were created in 2000 in France to remunerate electricity distribution and transmission companies. In France, in the TURPE 4 period (2014-2017), CAPEX was recognized in the regulated asset base (RAB) even if they were not included in the ex-ante cost trajectory, and their amortizations are covered as pass-through. A specific account, the "compte de régulation des charges et produits" (CRCP), recognizes all differences between the initial asset depreciation trajectory and the actual one for future tariff calculations. Costs for R&D and pilot projects are covered within the distribution network tariff. If the DSO spends less than the allowed amount, this amount is returned to the tariff. Spending above the forecasted amount is at the company's risk.

On the other hand, CRE (Commission de Régulation de l'Énergie, the French regulator) sets efficiency requirements for OPEX. For instance, if OPEX is lower than the efficiency targets defined ex-ante, ENEDIS, which manages the public electricity distribution network for 95% of continental France, keeps 100% of the additional productivity gains, but if OPEX is higher, ENEDIS bears 100% of productivity losses. With this symmetry principle, any additional R&D costs would significantly hamper efficiency requirements, since they often incur higher costs in the beginning, which will be recovered later on. This is why CRE set up a special scheme for R&D and innovation. Although this scheme is quite favourable towards R&D investments, DSOs need cash in advance since amortizations are only covered by the tariff in the long run (30-40 years) and there is a need for the DSOs to keep the tariff level stable over time, in order to keep some sustainability for customers.

CRE elaborated a rather innovative treatment of R&D operating expenditures for TURPE 4, where all OPEX relative to research, innovation, and smart grids demonstration programs are put in a specific budget which is not concerned by efficiency requirements.

For TURPE 4 period, ENEDIS<sup>25</sup> presented following OPEX previsions

In current m€	2014	2015	2016	2017	2018
<b>Theme "improve the efficiency of distribution sector professions"</b>	16	16	17	17	66

<sup>24</sup> Source: Eurelectric, July 2016, Innovation Incentives for DSOs - A Must in the New Energy Market Development

<sup>25</sup> ENEDIS: L'électricité en Réseau manages the public electricity distribution network for 95% of continental France.





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In current m€	2014	2015	2016	2017	2018
<b>Theme “prepare the evolution of distribution professions”</b>	15	16	19	19	69
<b>The smart grid demonstration program</b>	19	23	24	24	90
<b>R&amp;D Operating Expenses</b>	50	55	60	60	225

In exchange, CRE introduced a follow-up of ENEDIS innovation projects, in form of a report that ENEDIS has to send to CRE each year, including the following elements:

- A description of the projects carried out with the associated expenses and results obtained.
- A list of projects in progress and future projects with the expected outcomes.
- The expenses for the past year.
- The forecast expenses for each year up to the end of the tariff period.
- The number of full-time equivalents associated with R&D programs.
- The support and subsidies received.

Any annual differences between the actual and forecasted trajectory will have to be justified by ENEDIS within the framework of the annual report sent to CRE.

CRE will review, at the end of the tariff period, the sums actually spent by ENEDIS and will return to users, via the CRCP mechanism, the difference between the forecasted and actual trajectory. However, any costs higher than expected in this budget won't be covered by CRE.

Eventually, and for the record, investments in R&D and innovation, particularly in the smart grids field are entirely passed through, like other ENEDIS investment expenditure.

Every two years, the Regulator publishes a public report on his website on innovation projects, based on ENEDIS reporting.

The first advantage of such a mechanism is to secure funding for R&D activities over the whole tariff period, without taking the risk to hamper efficiency requirements. The general 4-year budget is defined ex-ante, but the budget per annum, as well as the distinction between the three themes, is for information purposes only. Consequently, ENEDIS has to explain the differences between what was announced and what was achieved every year, but the general assessment will occur at the end of the regulatory period.

This incentive scheme also contributes to improving ENEDIS's image as an innovative company for network users. Historically, research at ENEDIS has always been spread out over different entities, so general R&D objectives were not clear for everyone. The need to publish an annual report on R&D activities caused ENEDIS to take a step back and brainstorm on all gains that were expected from the different innovation programs. This led to a global synthesis of R&D and a better management of research programs, as well as a better communication towards users.





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Eventually, this mechanism allows to increase R&D under ENEDIS project management (statement of requirements, identification of main results, financial monitoring), and to vary R&D providers.

One of the main risks identified by ENEDIS concerns the privacy of information made public by CRE. The company has to be very watchful on the information given in order to insure a protection of the intellectual property rights.

In the TURPE 5 current discussions, ENEDIS asked for a similar treatment of R&D expenditures and presented updated cost trajectory for its R&D program. The only difference being that ENEDIS asked for a symmetrical mechanism, where ENEDIS doesn't have to pay for additional OPEX in case the total budget is higher than expected.

France is one of very few examples where the tariff promotes also demand response program based on critical peak pricing. Under the critical peak pricing scheme, the consumer is requested to reduce demand with a 24-hour notice signal for some given days a year.

### 3.2.4 Norway<sup>26 27</sup>

Norwegian Regulatory Authority (NVE) regulates the Norwegian DSOs by using a combination of the company's own costs and the costs from benchmarking models. NVE calculates yearly revenue caps with elements of yardstick competition. 40% of the revenue cap is based on the company's own costs, and 60% of the revenue cap is based on the cost norm where benchmarking models are used. In the benchmarking total costs are minimized given the outputs defined in the model.

The regulatory authority wants to stimulate increased participation in R&D activities to support a more efficient operation and utilization of the electricity network. Costs for R&D are treated as pass-through costs when they fulfil certain conditions, in order to avoid short term disincentives.

Since the outputs of the tariff model are rarely increased by R&D in the short run, DSOs would perform worse in the benchmarking. This would give disincentives against R&D for a DSO and that is not desirable in a time where there are changes happening in the industry. Based on this, a new mechanism was introduced in 2013 to strengthen the incentives for investing in R&D. In the mechanism, R&D costs are treated as pass-through costs, i.e. they are not included in the benchmarking and can be included directly into the tariff base.

R&D projects that can contribute to streamlining operations and developing the grid can be included in NVE's R&D funding scheme. The goal is to stimulate the network companies to invest more in R&D. Project costs from approved R&D projects can be covered as an addition to the revenue cap. The scheme allows for specific and prequalified R&D project costs up to 0.3% of each DSO's invested grid capital, to be recovered directly through the grid tariff (i.e. outside the revenue cap regulation scheme).

In Norway, the decision that whether the project is considered as an R&D project or not, is delegated to a third party and R&D projects are approved by an external body, e.g. Norwegian Research Council (NFR). This ensures that the burden of work for the NRA is reduced. The results of the projects are required to be publicized.

<sup>26</sup> Source: Eurelectric, July 2016, Innovation incentives for DSOs - a must in the new energy market development

<sup>27</sup> Source: www.nve.no





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NVE has designed a scheme where distribution companies receive full financial coverage for some percentage of their regulatory asset base for R&D projects that meet certain criteria. Following conditions must be fulfilled before the costs are accepted in this mechanism:

- The R&D must be useful for grid operation/investments/planning. The project must be able to contribute to increased efficient operation, utilization and development of the power grid
- It represents a maximum of 0.3 % of the DSO's regulatory asset base
- The project must be found worthy of an institution that grants R&D projects. The R&D project is approved by an external body, e.g. the Research Council. This ensures the burden of work for the NRA is reduced. As the NRA must not evaluate whether it can be considered as research, that decision is delegated to a third party.
- Information about project goals and results should be open and accessible to everyone

Once these criteria are met, the project owner can apply to have his project approved in our R&D funding scheme. The application must be sent electronically to [nve@nve.no](mailto:nve@nve.no) and must contain at least the following documentation:

- Documentation that the project was found to be worthy of support
- A brief explanation of why the project is relevant and how the project contributes to more efficient operation or utilization of the network
- An overview of which network companies are to participate in the project
- A statement that the project will comply with the Accounting Act's requirements for managing R&D costs
- A statement that the project results will be made widely available

When NVE examines whether the project meets the criteria, they send a response to the project owner where they either approve or reject the application. If approved, the application is included in the list of "Approved R&D projects".





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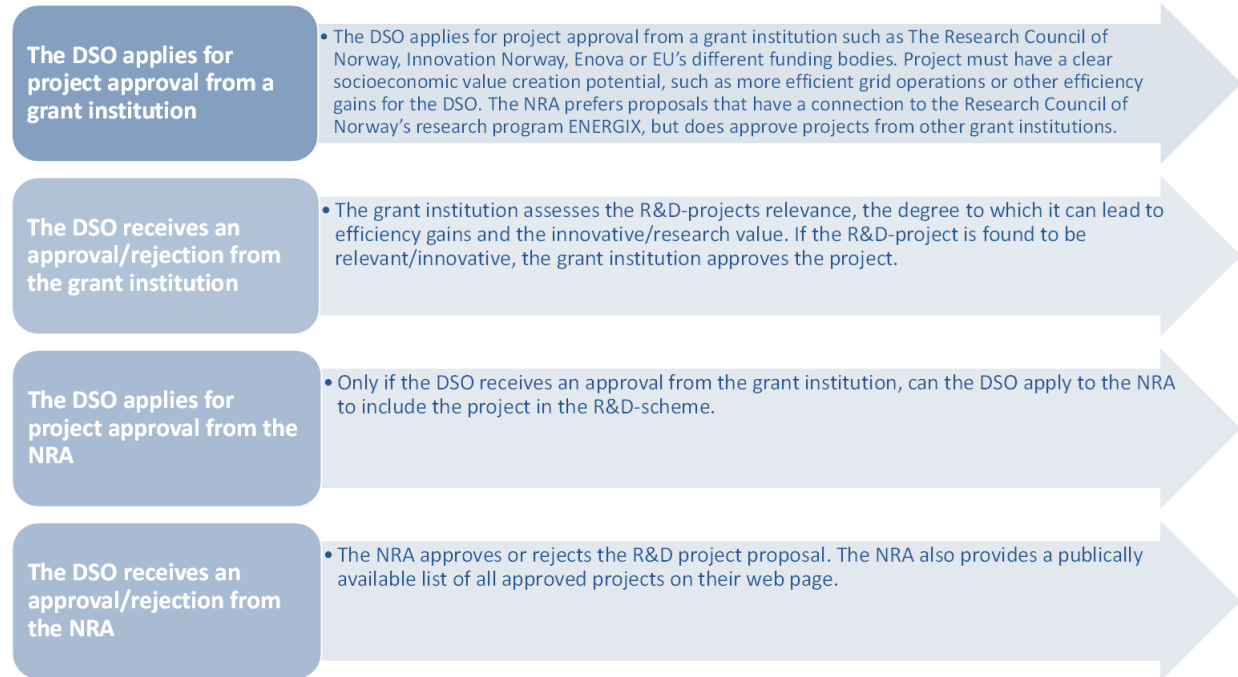


Figure 12: Application Procedure to the Funding Scheme

Some other characteristics related to the funding scheme are as follows:

- All costs related to the grid company reflected in the project's budget and accounts can be covered by the scheme. If the company's own efforts are only reflected in the company's own accounts, it cannot be included. The costs that the company reports to NVE each year must be reconcilable with the project accounts.
- Projects that receive financial support from the NFR or others must follow the time frame stipulated in the contract. Projects that are found to be worthy but do not receive financial support do not have the same requirements from the NFR. As long as the NFR has characterized the project as worthy of support, the project may be included in the scheme even if the project start is postponed somewhat or if the project period is longer than planned. However, NVE expects to be informed if the project changes significantly from the original project plan, whether the project's content or time frame.
- Depending on the grant institution and the complexity of the project (typically the number of partners involved), the approval process takes between two and twelve months.
- The R&D scheme covers all the DSO's costs, limited to the R&D projects' budget. Both internal and external costs may be included.
- Ongoing R&D projects that have previously been approved by a grant institution may also be included in the R&D scheme. However, only costs (internal or external) that have occurred after 1.1.2013 may be included.

Figure 13 shows development of the projects approved between 2013 & 2017.





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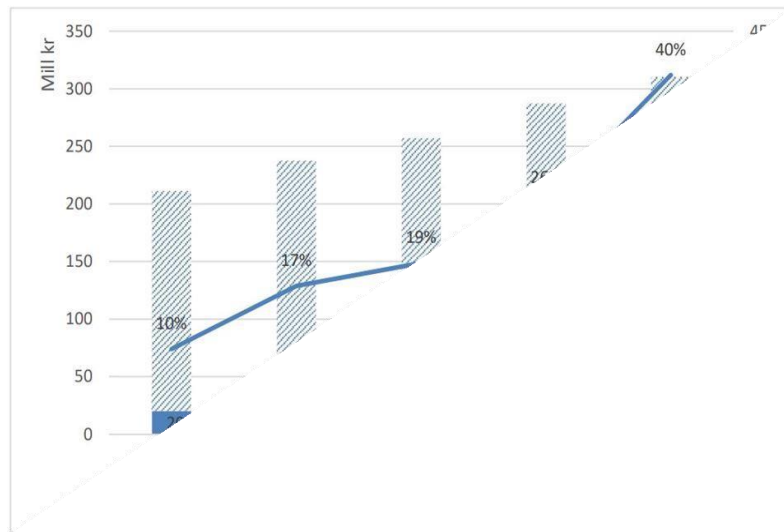


Figure 13: Funding of R&D Projects between 2013 & 2017

In 2013, 25 out of 148 DSOs had 103 R&D projects approved under the R&D scheme. The total budget for these R&D projects was close to €2.3 million. In 2014, 31 companies had 162 R&D projects approved under the R&D scheme. The total budget for these R&D projects was close to €4.9 million. Under the R&D scheme, total budget that could be applied has been €22 million and €24 million in 2013 and 2014 respectively. At the end of December 2018, NVE approved 135 R&D applications. Current projects under the R&D schemes include projects related to tariff design, technology development such as smart energy systems, new cable technologies, and reliability and monitoring.

Two concrete projects are briefly described below:

✓ **The DeVID project** (2012-2014) involved 17 DSOs. The project aimed at developing and testing methods related to how smart meters provide opportunities for better grid operations, developing methods for using demand response and guaranteeing personal information security.

✓ **The DGnett project** (2014-2017) involves 5 DSOs. The project aims to identify alternative solutions to reducing costs related to strengthening the grid, voltage regulation, reactive and active power control when integrating distributed production.

### 3.2.5 Portugal<sup>28</sup>

In order to enable the definition of effective incentive schemes, which balance different perspectives, the Portuguese NRA (ERSE) has implemented a set of regulatory policies which are based on several rules, such as transparency, collaboration with stakeholders, and monitoring, under a stable and predictable regulatory framework. These rules have consistently supported ERSE in defining its main regulatory goals and in evaluating, or adapting if necessary, the regulatory tools it applies, based on the feedback from stakeholders.

For instance, to set network access tariffs, regulatory financial reporting rules were established following several discussions with regulated companies. Each year, ERSE’s network access tariffs proposal undergoes a public

<sup>28</sup> Source: Eurelectric, July 2016, Innovation Incentives for DSOs - A Must in the New Energy Market Development





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consultation process, during which all of ERSE’s tariffs documentation is shared with the public, and representatives of all stakeholders are invited to provide their views and comments before the final tariffs proposal is approved and published. The publication of regulatory codes that imply changes to the regulatory framework, and other statutory responsibilities such as providing non mandatory opinion on companies’ network investment plans are also carried out through a process that includes a consultation period, where all relevant information is transparently shared. In this case, even though ERSE’s opinion is not binding, it can have a significant influence in the process because it considers stakeholder perspectives.

Another key tool that has contributed to the effectiveness and stability of the Portuguese regulatory framework has been the periodic monitoring of a set of variables which guide regulatory strategies, such as quality of service, regulated activity profitability, the level of infrastructure utilization, and cost efficiency. This set of variables is under review in order to capture further outputs of the network service.

The mechanism adopted by ERSE to promote innovation also benefits from this effective governance framework. Innovation incentives were designed after a consultation process in which stakeholders perspectives were balanced: on the one hand consumers, who tend to be more concerned with cost control in the short run, and on the other hand the DSO, that requires a stable regulatory framework in the long run. The current version of the mechanism encourages regulated companies to invest in projects/ technologies that would lower operating costs while also generating other benefits (i. e., improved quality of service). Moreover, DSO’s innovation is also fostered through an incentive based tender process designed to promote energy efficiency, which is open to all kinds of stakeholders. The incumbent DSO has participated with projects focused on energy efficiency in public lighting (one of its core activities).

Portuguese regulatory framework has enabled innovation at DSO level that may push the DSO to higher service levels, like meter reading frequency and consumption data acquisition, dispersed generation metering, quality of service data coverage and reporting, distribution network asset reporting and implementation of automation and remote control solutions, etc.

### 3.2.6 Netherlands<sup>29 30</sup>

The Netherlands Authority for Consumers and Markets (ACM) regulates the Dutch DSOs by using yardstick competition. ACM combines yardstick competition with output regulation and sets the revenue based on the total costs. The revenue is set ex-ante at the start of a regulatory period of three to five years and it is based on the total costs of the sector, which allows the DSOs to recover sufficient revenue and provides incentives for them to reduce the costs.

According to ACM, innovation is a means to reach other goals and with the above characteristics of regulation, DSOs have the right incentives to reach the relevant goals. Due to these incentives, DSOs are also triggered to innovate to improve their performance. One of many examples is that Dutch DSOs are moving towards smart grids, where stations can be controlled from a distance and the quality of service increases. The expectation is that this will reduce outage duration considerably.

The yardstick regulation creates an environment where DSOs are incentivized to perform better, both in the short and the long run. Costs for innovation are included in the total costs of the sector and are remunerated to the DSOs

<sup>29</sup> Source: Eurelectric, July 2016, Innovation Incentives for DSOs - A Must in the New Energy Market Development

<sup>30</sup> Source: CEER, January 2017, Incentives Schemes for regulating DSOs, including for Innovation Consultation Paper





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through the yardstick approach. In this way, the DSOs can find their own balance in their degree of innovation and are able to optimize their choices.

There are innovation programs on smart grids and smart energy systems in the country since the beginning of 2000. There is no public funding involved for these projects but there are extra space/exemptions within the legislation (electricity law) for a specific project and a specific time. In addition, there are no exemptions on energy taxes. On the other hand, if innovation is necessary technical funding is possible from other innovation programs.

The program that started in 2015 provided some exemptions in the legislation. This program is now closed, and 17 projects are approved. According to the legislation there are two types of projects that are eligible for exemption and the duration of exemption is at most 10 years:

- **Large Experiment:** the waiver holder (a cooperative association - who gets the dispensation) - in consultation with a regional grid operator (DSO) - carries out the large experiment in the DSO-grid with a maximum of 10,000 customers - mainly consumers - who use the electricity. In this large experiment the waiver holder can combine renewable electricity production/ CHP, supply to the consumers and set their own tariffs. By matching supply and demand they can try to reduce the necessary grid capacity. The regional grid operator will continue to fulfil the other independent statutory tasks relating to grid management in large experiments.
- **Project Network:** a joint network of up to 500 customers with only one connection to the grid of a network operator (DSO). In a project network, the waver holder may combine production, supply and management of the local electricity grid. (Compared to a big experiment they can also operate a local electricity grid).

Within these programs, parties who want to start a project and seek for an approval to operate with exemptions of the law have to comply with at least the following criteria:

- participation must be open and voluntary
- members must be allowed to leave the experiment
- members of a cooperation shall not lose their rights and obligations as household customers
- corporations are financially responsible for the imbalances they cause in the electricity system, or have delegated this responsibility to a balance responsible party
- it must be safe
- dispensation is not necessary to fulfil the experiment (things are already allowed)
- the consumer protection must be ok, and in line with European requirements (like freedom of choice)
- financial, technical and organization expertise is required
- a minimum of 80% of the participants must be consumer
- the production capacity must be limited to the final use of the participants





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- there is an obligation that there are sufficient arrangements in the case the party goes bankrupt and consumers must be certain of the supply of electricity by another supplier

Two examples for the selected projects are as follows:

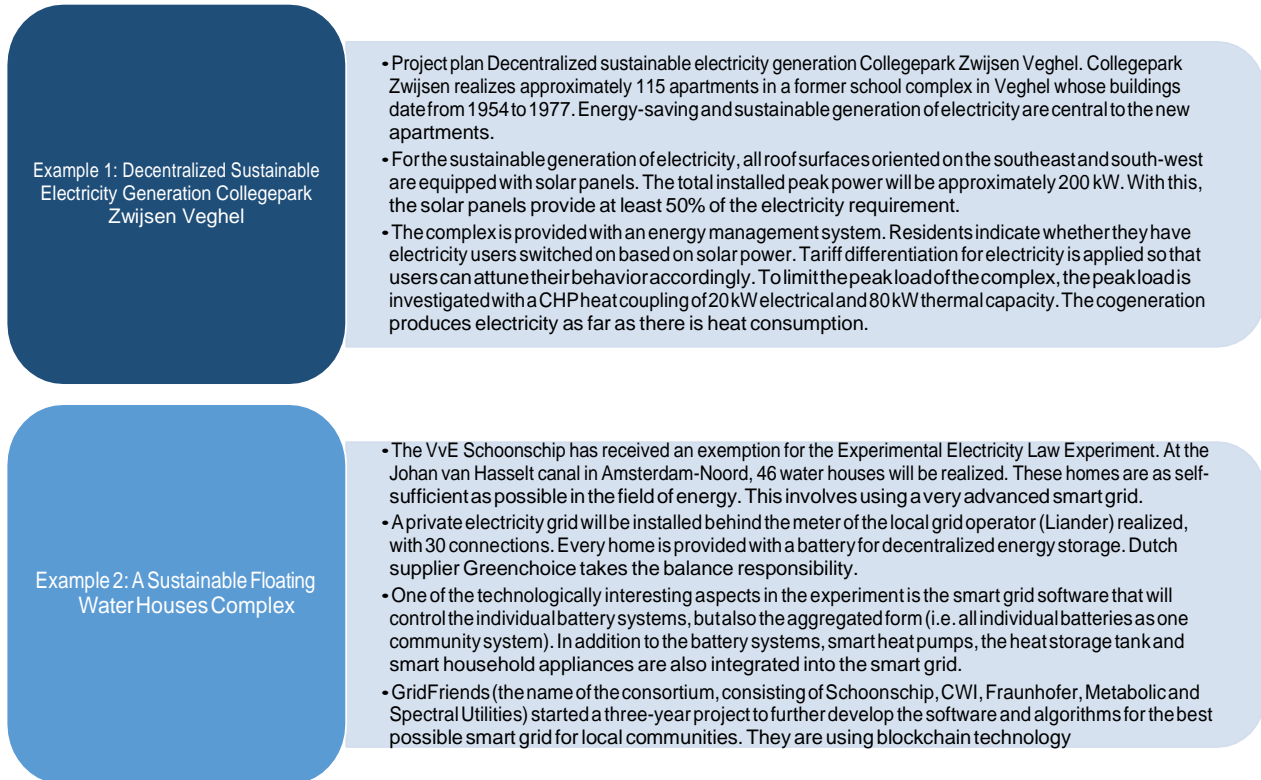


Figure 14: Examples and Good Practices of Designing and Implementing Existing Sandbox

### 3.2.7 Finland

According to CEER<sup>31</sup>, 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. This way the electricity distribution network operator may incur research and development costs before the new technologies are in full use and utilisable. The Finnish NRA deducts reasonable R&D costs during the calculation of realised adjusted profit for network operators, in order to foster the active innovation and R&D efforts. However, acceptable R&D and innovation activities costs must be recorded as expenses in the unbundled profit and loss account since capitalised R&D costs are not accepted to be included in the calculation of the innovation incentive. Moreover, 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 electricity distribution sector.

Finally, the impact of the innovation incentive is deducted when calculating realised 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

<sup>31</sup> CEER - Report on Regulatory Frameworks for European Energy Networks 2019





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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.

### 3.2.8 General Overview of EU Practices

Innovation is recognized as one of the key pillars of the Energy Union. The Energy Union Communication adopted on 25 February 2015, dedicates one of its five dimensions to research, innovation and competitiveness. With the objective of implementing the strategy, the Commission presented a comprehensive research, innovation and competitiveness strategy, which supports the objectives of the Energy Union and the initiative “Accelerating the European energy system transformation- An integrated Strategic Energy Technology (SET) Plan” was started as an approach to accelerate the energy system transformation. Within the SET plan, innovation is considered in three areas that are:

- Fundamental research, knowledge science, required to firmly anchor the bridge
- Technology development
- Product development including process, technology and prototype development

On the other hand, R&D directly supports the development of knowledge and technology, because it develops the knowledge which can be used to implement successful technology. The following figure shows development of technologies that could have disruptive impact on the power sector.

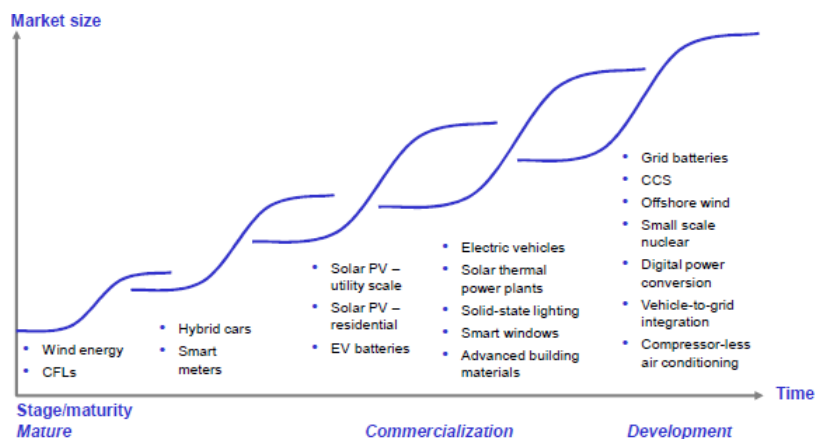


Figure 15: Development of Technologies<sup>32</sup>

Distribution System Operators (DSOs) play an important role in the electricity sector since they are responsible for improving the functioning of electricity distribution networks considering the technological developments such as deployment of smart grids, electrical vehicle charging stations or distributed generation. All of these technological developments require increasingly innovative solutions and DSOs are the natural monopolies who have to develop those innovative concepts under a certain regulatory framework that incentivizes them. Innovation in distribution system is important, since;

<sup>32</sup> Source: Conti F., 2013, Eurelectric’s Innovation Action Plan: Shaping the Prospects of Future Energy Technologies



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- The growth of distributed generation affects DSOs ability to maintain and upgrade their grid infrastructure,
- DSOs are responsible for the deployment of smart grids and contributing to the development of smart energy systems, while they maintain the smooth operation of the networks,
- There is an increasing need for investments in the ageing distribution networks.

When the abovementioned items are taken into account, innovation may enhance network operation, improve reliability of the grid and lead to a more efficient system than using conventional ones. As an example, innovation may help to reduce network expansion, and maximize the use of the existing infrastructure or it may help to better exploit available network capacity or to avoid network expansion in case of network congestions due to increasing feed-in from renewables.

As a result of these requirements and developments, investment in smart grid R&D and demonstration activities has grown considerably in Europe. Figure 16 indicates the number of projects and investment amount for R&D and demonstration projects in Europe.

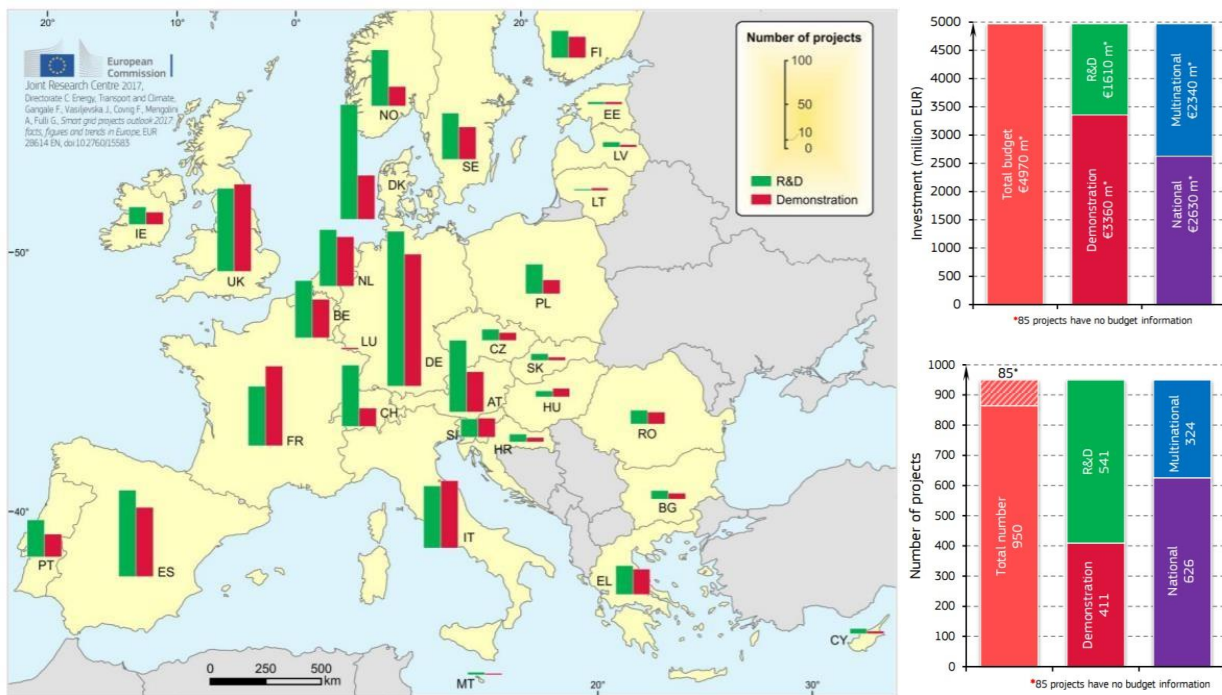


Figure 16: Number of R&D and Demonstration Projects in the EU

The number of initiatives and the level of investment in each Member State vary in relation to country-specific circumstances, e.g. national policies, the state of the electricity grids, the regulatory framework, the existence and scope of co-funding mechanisms at national and European level. In addition, R&D projects are more numerous than demonstration projects in most countries, with the exceptions of France, Italy, Luxembourg and the United Kingdom.

In terms of R&D and demonstration projects' financing, most important source of financing is private investment for smart grid projects. Stakeholder with the highest investment are DSOs but emerging stakeholders are steadily





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increasing their investment. Domains with highest investment (80%) has been smart network management, demand side management and integration of distributed generation and storage.<sup>33</sup>

Each country has its own characteristics, and each National Regulatory Authority (NRA) determines its goals and activities based on the circumstances that they operate in. different approaches exist around Europe for triggering innovation and R&D. These mechanisms contribute to investing in innovation to improve or maintain DSO's quality of operation in the long run. NRA's might decide to explicitly support innovation, incentives might come more direct or in some cases innovation might not be the priority of the country. Innovation might be supported in a direct and indirect way as shown in Figure 17.

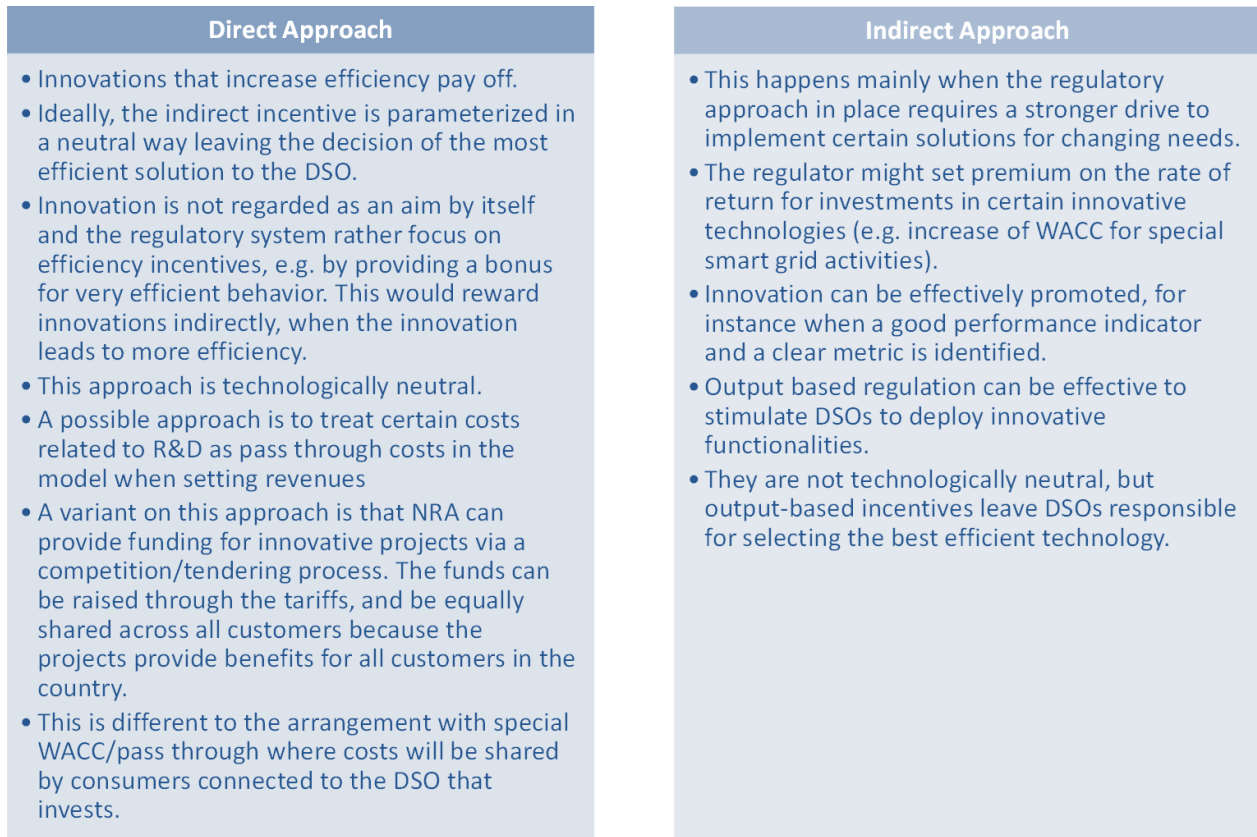


Figure 17: Approaches to Supporting Innovation<sup>34</sup>

Historically, DSOs were mostly financed to decrease their costs via cost-based mechanisms and innovations were incentivized only in a few EU member countries. According to a survey conducted by EURELECTRIC in 2016, incentives for innovation within each national regulatory framework was analysed (Deployment of smart meters is not included as innovation).

<sup>33</sup> Source: Büttner Held B, October 2017, Assessment of the Implementation of Smart Energy Networks (Smart Grids and Smart Gas Grid) from a Legal/Regulatory Perspective

<sup>34</sup> Source: CEER, 24 January 2017, Incentives Schemes for Regulating DSOs, including for Innovation Consultation Paper





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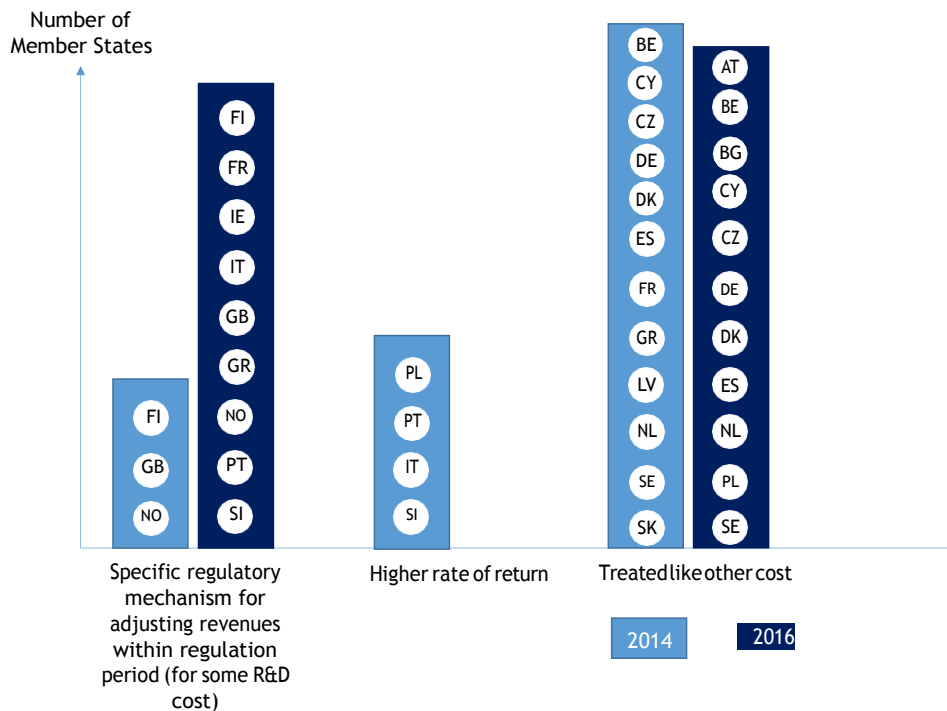


Figure 18: Specific Mechanism to Incentivize Innovation (EURELECTRIC, July 2016) <sup>35</sup>

The survey showed that the number of Member States that has a specific mechanism regarding innovation increased from 2014 to 2016, however it is still beyond the number of countries, where innovation and R&D costs are treated like any other cost and these countries have not introduced an incentive mechanism for expenditures for R&D and/or pilot projects. Norway, Finland, Great Britain, France, Greece, Ireland, Italy, Portugal and Slovenia are the countries that have implemented a new specific regulatory mechanism to promote R&D and/or pilot projects. To summarize:

- In Finland, there has been a specific innovation incentive since 2012. The current regulatory methodology for 2016 - 2019, and the one for 2020 - 2023, envisage that R&D costs of up to 1% from the annual turnover can be treated as a pass-through cost. Only OPEX can be utilized in this incentive (not CAPEX). The regulator has given some instructions in advance on what type of costs can be seen as R&D costs, but the final interpretation will be received only afterwards, after the regulatory period. R&D OPEX which can be included in the incentive should be related to the creation of totally new information, technology or products for electricity network business (e.g. smart solutions related pilot projects). The results from the projects should also be publicly available.
- In the current French regulatory period, R&D and pilot projects' operating costs are covered by a specific portion of the distribution. In France, costs for smart grid related R&D and pilot projects are covered within the distribution network tariff. These costs are excluded from the benchmarking.

<sup>35</sup> Source: Büttner Held B, October 2017, Assessment of the Implementation of Smart Energy Networks (Smart Grids and Smart Gas Grid) from a Legal/Regulatory Perspective





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- From 2017 onwards, the approved budget for R&D and pilot projects started to be added to the annual allowed revenues in Greece
- In Norway, expenditures for R&D and pilot projects are added to the allowed revenues (max. 0.3% of regulated asset base)
- The Slovenian regulatory framework acknowledges 3% of the book value for smart grid investments
- In Great Britain, together with RIIO, Ofgem grants with extra TOTEX the innovative initiatives to encourage innovation. The RIIO model does not differentiate between CAPEX and OPEX. OPEX for funded smart grid pilot projects will be recognized in the allowed revenues as well.
- In Portugal, the DSO receives 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.
- In Ireland, the regulator can provide OPEX allowances for smart grid related R&D projects. Separately, there is also an 'Innovation OPEX fund' for projects. If they succeed, they strategically innovate and change how the DSO operates.

Among those, seven countries (except Finland and Greece) have a regulatory framework that fosters or rather hampers innovation/R&D as shown in Figure 19.

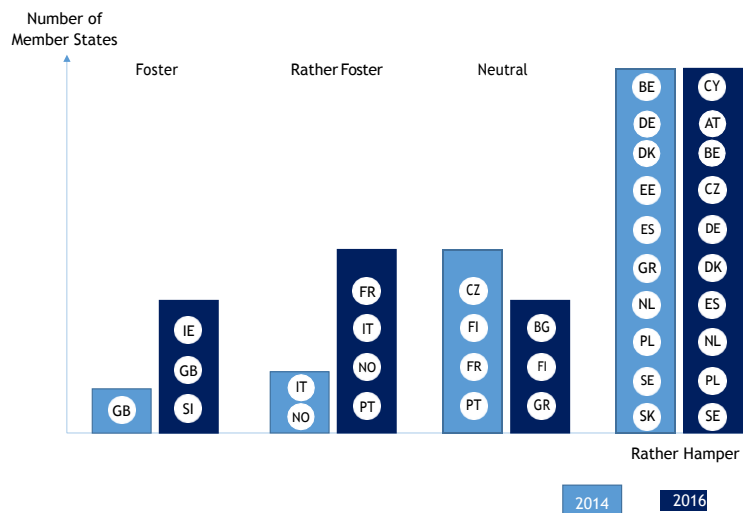


Figure 19: Fostering of innovation/R&D by the Regulatory Framework

In 2016, four DSOs (from France, Ireland, Portugal and Slovenia) considered that their regulatory frameworks fosters or rather fosters innovation/R&D. Greece has implemented a new specific mechanism to promote innovation, and it has not been properly evaluated at the time of the report published so it is categorized as neutral. In Denmark, the regulatory framework rather hampers innovation/R&D; however, in some cases Smart Grid costs may be subtracted from the cost base for the benchmarking. According to Euroelectric's study, if the regulatory framework treats costs for innovation/ R&D like any other costs, the system rather hampers innovation.





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In 2017, the Joint Research Centre (JRC) published a report on smart grids where financing of these projects was also mentioned. Within the scope of the JRC report <sup>36</sup>, six project domains were identified that are smart network management (SNM), demand side management (DSM), integration of distributed generation and storage (DG&S), electric mobility (E-mobility), integration of large-scale renewable energy sources (L\_RES) and other. On the other hand, the main actors participating in smart grid projects were grouped in 15 different stakeholder categories that are; generation companies, utilities, transmission system operators (TSOs), DSOs, retail companies, ICT and telecom companies, technology manufacturers, industry associations, companies providing engineering services, universities, research centres, consultancies, public institutions, emerging stakeholders and other.

DSOs are the stakeholders with the highest investment, but non-traditional actors such as public institutions and other emerging stakeholders are steadily increasing their investment in the field. According to the Figure 19; 540 R&D and 410 demonstration projects has been performed in 2017 with investment amount €1.61 billion and €3.63 billion respectively.



Figure 20: Summary of 2017 Database <sup>37</sup>

There are mainly three types of funding in EU, which are private, national and EU funding. Private investment is the most important source of financing of smart grid projects, but European and national funding play an important role in leveraging private finance and incentivizing investment. Only 15% of the projects in the database are financed exclusively by private resources and this shows the importance of European and national funding to leverage private finance and incentivize investment. In some of the countries national regulatory reforms introduced specific incentives for innovation activities, which might encourage DSOs to invest more in innovation projects. In addition, national funding also supports actors that normally have limited access to capital, such as

<sup>36</sup> Source: Gangale F., Vasiljevska J., Covrig C. F., Mengolini A., Fulli G., (2017), JRC Science for Policy Report, Smart Grid Projects Outlook 2017, Facts, Figures and Trends in Europe

<sup>37</sup> Source: Gangale F., Vasiljevska J., Covrig C. F., Mengolini A., Fulli G., (2017), JRC Science for Policy Report, Smart Grid Projects Outlook 2017, Facts, Figures and Trends in Europe





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SMEs. European funding seems to play a key role in supporting investment especially in those countries where smart grids are still not high on the national agenda.

According to JRC, funding made available to network operators by NRAs, to give specific incentives to innovation activities, is considered within the category own/private financing since most investment made by network operators is financed through tariffs, either through the general incentive mechanism for investment or through specific incentive schemes/programs. Irrespective of the regulatory mechanism, once the DSO gets its revenues, they become part of its own/private resources. Examples of this type of financing are the call for smart grid demonstration projects launched by the Italian NRA and the United Kingdom Low Carbon Networks Fund (LCNF).

The amount of available co-funding has a strong influence on the level of investment and can influence the project scope, supporting the development of more ambitious and expensive projects. Countries with extensive supporting mechanisms in place, such as Germany and the United Kingdom, show a high level of investment. In addition, a country's participation to EU co-funded projects can also positively influence the national level of investment, as EU co-funded projects show a higher average budget compared to projects receiving only national co-funding (€7.21 million and €4.72 million respectively).

In most countries R&D and demonstration projects are treated like any other cost, without any specific compensation for the risks involved in testing new processes and technologies. Public institutions are increasingly interested in participating in smart grid projects as a way to find solutions to improve the sustainability, affordability and security of local energy systems, thus addressing the concerns of a growing number of consumers and communities. Their participation in smart grid projects is nevertheless hindered by their lack of experience and resources. For the vast majority of projects, private investors have had the need to seek financial support from national and European funding schemes. This observation confirms the importance of external funding to leverage private finance and incentivize investment.

Figure 21 shows investment amount in terms of financing type:

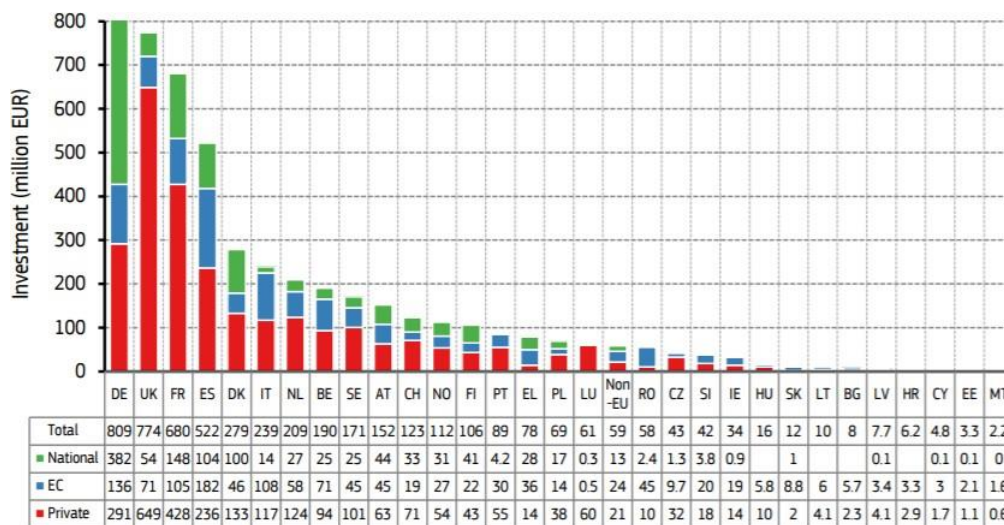


Figure 21: Total Investment per Country by Source of Financing





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- In the United Kingdom, the innovation incentives made available by NRA is considered as private financing. About 30% the projects from the United Kingdom received such incentives, and this circumstance increased the share of total private investment.
- In Luxembourg, the high percentage of private financing is attributable to one big project led by the transmission and distribution network operator, Creos Luxembourg, to improve the observability and controllability of the networks, which includes the roll-out of smart meters.
- Private investment is also high in Belgium, Denmark (mostly the area around Copenhagen) Spain (particularly the Basque region area), France (mainly the area around Paris), Italy and the Netherlands.

National funding schemes can be a powerful tool to encourage innovation and to support actors who normally have limited access to capital, such as SMEs. For network companies, access to national funding can be a valid alternative to regulatory funding in order to pursue innovation projects. Some Member States have set up extensive supporting schemes for smart grid innovation. In the majority of Member States share of national funding percentage is under 10%, while in seven countries it is over 20% (Denmark, Germany, Greece, France, Austria, Poland and Finland).

- As an example, in Germany, national funding accounts for 47% of the total national investment. An interesting example of such funding comes from the “E-Energy – ICT Based Energy System of the Future” initiative, a joint funding program of the Federal Ministry of Economics and Technology (BMWi) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The 4-year initiative had a funding of about €60 million and promoted the creation of six e-energy model regions where key technologies and business models for smart grid deployment were developed and tested.
- In Denmark, national funding accounts for 36% of the total national investment. A relevant part of this funding comes from ForskEL, a funding program launched in 1998 and administered by Energinet.dk, the national TSO for electricity and gas. The purpose of the program is to grant funding for research, development and demonstration projects needed to utilize environmentally friendly electricity generation technologies, including the development of an environmentally friendly and secure electricity system. On an annual basis, the Minister for Energy, Utilities and Climate determines the focus areas of the program as well as the financial framework. In the last few years, the annual funding made available by ForskEL amounted to 130 million DKK, equivalent to about €17.5 million.
- In Finland, for example, smart grid innovation projects have received funding by Tekes, the Finnish Funding Agency for Innovation. These funds have been channelled mostly through the Smart Grid Energy Market (SGEM) program, a 5-year initiative that focuses on power distribution and interfaces.
- In France, several smart grid projects have been funded by the Investment for the Future Program (Programme d'Investissements d'Avenir (PIA)).





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### 3.3 Roles, Responsibilities, Strategies and Actions of Regulated Entities and Public Institutions in Incentivizing Country-Specific Targets (Electricity Distribution)

#### 3.3.1 Overview

In most of the countries, NRAs identify regulatory models with incentives schemes considering the specific conditions situations and challenges in their country as well as the developments in energy sector. National Regulatory Authorities need to set incentives which deliver the most efficient long-term outcomes for consumers, especially in the absence of competitive pressure for DSOs. Regulatory decisions create a wide range of effects, where the NRA has to strike a balance in setting the (financial) breadth of regulation, efficiency incentives and explicit mechanisms for other aims like quality of service, market integration and the promotion of innovative solutions. For instance, a very strong focus on cost efficiency might weaken incentives for quality or incentives for goals other than cost efficiency. These effects have to be balanced by each NRA, taking into consideration the regulatory framework. In this regard, there is no one unique solution in terms of regulatory approach. NRAs should also try to keep regulation as neutral and unbiased as possible, so that DSOs can make their own decisions on how to achieve the goals under an optimal allocation of resources and balance between operational cost (OPEX) and capital cost (CAPEX).

The regulated entities and public institutions that could potentially be the key stakeholders in R&D projects and innovation activities in the electricity distribution sectors are described below, along with their current and future roles and responsibilities.

#### National Regulatory Authorities

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 incentivization of R&D projects and innovation activities, NRAs are also responsible for setting the framework for incentivizing innovation. According to CEER<sup>38</sup>, 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.

#### Electricity Distribution System Operator

Electricity Distribution System Operators (DSOs) play a fundamental role in the operation of electricity networks since they are responsible for the operation, maintenance, and development of the portion of the electricity network that links the transmission system and the end customer. Moreover, electricity DSOs play an important role as market facilitators for suppliers by making sure that the electricity is transported in a safe and efficient manner. Finally, CEER<sup>38</sup> acknowledges also the importance of electricity DSOs to decide on the suitable innovation solutions to be applied in their networks, according to according to the individual needs of the electricity DSOs.

<sup>38</sup> “C17-DS-37-05 - Incentives Schemes for Regulating Distribution System Operators, including for innovation”, CEER, 2018





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### Electricity Transmission System Operator

Electricity Transmission System Operators (TSOs) are responsible for the operation and maintenance of the transmission network, as well as its development. Moreover, one of the main roles of TSOs is to guarantee the security of supply to the increasing energy demands. Since the roles of TSOs and DSOs are by nature closely coupled, innovation incentivization schemes should foster the collaboration of electricity TSOs and DSOs in specific innovation areas and the dissemination of the R&D results with the relevant stakeholders of the energy system.

### Gas System Operators

The gas 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.

However, a number of non-regulated stakeholders, that are closely coupled, play an important role in incentivizing and fostering innovation in the electricity distribution sector.

### Consumers

Consumers are a key stakeholder in the energy chain, since according to CEER<sup>38</sup> 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 R&D projects and innovation activities through network tariffs. Finally, for DSOs, consumers play 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 innovation in the European setting. In UK and France, the NRAs engage national research institutions in the evaluation process of R&D projects and innovation requesting funding. Moreover, DSOs often collaborate with the academia and research institutions for their R&D activities. Finally, CEER<sup>38</sup> 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 R&D and demonstration projects, national funding programs or European Framework Programs for Research and Innovation.





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### International Entities

The European Commission provides funding for R&D projects and innovation 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. These frameworks have already been presented and it is recommended to DSOs to exploit these funding mechanisms by joining consortia that also involve European electricity DSOs and TSOs to finance their own R&D and innovation activities.

### 3.3.2 Innovation and R&D

CEER supports innovative solutions where they are in the energy consumer interest, avoiding regulatory overburdening when setting reporting requirements and allowing only efficient implementation costs for innovative solutions from DSOs. Innovation may come in different forms. Innovation may enhance network operation, e.g. in terms of intelligent steering and control or measuring systems. Ideally, using innovative solutions leads to a more efficient system than using conventional ones. NRAs act as the main body to develop the regulations that define the concept of innovation.

#### Innovation

help to reduce network expansion, and maximize the use of the existing infrastructure

(the employment of network beneficial flexibility services and other innovative managements of the distribution grid) help to better exploit available network capacity or to avoid network expansion in case of network congestions due to increasing feed-in from renewables

help to improve operational aspects within the DSO

improve the reliability of the grid

Figure 22: More efficient systems with innovation<sup>39</sup>

NRAs may decide to explicitly incentivize innovation and innovation incentives can be considered as one of the main instruments to achieve regulatory aims (e.g. quality of supply, efficiency). Depending on which of these strategies is being pursued, the calibration of regulatory incentives may vary significantly.

In the first case (indirect), where innovation rather constitutes a simple instrument to reach the regulatory aim of efficiency, incentives for innovation will come in an indirect form linked to the efficiency incentive applied. When a good performance indicator and a clear metric is identified, the regulator can set up an efficient, reliable and controllable output-based mechanism. For instance, in a country where TOTEX benchmarking yields efficiency targets for a DSO. A DSO might realize that its distribution task with an innovative solution is less costly than the conventional solution employed by DSO B. In this situation, the innovative DSO would have a higher profit and innovations that increase efficiency pay off and if the incentive is indirect, the decision for the most efficient solution is left to the network operator. Innovation is not regarded as an aim by itself and the regulatory system rather focus

<sup>39</sup> Source: CEER, January 2017, Incentives Schemes for regulating DSOs, including for Innovation





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on efficiency incentives, e.g. by providing a bonus for very efficient behaviour. This would reward innovations indirectly when the innovation leads to more efficiency. This approach is technologically neutral.

In the second case, where innovation is one of the main instruments, incentives may come in more direct, explicit forms. This happens mainly when the regulatory approach in place requires a stronger drive to implement certain solutions for changing needs. In these cases, the regulator might increase WACC for certain innovative technologies such as smart grids. Another possible approach is to treat certain costs related to R&D as pass through costs in the model when setting revenues. Here, some criteria must be defined for the items to be included. The criteria shall be both good enough to promote relevant innovations and easy enough to apply in practice.

In order to enable the definition of effective incentive schemes, which balance different perspectives, the Portuguese NRA (ERSE) has implemented a set of regulatory policies which are based on several rules, such as transparency, collaboration with stakeholders, and monitoring, under a stable and predictable regulatory framework. These rules have consistently supported ERSE in defining its main regulatory goals and in evaluating, or adapting if necessary, the regulatory tools it applies, based on the feedback from stakeholders.

Portuguese regulatory framework has enabled innovation at DSO level that may push the DSO to higher service levels, like meter reading frequency and consumption data acquisition, dispersed generation metering, quality of service data coverage and reporting, distribution network asset reporting and implementation of automation and remote control solutions, etc. The mechanism adopted by ERSE to promote innovation also benefits from this effective governance framework. Innovation incentives were designed after a consultation process in which stakeholders perspectives were balanced: on the one hand consumers, who tend to be more concerned with cost control in the short run, and on the other hand the DSO, that requires a stable regulatory framework in the long run. The current version of the mechanism encourages regulated companies to invest in projects/ technologies that would lower operating costs while also generating other benefits (i.e., improved quality of service).<sup>40</sup>

### 3.3.3 Electric Vehicles Charging Infrastructure

Electric mobility is progressing rapidly across Europe with many countries and companies that are planning and implementing Electric Vehicle (EV) charging infrastructure. In EU countries, EV charging infrastructure does not have the characteristics of a natural monopoly and the role and responsibilities can be assigned to a range of stakeholders.

Several actors including charge point providers, power companies, car producers, national and local government may play a role in the provision of EV charging infrastructure, such as DSOs or suppliers who can use the charging points to sell electricity. Other commercial actors may also provide access to EV infrastructure, such as private investors and independent e-mobility providers who may provide electricity bundled with other services.

This infrastructure can be built in a competitive market environment and in line with the regulations Member States shall ensure that DSOs cooperate on a non-discriminatory basis with any person establishing or operating charging points accessible to the public. That is, DSOs should treat EV charging infrastructure operators as they do with any other network user.

Independent of the choice for DSOs or market actors in charge of EV charging infrastructure, DSOs supervise the consequences of additional charging points for grid reliability and the need for additional network capacity like for

<sup>40</sup> Source: CEER, January 2017, Incentives Schemes for regulating DSOs, including for Innovation Consultation Paper





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regular grid connection. They also provide proactively information on potential network constraints for EV charging points to multiple market players. The other way around DSOs should be informed in advance of proposals for new charging points in the grid. In that way they are allowed to prepare themselves adequately for adjustments in network planning and/or operation.

In most of the EU member states, public and private companies cooperate in order to strengthen the EV infrastructure, main use of the funds such as TEN-T, CEF, Horizon 2020 etc. The general approach to install fast EV charging stations is that; a tender document is published and awarded company is chosen in a competitive environment. In most cases, funding meets only a portion of the investment and the remaining amount is financed by the company's own budget. Recently, as a result of increasing EVs and maturity of the market, the sector became more profitable for the companies providing EV charging services. As a result of this, the requirement for public funding decreased and distributors started investments to get a market share in the competitive market.

- In Norway, in addition to the national government as the main body, local government and municipalities are also supporting instalment of EV charging stations. In the first phase, support mechanism constituted 100% of the installation cost, however no support was provided for OPEX. Main sponsor of the Norway's EV charging infrastructure has been state-owned Enova and the company has invested €6 million in 2009 and published 4 competitive tender documents in 2015 and in 2016. In 2018, €2.1 million budget was spared in Oslo to install EV charging stations.
- In the Netherlands, Government has programs such as Electric Mobility Gets Up to Speed and Green Deal. However, local authorities' role and responsibilities are much more compared to the government. There is an open tender process performed by the government and both network companies and private companies can apply for tenders. Local authorities provide funding mostly for equipment and installation, whereas awarded consortium is responsible for operation of the infrastructure. Consortium members are electricity generators (NUON/Vattenfall, Essent/RWE), construction companies (Heijmans, BAM, Ballast Nedam) and charging equipment manufacturers (Enovates, Alfen, RWE). In some cases, additional services providers are also involved within the consortium (The New Motion, BlueCorner).
- In UK, the Government introduced the Plugged-in-Places (PiPs - 8 regional network) program, which is based on cooperation of local authorities and private sector. Office for Low Emission Vehicles (OLEV) provides funding to local authorities for installation of Level 2 charging stations. 75% of the hardware cost is met by the program. Local authorities have private funds and pilot projects regarding installation of charging infrastructure.

### 3.3.4 Storage Facilities

Several countries in Europe are moving to a more decentralized, intermittent generation at an increasingly local level. Intermittent generation which is often connected at distribution level brings a new set of challenges for grid operators and energy storage plays an increasingly important role for DSOs with respect to managing grid constraints. CEER takes the position that storage related services are to be provided by market-based entities and this activity should become an entirely competition based non-DSO activity. However, in specific circumstances where there is technical justification and the activity has received approval by the relevant NRA, DSOs can utilize new technologies such as battery storage for the provision of services which they are required to deliver within the remit of their core operations. As part of their core regulated activity, DSOs are required to ensure interruptions to electricity supply are minimized. Where outages and temporal technical constraints require DSOs to support their grid with local power injections, DSOs might be able to do so using battery storage.





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- As an example, in Norway, NVE is incentivizing national pilots where DSOs can both own and operate batteries as an alternative to traditional grid investments. The applications for storage are restricted as part of these pilots, primarily for resolving short duration capacity problems and poor voltage quality in long and weak feeders as they occur at the outermost ends of the network in scarcely populated areas. NVE suggests that a limited number of small stand-alone batteries can be beneficial to local grid conditions and should not have any significant impact on the energy market. When cost-effective batteries with improved charging and discharging capabilities become available, e.g. using larger grid installed storage systems or EVs, new regulations must be developed and implemented. It is highly unlikely that DSOs will be allowed to own energy storage systems in such circumstances.<sup>41</sup>
- In Italy, energy storage investments undertaken by DSOs are not recoverable through distribution network tariffs, unless the DSO submits a proposal providing a cost benefit analysis to the regulator that justifies such investments. ARERA, the Italian energy regulator, commissioned an academic research to devise a methodology to appraise investments in storage investments undertaken by DSOs, primarily concerned with their socio-economic benefit/cost ratio, considering different features in terms of distribution network topology and conditions, and load and generation profiles. The methodology was applied to medium voltage (MV) networks, which are statistically representative of various types of Italian MV networks. The methodology considers CAPEX for the storage facility investment and seven benefit categories:
  - Deferred or avoided capital expenditures for network elements (e.g. revamping or substitution of lines and transformers)
  - Avoided curtailments of RES generation
  - Reduction of energy losses
  - Improvement of continuity of supply
  - Reduction of reactive power exchange at the TSO/DSO interface
  - Voltage dip mitigation
  - Improvement of voltage regulation capabilities.

The analysis determined that a storage facility can be economically efficient (i.e. benefits outweigh costs, over a medium-term horizon of 10 years), given the average distribution network topology in Italy and reasonable assumptions on load and generation profiles.

- In the United Kingdom, Ofgem has made changes to the regulatory framework to ensure that the provision of storage related services is a market activity unless very specific technical circumstances warrant DSO ownership and operation of storage assets. To that end, regulatory interventions have been made to classify storage as an activity of electricity generation and to disallow DSOs from generating electricity; thereby allowing for continued ownership of storage assets by DSOs but ensuring operation such assets are operated by third parties to avoid conflicts of interest. This new regulatory regime does however allow DSOs to operate assets with generation capability in very limited circumstances, for example on island systems and where storage assets are part of technical DSO operations (such as outage management or back-up power for operational centres), or indeed under an exceptions regime for which the DSO has to

<sup>41</sup> Source: March 2019, New Services and DSO Involvement A CEER Conclusions Paper





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apply for, evidencing that a market test did not yield any third party interest and that DSO operation of the asset is the most cost-efficient solution.

### 3.3.5 Distributed Generation

The European Union’s draft Electricity Regulation requires DSOs to facilitate the integration of distributed energy resources. With the increase of distributed generation and the amount of small-scale prosumers, which is often not dispatchable due to its intermittent nature, network flows become more variable and cannot longer be efficiently resolved in the network planning phase by increasing network investments. In this regard, DSOs have to fulfil new roles or have to expand existing roles towards optimization of local generation and consumption.

Broadly two categories of DSOs can be distinguished that are DSOs that are responsible for complex systems and DSOs responsible for less complex systems. DSOs in member states with a higher penetration of DER and a higher number of small scale prosumers (i.e. more complex systems) are likely to perform already the initial steps of active network management, while DSOs in member states with a lower penetration of DER may still operate their network on the basis of passive network management.<sup>42</sup> Within this context; conventional and emerging roles of DSOs might be listed as follows:



Figure 23: Conventional and Emerging Roles of DSOs<sup>43</sup>

### 3.3.6 Energy Efficiency

Energy efficiency services have several competitive features. For instance, they have the characteristics of a private good that can be bought and sold in competitive markets or entry and exit barriers to the supply of energy efficiency services are limited. These increase the scope for innovation and often results from the involvement of new actors. A number of different actors can provide energy efficiency services, such as DSOs, electricity suppliers, as well as independent firms, such as ESCOs.

On the other hand, energy efficiency services have several monopolistic features such as economies of scale may be realized by following district-by-district approach, some economies of scope might be realized with either provision of metering services by DSOs or provision of renewable energy by suppliers. Given the monopolistic characteristics of energy efficiency services, there are a number of clear reasons for public intervention. However, the characteristics do not point to a natural monopoly and therefore an exclusive role for DSOs. This implies that

<sup>42</sup> Source: ECORYS, April 2014, The Role of DSOs in a Smart Grid Environment,

<sup>43</sup> Source: IRENA, 2019, Future Role of Distribution System Operators, Innovation Landscape Brief





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several actors may qualify for the provision of energy efficiency services. In terms of energy efficiency services suppliers are mostly the main point of contact.

In Portugal DSO's innovation is fostered through an incentive based tender process designed to promote energy efficiency, which is open to all kinds of stakeholders. The incumbent DSO has participated with projects focused on energy efficiency in public lighting (one of its core activities).

### 3.4 As-is Regulatory Practices and Innovation Activities of Electricity Distribution Companies in Turkey

#### 3.4.1 General Information about Regulatory Practices, Strategy and R&D Targets

In Turkey, R&D activities of electricity distribution companies are regulated by the R&D Principles and Procedures published in the Official gazette dated 28 March 2014. R&D budgets within the scope of tariffs shall be only used to increase innovation, efficiency and service quality, decrease losses and costs related to losses, develop technology related to system operation, generate information and improve electricity and natural gas infrastructure.

All of the expenses to perform an R&D project including software/hardware, engineering/consultancy, training, documentation, transportation, personnel etc. are met by R&D budget. General expenses related to R&D activities (establishment of design or R&D centres by DSOs, collaborations with start-ups/entrepreneurs, etc.) and expenses of the projects that were rejected during the application phase are financed from R&D budget (at most 10% of the R&D budget).

R&D project applications are done each year in January and July and decisions regarding the applications are finalized within 3 months.

Within the scope of the application document; name, aim, scope of the project, scientific and technological characteristics, innovation level, risk assessment, targets, value added, efficiency and power of competition, total expected budget and duration as well as parties of the project have to be defined.

DSOs might apply for the projects on their own or for a common project.

Projects that are within the scope of operational activities are that have the characteristic of investment are not accepted as R&D projects.

R&D projects that are funded by EU, TUBITAK or similar institutions are also approved as R&D projects without additional evaluation. The budget that is not funded is met by DSO's own R&D budget.

Budget and duration of approved R&D projects do not change. However, in case it is approved by the commission, duration of the project might be extended at most 50% and budget might be revised once.

Promoting development required technology and innovation for efficient and effective system operation, current legislation frames R&D activities based on the following criteria:

- Development of technology and know-how for system operations
- Increase in the prevalence of domestic technology





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- Enhancement of service quality, system performance and security
- Reduction of costs through operational efficiency and improvement of system losses
- Reaching the international quality standards in distribution system

### 3.4.2 Factors Promoting R&D Applications

Supporting the abovementioned strategy, allocated R&D budget can be utilized for any costs and expenses such as consultancy, training, certification, transportation, equipment, even before and after project application and approval by the Commission. Besides, any reasonable costs regarding entrepreneurship activities, incubators, acceleration programs, idea generation competitions as well as activities under participation to promote and encourage entrepreneurship can be covered by R&D tariff model up to 10% of the approved R&D budget.

Furthermore, in the event that a patent is obtained as a result of the realization of an R&D project approved by the Commission within the framework of the Procedures and Principles, an extra amount that corresponds to 5% of the approved project budget per patent, excluding the R&D budget of the relevant distribution company (shall not exceed 500,000 (five hundred thousand) TL per project) is added to budget of the DSO. The added amount is not taken into account in the correction procedures of the related distribution company's R&D budget. This recent incentive added to the secondary legislation is a robust sign that shows EMRA's attitude fostering the innovation activities.

In addition to financial promotions, further convenience is provided through semi-annual application and prompt evaluation periods. Digital application folder is expected to satisfy at least project name, purpose, scope, term/schedule, originality, targets, financial plan through standard forms which can be jointly prepared based on complementary competences of distribution companies as well as individual application.

Approved R&D project budget may be revised for once only and the period may be revised more than once, provided that it does not exceed 50% of the approved period. In case of achievement of any invention, (patent or petty patent) industrial design, artefact, integrated circuit design, technical information and software as a deliverable of the R&D projects, probable intellectual and industrial property rights are considered in possession of the project executor or partners.

### 3.4.3 Monitoring and Reporting

Distribution companies are supposed to report and notify following cases regularly:

- Semi-annual development reports shall be submitted within 30 days
- Conclusion reports shall be submitted within 30 days as of the completion date
- Semi-annual Detailed progress reports regarding developments prior to the R&D activities, works completed or in progress, realized expenses, gained benefits and deliverables as well as necessary justification for termination of the R&D project or related activities

In order to announce the activity and achievements, a common website can be designed and setup with the attendance of all the distribution companies or other electronic platforms may be used following Commission's approval. Such expenses are covered by R&D tariff within the previously mentioned 10% of approved R&D budget.





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In case any intellectual property right arises during implementation process or at the end of an R&D project such as an invention, patent, utility model, industrial design, copyright, integrated circuit topography, technical information or software, these rights will be at the disposal of the operator or partner distribution companies of the relevant project.

### 3.4.4 Electricity Distribution R&D Projects Approved till 2020

Electricity distribution is the most advanced regulated energy sector on R&D and innovation activities.

'R&D in Energy Workshop' is regularly organized jointly by the Association of Distribution System Operators (ELDER) and the Natural Gas Distribution Companies Association (GAZBİR) under the coordination of EMRA. Gathering universities and technicians together with electricity and natural gas distribution companies, R&D Achievement Awards to winners are presented to selected projects/DSOs in this event.

So far, in the electricity distribution sector, DSOs have received approval of EMRA for more than 190 projects since 2014. Some of the projects have been completed already.

Following table presents approved electricity distribution R&D applications in terms of project name, category, duration and application period, respectively.

Table 5: Electricity Distribution R&D Projects Approved by EMRA Commission

#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
1	Development of Integrated Feeder Automation System by Using Fault Indicator Devices and Quick Recloser Circuit Breakers and Sectionalizers in MV Overhead Line Feeders	Monitoring and Control	14 months	Jul-14	ÇEDAS, AEDAS
2.1	Impact Analysis and Optimization of Embedded System in the Distribution System (PV)	Systems Embedded in Distribution	18 months	Jul-14	MEDAS, ÇEDAS
2.2	Impact Analysis and Optimization of Embedded System in the Distribution System (Load Management)	Systems Embedded in Distribution	18 months	Jul-14	MEDAS, Başkent
2.3	Impact Analysis and Optimization of Embedded System in the Distribution System (DG Best Practices)	Systems Embedded in Distribution	8 months	Jul-14	Aras, DEDAS
2.4	Impact Analysis and Optimization of Embedded System in the Distribution System (Electric Vehicles)	Systems Embedded in Distribution	22 months	Jul-14	Başkent, BEDAS
2.5	Impact Analysis and Optimization of Embedded System in the Distribution System (HPP)	Systems Embedded in Distribution	12 months	Jul-14	Aras

<sup>44</sup> ELDER's categorization, [www.argebilgi.info](http://www.argebilgi.info)





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
3	Coping with Theft and Loss in Electricity Distribution Network	Reducing Technical and Non-Technical Losses	14 months	Jul-14	ARAS EDAS, DEDAS
4	Methodology and Software Development for the Determination of the Technical Loss Level Accurately in Electricity Distribution Networks	Reducing Technical and Non-Technical Losses	20 months	Jul-14	BEDAS, MEDAS, ÇEDAS
5	Decision Support Tool for Adaption to Climate Change	Other	48 months	Jul-14	Akdeniz EDAS
6	Smart Energy Aware System	Other	35 months	Jul-14	ENERJISA (Horizon 2020)
7	Design a Protection / Control System for MV Network and Reconstruction for Closed Ring Operation with Pilot Zone Application	Network Operation	25 months	Jul-14	BEDAS
8	Effects and Optimization of Profile Coefficient Preparation Methodology on Imbalance Costs	Other	19 months	Jul-14	SEDAS
9	Determination of Economic Lifetime of Electricity Distribution Conductors	Material Technology	24 months	Jul-14	YEDAS
10	Determination of Pilot Application, Feasibility and Dissemination Roadmap for Smart Meters with Hybrid Communication Infrastructure	Network Operations	24 months	Jul-14	BEDAS, UEDAS, Akdeniz, ÇEDAS
11	Technical-Economic Analysis for Conversion of 3 phase MV/LV Distribution Transformers to 1-phase-Transformers in Rural Network	Climate, Environment and Emergency Action Plan	9 months	Jan-15	YEDAS
12	Encryption of Energy	Network Operations	15 months	Jan-15	DEDAS
13	Fault Detection with Ultraviolet Camera	Technology Development on Network Operations	12 months	Jan-15	KCETAS
14	Broadband Communication of Distribution Lines	Network Operations	12 months	Jan-15	KCETAS
15	New Generation Lighting Design	Monitoring and Control	11 months	Jan-15	Başkent





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
16	Research of Voltage Regulation Technologies for Medium and Low Voltage Networks	Communication Technology	14 months	Jan-15	Başkent, Toroslar, AYEDAS
17	Automatic Voltage Regulator (Booster Transformer) Pilot Application for Voltage Regulation and Reducing the Line Losses of MV Overhead Line and Cable Networks	Network Operations	18 months	Jan-15	UEDAS, ÇEDAS, BEDAS, Akdeniz
18	Analysis and Proposing Solutions for Faults and Life Shortening Events of Overloaded Underground Cables	Material Technology	18 months	Jan-15	BEDAS
19	Development an Android and IOS based Consumer Application Software and Integration with Outage Management System	Network Operations	6 months	Jan-15	AYDEM
20	Turkey's Smart Grid 2023 Project for Determining Vision and Strategy	T.A.Ş. 2023	9 months	Jan-15	Akdeniz, AYEDAS, AYDEM, Başkent, BEDAS, ÇEDAS, GDZ, Toroslar, UEDAS
21	Method, Metric and Algorithm Development Project for the Optimization of MV Network Investments	Network Operation	12 months	Jul-15	Akdeniz
22	Domestic Meter Prototype Development for Smart Grids	Material Technology	33 months	Jul-15	AYEDAS
23	Pilot Applications for Reducing the Effects of Short Circuit Currents and Investigation of Fault Current Limiting Solutions	Monitoring and Control	19 months	Jul-15	AYEDAS, Toroslar
24	Designing and Production a Unmanned Aircraft Prototype for Electricity Distribution Operations	Monitoring and Control	12 months	Jul-15	Başkent
25	Technical and Economic Feasibility Analysis (AGEF) of LV Express Feeder to Minimize No-Load Losses of Transformers in Summer Regions	Reducing Technical and Non-Technical Losses	9 months	Jul-15	Başkent, Toroslar
26	Investigating the Effects of Demand Side Participation on Distribution Companies and Determining the Positioning of Distribution Companies in the New Market Conditions	Demand Side Participation	18 months	Jul-15	Başkent





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
27	Central Uninterruptible Power Supply and Battery Monitoring System for Critical Loads	Communication Technology	3 months	Jul-15	Başkent
28	Development of Smart Meter Systems Cost-Benefit Analysis Methodology, Dissemination Roadmap Study for ADM and GDZ EDCo Regions	Communication Technology	3 months 3 week	Jul-15	GDZ, ADM
29	Technical and Economic Feasibility Analysis of Energy Distribution in LV Feeders with 1 kV Voltage Level	Network Operation	12 months	Jul-15	GDZ, ADM
30	Developing a Decision Support System Which Based on Technical and Economic Analysis for Determining the most appropriate MV Voltage Level, Equipment Selection and Maintenance Strategies by Considering the Specific Problems of Geographical and Climate Conditions.	Network Operation	8 months	Jul-15	GDZ, ADM
31	Maintenance Management System Prototype Development with Remote Sensing in Overhead Networks by Focusing Forecast and Reliability	Network Operation	18 months	Jul-15	Akdeniz, OEDAS
32	Converting of Electronic Meters by an Optical port for Communication and Remote Reading	Communication Technology	12 months	Jul-15	SEDAS
33	Development a Fault Test Equipment for Mobile Meters	Material Technology	18 months	Jul-15	Toroslar
34	Development and Pilot Application of Integrated Smart Grid Platform for Critical Infrastructure Management in Smart Cities	Communication Technology	36 months	Jul-15	Toroslar
35	Arc-Flash Analysis and Investigation of Onload Maintenance Applicability of Distribution Networks	OHS	14 months	Jul-15	Toroslar, Başkent, AYEDAS, TREDAS
36	Investigation of the Negative Effects of Electricity Distribution Systems on Birds and Methods of Reducing Birds-Related Outages and Pilot Applications	Climate, Environment and Emergency Action Plans	18 months	Jul-15	TREDAS
37	Network Ear	Network Operation	18 months	Jul-15	TREDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
38	Network Management Module Development for Compensation and Voltage Regulation	Monitoring and Control	12 months	Jul-15	YEDAS
39	Cyber Security Standardization in Smart Grid	Monitoring and Control	9 months	Jul-15	YEDAS
40	Determining the Optimum Application for ADMEDCo network by examining the Best World Examples for Storage Systems	Communication Technology	14 months	Jan-16	ADM
41	Design and Manufacturing of Thermoplastic Materials as Protective Elements for Cable Ducts	Material Technology	12 months	Jan-16	ADM, GDZ
42	Multi-Input Smart Distribution Automation System	Monitoring and Control	29 months	Jan-16	Akdeniz
43	Smart Seal System Development	Reducing Technical and Non-Technical Losses	9 months	Jan-16	Akdeniz
44	Developing solutions to Prevent Long-Term Outages due to Ice load in Electricity Grids	Monitoring and Control	18 months	Jan-16	Aras, KCETAŞ, OEDAS
45	Distributed Generation Control Project for the Solution of Load Flow and Voltage Regulation Problems Caused by Bi-Directional Load Flows	Demand Side Participation	18 months	Jan-16	Aras
46	Series (air or iron core) Reactor Application for Voltage Regulation and Load Flow Control in Electricity Distribution Networks	Material Technology	18 months	Jan-16	Aras
47	Developing a Smart System for the Simultaneous Monitoring and Condition Analysis of Distribution Transformers	Monitoring and Control	21 months	Jan-16	UEDAS
48	Submarine Cable Fault Detection by Using a Submarine Robot and Maintenance Management System Development	Monitoring and Control	30 months	Jan-16	UEDAS
49	Composite Core Aluminium Conductor Pilot Zone Application	Material Technology	20 months	Jan-16	UEDAS
50	Pilot Zone Application of Armature with Induction Lamp	Lighting	20 months	Jan-16	UEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
51	Designing a Feeder Measurement, Monitoring, Analysis and Protection System for Low Voltage Network	Monitoring and Control	18 months	Jan-16	BEDAS
52	Heat Control Project, which Creates a Selective Surface with Coatings Reflecting Solar Energy and Reduced Emissivity in Distribution Centres	Material Technology	8 months	Jan-16	BEDAS, UEDAS, Akdeniz
53	System Design and Prototype Production that Provides and Integrates Reliable Bi-Directional Energy Transfer of Separated Electricity Distribution and Transmission Systems	Monitoring and Control	36 months	Jan-16	BEDAS, UEDAS
54	Determining and Characterizing Voltage Collapses in the Electricity Distribution Network, Determining the Most Suitable Solutions by Researching the Methods to Eliminate the Voltage Collapse and Pilot Application	Monitoring and Control	18 months	Jan-16	TREDAS
55	Developing Algorithms and/or Products to Predict and Prevent Icing on MV Overhead Lines	Network Operation	18 months	Jan-16	Çoruh
56	Increasing the Voltage Stability by Controlling the Reactive Power of Distributed Generation in Distribution Networks	Systems Embedded in Distribution	18 months	Jan-16	Çoruh, Fırat
57	Development of Software that will Provide Access for Public Geographical Data to Electricity Distribution Companies and Provide Access to Outage-Fault Information to Consumers	Communication Technology	18 months	Jan-16	DEDAS, Başkent, Toroslar, AYEDAS
58	Development Algorithms and a Software for Automatic Classification of Possible Root Causes of Detected Energy Quality Problems in the Distribution Network	Monitoring and Control	18 months	Jan-16	KCETAŞ
59	Determining the Efficiency and Saving Potential of Lighting Armature	Lighting	12 months	Jan-16	KCETAŞ
60	Smart Sectionalizer System Application in Electricity Distribution System	Material Technology	20 months	Jan-16	Başkent





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
61	Control of Distributed Generation for the Solution of Load Flow and Voltage Regulation Problems Caused by Bi-Directional LoadFlows	Systems Embedded in Distribution	18 months	Jan-16	ARAS EDAS
62	Development of Virtual Reality-Based Occupational Health and Safety Simulations for the Electricity Distribution Sector	OHS	33 months	June-16	Başkent
63	Protection in Case of High Impedance Faults: Investigation of Protection Solutions for High Impedance Faults in Distribution Networks and Pilot Applications	Monitoring and Control	18 months	Jul-16	Aras
64	Developing a Reference Company Methodology, Model and Software for the Preparation of Business Income Requirements in the Electricity Distribution Sector	Other	24 months	Jul-16	14+ EDAS
65	Improving of Theft/Loss and Fault Analysis Processes by Using Big Data Algorithms	Reducing Technical and Non-Technical Losses	22 months	Jul-16	YEDAS
66	Development and Application of Smart Technologies to Improve Occupational Safety	OHS	12 months	Jul-16	ADM ve GDZ
67	Calculation and Separation of Technical Losses and Non-Technical Losses in Electricity Distribution Networks	Reducing Technical and Non-Technical Losses	18 months	Jul-16	ADM ve GDZ
68	System Due Diligence and Estimation of Fault Location Project for Improving Supply Continuity	Monitoring and Control	24 months	Jul-16	Akdeniz
69	Low Loss, Low Cost Energy Quality Regulator Design and Implementation for the Electricity Distribution System	Material Technology	24 months	Jul-16	Akdeniz
70	Development of a Linear Propagation, Inductive Feeding Sonic - Ultrasonic Bird Repellent System for Single Phase Conductor and Pilot Application to Prevent Outages from Bird Strikes in Electricity Distribution Lines	Climate, Environment and Emergency Action Plans	16 months	Jul-16	Akdeniz





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
71	Development of an e-Tender Software to be Used in the Distribution Sector	Other	4 months	Jul-16	AKEDAS
72	Outage Prevention System and Pilot Zone Application Using Real Time Temperature Tracking	Monitoring and Control	4 months	Jul-16	AKEDAS
73	Project for Developing Electrical Fault Estimation Using Meteorological Data and Decision Support System for Proactive Repair Activities	Monitoring and Control	18 months	Jul-16	TREDAS
74	Development of Equipment for Opening and Closing Thermal Magnetic Breaker Remotely to Prevent Occupational Accidents from Explosions	OHS	15 months	Jul-16	AYEDAS, Başkent, Toroslar
75	Proactive Network Design with Pattern Recognition	Other	24 months	Jul-16	Başkent
76	Smart Network Node	Monitoring and Control	26 months	Jul-16	BEDAS
77	Reducing Line Losses and Tension Dropping in Single Core MV Underground Cables by Bonding Type	Material Technology	12 months	Jul-16	BEDAS
78	Solving Power Quality Problems in Low Voltage Networks with IDPR Product	Monitoring and Control	16 months	Jul-16	BEDAS
79	Improving of Theft / Loss and Fault Analysis Processes by Using Big Data Algorithms	Reducing Technical and Non-Technical Losses	16 months	Jul-16	BEDAS
80	Remote Reading of Existing Digital Meters and Taking Subscriber Based Outage Information Instantaneously with Long-range Technology	Communication Technology	14 months	Jul-16	KCETAŞ
81	Common Protocol Development for M2M Communication Systems in Distribution Networks	Communication Technology	14 months	Jul-16	KCETAŞ
82	Detection of Faults and Planned Maintenance / Repair Works in Energy Transmission Lines and Cleaning of Ice Load on the Lines Through Remote Multicopter	Monitoring and Control	10 months	Jul-16	SEDAS
83	Determination of Connection Criteria of Generation Facilities to Distribution Network	Systems Embedded in Distribution	18 months	Jul-16	Toroslar, AYEDAS, Başkent





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
84	Solution Development for Analysis and Prevention of Arc Surges in Electricity Distribution Networks	Monitoring and Control	12 months	Jul-16	TREDAS
85	Electrical Fault Estimation Using Meteorological Data and Development of Decision Support System for Proactive Repair Activities	Monitoring and Control	18 months	Jul-16	TREDAS
86	Developing a Method and Device for the Detection of Distribution Network Elements' Faults Based on the Listening and Analysis of the Audio Signals	Material Technology	16 months	Jul-16	TREDAS
87	Arc Detection Protection System Development and Pilot Zone Application	Network Operation	19 months	Jul-16	UEDAS
88	Investigation of Faults which is caused by Lightning and Switching Pulses and Reducing Permanent Damages in Pole Type Distribution Transformers	Network Operation	16 months	Jan-17	Akdeniz
89	Narrow Band IoT (NB-IoT) Pilot Application	Communication Technology	12 months	Jan-17	Akdeniz
90	Power Electronics Based Voltage Regulator Development and Pilot Application	Material Technology	18 months	Jan-17	Akdeniz
91	DC Lighting of LED Lighting Systems and Remote Voltage Level Control and Adjusting the Brightness Level	Lighting	18 months	Jan-17	ADM ve GDZ
92	Wave Estimation Techniques and Fault Estimation Methods in Distribution Feeders	Monitoring and Control	18 months	Jan-17	ADM ve GDZ
93	Development a Mobile Feedback System	Communication Technology	12 months	Jan-17	BEDAS
94	Pilot Application for 30-40 years Rejuvenation of OG Underground Cables	Material Technology	16 months	Jan-17	BEDAS
95	Pilot Study of Determination and Application Areas of Off Grid	Systems Embedded in Distribution	16 months	Jan-17	ÇEDAS
96	Development and Pilot Application of External Type MV Combined Current-Voltage Sensor for Effective Observation and Analysis in Distribution Systems	Reducing Technical and Non-Technical Losses	18 months	Jan-17	DEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
97	Investigation of Application Examples for Supporting Consumers in Electricity Market and Development a Method	Other	12 months	Jan-17	DEDAS, Aras, VEDAS
98	Research and Suggestion Development for the Multi-Time Application of the National Distribution Tariff Considering the Regional Factors	Other	15 months	Jan-17	AYEDAS, Başkent, Toroslar
99	Transformer Predictive Maintenance Strategy Project with SFRA Technique	Monitoring and Control	18 months	Jan-17	KCETAŞ
100	Assessment of the Participation of Distribution Networks to Ancillary Services from the Perspective of Technical, Benefit-Cost and Legislation Project	Demand Side Participation	18 months	Jan-17	MEDAS
101	Development of an Algorithm Based on Probabilistic Risk Management in the Operation of Distribution Networks Working Under Emergency Scenarios	Climate, Environment and Emergency Action Plans	12 months	Jan-17	SEDAS
102	Transition to Self-Healing Network Project with Appropriate Switching Operations	Monitoring and Control	18 months	Jan-17	SEDAS
103	Determination of Methods for Testing Overhead Line Poles and Production of Direct Support Apparatus Prototype	Material Technology	15 months	Jan-17	Toroslar
104	Fault Warning System Project	Network Operation	18 months	Jan-17	Başkent, Toroslar
105	Maintenance and Repair Training Application in Scada Operations with Augmented Reality Technology (S.A.R.P)	OHS	14 months	Jul-17	SEDAS
106	Development of Problem Estimation and Preventive Maintenance Program for Breakdown - Maintenance Services, Adaptation of Augmented Reality Technology to Operational Processes	Network Operation	15 months	Jul-17	SEDAS
107	Research and Suggestion Development for Market Mechanisms and Inter-Institutional Coordination that will be necessary After the Participation of Demand and Distributed Generation Resources to the Market Through the Combiners	Demand Side Participation	18 months	Jul-17	AKEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
108	Determining the Most Appropriate Tree Type for the Expansion of the Use of Wood Poles in Electricity Distribution Networks, the Best Production and Installation Techniques and the Best Direction for the Destruction of the Wood Poles that Expire Their Life	Network Operation	12 months	Jul-17	AKEDAS
109	Development of a Mobile Device Software to be Used in Field Investment Processes	Other	8 months	Jul-17	AKEDAS
110	Investigation, Design and Pilot Application of the Most Appropriate Alarm Systems Used in the World According to Transformer Types and Usage Areas	Monitoring and Control	26 months	Jul-17	GDZ
111	Interior Installation Control and New Generation Residual Current Protection Relay Project	Network Operation	18 months	Jul-17	KCETAŞ
112	Development of Hybrid Ice Load Prevention and Bird Abduction System in Electricity Distribution Lines	Network Operation	14 months	Jul-17	UEDAS
113	Investigation of Effectiveness of Petersen Coil Application for Reducing Forest Fires	Climate, Environment and Emergency Action Plans	12 months	Jul-17	Akdeniz
114	Investigation and Improvement of Status of Grounding Systems in the Distribution Network	Network Operation	12 months	Jul-17	Akdeniz
115	Pilot Study of Developing a Synchronization System from a Single Centre with Low Frequency and High Propagation and Application in Distribution Network	Monitoring and Control	17 months	Jul-17	Akdeniz
116	Pilot Application Within the Scope of Preventive Maintenance	Network Operation	10 months	Jul-17	BEDAS
117	Analysis and Limitation of Single-Phase to Ground Short Circuit Source Over-Voltages in Cable Networks	Network Operation	12 months	Jul-17	BEDAS
118	Hardware and System Development for Detecting Low Fault Currents in Distribution Networks	Network Operation	12 months	Jul-17	ÇEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
119	Comparing Technical and Operational Perspective of Turkey and Italy Electricity Distribution Companies	Other	9 months	Jul-17	VEDAS
120	Corporate and Customer Information Security Project in Electricity Distribution Sector	Other	12 months	Jul-17	Başkent
121	Micro Network Management Methods and Control Hardware Development	Monitoring and Control	24 months	Jul-17	Başkent
122	Investigation of the Effects of Electromagnetic Fields Generated by the Distribution Network on Human Health	Climate, Environment and Emergency Action Plans	12 months	Jul-17	BEDAS, AYEDAS, Toroslar
123	Project of Investigation of Capacitive Fault Currents in 380/33 kV Isolated Transformers and Their Effects on the System	Network Operation	7 months	Jul-17	AYEDAS
124	Transformation of GIS Data into Single Line Network Model	Other	10 months	Jul-17	DEDAS
125	Investigation of Chemical Energy Storage Technologies, Pilot Project Studies in Distribution Networks, Comparison of Studies	Systems Embedded in Distribution	24 months	Jan-18	ADM, Başkent, BEDAS, Fırat, MEDAS, OEDAS
126	Device Design that Detects Previous Line faults in New Generation Low Voltage Network	Material Technology	16 months	Jan-18	BEDAS
127	Image Processing for Improving Illegal Use Detection and Consumption Estimation System in Agricultural Irrigation Areas	Reducing Technical and Non-Technical Losses	24 months	Jan-18	DEDAS
128	Development of Internal Fault Detector for Safety and Protection of Pole Type Distribution Transformers	Monitoring and Control	18 months	Jan-18	Akdeniz
129	DSP based Automatic Fault Locator and Power Quality Analyzer Development and Dissemination of the Project	Monitoring and Control	16 months	Jan-18	Akdeniz
130	New Generation Intelligent and Safe Electricity Distribution Networks	Network Operation	36 months	Jan-18	Başkent
131	Development of Community Security Services Coordination Platform in Crisis Management	Climate, Environment and Emergency Action Plan	18 months	Jan-18	AYEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
132	Triple Fused Pilot Application Project for Rural MV Distribution Network	Material Technology	12 months	Jan-18	MEDAS
133	Development and Pilot Implementation of IoT Based Low Consumption and Compact Fault Indicator Device	Communication Technology	18 months	Jan-18	AKEDAS
134	Research the Requirements and Developing an Action Plan for the Supply of Hydraulic Power Plants Connected to the Distribution Network in Emergency Conditions in Isolated Island Mode (Isolated Island HEPP)	Systems Embedded in Distribution	18 months	Jan-18	Çoruh
135	Calculation of Power Faults' Costs According to Regional Factors and Customer Categories and Investigation of their Relationship with Network Reliability	Monitoring and Control	15 months	Jan-18	GDZ, ADM, SEDAS, TREDAS
136	Design of "Pre-Fault Detection" Device Design in New Generation Low Voltage Network		16 months	Jan-18	BEDAS
137	D-ENVER2023: Energy Efficiency and Energy Saving Roadmap Project in Distribution	Climate, Environment and Emergency Action Plan	15 months	Jan-18	BEDAS, ÇEDAS, UEDAS
138	Cable Insulating Chemical Tests and Field Applications	Material Technology	12 months	Jan-18	BEDAS
139	Examining Chemical Energy Storage Technologies, Conducting Pilot Project Studies in Distribution Networks and Comparing the Studies	Systems Embedded in Distribution	24 months	Jan-18	Fırat
140	Wireless Energy Transfer	Material Technology	24 months	Jan-18	BEDAS
141	Development of Local Software Required for Investigating the Effect of Charging Stations and Electric Vehicles on the Network and Optimizing These Loads	Systems Embedded in Distribution	23 months	Jan-18	OEDAS
142	Providing Value Added and Increasing Prevalence with Integration of Advanced Storage Systems to Photovoltaic Generation	Systems Embedded in Distribution	36 months	Jul-18	ADM





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
143	Multilayer Demand Merger Solutions Providing Optimum Demand Management and Network Flexibility	Demand Side Participation	36 months	Jul-18	AKEDAS
144	Development an Algorithm to Determine the Locations of the Quality Recorders with the State Estimation Method for Optimum Monitoring of the Distribution Network	Monitoring and Control	18 months	Jul-18	Aras
145	Advanced Battery Management System	Systems Embedded in Distribution	24 months	Jul-18	BEDAS
146	Lighting Control and Product Development of Power Lines	Lighting	14 months	Jul-18	Çoruh
147	Development of Local Recloser (Automatic Recloser)	Monitoring and Control	18 months	Jul-18	AYEDAS
148	Researching New Grounding Techniques in Lighting	Lighting	14 months	Jul-18	KCETAŞ
149	Satisfaction 4.0	Other	12 months	Jul-18	OEDAS
150	Wireless Communication Network Project in Distribution Network	Communication Technology	12 months	Jul-18	SEDAS
151	Pilot Project for Implementation of Smart Distribution Centres (Smart Substation) in a Smart Network Vision	Monitoring and Control	18 months	Jul-18	SEDAS, Fırat
152	Alignment of Pole Types Used in Energy Transmission Lines to the New Generation Energy Distribution System and Development of a Local Software	Material Technology	15 months	Jul-18	Toroslar
153	Portable Vehicle Pallet System	Other	12 months	Jul-18	Toroslar
154	Development of a Low Carbon Residential Micro Network that Enables Bi-Directional Energy Sharing and Offers Payment Facilities	Systems Embedded in Distribution	36 months	Jul-18	UEDAS
155	Weekly Fault Prediction and Priority Maintenance Prediction Based on Machine Learning with Using OMS Based Fault Statistics and Geographic Information	Network Operation	14 months	Jan-19	ADM
156	Development of Substation Emulator for Using Artificial Intelligence Methods in Cyber Security Studies	Monitoring and Control	24 months	Jan-19	ADM, GDZ





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
157	Development of Generalized Remote Protection Coordination and Relay Setting Program Integrated with GIS	Monitoring and Control	18 months	Jan-19	Aras
158	Increasing Work Safety with the Temporal and Spatial Meteorological Risk Management Integrated into the Workforce Management System	OHS	18 months	Jan-19	Aras
159	Increasing Network Durability Using Synchrophasor in MV networks	Material Technology	18 months	Jan-19	Aras
160	Micro Network Management Methods and Control Hardware Development	Monitoring and Control	24 months	Jan-19	Başkent
161	HARVEST - the Energy Efficiency Potential of the Distribution Side Methodology	Climate, Environment and Emergency Action Plan	6 months	Jan-19	Başkent, AYEDAS, Toroslar
162	Feasibility Study of Replacing Lead-Acid Battery and Rectifier Groups with New Generation Lithium-Ion Battery and Rectifier Groups	Systems Embedded in Distribution	16 months	Jan-19	BEDAS, ÇEDAS
163	Underground Fault Detection with K9	Network Operation	6 months	Jan-19	BEDAS
164	Project for Developing Direct Connected Combi Meter with 1000A Current Measurement Capacity	Reducing Technical and Non-Technical Losses	14 months	Jan-19	DEDAS
165	Developing Fire Extinguishing System with Aerosol Technique and Drafting of Legislation at Distribution Network Points	Material Technology	12 months	Jan-19	DEDAS
166	Electric Field Sensitive Luminescence Nanocomposite Sensor Development Project at MV Levels	OHS	15 months	Jan-19	DEDAS
167	High Strength - Smart Panel Development Project	Material Technology	12 months	Jan-19	DEDAS
168	Small Size, Double Storey Substation Design Project in Distribution Network	Network Operation	15 months	Jan-19	AYEDAS
169	Production and Application of Medium Voltage Air Line Insulation Materials with Domestic and National Opportunities	Material Technology	16 months	Jan-19	MEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
170	Investigation of the Vertical Mounting Method of Medium Voltage Underground Cables and Pilot Application	Network Operation	12 months	Jan-19	MEDAS
171	Intelligent Door Access System Project that can Control Work Safety in Substations	Material Technology	15 months	Jan-19	SEDAS
172	Investigation of Moisture Problem Solution Suggestions and Development of Prototype Products in Substations	Network Operation	14 months	Jan-19	Toroslar
173	Increasing Energy Quality and Efficiency by Producing Sensor and Monitoring Software for High Voltage Overhead Lines	Monitoring and Control	20 months	Jan-19	Toroslar
174	Fault Warning System - Phase 2 (Development of Products that Can Detect High Impedance Faults by Wavelet Transformation Wave Analytics Method)	Monitoring and Control	12 months	Jan-19	Toroslar, Başkent
175	Developing Rectifiers with High Efficiency Battery Charging Systematic and Double Control Unit Compatible with Scada Systems	Material Technology	12 months	Jul-19	OEDAS
176	Investigation of New Methods for Connection of Overhead Line Conductors to Insulators and Pilot Application	Material Technology	12 months	Jul-19	MEDAS
177	Pilot Applications of Ancillary Services in Distribution System	Demand Side Participation	12 months	Jul-19	MEDAS
178	Project for Development of Mobile Tracking and Monitoring Device to be Used in Synchronization of Low Voltage (LV) Network Topology with GIS System with G3 PLC Technology	Material Technology	15 months	Jul-19	SEDAS
179	Development of Thermal Marking Technique (ThermoSign) Project for the Detection of Fault Source Warming in Electrical Equipment	Monitoring and Control	18 months	Jul-19	SEDAS, DEDAS
180	Occupational Safety Early Warning System Project	OHS	12 months	Jul-19	SEDAS





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#	Project Name	Categories <sup>44</sup>	Project Duration	Project Application Period	Stakeholder DSOs
181	Development of Internal Fault Detector (IFD) for Safety and Protection of Pole Type Distribution Transformers	Material Technology	18 months	Jul-19	AKEDAS
182	Innovative Application Project to Reduce Losses and Faults in MV Distribution Cables	Material Technology	16 months	Jul-19	AKEDAS
183	Pilot Application Project for Consumer Perception Management, Demand Management and Improving Energy Efficiency	Other	18 months	Jul-19	GDZ, ADM
184	Determination of Cable Isolation Status from Unused Efficient Appliances in Turkey and the Relevant Action Plan	Monitoring and Control	18 months	Jul-19	GDZ
185	Reflective Based Optical Lighting Design	Lighting	12 months	Jul-19	DEDAS
186	Research and Design an Insulated Circuit Breaker without SF6 Gas	Material Technology	12 months	Jul-19	DEDAS
187	Voltage Sensor Development for Dielectric Strength of Transformer Oil	Material Technology	15 months	Jul-19	DEDAS
188	Communication with a Meter which does not have Neutral	Material Technology	18 months	Jul-19	DEDAS, Aras, VEDAS
189	Developing an OHS Mobile Application and Evaluation Platform for the Electricity Distribution Sector	OHS	12 months	Jul-19	ARAS
190	Pilot Application for Smart Transformer	Material Technology	18 months	Jul-19	ARAS
191	Pilot Application for Fully Isolated LV Overhead Line Conductor	Material Technology	9 months	Jul-19	VEDAS
192	In-Line Afforestation Strategies for Reducing Losses and Preventing Fire Risk in Energy Transmission Lines- Laurel (Laurus nobilis L.)	Other	14 months	Jul-19	BEDAS
193	Fault Detection and Analysis with Image Processing	Network Operations	10 months	Jul-19	BEDAS
194	Estimation and Optimization of Network Faults	Network Operations	15 months	Jul-19	BEDAS





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### 3.5 Gap Analysis & Recommendations

This section presents a list of recommendations that are expected to foster innovation and R&D activities within the electricity distribution companies, as well as identifies gaps in the existing regulatory framework and proposes the necessary amendments to the secondary legislation.

#### 3.5.1 Overarching Principles

Based on the desktop review of different practices regarding incentivizing innovation and taking into consideration the existing regulatory framework in Turkey, the following overarching principles were identified that are related to the electricity distribution sector.

The implementation of innovation incentives should target the reduction of financial risk for DSOs while increasing their participation in pilot projects and innovative programs. In addition to financial support, and since much of the needed innovation will take the form of setting up new market roles and business processes, NRAs and governments should take an active stance towards creating the conditions for DSOs to experiment in uncharted territory. This should be done even if it requires temporarily and/or locally overriding the prevailing regulation to enable pilots with duly approval of the regulatory authority

Specific regulatory mechanism for innovation, research and development promotion (R&D) through dedicated annual funding is appropriate to incentivize DSOs to undertake these activities. Once the promoted technology becomes commercially viable and mass deployed, it should be treated as any other DSO investment. Innovation incentives should be introduced through simple not expensive pilot models at the first phase with gradual increase of complexity and funding allowance. Both the capital and the operating expenses are to be allowed by dedicated R&D budget, whereas any capitalization of the R&D costs in the RAB must be reflected in corresponding revenues.

Overarching Principles for Electricity Distribution
<p><b>Overarching Principle 1</b></p> <p>The ultimate goal of innovation for DSOs is to provide benefits to their consumers. To achieve this, the objectives can be broader than cost-efficiency approach alone. Regulator need to play a role in responding to emerging trends in the sector, whilst ensuring that citizens' money isn't invested in technologies which have limited use. As DSOs are natural monopoly elements, Regulator need to incentivise companies to innovate to deliver a better service to customers at an affordable price.</p>
<p><b>Overarching Principle 2</b></p> <p>R&amp;D activities carry some risk, and significant expenditures is often required to develop new approaches and technologies. Bill payers bear some of the risk associated with innovation. The Regulator must ensure that innovation is proportionate and good value for money. Consumers can also stand to gain through improvements in service and efficiencies driving down cost. Creating the right incentives for DSOs to innovate in the ways they would in a competitive market, while protecting interests of customers reliant on a monopoly service, is therefore in bill payers' interests.</p>





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Overarching Principles for Electricity Distribution	
<b>Overarching Principle 3</b>	Incentives to innovation and inter-sectorial synergies: incentives for distributors to deploy innovative technologies should be mainly a by-product of regulatory schemes targeting outputs, rather than being pursued through schemes targeting specific technologies or solutions. This would ensure that only innovation directly impacting on the value of the service for network users be implemented and, more generally, that regulation be technology neutral. The same recommendation holds for incentives to exploit synergies between distribution investments and the supply of non-energy local services
<b>Overarching Principle 4</b>	Innovation costs should not be simply treated as operational expenditure and its unique characteristics should be recognised. As the purpose of classical price-based regulation is not constructed with innovation in mind, special treatment may be required to foster and nourish it.
<b>Overarching Principle 5</b>	Electricity DSOs should take a proactive approach, seeking to cooperate and work with other areas of industry not directly in the sector.
<b>Overarching Principle 6</b>	The regulatory treatment of costs may need to be different for two distinct phases of innovation: <ul style="list-style-type: none"> <li>• research &amp; development (including patents and intellectual property rights development) and</li> <li>• roll-out.</li> </ul>
<b>Overarching Principle 7</b>	A clear categorization of R&D projects according to their TRL should exist, that will allow budget allocation, as well as evaluation of proposals for innovation projects.

In Table 6 the main regulatory targets (RT) for EMRA are shown, related to the overarching principles, and the respective as-is status in Turkey taking also into account secondary legislation that has been revised on March 26, 2020 for regulating R&D activities of electricity distribution companies.

Table 6: EMRA's Strategical Targets for Innovation Activities in Electricity Distribution Sector

Regulatory Target	Effective in Turkey
RT 1	Development of technology and know-how for system operations
RT 2	Increase in the prevalence of domestic technology





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Regulatory Target	Effective in Turkey
RT 3	Enhancement of service quality, system performance and security
RT 4	Reduction of costs through operational efficiency and improvement of system losses
RT 5	Reaching the international quality standards in natural electricity distribution system

### 3.5.2 Summary of Recommendations

Per our analysis and assessment, general regulatory framework in Turkey for fostering innovation activities of distribution companies is well-developed, robust and well beyond the average EU practices, although the relevant secondary legislation become effective only the last 5-6 years.

Expected changes in the electricity sector raise new challenges for national regulators in designing effective regulatory models. These changes and new challenges can be divided in three categories: technical, economic and organisational. These new challenges generally trigger the need for changes in regulatory tools and/or regulatory aims.

“Principles and Procedures for Supporting Research, Development and Innovation Activities of Electricity and Natural Gas Distribution Companies” are being improved by EMRA as additional regulatory needs arise and the maturity of the DSOs evolve on innovation activities (For example, with a very recent update on the secondary legislation; incentives have been defined for patenting and a dedicated budget has been allocated for encouraging collaborations with start-ups and entrepreneurs to further catalyse the innovation environment.)

In this part, the recommendations are provided to

- enable further evolvement of regulatory support,
- improve project evaluation and monitoring processes and
- facilitate large-scale innovation and pilot demonstration projects.

To summarize key elements of our recommendations, the following could be listed:

- EMRA should continue to support DSO innovation to ensure the culture of innovation continues to develop within the distribution sector. Consideration should be given as to how support for DSO innovation can best accommodate the future requirements of the entire energy system.
- DSOs should be required to develop and publish an ‘innovation roadmap’. This should be developed in line with the national strategies and in conjunction with TEIAS’ plans.
- Both the capital and the operating expenses are to be allowed by dedicated R&D budget, whereas any capitalization of the R&D costs in the RAB must be reflected in corresponding revenues.
- There should be greater focus on the sharing of project knowledge and learning - particularly across and between the DSOs - in order to maximise the benefits and value of R&D budgets allocated.





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- More focus should be placed on the learning which results from unsuccessful projects, or parts of projects.
- Monitoring/reporting requirements associated with R&D projects should be reviewed to facilitate the assessment of quantitative benefits and a systematic tracking of project outcomes should be implemented.
- DSOs should be encouraged to coordinate with relevant governmental institutes, and other R&D stakeholders, to explore opportunities to share and exchange project learnings and experience with other energy sectors.

Table 7 provides a summary of the specific recommendation for electricity distribution sector. A detailed analysis of the recommendations is given in the next subsection.





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Table 7: Summary of Recommendations for Electricity Distribution Sector

ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
<b>Recommendations About Tariff Methodologies and Incentives</b>					
R1	Transparency of Costs	Electricity DSOs should be fully transparent on costs that are related to innovation and R&D by providing financial information to EMRA both during the R&D project or innovation activity proposal phase, as well as after the completion of the project or the activity.	During project proposal application submission, electricity DSOs should provide to EMRA financial information that will help EMRA assess project spending upon project completion.	EMRA receives the intermediate progress and final reports of each R&D project from DSOs, which also includes details of expenditures.	EMRA, Electricity DSOs
R2	Roll-out Initiatives	The Electricity DSOs' roll out of initiatives with demonstrable benefits must be supported by the Regulator. Systematic CBAs are recommended especially for large scale projects.	CEER <sup>38</sup> proposes that in order to facilitate an innovative environment, subsequent to a previous CBA, certain specifically pro-innovation regulatory measures might be justified. These measures might include, amongst others, providing incentives or mechanisms for innovative pilot projects.	DSOs provide ad-hoc information about the benefits of their projects, in the R&D application forms.	EMRA, Electricity DSOs
R3	Tariff Methodologies and Incentives	EMRA should also allocate dedicated budget in CAPEX allowances for the deployment and roll-out of technological investments.	CEER <sup>38</sup> proposes that in order to facilitate an innovative environment, subsequent to a previous CBA, certain specifically pro-innovation regulatory measures might be justified. These measures might include, amongst others, providing incentives or mechanisms for innovative pilot projects.	Incentivization schemes for pilot projects are already defined in the draft legislation for electricity distribution (0.2% of the network CAPEX). The recommended percentage for this type of projects would be 2% of the network investments, mainly to encourage large-scale pilot projects.	EMRA, Electricity DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R4	Incentivizing Strategic Large-Scale Demo Projects via recognizing them as CAPEX.	Additional premium might be added to CAPEX in case electricity DSO makes expenses for strategic large-scale demonstration/ pilot implementation projects. EMRA may select a few projects for each tariff project that will receive the incentive.	Incentivizing large scale innovation projects is considered an important aspect for promoting innovation in the electricity distribution sector.	Does not exist as of today.	EMRA, Electricity DSOs
R5	Innovation Maturity Assessment	EMRA is recommended to identify the maturity of the innovation activities of electricity DSOs (2 assessment practices in each Tariff Period) through evaluation of defined metrics.  The innovation maturity level of the DSOs can be linked with OPEX incentives (like quality factor, if applied for electricity distribution sector in the next tariff period).	It is important for EMRA to evaluate and assess the maturity of ongoing R&D projects and innovation activities for electricity DSOs during project implementation. Apart from purely financial and economic criteria, according to CEER <sup>38</sup> , criteria related to the outcomes of the projects measuring regulatory aims such as efficiency and/or reliability should also be applied.	Such a methodology is not applied.	EMRA, Electricity DSOs
R6	Innovation Ecosystem Development and Incubation Activities	In order to establish an active and effective start-up ecosystem in the electricity distribution sector, regulations might pave the way (limited to at most 10% of the R&D budget) for electricity DSOs to invest in start-ups.	Fostering the innovation ecosystem development and the related incubation activities for R&D focusing on smartening electricity distribution networks, is an important step to establish an active and effective start-up ecosystem.	After initiation of Task 3.2 activities, the revised R&D rules and procedures (dated March 26 <sup>th</sup> , 2020) for DSOs allowed the stated collaborations with start-ups.	EMRA, Electricity DSOs, Ministry





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R7	Research and Development Budget Allocation	The total R&D budget might be revised as 2% of the specific OPEX instead of 1%.	In many cases, depending on the individual situation of the electricity DSOs, there is a particular need for higher R&D budget, especially for strategic innovative projects. In such cases, according to CEER <sup>38</sup> , regulation on innovation should be related to the whole system, thus an increase in R&D specific OPEX is recommended.	Allocated R&D budget for electricity DSOs is 1% of their OPEX.	EMRA, Electricity DSOs
<b>Innovation Business Plan/Master Plan</b>					
R8	Innovation Master Plan	Electricity DSOs could document their 5 and 10-years innovation and R&D plans and submit them to EMRA.	The innovation strategy plan discusses the innovation already deployed, the 5 to 10 years proposed innovation plan, as well as the related funding requirements. For example, in UK, DSOs provide their innovation plan, as part of their business plan for the tariff period.	Electricity DSOs are not required to prepare such a planning for innovation activities.	EMRA, Electricity DSOs
<b>Evaluation for R&amp;D Project Applications and Monitoring</b>					
R9	Innovation Project Assessment Criteria	Detailed evaluation criteria based on scoring can be implemented for evaluation of project applications. It is also recommended to provide solid feedbacks to DSOs about causes of the rejection.	Evaluation of innovation projects under certain criteria, such as relevance, maturity and impact, will allow EMRA to prioritize R&D budget allocation.	There is not a robust and comprehensive assessment methodology that is announced to public.	EMRA, Electricity DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R10	Evaluation of Project Applications	EMRA might get support from external bodies (e.g. academia, independent subject matter experts) for monitoring of the R&D projects and for provision of feedback in annual basis.	In several EU countries, the decision that whether the project is considered as an R&D project or not, is delegated to a third party and R&D projects are approved by an external body, e.g. Norwegian Research Council (NFR).	Project applications are evaluated by R&D commission under EMRA.	EMRA, Electricity DSOs, Others
R11	Innovation Project Assessment Criteria	Detailed evaluation criteria based on scoring should be implemented for evaluation of project applications. It is also recommended to provide solid feedbacks to electricity DSOs about causes of the rejection.	The European Commission, for the evaluation of innovation activities and R&D projects under the Horizon 2020 framework program, has a set of clearly defined evaluation criteria.	The impact ratios of different criteria for the evaluation of R&D applications are not published publicly, or do not exist.	EMRA, Electricity DSOs
R12	Evaluation of Project Results and Impact	Categories of impact for innovation activities and R&D projects are outputs, results, impact, as well as their respective Key Performance Indicators.	Evaluation of the project impact in a systematic and effective manner will provide EMRA with the ability to assess R&D spending over the years.	DSO are obliged to submit project completion reports to EMRA, however there is not a systematic approach to track the results/outputs/success of the R&D projects.	EMRA, Electricity DSOs
<b>Allocation of R&amp;D Budget According to Project Types</b>					
R13	TRL-related Project Categories	R&D and innovation projects for electricity distribution companies could be categorized in terms of technology readiness level.	Technology Readiness Level categorization will allow EMRA to evaluate the maturity of projects in a systematic and efficient manner.	Such definitions do not exist as of today.	EMRA, Electricity DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R14	Budget-related Project Categories	R&D and innovation projects for electricity distribution companies can be categorized in terms of their budget.	Budget-related project categorization will allow EMRA to prioritize R&D spending based on the size and impact of the R&D projects and innovation activities.	Such definitions do not exist as of today.	EMRA, Electricity DSOs
R15	Research and Development Budget Allocation	R&D budget of the electricity distribution companies could be allotted according to the TRL and project type.	Project categorization based on project maturity will allow EMRA to prioritize R&D spending for R&D projects and innovation activities.	Such allocation does not exist as of today.	EMRA, Electricity DSOs
<b>Priority Innovation Areas Turkish Electricity Distribution Sector</b>					
R16	Priority Areas and Calls for Applications	For each R&D project application period, priority areas for electricity distribution companies can be defined and declared considering the Technology Readiness Level.	A set of predefined priority areas for R&D projects and innovation activities are defined for electricity DSOs	The recent change (March 2020) in the secondary legislation provides EMRA the power to identify the call topics: “The priority topics for R&D studies and the limitation for the number of projects may be determined by the Commission and could be announced on the website of EMRA and at the electronic platform at latest, within 3 months before the project application period.	EMRA, Electricity DSOs
<b>Other Recommendations</b>					





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R17	Public Access to Innovation Process	The results of the funded innovation projects can be publicly available to promote transparency. Rejected projects might also be published with DSOs' permission.	EMRA should foster dissemination activities of the projects; results, impact and lessons learnt.	GAZBIR/ELDER provide information on R&D projects in dedicated website ( <a href="https://www.argebilgi.info/">https://www.argebilgi.info/</a> ). The provided information can be more structured, and EMRA may identify the minimum requirements for dissemination of project outcomes.	EMRA, Electricity DSOs
R18	Communication and Dissemination of Innovation Activities	EMRA should request and push GAZBIR (association of electricity DSOs) to disseminate the R&D projects after removal of sensitive information. Electricity DSOs should communicate the benefits of their innovation programs to increase their social acceptance from consumer's perspective and to have greater collaboration from other electricity DSOs.	In Turkey, R&D activities are funded from revenue cap and should be disseminated. Also, electricity DSOs should disseminate results and lessons-learnt from R&D projects and innovation activities to all regulated entities, both for electricity and gas, to foster cooperation and potential synergies.	GAZBIR/ELDER provide information on R&D projects in dedicated website ( <a href="https://www.argebilgi.info/">https://www.argebilgi.info/</a> ). The provided information can be more structured, and EMRA may identify the minimum requirements for dissemination of project outcomes.	EMRA, Electricity DSOs





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### 3.5.3 Detailed Descriptions About the Recommendations

#### 3.5.3.1 Recommendations About Tariff Methodologies and Incentives

After review of regulatory practices for distribution innovation activities in Europe and Turkey, the following recommendations about tariff methodologies and incentives were proposed.

#### Recommendation 1 Transparency of Costs

Electricity DSOs should be fully transparent on costs that are related to innovation and R&D by providing financial information to EMRA both during the R&D project or innovation activity proposal phase, as well as after the completion of the project or the activity.

**Supportive Arguments:** During project proposal application submission, electricity DSOs should provide to EMRA the following information that will help EMRA assess project spending upon project completion:

- forecasted total project costs,
- initial net funding required,
- beneficiary’s compulsory contribution,
- outstanding funding required,
- bid preparation costs.

A similar approach is followed for projects funded under the NIC of Ofgem in UK. The electricity DSO should provide EMRA with a Project Completion Report for each project that has received funding. Among other things, the Project Completion Report should identify any unspent approved amounts and additional funding for the project, so these can be deemed to be disallowed expenditure. Financial statements related to the R&D project or innovation activity should also be presented to EMRA during interim and final project evaluation.

**As-is Status in Turkey:** EMRA receives the intermediate progress and final reports of each R&D project from DSOs, which also includes details of expenditures. It’s recommended to define certain budget templates by EMRA to increase the reporting about expenditures related to both external R&D resources and internal DSO employees.

#### Recommendation 2 Roll-out Initiatives

The electricity DSOs’ roll out of initiatives with demonstrable benefits must be supported by the Regulator. Systematic CBAs are recommended especially for large scale projects.

**Supportive Arguments:** CEER<sup>38</sup> proposes that in order to facilitate an innovative environment, subsequent to a previous CBA, certain specifically pro-innovation regulatory measures might be justified. These measures might include, amongst others, providing incentives or mechanisms for innovative pilot projects.

In UK, 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





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## Recommendation 2 Roll-out Initiatives

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 electricity DSO. During RIIO-1, there are two application windows for electricity distribution companies to apply for funding. However, Ofgem does not see any compelling evidence for a need of IRM in RIIO-2, mainly due to the fact that the price control period of five (5) years in RIIO-2 raises the need for a dedicated funding mechanism for the support of roll-out. Additionally, electricity DSOs will to be supported via the TOTEX incentivization mechanism to roll-out of proven innovative technologies, by retaining a share of any efficiency savings that result.

**As-is Status in Turkey:** DSOs provide ad-hoc information about the benefits of their projects, in the R&D application forms.

The recommended changes on revenue requirements for EMRA, based on international best practice, are presented below.

## Recommendation 3 Tariff Methodologies and Incentives

EMRA should also allocate dedicated budget in CAPEX allowances for the deployment and roll-out of technological investments, as follows:

- **Large-scale pilot projects:** As such, we consider projects directly derived as an outcome of R&D programs and innovation activities and a dedicated 0.5% CAPEX budget should be allocated to these expenditures.
- **Smart grid and ICT investments:** A dedicated 5% CAPEX budget should be allocated to these expenditures.

**Supportive Arguments:** CEER<sup>38</sup> proposes that in order to facilitate an innovative environment, subsequent to a previous CBA, certain specifically pro-innovation regulatory measures might be justified. These measures might include, amongst others, providing incentives or mechanisms for innovative pilot projects.

**As-is Status in Turkey:** Incentivization schemes for pilot projects are already defined in the draft legislation for electricity distribution (0.5% of the network CAPEX). The recommended percentage for this type of projects would be 2% of the network investments, mainly to encourage large-scale pilot projects.

On the other hand, as far smart grid and ICT investments are concerned, dedicated CAPEX allocation is already in place for electricity distribution companies (5% of the network CAPEX).



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#### Recommendation 4 Incentivizing Strategic Large-Scale Demo Projects via recognizing them as CAPEX

Additional premium might be added to CAPEX in case electricity DSO makes expenses for strategic large-scale demonstration/ pilot implementation projects. EMRA may select a few projects for each tariff project that will receive the incentive.

**Supportive Arguments:** Incentivizing large-scale innovation projects is considered an important aspect for promoting innovation in the electricity distribution sector. Moreover, CEER<sup>38</sup> proposes that in order to facilitate an innovative environment, subsequent to a previous CBA, certain specifically pro-innovation regulatory measures might be justified. These measures might include, amongst others, providing incentives or mechanisms for innovative pilot projects.

The Italian regulatory authority, ARERA selected eight smart grids pilot projects and incentivized them with an increase of 2% WACC remuneration for 12 years.

**As-is Status in Turkey:** Does not exist as of today.

#### Recommendation 5 Innovation Maturity Assessment

EMRA is recommended to identify the maturity of the innovation activities of electricity DSOs (2 assessment practices in each Tariff Period) through evaluation of defined metrics and characteristics such as:

- utilization of the R&D budget,
- successful completion of the R&D project (as a ratio),
- actual operation/implementation of the R&D/innovation projects,
- number of patents filed/pending/awarded/rejected,
- national/international cooperation developed for the R&D activities,
- R&D export and revenues,
- resolution and reality of the 5 and 10-years innovation planning,
- establishment of an R&D centre,
- competencies for R&D, technology and know-how,
- number of new products/services released for DSO usage
- number of new products released for commercialization
- dedicated R&D division and staff, and
- digitalization level of the DSO processes.

Innovation maturity levels might be included within the context of performance component (or quality factor, if applied for electricity distribution sector in the next tariff period) item of the revenue requirement.



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## Recommendation 5 Innovation Maturity Assessment

**Supportive Arguments:** It is important for EMRA to evaluate and assess the maturity of ongoing R&D projects and innovation activities for electricity DSOs during project implementation. Especially for roll-out projects and/or strategic large-scale demonstration projects, evaluation should be performed based on specific criteria and metrics. Apart from purely financial and economic criteria, according to CEER<sup>38</sup>, criteria related to the outcomes of the projects measuring regulatory aims such as efficiency and/or reliability should also be applied.

**As-is Status in Turkey:** Such a methodology is not applied.

## Recommendation 6 Innovation Ecosystem Development and Incubation Activities

In order to establish an active and effective start-up ecosystem in the electricity distribution sector, regulations might pave the way (limited to at most 10% of the R&D budget) for electricity DSOs to invest in start-ups. To this extent:

- Electricity DSOs might submit their “business plans” to EMRA regarding incubation activities such as target products and services, responsibility limits, investment/partnership calendar, company valuation methodology etc.
- Definition of the evaluation criteria and minimum content (e.g. export potential, sustainability) of the business plan, which is requested from DSOs for development of the ecosystem and incubation activities
- Revenue sharing model of 50% (DSO)-50% (tariff) might be applied for the incomes directly received from the innovation activities and investment to start-ups or selling products/ know-how.
- In case of know-how export via these efforts, revenue sharing might be revised (tariff: 30%, DSO: 70%)

**Supportive Arguments:** Fostering the innovation ecosystem development and the related incubation activities for R&D focusing on smartening electricity distribution networks, is an important step to establish an active and effective start-up ecosystem. In the European Union, the support of start-up companies is fostered by the various R&D funding mechanisms, such as the Horizon 2020 framework program and others. Recently, and in order to help build a strong European ecosystem where start-ups can thrive, Start-up Europe<sup>45</sup> empowered seven (7) projects, funded under Horizon 2020, that are connecting local ecosystems across Europe, along different technological areas.

**As-is Status in Turkey:** After initiation of Task 3.2 activities, the revised R&D rules and procedures (dated March 26th, 2020) for DSOs allowed the stated collaborations with start-ups.

<sup>45</sup> <https://ec.europa.eu/digital-single-market/en/news/startup-europe-growth-h2020-projects>



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### Recommendation 7 Research and Development Budget Allocation

The total R&D budget might be revised as 2% of the specific OPEX instead of 1%.

**Supportive Arguments:** In many cases, depending on the individual situation of the electricity DSOs, there is a particular need for higher R&D budget, especially for strategic innovative projects. In such cases, according to CEER<sup>38</sup>, regulation on innovation should be related to the whole system, thus an increase in R&D specific OPEX is recommended.

**As-is Status in Turkey:** Allocated R&D budget for electricity DSOs is 1% of their OPEX.

#### 3.5.3.2 Scope of Innovation Business/Master Plan

With regards to the plans for future innovation and R&D activities of the electricity distribution companies, electricity DSOs will prepare and submit to EMRA their “Innovation Master Plans”.

### Recommendation 8 Innovation Master Plan

Electricity DSOs could document their 5 and 10-years innovation and R&D plans and submit them to EMRA.

**Supportive Arguments:** For the electricity distribution price control RIIO-GD1 Ofgem is requesting electricity DSOs to submit their business plan, also including their plans for innovation, describing, among others:

- the innovation stimulus,
- the direct innovation funding; and
- the revenue adjustment mechanism for rolling out innovative solutions.

The innovation strategy plan discusses the innovation already deployed, the 5 to 10 years proposed innovation plan, as well as the related funding requirements<sup>46</sup>.

**As-is Status in Turkey:** Electricity DSOs are not required to prepare such a planning for innovation activities.

In the following, a guideline is provided with best practise recommendations related to the sections and subsections of the “Innovation Master Plan” in terms of their scope and contents. The proposed structure for the “Innovation Master Plan” to be prepared by the electricity DSOs is shown below, where [Electricity DSO] should be replaced with the name of the particular electricity distribution company responsible for the preparation of the plan.

<sup>46</sup> “RIIO-GD1 Business Plan 2013-2021 - Part B3: Innovation”, Wales & West Utilities, 2011



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## Recommendation about the Outline of Innovation Master Plans

### 1. Background

- 1.1. Introduction to [Electricity DSO]
- 1.2. Overview of Innovation Strategy

### 2. Introduction

- 2.1. Innovation Process
- 2.2. Stakeholder Involvement
- 2.3. Assessment of Effective Regulatory Framework for Innovation

### 3. Innovation for [Electricity DSO]

- 3.1. Scope of Innovation
- 3.2. Stages of Innovation
- 3.3. Innovation Objectives
- 3.4. Funding the Innovation
- 3.5. Approach to Innovation
- 3.6. Selecting and Prioritizing Ideas
- 3.7. Developing Plans for Innovation
- 3.8. Stakeholder Engagement for Innovation
- 3.9. Collaboration Between DSO and TSO

### 4. Innovation Progress

- 4.1. Innovation Performance to Date
- 4.2. Future Innovations

### 5. Governance Arrangements

- 5.1. Research 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 Innovation

Below, we analyse the sections and subsections of the “Innovation Master Plan”.



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## Section 1

### Background

This section provides background information about the electricity DSO and outlines briefly its innovation strategy, by providing a high-level description of the structure and the contents of the “Innovation Master Plan”. The subsections of this section are listed below:

- 1.1. Introduction to DSO
- 1.2. Overview of Innovation Strategy

## Section 2

### Introduction

This section outlines the electricity DSOs vision on innovation, as well as the framework for stakeholder involvement along with the governance and the regulatory framework. Subsection **Innovation Process** briefly presents the rationale for innovation for the electricity distribution companies, as well as the approach towards achieving the desired level of innovation within these companies. A general overview of involving all the necessary stakeholders in this innovation process is presented briefly in subsection **Stakeholder Involvement** of the document. Finally, an overview of the governance and the regulatory framework related to innovation is outlined in subsection **Assessment of Effective Regulatory Framework for Innovation**, where the regulation schemes related to innovation and R&D might be discussed and briefly presented.

The subsections of this section are listed below:

- 2.1. Innovation Process
- 2.2. Stakeholder Involvement
- 2.3. Regulatory Framework for Innovation

## Section 3

### Innovation for EMRA

This section is the core of the “Innovation Master Plan” document, as it describes in detail the scope of innovation, as well as the innovation process itself for the distribution sector. Subsection **Scope of Innovation** presents the main categories of innovation for the electricity DSO. These categories may include:

- **Assets:** Projects in this category collect data from the network they test alternative investment strategies that can defer expensive investments,
- **Customers:** These projects develop new solutions to enable the provision of better services to the customers. They may also involve testing of new customer tariffs and
- **Operations:** This category of projects demonstrate direct benefits to network operations from the application of technology.

Innovation categories for electricity distribution companies can be further described across different broad areas:

- Network improvements and system operability,
- Transition to a low-carbon future,
- New technologies and commercial evolution,



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- Customer and stakeholder focus; and
- Safety, health and environment.

Subsection **Stages of Innovation** sets out the areas of innovation for the electricity distribution companies and should also take into account:

- Working at various stages of development spanning higher TRL 3 to 8,
- Exploring both technology and commercial solutions,
- Covering the whole range of asset types and network pressure,
- Assessing risk, with no projects carrying unnecessary risk; and
- Utilizing a variety of external funding mechanisms to supplement [Electricity DSO] own R&D budget.

The three distinct pillars of innovation described above, can be distilled further into the desired objectives proposed below. This context constitutes part of the **Innovation Objectives** subsection.

- Developing new smart technologies that will allow the efficient operation and monitoring of the electricity distribution grid,
- Ensuring that a network is technically and commercially developed to deliver the required quality of service to support current and future system needs,
- Delivering solutions that are compatible with the existing network,
- Enabling solutions that can be quickly transitioned to become business as usual and
- Providing value for money.

The various funding and incentivization schemes for innovation and R&D for electricity distribution companies are described in the subsection **Funding of Innovation** of the document.

Subsection **Approach to Innovation** outlines the electricity DSO's approach to innovation to deliver the desired objective in an effective and efficient manner. This approach may include:

- Active involvement staff from across the business in the generations of ideas, development of solutions and implementation of projects,
- Working with a wide range of stakeholders to understand their needs,
- Making use of a wide range of innovation incentives and funding provided by the government, regulator and other funding mechanisms (e.g. European Commission's framework programs, etc.),
- Defining clear objectives for each project so that delivery can be focused, and progress can be accurately tracked,
- Using a small core delivery team to co-ordinate innovation projects,
- Avoiding theoretical research or innovation that does not have clear objectives and benefits,
- Incorporating innovative solutions into existing equipment and processes and
- Sharing lessons learnt with other organizations.



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Subsection **Selecting and Prioritizing Ideas** describes the electricity DSO's process for selecting and prioritizing innovation and R&D ideas. Key elements used to select and prioritize a project are the positive impacts of a project on the electricity distribution company's customers and the Cost Benefit Analysis (CBA) outcome.

To cope with the continuously changing innovation environment, as well as with the latest technological advancements, the electricity DSO's innovation plans should be regularly updated based on the most recent innovation and technological trends. The process of updating the innovation plans and leverage information from external bodies are the scope of the subsection **Developing Plans for Innovation**.

Subsection **Stakeholder Engagement for Innovation** stipulates the process of stakeholder engagement across all areas of the electricity DSO's business, in such a way that the benefits of improvements and benefits span across all business areas of electricity DSO.

Finally, the framework for the collaboration of the electricity distribution company with BOTAŞ and/or any other third party are set forth in subsection **Collaboration Between the DSO and TSO**.

The subsections of this section are listed below:

- 3.1. Scope of Innovation
- 3.2. Stages of Innovation
- 3.3. Innovation Objectives
- 3.4. Funding the Innovation
- 3.5. Approach to Innovation
- 3.6. Selecting and Prioritizing Ideas
- 3.7. Developing Plans for Innovation
- 3.8. Stakeholder Engagement for Innovation
- 3.9. Collaboration Between the DSO and TSO

## Section 4 Innovation Progress

This section describes the current status and future view of innovation and R&D for electricity distribution companies.

Subsection **Innovation Performance to Date** provides an overview of the completed projects so far related to innovation and R&D activities in the electricity distribution sector. The analysis can also include statistical figures on the type and number of the completed projects, as well as information related to their progress.

Finally, subsection **Future Innovations** sets out potential future project areas that the electricity DSO considers important for the electricity distribution sector.

The subsections of this section are listed below:

- 4.1. Innovation Performance to Date
- 4.2. Future Innovations



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## Section 5

## Governance Arrangements

This section describes the governance framework for innovation and R&D activities in the electricity distribution sector.

Subsection **Research Partners and Supplier Arrangements** sets out the framework for the collaboration with universities, research establishments, and manufacturers, as well as the arrangements needed with the various suppliers both in Turkey and across the world.

Risk management related issues are tackled in subsection **Managing Risk and Future Uncertainty**. It is suggested that the electricity DSO should ensure that new technologies for the electricity distribution sector either fit into existing policies and standards or the electricity DSO should develop new policies and standards as a part of the innovation process.

In subsection **Tracking Benefits** the evaluation of past and ongoing projects in the electricity distribution sector should take place. This will allow the electricity DSO to monitor efficiently the progress of the ongoing progress and assess shall the benefits delivered are in line with those predicted at the time of approval. Smaller projects should be reported annually in the electricity DSO's innovation summary report, while major projects should report progress including benefits delivery as part of their regular reporting regime. The different types of project should follow the categorizations proposed in the Recommendations of this document.

Subsection **Keeping Strategy Up to Date** focuses on the process of updating the "Innovation Master Plan" on an annual plan and should also include provision of taking into account new Government incentives or international funding mechanism that could support the innovation and R&D in the electricity distribution sector. Moreover, the annually updated "Innovation Master Plan" needs to also take into consideration new technological advancements, as well as external factors that may influence the electricity DSO's innovation strategy. Last, but not least, lessons learnt from past projects in the area of electricity distribution need to be taken into account.

The subsections of this section are listed below:

- 5.1. Research Partners and Supplier Arrangements
- 5.2. Managing Risk and Future Uncertainty
- 5.3. Tracking Benefits
- 5.4. Keeping the Strategy Up to Date

## Section 6

## Delivering Benefits from Innovation

This section summarizes the benefits delivered from projects supported by the electricity DSO.

### 3.5.3.3 Evaluation of R&D Project Applications and Monitoring

Below we provide a set of recommendation related to innovation and R&D activities of electricity distribution companies that address issues related to priority areas, strategic targets for innovation, as well as to evaluation and monitoring of R&D projects.



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## Recommendation 9 Innovation Project Assessment Criteria

Detailed evaluation criteria based on scoring can be implemented for evaluation of project applications. It is also recommended to provide solid feedbacks to DSOs about causes of the rejection.

**Supportive Arguments:** Evaluation of innovation projects under certain criteria, such as relevance, maturity and impact, will allow EMRA to prioritize R&D budget allocation. In UK, Ofgem evaluates electricity-related project applications for the NIC according to the following evaluation criteria:

- acceleration of the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers,
- provision of value for money to customers,
- knowledge generation that can be shared amongst all relevant Network Licensees,
- innovation (i.e. not business as usual) and unproven business case where the innovation risk warrants a limited development and/or demonstration project to demonstrate its effectiveness,
- involvement of other project partners and external funding,
- relevance and timing and
- demonstration of a robust methodology and that the project is ready to implement.

In Ireland, proposals seeking funding under the Electricity Innovation Fund are assessed under certain criteria, such as relevance, maturity and impact.

**As-is Status in Turkey:** There is not a robust and comprehensive assessment methodology that is announced to public.

## Recommendation 10 Evaluation of Project Applications

EMRA might get support from external bodies (e.g. academia, independent subject matter experts) for monitoring of the R&D projects and for provision of feedback in annual basis.

**Supportive Arguments:** The Regulator must define clear criteria for what will be included in the project evaluations. The challenge is to make those criteria both good enough to promote relevant innovations and easy enough to apply in practice. This is the usual balance between accuracy and simplicity that Regulators often face. The Regulators can choose to do all evaluation of a project themselves or try to leave the evaluations to some external bodies to reduce their own burden of work.

In several EU countries, the decision that whether the project is considered as an R&D project or not, is delegated to a third party and R&D projects are approved by an external body, e.g. Norwegian Research Council (NFR).

In UK, Ofgem evaluates electricity-related project application for the NIC according to the evaluation criteria.

**As-is Status in Turkey:** Project applications are evaluated by R&D commission under EMRA.





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Fostering the development of an innovation ecosystem in the electricity distribution sector it is expected to lead in the close collaboration between electricity DSOs and start-ups and academia.

The process of evaluation of R&D project application is of great importance for the efficient distribution of the available funding to the electricity DSOs so that the needed outcomes are derived, and the desired benefits are realized.

### Recommendation 11 Innovation Project Assessment Criteria

Detailed evaluation criteria based on scoring should be implemented for evaluation of project applications. It is also recommended to provide solid feedbacks to electricity DSOs about causes of the rejection.

**Supportive Arguments:** The European Commission, for the evaluation of innovation activities and R&D projects under the Horizon 2020 framework program, has a set of clearly defined evaluation criteria<sup>47</sup> that cover the following aspect of the submitted project proposals:

- Excellence,
- Impact and
- Quality and efficiency of the implementation.

In UK, Ofgem sets a number of evaluation criteria for project proposals submitted under the NIC:

- acceleration of the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers,
- provision of value for money to customers,
- knowledge generation that can be shared amongst all relevant Network Licensees,
- innovation (i.e. not business as usual) and unproven business case where the innovation risk warrants a limited development and/or demonstration project to demonstrate its effectiveness,
- involvement of other project partners and external funding,
- relevance and timing; and
- demonstration of a robust methodology and that the project is ready to implement.

Similarly, for the project submitted under NIA, the following requirements apply:

- Has the potential to develop learning that can be applied by Relevant Network Licensees,
- Has the potential to deliver net financial benefits to network Customers,
- Is innovative (i.e. not business as usual) and has an unproven business case where the risk warrants a limited Research, Development or Demonstration Project to demonstrate its effectiveness; and
- Does not lead to unnecessary duplication.

<sup>47</sup> “Horizon 2020 Work Programme 2018-2020 - Annex H: Evaluation Rules”, European Commission, 2017





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#### Recommendation 11 Innovation Project Assessment Criteria

Moreover, Ofgem also publishes on their website the list of projects not awarded with funding under the NIC, along with any non-confidential document submitted by the project stakeholders.

**As-is Status in Turkey:** The impact ratios of different criteria for the evaluation of R&D applications are not published publicly, or do not exist.

A sample proposed evaluation matrix for R&D project applications is given in Table 8 below.



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Table 8: Evaluation Matrix for R&D Project Applications

No	Criteria	Criterion Type	TRL 1-5 <sup>48</sup>	TRL 6-7	TRL 8-9
1	Consistence with the topics and criteria of the Call	Knock-out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Consistence of the project category and content of the application	Knock-out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Project expenditures should not overlap with CAPEX and other OPEX	Knock-out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<b>R&amp;D Quality, Innovation and Impact</b>	<b>Score</b>	<b>55%</b>	<b>45%</b>	<b>30%</b>
4.1	Clear project objectives and targets	Score	5%	2.5%	5%
4.2	Clearly defined success criteria and Key Performance Indicators	Score	N/A <sup>49</sup>	5.0%	5%
4.3	R&D characteristics	Score	15%	7.5%	5%
4.4	Innovative aspect	Score	15%	7.5%	5%
4.5	Innovation potential	Score	20%	10.0%	N/A
4.6	Operational dissemination potential	Score	N/A	12.5%	10%
5	<b>Quality of the Proposal Application</b>	<b>Score</b>	<b>20%</b>	<b>25%</b>	<b>35%</b>
5.1	Clearly defined Project Plan	Score	4%	4%	5.0%
5.2	Clearly defined Method Statement	Score	4%	4%	5%

<sup>48</sup> It is recommended not to execute an application and evaluation/approval process for small scale projects with budget below 300kTL (2020 CPI). However, reporting and monitoring for the whole project lifecycle should be implemented.

<sup>49</sup> Not Applicable





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No	Criteria	Criterion Type	TRL 1-5 <sup>48</sup>	TRL 6-7	TRL 8-9
5.3	Clearly defined Project Management and Quality Plan	Score	5%	5%	5%
5.4	Clearly defined budget	Score	3%	5%	10%
5.5	Clearly defined Dissemination Plan	Score	N/A	5%	10%
5.6	Clearly defined Human Resource Plan	Score	4	2%	N/A
<b>6</b>	<b>Benefits and Achievements</b>	<b>Score</b>	<b>25%</b>	<b>30%</b>	<b>35%</b>
6.1	Quantitative improvement of Quality of Service/customer satisfaction	Score	8%	N/A	N/A
6.2	Qualitative improvement of Quality of Service/customer satisfaction	Score	N/A	10%	5%
6.3	Sectoral and national achievements (qualitative)	Score	5%	5%	5%
6.4	Sectoral and societal cost-benefit assessment (basic quantitative)	Score	7%	10%	N/A
6.5	Sectoral and societal cost-benefit analysis (extended qualitative)	Score	N/A	N/A	12.5%
6.6	Support new business and market models	Score	5%	5%	12.5%
<b>7</b>	<b>Other Criteria</b>				
7.1	Cooperation with the academia	Weight	1.02	1.02	1.02
7.2	Cooperation with start-up companies	Weight	1.03	1.03	1.03
7.3	Proof-of-Concept/Prototype development studies	Weight	1.05	N/A	N/A
7.4	Cooperation with other electricity DSOs	Weight	1.02	1.03	1.05





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No	Criteria	Criterion Type	TRL 1-5 <sup>48</sup>	TRL 6-7	TRL 8-9
7.5	Cooperation with TEİAŞ	Weight	1.02	1.02	1.05
7.6	Harmonization of other infrastructures (e.g. electricity, water, telecoms, etc.)	Weight	1.03	1.03	1.05
7.7	Improvement of effectiveness of existing systems	Weight	1.05	1.05	1.02



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According to the European Commission, a set of Key Performance Indicators (KPIs) are used to assess the results and impact of innovation and R&D projects in the context of the Horizon 2020 framework program<sup>50</sup>.

## Recommendation 12 Evaluation of Project Results and Impact

Categories of impact for innovation activities and R&D projects.

- **Outputs** are what is directly produced or supplied through the EU intervention. They often relate to the expected deliverables of the intervention. Outputs generally occur within the short to medium term.
- **Results** capture more direct, short to medium term changes in a situation.
- **Impact** broadly defines the wider societal, economic or environmental cumulative changes over a longer period of time.
- **Indicators** are defined as the measurement of an objective to be met, a resource mobilized, an effect obtained or a context variable.
- **Output indicators** relate to the specific deliverables of the intervention.
- **Result indicators** represent the immediate effects of the measure concerned and look at its direct addressees.
- **Impact indicators** represent what the successful outcome should be in terms of impact on the economy/society beyond those directly affected by the intervention.

**Supportive Arguments:** The evaluation of the project impact in a systematic and effective manner will provide EMRA with the ability to assess R&D spending over the years. To evaluate the results and the impact from innovation activities and R&D projects, electricity and gas networks operators in UK jointly prepared, under the Energy Networks Association (ENA), a benefit tracking methodology that delivers a wide range of benefits to network customers and wider stakeholders. This has been designed to increase transparency on the benefits of network innovation projects<sup>51</sup>.

The benefit tracking methodology involved annual and biannual reporting. The annual reporting includes the ENA innovation balancing scorecard that captures different measures and deliverable, as well as the innovation benefits table that contain information on project-specific CBA, benefits (e.g. financial, environmental, customer, safety, etc.), project TRL, stakeholders involved and other information. Moreover, the annual report includes, whenever possible, the specific annual innovation summary reports, the individual project completion reports, as well as the annual industry report. The bi-annual reporting reports on the electricity network innovation strategies.

The purpose of the benefits reporting framework under ENA, is to<sup>51</sup>:

- enable consistent and transparent measurement of innovation costs and benefits delivered across Great Britain,
- demonstrate progress against innovation strategies, both individual network and sector-wide,

<sup>50</sup> "Horizon 2020 Indicators - Assessing the results and impact of Horizon 2020", European Commission

<sup>51</sup> "ENA Benefits Reporting Framework - Delivery Plan", Energy Networks Association, 2019





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### Recommendation 12 Evaluation of Project Results and Impact

- report on innovation that has been transferred to Business as Usual (BAU), both within the network working on a project and how it has been adopted across other networks where relevant and to
- ensure mechanisms are clear so that Ofgem can incorporate these into the relevant RIIO-2 innovation governance documents.

**As-is Status in Turkey:** DSO are obliged to submit project completion reports to EMRA, however there is not a systematic approach to track the results/outputs/success of the R&D projects.

### 3.5.3.4 Allocation of R&D Budget According to Project Types

#### Recommendation 13 TRL-related Project Categories

R&D and innovation projects for electricity distribution companies could be categorized in terms of technology readiness level. The recommended categories are as follows:

- TRL 1-5: Support for basic scientific studies, prototypes and Proof-of-Concept studies,
- TRL 5-8: Standard and/or conventional R&D and innovation projects (solutions, implementations, and technologies in trial phase)
- TRL 8-9: Large scale demonstrations and pilot implementation projects (completed and ready to be implemented solutions and technologies)

**Supportive Arguments:** Technology Readiness Level categorization will allow EMRA to evaluate the maturity of projects in a systematic and efficient manner. In UK within the scope of innovation stimulus package, two different incentive is defined. Among these, the NIA is to fund small-scale Research, Development, and Demonstration Projects, and can cover all types of innovation, including commercial, technological and operational. On the other hand, NIC is focused on funding larger scale and more complex, innovative projects, therefore, funding is awarded through an annual competitive process.

**As-is Status in Turkey:** Such definitions do not exist as of today. The outcomes of R&D projects are not clearly defined where they stand in terms of technology readiness level. Our recommendation includes the announcement of EMRA's guidance and target-setting of technology readiness levels for this different innovation areas, as part of call for project proposals

The Technology Readiness Level (TRL) scale was originally defined by NASA in the 1990's as a means for measuring or indicating the maturity of a given technology. The TRL spans over nine levels as shown in the table below.

Table 9: European Union Technology Readiness Levels

European Union Technology Readiness Levels Definition	
TRL 1	Basic principles observed
TRL 2	Technology concept formulated





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European Union Technology Readiness Levels Definition	
<b>TRL 3</b>	Experimental proof of concept
<b>TRL 4</b>	Technology validated in lab
<b>TRL 5</b>	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
<b>TRL 6</b>	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
<b>TRL 7</b>	System prototype demonstration in operational environment
<b>TRL 8</b>	System complete and qualified
<b>TRL 9</b>	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies or in space)

Horizon 2020 has selected the TRL scale as an indicator to better position the requested projects in the program (as expressed in the Horizon 2020 annual work programs). The TRL, offers a unified scale for measuring technological readiness that enables both applicants and reviewers to meet with the expectations of the European Commission.

Apart from offering a way of meeting EC expectations, TRL can be used as an indication of the “entry point” for an application, indicating the maturity level of a technology/product/process at the beginning of the project. Therefore, using the TRL scale one can track the evolution of the aforementioned technology/product/process throughout the project lifecycle.

#### Recommendation 14 Budget-Related Project Categories

R&D and innovation projects for electricity distribution companies can be categorized in terms of their budget. The recommended categories are as follows:

- **Small-scale R&D and Innovation Projects (budget less than 300.000 TL):** It is recommended that small scale projects do not need to get approval from EMRA R&D commission, or an agile and simpler process might be applied. Regulatory monitoring and electricity DSO reporting are still to be applied for these projects as well.
- **Medium-scale R&D and Innovation Projects (budget between 300.000 and 2.000.000 TL):** Execution of existing conventional process.
- **Large-scale Innovation and Pilot Demonstration Projects (budget greater than 2.000.000 TL):** The following characteristics may apply:
  - Comprehensive CBA might be requested from the electricity DSOs.
  - Promotion of large-scale pilot implementation and demonstration studies.
  - Single project application for each year.





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#### Recommendation 14 Budget-Related Project Categories

- Competition should be executed amongst the applicants (call topics, evaluation criteria and number of projects and/or budget) for each application period.
- KPIs should be defined to measure the success of the project.
- Encouraging joint application of electricity DSOs.
- Certain percentage of the budget allocation can be linked with the realization of project objectives.

**Supportive Arguments:** Budget-related project categorization will allow EMRA to prioritize R&D spending based on the size and impact of the R&D projects and innovation activities. A different categorization of projects can be made based in their budget. According to Article 100 (Major projects) of Regulation (EU) No 1303/2013, a major project is an investment operation comprising “a series of works, activities or services intended to accomplish an indivisible task of a precise economic and technical nature which has clearly identified goals and for which the total eligible cost exceeds EUR 50 million.”

**As-is Status in Turkey:** Does not exist as of today.

Moreover, the R&D budget allocation can made based on the project type and TRL level.

#### Recommendation 15 Research and Development Budget Allocation

R&D budget of the electricity distribution companies could be allotted according to the TRL and project type.

**Supportive Arguments:** Project categorization based on project maturity will allow EMRA to prioritize R&D spending for R&D projects and innovation activities.

Maturity assessment of innovation activities and R&D projects is also performed by the European Commission for the funding framework programs and mechanisms by means of TRL.

In UK, Ofgem also measure the maturity of the innovation and R&D activities based on the TRL of the projects and technologies. For project funded under the NIC, only projects with TRL between 4 and 8 will be eligible for funding from the NIC, while for project submitted for funding under NIA such a requirement does not exist.

**As-is Status in Turkey:** Does not exist as of today.





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A proposed budget allocation based on the R&D project type and TRL is provided in Table 10 below.

Table 10: R&D Project Types Budget Allocation

R&D Project Type	TRL 1-5	TRL 5-8	TRL 8-9	TOTAL
Small-scale	10%	10%	-	20%
Mid-scale	10%	10%	10%	30%
Large-scale	-	10%	30%	45%
<b>TOTAL</b>	<b>20%</b>	<b>30%</b>	<b>40%</b>	<b>90%<sup>52</sup></b>

### 3.5.3.5 Priority Innovation Areas for the Turkish Electricity Distribution Sector

Innovation may come in different forms. Innovation may enhance network operation, e.g. in terms of intelligent steering and control or measuring systems. Ideally, using innovative solutions leads to a more efficient system than using conventional ones. To give some examples, innovation may help to reduce network expansion, and maximize the use of the existing infrastructure. Likewise, the employment of network beneficial flexibility services and other innovative managements of the distribution grid may help to better exploit available network capacity or to avoid network expansion in case of network congestions due to increasing feed-in from renewables. Also, innovation can help to improve operational aspects within the DSO. Important as well is that innovative solutions can improve the reliability of the grid.

#### Recommendation 16 Priority Areas and Calls for Applications

For each R&D project application period, priority areas for electricity distribution companies can be defined and declared considering the Technology Readiness Level (TRL).

**Supportive Arguments:** The priority areas for EMRA should focus on achieving the following goals:

- Increase throughput through the electricity system,
- Assist in the transition to a low carbon economy,
- Deliver significant carbon savings and
- Provide measurable value to all customers.

These goals should also be considered from a whole-system view, which also takes into account the welfare of customers, as proposed by CEER.

<sup>52</sup> Expenses and expenditures listed below are covered by R&D budget, up to 10% of the R&D budget of the DSO for the effective tariff period:

- Expenses in relation to the projects rejected at the application stage,
- In case an R&D, Design and Incubation Center is established by the relevant distribution company, the expenses and expenses incurred except for those covered by other legislation related to the said center,
- Costs and expenses incurred to support and promote entrepreneurship activities, Incubation Centers, acceleration programs, contests and other cooperation activities with technoparks.



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## Recommendation 16 Priority Areas and Calls for Applications

**As-is Status in Turkey:** The recent change (March 2020) in the secondary legislation provides EMRA the role to identify the call topics: “The priority topics for R&D studies and the limitation for the number of projects may be determined by the Commission and could be announced on the website of EMRA and at the electronic platform at latest, within 3 months before the project application period.

The following priority areas for R&D projects and innovation activities are proposed for consideration of EMRA and sector stakeholders.

Table 11: Priority Innovation Areas for Electricity Distribution

New Material, Equipment and Technologies	
Fault Detection and Locating Solutions	Short-term
Advanced Protection Solutions	Medium-term
New Primary Equipment Technologies	Medium-term
New Secondary Equipment Technologies	Medium-term
Advanced Distribution Automation Hardware	Medium-term
Advanced Power System Applications (DLR, WAMS, etc.)	Medium-term
DC Distribution Networks	Long-term
New Substation Designs	Long-term
New Overhead Line Designs	Long-term
Anti-icing & De-icing Solutions	Short-term
Grid Management, Operations and Planning	
Reliability and Resilience	Short-term
Observability and Controllability of the Network	Medium-term
ADMS Applications	Short-term
Grid Optimization	Short-term
Power Quality	Medium-term
Interaction with Other Energy Networks	Medium-term
Integration of Electricity and Gas Networks	Long-term
Power-to-Gas Solutions	Long-term
Fault Level Monitoring and Fault Current Limiters	Medium-term



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Self-Healing Networks and Adaptive Protection	Medium-term
Outage Analytics and Prediction	Medium-term
Active Network Management	Medium-term
Utility Owned Telecommunication Solutions	Medium-term
Resource Optimization	Short-term
Live-Line Working and Maintenance	Long-term
Occupational Health and Safety	Short-term
LED Lighting	Short-term
Voltage Regulation Techniques	Short-term
Network Planning	Medium-term
Virtual/Augmented Reality in Network Operations	Medium-term
Big Data Analytics	Short-term
<b>DER Integration</b>	
High Penetration of LV DERs	Medium-term
Grid Integration of EV Charging Infrastructure	Short-term
Vehicle-to-Grid (V2G), EVs as a Grid Asset	Long-term
Micro-grids	Long-term
Power Storage Integration	Medium-term
Demand Side Response (C&I)	Medium-term
Demand Side Response (Residential)	Long-term
Distribution Ancillary Services	Short-term
Flexibility Management	Short-term
Energy Efficiency and Management Services	Medium-term
Demand Forecasting	Short-term
DER Forecasting	Short-term
Flexibility Forecasting	Medium-term
Flexible Market Design and Business Models	Long-term
DERMS (Distributed Energy Management Systems)	Short-term
Hierarchical DER Management	Long-term





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## Asset Management

Asset Performance Management	Short-term
Lifecycle Optimization and Improvement of Network Components	Medium-term
Drone and Asset Monitoring Solutions	Short-term
Predictive Maintenance and Asset Analytics	Medium-term
Distributed Information Acquisition and Decision Making	Medium-term
Advanced Asset Diagnostic Analysis and Root-Cause Analytics	Medium-term

## Coping with Losses

Theft Detection and Prevention Field Solutions	Short-term
Theft Analytics	Short-term
Technical Loss Optimization	Medium-term
Intelligent Meter Implementation Solutions	Short-term

## Security

Cybersecurity	Short-term
Field and asset physical security	Medium-term
Incident management	Medium-term
ICT systems intrusion detection	Medium-term

## Smart Meters

Interoperability and Common Standards for AMI	Short-term
Meter Data Management and Analytics	Short-term
Large-Scale Pilot Rollouts	Medium-term
Ad-hoc Solutions for Reduction of Cost of Smart Meter Roll-out	Medium-term
Integration of Electricity and Gas Smart Meters	Long-term
Connectivity via 5G mobile networks	Medium-term
Internet-of-Things	Medium-term

## Enterprise IT and Integration

Enterprise Service Bus Architecture for IT and OT Convergence	Short-term
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Improvement of Customer Interaction Systems/Applications	Short-term
CIM, Data Model and Interoperability	Long-term
Enterprise IT	Medium-term





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### 3.5.3.6 Other Recommendations

#### Recommendation 17 Public Access to Innovation Process

The results of the funded innovation projects can be publicly available to promote transparency. Rejected projects might also be published with DSOs' permission.

**Supportive Arguments:** EMRA should foster dissemination activities of the projects; results, impact and lessons learnt.

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.

**As-is Status in Turkey:** GAZBIR/ELDER provide information on R&D projects in dedicated website (<https://www.argebilgi.info/>). The provided information can be more structured, and EMRA may identify the minimum requirements for dissemination of project outcomes.

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. In this context, open access refers to:

- peer-reviewed scientific research articles and
- research data.

Open access to all **peer-reviewed scientific publications** produced by projects funded under the Horizon 2020<sup>53</sup>, can be granted by means of the following options:

- **Self-archiving** (also referred to as “**green**” **open access**) where a published article or the final peer-reviewed manuscript is archived (deposited) in an online repository before, alongside or after its publication. Beneficiaries must ensure open access to the publication within a maximum of six months (twelve months for publications in the social sciences and humanities).
- **Open access publishing** (also referred to as “**gold**” **open access**) where an article is immediately provided in open access mode (on the publisher/journal website).

Finally, by the term “**research data**” we refer to information (particularly facts or numbers) that is collected in order to be examined and considered and serve as the basis for reasoning, discussion or calculation. Beneficiaries of Horizon 2020 grant need to also ensure open access of research data.

<sup>53</sup> “Open Access”, Horizon 2020 Online Manual





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The open access process of peer-reviewed scientific publications and research data under the Horizon 2020 framework program is illustrated in Figure 24.

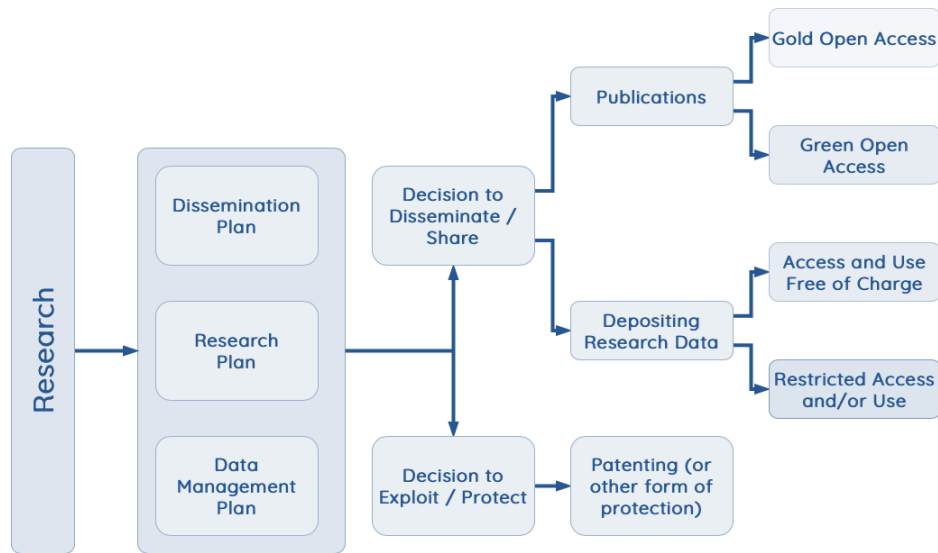


Figure 24: Open Access Under the Horizon 2020 Framework Program

### Recommendation 18 Communication and Dissemination of Innovation Activities

EMRA should request and push ELDER (association of electricity DSOs) to disseminate the R&D projects after removal of sensitive information. Electricity DSOs should communicate the benefits of their innovation programs to increase their social acceptance from consumer’s perspective and to have greater collaboration from other electricity DSOs.

**Supportive Arguments:** In Turkey, R&D activities are funded from revenue cap and should be disseminated. Also, electricity DSOs should disseminate results and lessons-learned from R&D projects and innovation activities to all regulated entities, both for electricity and gas, to foster cooperation and potential synergies.

In UK, 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.

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## 4 Electricity Transmission Sector Report

Renewable energy technologies, load demand management technologies, electrical vehicles and electricity storage technologies require new investments that must not be in conflict with the existing system. Current transmission regulations, business models, cost allocations, and planning criteria may not properly address new technologies' needs. In addition, the current system encourages cost reduction and reliability, not innovation

### 4.1 Introduction of Electricity Transmission Part

Innovation is a fundamental electricity transmission activity to upgrade transmission network operations, increase the quality of services, create value for customers, disseminate knowledge and move forward into modernized network. There exists a common approach in most of European countries, and at EU level, to promote innovative technologies through regulatory incentives, enabling new business models or encourage partnerships across the energy sector. ENTSOE, CEER and the European Commission are working on guidelines and recommendations to foster the implementation of innovative solutions by TSOs in pursuit to the energy transition.

In this chapter we present several regulatory approaches in incentivising innovation activities of electricity TSOs. The most common practice applied by European countries is to include a special allowance in the revenue cap linked to innovation and R&D costs. We have compared best practices in use paying special attention to overarching principles, eligibility criteria of R&D allowed expenditures, evaluation and monitoring obligations. We outline the roles and responsibilities of each key stakeholder for the most critical areas of innovation in the transmission sector. Based on international best practices and taking into consideration the current situation in Turkey we develop a set of recommendations to be considered by EMRA in the design and implementation of the innovation regulatory support mechanisms.

### 4.2 Innovation and R&D Studies in European Electricity Transmission

#### 4.2.1 ENTSO-E Vision on Transmission Innovation

According to European Network of Transmission System Operators for Electricity (ENTSO-E), the transition of the European electricity system to a low-carbon energy system is one of the major challenges. TSOs, having key role as system integrators for new services and technologies, are at the centre of this transition.

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.

For this reason, 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. In this roadmap, cooperation is intended to be promoted in two dimensional: Vertical and horizontal cooperation. As per 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.





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With the transition towards a decarbonized society, the electricity systems will definitely face with fundamental challenges. At the same time, TSOs have to cope with the changing energy landscape and to realize the next phase of the energy transition in a timely and efficient way with maximum welfare and benefits for society.

The Communication “Towards an Integrated Strategic Energy Technology Plan: Accelerating the European Energy System Transformation”, set up the new frameworks for R & I activities: the European Technology and Innovation Platforms (ETIPs). These structures merge the former SET Plan European Industrial Initiatives (EII) and the European Technology Platforms. At the same time, funding tools - through the Horizon 2020 program - have shifted from a technology-driven approach to a challenge-driven approach. New stakeholders and market players (in generation, storage and market services) are on board with new opportunities for consumers. This puts network operators in a pivotal role and implies a higher responsibility towards society. The transmission grid, as the backbone of the power system, is the key enabler to facilitate the transition to a low-carbon energy system.

TSOs have a key role as system integrators of different components based on technologies (e.g., ICT, materials, storage, and power electronics). The TSO community should also be prepared to face game-changing modifications such as new actors entering the power system. Moreover, TSOs should ensure that the three dimensions of innovation - technology, process and business model - are addressed. TSOs’ role is crucial in this context and the Roadmaps support their engagement in Research and Innovation activities. To this purpose ENTSO-E intends to promote vertical and 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 in the following clusters;

- Power System Modernization

Main purpose: The development of an optimal grid design by using the most cost-effective technologies/solution enabling flexibility.

- Security and System Stability

Main purpose: The improvement of the observability and controllability of the transmission system.

- Power System Flexibility

Main purpose: The deployment of existing and new system flexibility options.

- Power System Economics & Efficiency

Main Purpose: 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

Main Purpose: The achievement of a more efficient market with an optimized energy mix and security of supply through integration of market and grid operations

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





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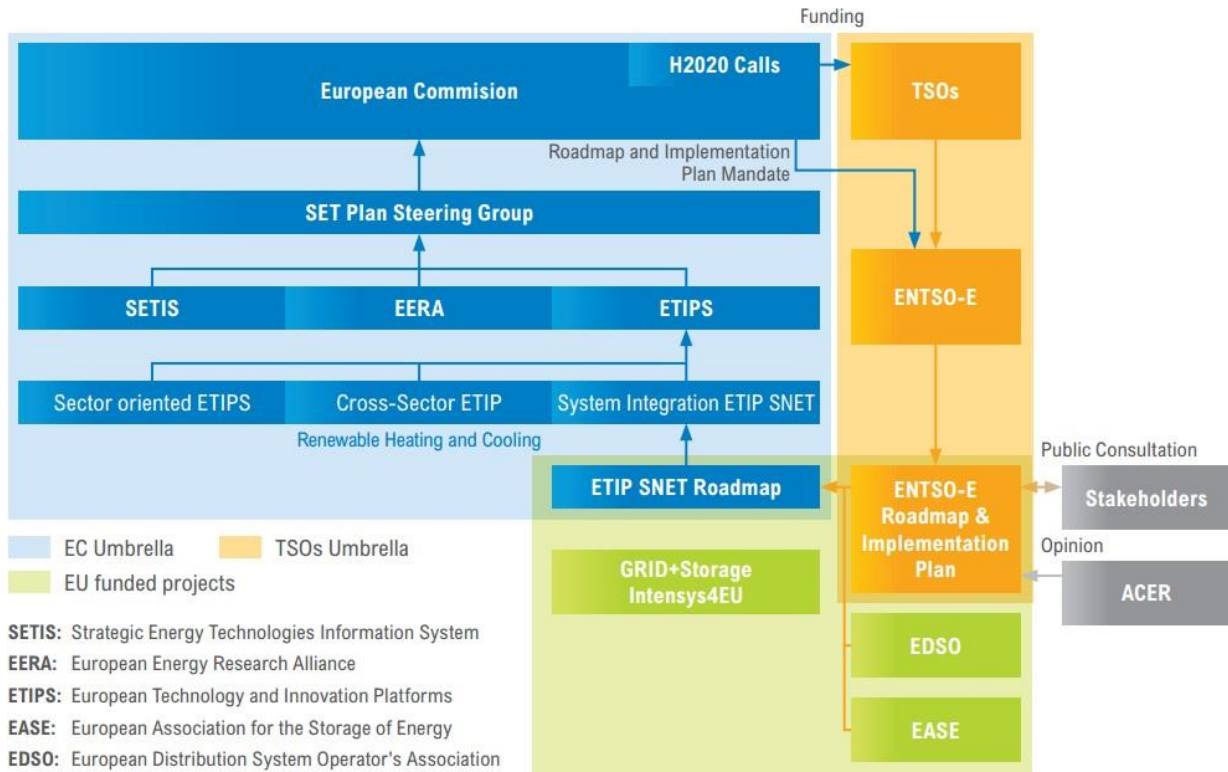


Figure 25: Interactions Between ENTSO-E and Other Bodies regarding Innovation

#### 4.2.2 ENTSO-E Innovation Clusters and Functional Objectives

ENTSO-E and its Members (TSOs) have created a public platform for communication and exchange of best practices applied at national level<sup>54</sup>. These innovative solutions focus on power system modernization, security and system stability, power system flexibility, power system economics and efficiency, ICT and digitalization of power system and other innovative applications to support the achievement of the current EU goals and national strategies.

Electricity Transmission innovation projects are classified under each of the following topics:



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Table 12: Electricity Transmission Innovation Projects: ENTSO-E Clusters<sup>55</sup>

Innovation Area	Brief Description	Functional Objectives
<b>C1 Power System Modernisation</b>	<p>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.</p>	<ul style="list-style-type: none"> <li>• T1 Optimal grid design: Planning, adequacy, tools</li> <li>• T2 Smart Asset Management: Predictive and on-condition maintenance; CAPEX optimisation</li> <li>• T3 New materials &amp; technologies: Use of new materials and power technologies; new construction and maintenance methods</li> <li>• T4 Environmental challenges &amp; Stakeholders: Environmental impact, public acceptance, stakeholder's participation</li> </ul>
<b>C2 Security and System Stability</b>	<p>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 defence 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.</p>	<ul style="list-style-type: none"> <li>• T5 Grid observability: Observability of the grid: PMUs, WAM, Sensors, DSO information exchange</li> <li>• T6 Grid controllability: Controllability of the grid; frequency and voltage stability, power quality, synthetic inertia</li> <li>• T7 Expert systems and tools: Decision support tools, automatic control and expert systems</li> <li>• T8 Reliability and resilience: Défense and restauration plans, probabilistic approach, risk assessment, self-healing</li> <li>• T9 Enhanced ancillary services: For network operation; cross-border supply of services</li> </ul>

<sup>55</sup> ENTSO-E Research, Development & Innovation Roadmap 2017– 2026





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Innovation Area	Brief Description	Functional Objectives
<b>C3 Power System Flexibility</b>	<p>This cluster supports the deployment of existing and new system flexibility options such as:</p> <ul style="list-style-type: none"> <li>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.</li> <li>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 behaviour and quantify the degree of flexibility provided by the distribution networks.</li> <li>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.</li> <li>The enhanced use of the transmission assets.</li> </ul>	<ul style="list-style-type: none"> <li>T10 Storage integration: Definition and use of storage services; system added value from storage</li> <li>T11 Demand Response: Tools to use DSR, Load profile, EV impact</li> <li>T12 RES forecast: Improved RES forecast and optimal capacity operation</li> <li>T13 Flexible grid use: Dynamic rating equipment, power electronic devices; use of interconnectors</li> <li>T14 Interaction with non-electrical energy networks: Interaction/coordination with other energy networks (gas, heat, transport)</li> </ul>
<b>C4 Power System Economics &amp; Efficiency</b>	<p>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 optimised 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 optimisation 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.</p>	<ul style="list-style-type: none"> <li>T15 Market - grid integration: Integration of market and grid operation across timeframes (up to real time)</li> <li>T16 Business models: For storage, grid extension, distributed generation for optimal investments in the network</li> <li>T17 Flexible market design: Market design for adequacy, flexibility use, cross border exchanges, rationale use of RES, demand management</li> </ul>





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Innovation Area	Brief Description	Functional Objectives
<b>C5 ICT &amp; Digitalisation of Power System</b>	<p>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 standardisation 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.</p>	<ul style="list-style-type: none"> <li>• T18 Big data: Big data analytics, data mining, data management</li> <li>• T19 Standardisation &amp; data exchange: Standardisation, protocols for communications and data exchange with DSOs and other grid operators</li> <li>• T20 Internet of Things: New communication technologies, Internet of Things</li> <li>• T21 Cybersecurity</li> </ul>





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### 4.2.3 ENTSO-E Recommendations for Innovation Framework

Final R&I Roadmap of ENTSO-E suggests several recommendations to overcome barriers and limitations that have been observed in member TSO. Majority of the recommendations 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.
- 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.

### 4.3 Innovation in Electricity Transmission: International Benchmark

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 the regulatory innovation incentives in use in each country but also the application of these incentives by each TSO.

Consolidated descriptions serve as a benchmark on international practices related to regulations and tariff methodologies for innovation activities in the electricity transmission sector. The following countries are considered in the analysis:

- United Kingdom,
- Italy,



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- France,
- Norway and
- Finland.

This recap helps us to design the most suitable innovation incentive for the Turkey case.

### 4.3.1 United Kingdom

#### 4.3.1.1 *Regulatory practices related to innovation*

Great Britain has a long tradition of continuous enhancement of its regulatory approaches to consider the changes and development of the energy sector.

Innovation is a key element of the RIIO (Revenue = Incentives + Innovation + Outputs) model for price controls. According to Ofgem (NRA) RIIO framework provides strong incentives for Network Licensees to innovate as part of normal business. However, certain Research, Development, and Demonstration Projects are speculative in nature and yield uncertain commercial returns. In addition, where benefits are linked to the decarbonization of the network, it may be difficult to commercialise the respective carbon and/or environmental benefits and shareholders may be unwilling to speculatively fund such Projects.

The Network Innovation Allowance, the Network Innovation Competition and Innovation roll-out mechanism are primary funding mechanisms for R&D and innovation projects.

The projects funded beneath the Network Innovation Allowance and Network Innovation Competition partly are mainly aimed at comparatively smaller projects.

Additionally, there are other price control mechanisms which encourage innovation, such as sharing factors (i.e. although simplified, if costs can be reduced the benefit is shared between the TSO and consumers), which drives more innovative approaches to TSO obligations such as new infrastructure build. Those ‘other elements’ provide the funding for implementation of other innovations under conventional investments.

NIA and NIC awarded projects are included as part of the revenue to be recovered via network tariffs.

#### 4.3.1.2 *Network Innovation Allowance*<sup>56</sup>

The Network Innovation Allowance (NIA) was established as part of the RIIO-ET1 price control. It is designed to fund small scale research, development and demonstration projects. The NIA provides each licensee with an allowance to spend on innovation projects in line with the NIA Governance Document. If successful, these projects should bring a wide variety of financial, operational, environmental and safety benefits.

The NIA is a set annual allowance (0.5-1%) that each Network Licensee (TSOs and DSOs) will receive to fund small-scale innovative projects as part of its price control settlement. The NIA will fund smaller scale Research, Development, and Demonstration Projects, and can cover all types of innovation, including commercial,

<sup>56</sup> Ofgem Network Innovation Allowance Governance Document





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technological and operational. The NIA provides limited funding to Network Licensees to use to fund smaller Projects which meet the eligibility criteria.

There will be no initial requirement for a utility portfolio to contain a specific percentage split between different types of innovative Methods and Solutions. There is no minimum or maximum size for a NIA Project.

ANIA Project must have the potential to have a Direct Impact on a utility's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following:

- A specific piece of new (i.e. unproven in GB, or where a Method has been trialled outside GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and software).
- A specific novel arrangement or application of existing transmission systems and equipment (including control and/or communication systems and/or software).
- A specific novel operational practice directly related to the operation of the GB transmission system; or
- A specific novel commercial arrangement.

In addition, a NIA Project must meet the following requirements:

- a. Has the potential to develop learning that can be applied by Relevant Network Licensees.
- b. Has the potential to deliver net financial benefits to network Customers.
- c. Is innovative (i.e. not business as usual) and has an unproven business case where the risk warrants a limited Research, Development or Demonstration Project to demonstrate its effectiveness.
- d. Does not lead to unnecessary duplication with other innovation projects under other incentive mechanisms (e.g. NIC).

The implementation of innovation projects under the NIA is carried out based on the following guidelines:

1. Project Eligibility Assessment (PEA). Before Registration of a NIA Project, the Funding Licensee(s) must produce a PEA demonstrating that the Project meets eligibility requirements and that Network Licensee is not implementing the Project as part of its normal business activity.
2. Project benefits guide. To ensure a consistent approach in assessing the benefits of Projects Ofgem requires Network Licensees to work together to develop and maintain a common guide for converting different types of benefit into financial terms.
3. Registration process requirements. In order for a Project to be eligible for funding, it must be registered on the NIA portal of Ofgem. The Registration process does not generally involve Ofgem approving Projects. A Network Licensee can still register a NIA Project even if it does not expect to incur any Allowable NIA Expenditure. In doing so, it will still be eligible to receive Allowable NIA Expenditure if the outturn costs and benefits are different from expectation.





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4. Eligible NIA Expenditure requirements. Eligible NIA Expenditure is expenditure on a Project that is related to the implementation of the Network Licensee's Project subject to the restrictions set out by Ofgem regulation.

#### 4.3.1.3 Network Innovation Competition<sup>57</sup>

The Electricity NIC is open to Network Licensees (TSOs and DSOs) who wish to bid for funding for innovative Projects which could deliver carbon or environmental benefits for customers and that would not be funded by the Network Licensee without additional funding being made available. Network Licensees can collaborate with each other and Non-Network Licensees on NIC projects as Project Partners. Project Partners are able to contribute External Funding to a Project but are eligible to lead bids for funding only through a Network Licensee.

Funding is awarded following a two-stage competitive process:

1. Initial Screening Process.

Projects must first pass through an Initial Screening Process (ISP) to demonstrate they are eligible to be considered for funding. Each Formula Year, a Network Licensee Group can submit up to four Projects at the ISP stage. The purpose of the ISP is to reduce the risk of Network Licensees spending time and money developing ineligible Projects by providing an early indication of which Projects may become eligible for funding

A NIC Project must have the potential to have a Direct Impact on a Network Licensee's network or on the operations of the GB System Operator and involve the Development or Demonstration of at least one of the following:

- a. A specific piece of new (i.e. unproven in GB) equipment (including control and/or communications systems and/or software).
- b. A specific novel arrangement or application of existing transmission and/or distribution equipment (including control and communications systems software).
- c. A specific novel operational practice directly related to the operation of the transmission system; or
- d. A specific novel commercial arrangement.

In addition to meeting one or more of the requirements set out above in order to pass ISP, a Network Licensee must also demonstrate in its completed Screening Submission that the Project meets all the following ISP criteria:

- i. Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to existing and/or future network customers
- ii. Delivers value for money for customers
- iii. Creates knowledge that can be shared across energy networks in GB or create opportunities for roll-out across a significant proportion of GB networks

<sup>57</sup> Ofgem Network Innovation Competition Governance Document





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- iv. Is innovative (i.e. not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness

Ofgem has 20 working days to carry the ISP and evaluate which projects are eligible for the NIC.

## 2. Full Submission Process.

In any Formula Year, a Network Licensee Group may submit up to four Projects which have passed the ISP for Full Submission in its capacity as Funding Licensee.

To calculate the level of funding the Network Licensee wishes to request from the NIC for a Project as part of the Full Submission (the NIC Funding Request), the Network Licensee must determine the Total Project Costs and Initial Net Funding Required. Ofgem may award only a part of the total project costs, i.e. remaining costs of the projects are borne by Network Licensees or other Partners.

Ofgem will appoint an Expert Panel that will provide a recommendation to the Authority as to which Projects should receive funding. The Authority will make the decision in relation to which Projects should be awarded funding and will take into account the recommendation of the Expert Panel in awarding funding from the NIC.

The evaluation criteria will be based on the same 4 principles considered during the ISP (see above). Involvement of other Partners and External Funding, timing and robust methodology and implementation plan are also evaluation criteria.

## 3. Implementation monitoring

Ofgem will issue a direction (the Funding Direction) that will set out the total amount that can be recovered from or returned to GB customers through Transmission Charges to cover NIC Funding in each year.

Network Licensee must adhere to some requirements if it is awarded funding for a NIC Project:

- Separate bank account for the project.
- Customer protection requirements.
- Reporting requirements: Project Progress Report (PPR). The Network Licensee will be required to provide a detailed report which contains sufficient detail to allow Ofgem to evaluate the progress of the Project.
- Reporting requirements: Close Down Report. The Network Licensee must submit its Close Down Report to Ofgem within three Calendar Months of the Project end date.
- Project audits. All NIC Projects may be subject to an audit at any time undertaken by Ofgem, or by a third party appointed at the discretion of Ofgem.

To facilitate knowledge, transfer a default treatment for Intellectual Property Rights (IPR) has been developed by Ofgem. Any royalties earned by a Network Licensee through Foreground IPR are shared with customers in proportion to the funds that customers have contributed to the Project.





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#### 4.3.1.4 **Selected transmission projects supported**

##### **Black Start from Distributed Energy Resources (National Grid Electricity System Operator) - 2018**

This project will trial how different types of distributed energy resources (DERs) can provide black start services and local restoration. The proposed project will build on existing research in GB and internationally and investigate if DERs are a viable solution to provide Black Start services, and how to coordinate stakeholders to best manage restoration efforts. The project aims to provide a commercial and regulatory framework for how Black Start services from DERs can be purchased and regulated.

##### **Transmission & Distribution Interface (TDI) 2.0 (National Grid Electricity Transmission) - 2016**

TDI 2.0 will demonstrate how services traditionally offered by transmission-connected generation to the SO (such as voltage stability and thermal capacity) can be provided by distribution-connected energy resources. The distribution company will effectively act as ‘gatekeeper’ in providing some of these services to the SO. The project will also examine how these new services interact with the existing commercial arrangements.

##### **Off-grid Substation Environment for the Acceleration of Innovation Technologies (OSEAIT) - 2015**

This project aims to modify an existing 400kV electricity substation into a field trial facility to host electricity related innovation projects in a live substation environment.

##### **Enhanced Frequency Control Capability - 2014**

This project will develop and demonstrate an innovative package of tools to enhance the capability to deliver system frequency control.

##### **Phoenix – System Security and Synchronous Compensators (Scottish Power Transmission) -2016**

Phoenix will trial a novel combination of compensation equipment. The equipment will provide a new method of providing ancillary services (such as frequency regulation and voltage control) to the transmission system operator (SO), traditionally provided by large thermal generators. The project would also test how these services can be offered commercially and investigate the associated agreements that need to be put in place for this to become a business as usual option across the GB network.

##### **Future Intelligent Transmission Network Substation (FITNESS) – 2015**

This project aims to deliver a live multi-vendor digital substation instrumentation system to protect, monitor and control the transmission network.

##### **Visualisation of Real Time System Dynamics using Enhanced Monitoring (VISOR) - 2013**

This project will use enhanced monitoring techniques to provide a number of benefits associated with the secure integration of new technologies onto the transmission network and also provide visibility of system voltage and stability limits.

##### **New Suite of Transmission Structures (NeSTS) - 2015**

This project aims to develop a new suite of overhead line supports that are smaller, better for the environment and could result in financial savings for customers.





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#### **Modular Approach to Substation Construction - 2014**

This project aims to develop and trial a modular approach to substation construction which integrates substation components with other innovations in civil works and cabling.

#### **Multi-Terminal Test Environment (MTTE) for High Voltage Direct Current Systems - 2013**

This project aims to establish a facility to demonstrate and test multi-terminal and multi-vendor High Voltage Direct Current transmission solutions.

#### **Offshore cable repair vessel and universal joint (TC Ormonde OFTO) - 2014**

This project will convert an existing telecom-cable repair vessel so that it can repair OFTO power cables. It will also manufacture and test a new cable jointing system.

### **4.3.2 Italy**

#### **4.3.2.1 Overview of Regulatory Incentives**

In the existing regulation in Italy, there is no specific responsibility of TSO to innovate. It's mainly part of NDP process. Under Legislative Decree, no.93 of 1 June 2011, TSO is required to submit a 10-year network development plan to ARERA and to the Ministry for Economic Development for approval. TSO has the duty to operate the transmission grid efficiently and effectively. This responsibility is an indirect motivation to implement innovative solutions to cut the costs.

On the other hand, the Regulator doesn't have a specific power to push the TSO about innovation activities. However, expenditures of efficient implementation of recent technologies can be included in system charges. This provides the Regulator certain ability to identify targets regarding innovation, only in the case that they are efficient.

In the case of innovative solutions which can be considered as promising for future, the Regulator may value the possibility of an initial support, including specific incentives. As an example, in 2012 the Regulator has supported first electro-chemical power storage and DLR (dynamic line rating) applications in the transmission system. In any case, the possibility to define specific cost allowance rules for specific innovative projects is not an automatic process and the evaluations are performed case by case. The key (and project-specific) feature to support related projects was a (conditional) WACC premium. To balance this premium feature (200 basis points for 12 years), the Regulator has set a conditionality on the minimum performance of the pilot project (prevented RES curtailment energy) and an extended allowance of ex-post CAPEX increases subject to approval (exceeded CAPEX is also allowable in the regulations, as far as they are efficient).

Although there are not well-defined responsibilities of TSO for innovation activities, the TSO has a solid "Innovation Plan" (recent version for 2019-2023) that details the activities and projects planned for the near future.

#### **4.3.2.2 Innovation Activities of Italian Electricity TSO**

The future of the energy system and achievement of the decarbonisation target are strongly dependent on the ability of players like Terna to innovate, discover new technologies and integrate the various sources of renewable energy and the different infrastructure.





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Become a “TSO 2.0”: this is the main target of Terna’s commitment in the field of innovation which refers to a new approach to managing the energy system based on a high level of integration with new technologies both in respect of the grid and the market.

Terna is concentrating on the following main areas in its Innovation Plan<sup>58</sup>:

- Transmission technologies
  - Application of innovative techniques for transformers insulation
  - Line monitoring, innovative materials with improved electric characteristics for lines or transformers
  - HVDC cables and insulators
  - Carbon fibre conductors
  - New anti-icing technologies.
- Power system management
  - New logic algorithms to optimise dispatching services
  - Big Data Technologies for the development of innovative models of data analysis
  - Application of Internet of Things tools in the management and monitoring of the transmission network sensors (drones, robots and distributed computing/connectivity)
- Development of grids, markets and regulatory framework
  - New studies and models on the impacts of climate changes, e-mobility and RES penetration
  - Application of innovative tools for the network planning
  - Forecasting models of market scenarios and dispatching services optimization
- Smart grids& storage
  - Storage: analysis of different storage solutions in terms of material and management and studies on the possible regulation services provided by storage systems and new resources (enhanced primary regulation, balancing, synthetic inertia, etc.)
  - Optimal coordination of different flexibilities resources in grid context with high share of renewables penetration.

<sup>58</sup> [www.terna.it/en/about-us/innovation-plan](http://www.terna.it/en/about-us/innovation-plan)





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- **Sustainability:** This includes all the projects aimed at promoting a more sensitive approach to environmental issues. It is an integral part of the corporate mission and is relevant to all the other clusters.

### 4.3.3 France

#### 4.3.3.1 Overview of regulatory practices

The general regulatory principle can be described as incentive-based revenue cap with pass through elements. TSO's capital cost differentials between forecast and actual trajectories are now 100% covered by the tariff through the reconciliation. The treatment of CAPEX encourages innovative projects that are efficient. CRE put in place incentives for innovation in the way CAPEX are dealt when setting the tariff.

In accordance with the public service mission assigned to TSOs, the Public Service include efforts on R&D. As such, TSO must undertake studies for the development of innovative technologies and improvement of the performance of its facilities and the TSO invests on the development of intelligent grids. TSO has tangible duties to make digital transformation happen and implement state-of-the-art technologies, as well development of them.

Per regulations (public service contract), the responsibilities of TSO include:

- **Technological change:** offering new technical development solutions by fostering the emergence of new components which take advantage of nanotechnology development, power electronics and superconductivity.
- **Digital change:** development of a methodology to facilitate infrastructure maintenance and optimization and contributing to the development of intelligent networks.

These changes and development should aim the promotion of RES integration to the grid, improvement of power system management tools and market mechanisms, and enabling real-time data services in order to support energy transition.

The French Energy Regulatory Commission (Commission de Régulation de l'Énergie - CRE) introduced in its transmission price control an incentive scheme for Research and Development (R&D) cost. The tariff aims to provide the TSOs with all the resources needed to respond to the challenges of energy transition and takes account of the changes in the market.

The national regulatory framework is supporting R&D and innovation activities, finally concluding in integration of projects to the RAB. The regulations provide enough flexibility for decisions adapting in parallel with project execution or after that.

TURPE price controls are applied for both distribution and transmission utilities. The current price control for TSO is TURPE 5 HTB and is effective from 2017- 2021, setting limits on what RTE can charge for development and operation of the network.

R&D and innovation expenditures, with a focus in smart grids, are entirely covered as well as RTE's other investment expenditures. TURPE 5 HTB supports performance incentives and provides the TSO the possibility to receive extra budgets during the tariff implementation period for financing innovation and intelligent grid projects, which is subject to approval of its feasibility on the basis of the CBA.





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CRE tries to sustain the balance between implementation of innovative solutions and investments for new infrastructure. In this context, if RTE exceeds the allowed budget for R&D and innovation activities, the delta is not covered in its tariff. In addition to the existing price control, smaller projects, at a lower value and a smaller scale, may be promoted through other mechanisms, which allow their development by limiting the risks in early stage of innovation before the project is considered for a wider development (i. e. large scale pilot deployments).

A process for approval of innovative projects exists to reduce the risk of non-accepted expenditures. If TSO want to start activities that are not directly associated with their main tasks, the activities must be approved by the CRE in advance.

The TSOs on a yearly basis must report to CRE on the actual spending, list of current and upcoming R&D related projects with expected results. At the end of the price control period, any underspending on the allocated R&D amount is accumulated in an account and reimbursed back to the network users.



Figure 26: Overview of French Innovation Revenue Methodology

TSO has to send an annual report of R&D projects to CRE for publication in order to report to the users on innovation projects carried out by the TSOs. This report needs to include the following in particular:

- A description of the projects carried out and partnerships made, together with a list of related expenses and the results obtained.
- A list of current and upcoming projects, together with the expected results.
- The amounts spent over the past year.
- Expenditure forecasts for each year until the end of the tariff period.
- The number of full-time equivalents allocated to the R&D programmes.
- Any support or grants received.

On the other hand, the latest R&D plan of RTE (2017-2020) has been categorized in 6 programmes:

- Asset management
- Grid infrastructure evolution
- Environment and society





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- Power system functioning and operation
- Optimal grid development for the energy transition
- Foresight, economics and smart grids

#### 4.3.3.2 Selected transmission projects supported

In France, existing regulatory framework supports R&D and innovation projects (including large-scale ones) that are considered as feasible in terms of costs and economic / technical benefits.

Some examples to innovation projects supported:

- **RINGO:** It's as a large-scale R&D project for implementation of battery storage with an aim at showing the relevance of smart storage for operational performance of the network and congestion management. RINGO project is a good example to show the approach of the regulatory framework. Although, the projects has a deep R&D characteristics, it is treated like as other regulated investment, with some amendments concerning the allowance of the storage operation by the TSO and the length of the experiment (3 years). The project might be expected to face a regulatory barrier because of the unclear status of electricity storage in the electricity market.
- **Biscay Gulf (BG):** The goal of this project is to implement highly innovative 2 GW underwater line to reinforce the link between the Iberian Peninsula and the rest of the European electricity market without getting through the Pyrenees mountains.
- **iTESLA (Innovative Tools for Electrical System Security within Large Areas):** The iTesla project is a new-generation platform used to analyse projected network situations covering a time horizon ranging from D-2 to real time. The underlying objective is to optimise operational security margins, by not taking excessive and costly margins, without compromising the secure operation of the network. The iTesla platform is a decision-support tool meant to be used at transmission system operator (TSO) level, or by a group of TSOs (such as the CORESO coordination centre, for example)
- **Data Sharing:** GRTgaz and RTE jointly established the freely accessible Open Data Réseaux Énergies (ODRE) platform. This platform provides citizens, scientists, regional communities and economic players with a wealth of useful data on the generation and use of energy both nationally and locally.

#### 4.3.4 Norway

NVE regulates the Norwegian DSOs and TSO by using a combination of the company's own costs and the costs from benchmarking models. In addition, costs for R&D are treated as pass-through costs when they fulfil certain conditions, in order to avoid short term disincentives.

The Norwegian NRA calculates yearly revenue caps with elements of yardstick competition. 40% of the revenue cap is based on the company's own costs, and 60% on the cost norm where benchmarking models are used. In the benchmarking, total costs are minimized given the outputs defined in the model.

Research and development rarely increase outputs of the model in the short run. This means that conducting R&D would increase costs without any corresponding increase in output in the same year, i.e. the TSO would perform





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worse in the benchmarking. This would give disincentives against R&D for the TSO and that is not desirable in a time where there are changes happening in the industry. Based on this, a new mechanism was introduced in 2013 to strengthen the incentives for investing in R&D. In the mechanism, R&D costs are treated as pass-through costs, i.e. they are not included in the benchmarking and can be included directly into the tariff base. Three conditions must be fulfilled before the costs are accepted in this mechanism:

- The R&D is useful for grid operation/ investments/ planning
- It represents a maximum of 0.3 % of the TSO's regulatory asset base
- The R&D project is approved by an external body, e.g. the research council. This ensures the burden of work for the NRA is reduced. As the NRA must not evaluate whether it can be considered as research, that decision is delegated to a third party.

Once these criteria are met, the project owner can apply to have his project approved in our R&D funding scheme. The application must be sent electronically to NVE and must contain at least the following documentation:

- Documentation that the project was found to be worthy of support
- A brief explanation of why the project is relevant and how the project contributes to more efficient operation or utilization of the network
- An overview of which network companies are to participate in the project
- A statement that the project will comply with the Accounting Act's requirements for managing R&D costs
- A statement that the project results will be made widely available

In Norway, the following incentives for R&D are in place or can be used:

- EU R&D project funding (Horizon 2020)
- Nordic R&D project funding (NER - financing from the Nordic countries)
- Skattefunn (tax benefit)
- NVE ordning (additional financing from the regulator)
- NFR - Norwegian Research council (R&D project grants)

#### 4.3.5 Finland

Although the Monitoring Act does not assign the Regulator specific responsibilities and powers for incentivizing innovation, the Finnish Regulator encourages innovation through its regulatory methodology and the innovation incentive.

The regulatory methodology for calculating reasonable return contains an innovation incentive. The Finnish Regulator deducts reasonable R&D costs during the calculation of realised adjusted profit for network operators, in



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order to support the active innovation and R&D efforts (instead of directly controlling prices, the Regulator implements an ex-post tariffs adjustment at the end of a four-year tariff period on the basis of a calculation of reasonable yearly returns). However, acceptable R&D and innovation activities costs must be recorded as expenses in the unbundled profit and loss account since capitalised R&D costs are not accepted to be included in the calculation of the innovation incentive. Moreover, 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.

The results of projects for which costs have been accepted in the innovation incentive must be public so they can be used by the sector as a whole, with the exception of confidential customer information or results protected by industrial property rights.

The impact of the innovation incentive is deducted when calculating realised 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.

Further, recently, the Ministry of Economic Affairs and Employment, which is responsible for energy policy, set up a working group tasked with investigating the possibilities of smart grids in the electricity market. The working group contains members from e.g. both the Regulator and the TSO. In particular, the task of the working group is to investigate and make proposals on how smart grids can empower electricity consumers to actively participate in the market and promote security of supply.

#### 4.3.6 Recap of EU Countries

As it can be seen in the below table, some of the European countries have no reference to innovation or related concepts in regulatory framework. This does not mean that TSOs of these countries do not undertake innovation projects or R&D expenditures, but these are not directly incentivised via revenue allowance or special innovation funding mechanisms.

Table 13: EU Countries with Dedicated Regulation/Incentive Mechanism for Transmission Innovation

Reference to innovation in regulatory framework		No reference to innovation or related concepts in regulatory framework
Austria	Italy	Czechia
Bulgaria	Lithuania	Estonia
Belgium	Luxembourg	Greece
Croatia	Poland	Latvia
Denmark	Romania	Netherlands
Finland	Slovenia	Portugal
France	Sweden	Slovakia
Germany	UK	Spain
Hungary		
Ireland		

Source: European Commission (2019) Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?





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We have already presented the regulatory approaches to transmission innovation of 5 European countries: UK, France, Finland, Italy and Norway. To complete the European benchmark, we think it is interesting to provide brief information about additional EU countries. In 2019, the European Commission commissioned a report entitled “Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?”<sup>59</sup> which contains useful briefs on regulatory practices in use in European countries.

The EC report identified some countries with specific references to innovation or related concepts in the regulatory framework applicable to TSOs. In general, legislation of these countries includes an explicit mandate to NRAs and TSOs to promote innovation activities.

As summarized, there is generally no clear and consistent content in the regulatory frameworks across the EU for innovation or similar related concepts (such as research and development, technological change and smart grids).

- **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 favourable 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.

- **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, Belgium, Finland, Germany, Ireland, Italy, Luxembourg, Slovenia, UK.

- In Finland, the impact of the innovation incentive is deducted when calculating realised 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.
- In Germany, limited costs of R&D are approved within the revenue cap. However, the Regulator provides support for innovative projects as long as a reasonable relationship exists between monetary expenditure and economic/technical benefits.

<sup>59</sup> European Commission (2019) Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?





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- In UK, as defined in innovation support mechanism established by Ofgem, 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 Regulator.
- **Category 1.3:** Innovation related references are included in the TYNDP (Network Development Plan). In these countries, there is no specific treatment to innovative investments, and they are included in network development plans.

Examples: Croatia, Hungary, Poland.

- **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 Spain, there are 76 technology innovation projects that aims efficiency increment and facilitation of the integration of renewables in Spain.

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.
- 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





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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.

It could be concluded that including provisions relating to R&D incentives for the take-up of innovative solutions increase the likelihood that innovative projects are conducted, the examples above show that the success of such provisions depends on the entire structure of the regulatory framework. Moreover, it also depends on the mind-set of the sector stakeholders involved.

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.

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)

The following table provides a comparison of the regulatory practices in different EU countries for TSOs regarding innovation activities.





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Table 14: Cross-Country Comparison of Electricity TSO Innovation Incentives/Funding Mechanisms

EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	Regulatory Approach to Innovative Investments		Category 1: 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 (Network Development Plans)	Category 2: No reference to innovation in the regulatory framework
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 perse, 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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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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 optimisation and development of intelligent networks			





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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		
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	





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	Regulatory Approach to Innovative Investments		Category 1: 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 (Network Development Plans)	Category 2: No reference to innovation in the regulatory framework
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		
Latvia	Yes	Cost-plus/Rate-of-Return (Cost based)	No Defined Period		✓				Strong emphasis to innovation through the development of the electricity transmission system in an economic and efficient manner and NDP requirements. However, there are no explicit funding mechanisms in favour of innovative investments beyond CEF for PCIs





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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 modernisation agenda targeting introduction of smart grid and new technologies. Tariff methodology includes pass through of R&D costs related to TSO activities and may be included in tariff up to 1% of maximum allowed income		





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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	
Portugal	No	Combined model of Price Cap (OPEX), standard costs in new investments and Rate-of Return (CAPEX)	3 years		✓				No reference





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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 legislation			
Slovakia	Yes	Cost-plus / Rate-of-Return	5 years		✓				No reference
Slovenia	Yes	Revenue Cap	3 years	✓			Some incentives exist that appear to favour innovation, e.g. investments in smart meters and smart grid projects and in pilot stage		
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





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EU Countries	TSO in State Ownership	Tariff Methodologies	Regulatory Periods	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 (Network Development Plans)	
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)	✓			<ul style="list-style-type: none"> <li>- The TSO can apply for revenue adjustment for innovation projects if they can demonstrate cost efficient, low carbon or environmental benefits;</li> <li>- Network Innovation Allowance and Network Innovation Competition fosters smaller innovative trials and projects;</li> <li>- The NRA has established Innovation Link which allows solutions outside of regulatory model to be proposed for trial.</li> </ul>		





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## 4.4 Roles, Responsibilities, Strategies and Actions of Regulated Entities and Public Institutions in Incentivizing Country-Specific Targets (Electricity Transmission)

### 4.4.1 Overview

The promotion of transmission innovation activities at national level requires a close collaboration between several stakeholders. TEIAS, as the unique TSO in Turkey, has first-hand knowledge of the needs of the electricity transmission network and the state-of-the-art technology. Therefore, TEIAS should lead the national innovation strategy of the electricity transmission sector. EMRA (NRA of Turkey) should also play a key role monitoring and incentivising innovation activities. If necessary, EMRA shall develop, implement and monitor the adequate regulatory innovation incentives. The success of the innovation incentives relies heavily on whether all national stakeholders are aligned around common objectives and strategies.

Based on our analysis of European experiences we identify the following key stakeholders:

1. *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.
2. *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.
3. *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<sup>60</sup> 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.
4. *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.

<sup>60</sup> E.g. France and Lithuania. See international benchmark section for additional information.



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These are the key stakeholders for the design and implementation of national innovation strategies for electricity transmission activities. Additionally, there are other agents that will eventually be involved in the innovation activities:

5. *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.
6. *R&D entities* (universities, R&D centres, advisors, etc). 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.
7. *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.

The following picture displays the role of the above-mentioned entities in the national innovation strategy of European countries:

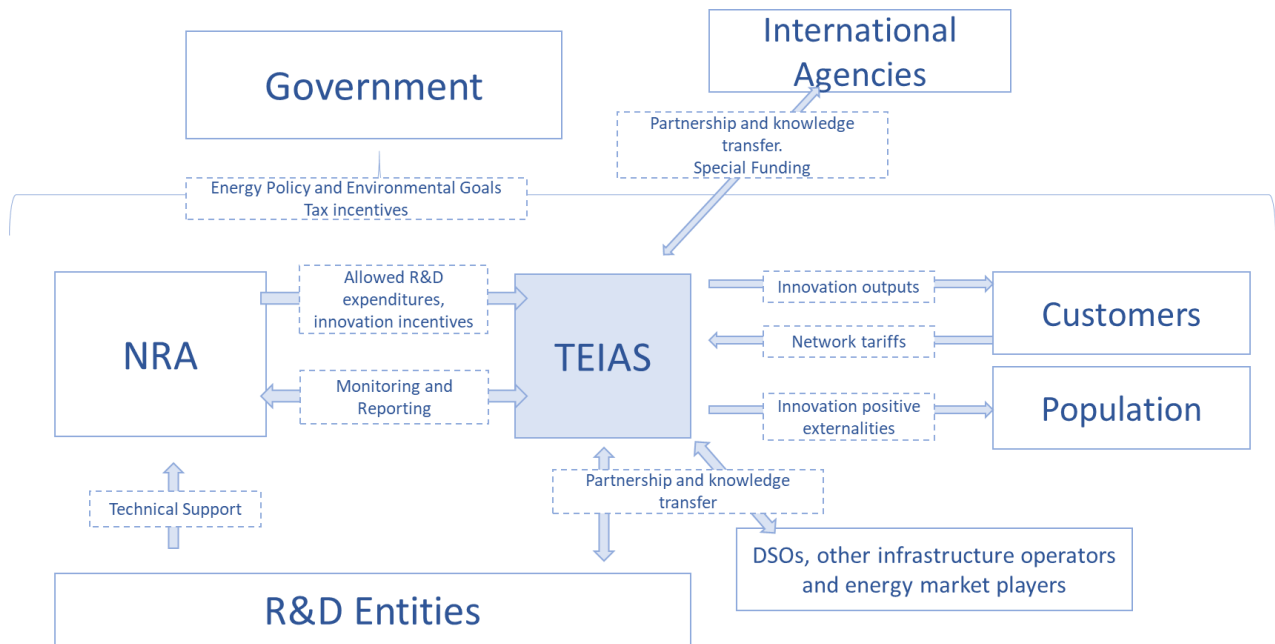


Figure 27: Innovation Strategy Stakeholders

Looking in more detailed into the Turkish electricity system and market institutional set up we have identified the following list of stakeholders



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Table 15: Turkey Electricity Transmission Innovation Strategy: Key Stakeholders

Generic Stakeholder	Turkish stakeholders
Government	Ministry of Energy and Nature Resource (MENR)
NRA	Energy Market Regulatory Authority (EMRA)
Electricity TSO	TEIAS
Electricity DSOs	21 Gas Distribution Companies (Regulated, Private)
Market Operator	EPIAS
Electricity Market Players	Wholesale and Retail Suppliers
Customers	Electricity customers
Public	83 million population
R&D Entities	TUBITAK, Universities, Regional Development Agencies
Government	Ministry of Transport and Infrastructure
Government	Ministry of Industry and Technology
Government	Ministry of Environment and Urbanization
Government	Presidential Science, Technology and Innovation Policies Board
International Agencies	European institutions: ENTSO-E, EU, etc.

#### 4.4.2 Grid Operation and Safety

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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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, we have identified some non-energy governmental regulations that could conditionate the implementation of innovative technology solutions in the operations of Turkish transmission network.

1. Local R&D funds for the industry could be prioritized to cover required technologies for TSO.
2. 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.

Table 16: Roles and Responsibilities Matrix: Grid Operations Innovation

Entity	Role	Main responsibility	Specific duties
Government		Not relevant in European countries	
National Regulatory Authority		Monitoring and allowed revenues determination	- Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&D expenditures of TSO related to O&M new technologies pilot projects)
Electricity TSO		Network operations and investments	- Undertake R&D expenditures: pilot projects and external R&D studies (research centres). - Ensuring safety network operations.

We consider this roles and responsibilities matrix to be compatible with current regulatory framework and institutional design of the Turkish system.

#### 4.4.3 Power Electronics

High penetration of power electronic interfaced DG resources, flexible AC transmission technologies and high voltage direct current transmission systems will result in a hybrid AC-DC power system in the future. Further penetration of renewable and distributed generation will have a significant impact on the interconnected system dynamic profile and eventually on how the electrical network will be operated in the future. Indeed, the transition from a power system based on conventional synchronous generators to one with Power Electronics raises different challenges related to system dynamics, for example like the 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). Coping with all the challenges, innovation, research and development in the electrical energy business



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should be recognized as a crucial step. 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.

#### 4.4.4 Data Management and Digitalization

Automatization and digitalization are key to achieve efficient transmission network operations. The digitalization of TSOs' activities may include several topics not all of which may be considered as R&D activities.

The digitalization strategy of a TSO may focus on strengthening and developing the digital skills of the company's human resources to allow them to work in a more creative, flexible and coordinated way.

However, when we talk about R&D investments related to digitalization we talk about the optimisation of the value chain through advanced data analytics aiming to achieve greater efficiency in TSO operations (optimisation of operating costs, costs associated with managing the life cycle of assets, etc.).

A good example of a Digitalization Strategy of a TSO is the one implemented by National Grid (UK):

*Focusing our Digital investment in this area will allow us to build on our core capabilities in asset management, providing us with the capability to further automate and optimise asset interventions in the future, and investigate the potential for practical applications like Augmented and Virtual Reality to unlock longer term value. However, in addition, these investments will start providing the data and platforms to unlock opportunities for our customers and stakeholders to innovate and optimise their use of our networks<sup>61</sup>.*

National Grid has identified the following priority areas for digitalization:

- Establish a comprehensive data strategy, including master data modelling for assets, and build capabilities for advanced analytics.
- Implement real-time technologies to ingest asset data and enable advanced analytics and insights
- Increase data-driven engineering, asset design and construction
- Innovate with Artificial intelligence.
- Enhance customer relationship management and Digital experience.

<sup>61</sup> National Grid (2019) Digitalization Strategy.



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Usually NRAs do not interfere directly in the digitalization strategy of system operators. However, in the UK, Ofgem requested energy companies to publish their digitalisation strategies as part of their business plan to increase transparency.

Some digitalization investments related to the above topics could be considered as R&D expenditures subject to be recovered via allowed R&D revenues. In France, the “adaptation to the digital transition” is included as a specific innovation area. It is important to monitor carefully IT expenditures to avoid over enumeration or double counting. For example, the cost of testing a new software could be included within the R&D allowed expenditure but the price of a long-term software license might also be considered as a CAPEX.

In European countries, the national government has not a specific role in data management and digitalization related matters of TSOs. However, governments can set national goals for the deployment of IT technologies.

In Turkish National Energy Strategy for 2019-2023 one of the objectives is directly related to digitalization and ICT.

Table 17: Roles and Responsibilities Matrix: Data Management and Digitization

Entity	Role	Main responsibility	Specific duties
National Government		Set national goals for IT upgrading	
National Regulatory Authority		Monitoring and allowed revenues setting	<ul style="list-style-type: none"> <li>- Active encouragement of digitalization (optional)</li> <li>- Allowed digitalization expenditures in the revenue cap as part of the innovation incentives.</li> </ul>
Electricity TSO		Data management	<ul style="list-style-type: none"> <li>- Design and implementation of digitalization strategy</li> <li>- Upgrade data management and information system.</li> </ul>

We consider this roles and responsibilities matrix to be compatible with current regulatory framework and institutional design of the Turkish Electricity Transmission Sector.

#### 4.4.5 Sector Coupling<sup>62</sup>

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

<sup>62</sup> ENTSO-E Vision on Market Design and System Operation towards 2030





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In Europe, there is a strong political drive towards coupling sectors, where technologies like power to X - X being gas, heat, transport, or products - are coming into play. Electricity and gas are both complementary in the form of flexibility exchange, as well as dependent in terms of black start capabilities.

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.

ENTSO-E’s vision for the future operation of the power system is illustrated in the visuals below.

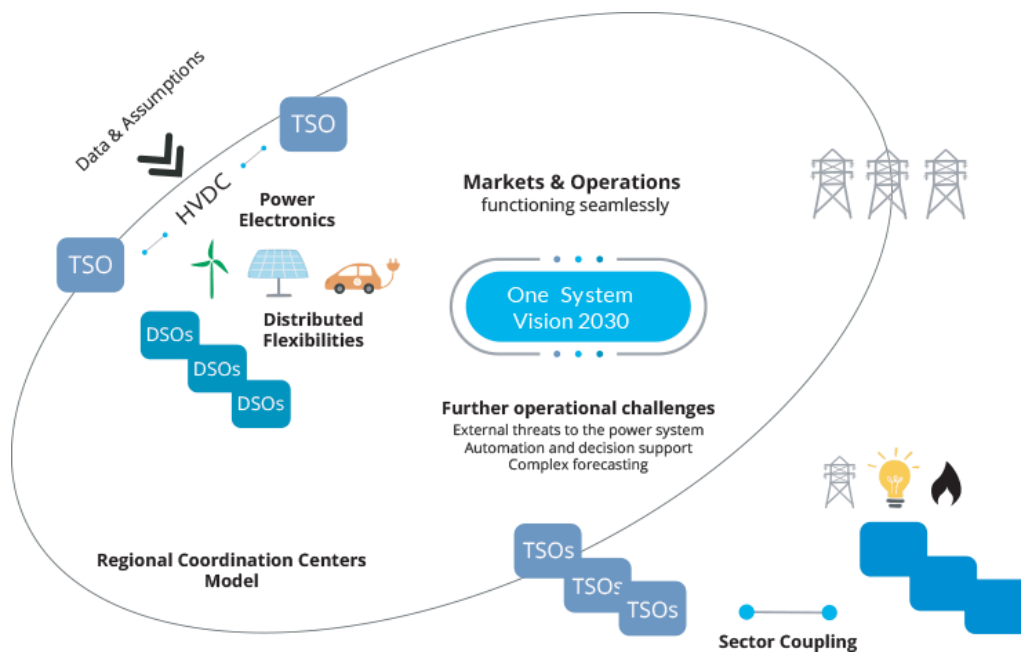


Figure 28: ENTSO-E One System Vision 2030



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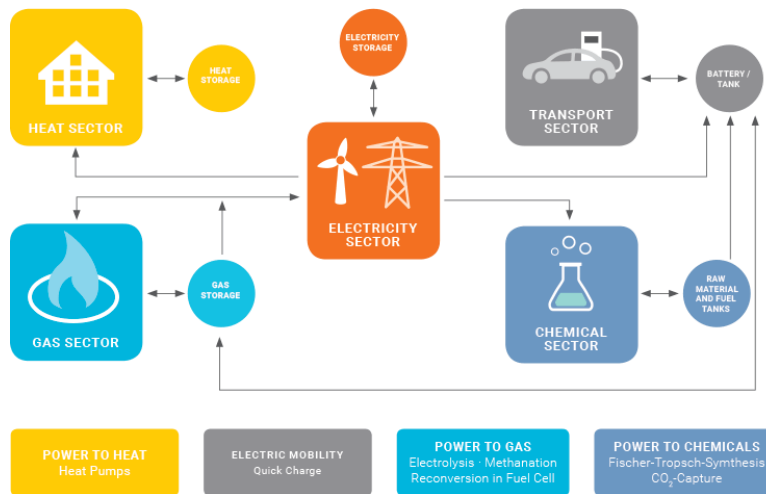


Figure 29: A Sample Illustration of Sector Coupling

According to this vision, the system of the future will need stronger adaptation to local needs. This will be mostly required by the need for shared access to distributed flexibilities. This will depend on the market structure, network, institutional and economic realities of each country, with the drive for technology, automation and decision support that will need to adapt to local constraints, culture and realities, as well as the power electronics solutions and forecasting that will have a strong localised component. The in-depth knowledge of local constraints, through our own local footprint and close relationships with institutions, customers, shareholders and the public at large, and through our partnerships with Distribution System Operators

#### 4.4.6 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 ICCC link for network management systems)
- Smart meters at transmission - distribution connection points.
- Flexibility: the successful implantation of innovative solutions for grid services will require close coordination 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. Following these trends, the first clear driver for the electricity system is the efficient use of distributed flexibilities, as it is clear that in the future a significant part of the means to operate the system will be located in the distribution networks. Taking also into account the need to integrate new distributed resources in a non-discriminatory, secure and efficient way, mechanisms for accessing flexibility services through shared market mechanisms and a strong cooperation between TSOs and DSOs is required. 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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System Operators are the agents responsible for the implementation of smart networks strategies, but the NRA shall also participate establishing the guidelines and solving any disputes that may arise between TSOs and DSOs.

The upgrading of the relations between TSOs and DSOs is usually included as an area for potential innovation and therefore related expenses of TSOs can be included in the innovation incentive of the revenue cap.

Generally, the collaboration with other entities (including DSOs) is positively valued for the approval of R&D projects. In UK partnership between TSOs and DSOs is positive assessed for allocation of the Innovation Competition Fund (NIC).

Table 18: Roles and Responsibilities Matrix: Relation between TSO and DSO

Entity	Role	Main responsibility	Specific duties
National Government		Not relevant in European countries	
National Regulatory Authority		Monitoring, arbitration and allowed revenue setting	<ul style="list-style-type: none"> <li>- Supervision and disputes resolution.</li> <li>- Incentivise TSO-DSO collaboration in innovation activities.</li> <li>- Implementation and monitoring of innovation regulatory incentives.</li> </ul>
Electricity TSO		Operate and upgrade the electricity system in cooperation with DSOs	<ul style="list-style-type: none"> <li>- Undertake R&amp;D expenditures in cooperation with DSOs: pilot projects.</li> </ul>

We consider this roles and responsibilities matrix to be compatible with current regulatory framework and institutional design of the Turkish system.

#### 4.5 Regulatory Practices, TSO Innovation Activities in Turkey

The vision of TEIAS is to integrate into international energy markets and to become a pioneering system and network operator in line with national energy policies of Turkey. In parallel to the developments in energy demand, TEIAS expands its electricity transmission infrastructure and operates in international standards, in a quality way, economically and reliably.

The Main Statutory Document of TEIAS gives a specific responsibility and power to the TSO for conducting R&D studies and determining new performance criteria to increase service quality and customer satisfaction,

In April 2018, “TEIAS Advisory Board and R&D Directive” has been published, which has been developed to organize the R&D activities regarding designing new processes, products and applications that will provide scientific and technological development related to the fields of activity of TEIAS. The scope of this Directive includes the determination of the application, implementation, audit and reporting principles of the Research and Development activities at TEIAS General Directorate as well as the issues related to the Advisory Board.



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The main principle of the R&D Directive of TEIAS is to discipline the R&D activities carried out within a plan and program by targeting technological, safe and economic development, and to make it systematic, open to continuous developments.

Organizational structure of R&D activities within TEIAS is as follows:

- Technical Working Groups,
- Advisory Board.

There is a dedicated department in TEIAS, that is responsible for implementation, monitoring and coordination of R&D activities under the Directive.

Considering the needs and technical developments, the Directive is assessed by the Advisory Board under the coordination of the General Directorate by incorporating the suggestions from TEIAS departments and updated according to the provisions of the relevant legislation.

R&D Budget is determined by EMRA within the system usage revenue ceiling of the year with the Board Decision.

The R&D project in TEIAS is categorized in 4 groups:

- **Type A Projects:** These are the projects to be carried out by TEIAS staff and Master's and Doctorate theses of TEIAS personnel and who have received the opinion that "It is a useful study that has the quality of R&D practice for TEIAS" by the Advisory Board.
- **Type B Projects:** Projects carried out jointly with TEIAS, other public institutions and organizations and/or universities, institutes and/or private sector institutions in accordance with the provisions of the R&D protocols developed for the project,
- **Type C Projects:** Projects undertaken by local and/or foreign natural and legal persons through the tender of consultancy or service under the Public Procurement Law,
- **Type D Projects:** This category consists of projects that are carried out in cooperation with research institutes (TUBITAK) or domestic/foreign private institutions, and which are carried out in accordance with the legislation of these institutions/organizations and are fully supported for funds. In case of partial support for the project, TEIAS also provides the supports under its responsibility from the R&D budget.

Advisory Board members are determined by the General Directorate authorization. The Advisory Board consists of a maximum of eleven members listed below.

- Chairman of the Board
- Vice Chairman of the Board,
- Maximum three representatives to be determined by the General Manager,
- University Faculty Members (maximum of four representatives),



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- Two representatives from industry experts.

The role and responsibilities of Advisory Board are defined in the Directive:

- Carry out studies and make recommendations for the development of TEIAS's institutional and technical capacity,
- Evaluate the R&D projects proposed to the Board,
- Develop project suggestions directed in line with R&D needs,
- Ensure the promotion and dissemination of R&D projects,
- Support the development of national and regional priority projects,
- Encourage the preparation of international R&D projects,
- Diversify financial resources for research and increase the contribution of target groups to research,
- Impact analysis of the results of R&D projects and to ensure that the actions to be taken according to the results are notified to the relevant departments,
- Identify and publishing Research Areas.

The role and responsibilities of Technical Committees are defined in the Directive:

- Interact and exchange information with the Advisory Board on the specific technical context that is under its responsibility
- Participate in symposiums, workshops and congresses to increase their knowledge both for themselves and for TEIAS,
- Provide participation and support when necessary, by following the activities carried out under the relevant CIGRE Working Committees,
- Reveal the technical problems of TEIAS and to offer solutions to these problems together with the Advisory Board,
- Work on standards, specifications etc. for the products to be developed for TEIAS.

In order to properly select project topics and increase the probability of acceptance of the project, the following path is recommended to be followed in the application:

- The R&D project application form (standard template) is developed after determination of the subject (within the Research Areas) and name of the project to be submitted to the Advisory Board. Applications are made to the R&D Department for evaluation at the Advisory Board.



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- The project proposal is not reviewed for uniqueness against the previous and ongoing works. Project bidders also offer literature review in their submission.
- It is ensured that the projects with similar purposes and targeting the same or similar regions are evaluated as regional or national projects by the Advisory Board.
- The proposed projects are sent to the academic consultants determined by the Advisory Board for further detailed scientific evaluation, if deemed necessary.
- For projects deemed eligible to be supported by the Advisory Board, it is put into effect following the signing of the R&D Protocol between the project manager (s) and the Directorate and the General Directorate Approval.
- For projects deemed eligible to be supported by the Advisory Board, it is initiated by signing an R&D Protocol between the project stakeholder(s) and the Directorate and the General Directorate Approval.
- A commitment must be obtained from the TEIAS departments that will use/be affected by the project outputs or will be a stakeholder during project implementation.

Projects are evaluated against the following main criteria:

- Compliance of project proposals with Research Areas,
- The contribution of the project to the relevant Research Area(s),
- Ability to produce new information and technology,
- The applicability of the information and technology to be obtained from the project results,
- Originality of the projects; interdisciplinary feature,
- Bringing solutions to the problems encountered in the fields of interest of TEIAS; being environmentally friendly and sustainable,
- Proper allocation of R&D staff and other resources for successfully completed the project within the prescribed duration,
- Technical experience and adequacy of the department proposing the project in terms of personnel and physical infrastructure,
- Widespread economic, environmental and social impact of the project.

Project proposals are accepted four times a year in January, April, July and October of each year. In cases where the project is urgent, necessary and critical for TEIAS R&D strategy and country interests; With the approval of the General Manager, the project application is accepted outside the application periods. Evaluation of the applications related to the projects is concluded by the Advisory Board within two months at the latest.





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Planning and implementation of the monitoring and review of the projects are carried out by the project coordinators. The reports prepared in line with the information obtained as a result of these duties are submitted to the Advisory Board. For each supported and executed project, at least one Advisory Board member is assigned as an Observer.

Project stakeholders send Project Monitoring Reports to the R&D Department and project coordinator, which they will prepare for each six-month period. Advisory Board, by evaluating the Project Monitoring Report; decides to continue the support of the relevant project, to warn the project stakeholders, to give additional time to the project, to stop or to terminate the Protocol.

The Advisory Board decides whether a project is successful and can proceed to preparation of final reports. Project stakeholders send the final report to the R&D Department and the Project Coordinator within two months at the latest after the project is completed. The Advisory Board may decide to publish certain projects after evaluation. R&D Department is presented by the project stakeholders to be published within three months at the latest under the coordination of the project coordinator after necessary corrections are made and brought to the appropriate format.

The identified research areas and their priorities for TEIAS is presented in the following table.

Table 19: TEIAS R&D Areas and Priorities

Program	Sub-program	Priority Status
<b>Power System Modernization</b>	Asset Management	Medium
	Optimal Network Planning/Development	High
	New Hardware and Material	High
	HVDC	Medium
	Efficiency	High
<b>Power System Security and Stability</b>	System Observability and Controllability	High
	Smart Systems	High
	Enhanced Ancillary Services	Medium
	Power Quality	Medium
<b>Power System Flexibility</b>	Power Storage	High
	RES Integration	High
	Demand Forecasting	Medium
	Demand Side Management	Medium
	FACTS Technologies	High
<b>Digital Technologies</b>	Smart Grid	Low
	Big Data	Medium
	IoT	Low



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Program	Sub-program	Priority Status
	Cyber Security	Medium

TEIAS has adopted challenge-based clusters and functional objectives of ENTSO-E R&I roadmap and research areas of TEIAS are almost in line with ENTSO-E requirements.

Other observation regarding TEIAS' R&D and innovation processes can be listed as follows:

- The details of the R&I projects such as the results of closed projects and progress of on-going projects are not disclosed publicly.
- TEIAS has hesitations for especially risky projects due to Public Procurement Law (KİK). (Typical R&D partners are universities, R&D institutes (TUBITAK MAM) and manufactures.
- Typical R&D partners for TEIAS are, caused by laws for public procurement, mainly R&D institutes and universities. This means that there are at least 2 innovation barriers are over there to tackle before TSOs can actually start to use the innovation. This is a contributing factor to why innovations typically take such a long time in TSO.
- R&I Projects are susceptible to being challenged by inspection bodies having tangible-results oriented approach which contrasts with nature of R&I activities.
- TEIAS is more prone to realize low-risky R&I projects having tangible outputs.
- TEIAS has completed and on-going international IPA funded innovation projects under EU - Turkey Financial Program of 2002-2007 and IPA 2007-2013. In some of the projects (like power storage, grid efficiency, etc. projects) TEIAS is the end beneficiary and in many other project TEIAS is involved as a project stakeholder.
- TEIAS conducted Smart Grid in the Electricity Transmission Feasibility Study in Turkey in 2015 backed by US Trade and Development Agency (USTDA) to identify general gaps between TEIASs transmission system and system using smart grid applications.





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## 4.6 Gap Analysis and Recommendations

As the power system transformation progresses because of the increasing share of renewable generation, new challenges will emerge. There will be new ways in which consumers interact with the energy system, enhanced ancillary services, monitoring, control and interoperability of system, etc. The regulatory framework will need to evolve to support such innovation and avoid undue barriers to entry. At the same time, it will need to ensure there are adequate protections for consumers, including those less willing or able to actively engage. It may become necessary in future for there to be a more fundamental review of industry arrangements to ensure that all parties are able to compete on a level playing field with suppliers, while ensuring the right protections shall be set in place for consumers.

A key role for the Government and EMRA is to create the environment for new ideas to flourish by removing barriers to innovation. Electricity transmission system needs technologies and infrastructure that should be both cost-efficient and clean, but it also needs innovation in processes, transactions, and consumer offerings. This shall be a fundamental part of the Government's Industrial Strategy and EMRA's approach to regulation.

There is 'de-regulation' of EMRA on TSO's R&D budget and projects in Turkey. There is advantages and disadvantages of the existing regulation framework of EMRA for the TEİAŞ' innovation activities aiming to obtain R&D outputs. However, we can assess that advantages are less than disadvantages, because the existing TEİAŞ' activities on the innovative projects are not at expected level as quantity and quality level.

Beyond addressing these regulation approaches, there is a question of how innovation in the transmission system infrastructure and operation technologies of the future can be catalysed. TEİAŞ doesn't have any exemption from Public Procurement Law. Innovative Projects are susceptible to being challenged by inspection bodies having tangible-results oriented approach which contrasts with nature of R&I activities. TEİAŞ has hesitations for especially risky projects due to Public Procurement Law. Therefore, TEİAŞ is more prone to realize low-risky innovative projects having tangible outputs. On the other hand, innovative projects, capital intensive projects resulting in uncertain future OPEX gains (efficiency improvements / cost reductions) has not incentivised by the regulatory framework yet.

As part of this, there is a need for roles and responsibilities of EMRA to set up regularity framework to support TEİAŞ, as the regulated monopolies, by removing barriers for innovative projects in the transmission system to evolve so that network and system operation as a whole is managed efficiently. Thus, TEİAŞ departments to catalyse innovation activities, not pursuing a timid approach anymore.

After analysing the current situation in Turkey with respect electricity transmission innovation we think it is recommendable that EMRA develops a new innovative incentive mechanism.

The innovation incentive mechanism for Turkey electricity transmission sector should be based on three general principles:

1. Effectiveness. The final objective is to upgrade TSO innovation activities aiming to obtain R&D outputs that could eventually lead to benefits for both network users and TSOs (e.g. efficiency gains) and positive externalities for the population (e.g. carbon emissions saving). Therefore, the innovation incentive mechanism must be effective, that is, it must achieve that TEİAŞ invests on R&D activities and on the deployment of innovative solutions.



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2. Flexibility. The mechanism shall be designed in a way that leaves enough flexibility for both TEIAS and EMRA to implement the incentive in the most suitable way. Establishing rigid and predefined regulatory and compliance requirements at this early stage of the innovation strategy may hamper the implementation of the strategy. Compliance requirements should not be an excessive administrative burden for TEIAS that could eventually discourage R&D expenditures.
3. Efficiency. Innovation incentive costs will ultimately be borne by customers via network tariffs. There is a direct trade-off in the short-term between higher allowed R&D expenditures and higher network tariffs. The incentive mechanism must not allow TEIAS to include in the revenue cap excessive unjustified expenses. The role of EMRA is to review and monitor innovation expenditures of BOTAS to guarantee that allowed R&D revenues are invested in an efficient way.

Based on these principles, international experiences, and the situation in Turkey we think that the innovation incentive mechanism for electricity transmission shall be defined around the following key features:

- Definition of innovation priority areas.
- Specific OPEX allowance for innovation and R&D expenditures of BOTAS revenue determination.
- R&D expenditures are included, upon approval of EMRA, in the revenue cap recovered via network tariffs.
- Periodical reporting and monitoring of TEIAS R&D expenditures by EMRA.

These features are presented in more detailed in the following table:



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Table 20: Proposed Innovation Incentive Mechanism for Turkey: Key Features for Transmission

Feature	Recommendation	Explanation	Justification	Key Stakeholders
<b>R&amp;I KPIs</b>	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.
<b>Funding innovation incentives</b>	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.	<p>For each regulatory period, TEIAS shall propose a trajectory for R&amp;D and Innovation expenditures. This trajectory should include indicative values for:</p> <ul style="list-style-type: none"> <li>- Project description and budget of specific R&amp;D projects.</li> <li>- General R&amp;D expenditure allocated by research area</li> </ul> <p>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 recommendation is to evaluate the proposal with external support (e.g. advisors). We recommend targeting a yearly R&amp;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&amp;D budget has not been spent by TEIAS. Unspent amounts shall be reconciliate in the revenue determination of the next tariff period.</p>	<p>We think OPEX based solutions for funding R&amp;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&amp;D expenditures is an international benchmark (which roughly corresponds to 2% of OPEX)</p>	EMRA and TEIAS





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Feature	Recommendation	Explanation	Justification	Key Stakeholders
<b>Procurement and project implementation rules</b>	Special treatment to critical innovative projects like exemptions from the regulation	<p>In TEIAS' R&amp;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.</p> <p>We recommend to accelerate R&amp;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&amp;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.</p>	<p>In order to achieve R&amp;D objectives, the need to identify which procurement policies could stimulate R&amp;D activities is crucial.</p> <p>While public procurement rules usually are designed for off-the-shelf products and services without requesting any additional R&amp;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&amp;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.</p>	Public Procurement Institution, Ministry of Finance, TEIAS, EMRA
<b>R&amp;D Project Monitoring Requirements (post-project)</b>	Yearly reporting of R&D expenditures	<p>Each year, TEIAS shall send to EMRA a report presenting:</p> <ul style="list-style-type: none"> <li>- Status of ongoing R&amp;D projects and investigations: objective, budget, partners, expected output, etc.</li> <li>- Review of finished projects: objective, budget, partners, project results, etc.</li> </ul> <p>These reports will help EMRA in two ways:</p> <ul style="list-style-type: none"> <li>- Monitoring TEIAS R&amp;D expenditures.</li> <li>- Knowledge dissemination. These reports must be published in both TEIAS and EMRA website.</li> </ul>	<p>In all countries analysed, TSOs must comply with reporting obligations related to innovation incentives. Usually innovation reports are publicly available to facilitate knowledge transfer.</p>	EMRA and TEIAS





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Feature	Recommendation	Explanation	Justification	Key Stakeholders
<p><b>Public Access to Innovation Process and Projects</b></p>	<p>The results of the innovation projects can be publicly available to promote transparency.</p>	<p>EMRA should foster dissemination activities of the projects; results, impact and lessons learnt.</p>	<p>It's a common practice to provide public access to the projects that are funded via tariffs:</p> <ul style="list-style-type: none"> <li>- Dissemination of R&amp;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.</li> <li>- Ofgem expect innovation activities and R&amp;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.</li> </ul>	<p>EMRA, TEIAS</p>





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Feature	Recommendation	Explanation	Justification	Key Stakeholders
<b>Amendments to Secondary Legislation</b>	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: <ul style="list-style-type: none"> <li>• Eligibility criteria for R&amp;D allowed expenditures.</li> <li>• Evaluation criteria.</li> <li>• Monitoring and reporting obligations of TEIAS.</li> </ul>	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





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### 4.7 Innovation Master Plan Outline

The Innovation Master Plan for the Transmission sector shall establish and develop the national priorities and strategy related to innovative technologies application. The Master Plan shall be the framework document driving innovation activities of TEIAS together with the regulatory incentives developed by EMRA. The Master Plan must not be considered only as a document for internal use of EMRA and TEIAS, thus it should have a broader scope. The Innovation Plans should be the guidance for any stakeholder potentially involved in transmission innovation activities both national and abroad. The innovation activities to be planned in this master plan should aim to support TEIAS, as key system integrator of different components and technologies, to answer to societal challenges. TEIAS should also be prepared to face game-changing environments, such as new actors entering the electricity market (e. g., storage, ICT, prosumers, active customers).

One of the objectives of the Master Plan is to engage institutions such as universities and R&D centres in the innovation strategy implementation. Therefore, it is recommendable to include a clear assessment of the electricity transmission sector focused on innovation: market players, institutional set-up, regulatory framework, innovative solutions in place and under development. A comprehensive innovation master plan may help to foster partnerships between national institutions and foreign TSOs, private investors, universities, etc.

TEIAS and EMRA should be in charge of developing the innovation master plan in close collaboration with the Government. We think TEIAS should be the primary responsible of the preparation of the innovation master plan considering its first-hand knowledge of the needs of the electricity transmission network and the state-of-the-art technology. EMRA role should be more focused on the regulatory and legal contents and also the overall assessment, support and monitoring of the plan preparation. The role of the national government is to oversee that the electricity transmission innovation master plan is aligned with the overall national energy strategy.

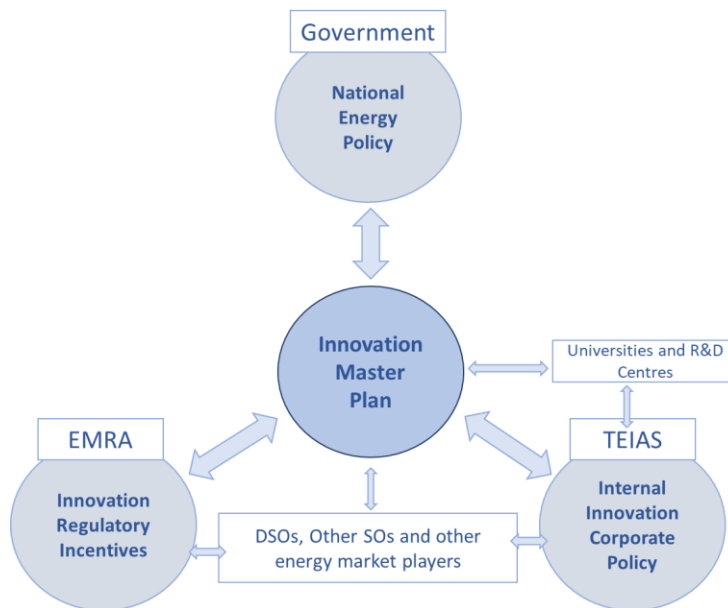


Figure 30: Innovation Master Plan: Stakeholders Involvement





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The Innovation Master Plan for Electricity Transmission could follow a top-down approach like the one in use by the National Energy Strategy (2019-2023)<sup>63</sup>. The top-down approach is based on an objective-target-performance indicators sequence as we present below.

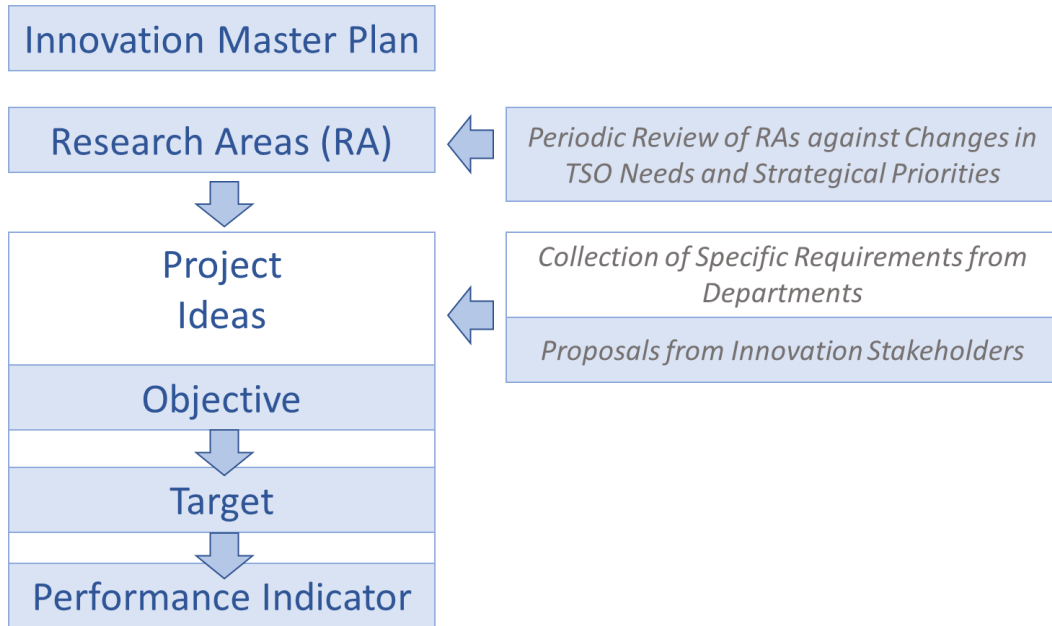


Figure 31: Innovation Master Plan: Indicative Top-Down Approach

This is an indicative top-down approach for a detailed Innovation Master Plan but establishing performance indicators at the early stages of the innovation strategy is not necessary. It is worth stressing that the Master Plan shall not be a binding document but an overall strategy aiming to increase transparency and predictability of the innovation activities in the transmission sector.

We have reviewed the existing Research Areas that has been already identified by TEIAS and it’s been observed that the categorization and definition of innovation topics are in-line with ENTSO-E categories (with slight differences). We recommend TEIAS to periodically revisit these categorizations (again using ENTSO-E definitions as a guideline) and the priority tags according to the changing need of the system, company and country. Here follows, some proposal which shows the Consultant’s view on the definitions and priorities for the Research Areas, slightly differing from TEIAS’ effective definitions.

<sup>63</sup> MENR (2019-2023) Strategic Plan





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Table 21: Recommended Changes to TEIAS Research Areas and Priorities

Cluster/Program	Sub-program	Brief Comments on Functional Areas	Priority Status
<b>Power System Modernization</b>	Asset Management	Asset performance management, predictive maintenance, optimization of capacity utilization and CAPEX.	Medium
	Optimal Network Planning/Development	State-of-the art software tools and methodologies for optimal grid planning	High
	New Material and Technologies	Use of new materials and power technologies; new construction and maintenance methods	High
	HVDC	This sub-program can be combined with FACTS sub-program	Medium
	Efficiency	No need to have a separate sub-program, it should be already present and spread in all clusters/sub-programs.	NA
<b>Power System Security and Stability</b>	System Observability and Controllability	Observability of the grid: PMUs, WAM, Sensors, DSO information exchange  Controllability of the grid: frequency and voltage stability, power quality, synthetic inertia	High
	Smart Systems	Decision support tools, automatic control and expert systems	High
	Enhanced Ancillary Services	Enhanced ancillary services for network operation, AnS from DERs including storage, distributed generation, demand management, etc.	Medium
	Power Quality	This sub-program can be considered under System Observability & Controllability sub-program	NA
	Reliability and Resilience	Reliability and resilience: defence and restoration plans, probabilistic approach, risk assessment, self-healing	High
<b>Power System Flexibility</b>	Power Storage	Storage integration, definition and use of storage services; system added value from storage	Medium
	RES Integration	Improved RES integration and optimal capacity operation	Medium





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Cluster/Program	Sub-program	Brief Comments on Functional Areas	Priority Status
	Demand and RES Forecasting	Improved forecasting techniques, implementation of machine learning and AI-based forecasting tools	Medium
	Demand Side Management	Demand Response, tools to use DSR; Load profile, EV impact	Low
	FACTS Technologies	Power control devices (FACTS, PST, HVDC, VSC), storage and other technologies are to be demonstrated and validated, as well as single-phase auto-reclosure, and point-on-wave switching.  Flexible grid use: dynamic rating equipment, power electronic devices; use of interconnectors	High
<b>Digital Technologies</b>	Smart Grid	As most of the definitions in Research Areas fall under recent Smart Grid definitions, we don't think that a separate sub-program for that is needed.	NA
	Big Data	Big data, data mining, data management	High
	IoT	New communication technologies, Internet of Things	Low
	Cyber Security	Cyber-physical security system, measures	High
	Standardization & data exchange	We recommend the addition of this sub-program.  Standardization, protocols for communications and data exchange, Enterprise IT architecture and integration	Medium
<b>Power System Economics &amp; Efficiency<sup>64</sup></b>	Market - grid integration	Integration of market and grid operation across timeframes (up to real time)	Medium
	New business models	Business models (for storage, grid extension, distributed generation) for optimal investments in the network	Low
	Flexible market design	Market design for adequacy, flexibility use, cross border exchanges, rationale use of RES, demand management	Medium

<sup>64</sup> We recommend adding a new cluster and sub-programs that TEIAS and EPIAS can execute joint innovation activities for further development of markets in Turkey.





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Finally, we present a proposed outline of the Innovation Master Plan for Transmission. For the purposes of coherence, the outline is similar to the Distribution Innovation Master Plan but there should be one important difference on the roles of EMRA and system operations in the master plan preparation. In distribution, EMRA is recommended to directly be involved in coordinating the preparation of the Innovation Master Plan since there are more than 20 DSOs. In transmission, TEIAS is the unique TSO and therefore is well positioned to play a leading role in the preparation of the national Innovation Master Plan for Electricity Transmission.

Table 22: Innovation Master Plan: Electricity Transmission (Tentative Outline)

Innovation Master Plan: Electricity Transmission	
<b>1. 1. Background</b>	
1.1. Overview of national electricity sector.	
1.2. Introduction to EMRA	
1.3. Introduction to TEIAS	
1.4. Overview of Innovation Strategy	
<b>2. Introduction</b>	
2.1. Innovation Process	
2.2. Stakeholder Involvement	
<b>3. National Innovation Strategy</b>	
3.1. Scope of Innovation	
3.2. Stages of Innovation	
3.3. Innovation Objectives	
3.4. Funding the Innovation	
3.5. Approach to Innovation	
3.6. Selecting and Prioritizing Ideas	
3.7. Developing Plans for Innovation	
3.8. Stakeholder Engagement for Innovation	
3.9. Collaboration Between TEIAS and DSOs	
<b>4. Innovation for BOTAS</b>	
4.1. BOTAS innovation corporate policy and strategy	
4.2. Innovation Performance to Date	
4.3. Future Innovations	
<b>5. Governance Arrangements</b>	
5.1. Research Partners and Supplier Arrangements	
5.2. Managing Risk and Future Uncertainty	
5.3. Tracking Benefits	
5.4. Keeping the Strategy Up to Date	
<b>6. Delivering Benefits from Innovation</b>	





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