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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 Natural Gas Sectors (Volume-I)

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## Abbreviations

ACER	Agency for the Cooperation of Energy Regulators
AMI	Advanced Manufacturing Infrastructure
AMS	Advanced Metering Systems
APL	Acoustic Pipe Locator
ARERA	The Italian Regulatory Authority for Energy, Networks and Environment
AT	High Voltage
ATEX	Equipment for potentially explosive atmospheres
ATRD5	The French Gas Distribution Price Control (2018-2022)
ATRT6	The French Gas Transmission Price Control (2017-2021)
BMWi	Federal Ministry for Economic Affairs and Energy
BOTAS	The Turkish Petroleum Pipeline Company
BTE	Special Low Voltage
BTN	Normal Low Voltage
CAPEX	Capital Expenditures
CAPM	Capital Asset Pricing Model
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
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
CRE	The French Energy Regulatory Commission
CRU	The Commission for Regulation of Utilities
DDS	Demand Derivation System
DEA	Data Envelopment Analysis
DNO	Distribution Network Operators
DPCR5	The British Distribution Price Control Review 5 (2010-2015)
DSO	Distribution System Operator
EA	Energy Authority
EASME	Executive Agency for Small and Medium-sized Enterprises
EBIT	Earnings Before Interest and Taxes
EC	European Commission





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EDSO	European Distribution System Operators
EIB	European Investment Bank
EML	Electricity Market Law
EMPIR	European Metrology Programme for Innovation and Research
EMRA	Energy Market Regulatory Authority
ENA	The British Energy Networks Association
ENTSOG	European Network of Transmission System Operators for Gas
EnWG	German Energy Industry Act
ERDF	The European Regional Development Fund
ERGAR	The European Renewable Gas Registry
EU	European Union
EUR	Euro
FCA	Financial Conduct Authority
FCO	First Call Operatives
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	Giga Watt Hours
ICT	Information and Communication Technology
IFI	Innovation Funding Incentive
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
KPI	Key Performance Indicator
LCNG	Liquid to Compressed Natural Gas
LNG	Liquified Natural Gas
MAT	Very High Voltage
MENR	Ministry of Energy and Natural Resources
MT	Medium Voltage
NCG	Non-condensable Gas
NG	Natural Gas
NGG	National Grid Gas



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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
PC3	The Irish Gas Transmission Price Control (2012-2017)
PC4	The Irish Gas Transmission Price Control (2017-2022)
PE	Polyethylene Pipe
PtG	Power-to-Gas
QoS	Quality of Service
R&D	Research and Development
R&I	Research and Innovation
RAB	Regulatory Asset Base
RES	Renewable Energy Source
RIIO	Revenue=Incentive + Innovation + Output
RNG	Renewable Natural Gas
RoR	Rate of Return
RoRE	Return on Regulatory Equity
ROSS	Regulation by objectives of services and expenditure
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
SGN	Scotia Gas Networks
SME	Small and Medium Sized Enterprises
SNG	Synthetic Natural Gas
SoLR	Supplier of Last Resort
T&D	Transmission and Distribution
TEIAS	Turkish Electricity Transmission Co.
TEK	Norwegian Weighting System for Regional Networks
TEN-T	Trans-European Transport Network
THD	Total Harmonic Distortion



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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	The Scientific and Technological Research Council of Turkey
UK	United Kingdom
USLA	Norwegian Pay-out for Very Long-term Interruptions
Val	Value of Loss Load
VNF	Virtual Network Function
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-I<sup>1</sup>) consists of the following elements:

- Gas Distribution Sector Innovation Report
- Gas 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 practises adopted by the beneficiary country and to elaborate the needed recommendations.

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<sup>1</sup> Relevant chapters for Electricity Distribution and Transmission are presented in Volume-II.



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## 2 Gas Distribution Sector Innovation Report

### 2.1 Introduction of Gas Distribution Part

Gas distribution companies worldwide undergo a significant shift from their traditional role of being solely gas transporters towards the more active role of providing innovative services to their customers, as well as to foster energy market participation. The primary responsibility of gas Distribution System Operators (DSOs) is to distribute gas to their consumers in an efficient and safe manner. To achieve this task, the existence of secure and reliable gas networks is of primary importance. Especially with the introduction of biogas and biomethane production, gas DSOs are affected in several ways and thus there is the need for them to ensure the stability of the gas distribution grid. Moreover, gas networks are characterized by increased flexibility when compared to their electricity counterparts due to their storage potential and the predictability of peak demand. This renders the interoperability of gas and electricity networks as a key factor for increasing the efficiency of both networks, especially through power-to-gas technologies.

It is therefore evident that in order for gas DSOs to face effectively the challenges from the undergoing transformation of the gas grids, the development of a smart gas grid equipped with technologies, such as enhanced automation systems for real-time information, monitoring and control mechanisms for gas quality and pressure, as well as other systems are needed. To this extent, smart gas meters, as proposed in the Third Energy Package, Directive for the Internal Gas Market, are important to provide the required visibility of the gas distribution grid and to provide energy efficiency services to the end users.

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 gas 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 gas distribution network take place to meet the challenges of the current and future rules of gas DSOs.

In this chapter we present several regulatory approaches in incentivising innovation activities of gas 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 gas 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.

### 2.2 Innovation and R&D Studies in European Gas Distribution

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 gas distribution companies within the European Union.





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## 2.2.1 Innovation Funding and Mechanisms in EU

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

- Horizon 2020 Framework Program,
- Horizon Europe Framework Program,
- Connecting Europe Facility,
- InnoFin,
- European Regional Development Fund,
- Life Program and
- Innovation Fund

### 2.2.1.1 *Horizon 2020 Framework Program<sup>2</sup>*

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.

### 2.2.1.2 *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 1, 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 1).

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

<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)



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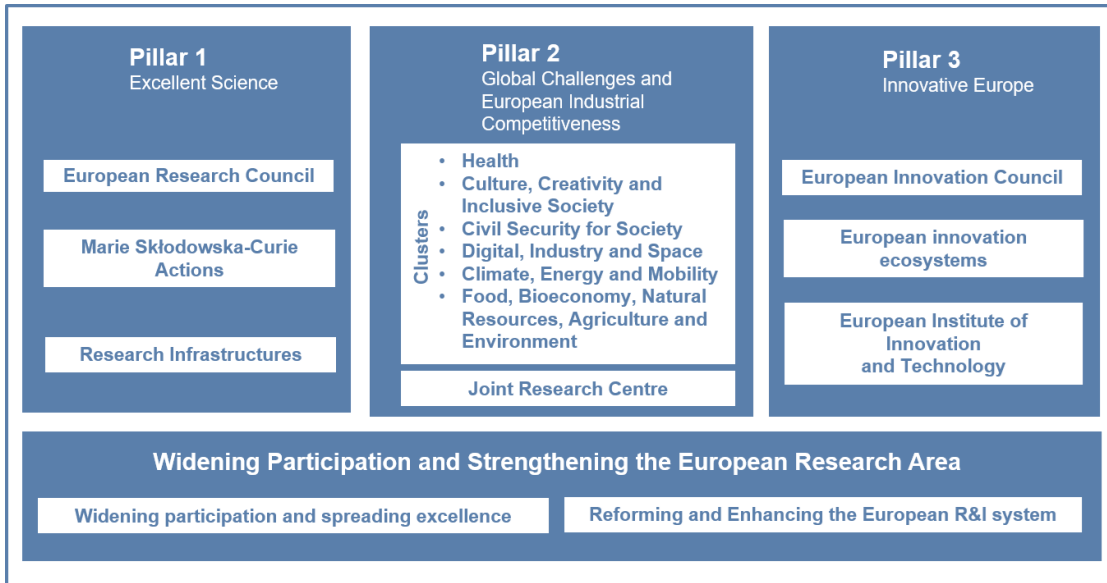


Figure 1: Preliminary Structure of Horizon Europe

### 2.2.1.3 Connecting Europe Facility<sup>4</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 gas 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 for deploying the respective commercial instruments and funding as well as for efficiently managing the technical & financial implementation of 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. Estimations are emanating from up to 70 billion EURO to be invested only in the gas sector; in the years from 2014 to 2020, 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).

### 2.2.1.4 InnovFin<sup>5</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

<sup>4</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility>

<sup>5</sup> <https://www.eib.org/en/products/blending/innovfin/index.htm>





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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.
- **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.

#### 2.2.1.5 *European Regional Development Fund*

The European Regional Development Fund (ERDF) is a program that provides funding for R&D projects dedicated to the implementation of the digital agenda and the energy transition process, which are preferably supposed to be planned and implemented by regional SMEs. The general objective of the ERDF is to strive for a strengthening of the economic imbalances and the feeling of social cohesion throughout the EU as well as within the different regions of the member states. Pertinent information regarding the applied criteria for allocating the financial resources of ERDF are comprehensively summarized on the ERDF-specific WEB-site<sup>6</sup>.

#### 2.2.1.6 *LIFE Program*<sup>7</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.

<sup>6</sup> [https://ec.europa.eu/regional\\_policy/en/funding/erdf/](https://ec.europa.eu/regional_policy/en/funding/erdf/)

<sup>7</sup> <https://ec.europa.eu/easme/en/life>





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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 7<sup>th</sup> environmental action plan.

### 2.2.1.7 Innovation Fund

The Innovation Fund<sup>8</sup> is one of the world's largest funding programmes for demonstration of innovative low-carbon technologies.

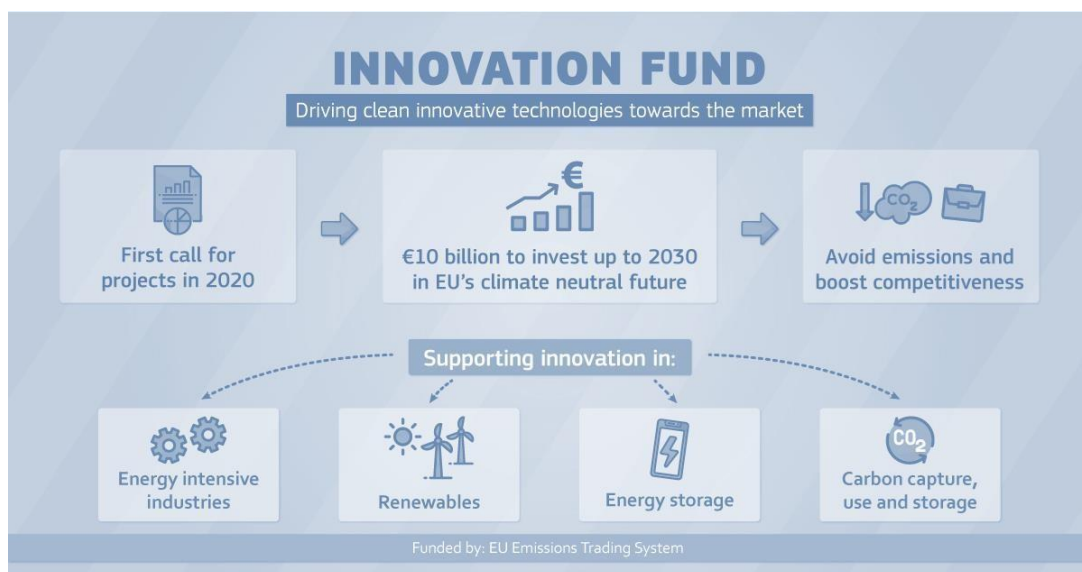


Figure 2: Innovation Fund - Key Information

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.

<sup>8</sup> [https://ec.europa.eu/clima/policies/innovation-fund\\_en](https://ec.europa.eu/clima/policies/innovation-fund_en)



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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>9</sup>.

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

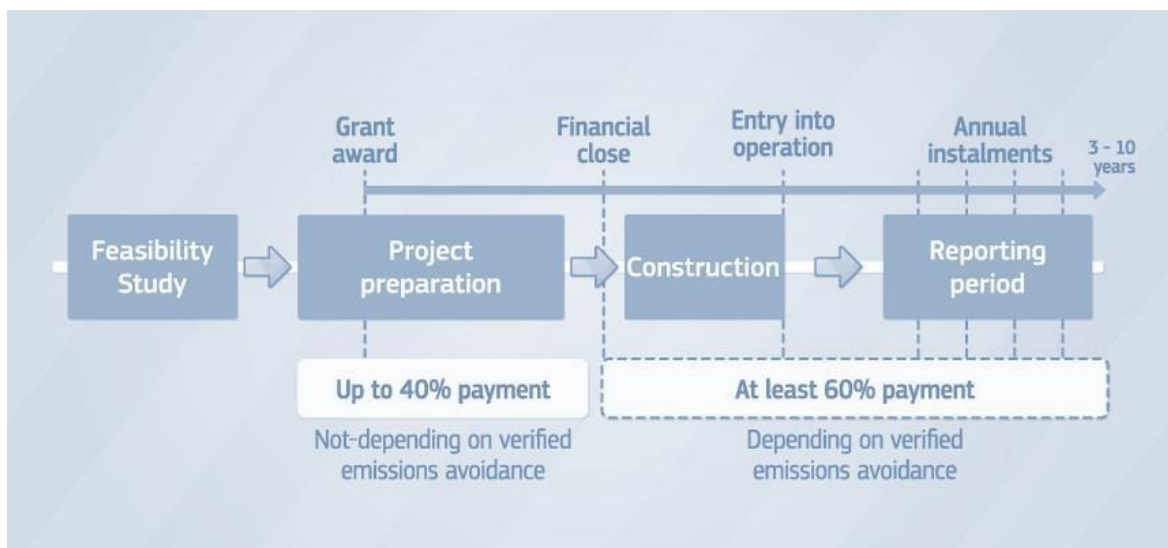


Figure 3: Grant Financing

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.

<sup>9</sup> [https://ec.europa.eu/clima/policies/innovation-fund\\_en](https://ec.europa.eu/clima/policies/innovation-fund_en)



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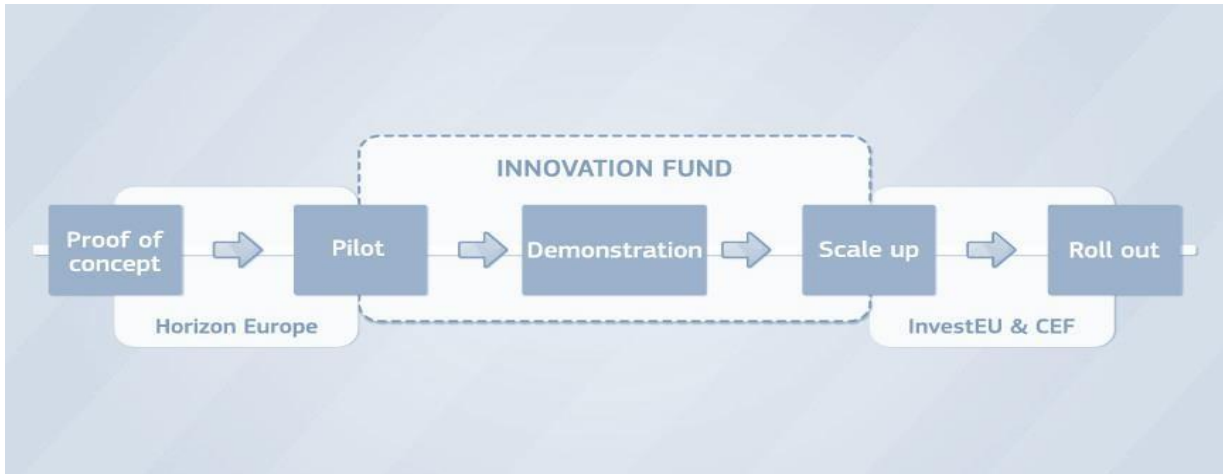


Figure 4: Innovation Fund Structure



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## 2.3 International Benchmarks

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

- United Kingdom,
- Ireland,
- France,
- Italy and
- Finland.

### 2.3.1 United Kingdom

The UK's RIIO framework stands for **Revenue = Incentives + Innovation + Outputs** and is considered as one of the most comprehensive performance-based regulatory frameworks. The RIIO has been developed in such a way so that it rewards utilities for achieving desired outcomes.

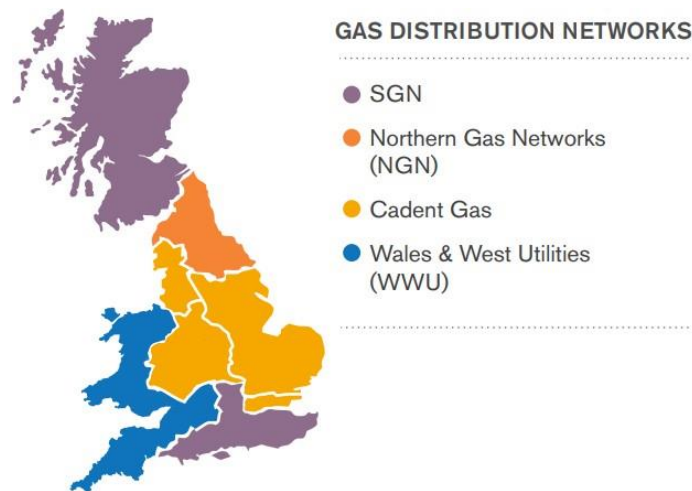


Figure 5: Gas Distribution Networks in UK

#### 2.3.1.1 Network Regulation: The RIIO Model

The primary objective of the RIIO model is to foster the development of the electricity and gas networks in an efficient manner towards sustainable energy markets. The first RIIO control for gas distribution was introduced in 2013. A schematic overview of the RIIO model is shown in Figure 6.



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Figure 6: The RIIO Model

The RIIO model consists of four (4) main features, selected in such a way to encourage utilities to innovate and achieve favourable outputs:

- a multi-year rate plan,
- the total expenditure (TOTEX) approach,
- performance incentives, and
- an innovation fund,

as illustrated in the following figure.

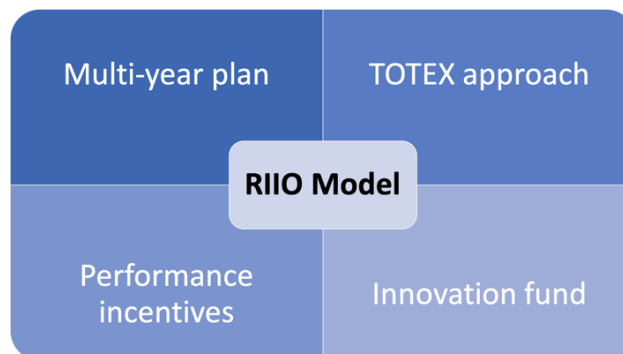


Figure 7: Features of the RIIO Model



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These features are analysed below.

### Multi-Year Rate Plan

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

### TOTEX

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

### Performance Incentives

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

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

It should be mentioned that some of the targets are also tied to financial incentivization schemes that worth up to +/- 250 basis points. These targets are also used as the means for evaluating the performance of utilities via benchmarking and scorecards, thus incentivizing utilities to perform efficiently.



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## Innovation Fund

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

According to Ofgem, gas network operators face several challenges, as one may observe from Figure 8.

Figure 8: Gas Networks - Specific Challenges

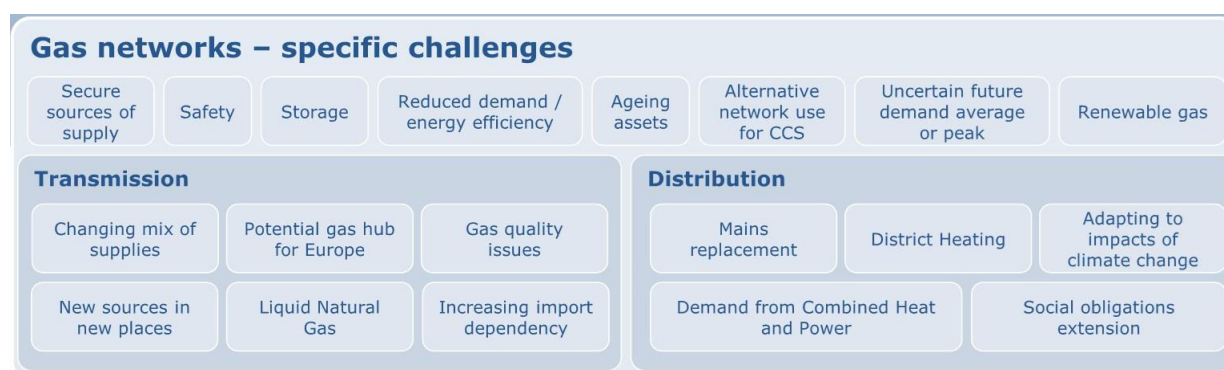


Figure 8: Gas Networks - Specific Challenges

To address the challenges mentioned above, Ofgem identified the following needs for innovation in networks:

- companies may not take account of all the benefits from innovation that accrue to a wide range of parties as they consider the relative merits of innovations,
- the upfront costs of innovation may be significant, potentially outweighing expected benefits for the network company itself,
- the long-term private cost to network companies from choosing not to innovate may not be significant, particularly if the costs associated with continuing to deploy existing technologies are generally funded under a price control, and
- companies may discount the future benefits of innovation if the carbon price is low or they doubt the political commitment to meet the targets.

It should be mentioned that outputs are a core concept of the RIIO model. Figure 9 illustrates the way objectives and outputs are related under the RIIO model.



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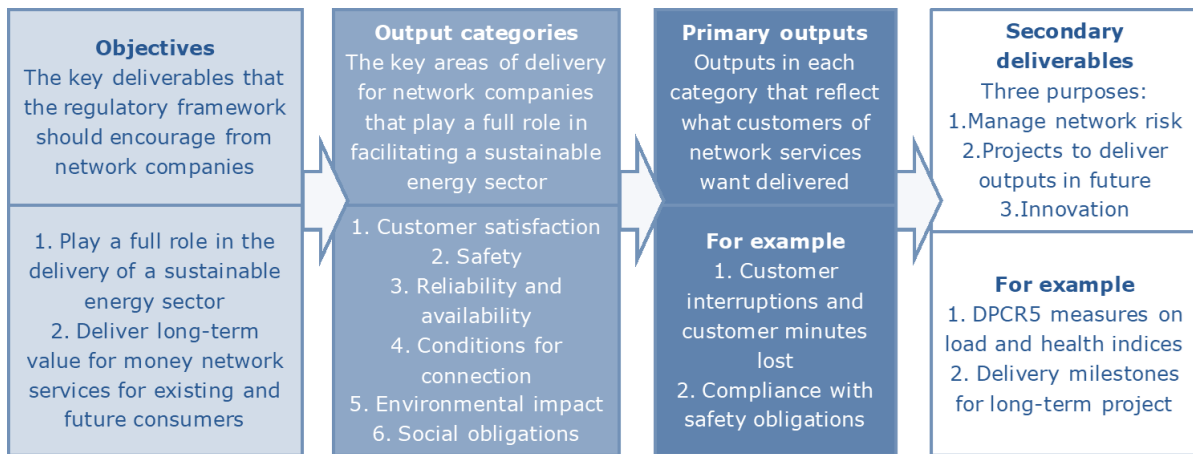


Figure 9: The Framework for Setting Outputs

The RIIO framework also offers opportunities for commercial innovation as illustrated in Figure 10.

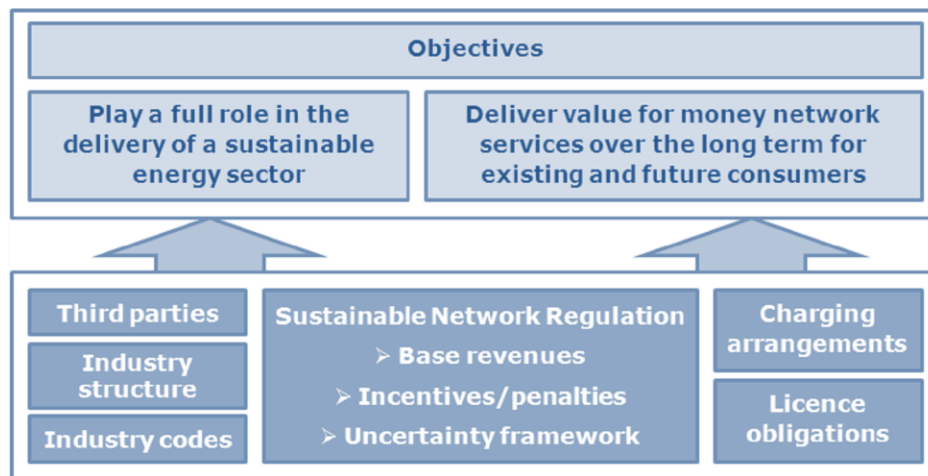


Figure 10: Opportunities for Commercial Innovation Arising from Interactions Across Different Elements of the Wider Regulatory Framework

### 2.3.1.2 RIIO-GD1 Network Price Control

RIIO-GD1<sup>10</sup> is the first price control review for gas distribution to use the RIIO model of network regulation. The RIIO-GD1 price control specifies the goals that the eight (8) Gas Distribution Networks (GDNs) need to deliver to their customers. Moreover, it stipulates the associated revenues that the gas distribution network operators are allowed to collect for the eight-year period ranging from 1 April 2013 until 31 March 2021. The main purpose of the RIIO network regulation model is to incentivize gas DSOs to provide their customers with real benefits, while at the same time drives the gas distribution companies to address the challenges of delivering a low carbon, sustainable energy sector at value for money for existing and future customers.

<sup>10</sup> <https://www.ofgem.gov.uk/gas/distribution-networks/network-innovation>



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As a continuation of RIIO, for which the current price controls for gas distribution (RIIO-GD1) end on March 31, 2021, RIIO-2 will be the next price controls for the network companies running the gas and electricity transmission and distribution networks. In order to foster even more the reduction of costs for consumers and gas DSOs, as well as to promote the energy transition via innovation and competition, the following decisions were taken by Ofgem for the RIIO-2 framework:

- to retain an innovation stimulus package, limited to innovation projects that might not otherwise be delivered under the core RIIO-2 framework. Ofgem will carry out further work on three broad areas of reform
  - increased alignment to energy transition challenges,
  - greater coordination with wider public funding and
  - increased third party engagement (including potential direct access)
- to extend the role of competition (for the market) where it is appropriate and provides better value for consumers to identify projects suitable for competition in other sectors.

### 2.3.1.3 *Gas Network Innovation Competition*

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

### 2.3.1.4 *Gas Network Innovation Allowance*

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

Funding under NIA is limited and can be used for:

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

NIA focuses on the funding of innovative pilot projects as part of its price control settlement. In this respect, the NIA provides funding to smaller R&D and demonstration projects covering all aspects of innovation, such as commercial, technological, and operational. On the other hand, NIC focuses on more complex innovative projects, a fact that also justifies its annual competitive process, and has the potential of supporting projects that deliver low carbon and/or environmental benefits to customers.

The amount of funding under NIA that is available to each Network Licensee can be calculated using the formulae in the NIA Licence Condition. Moreover, the allowance is set at the start of the price control based on the quality of the innovation strategy proposed<sup>33</sup>. Under the RIIO-GD1 price control for gas distribution a 0.5 to 1% of yearly





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revenue is allocated. Moreover, a maximum of 90% of NIA expenditure can be covered by the set allowance. With regards to NIC, in 2017-2018, two gas distribution network projects were selected by Ofgem to receive a total of £15.2 million of NIC funding. Ofgem have committed to making £20 million available each year through the Gas NIC annually until March 2021<sup>11</sup>. Additionally, the RIIO-GD1 price control period 2013-2021, the percentage of innovation within allowed revenues for gas DSOs under the NIA was between 0.5% (SGN and WWU) and 0.6% (NGGD and NGN). For the NIC, the percentage of innovation within allowed revenues as 0.6%. Finally, depending on the chosen method, the total innovation funding available for UK's gas distribution companies is around 1% of TOTEX, as per the RIIO-GD1 decision. The main difference is that half of this funding is subject to competition, where only the best innovation projects proposed receive funding. This ensures that through this competition the risk of projects not delivering benefits to the customers is reduced.

### 2.3.1.5 *Indicative Projects Under Network Innovation*

Indicative projects under network innovation are listed in the Appendix.

## 2.3.2 Ireland

The funding mechanisms and schemes for innovation actions and R&D projects in Ireland are described below.

### 2.3.2.1 *Innovation Funding*

According to CEER<sup>12</sup>, for the price control period ranging from 2013-2017 an allowance of €8 million was available for innovation OPEX funding, of which €7.2 million was allocated to gas transmission and **€0.8 million to distribution**. The main focus areas of innovation funding were related to CNG for the transport section, as well as renewable gas and research grants. For the upcoming price control period, ranging from October 2017 until 2023, an innovation allowance of up to €20.0 million approximately 1% of allowed revenue has been allocated. The selected focus areas are:

- CNG,
- biogas,
- research,
- business and technical services and
- program management services.

**This innovation funding is treated as a pass-through cost item and is not part of the efficiency requirement.**

In 2015, Gas Network Ireland (GNI) requested an additional allowance of €800,000 to support the conversion of fleet vehicles to CNG, while the Commission of Energy Regulation (CER) approved an additional allowance of €400,000. Under the GNI's third price control (PC3) initiative, approximately 22 vehicles were identified for conversion to CNG. GNI predict that this will result in an additional 15GWh of gas consumption per annum.

**Innovation funding is divided between the transmission and distribution networks in a ratio of 90:10 and therefore €40,000 will be included in distribution revenues.**

<sup>11</sup> "Gas Network Innovation Competition Governance Document – v3.0", Ofgem, 2017

<sup>12</sup> CEER – Study on the Future Role of Gas from a Regulatory Perspective



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The responsibility to determine the best possible allocation of innovation funding, fall under both Gas Networks Ireland (TSO) and the Gas Innovation Group. Applications for funding submitted to the Gas Innovation Group will demonstrate the potential to achieve the following:

- deliver significant carbon savings,
- increase throughput through the gas system,
- assists in the transition to a low carbon economy and
- provide measurable value to all gas customers.

### 2.3.2.2 Gas Innovation Fund

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

The Gas Innovation Fund has been divided into the following two broad categories, as shown below.

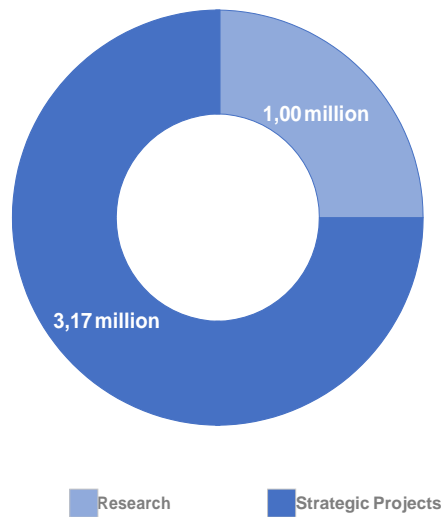


Figure 11: Budget Allocation of Gas Innovation Fund

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





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The Causeway Study is a jointly funded project by EU and CRU that its with main focus is to study the impact that the installation of 14 CNG stations in Ireland will have on the gas network. A grant of €6.5m was provided by the EU, while CRU has approved an additional €12.83m for the study to be completed. The allowance for the Causeway Study makes up the majority of the €17.5m that was approved by the regulator for innovation. It should be mentioned that CRU indicated that an additional €2.5m might be available at a later date in PC4 for innovation funding and that he decision about the additional €2.5m will be informed by the outcomes and outputs of the innovation fund throughout PC4. Finally, CRU has provided an allowance of €0.5m for the PC4 period to GNI to maintain the innovation framework developed during PC3, as well as for purposes of program management.

As mentioned earlier, the four key priorities for the Gas Innovation Fund are shown below.

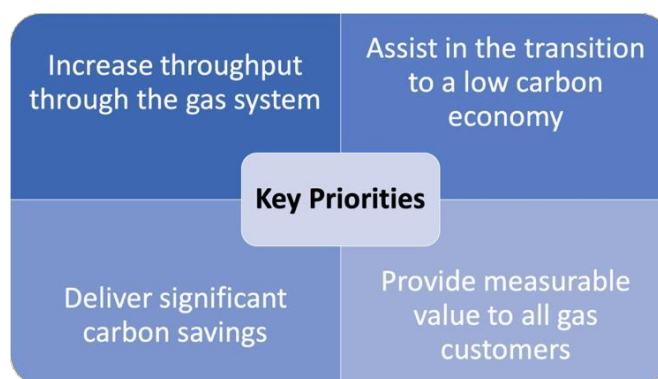


Figure 12: Key priorities of Gas Innovation Fund

The key priorities of the Gas Innovation Fund are analysed below.

### Increase throughput through the gas system

The tariffs for using the gas network are set on the basis of the allowed revenue and the expected usage of the network, given the fact that GNI is a regulated entity by CRU under a revenue cap model which ensures that GNI earns no more and no less than the amount of revenue that the regulator has agreed for a five year period. Increasing the use of gas network will result in lower usage tariffs for everyone using it. Such an increase in throughput through the gas system is the use of Compressed Natural Gas (CNG) in transport.

### Assist in the transition to a low carbon economy

Following the European roadmap, Ireland is also targeting the transition to a low-carbon economy. Ireland’s vision is set forth in the Energy White Paper entitled “Ireland’s transition to a low carbon energy future”, which serves a framework for the Irish energy policy up to 2030. Energy transition ensures competitive and affordable energy to all consumers, as well as the creation of new growth opportunities and employment positions, while at the same time providing greater security of supply by also minimizing the energy import dependence. Such an action to foster the desired energy transition to a low-carbon economy is the production of biomethane and its





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### Assist in the transition to a low carbon economy

injection into the gas network, based on the fact that biomethane is a renewable, carbon neutral fuel which gas customers can use to decarbonise their thermal needs without requiring any change to their equipment.

### Deliver significant carbon savings

The reduction of Greenhouse Gasses (GHG) emissions from the energy sector constitutes a key goal of the European Union, targeting a reduction between 80% and 95% (compared to 1990 levels) by 2050. The 2020 climate change goals require a 20% reduction in GHG emissions, while the 2030 targets are aiming for 40% reductions in GHG emissions compared to their 1990 levels. Innovation actions towards this direction include, for example, delivering carbon savings is by switching from burning coal to using gas for a consumer or, on a larger scale, carbon capture and storage is used to capture carbon from industrial use or power generation.

### Provide measurable value to all gas customers

At the heart of the Gas Innovation Fund is the provision of measurable value to all gas customers. These goals can be achieved in various ways, such as increasing the usage of the gas network to by means of innovation activities and R&D project that foster the sustainability of the gas network. Research focus areas may include the production and use of renewable gases to meet the future needs of customers, as well as innovation actions that leverage the synergies between the electricity and gas networks, as for example power-to-gas technologies.

Proposals seeking funding under the Gas Innovation Fund are assessed under certain criteria, such as the following.

1. **Relevance:** How relevant is the project with regard to addressing the Gas Innovation Fund priorities?
2. **Maturity:** How mature is the project, have elements of the project already started?
3. **Impact:** What impact will the project have and what are the potential practical applications for the project?

It should be mentioned that the innovation fund is treated as OPEX, meaning that is not included within the RAB. GNI are allowed to recover outturn OPEX up to the allowed level of the innovation fund, while in the case of outturn OPEX being under the allowed level, this amount is not allowed to be recovered; i.e. GNI can recover only the minimum of outturn or allowed innovation funding. This amount is not known at the end of the price control, so there will need to be an adjustment early within the PC4 price control for assessing PC3 innovation expenditure.

### 2.3.3 France

An incentive scheme for R&D costs has been introduced by the French Energy Regulatory Commission (Commission de regulation de l'énergie – CRE) in the current price control started in 2017. CRE uses a revenue cap with a four-year regulatory period. For each year, the revenues are set ex-ante, serving as an estimation of OPEX and a return on the RAB. It should be mentioned that OPEX and CAPEX are treated differently, thus forming a hybrid system in which OPEX are subject to incentive regulation while CAPEX is subject to rate of return regulation and can thus





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create incentive bias. CRE also introduced a further differentiation between network and non-network expenses. While network expenditures are treated as before, for non-network expenditures OPEX and CAPEX are subject to the same incentives.<sup>13</sup>

The need for gas DSOs to lead the necessary innovation actions and R&D projects in order to provide to their customers efficient and high-quality services was recognized as a need by CRE. CRE aim is to ensure that GRDF, the gas distribution company of France, has the necessary resources for carrying out the required R&D activities and that these resources are used in the most efficient manner.

In this respect, CRE defines as an R&D budget all the mounts that will be used for R&D, as well as for performing the necessary innovation activities. The present decision introduces a mechanism aimed at providing GRDF with the means to carry out the R&D projects required for the construction of the networks of the future by guaranteeing in particular that tariff matters do not hinder R&D projects. Moreover, GRDF has also set up a mechanism for monitoring gas-related projects, in order to provide gas market stakeholders with visibility into the innovation projects fostered and funded by GRDF.

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

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

For GRDF, according to the deliberation of the CRE of 10 March 2016 on the equalized tariff for the use of public natural gas distribution networks<sup>14</sup>, the reference R&D expenditure that includes smart grids projects, but excludes any R&D spending to increase the number of customers connected to the gas networks, are shown in the table below.

Table 1: GRDF's R&D Expenses for the ATRD5 Period

In current €M	2016	2017	2018	2019	Average
<b>R&amp;D</b>	9.7	10.5	11.4	11.2	10.7

<sup>13</sup> Regulation, Innovation, and Systems Integration: Evidence from the EU

<sup>14</sup> "Deliberation of the French Energy Regulatory Commission of 10 March 2016 forming a decision on the equalised tariff for the use of GRDF's public natural gas distribution networks", CRE, 2016





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The forecasted OPEX presented by GRDF for the ATRD5 period is presented in Table 2.

Table 2: GRDF's OPEX Forecast for the ATRD5 Period

In current €M	2016	2017	2018	2019	Average
<b>OPEX</b>	1,533.5	1,544.4	1,546.8	1,553.6	1,544.6
<b>% R&amp;D</b>	<b>0.63%</b>	<b>0.68%</b>	<b>0.74%</b>	<b>0.72%</b>	<b>0.69%</b>

It can be seen that the average R&D expenditure is approximately 0.69% of the forecasted OPEX of GRDF.

According to the deliberation by the French Energy Regulation Commission of 23 January 2020 deciding on the equalized tariff for the use of GRDF's public natural gas distribution networks<sup>15</sup>, CRE adopted the following R&D trajectory for GRDF for the ATRD6 period.

Table 3: GRDF's Trajectory of R&D Expenses for the ATRD6 Period

In current €M	2020	2021	2022	2023	Average
<b>R&amp;D</b>	15.4	15.7	15.9	16.2	15.8

The allowed revenue for the 2020-2023 tariff period is shown in the table below.

Table 4: GRDF's Allowed Revenue for the 2020-2023 Tariff Period

In current €M	2020	2021	2022	2023	Average
<b>Allowed revenue</b>	3,097.0	3,174.8	3,274.2	3,288.0	3,208.5
<b>% R&amp;D</b>	<b>0.50%</b>	<b>0.49%</b>	<b>0.49%</b>	<b>0.49%</b>	<b>0.49%</b>

From table above we can observe that the average R&D expenditure is approximately 0.49% of the allowed revenue of GRDF.

### 2.3.4 Italy

Italy has more than 200 gas distribution and metering companies, with the smallest service less than 5.000 clients, while the largest distribution company serves more than 5.000.000 customers<sup>16</sup>. The distributed volume of gas is more than 20 billion m<sup>3</sup>, while the aggregated RAB is approximately 17 billion EURO.

The current distribution tariff system in Italy is illustrated in Figure 13 shown below.

<sup>15</sup> "Deliberation N 2020-010", CRE, 2020

<sup>16</sup> "Distribution Tariff Setting Methodologies in Italy", ARERA 2019





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Figure 15: Building blocks of allowed cost calculation in Italy (Source ARERA)

The allowed operating costs are basically aligned to actual cost at the beginning of each regulatory period that lasts for 6 years (previously 4 years). Moreover, the actual costs are calculated on the basis of costs reported in the separated annual accounts according to the unbundling rules defined by the NRA. It should be mentioned that the actual costs considered to set the allowed operating costs are net of non-recurring costs, financial costs, advertising and marketing costs, sanctions, tax funds, litigation costs (if unsuccessful), and not compulsory insurance costs<sup>16</sup>.

According to ARERA, the following two mechanisms are applied to determine the allowed operating costs:

- **price-cap:** annual tariff reviews are based on the price-cap and include adjustments reflecting cost variations arising from unforeseeable and exceptional events, changes in regulation and changes in universal service obligations, where applicable and
- **profit-sharing mechanism:** on the basis of this mechanism at the end of the regulatory period, in order to set tariffs for the following period, efficiency gains are shared between network operators and network users.

With regards to the allowed rate of return calculation methodology review, Decision 597/2014/R/COM stated the general approach to be followed:

- the allowed rate of return is calculated as a weighted average cost of capital (WACC);
- the allowed rate of return is calculated as real and pre-tax; and
- the cost of equity is calculated according to the Capital Asset Pricing Model (CAPM).

The cost allocation criteria for gas distribution in Italy are illustrated graphically in Figure 16.



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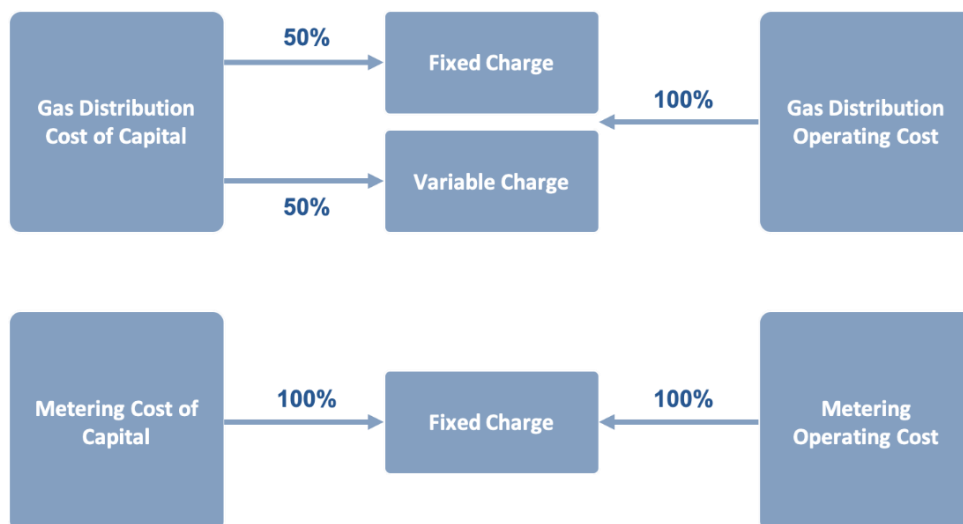


Figure 16: Cost allocation criteria for gas distribution in Italy (Source: ARERA)

The Italian NRA, the Autorità di Regolazione per Energia Reti e Ambiente (ARERA, previously AEEGSI), follows a six-year period for gas distribution, where revenues are being established ex-ante with a RAB-based approach and with deviations from forecast expenses being treated differently according to whether they are operational (incentive regulation) or capital (cost of service).

Starting from 2020, a TOTEX approach will be adopted for both electricity and gas to cope with the distortion that may be posed by the current regulatory approach. Under the TOTEX approach CAPEX and OPEX are treated in the same way by the regulatory authority. Finally, the implementation of smart grid and innovation projects are incentivized by a 2% increase in the WACC for twelve (12) years. The TOTEX approach is considered by ARERA more efficient compared to the present hybrid approach (price cap applied to operating costs and cost of service regulation applied to capital costs). In the new regulatory strategic framework approved with the Decision 242/2019/A (June 2019) the TOTEX approach has been integrated in a more comprehensive regulation by objectives of service and expenditure approach (ROSS). Moreover, DCO 335/2015 outlines the key features of TOTEX approach:

- focus on future expenditure;
- output orientation; and
- stronger incentive to improve total productivity.

It should be mentioned that the adoption of a TOTEX approach implies giving more relevance to forecast and business plans. Due to information asymmetry, it is therefore necessary to introduce “truth telling” incentives in order to obtain credible business plans from regulated companies. Also, cost assessment and total expenditure analysis play a key role in the implementation of TOTEX, while at the same time requires to strengthen enforcement, in order to control the actual level of outputs and of expenditure.

### 2.3.5 Finland

The Finnish natural gas market is presently isolated with a pipeline connection only to the importing country Russia. There is only one importer and wholesale supplier – Gasum Oy – which also owns and operates the natural gas transmission network. Commissioning of Balticconnector pipeline by the end of 2019 will connect the Finnish



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market to the Estonian and Baltic gas markets by creating the environment for establishing a common entry-exit zone for Finland and the Baltics. There were 24 local natural gas distribution system operators at the end of 2018. All the Finnish natural gas DSO's and the consumption sites of natural gas are situated in the southern part of the country along the gas transmission network. Approximately 80 per cent of the Finnish gas DSOs are wholly or mainly owned by municipalities. The rest 20 per cent of the DSOs are owned by industrial users of natural gas. In Finland, retail supply of natural gas is done in most cases within the same company as gas distribution.

The Finnish natural gas market has been under sector-specific regulatory supervision since the assertion of the Natural Gas Market Act in August 2000. The Natural Gas Market Act was amended first at the beginning of the year 2005 to implement the Natural Gas Market Directive (2003/55/EC) and the second time in 2013 to include the requirements of the Gas Directive 2009/73/EC. A new Natural Gas Market Act (587/2017) came into force 1 January 2018. The intention of the new act is to open the gas market for competition, require ownership unbundling of the TSO and lift the derogation by 1 January 2020. From 1 January 2020, the Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks and European gas network codes will be applied in Finland.

Finland has availed itself of the possibility of a derogation allowed by the Natural Gas Market Directive. Following this, the natural gas market has not been opened and certain provisions from the European natural gas market regulation, e.g. network codes, are not applied in Finland. This exemption is effective as long as Finland does not have a direct connection to the natural gas network of any other EU Member State and as long as Finland has only one main natural gas supplier.

Legal and operative unbundling requirements are required from distribution network operators in Finland as Member States may decide that the unbundling provisions are not applied to network operators with less than 100,000 customers. All Finnish natural gas distribution system operators fall below the limit set by the Directive.

In Finland, the length of regulatory periods is four (4) years. In November 2015, the Energy Authority confirmed with its decisions the methodology to be followed in natural gas system operation during the third and fourth regulatory periods in 2016-2019 and 2020-2023.

According to the Act on Supervision of Electricity and Gas Markets the methodology confirmed by the regulator may include the following items:

- method for the valuation of regulated asset value
- method for determining approved rate of return on capital
- method for determining realised profit of network operations
- method for setting efficiency targets for network operations

The present methodology of setting network tariffs includes all items mentioned above, besides efficiency targets for distribution network operations<sup>17</sup>.

According to CEER<sup>18</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 gas distribution network operator may incur research and development costs before the new technologies are in full use and utilisable. The

<sup>17</sup> "National Report 2017 to the Agency for the Cooperation of Energy Regulators and to the European Commission – Finland", Energy Authority, 2017

<sup>18</sup> CEER – Report on Regulatory Frameworks for European Energy Networks 2019





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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 gas 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 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.

### 2.3.6 Recap of EU Countries and Comparison with Existing Practices in Turkey in Gas Distribution Sector

Table 5 provides an overview of the cross-country comparison of innovation incentives/funding mechanisms for gas DSOs.



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Table 5: Cross-Country Comparison of Innovation Incentives/Funding Mechanisms for Gas DSOs

Innovation Regulatory Feature	United Kingdom	Ireland	Italy	France	Finland	Turkey
<b>High level description of innovation activities and regulatory framework</b>	RIIO framework stands for Revenue = Incentives + Innovation + Outputs and is considered as one of the most comprehensive performance-based regulatory frameworks.	The main focus areas of innovation funding were related to CNG for the transport section, as well as renewable gas and research grants.	The Italian NRA, follows a six-year period for gas distribution, where revenues are being established ex-ante with a RAB-based approach and with deviations from forecast expenses being treated differently according to whether they are OPEX or CAPEX.	CRE defines as an R&D budget all the mounts that will be used for R&D, as well as for performing the necessary innovation activities.	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.	With a clear reference to support to innovation activities of distribution companies both in relevant legislations and the Strategic Plan of MENR, the regulations and policy in Turkey explicitly foster innovation activities of distribution companies. Furthermore, the secondary legislation is evolving as the innovation maturity of the sector is improved gradually through the support of the Regulator.
<b>Innovation Regulatory Incentives in use</b>	Two funding mechanisms in place for innovation projects: The Network Innovation Alliance (NIA) and the Network Innovation Competition (NIC).	For the price control period ranging from 2013-2017 an allowance of €0.8 million was available for gas distribution innovation OPEX funding.	Starting from 2020, a TOTEX approach will be adopted for both electricity and gas to cope with the distortion that may be posed by the current regulatory approach.	For each year, the revenues are set ex-ante, serving as an estimation of OPEX and a return on the RAB. OPEX and CAPEX are treated differently. OPEX are subject to incentive regulation, while CAPEX is subject to rate of return regulation and can thus create incentive bias.	Innovation incentive is calculated so that a share corresponding to a maximum of 1% of the DSO's total turnover from network operations.	Allocated R&D budget for DSOs is 1% of their OPEX.





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Innovation Regulatory Feature	United Kingdom	Ireland	Italy	France	Finland	Turkey
<b>Financing innovation incentives</b>	Innovation incentives are included as part of the RIIO model.	Innovation funding is treated as a pass-through cost item and is not part of the efficiency requirement.	Under the TOTEX approach CAPEX and OPEX are treated in the same way by the regulatory authority. The implementation of smart grid and innovation projects are incentivized by a 12% increase in the WACC for twelve (12) years	CRE introduces further differentiation between network and non-network expenses. Non-network expenditures OPEX and CAPEX are subject to the same incentives.	Allowed innovation incentive is recovered from end-users through tariffs.	Innovation funding is treated as a pass-through cost item and is not part of the efficiency requirement.



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Innovation Regulatory Feature	United Kingdom	Ireland	Italy	France	Finland	Turkey
<p><b>Eligible R&amp;D expenditures/projects</b></p>	<p>Ofgem allows for new equipment, as well as novel applications of existing equipment and new operational practices, as long as the foster and promote environmental benefits, value for customers; and creation of knowledge.</p>	<p>Eligible applications for funding submitted to the Gas Innovation Group will demonstrate the potential to achieve delivery of significant carbon savings; increase throughput through the gas system; assists in the transition to a low carbon economy; and provision measurable value to all gas customers.</p>	<p>No predefined eligible R&amp;D expenditures.</p>	<p>Innovation actions and R&amp;D projects providing to customers efficient and high-quality services.</p>	<p>OPEX R&amp;D and innovation activities cost must be recorded as expenses in the unbundled profit and loss account since capitalised R&amp;D costs are not accepted to be included in the calculation of the innovation incentive.</p>	<p>For R&amp;D project expenditures, DSOs apply to EMRA twice a year to get an approval of R&amp;D Commission.</p> <p>On the other hand, expenses below are covered by R&amp;D budget, up to 10% of the R&amp;D budget:</p> <ul style="list-style-type: none"> <li>- Expenses in relation to the projects rejected at the application stage,</li> <li>- In case of an R&amp;D, Design and Incubation Centre is established by the relevant distribution company, the expenses and expenses incurred except for those covered by other legislation related to the said centre,</li> <li>- Costs and expenses incurred to support and promote entrepreneurship activities, Incubation Centres, acceleration programs, contests and other cooperation activities with technoparks.</li> </ul>





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Innovation Regulatory Feature	United Kingdom	Ireland	Italy	France	Finland	Turkey
<b>R&amp;D expenditures approval, evaluation criteria and external experts' involvement.</b>	Ofgem evaluates gas-related project applications for the NIA and NIC according to the following evaluation criteria. Project budget is app	The responsibility to determine the best possible allocation of innovation funding, fall under both Gas Networks Ireland (TSO) and the Gas Innovation Group. Proposals seeking funding under the Gas Innovation Fund are assessed under certain criteria, such as relevance, maturity, and impact.	Information not available.	Actual R&D OPEX incurred by GRDF are reviewed by CRE at the end of the tariff period. Any positive difference between the forecasted and actual trajectories will be returned to the customers.	Acceptable R&D costs need to be directly related to new knowledge creation, as well as use of new technologies and the development of products or network operation methods for the gas distribution sector	R&D projects are evaluated by R&D Commission of EMRA, with the rules and principles defined in " <i>Principles and Procedures for Supporting Research, Development and Innovation Activities of Electricity and Natural Gas Distribution Companies</i> "
<b>Implementation, monitoring, reporting obligations and audit</b>	For projects funded under the NIC of Ofgem, the beneficiary has to report, during the project proposal application submission project-specific financial information. A Close Down Report is also submitted for each project that has received NIC funding.	The Gas Innovation Fund requires applicants to provide a detailed budget for any proposal submitted, along with information on budget justification and other co-funding sources.	Information not available.	GRDF submits to CRE a review of the previous year. This review is submitted before the end of the first quarter of each calendar year.	R&D costs should be recorder separately in the unbundled financial statements.	For projects longer than 6 (six) months, 6 (six) months progress report is prepared by the distribution company considering the start date of the related project and submitted to the Regulator within 30 (thirty) days. Final result reports for the completed projects are submitted to the Regulator through EBIS (EMRA notification system) within 30 (thirty) days from the date of the completion of the related project.





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Innovation Regulatory Feature	United Kingdom	Ireland	Italy	France	Finland	Turkey
<p><b>Collaboration, partnership and knowledge transfer</b></p>	<p>Ofgem expect innovation activities and R&amp;D project stakeholders to collaborate with each other on many of the projects supported by the NIA. 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.</p>	<p>ICRU publishes an Innovation Reporting Framework related to the Gas Innovation Fund. Gas Networks Ireland is also required to provide an annual report to the CRU for each gas year of the price control. The annual report outlines the activities of the Gas Innovation Fund for that particular time period.</p>	<p>There is no specific mention to collaboration with other regulated entities or third parties.</p>	<p>There is no specific mention to collaboration with other regulated entities or third parties. CRE publishes a biannual report with the R&amp;D actions performed by GRDF that provides visibility into the innovation projects led by GRDF and funded under the ATRD tariff. GRDF has also set up a mechanism for monitoring gas-related projects, in order to provide gas market stakeholders with visibility into the innovation projects fostered and funded by GRDF.</p>	<p>There is no specific mention to collaboration with other regulated entities or third parties. Projects results are made publicly available.</p>	<p>DSO are encouraged to collaborate with R&amp;D stakeholders (universities, start-ups, solution and technology providers, start-ups, consultants, etc.)</p> <p>DSOs are allowed to establish an R&amp;D Centre, which provides tax incentives and regulated by Ministry of Industry and Technology.</p>





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

The regulated entities and public institutions that could potentially be the key stakeholders in R&D projects and innovation activities in the gas 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>19</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.

### Gas Distribution System Operator

Gas Distribution System Operators (DSOs) play a fundamental role in the operation of gas networks since they are responsible for the operation, maintenance, and development of the portion of the gas network that links the transmission system and the end customer. Moreover, gas DSOs play an important role as market facilitators for gas suppliers by making sure that the gas is transported in a safe and efficient manner. Finally, CEER<sup>19</sup> acknowledges also the importance of gas DSOs to decide on the suitable innovation solutions to be applied in their networks, according to according to the individual needs of the gas DSOs.

### Gas Transmission System Operator

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

<sup>19</sup> "C17-DS-37-05 – Incentives Schemes for Regulating Distribution System Operators, including for innovation", CEER, 2018



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## Electricity System Operators

The electricity TSOs and DSOs play an important role in modern energy systems. Gas technologies are capable of providing flexibility solutions to the electricity networks either through power-to-gas solutions, by storing the excess of electricity supply, or via CHP solutions, by lowering electricity demands.

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

## Consumers

Consumers are a key stakeholder in the energy chain, since according to CEER<sup>19</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 gas 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, gas DSOs often collaborate with the academia and research institutions for their R&D activities. Finally, CEER<sup>19</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.

## 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 gas DSOs to exploit these funding mechanisms by joining consortia that also involve European gas DSOs and TSOs to finance their own R&D and innovation activities.

According to a report<sup>20</sup> from GEODE Working Group Gas, the traditional role of the gas DSOs is changing as operators move from being solely gas transporters to providing innovative services to consumers and enabling

<sup>20</sup> "The Future Role of Gas Distribution Networks – Delivering Gas to Consumers" GEODE Working Group Gas, 2014



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interoperable solutions to all market participants. GEODE Working Group Gas foresees the future roles and responsibilities for gas DSOs described below.

### Biogas

The development of biogas and biomethane production affects gas DSOs in several ways since they are the responsible entities for maintaining the stability of the gas distribution grid. Therefore, it is in their interest that the quantity and quality of the biogas used remains stable. Gas DSOs are also responsible for the connection of biogas plants to the distribution grid, a responsibility that includes extending the network and installing appropriate technologies. This represents a significant investment for gas DSOs. Regulators should ensure that gas DSOs do not bear any risk regarding the connection of biogas power plants to the grid by providing that adequate mechanisms for cost compensation are in place.

### Energy Storage and Power-to-Gas

Power-to-Gas technologies are an efficient way to use the surplus in renewable energy produced at times of low demand. Power-to-Gas technologies involve the production of hydrogen from electricity in a process of electrolyzation. Subsequently, the gas produced can be transformed into methane by adding carbon monoxide and can be stored for later use, injected into the gas grid or even converted back into electricity. Power-to-Gas solves in an alternative way the problem of the storage of energy produced by renewable sources, especially taking into account the increased use of renewable energies and the volatile nature of their production. These types of technologies represent an opportunity for gas DSOs since they offer the means for ensuring the stability of both the gas and electricity grids.

### Transportation and Gas Vehicles

Fostering the use of alternative fuels for transportation requires a significant increase in the number of gas filling stations. In the European Union, there exist approximately 3,000 CNG and 50 LNG filling stations. The majority of the CNG stations are located in Italy and Germany. The network of gas filling stations requires the gas DSO's infrastructure, thus making the gas DSO responsible for the connection of the filling stations to the distribution grid. Therefore, putting in place the required infrastructure is an important step for increasing the number of natural gas vehicles. However, the connection of the filling stations to the distribution grid should not introduce and technical or financial risks and jeopardize the normal operation of the gas DSOs.

### Combined Heat and Power

Some CHP plants use locally produced biogas, which do not need to be connected to the gas distribution grid. However, in some cases gas DSOs are responsible for both the gas and electricity/heating grids. Moreover, some CHP plants also use natural gas from the gas grid and therefore a connection to the gas grid is required. It is



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necessary to ensure legal security for DSOs regarding the increasing challenge of grid stability and the handling of priority rules for the feed-in of electricity. The Energy Efficiency Directive<sup>21</sup> considers clear feed-in priority rules between green electricity and electricity generated by high-efficiency CHP.

## Smart Gas Grids

Managing the gas distribution grid in an efficient and effective manner, the collection of precise data is of paramount importance for the gas DSO. Therefore, the roll-out of smart meters, as proposed by the Third Energy Package<sup>22</sup>, Directive for the Internal Gas Market, is key to achieve the goal of the effective management of the gas grid. Another aspect that is essential for the realization of the smart gas grid is the injection into the grid of non-conventional gases such as biomethane, hydrogen or LNG and the ability of the gas DSOs to monitor and control the gas quality and pressure. Last, but not least, the use of smart tools for managing the gas distribution grid will also contribute to the safety the gas distribution networks, a top priority of the gas DSOs, in and cost-efficient way.

### 2.4.1 Gas Smart Meter

Gas smart meters constitute a key component of energy transition when it comes to gas distribution networks. In this section we provide an overview of the regulatory framework for gas smart metering deployment in all EU-28 Member States. A European smart metering benchmark study<sup>23</sup> identified the following market drivers for the deployment of smart meters:

- digitalization of the distribution grid and optimization of the network operations,
- digitalization of the retail market to foster innovation and new services by private actors,
- supporting actions for tackling fuel poverty,
- supporting energy efficiency.

The study also revealed that among the four (4) market drivers identified above, “digitalization of the distribution grid to allow optimization of the network operations” emerges as the most important driver, since it provides allows grid operators to optimize the operation and usage of their existing assets, thus deferring additional investments and generating indirect benefits for the consumer. **In the case of gas smart meter, energy efficiency is not a key driver, except from countries where fuel poverty risk is high (e.g. Romania). Finally, even though injecting biogas in the distribution grid has become a reality in some Member States, it is not considered as a significant driver for gas smart metering rollout.**

The overview of the relevant legislation for gas smart meters across the Member States is given in Table 6.

<sup>21</sup> “Directive 2012/27/EU of the European Parliament and of the Council”, European Parliament, 2012

<sup>22</sup> [https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package\\_en](https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en)

<sup>23</sup> “European smart metering benchmark”, European Commission, DG Energy



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Table 6: National Legislation for the Deployment of Gas Smart Meters

Country	Relevant legislation for gas smart metering
<b>Austria</b>	The primary law is “GWG2011”. The status of this law is also nearly unchanged since implementation. A delegated law that further implement smart metering deployment is “G-IMA-VO”, which contains functional requirements for Gas Meters.
<b>Belgium</b>	The primary law that enables smart metering for gas in the Brussels Capital Region is the “l’ordonnance du 1er avril 2004 relative à l’organisation du marché du gaz en Région de Bruxelles-Capitale”. At this stage there are no laws that enable smart metering for gas in Wallonia. In Flanders, the primary law that enables smart metering for electricity and gas is the ‘Energiedecreet’.
<b>Bulgaria</b>	<i>No specific laws have been adopted to frame the deployment of smart metering.</i>
<b>Croatia</b>	The Croatian primary law that enables both smart electricity and gas metering is the “Energy Act”.
<b>Czech Republic</b>	“Act No. 458/2000, Coll. on Business Conditions and Public Administration in the Energy Sectors and on Amendment Other Laws (Energy Act).”
<b>Denmark</b>	<i>No specific laws have been adopted to frame the deployment of smart metering.</i>
<b>Estonia</b>	The primary law that enables smart metering for gas is the “Natural Gas Act”, which was revised and valid as of June 2017.
<b>Finland</b>	N/A
<b>France</b>	A framework similar to that of the electricity market has been adopted.
<b>Germany</b>	The primary law that enables smart metering for both electricity and gas is “Gesetz zur Digitalisierung der Energiewende”.
<b>Greece</b>	N/A
<b>Hungary</b>	The primary laws that enable smart metering for gas is the “Natural Gas Act XL of 2008”. The “Government Decree No. 26/2016” is currently the delegated law that further implements smart metering deployment for both smart electricity and gas meters.
<b>Ireland</b>	The primary law introduced by the Department of Communications, Climate Action and Environment in 2014 that enables smart metering for electricity and gas meters is the “Statutory Instrument 426”, transposed into Irish law by way of secondary legislation based on the obligations under the Third Directive.
<b>Italy</b>	Although a first legislative mandate was laid down in “Law 99/2009”, the primary law enabling smart metering for gas in Italy is the “Legislative Decree 102/20143” (same as for electricity).
<b>Latvia</b>	<i>No specific laws have been adopted to frame the deployment of smart metering for natural gas.</i>
<b>Lithuania</b>	<i>No specific laws have been adopted to frame the deployment of smart metering.</i>





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Country	Relevant legislation for gas smart metering
<b>Luxemburg</b>	The primary law that enables smart metering for gas is “Loi modifiée du 1er août 2007 relative à l'organisation du marché du gaz naturel”. The last revision of this law was in 2015.
<b>Malta</b>	<i>There is no gas market in Malta.</i>
<b>The Netherlands</b>	<p>The primary laws that enables smart metering for electricity and gas are:</p> <ul style="list-style-type: none"> <li>• “Wet implementatie EG-richtlijnen energie-efficiëntie”</li> <li>• “Wijziging van de Elektriciteitswet 1998”</li> <li>• “Gaswet ter verbetering van de werking van de elektriciteits- en gasmarkt (31374)”</li> </ul> <p>These laws are currently under revision.</p>
<b>Poland</b>	The primary law that enables smart metering for electricity and gas is the “Energy Law”.
<b>Portugal</b>	The primary laws that enable smart metering for electricity and gas are “Decreto-Lei n° 215-A/2012” (October 8) and “Decreto-Lei n° 231/2012” (October 26), which have been both revised. Concerning gas smart metering, at present, there is no delegated law to further implement its deployment.
<b>Romania</b>	<i>There is currently no specific law framing the deployment of smart metering for natural gas.</i>
<b>Slovakia</b>	<i>No Decree is in place for the implementation of gas smart meters.</i>
<b>Slovenia</b>	The “Energy Act” is currently the primary law that enables electricity and gas smart metering in Slovenia, as it includes Articles 174 addressing “Intelligent metering systems” for the gas sector.
<b>Spain</b>	<i>There is no specific law in place framing the deployment of smart metering for gas.</i>
<b>Sweden</b>	N/A
<b>United Kingdom</b>	A framework similar to that of the electricity market has been adopted.

Source: European Commission<sup>23</sup>

From the table above, one may observe that approximately a quarter of Member States have defined implementation strategies for gas smart meters, taking into account specific legal provisions. It should be mentioned that the majority of these Member States **have replicated the legal framework they have adopted for electricity smart meters for the implementation of gas smart meters or have adopted implementation laws dedicated to both electricity and gas smart meters**. An interesting finding revealed by this study is the fact that legal framework for gas smart meters is still at an early stage when compared to electricity. However, this delay in the adoption of a legal framework for the deployment of gas smart meters is justified by the fact that the average ratio of gas meters over electricity meters within the EU is ca. 29% and some Member States do not host any gas market (e.g. Malta).

Finally, it should be mentioned that Member States have to transpose the EU Directives into national law. The detailed rules on gas smart metering are only required to be adopted in the case that the CBA for a (wide-scale or partial) rollout of gas smart meters is positive.



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The gas DSOs are responsible for deriving the technical specifications of smart meters, while a minimum set of functionalities for gas smart meters are provided in Recommendation 2012/148/EU. Gas DSOs are also responsible for performing the required CBA.

An overview of Member States with an implementation strategy in place and specific legal provisions for the deployment of gas smart meters is shown in Figure 17, while the revised CBA results, considering a large-scale rollout of gas smart meters as of July 2018 are depicted in Figure 18.

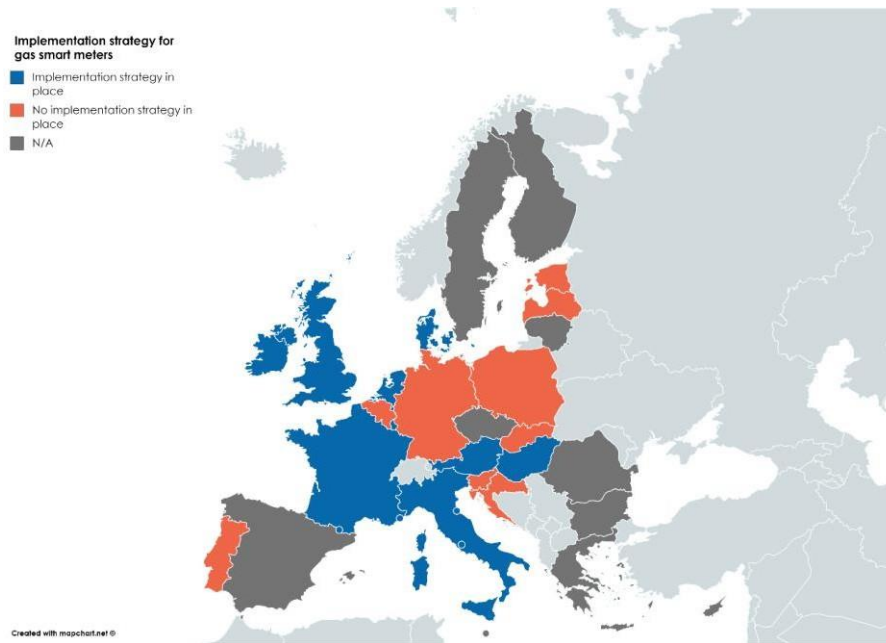


Figure 17: Overview of Member States which have an Implementation Strategy in Place with Specific Legal Provisions for the Deployment of Gas Smart Meters<sup>24</sup> (EC)

<sup>24</sup> N/A Stands for Data not Made Available in the Course of the Project by the Relevant National Authorities



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Revised CBA results for gas smart meters

- Positive
- No CBA
- Negative
- No gas distribution

Created with mapchart.net

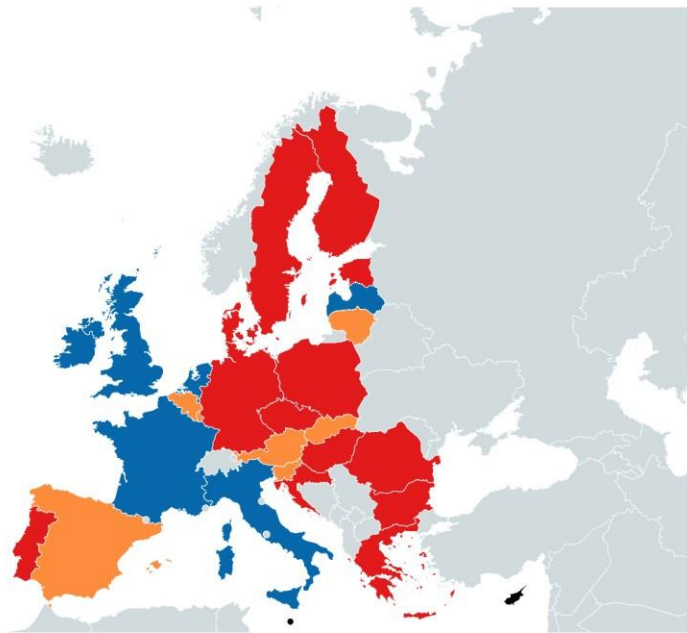


Figure 18: Revised CBA Results, Considering a Large-Scale Rollout of Gas Smart Meters as of July 2018 (EC)

The benefits that are considered in the case of gas smart meters are:

- meter reading & operation savings,
- bill reduction due to energy efficiency,
- non-technical (administrative, including fraud) losses
- operation & maintenance of assets,
- reduction of CO<sub>2</sub> emission
- leakage reduction,
- increased competition in retail market,
- outage management,
- air pollution (particulate matters, NO<sub>x</sub>, SO<sub>2</sub>) and
- other benefits not considered above.



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## 2.4.2 Flexibility Services

European associations representing DSOs (CEDEC, EDSO, Eurelectric, Eurogas and GEODE) have initiated a DSO committee on flexibility markets<sup>25</sup>. The purpose of the committee was to foster cooperation and to provide expertise to DSOs in the areas of flexibility for gas and electricity and provide insights in the following areas<sup>26</sup>.

### Problem Definition

Assess whether current flexibility arrangements under the European Balancing Network Code are sufficient for the system with increasing penetration of renewable gasses at local level.

### Solution Space

Given the above, what is the definition or specification of the services and/or technologies that could assist the gas DSO? What are the factors affecting the choice of option and the regulatory environment necessary to accommodate it?

### Technologies

What is the range of known gas-based technologies or resources that might be candidates to offer flexibility services to the system, for example demand-side response; local gas-based generation like micro-CHP and fuel cells; power-to-gas plants; plants which inject hydrogen; biomethane (“green gas”); grid storage; or heat storage? What is the catalogue of potential supply? What does technological advance hold for this catalogue?

### Modes of Service Acquisition

In recognition that in business-as-usual, the gas DSOs acquire a wide range of services and products (under regulatory supervision), what are the possibilities open to the gas DSOs to acquire these services for example by arms-length commercial procurement or otherwise? What are the prospects of organised liquid markets developing for these services (for example through EU-certified biogas) and what might be the “footprint” of these markets (local or regional or other)? What are the consequences or remedies open to the gas DSO in the event of non-performance by any of the service providers?

Gas technologies are capable of providing flexibility solutions to the electricity grids either through power-to-gas solutions, by storing the excess of electricity supply, or via CHP solutions, by lowering electricity demands. To meet

<sup>25</sup> “Enhanced DSO Cooperation”, Eurelectric

<sup>26</sup> “Flexibility in the Energy Transition: A Toolbox for Gas DSOs”, CEDEC-Eurogas-GEODE





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the energy and climate goals of European Union and foster the energy transition, it is important that the regulations and policies adapt to the new and future roles, related to flexibility, of the gas DSOs. This can be achieved by:

- fostering R&D of gas technologies that provide flexibility to the energy system, such as technologies related to biomethane, hydrogen, micro-CHP, reverse flows and others,
- encouraging renewable and smart gas producers to become flexibility providers via power-to-grid and micro- and mini-CHP solutions and
- considering the active role of gas DSOs in managing flexibility on their grids.

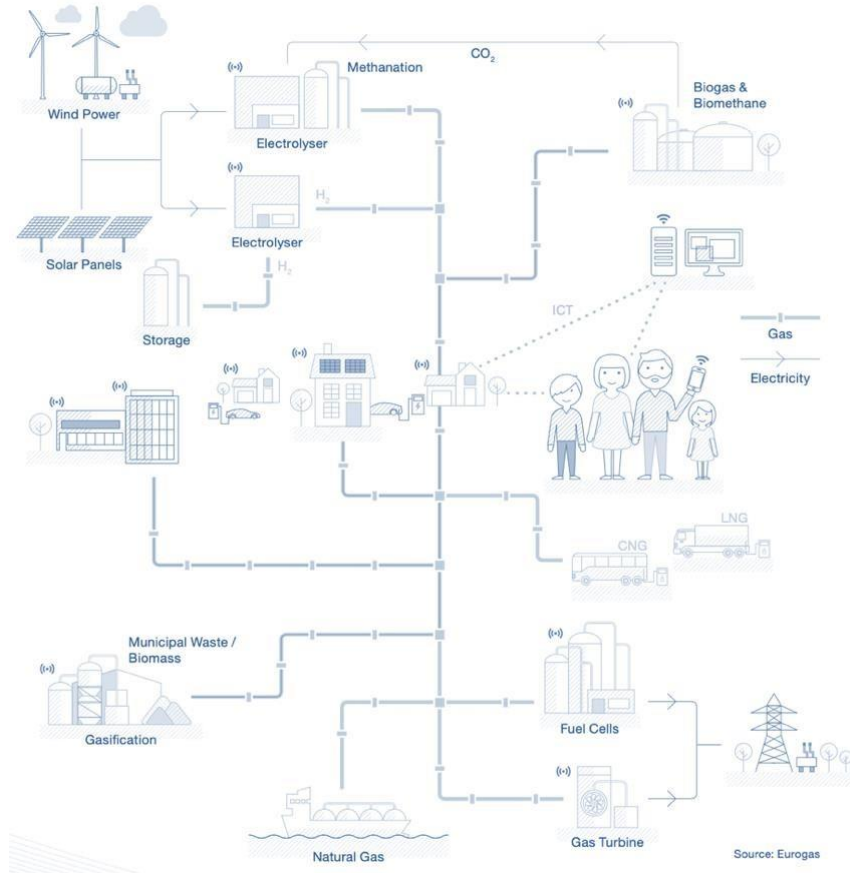


Figure 19: Integrating Renewable Gas in a Smart & Clean Energy System (Eurogas)

### 2.4.2.1 Power-to-Gas

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

- The transformation of electric power into hydrogen or SNG allows to use the energy at any time and locations by using the gas networks.



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

The main European demonstrators combining power-to-gas and injection are show in Figure 20 below.

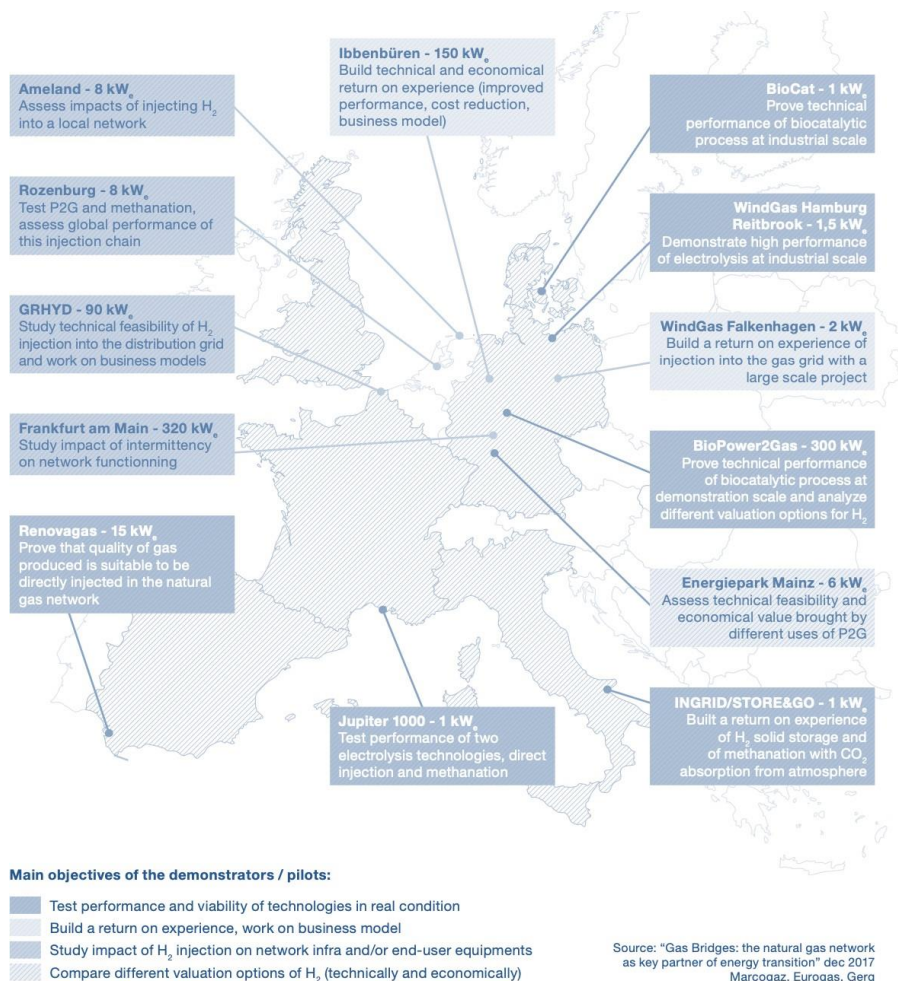


Figure 20: Main European Demonstrators Combining Power-to-Gas and Injection<sup>27</sup>

The most common barriers to the wide adoption of power-to-gas solutions are described below<sup>26</sup>.

- The evolution of the legal/regulatory framework is required to exploit the potential of power-to-gas solutions.

<sup>27</sup> Source: Marcogaz, Eurogas, Gerg



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- Innovation activities and R&D projects related to power-to-gas deployment should be encouraged.
- Fees and levies for the input-electricity have to be revised for power-to-gas plants.
- Implementation of support schemes.
- Incentivization of producers of excess renewable intermittent electricity to avoid curtailment and use power-to-gas technologies.
- Purchase of flexibility from power-to-gas plants should be allowed for electricity network operators. In case a capacity market is in place, the power-to-gas plant should be allowed to take part in the auction.

#### 2.4.2.2 *Micro-CHP*

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

Mini- and micro-CHP systems provide a number of benefits, since they allow a greater interaction between the electricity and gas systems. Moreover, they bring efficiency and flexibility to the energy system. Some of the benefits of mini- and micro-CHP systems are provided below.<sup>26</sup>

- Provide the ability for load shifting between the electricity and the gas network using heat storage, thus maximizing the efficient utilization of electricity and gas grids.
- Provide fuel savings by avoiding exhaust heat losses in many large power generation stations, thus leading to significant reductions of CO emissions (some 3 to 6 tons of CO emissions annually), as well as reductions in NO<sub>x</sub> and CO<sub>2</sub>.
- Micro-CHP reduce transmission and distribution losses of electricity from power stations to end-users.
- Allow electricity DSOs/TSOs to avoid investments in cross border-flows, as well as investments related to the reinforcement of the electricity grid of infrastructure.
- Low need for additional investment in the gas network since gas grid infrastructure is already in place.
- Micro-CHP systems and the electricity smart meters, for both consumption and generation of electricity, and supplier services, provide the necessary link between the gas and electricity networks, thus providing high interoperability.

#### 2.4.3 **Infrastructure for Natural Gas Vehicles**

The number of vehicles running on CNG are around 1.2 million representing 0.7% of the EU28 vehicle fleet including Switzerland. It should be mentioned that 75% of the market corresponds to the CNG vehicles of Italy. Moreover, more than 3,000 refuelling points are available, 2/3 of which in Germany and Italy, while 18 million CNG vehicles are running in the world, representing 1.2% of the world vehicle fleet.

Natural gas and biomethane can fuel established combustion engines. The performance is equivalent to that of gasoline or diesel units, while they are characterized by cleaner exhaust emissions. CNG and LNG refuelling



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infrastructure is necessary for running these vehicles. It should be mentioned that natural gas and biomethane can also be used in the LNG for fuelling combustion engines in buses and trucks, boats and ships, the market mainly developed through dual fuel systems. Moreover, more and more LNG mono fuel systems having the European type approval (ECE Regulation 110) are being introduced to the market. LNG increases the operability of commercial vehicles, as more energy can be stored on-board the vehicle, but the engine technology remains the same with CNG and LNG.

Table 7: Statistics for Natural Gas Infrastructure

	CNG Stations	LNG/LCNG Stations	Gas Driven Vehicles
<b>Austria</b>	175	0	8,323
<b>Belgium</b>	20	3	1,033
<b>Bulgaria</b>	108	0	61,320
<b>Croatia</b>	3	0	329
<b>Czech Republic</b>	81	0	7,488
<b>Denmark</b>	7	0	104
<b>Estonia</b>	5	0	340
<b>Finland</b>	23	1	1,689
<b>France</b>	37	3	13,550
<b>Germany</b>	919	0	98,172
<b>Greece</b>	10	0	1,000
<b>Hungary</b>	5	0	5,118
<b>Iceland</b>	5	0	1,371
<b>Ireland</b>	0	0	3
<b>Italy</b>	1.010	2	885,300
<b>Latvia</b>	1	0	29
<b>Lichtenstein</b>	3	0	143
<b>Lithuania</b>	1	0	380
<b>Luxemburg</b>	7	0	270
<b>Malta</b>	0	0	-
<b>Netherlands</b>	133	7	7,573
<b>Norway</b>	17	0	667
<b>Poland</b>	25	0	3,600
<b>Portugal</b>	3	3	586
<b>Romania</b>	0	0	-
<b>Slovakia</b>	10	0	1.426



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	CNG Stations	LNG/LCNG Stations	Gas Driven Vehicles
<b>Slovenia</b>	3	1	58
<b>Spain</b>	45	15	3,990
<b>Sweden</b>	161	11	46,715
<b>Switzerland</b>	134	0	11,640
<b>United Kingdom</b>	7	13	718
<b>TOTAL EU+EFTA</b>	<b>2.953</b>	<b>55</b>	<b>1,156,678</b>

#### 2.4.4 Energy Efficiency Services

According to a study from the Directorate-General for Energy of the European Commission<sup>28</sup>, the distribution of natural gas to residential and small industrial customers is carried out through medium to low pressure underground pipelines (distribution mains and service lines). Figure 21 illustrates the mapping of the key mechanism that are responsible for losses in the gas distribution networks. Losses can be due to natural gas emissions and gas or electricity consumption. In the case of gas emissions, these can vary widely depending on the material of the pipeline as fugitive emissions from older networks are much higher than more recent ones. Moreover, gas or electricity own consumption can differ from one network to another, depending on situations (e.g. existence of cathodically protected steel, heaters at regulation stations).

<sup>28</sup> "Identifying Energy Efficiency Improvements and Saving Potential in Energy Networks, Including Analysis of the Value of Demand Response", DG ENER, 2015





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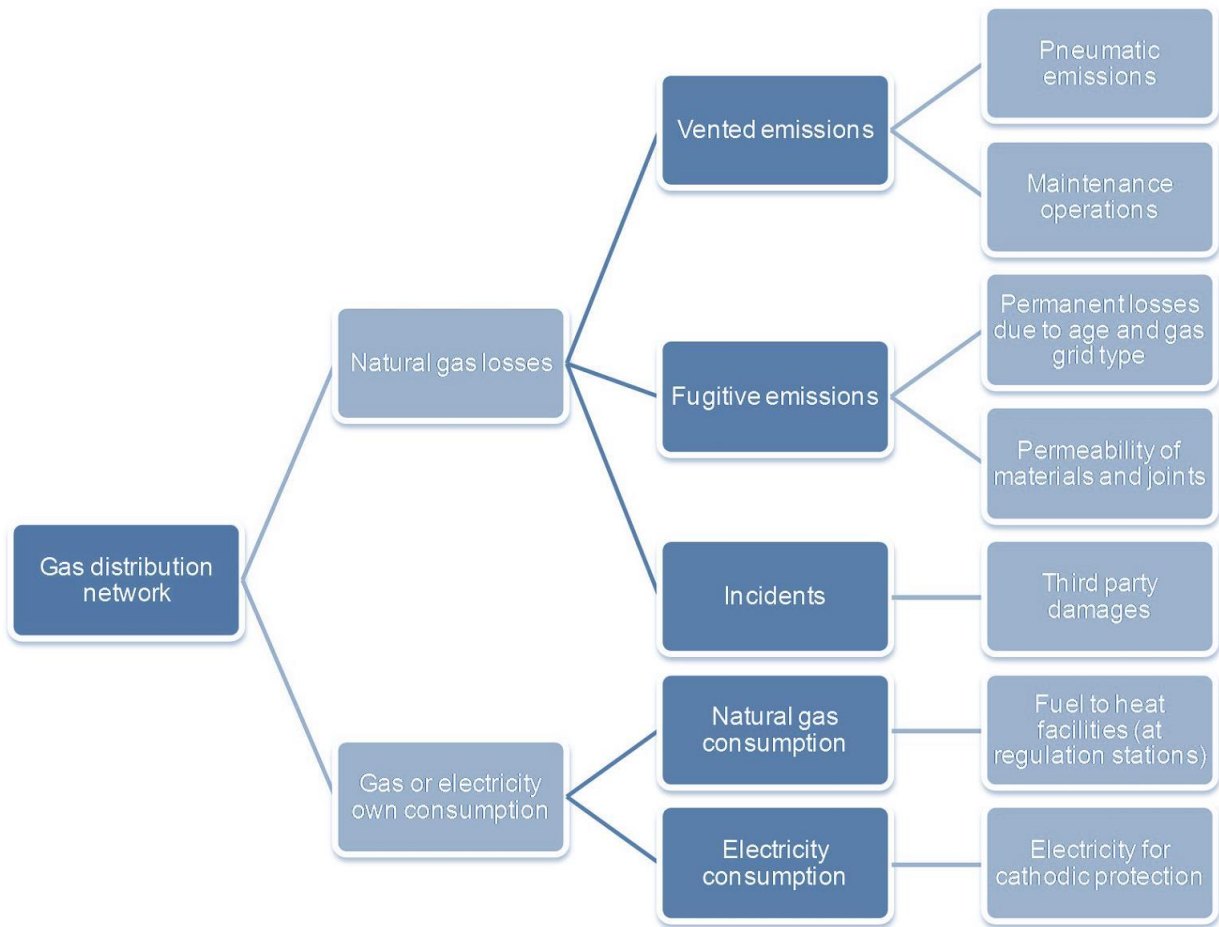


Figure 21: Mapping of Losses in Gas Distribution Grids<sup>39</sup>

A list of measures for addressing the sources of loss in gas distribution networks are outlined in Table 8. The table also describes the reduction potential of each measure, as well as it identifies the key factors affecting this potential.

Table 8: Mapping of the Energy Efficiency Potential of each Measure on the Gas Distribution Network

Category of Losses	Type of Losses	Associated Measures	Qualitative Potential	Key Factors
Natural Gas Losses	Pneumatic emissions	Reduction of vented gas	+	Number of gas-driven pneumatic devices Pressure level, volume of vented pipe
	Maintenance operations Permanent losses due to age and gas grid type	Reduction of vented gas	+	Pressure level, volume of vented pipe
		Recompression	+	Length and age of the network





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Category of Losses	Type of Losses	Associated Measures	Qualitative Potential	Key Factors
	Permeability of materials and joints Pneumatic emissions	Inspection and maintenance programs	++	Length and age of the network
		Pressure management	N/A	Length and age of the grid, pipes and joints materials
	Maintenance operations	Replacement or repair/relining of old pipes	+++	Number of gas-driven pneumatic devices Pressure level, volume of vented pipe
	Third party damages	Mapping, relation with contractors, emergency call centres, protection of pipes in sensitive areas, shut-off valves	++	Length of the grid, pressure level, sensitivity of the pipe area (urban or rural, works area, etc.)
Gas or electricity own consumption	Fuel to heat facilities (at regulation stations)	Improved burner design and avoid heating when possible	+	Number and efficiency of heaters, necessity of burners
	Electricity for cathodic protection	N/A	N/A	N/A

Source: DG ENER<sup>28</sup>

Table 9 shows the type of implementation costs, as well as an estimation of cost levels associated to measures with a significant reduction potential in gas distribution networks<sup>28</sup>.

Table 9: Type of Implementing Costs and Estimated Cost Levels for the Gas Distribution Network

Category of Losses	Type of Losses	Associated Measures	Qualitative Reduction Potential	Type of Costs	Cost Level
Natural Gas Losses	Permanent losses due to age and gas grid type	Inspection and maintenance programs	++	Operating costs (maintenance) labour costs	+
	Permeability of materials and joints	Replacement or repair/relining of old pipes	+++	Capital costs (new pipes or liners), operating costs (maintenance), labour costs	+++



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Category of Losses	Type of Losses	Associated Measures	Qualitative Reduction Potential	Type of Costs	Cost Level
	Third-party damages	Mapping, relation with contractors, emergency call centres, protection of pipes in sensitive areas, shut-off valves	++	Mainly labour costs Capital costs (for protection of pipes and shut-off valves)	Variable

Source: DG ENER<sup>28</sup>

With regards to increasing the energy efficiency in gas and electricity networks, Article 15(2) of the Directive 2012/27/EU states that:

*“Member States shall ensure, by 30 June 2015, that:*

- a) an assessment is undertaken of the energy efficiency potentials of their gas and electricity infrastructure, in particular regarding transmission, distribution, load management and interoperability, and connection to energy generating installations, including access possibilities for micro energy generators,*
- b) concrete measures and investments are identified for the introduction of cost-effective energy efficiency improvements in the network infrastructure, with a timetable for their introduction.”*

In this context, Ofgem in UK conducted a study among the various system operators, in order to assess the efficiency potentials for the gas and electricity infrastructure by collecting best practices and related information. The goal of the study was to identify concrete measure and investments that will allow system operators to introduce cost-effective energy efficiency improvements in their network infrastructure.

In Finland, the proposal for the transposed legislation was discussed and handled in the Finnish Parliament during autumn 2014 and the legislation has come in force beginning of 2015. In May 2015, the Finnish Ministry of Employment and Economy together with the Energy Authority have launched a survey on fulfilling the requirements of Article 15(2). Authorities have also invited other stakeholders (like Finnish Energy Industries and Finnish Gas Association) to join the survey. The survey is carried out by Lappeenranta University of Technology (LUT) and ended in June 2015.

In Belgium, Synergrid, the federation of electricity and gas network operators, carried out, in the context of the Article 15(2), an assessment of the energy efficiency potentials of gas and electricity infrastructure, together with the energy regulators (FORBEG, Forum for Regulatory Bodies). The scope of the study considers energy efficiency in a larger sense than just the reduction of losses. In particular, the study looks at:

- potential for reduced grid losses and reduced energy consumption by the network operators and
- potential to improve the efficient operation of available energy infrastructure, which in turn could allow reducing the need for investing in new infrastructure.

The categories of measures that will be considered are as follows:

- investing measures by the network operators,



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- operational measures by the network operators; and
- changing the behaviour of the consumers, considering incentivizing mechanisms.

Finally, a similar study was also carried out by the Swedish Energy Agency to assess the energy efficiency potential of gas and electricity grid in Sweden. One of the key outcomes of the study is that reduction of losses should not be the main driver of grid investments, as that can lead to sub-optimal solutions. On the contrary, a systems approach for energy efficiency should be adopted.

#### 2.4.5 Smart Gas Grids

To meet the European goals for energy transition, the development of smart and integrated networks is of great importance. These smart networks need to be developed following a holistic energy system approach that includes gas, electricity, heat, transport and information technologies. Moreover, as network and gas utilization will play a major role in achieving the efficiency goals and will enable cost saving solutions for many problems encountered in the electricity networks.

This holistic energy system approach requires active networks with interactive functionalities to integrate multiple energy sources and services to foster the participation and engagement of consumers in using and producing energy more efficiently. In contrast with electricity grid that require real-time responses to sudden changes in demand, peak load reduction or load control, gas networks are inherently more flexible due to their ability to store large amounts of energy. However, as the uncertainties related to future development of efficient and large-scale electricity storage technologies remain, gas will increasingly become a key provider of both heating and electricity balancing services.

The major benefits of smart gas grids are:

- reducing greenhouse gas emissions,
- increasing the share of renewable energy (biomethane, syngas, injection of H<sub>2</sub>, etc.),
- optimising the intermittent production of renewable energy,
- contributing to improve the security of supply,
- improving energy efficiency by enabling the active participation of the end users,
- creating the conditions for efficient use of energy networks, giving consumers the ability to choose the most economic energy source in real-time, and at the same time save energy,
- avoiding costly investments in electricity grids by using gas networks and gas appliances, supporting economic development,
- enabling consumers to become “prosumers” by using gas to lower the “peaks” in the electricity network and to reduce energy losses in the electricity transmission and distribution networks,
- enabling synergies between gas and electricity networks through the encouragement of distributed generation and
- comparing with electricity, gas can be stored more cost-efficiently and the scope for local production is limited to the feed-in of alternative gases such as biogas.



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

Moreover, in Italy, starting from 2020, a TOTEX approach will be adopted for both electricity and gas to cope with the distortion that may be posed by the current regulatory approach. Under the TOTEX approach CAPEX and OPEX are treated in the same way by the regulatory authority. The implementation of smart grid and innovation projects are incentivized by a 2% increase in the WACC for twelve (12) years.

A detailed analysis of smart gas distributions grids is provided as part of the deliverable “Preparation of Smart Grid Road Map and Required Methodological Tariff Approaches” of Task 4.

## 2.5 As-is Regulatory Practices and Innovation Activities of Gas Distribution Companies in Turkey

### 2.5.1 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.



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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
- 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 natural gas distribution system

### 2.5.2 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, industry & utility benefits, 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 DSO.

### 2.5.3 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





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- 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.

#### 2.5.4 Natural Gas R&D Projects Approved till 2020

Natural gas distribution R&D applications are responding mainly preliminary requirements such as improvement in security, effective network operations and penetration of infrastructure.

'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.

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

Table 10: Natural Gas R&D Project Applications Approved by the Commission

No	Project Name	Category	Duration	Application Period
1	Project to Improve Efficiency and Service Quality with Change Engineering Approaches	Network Operations	18 months	July 2014
2	Magnetic Interaction Detection of Natural Gas Meters (Diaphragm, Rotary Type, Turbine Type)	Network Operations	18 months	Jan 2015
3	Bursagaz Earthquake Risks Management System	Climate, Environment and Emergency Action Plan	40 months	Jan 2015
4	Pipeline Holistic Management	Network Operations	16 months	July 2015
5	The Model of Usage in Natural Gas Distribution Network Management as the Decision Support System of Geographic Information Systems	Technology Development on Network Operations	20 months	July 2015
6	Combining the Project Approval Processes of the Natural Gas Internal Facility Project in a Common System	Network Operations	18 months	July 2015
7	Remote Gas Leak Detection in Natural Gas Internal Facilities	Monitoring and Control	18 months	July 2015





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No	Project Name	Category	Duration	Application Period
8	Reading the Mechanical Meter Index with Image Processing Method	Communication Technology	12 months	Jan 2016
9	Improvement of Shunt Flue Systems in Conformity with Standards	Equipment Technology	5 months	Jan 2016
10	Development of a System that will not Need to Install Service Regulators Prior to Gas Interruption	Network Operations	20 Months	Jan 2016
11	Project for Collection and Transfer of Remote Meter Data with National Education	Communication Technology	12 months	July 2016
12	Domestic Gas Stopper/Breaker Prototype Design and Manufacturing Project	Equipment Technology	22 months	Jan 2017
13	Project of Controlling PE Pipe Welds by PAUT (Ultrasonic Test) Method	Monitoring and Control	15 months	Jan 2017
14	Development of Measurement Equipment and Software for Regional Regulators for Load Management	Monitoring and Control	12 months	Jan 2017
15	Project for Developing an Accurate and Consistent Method for Methane Emission Estimation from Gas Distribution Networks	Other	18 months	Jan 2017
16	Domestic Odorization Unit/System	Network Operations	8 months	July 2017
17	Magnetic Interaction Detection of Natural Gas Meters (Diaphragm, Rotary Type, Turbine Type)	Technology Development on Network Operations	18 months	July 2017
18	Turkey High Pressure Calibration Facility Feasibility Study for the Establishment of Optimal Detection and Management	Equipment Technology	12 months	July 2017
19	A New Generation Digital RF Communication Method Development and Pilot Application Project for Automatic Reading of Mechanical Natural Gas Meters	Communication Technology	18 months	July 2017
20	Development of a Method on Intermediate Depth Calculations and Depth Photographs	Technology Development on Network Operations	8 months	Jan 2018
21	KPI Project	Other	9 months	July 2018





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No	Project Name	Category	Duration	Application Period
22	Visual Education Centre Project	Other	18 months	July 2018
23	National Chimney Registration and Control System Software	Network Operations	12 months	July 2018
24	Local Odour Measurement Chromatography	Technology Development on Network Operations	36 months	July 2018
25	Integration of Solar Collectors to KASKAD System at Container Type RM-A Stations	Network Operations	18 months	July 2018
26	Robotic Process Automation Project	Technology Development on Network Operations	14 months	July 2018
27	AGES - Hands Free with Smart Glasses	Occupational Health and Safety	12 months	Jan 2019
28	Comparison of Meters Working with Microthermal Measurement Principle with Mechanical Meters Project	Network Operations	24 months	Jan 2019
29	Composite Project	Equipment Technology	18 months	July 2019
30	Remote Gas Cutting Project	Network Operations	12 months	July 2019
31	Underground Natural Gas Leak Violation Detection Project	Network Operations	12 months	July 2019
32	Eskisehir Infrastructure Coordination Information System Software Development Project	Technology Development on Network Operations	24 months	July 2019
33	Bellows (G4 and G6) Meter Sound Test Cabinet Design Project	Equipment Technology	12 months	July 2019
34	İZGAZ Smart Meter Project	Equipment Technology	20 months	July 2019
35	Domestic Gas Stopper/Breaker Prototype Design Verification and Certification Project (Phase 2)	Equipment Technology	6 months	July 2019
36	Remote Metering and Manipulation Detection System Project	Technology Development on Network Operations	18 months	July 2019





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No	Project Name	Category	Duration	Application Period
37	Establishing Natural Gas Technical Product / Material Technical Principles and Supply Management System	Equipment Technology	24 months	July 2019
38	Renewable Gas Production Project	Energy Efficiency	24 months	July 2019
39	Subscriber Teller Machine Project	Other	24 months	July 2019
40	Infrastructure Network Design Application Project	Technology Development on Network Operations	36 months	July 2019
41	Odour Cabinet Design Project	Technology Development on Network Operations	12 months	July 2019

The table shows that out of 41 project, 28 R&D projects (%69) are categorized in Network Operations, Technology Development and Equipment Technology topics.

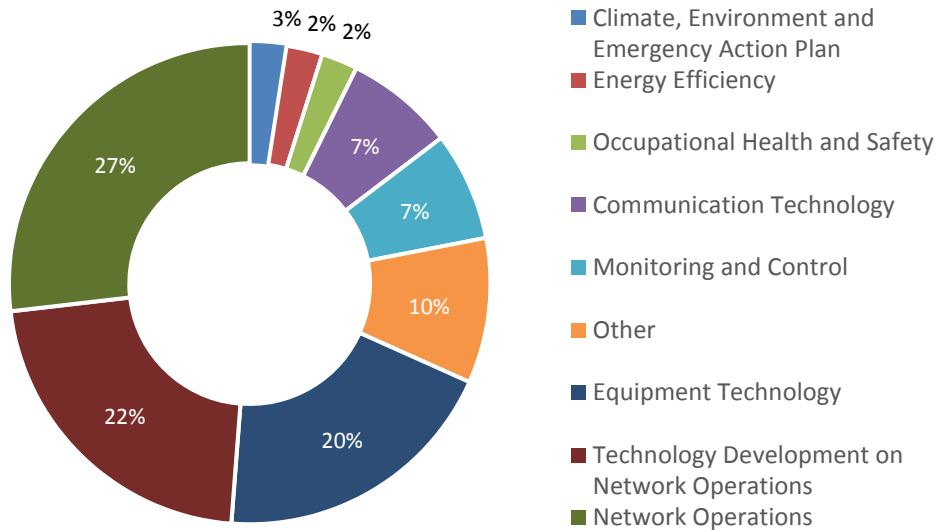


Figure 22: R&D Projects in Turkey for the Gas Distribution Sector





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## 2.6 Gap Analysis & Recommendations

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

### 2.6.1 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 gas 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 Gas Distribution

##### Overarching Principle 1

The ultimate goal of innovation for gas DSOs is to provide benefits to their consumers. To achieve this, the objectives can be broader than cost-efficiency approach alone and can include for example: the decarbonization of the energy system and the promotion of an informed and engaged energy consumer, both of which have societal benefits and contribute strongly to the achievement of an Energy Union.

##### Overarching Principle 2

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.

##### Overarching Principle 3

Gas DSOs should take a proactive approach, seeking to cooperate and work with other areas of industry not directly in the gas business.





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#### Overarching Principle 4

The regulatory treatment of costs may need to be different for two distinct phases of innovation:

- research & development (including patents and intellectual property rights development) and
- roll-out.

#### Overarching Principle 5

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 11 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 gas distribution companies.

*Table 11: EMRA's Strategical Targets for Innovation Activities in Gas 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
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 gas distribution system





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## 2.6.2 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 gas sector raise new challenges for 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 BOTAS’ 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.
- 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 12 provides a summary of the recommendation for gas distribution. A detailed analysis of the recommendations is given in the next subsection.



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Table 12: Summary of Recommendations for Gas 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	Gas 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, gas 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, Gas DSOs
R2	Roll-out Initiatives	The gas 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>19</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, Gas DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
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>19</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.	<p>Incentivization schemes for pilot projects are already defined in the draft legislation for electricity distribution (0.5% of the network CAPEX). Therefore, by analogy, we recommend a similar mechanism to be applied as well for gas distribution. The recommended percentage for this type of projects would be 2% of the network investments, mainly to encourage large-scale pilot projects.</p> <p>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). A similar revenue regulation is suggested for gas distribution, as well.</p>	EMRA, Gas DSOs
R4	Incentivizing Strategic Large-Scale Demo Projects via recognizing them as CAPEX.	Additional premium might be added to CAPEX in case gas 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 gas distribution sector.	Does not exist as of today.	EMRA, Gas DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R5	Innovation Maturity Assessment	<p>EMRA is recommended to identify the maturity of the innovation activities of gas DSOs (2 assessment practices in each Tariff Period) through evaluation of defined metrics.</p> <p>The innovation maturity level of the DSOs can be linked with OPEX incentives (like quality factor, if applied for gas distribution sector in the next tariff period).</p>	<p>It is important for EMRA to evaluate and assess the maturity of ongoing R&amp;D projects and innovation activities for gas DSOS during project implementation. Apart from purely financial and economic criteria, according to CEER<sup>19</sup>, criteria related to the outcomes of the projects measuring regulatory aims such as efficiency and/or reliability should also be applied.</p>	Such a methodology is not applied.	EMRA, Gas DSOs
R6	Innovation Ecosystem Development and Incubation Activities	In order to establish an active and effective start-up ecosystem in the gas distribution sector, regulations might pave the way (limited to at most 10% of the R&D budget) for gas DSOs to invest in start-ups.	Fostering the innovation ecosystem development and the related incubation activities for R&D focusing on smartening gas 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, Gas DSOs, Ministry
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 gas DSOs, there is a particular need for higher R&D budget, especially for strategic innovative projects. In such cases, according to CEER <sup>19</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 gas DSOs is 1% of their OPEX.	EMRA, Gas DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
<b>Innovation Business Plan/Master Plan</b>					
R8	Innovation Master Plan	Gas 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.	Gas DSOs are not required to prepare such a planning for innovation activities.	EMRA, Gas 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, Gas DSOs
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, Gas DSOs, Others





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
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 gas 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, Gas 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, Gas DSOs
<b>Allocation of R&amp;D Budget According to Project Types</b>					
R13	TRL-related Project Categories	R&D and innovation projects for gas 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, Gas DSOs
R14	Budget-related Project Categories	R&D and innovation projects for gas 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, Gas DSOs
R15	Research and Development Budget Allocation	R&D budget of the gas 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, Gas DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
<b>Priority Innovation Areas Turkish Gas Distribution Sector</b>					
R16	Priority Areas and Calls for Applications	For each R&D project application period, priority areas for gas 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 gas 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, Gas DSOs
<b>Other Recommendations</b>					
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, Gas DSOs





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ID	Recommendation	Explanation	Supportive Arguments	As-is Status in Turkey	Key Stakeholders Involved
R18	Communication and Dissemination of Innovation Activities	EMRA should request and push GAZBIR (association of gas DSOs) to disseminate the R&D projects after removal of sensitive information. Gas 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 gas DSOs.	In Turkey, R&D activities are funded from revenue cap and should be disseminated. Also, gas 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.	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, Gas DSOs





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### 2.6.3 Detailed Descriptions About the Recommendations

#### 2.6.3.1 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

Gas 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, gas 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 gas 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.

In Ireland, the Gas Innovation Fund requires applicants to provide a detailed budget for any proposal submitted, along with information on budget justification and other co-funding sources<sup>29</sup>.

**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 gas DSOs’ rollout of initiatives with demonstrable benefits must be supported by the Regulator. Systematic CBAs are recommended especially for large scale projects.

<sup>29</sup> “Gas Innovation Fund: Guide for Applicants”, Gas Networks Ireland, 2020



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## Recommendation 2 Roll-out Initiatives

**Supportive Arguments:** CEER<sup>19</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 development of a low-carbon energy sector in UK and provision of broader environmental benefits. The IRM provides funding also to transition proven innovative technologies to business as usual (BAU) if the roll-out of these technologies cannot be funded under the TOTEX allowance of the gas DSO. During RIIO-1, there are two application windows for gas distribution companies to apply for funding. 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, gas 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.

The Gas Innovation Fund in Ireland, apart from the R&D activities, provides also funding for strategic projects for the gas DSO.

**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>19</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). Therefore, by analogy, we recommend a similar mechanism to be applied as well for gas distribution. The recommended percentage for this type of projects would be 2% of the network investments, mainly to encourage large-scale pilot projects.





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### Recommendation 3 Tariff Methodologies and Incentives

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). A similar revenue regulation is suggested for gas distribution, as well.

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

Additional premium might be added to CAPEX in case gas 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 gas distribution sector. Moreover, CEER<sup>19</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 gas 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,



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### Recommendation 5 Innovation Maturity Assessment

- 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 gas distribution sector in the next tariff period) item of the revenue requirement.

**Supportive Arguments:** It is important for EMRA to evaluate and assess the maturity of ongoing R&D projects and innovation activities for gas 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>19</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 gas distribution sector, regulations might pave the way (limited to at most 10% of the R&D budget) for gas DSOs to invest in start-ups. To this extent:

- Gas 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 gas 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>30</sup> empowered seven (7) projects, funded under Horizon 2020, that are connecting local ecosystems across Europe, along different technological areas.

<sup>30</sup> <https://ec.europa.eu/digital-single-market/en/news/startup-europe-growth-h2020-projects>





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### Recommendation 6 Innovation Ecosystem Development and Incubation Activities

**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.

### 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 gas DSOs, there is a particular need for higher R&D budget, especially for strategic innovative projects. In such cases, according to CEER<sup>19</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 gas DSOs is 1% of their OPEX.

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

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

### Recommendation 8 Innovation Master Plan

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

**Supportive Arguments:** For the gas distribution price control RIIO-GD1 Ofgem is requesting gas 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>31</sup>.

**As-is Status in Turkey:** Gas 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

<sup>31</sup> “RIIO-GD1 Business Plan 2013-2021 – Part B3: Innovation”, Wales & West Utilities, 2011





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Master Plan” to be prepared by the gas DSOs is shown below, where [Gas DSO] should be replaced with the name of the particular gas distribution company responsible for the preparation of the plan.





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## Recommendation about the Outline of Innovation Master Plans

### 1. Background

- 1.1. Introduction to [Gas 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 [Gas 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 gas 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 gas 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 gas 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. Assessment of Effective 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 gas 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 gas 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,
- Customer and stakeholder focus; and



- Safety, health and environment.

Subsection **Stages of Innovation** sets out the areas of innovation for the gas 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 [Gas 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 gas 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 gas distribution companies are described in the subsection **Funding of Innovation** of the document.

Subsection **Approach to Innovation** outlines the gas 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 gas 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 gas 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 gas 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 gas DSO’s business, in such a way that the benefits of improvements and benefits span across all business areas of gas DSO.

Finally, the framework for the collaboration of the gas 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 gas 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 gas 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 gas DSO considers important for the gas distribution sector.

The subsections of this section are listed below:

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

## Section 5

### Governance Arrangements

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



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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 gas DSO should ensure that new technologies for the gas distribution sector either fit into existing policies and standards or the gas 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 gas distribution sector should take place. This will allow the gas 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 gas 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 gas 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 gas DSO’s innovation strategy. Last, but not least, lessons learnt form past projects in the area of gas 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 gas DSO.

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

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

#### 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.



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## Recommendation 9 Innovation Project Assessment Criteria

**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 gas-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 gas 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 Gas 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 gas-related project application for the NIC according to the evaluation criteria.

In Ireland, projects requesting funding under the Gas Innovation Fund are evaluated based on the criteria stipulated also in other recommendations.

**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 gas distribution sector it is expected to lead in the close collaboration between gas 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 gas 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 gas 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>32</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 gas 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<sup>33</sup>:

- 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.

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.

<sup>32</sup> "Horizon 2020 Work Programme 2018-2020 – Annex H: Evaluation Rules", European Commission, 2017

<sup>33</sup> "Gas Network Innovation Allowance Governance Document – Governance Document v.3.0", Ofgem, 2017



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## Recommendation 11 Innovation Project Assessment Criteria

In Ireland, projects requesting funding under the Gas Innovation Fund are evaluated based on the criteria stipulated in Recommendation 19.

**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 presented in the table below. In the evaluation criteria presented, the following types were considered:

- **Knock-out criteria:** refers to criteria that are of paramount importance to the R&D project applications (irrespective of the TRL) and reflect the consistency of the application to the Call objectives, as well as to the fact that project expenditures should not overlap with CAPEX and other OPEX;
- **Score:** refers to the scores assigned to the various criteria used for R&D project applications evaluation. Higher scores have been assigned to lower TRL solutions with regards to their R&D quality, innovation and impact aspects to highlight the fact that solution with lower TRL levels is expected to have more of a research and innovation angle compared to mature/commercial solutions. However, since commercial solutions is expected to deliver more concrete benefits and are usually associated with a larger budget allocation (please refer to Recommendation 15), criteria associated with the overall quality of the application proposal, as well as with the expected benefits and achievements are assigned higher scores compare to proposals that involve solutions with lower TRL; and
- **Weight:** refers to the weights assigned to the various criteria used for R&D project applications evaluation. Weights are assigned to criteria in a similar manner to the assignment of scores. Specifically, higher weights are assigned to higher TRL solutions in the case of projects promoting the cooperation between gas DSOs or between a gas DSO and BOTAŞ, as well as for projects that involve system operators of other infrastructure, such as electricity or water. Finally, it should be mentioned that in the case of evaluating the improvement of effectiveness of existing systems expected to be achieved by projects, higher weights are assigned to lower and medium TRL solution, since more innovative solutions are expected to have a more drastic impact on the efficient operation of existing networks.



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Table 13: Evaluation Matrix for R&D Project Applications

No	Criteria	Criterion Type	TRL 1-5 <sup>34</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>35</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>34</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>35</sup> Not Applicable





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No	Criteria	Criterion Type	TRL 1-5 <sup>34</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 gas DSOs	Weight	1.02	1.03	1.05





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No	Criteria	Criterion Type	TRL 1-5 <sup>34</sup>	TRL 6-7	TRL 8-9
7.5	Cooperation with BOTAŞ	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>36</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 an R&D projects, gas and electricity 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>37</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 gas network innovation strategies.

The purpose of the benefits reporting framework under ENA, is to<sup>37</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,
- 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

<sup>36</sup> "Horizon 2020 Indicators – Assessing the results and impact of Horizon 2020", European Commission

<sup>37</sup> "ENA Benefits Reporting Framework – Delivery Plan", Energy Networks Association, 2019



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### Recommendation 12 Evaluation of Project Results and Impact

- 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.

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

#### Recommendation 13 TRL-related Project Categories

R&D and innovation projects for gas 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.

The Gas Innovation Fund in Ireland requires applicants to provide detailed information on the TRL of the proposed innovation project for any proposal submitted<sup>29</sup>.

**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 14: European Union Technology Readiness Levels

European Union Technology Readiness Levels Definition	
<b>TRL 1</b>	Basic principles observed
<b>TRL 2</b>	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 gas 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 gas 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 gas 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 gas 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 gas 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.

A proposed budget allocation based on the R&D project type and TRL is provided in Table 15 below.

Table 15: 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%





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R&D Project Type	TRL 1-5	TRL 5-8	TRL 8-9	TOTAL
Mid-scale	10%	10%	10%	<b>30%</b>
Large-scale	-	10%	30%	<b>45%</b>
<b>TOTAL</b>	<b>20%</b>	<b>30%</b>	<b>40%</b>	<b>90%<sup>38</sup></b>

The rationale behind the budget allocation described in Table 15 is that for projects deploying mature innovative solutions with a TRL between 5 and 9 a larger portion of the budget is allocated. Moreover, among these mature innovative solution, large-scale demonstration projects are promoted in the case that the readiness levels of the technologies involved are high (i.e. TRL 8-9). For less mature technologies, there is no specific preference between the size of the demonstration activities.

### 2.6.3.5 Priority Innovation Areas for the Turkish Gas Distribution Sector

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

For each R&D project application period, priority areas for gas 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 gas system,
- Assist in the transition to a low carbon economy,
- Deliver significant carbon savings and
- Provide measurable value to all gas 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.

**As-is Status in Turkey:** 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.

The following priority areas for R&D projects and innovation activities are proposed to EMRA.

<sup>38</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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Table 16: Priority Innovation Areas for Gas Distribution

Future of Gas	
Integration of gas and electricity networks	Medium-term
Enabled consumers and markets	Medium-term
LNG/CNG transport infrastructure	Long-term
Gas demand forecasting	Short-term
Micro- and mini-CHP integration in gas distribution networks	Short-term
Power-to-gas solutions	Short-term
Renewable gases	Short-term
Natural gas regasification	Medium-term
Natural gas hydration	Long-term
Safety and Emergency	
Gas composition and safety management	Short-term
Protecting against third-party interference damage	Medium-term
Improved warning systems	Medium-term
Virtual reality used for network and above-ground installation design	Long-term
Reduction of gas leakage	Short-term
Detection of flammable and toxic gases	Short-term
New management and control systems for pressure level regulation in gas distribution networks	Medium-term
Realtime gas pressure optimization	Long-term
Reliability and Maintenance	
Asset management	Short-term
Asset integrity	Medium-term
Operational improvement	Short-term
Remote monitoring and control	Medium-term
Distributed information acquisition and decision making	Long-term
Predictive maintenance of gas distribution networks	Medium-term
Distribution Mains Replacement	





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Future of Gas	
Robotics and digitalization	Long-term
Alternatives to replacement	Medium-term
New materials	Long-term
Pipe fracture detection and monitoring	Medium-term
Security	
Cybersecurity	Short-term
Site and asset security	Medium-term
Incident management	Medium-term
ICT systems intrusion detection	Medium-term
Smart Gas Meters	
Integration of electricity and gas smart meters	Short-term
Connectivity via 5G mobile networks	Short-term
Internet-of-Things	Medium-term
Enterprise Service Bus architecture for IT and OT systems integration	Long-term
Provision of flexibility to the electricity system	Long-term
Outage Management System (OMS)	Medium-term
Demand management and load shifting	Long-term

### 2.6.3.6 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.



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### Recommendation 17 Public Access to Innovation Process

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.

In Ireland, CRU publishes an Innovation Reporting Framework related to the Gas Innovation Fund. Gas Networks Ireland is also required to provide an annual report to the CRU for each gas year of the price control. The annual report outlines the activities of the Gas Innovation Fund for that particular time period<sup>40</sup>.

**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>39</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.

The open access process of peer-reviewed scientific publications and research data under the Horizon 2020 framework program is illustrated in Figure 23.

<sup>39</sup> “Open Access”, Horizon 2020 Online Manual



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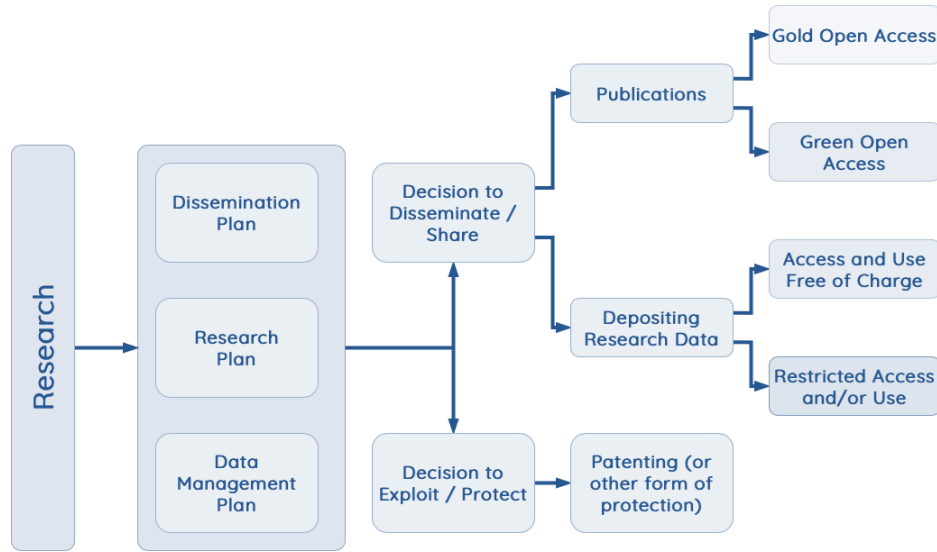


Figure 23: Open Access Under the Horizon 2020 Framework Program

### Recommendation 18 Communication and Dissemination of Innovation Activities

EMRA should request and push GAZBIR (association of gas DSOs) to disseminate the R&D projects after removal of sensitive information. Gas 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 gas DSOs.

**Supportive Arguments:** In Turkey, R&D activities are funded from revenue cap and should be disseminated. Also, gas 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.

In Ireland, CRU publishes an Innovation Reporting Framework related to the Gas Innovation Fund. Gas Networks Ireland is also required to provide an annual report to the CRU for each gas year of the price control. The annual report outlines the activities of the Gas Innovation Fund for that particular time period<sup>40</sup>.

**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.

<sup>40</sup> <https://www.gasnetworks.ie/business/renewable-gas/innovation-fund/>





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## 3 Gas Transmission Sector Innovation Report

### 3.1 Introduction of Gas Transmission Part

Innovation in gas transmission activities is fundamental to upgrade transmission network operations, increase the quality of services, create value for customers, disseminate knowledge and move forward into the carbon emissions reduction. 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. ENTSOG, 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 gas 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 overcharging 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 gas 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 Innovation and R&D Studies in European Gas Transmission

Most of the key drivers of gas transmission system innovation in the following years (renewable gas integration, LNG and CNG transportation, etc.) will require cross border cooperation at regional and EU level. The cooperation among European TSOs is indispensable in some topics due to the technical specifications of gas transmission network (e.g. harmonized gas quality standards applicable to biogas production). Moreover, the EU is trying to develop a common approach in incentivizing the decarbonization of energy sector and the implementation of innovative solutions. The European Commission is working on a new legislative package focused on the future of gas in the energy sector. Additionally, there are several initiatives at EU level aiming to foster innovative solutions in gas networks via funding mechanisms and/or collaboration between EU TSOs.

The European Commission has already set out a clear vision of how to achieve climate neutrality by 2050. This vision should form the basis for the long-term strategy that the EU will submit to the United Nations Framework Convention on Climate Change. To set out clearly the conditions for an effective and fair transition, to provide predictability for investors, and to ensure that the transition is irreversible, the Commission has proposed the first European 'Climate Law'. This law presents a proposal to enshrine in legislation the EU's political commitment to be climate neutral by 2050. The European Climate Law sets the 2050 target and the direction of travel for all EU policy, and gives predictability for public authorities, businesses and citizens<sup>41</sup>. The European Climate Law should have a large impact on the gas decarbonisation pathway.

#### 3.2.1 Gas Decarbonization Package 2020-2021

Negotiations on the Clean Energy Package (CEP) came to an end in 2018 and European Commission, the Council and the European Parliament finally reached a political agreement on the outstanding pieces of legislation. With

<sup>41</sup> EC (2019) Communication on the European Green Deal





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the “European Green Deal” coming up, and updated climate targets in the pipeline, the initiative is set to take a new dimension, focusing on decarbonization strategies for 2030 and 2050.

The European Commission is working on a new package of legislation for the gas sector. The primary purpose of the package is to create Europe’s first regulatory framework for “green” (renewable or decarbonized) gas. The “gas package” has been renamed the “gas decarbonization package” or simply the “decarbonization package,” and is expected to be published in late 2020 or even in 2021.

An assessment carried out by the Florence School of Regulation suggests that “gas decarbonization package” will focus on the following topics<sup>42</sup>:

- Development of a vision on the role of gas up to 2050 with renewable gas and decarbonized gas targets.
- The package will build upon the Third Energy Package (Regulation (EC) No 715/2009 and Directive 2009/73/EC) and the developments of the Clean Energy Package (Renewable Energy Directive, Directive 2018/2001).
- The synchronization of the unbundling framework for electricity TSOs and gas TSOs, which could allow them to operate the Power-to-Gas facilities. This would be a key challenge as TSOs are among the key advocates of P2G solutions.
- Cross-border trade of renewable gases with a system of EU-wide certification or guarantees of origin.
- Addressing barriers related to gas quality and injection tariffs for renewable gases inserted into gas grids.
- Integrated electricity and gas market design, e.g. by allowing conditional electricity and gas bids.

Apart from these points, from a regulatory perspective, we think it may be necessary to review existing regulation to align it to new decarbonization objectives:

- The Interoperability Network Code (INC) of 2015: Commission Regulation (EU) 2015/703 established a network code on interoperability and data exchange rules in 2015. An appropriate degree of harmonization in technical, operational and communication areas is key to overcome potential barriers to the free flow of gas in the Union, thus hampering market integration.
- Gas Quality Standards. It will be necessary to update CEN (European Committee for Standardization) provisions and standards on gas quality to integrate renewable gases.
- Another element of the decarbonization package could be a reform of the EU’s trans-European energy networks (TEN-E) regulation, which decides which infrastructure projects are eligible for EU support from the Connecting Europe Facility (CEF).

<sup>42</sup> Olczak (2019), What to Expect from the 2020 Gas Package.





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### 3.2.2 ENTSO-G vision on Gas Transmission Innovation

#### 3.2.2.1 ENTSO-G Roadmap 2050 for Gas Grids<sup>43</sup>

Gas Transmission System Operators (TSOs) propose a Roadmap for 2050 to make the gas grids ready for energy transition. The aim of the Roadmap is to provide recommendations and highlight gas TSOs' proposals on how to effectively combine well-functioning, liquid gas market and achieved effective security of gas supply with the commitment to decarbonize.

This Roadmap offers three possible pathways forward for the Member States, industry and consumers on how to achieve net-zero greenhouse gas emissions by 2050 with gas grids:

- Methane Pathway.
- Blending Hydrogen and Methane Pathway.
- Hydrogen Pathway.



Figure 24: Overview of ENTSO-G Roadmap 2050: Main Principles<sup>44</sup>

ENTSO-G sets out seven strategic lines of action for gas transmission innovation and decarbonization:

1. Market development. European countries shall maintain and further develop the internal market achievements and gas market design based on the following principles:
  - Aim for existing gas legislation to include hydrogen and strengthen the role of biomethane; include in TSOs' services and establish the principles for reasonable remuneration of services provided by the gas grid companies (blending, conversion, flow management, digitalization and data provision, providing the flexibility for energy system).
  - Continue to trade biomethane, hydrogen and natural gas based on energy content.

<sup>43</sup> ENTSO-G (2020) roadmap 2050 for gas grids

<sup>44</sup> ENTSO-G Roadmap 2020 for gas grids





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- Document and track climate value of a given source of gas.
  - A trustworthy EU-wide GOs/ certificate system should be established.
2. Principles for New Gases Transportation. The integration of renewable gases in traditional gas networks will prevent market fragmentation as hydrogen usage develops alongside (bio)methane usage. Benefits of TSOs managing hydrogen pipelines would be as follows:
- Infrastructure optimization and cost savings as a result of coordinated planning reflecting the development needs of the sector (e.g. blending and/or dedicated pipelines; full/ partial conversion to hydrogen of existing pipelines etc.).
  - TSOs may own and operate P2G as conversion facilities without ownership of commodity on a TPA basis according to market nominations like for basic transportation services.
  - Ensuring non-discriminatory TPA regime for market players to the hydrogen network. “Large” gas producers using methane reforming would have access as well as “small” users of a P2G facilities. On the consumer side, establishing a level playing field between consumers with large demand and more modest needs will also be beneficial for competition.
  - Guaranteeing viability of pipelines in development stage, as load factor progressively increases.
3. Guarantees of Origin (GO). ENTSO-G welcomes development of national registers and the cross-border trade of biomethane and hydrogen certificates among the member registries by establishing a European GOs/ certificates.
4. Sector Coupling. A Hybrid Energy System building on the regional strengths of existing energy infrastructure, will also require EU-wide principles for Sector Coupling. The legislative framework for sector coupling has not been integrated in the legislation so far. Present market conditions do not seem to support sufficiently an up-scaling as commercial activities needed for optimizing gas and electricity infrastructure functioning. ENTSO-G finds that TSO ownership of P2G facilities should be considered – as a way socializing costs as well as ensuring third-party access to such infrastructure. P2G could be considered as conversion facilities – converting from the electricity system to the gas system – as system activity, like LNG terminals.
5. Regulatory Sandbox<sup>45</sup>. According to ENTSO-G the current market framework does not provide enough incentives for development of the necessary technologies. Therefore recommends:
- Accept the framework concept of regulatory sandbox at EU level and implement also at national level under supervision by the NRAs, so that the TSOs can develop R&D and pilot decarbonization projects.
  - Provide framework for regulatory sandbox to address issues on need for regulatory innovation in controlled and transparent manner to facilitate investment framework allowing for flexibility/freedom from general EU rules (i. e. state aid, funding access criteria, ownership unbundling, cost socialization via Regulated Asset Base) under regulatory oversight.
  - Assess gas decarbonization technologies for maturity and necessity for support under R&D friendly framework, targeted in time and effect under certain conditions.
  - Establish Regulatory Sandbox guidelines to offer some regulatory flexibility for TSOs’ pilot projects and clarity for NRAs for cost allocation in technology incubation/roll out phase.

<sup>45</sup> Originally defined for “fintech” sector, the regulatory sandbox (e.g. the FCA in UK) is a tool to allow the regulated companies to test new products or services for a limited period of time (usually 6 months), with some regulatory dispensations and waivers. After the six-month trial period, if the test ended positively, the companies shall return to the standard authorization period.



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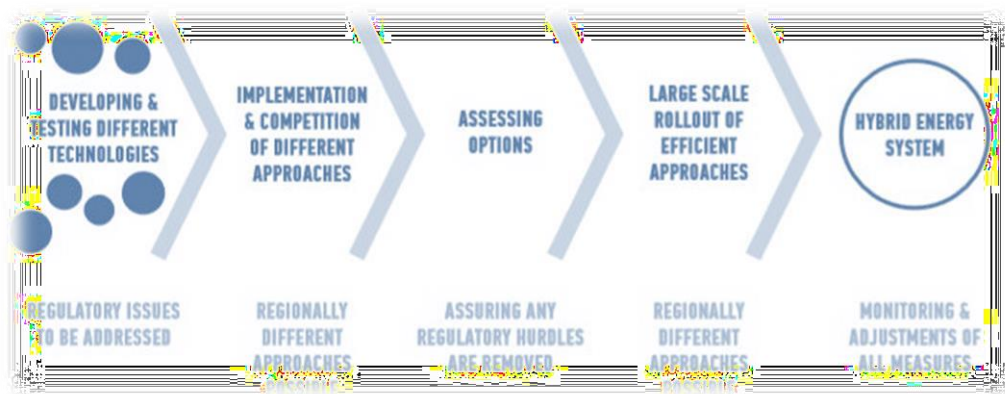


Figure 25: ENTSO-G Regulatory Sandbox

6. European Gas Quality. The European Gas TSOs have experience and knowledge in gas quality handling as part of their daily business is handling gasses from different sources. With decarbonization and increasing shares of hydrogen and biomethane in the system, the handling of differing qualities becomes even more important and challenging. The handling of the diverse gas qualities should go hand in hand with maintaining and developing the achievements of integrating the European gas market.
7. Principles for CO<sub>2</sub> transportation. ENTSO-G and its members find that an efficient and sustainable approach to decarbonization will include carbon capture, utilization and storage (CCUS) which, besides storage, will require CO<sub>2</sub> transportation systems in regions where needed. Principles for CO<sub>2</sub> transportation should address how to ensure efficient and safe transport and management (logistics and economics) of CO<sub>2</sub> from emitting locations to storage or usage locations.

### 3.2.2.2 ENTSO-G vision on Gas Decarbonisation Package<sup>46</sup>

The overall objectives of Gas Decarbonisation Package according to the ENTSO-G 2020 should pave the way for achieving the sustainability goals for gas as well as for electricity/gas interaction, pursuing the goals on gas markets and security of supply as well.

- Hybrid Energy Infrastructure. Building on both electricity and gas infrastructures is more efficient, resilient, sustainable and less expensive EU energy system.
- Technology Neutrality. All relevant technologies should contribute to transition based on a level playing field for support schemes & funding.
- Green Gas Innovation. Improved framework for green gases in decarbonised gas system to speed up EU energy transition.
- New Gas Markets. CO<sub>2</sub> reductions and air quality gains with natural gas in some regions - and in longer term with decarbonised gas.

<sup>46</sup> ENTSO-G (2018), Decarbonizing through gas networks– TSO perspective



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- **Product & Service Innovation.** Products & services of TSOs to address market needs & support efficient and sustainable use of assets.

ENTSO-G considered that it is necessary to promote and support innovation on decarbonizing the gas sector. Some of the requirements to drive gas decarbonization process includes establishing consistent terminology for renewable/decarbonised/climate-neutral gases and an EU-wide certification system for gases to ensure trustworthy tracking and efficient cross-border trading of renewable gases.

The role of grid operators shall be clarified in facilitating decarbonizing of EU energy system – including scaling up R&D/pilot projects, investing & operating P2G biogas facilities etc. Moreover, it should be established a risk-reward scheme for gas-related innovation ensuring sufficient investments and R&D expenditure.

### 3.2.3 ENTSO-G Innovative Projects Platform: Sample Projects<sup>47</sup>

ENTSO-G and its Members (TSOs) have created a public platform for communication and exchange of best practices applied at national level<sup>48</sup>. These innovative solutions focus on biogas, power to gas, hydrogen, CNG and other innovative applications to support the achievement of the current EU goals of reducing GHG emissions.

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<sup>47</sup> <https://www.entsog.eu/ipp>





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

Table 17: Gas Transmission Innovation Projects: ENTSO-G Innovative Projects Platform

Innovation Area	Brief Description	Sample Projects
<b>Technology</b>	<p>ENTSOG Members (TSOs) are developing new and innovative technologies to offer sustainable solutions for the gas sector. These technologies focus on optimization of the grid usage, creation of digital layer connections and support decarbonization of the EU gas system</p>	<ul style="list-style-type: none"> <li>- Hydrothermal gasification (GRT Gaz, France) is a technology converting wet biomass and treating organic wastes and residues. It uses the water contained into the biomass as the reaction environment in its supercritical phase to produce a synthesis gas. In Europe, several stakeholders are developing or currently operating pilot plants of this technology. The technology could reach industrial scale by 2023-25 with modular installations scaled between 0,5 and 6 t/h.</li> </ul>
<b>Regulation &amp; business model</b>	<p>Innovation brings new opportunities to invest and creates new opportunities for new business models. Without effective and efficient regulatory framework, it is difficult to invest into new technologies. In the past, regulation of gas networks was mainly meant to foster competition and improve efficiency. Currently, it is generally believed that regulation can also facilitate the process of decarbonization. ENTSOG Members (TSOs) engage in development of the new energy products and services to foster uptake of renewable and decarbonized gases into the grid.</p>	<ul style="list-style-type: none"> <li>- ERGaR (Energinet, Denmark) is founded as a cooperation between European registries of biomethane certificates that will enable cross border trade of biomethane certificates among the member registries. ERGaR will be the Europe-wide recognised organisation for administering and mass balancing volumes of renewable gases virtually distributed along the European natural gas network.</li> <li>- Jupiter 1000 Teréga with GRTgaz (France) developed a demonstration project for Power to Gas in Fos-sur-Mer. The aim of this initiative is to help shape this new sector by developing the technologies concerned, building the associated economic and regulatory models, and overcoming current technical reservations.</li> </ul>
<b>Partnership</b>	<p>ENTSOG's Members (TSOs) are engaging in new partnerships and initiatives such as the Green Gas Initiative, Gas for Climate initiative and are active via the European Power to Gas Platform, to name a few examples. TSOs are actively working together as well as with various private stakeholders on projects aimed to offer sustainable solutions for the gas sector and of the whole EU economy.</p>	<p>ENTSOG and its TSO members are engaging in partnership organisations to assess and create awareness about the role of renewable and low carbon gas in the future energy system:</p> <ul style="list-style-type: none"> <li>- Green Gas Initiative</li> <li>- European Power to Gas Platform</li> <li>- Gas for Climate</li> </ul>





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Innovation Area	Brief Description	Sample Projects
<b>Innovation &amp; Transition</b>	<p>Technological innovation is important for the transition to low carbon economy and combating climate change. New technologies such as power-to gas, biomethane, hydrogen, CNG will enable this transition.</p>	<ul style="list-style-type: none"> <li>- TEP Energy Solution (Snam, Italy) The acquisition of TEP Energy Solution (TEP), one of Italy's leading enterprises in the energy efficiency sector, is part of Snam's strategic plans aimed at facilitating decarbonization and better energy use in the areas where it operates. Snam intends to accelerate TEP's growth process, with the support of the company's management, and facilitate the transfer of energy efficiency know-how and technologies from large businesses to small and medium-sized enterprises and local institutions.</li> </ul>
<b>Carbon Capture and Storage</b>	<p>Carbon Capture and storage is the process of capturing waste CO2 from large point sources, such as fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere. The aim is to prevent the release of large quantities of CO2 into the atmosphere.</p>	<ul style="list-style-type: none"> <li>- Feasibility study of CCS in Ireland (GNI, Ireland) Ervia and Gas Networks Ireland are investigating the potential for a large-scale CCS project in Ireland to capture the CO2 from a number of gas-fired CCGT power plants so that they provide low-carbon electricity. Initial findings suggest that CCS may be technically and economically viable for Ireland and over the next few years Ervia will progress feasibility studies into the technology for Ireland.</li> </ul>
<b>Hydrogen</b>	<p>Hydrogen can be produced by various process technologies. Firstly, hydrogen can be obtained from natural gas through a steam reforming process or a methane pyrolysis process. Secondly, hydrogen can also be produced by splitting water into hydrogen and oxygen via electrolysis (power-to-gas). Thirdly, hydrogen can be produced via gasification process, by converting solid fuel (coal or woody biomass) to hydrogen. Fourthly, hydrogen can also be produced through anaerobic digestion, converting wet biomass to hydrogen. At present, steam methane reforming is the most common method of producing hydrogen.</p> <p>Hydrogen can be utilised directly as fuel or, depending on the application, blended with natural gas.</p>	<ul style="list-style-type: none"> <li>- Testing of the H2NG supply in Contursi Terme (Snam, Italy) Snam has launched its experiment of introducing a 5% hydrogen and natural gas blend into the Italian gas transmission network. The experiment, the first of its kind in Europe, is being conducted in Contursi Terme, and involves the supply of H2NG (a blend of hydrogen and gas) to two industrial companies in the area: a pasta factory and a mineral water bottling company.</li> </ul>





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Innovation Area	Brief Description	Sample Projects
<p><b>Biogas</b></p>	<p>Biogas is obtained via the anaerobic decomposition of the organic matter. After the process of upgrading, biogas becomes biomethane with the same quality standard as natural gas and can be transported via the existing grid infrastructure.</p>	<ul style="list-style-type: none"> <li>- RenovaGas (Enagás, Spain). RENOVAGAS is a research project whose first phase finished in 2017. It first aim was the development of a 15 kW demonstration plant for the production of synthetic natural gas (SNG) from the electrolytic production of hydrogen with renewable energy sources (RES) and its combination directly with a biogas stream, that is, without separating CO2 from the methane, through a methanation process, so the synthetic natural gas obtained was fully renewable.</li> </ul>
<p><b>Power to gas</b></p>	<p>Power-to-Gas is an instrument allowing for optimisation of the overall energy system since it deals with excess of renewable electricity (compared to the demand) which is difficult to store in large quantities for a long time.</p> <p>Power-to-Gas means a conversion of electrical power into a gaseous energy carrier. In a first step, electricity from renewable energy sources is used in an electrolyser to split water into hydrogen and oxygen. This process is called Electrolysis. An additional Methanation step, can be used to synthesise the hydrogen with carbon dioxide into methane.</p>	<ul style="list-style-type: none"> <li>- Hybridge (OGE, Germany) Amprion and Open Grid Europe (OGE) are joining forces to press ahead with intelligent sector coupling. The two companies are planning to trial the power-to-gas (PtG) technology on an industrial scale to help accelerate the energy transition. The aim is to build PtG plants in the 50 to 100 MW range. Potential sites in Lower Saxony and northern North Rhine-Westphalia have been identified.</li> </ul>
<p><b>CNG</b></p>	<p>Compressed Natural Gas (CNG) is a fuel source that is made from compressing natural gas to less than 1% of its standard atmospheric volume. Because CNG is a compressed form of the same gas it can be used in a combustion engine.</p>	<ul style="list-style-type: none"> <li>- The Causeway Project (GNI, Ireland) The Project will see the formation of a national Compressed Natural Gas (CNG) refuelling network, a renewable gas injection facility and the deployment of a fleet of CNG vehicles.</li> </ul>





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Innovation Area	Brief Description	Sample Projects
<b>Digitalisation</b>	<p>Digitalisation can bring various benefits to day-to-day operations such as enhanced control over the gas quality and cost reductions. Therefore, TSOs look at data-driven solutions to boost performance, enhance efficiency and boost competitiveness.</p>	<ul style="list-style-type: none"> <li>- NewGasMet: Flow metering of renewable gases (Enagás, Spain). The overall objective of the project is to increase knowledge about the accuracy and durability of commercially available gas meters after exposure to renewable gases (biogas, biomethane, hydrogen, syngas and mixtures with natural gas). This should lead to the improvement of existing meter designs and flow calibration standards. The project started in June of 2019 and will last for 3 years and is funded by the European Metrology Programme for Innovation and Research (EMPIR).</li> </ul>
<b>Heating &amp; Cooling</b>	<p>in Europe Heating and cooling in buildings and industry accounts for half of the EU's energy consumption, natural gas being the largest primary energy source (46%). Cutting the energy consumption in heating and cooling in buildings and industry can be achieved through various technologies. TSOs are working on developing cost-efficient solutions for the decarbonization of this sector.</p>	<ul style="list-style-type: none"> <li>- I-GAP project (Snam, Italy) The project aims to develop the technology of small gas absorption heat pumps (GAHP) to offer an economically sustainable and easily integrated solution for heating residential buildings. In particular, the project will quantify the energy, environmental and infrastructural benefits deriving from the widespread application of this technology. The main advantages of this technology are the ease of installation, lower operating costs and lower emissions of climate-changing gases. Duration: 01 October 2016 - 04 June 2020</li> </ul>
<b>Certification of green gases</b>	<p>To meet the European energy targets and climate goals, renewable, decarbonised and low-carbon gases play a key role in the transition. Especially the injection of renewable gases into natural gas grids is a key driver in the energy transition. Therefore, it is important to ensure the cross-border scale up and tradability of these gases i.e. biomethane and hydrogen. This can be achieved via pan European Guarantees of Origin and Certification Schemes. TSOs contribute effectively to the process.</p>	<ul style="list-style-type: none"> <li>- Vertogas certification agency (Gasunie, Netherlands) Vertogas applies the NTA 8080 sustainability criteria and can guarantee that the inputs (biomass) used to produce the gas are genuinely green and of high quality.</li> <li>- ERGaR (Energinet, Denmark)</li> <li>- Green gas Guarantees of Origin (Amber Grid, Lithuania)</li> </ul>





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### 3.2.4 Other Initiatives at European Level

#### 3.2.4.1 *European Metrology Programme for Innovation and Research*<sup>49</sup>

The European Metrology Programme for Innovation and Research (EMPIR) coordinates research projects to address grand challenges, while supporting and developing the SI system of measurement units. There is an increased focus within EMPIR on innovation activities to target the needs of industry and accelerate the uptake of research outputs. The programmes capacity-building projects aim to bridge the gap between EU member states with emerging measurement systems and those with more developed capabilities.

The EMPIR programme enables European metrology institutes, industrial and medical organisations, and academia to collaborate on a wide variety of joint research projects within specified fields: industry, energy, environment, health, SI Fundamental, Normative, Research Potential, and Support for Networks and Support for Impact projects. Annual EMPIR research calls between 2014 and 2020 are supported by 600 M€ of European Union funding enable project research for a maximum of 3 years (5 years for Support for Networks).

The EMPIR initiative is cofounded by EU Horizon 2020 and EMPIR Participating States.

#### 3.2.4.2 *European Gas Research Group*

The European Gas Research Group (GERG) works to develop innovative solutions for gas infrastructures. Most of EU TSOs are members of GERG. GERG focuses on five strategic areas:

- hydrogen,
- biomethane,
- methane emissions,
- LNG, and
- infrastructure and end-use.

### 3.2.5 Innovation Funding Mechanisms at EU Level

Currently there are several funding possibilities in the energy sector at EU level. Most of these funding mechanisms are not directly devoted to innovation but European gas transmission companies may benefit from some of them for investments on innovative projects. EU funding possibilities in the energy sector are:

- The Connecting Europe Facility (CEF). Under the CEF, €5.85 billion is available for trans-European energy infrastructure projects such as gas pipelines, transmission grids, Liquefied Natural Gas (LNG) terminals, gas storage, and smart grids.
- Horizon 2020 and Horizon Europe. Around €5.9 billion goes towards energy research and innovation projects in the EU's Horizon 2020 programme. These projects aim at the creation and improvement of clean energy technologies, such as smart energy networks, tidal power, and energy storage.
- The EU's Cohesion Fund. The fund supports energy-related projects that benefit the environment for example by reducing greenhouse gas emissions, increasing the use of renewable energy or improving energy efficiency. Part of the Cohesion Fund is used to implement the energy union strategy with the help of the Energy and Managing Authorities Network (EMA).
- European Regional Development Fund. One of the ERDF's four priority areas for 2014-2020 is 'the low carbon economy'.

<sup>49</sup> <https://www.euramet.org/research-innovation/research-empir/>





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- The European Investment Bank (EIB). EIB financed energy projects include renewable generation, infrastructure, and new technologies.

Regarding gas transmission projects, most relevant funding mechanisms are the CEF and Horizon 2020 that are partially implemented by the Innovation and Networks Executive Agency (INEA).

INEA officially started its activities on 1 January 2014 as the successor organisation of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission in 2006 to manage the technical and financial implementation of its TEN-T programme.

Its mission is to support the Commission, project promoters and stakeholders by providing expertise and high quality of programme management to infrastructure, research and innovation projects in the fields of transport, energy and telecommunications, and to promote synergies between these activities, to benefit economic growth and EU citizens.

### 3.2.5.1 *The Connecting Europe Facility: Energy*<sup>50</sup>

Some energy projects are not commercially viable and would normally not make it into investment programmes of infrastructure developers. CEF is engineered to address this investment gap in the energy sector. Financial instruments, by bringing in new classes of investors and mitigating certain risks, will help project promoters to access the necessary financing for their projects. Grants to contribute to the construction costs will be applied to fill in the gaps in commercial viability of the projects that are particularly relevant for Europe.

A total budget of €5.35 billion is made available for energy infrastructure projects for the 2014-2020 period, of which €4.6 in the form of grants managed by INEA. The majority of the funding is made in the form of allocated grants following competitive calls for proposals.

The 2020 CEF Energy call for proposals will make nearly €980 million available to finance Projects of Common Interest (PCIs) in the energy sector, namely in electricity, gas, smart grids and cross-border carbon dioxide network infrastructure. The CEF call for proposals aims to finance projects related, among other things, to the following objectives:

- Promote the integration on the internal energy market and the interoperability of electricity and gas networks.
- Integrating energy from renewable sources and developing smart energy networks
- Contributing to sustainable development and protection of the environment by the integration of energy from renewable sources and by the development of smart energy networks and cross-border carbon dioxide networks.

<sup>50</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy>



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### 3.2.5.2 **Horizon 2020 program<sup>51</sup>**

There are €83 million available for Horizon 2020 energy projects. Six energy topics under the 2018-2020 Horizon 2020 are open for application related to renewable energy solutions.

- Developing the next generation of renewable energy technologies
- Advanced drilling and well completion techniques for cost reduction in geothermal energy
- Offshore wind basic science and balance of plant
- New test rig devices for accelerating ocean energy technology development
- Development of next generation renewable fuel technologies from CO2 and renewable energy (Power and Energy to Renewable Fuels)
- Combined clean biofuel production and phytoremediation solutions from contaminated lands worldwide

It can be seen how some of the above topics may include gas network innovation projects related to renewable gases.

The projects will be selected for funding in a single-stage evaluation. The submitted proposals are evaluated by independent experts drawn from the European Commission's database of external evaluators. Grant agreements will be signed with the successful applicants.

### 3.3 Innovation in Gas Transmission: International Benchmark

The analysis of international experiences aims to extract all the 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.

The selection of international cases includes three countries with developed innovation incentives: United Kingdom, Ireland and France. In these countries, innovation incentives have been in place for at least one completed regulatory period. We present detailed information on how the innovation allowed budget was spent by each TSO.

We also analyse the cases of Finland and Italy as two countries with innovation incentives recently implemented or underdevelopment. We include the Spanish case as a country with no specific innovation incentive in use.

Finally, a recap of all the selected experiences is presented where the following features of each country case are included:

- High level description of innovation activities and regulatory framework.
- Innovation regulatory incentives.
- Financing innovation incentives.
- Eligible R&D expenditures/projects.
- R&D expenditures approval and evaluation.
- Implementation, monitoring and reporting obligations.
- Collaboration, partnership, and knowledge transfer.

<sup>51</sup> EU (2018) funding for energy beyond the 'Secure, Clean and Efficient Energy' challenge: Energy-relevant topics in other Horizon 2020 WP 20182020 parts.



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

### 3.3.1 UK

#### 3.3.1.1 Overview of regulatory incentives

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.

As part of its current framework - RIIO, Ofgem introduced specific incentives for innovation as part of an 'innovation stimulus'. There are two key mechanisms provided under the innovation stimulus:

- Network Innovation Allowance (NIA) allows the regulated network operators a funding opportunity of 0.5-1% of revenue to be spent on innovation projects, 90% of which can be recovered through the incentive mechanism (and finally network tariffs).
- Network Innovation Competition (NIC) funding is awarded through an annual competitive process. Up to £20 million per annum for NG DSOs and TSO.

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

Table 18: UK: Regulatory Network Innovation Funding Sources

	Network Innovation Allowance	Network Innovation Competition
<b>Description</b>	Annual allowance that each Network Licensee will receive to fund small-scale innovative projects as part of its price control settlement.	Funding is awarded through an annual competitive process
<b>Funding</b>	0.5-1% of yearly revenue of the TSO	Up to £20 million per annum for NG DSOs and TSO.
<b>Eligible projects</b>	Fund smaller scale projects	Funding larger scale and more complex, innovative projects
<b>Area</b>	Not defined	Solely on innovative Projects with potential low carbon and environmental benefits.

Source: Ofgem Network Innovation site

The Gas 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 gas 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





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Non-Network Licensees on Gas 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<sup>52</sup>.

The Gas NIC began in April 2013 and will run annually until March 2021. £20millions are available each year until March 2021 as part of the RIIO-T1 and RIIO-GD1 price controls. These amounts will be raised from transmission customers tariffs.

Funding is awarded following a two-stage competitive process. After the competition Ofgem will issue a direction (the Funding Direction) that will set out the total amount that can be recovered from or returned to UK customers through Transmission Charges to cover Gas NIC Funding in each year. 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.

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, technological and operational. The NIA provides limited funding to Network Licensees to use to fund smaller Projects which meet the eligibility criteria<sup>53</sup>.

There will be no initial requirement for a Network Licensee’s Project 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 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:

- A specific piece of new equipment.
- A specific novel arrangement or application of existing gas transportation equipment.
- A specific novel operational practice directly related to the operation of the UK Gas Transportation System; or
- A specific novel commercial arrangement.

### 3.3.1.2 *Application of innovation incentives*

In order to present the outputs of UK innovation support mechanisms we have analysed recent and in progress projects of national TSO (National Grid Gas) under the RIIO innovation support mechanisms<sup>54</sup>.

The following picture presents all R&D expenditures of National Grid Gas under the RIIO innovation support mechanisms:

<sup>52</sup> Ofgem (2017) Gas Network Innovation Competition Governance Document

<sup>53</sup> Ofgem (2017) Gas Network Innovation Allowance Governance Document

<sup>54</sup> NGG (2019) Network Innovation Allowance Annual Summary 2018/2019





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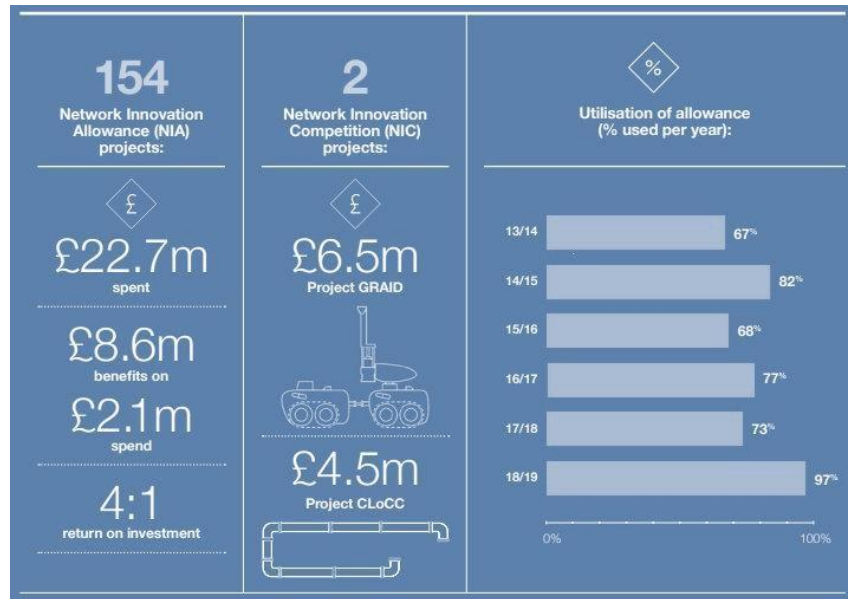


Figure 26: Great Britain TSO (National Grid Gas) Application of Network Innovation Revenues<sup>55</sup>

NGG requests proposals for innovative projects to compete within the NIC. Projects must include among other things a Cost Benefit Analysis (CBA) and Carbon/environmental benefit analysis. Main topics of NCG call for innovative projects proposals are:

- The Efficiency Challenge.
- Asset Management.
- Future of the National Transmission System (NTS).
- Safety and Environmental Impact.

Currently there are two projects of NGG awarded by the Network Innovation Competition.

The Project CLoCC (Customer Low Cost Connections, 2015-2018) with a budget £4.5m aims to minimise the cost and time of new gas connections to the national transmission system (NTS).

The Project GRAID (Gas Robotic Agile Inspection Device, 2014-2018) has a budget of £6.5m. This technological leap will allow NGGT to cut asset maintenance costs by eliminating unnecessary excavations and providing data to allow asset life extension. It will also generate carbon savings of more than 2,000 tonnes annually, equivalent to the emissions from almost 500 UK households.

Additionally, NCG is working on several small-scale projects included within the NIA allowance. Below you may find a selection of NCG projects (2019) financed under the NIA scheme together with a picture with NCG NIA expenditure breakdown per theme.

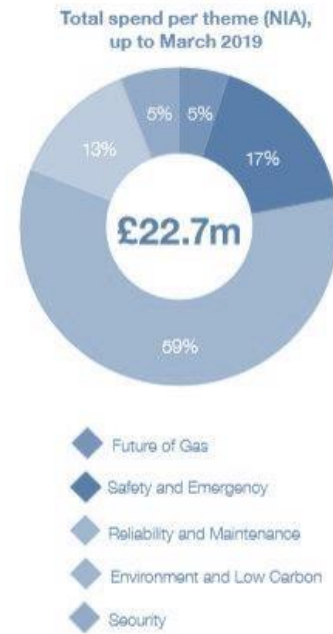
<sup>55</sup> NGG (2019) Network Innovation Allowance Annual Summary 2018/2019





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- Hydrogen in the NTS – foundation research and project roadmap.
- Feasibility study into 2% hydrogen blending at St Fergus and H2 pipeline and hub at Aberdeen.
- Mobile Condensate Tanks.
- Drones inspection of network assets.
- Derivation of a Risk Based Approach to High Pressure Filter & Pig Trap Closure Inspection Frequencies



Source: NGG (2019) Network Innovation Allowance Annual Summary 2018/2019





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### 3.3.2 Ireland

#### 3.3.2.1 Overview of regulatory incentives

In Ireland, the NRA has an innovation allowance for the Gas TSO to support and trial specific new and emerging technologies. The Commission for Regulation of Utilities (CRU, former CER) recognises a yearly amount of R&D investments to be included as OPEX of Gas Networks Ireland (GNI)<sup>56</sup>.

The adopted treatment of innovation funding as OPEX avoided complications of including small capital projects in the Regulatory Asset Base and was seen to be more consistent with the focus on innovation funding. Upon proposal of GNI (Transmission and Distribution Operator), CRU split the allowed OPEX 90/10 between the Transmission and Distribution activities. Detailed governance arrangements were developed for GNI's innovation fund and are used to determine which projects are funded within the network tariffs.

GNI is required to report annually on the outputs and outcomes of the innovation funding and benefits (or otherwise) of innovation projects to gas network customers. The purpose of the funding is to assist with the decarbonization of the Irish economy, provide value to gas network users, and to ensure that the gas network will continue to be utilised to the benefit of gas customers.

The CRU ensures that GNI report annually on the outputs of the innovation funding. These annual reports must be published on GNI's website. In addition, where the Gas Innovation Group awards funding for research purposes the results of such research will also be published GNI's website. Decisions for funding approved by the Gas Innovation Group should state measurable outputs and outcomes for the projects. These should be reported on in the subsequent innovation reports with the outputs and outcomes informing any further innovation funds in later price controls.

The CRU assesses the information provided in the project templates and annual reports. The CRU is of the view that projects funded by innovation funding should aim to achieve:

- Will deliver significant carbon savings,
- The transition to a decarbonised economy,
- Increased throughput on the gas system; and,
- Measurable value to all gas customers.

It will be the responsibility of GNI in consultation with the Gas Innovation Advisory Group (GIAG) to determine the best possible use of the innovation funding. The GIAG is comprised of representatives from academia, industry and policy, and is tasked with reviewing each funding application and advising GNI on the potential merits of each application.

GNI is required to submit Initial Innovation Project Forms and a Completed Innovation Project Forms for each project awarded funding<sup>57</sup>. These forms essentially allow the CRU to assess the outcomes and outputs of a project against the aims and objectives of that project.

<sup>56</sup> CER (2017) Decision on October 2017 to September 2022 Transmission Revenue for Gas Networks Ireland

<sup>57</sup> CRU (2018) Gas Innovation Reporting Framework Information Paper





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The CRU will assess the information provided in the project templates and annual reports. CRU’s assessment criteria of projects’ output are based on the overall objectives of the innovation activities:

- Carbon savings: Project reports should highlight how the project makes a contribution to the Government’s current strategy for reducing greenhouse gas (GHG) emissions.
- Increased throughput: innovation funding should aim to increase, or at least, maintain current levels of utilisation of the gas network.
- Value for customers: CRU expects that as a whole the project portfolio should provide a benefit to gas customers, which is reflective of the level of their investment.
- Other benefits: increase the stock of knowledge, additional environmental benefits and increased security of supply.

In addition to project forms, a yearly report must be published by GNI. This report will provide stakeholders and customers a clear picture on how projects funded through the innovation fund are being incorporated in business-as-usual operations and providing a benefit to customers. The CRU requires that where GNI awards funding for research purposes, GNI publishes on its website; a detailed summary of the results of such research, contributors to the research, and a link to any official publication stemming from the research.

### 3.3.2.2 Application of innovation incentives

In the last years, the fund has been used by Irish TSO to build a grid injection facility for biogas, and to undertake a study on the impacts of compressed natural gas on the Irish gas network for instance.

Table 19: Ireland: Allowed Innovation Expenditures

Category	2012/13	2013/14	2014/15	2015/16	2016/17f	Total
CNG	0	157	224	1,004	2,615	4,000
Biogas	0	0	31	29	1,789	1,850
Research	0	0	45	30	875	950
Business/ Technical	0	0	0	0	250	250
Programme management	95	222	252	303	78	950
<b>Total</b>	<b>95</b>	<b>379</b>	<b>553</b>	<b>1,366</b>	<b>5,607</b>	<b>8,000</b>

Source: CER, Consultation in October 2017 to September 2022 Transmission Revenue for Gas Networks Ireland

For the next regulatory period (2017-2022) The CRU has decided to allow an innovation funding of up to €20.0m over PC4 inclusive of the €12.83m allowed as part of the Causeway Study. Using GNI’s forecast transmission and distribution allowed revenues in PC4 this would imply innovation funding in PC4 of c. 1.0% of allowed revenue. This will include a provision for project management, research and a small number of strategic projects in addition to the existing allowance for the Causeway study. An innovation allowance of up to €20.0m will provide GNI with the ability to examine alternative uses for the natural gas grid as Ireland moves to a decarbonised economy by 2050.

The allowed innovation expenditure includes funding for projects related to: biogas purification; power-to-gas; low carbon heating solutions; carbon capture and storage projects; research and programme management.





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Table 20: Innovation OPEX for Distribution and Transmission (PC4)

Category	2017/18	2018/19	2019/20	2020/21	2021/22	Total
GNI request	5,000	5,000	5,000	5,000	5,000	25,000
CER allowance	4,000	4,000	4,000	4,000	4,000	20,000

Source: CRU, Decision on October 2017 to September 2022 Transmission Revenue for Gas Networks Ireland

Most of the innovation allowance has been used for the Causeway project (CNG) and there are feasibility studies undergoing related to CCS and hydrogen<sup>58</sup>:

- *The Causeway Study: this study researches the impact of CNG on the Irish Gas Network. The funding came jointly from the Innovation Allowance (€12.83m) and the EU fund of “Connecting Europe Facility” (€5.9m).*
- *Green connect: This is a new project that builds on the Causeway Study launched in 2020.*
- *Potential future CCS projects: There is a gas field that is almost depleted that could be suitable for storage. The project is currently in the pre-feasibility stage.*



Figure 27: Ireland (GNI) PC4 Gas Innovation Funding Structure

Proposals seeking funding by GNI under the Gas Innovation Fund are assessed under the following criteria:

- *Relevance – how relevant is the project with regard to addressing the Gas Innovation Fund priorities?*
- *Maturity – how mature is the project, have elements of the project already started?*
- *Impact – what impact will the project have and what are the potential practical applications for the project?*

<sup>58</sup> GNI (2019) PC4 Gas Innovation Fund Annual Report: 2017/18 and 2018/19





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### 3.3.3 France

#### 3.3.3.1 Overview of regulatory incentives

In accordance with the public service mission assigned to TSOs by the Energy Code, the Public Service include efforts on R&D. As such, GRTgaz (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 Smart-Grids and on new gas uses (biomethane, GNV, power to gas). Moreover, it encourages the projects for biomethane production to prepare the energy transition.

The French Energy Regulatory Commission (Commission de Régulation de l'Énergie - CRE) introduced in its gas transmission price control (ATRT6) an incentive scheme for Research and Development (R&D) cost. The ATRT6 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 gas market<sup>59</sup>.

A process for approval of innovative projects exists to reduce the risk of non-accepted expenditures. If TSOs 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.

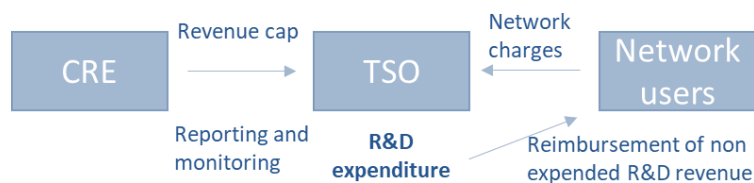


Figure 28: Overview of French Innovation Revenue Methodology

the TSOs will have 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 will 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.

#### 3.3.3.2 Application of innovation incentives

According to CRE tariff decision for 2017-2020 the following areas are included under the R&D incentive mechanism:

<sup>59</sup> CRE (2016) Deliberation of the French Energy Regulatory Commission of 15 December 2016 forming a decision on the tariff for the use of GRTgaz and TIGF natural gas transmission networks



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- Biomethane (2nd and 3rd generation).
- Power to Gas.
- Support for efficient uses in industry (partial).
- Leakage reduction (partial).
- H2 transmission.
- Direct support to research and innovation in green gas.
- De-optimisation costs linked to extrication of CRIGEN’s R&D activities.
- Data analysis.
- Integrity of facilities.

The following tables present the R&D expenditures allocated to each TSO (GRTgaz and Teréga) under the tariff order in use: ATRT6.

Table 21: France: Allowed R&D Revenues for NG TSOs-1

GRTgaz, in €m <sub>current</sub>	2017	2018	2019	2020	Average 17-20
R&D “within ATRT6”	12	12	12	12	12
GRTgaz 2020 Project	4	10	10	12	9
ATR6 total	16	22	22	24	21

Source: Deliberation of the French Energy Regulatory Commission of 15 December 2016 forming a decision on the tariff for the use of GRTgaz and TIGF natural gas transmission networks

Table 22: France: Allowed R&D Revenues for NG TSOs-2

TIGF, in €m <sub>current</sub>	2017	2018	2019	2020	Average 17-20
ATR6	2.3	2.2	2.1	2.0	2.2

Source: Deliberation of the French Energy Regulatory Commission of 15 December 2016 forming a decision on the tariff for the use of GRTgaz and TIGF natural gas transmission networks

During the last five years, most relevant R&D project carried out by French TSOs was related to power to gas solutions and H2 integration in the transmission network.

The Jupiter 1000 project was launched in 2014 and works began in 2017. This is the first industrial demonstrator of Power to Gas with a power rating of 1 MWe for electrolysis and a methanation process with carbon capture. Green hydrogen will be produced using two electrolyzers involving different technologies, from 100% renewable energy. GRTgaz and Teréga (French gas TSOs) work together with RTE (TSO in the electricity transmission network) and other technical partners to develop the technical and economic knowledge of the Power-to-Gas solutions<sup>60</sup>.

<sup>60</sup> <https://www.jupiter1000.eu/english>



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Initially no particular incentive mechanism was put in place for the development of Jupiter 1000 project. CRE was reluctant to accept the project considering a gas TSO was not the most appropriate party to execute this project due to unbundling restrictions. Finally, investment was approved by the CRE and Jupiter 1000 assets included as part of the RAB. Budget allocated to R&D expenditures is established in the four-year trajectory (ATRT6 tariff period: 2017-2021) and any extra cost out of the R&D allowance will be bear by the TSO.

GRTgaz also devotes R&D budget to traditional NG transmission activities such as digitalisation of management activities and innovative techniques for O&M works.

### 3.3.4 Finland

#### 3.3.4.1 Overview of regulatory incentives

Since 2016, Finish tariff regulatory framework of the Energy Authority (NRA)<sup>61</sup> for natural gas transmission includes an innovation incentive aiming to encourage network holders to develop and use innovative technical and functional solutions in network operations. Key objectives set for R&D activities in transmission network operations include the development and commissioning of smart natural gas networks and other new technologies and operating methods.

The EA encourages network holders towards active research and development by deducting reasonable research and development costs in the calculation of realised adjusted profit. Allowed R&D costs must be directly based on the design and implementation of projects related to the generation of new information, technologies, products or operating methods in network operations.

The innovation incentive is calculated so that at most a share corresponding to 1% from the sum of turnovers of network operations in unbundled income statements over a regulatory period is treated as reasonable research and development costs. The amount of research and development costs acceptable over a single year may be higher or lower than the share of 1% from the turnover of network operations over the specific year.

With regards eligible R&D costs, only costs directly related to innovative projects, acquisition of new knowledge, deployment of new technologies or applications are allowed. R&D costs may include external studies and research, travel costs directly related to the project, participation fees and staff costs. Before starting projects, TSOs should ask the Energy Authority whether the project costs can be accepted as part of the innovation incentive. Capital investments are not subject to innovation incentives.

Allowed R&D costs must be recognised as expenses in the unbundled income statement. Network holders must present non-activated research and development costs separately in notes to unbundled financial statements.

The results of projects whose costs are allowed by the innovation incentive, must be public and, for example, utilisable by other network holders in their network operations. Furthermore, results protected by industrial property rights do not need to be made public. Innovation project results must be sent to the Energy Authority, which will publish them on its website.

<sup>61</sup> EA (2016) Regulation methods during the third regulatory period from 1 January 2016 to 31 December 2019 and the fourth regulatory period from 1 January 2020 to 31 December 2023 Natural gas transmission system





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### **3.3.4.2 Innovation Incentives Application**

The ownership unbundling of Gasum's transmission business in Finland did not take effect until the beginning of 2020 in accordance with the Natural Gas Market Act. The new transmission network company Gasgrid Finland Oy began operations on January 1, 2020. Gasum acted as the Transmission System Operator (TSO) with system responsibility until the end of 2019. Therefore, no unbundled income statements are available yet, so it is not possible to monitor accurately the application of innovation incentives.

During 2019, the focus in Gasum (former incumbent) R&D effort was on the development of the Biogas business, particularly in Finland and Sweden. Research and product development costs related to the development of the Biogas business totalled €1.6 million (2018: €2.1 million).

### **3.3.5 Italy**

#### **3.3.5.1 Overview of Regulatory Incentives**

Currently, in Italy there is no feature specifically designed to encourage innovation in gas TSO activities but in 2018 the regulator (ARERA) launched a consultation proposal in 2018 to explore mechanisms to promote innovative uses of transport networks (consultation 420/2018/R/GAS on the subject of service quality and innovation of gas transmission service for the 5PRT). These mechanisms could eventually be included in the revenue methodology for the next regulatory period. The main objective of ARERA is the development of innovative technologies for the integration of different gas (such as bio-methane, other renewable gas and synthetic gases) into existing transport networks.

ARERA is already working on the implementing specific incentive mechanisms for projects or applications that are particularly innovative for natural gas transmission aimed at encouraging the attainment of environmental objectives, such as:

- The reduction of CH<sub>4</sub> emissions into the atmosphere, through specific mechanisms that encourage companies to take effective measures to control gas losses in the networks.
- Pilot projects to test innovative solutions to support energy transition: biomethane and other renewable gas and P2G projects or hydrogen transmission.

According to the consultation documents, the intention of ARERA is to establish a criterion for eligible projects that have not been detailed yet.

#### **3.3.5.2 Innovation Activities of Italian Gas TSO**

Even though currently there are no direct incentives for gas transmission innovation expenditure, Italian TSO (Snam) is among the most active EU TSOs on innovative solutions. Innovation expenditure may lead to efficiency gains and increased quality of service that in the end will result into higher revenues for the TSO. These are some of the innovative solutions under development or already implemented by Snam:

- Testing of the H<sub>2</sub>NG supply. Snam in 2019 launched its experiment of introducing a 5% hydrogen and natural gas blend into the Italian gas transmission network. This experiment is first of its kind in Europe.
- Intelligent pigs.
- Remote Operated Vehicles for underwater maintenance activities.
- Estimation of natural gas emissions: Collaboration continued within the European research group GERG.
- Geochemical and micro seismic monitoring.





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### 3.3.6 Spain

Spanish regulator (CNMC) did not allow any R&D expenditure in the revenue determination for the next regulatory period (2021-2026). According to the Spanish regulator this decision was made in order to increase transparency and avoid mal practices that could rise network tariffs.

The opinion of the CNMC is that Spanish gas transportation and regasification activities have been remunerated above cost reflective levels during the last years. The initial revenue proposal for 2021-2026 included a yearly remuneration cut of around -240 Million €/yearly (21.8% of total revenue). The remuneration cut was finally set at -117 Million €/yearly (13.5% of total revenue) due to important pressures by all stakeholders (including the government) to mitigate the remuneration cut.

The proposed remuneration cut gives an idea of the excessive remuneration that, according to the regulator, Spanish TSO have been receiving and explain why the CNMC is reluctant to allow new costs to be included in the revenue cap.

There is an incentive for O&M costs reduction in place that encourage TSOs to increase long-term efficiency. Efficiency gains may be achieved through the implementation of innovative technologies. If the implementation of innovation solutions fails, under current revenue model, these R&D costs cannot be recovered,

The fact that R&D costs are not allowed to be included in the revenue cap does not necessarily mean that Spanish TSO does not undertake innovation activities. Below we present a recap of the technological innovation activities that Enagás (main TSO in Spain) reported in 2018<sup>62</sup>:

1. Improving the different aspects of the company's present activities, such as energy efficiency and self-generation of energy, the measuring of gas and analysis of its components, operational safety, materials and equipment. The most significant projects on which work was carried out during the year were the desalination plant at the Barcelona facility in order to reduce water consumption, the autonomous generation of nitrogen at the Huelva facility and the installation of a heat exchanger at the Cartagena facility to reduce electrical energy consumption.
2. The analysis and development of technology that may be supported in the future and to upgrade infrastructure, and/or the company's know-how, such as production, analysis, certification and transport of synthetic natural gas, biogas, biomethane and hydrogen. The following projects are featured in this area:
  - a. The project carried out jointly by Enagás and Repsol, SUN2HY (Luxhor Project), for the development of a photoelectrolyzer for the production of hydrogen.
  - b. The ECO project, which consists of the development of simultaneous electrolysis of steam and CO<sub>2</sub> for the conversion of surplus renewable electricity into distributable and storable hydrocarbons such as methane.
  - c. Actions conducted within the framework of the CORE LNGas HIVE project coordinated by Enagás, in order to promote natural gas as an alternative fuel for maritime transport (see 'Climate change and energy efficiency' chapter).

<sup>62</sup> Enagás Annual Report 2018





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The amount invested in technological innovation by Enagás in 2018 was €3,493,032. This amount represents around 0.35% of yearly allowed revenue of Enagás.

### 3.3.7 Miscellaneous Regulatory Practices for Gas Transmission Innovation

We have already presented the regulatory approaches to gas transmission innovation of 6 European countries: UK, Ireland, France, Finland, Italy and Spain. 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>63</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.

For example, in Lithuania there is a statutory requirement on TSO to develop innovative pricing formulas, introduce intelligent systems and smart meters and promote efficiency. The Danish government may decide that the TSO in cooperation with distribution companies must initiate R&D activities with a view to efficient energy use, environmental improvements, and safety in natural gas use.

In other countries, the responsibility of innovation incentivization relies mainly on the NRAs or equivalent authority. In Bulgaria, the general statutory functions of NRA include performing assessments for introduction of smart metering systems while the Swedish Energy Agency has the funding authority to promote R&D in the gas transmission sector.

In Belgium, the legislation requires the tariff methodology to incentivize the TSO to undertake R&D investments.

Other European regulators include innovation incentives in the tariff methodologies even if there are no explicit references in the national legislation. The German NRA can allow part of R&D costs within the revenue cap only if the approved costs cover below 50% of costs which are not publicly funded. In Luxemburg, the tariff methodology includes pass through of R&D costs that may be included up to 1% of maximum allowed revenue. The Romanian energy authority may approve the TSO receiving an increment of 1.4% in the RoR of investments related to an increase in O&M efficiency.

The European Commission report found some evidence of innovative activities in some countries despite the lack of an explicit reference in the regulation or tariff methodology. In the Czech Republic, the NRA may indirectly promote innovation fining the TSO if it does not secure a reliable, safe and effective transmission network. The Slovenia TSO has developed an internal innovation management system encouraging employees to contribute new ideas to improve system operation and company procedures.

Countries such as Portugal and Slovakia have no reference to innovation or linked concepts in the regulatory framework and the revenue methodology gives priority to keep end users’ tariffs low in current economic conditions

<sup>63</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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### 3.3.8 Recap of EU Countries

As it can be seen in the below table, most of 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 23: EU Countries with Dedicated Regulation/Incentive Mechanism for Gas Network Innovation

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

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

We have presented some European countries (UK, Ireland, France and Finland) with supportive regulatory framework incentivising innovation and R&D expenditures. A cross comparison of these countries is presented below. Other countries such as Italy are currently developing innovation incentives for gas TSO aligned with best practices in use in other EU countries.

In the opposite side of these experiences, some countries do not include any incentive mechanism related to R&D. For example, Spanish regulator (CNMC) did not allowed any R&D expenditure in the revenue determination for the next regulatory period (2021-2026). But we have seen how the Spanish TSO has undertaken some R&D expenditures even if they cannot be recovered via allowed revenues.

TSOs of the country cases presented such as National Grid Gas (UK) and GRTgaz (France) are front runners in the application of most innovative solutions such as biogas integration, CNG network development, power to gas solutions, new O&M techniques, etc.

It is necessary to mention that Italian TSO (Snam) and Spanish TSO (Enagás) are also investing in innovative solutions even if these are not directly included in the allowed revenue. Some of the projects developed by Snam and Enagás are supported by EU funding mechanisms explained above but there are also other revenue sources arising from R&D expenditures that can make these investments profitable without direct incentives. R&D investments may lead to efficiency gains, leakage reduction, increases in the number of customers and sales or potential intellectual





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property rights. These potential benefits also encourage TSOs to assume the risk of undertaking R&D investments without related allowed revenues.





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Table 24: Cross-Country Comparison of Gas TSO Innovation Incentives/Funding Mechanisms

Innovation Regulatory Feature	Great Britain	France	Ireland	Finland
<b>High level description of innovation activities and regulatory framework</b>	<p>Most developed innovation incentive regulation among EU countries.</p> <p>Specific innovation incentives in place since 2010.</p> <p>National Grid Gas (NCG) develops innovation projects related to O&amp;M new technique, management upgrading, biogas, power to gas, etc.</p>	<p>TSOs, as public services providers, have the obligation to undertake R&amp;D efforts.</p> <p>Since 2016, Revenue requirement methodology includes an allowed R&amp;D expenditure trajectory for each TSO.</p> <p>GRTgaz (main TSO) is front-runner in power to gas solutions development and is also active in the development of new O&amp;M techniques and digitalisation of operations.</p>	<p>Revenue methodology includes since 2012 a Gas Innovation Fund to finance R&amp;D projects.</p> <p>Innovation efforts of GNI (TSO + DSO) in the last years have been focused on the development of CNG facilities.</p>	<p>Innovation incentive was developed by the NRA (Energy Authority) in 2016 but has not been fully implemented yet since the unbundling of gas transmission activities did not occur until January 2020.</p> <p>Innovation activities are focused on biogas integration.</p>





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Innovation Regulatory Feature	Great Britain	France	Ireland	Finland
<p><b>Innovation Regulatory Incentives in use</b></p>	<p>Two funding mechanisms are available for innovation projects of gas TSO:</p> <ul style="list-style-type: none"> <li>- Network Innovation Allowance (between 0.5-1% of yearly revenue, 0.7% for NCG).</li> <li>- Network Innovation Competition. Competitive fund allocated to TSO/DSOs via tenders. Up to 20 Million £/year for gas projects.</li> </ul> <p>NCG allowed innovation expenditure ≈ 7.5 Million £/year (9 M €) (2014-2019)</p>	<p>Before 2016, ad-hoc inclusion of innovation projects in the RAB. With the new tariffs methodology R&amp;D expenditure trajectory approved by the CRE (NRA) is included in the allowed OPEX of the TSO.</p> <p>CRE assesses the proposed R&amp;D expenditure trajectory to approve/reduce it and include the R&amp;D costs trajectory the regulated revenue.</p> <p>The amount of allowed R&amp;D expenditure is not regulated in advance. For the 2017-2020 regulatory period the following R&amp;D expenditures were allowed.</p> <ul style="list-style-type: none"> <li>- GRTgaz = 21 Million €/year, 2.7% of OPEX, 1.2% of total revenue.</li> <li>- TIGF = 2.2. Million €/year, 2.8% of OPEX, 0.9% of total revenue.</li> </ul>	<p>The CRU (NRA) decides for each regulatory period the amount for the Gas Innovation Fund that is considered as OPEX.</p> <p>GNI (TSO) proposes an amount for the innovation fund but the NRA must approve this amount.</p> <p>Gas innovation Fund (2017 -2022) for GNI= 3.6 Million €/year, 4.7% of Transmission OPEX. 2% of total revenue.</p>	<p>Up to 1 % of R&amp;D costs is allowed when calculating realised adjusted profits of the TSO for each regulatory period.</p>





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Innovation Regulatory Feature	Great Britain	France	Ireland	Finland
<b>Financing innovation incentives</b>	Innovation incentives are included as part of the RIIO revenue and are recovered via end-user's transmission tariffs.	R&D scheduled expenditure is included in TSO allowed revenue. Any budget allocated to R&D and not been used will be restored to users through a revenue balance account.  If TSO R&D expenditure is above the allowed trajectory, costs are borne by the TSO.	Gas Innovation Fund is included as part of GNI OPEX to be recovered via end-user's tariffs.	Allowed Innovation incentive is recovered via end-users' tariffs.
<b>Eligible R&amp;D expenditures/projects</b>	New equipment, novel application existing equipment, novel operational practice or a specific novel commercial arrangement with: <ul style="list-style-type: none"><li>- Environmental benefits</li><li>- Value for customers</li><li>- Creation of knowledge</li></ul>	There is no pre-defined eligible R&D expenditures or classification. Allowed operating expenses are calculated based on historical R&D projects and TSOs tariffs requests.  Main topics of R&D activities are biogas integration, P2G, energy efficiency, data analysis and leakage reductions.	Projects eligible of the Gas innovation Fund must: <ul style="list-style-type: none"><li>- Deliver carbon savings.</li><li>- Contribute to the transition to a decarbonised economy.</li><li>- Increased throughput on the gas system.</li><li>- Obtain measurable value to all gas customers.</li></ul>	Only OPEX R&D costs are allowed (staff costs, external studies, etc) no capital investments are included within the innovation incentive framework.  Expenditures related to new technologies and applications.





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Innovation Regulatory Feature	Great Britain	France	Ireland	Finland
<b>R&amp;D expenditures approval, evaluation criteria and external experts' involvement.</b>	<p>All projects implemented under the innovation incentive framework must be approved via technical evaluation (eligibility criteria, methodology, etc).</p> <p>An external expert panel advises the NRA during the evaluation phase.</p> <p>Financial evaluation of projects is done based on CBA and benchmarks.</p> <p>Project budget is approved before the implementation.</p>	<p>For each tariff regulatory period TSOs must submit a tariff requests including R&amp;D expenditure trajectory.</p> <p>Allowed R&amp;D expenditures are approved in general terms and by topic.</p> <p>The assessment of revenue requests (including R&amp;D) is done with the support of external advisers based on historical costs trajectories.</p>	<p>Gas Innovation Fund is approved for each five years regulatory period without detailed project by project evaluation.</p> <p>The innovation fund is administered by GNI in consultation with GIAG (external experts). It is responsibility of GNI in consultation with the GIAG to determine the best possible use of the innovation funding</p>	<p>TSO should ask the NRA for the confirmation on which of the proposed R&amp;D expenditures are eligible for the innovation incentive.</p>
<b>Implementation, monitoring, reporting obligations and audit</b>	<p>The TSO must report yearly the details of NIA expenditure. For NIC projects: Project Progress Report and Close Down Report.</p> <p>All NIC Projects may be subject to an audit at any time undertaken by the NRA or third parties. NIC projects shall have a different bank account.</p> <p>Close Down Report (or Halting Report) assessing the results of R&amp;D projects.</p>	<p>TSOs send an annual report of R&amp;D projects to CRE to be published.</p> <p>Yearly reports include the list of projects, results, amount spent, R&amp;D budget forecast, staff allocation and external partners/funders.</p>	<p>For each project awarded under the Gas Innovation, GNI must deliver two reports: Initial Innovation Project Forms and Completed Innovation Project Forms. These reports include project description, budget, funding, results and learnings.</p> <p>In addition, a yearly report must be produced by GNI with an overview of all projects financed by the Gas Innovation Fund.</p>	<p>TSO must present R&amp;D costs separately in notes to unbundled financial statements.</p> <p>R&amp;D results, including costs register, must be sent to the NRA and be published on its website.</p>

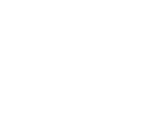




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Innovation Regulatory Feature	Great Britain	France	Ireland	Finland
<p><b><i>Collaboration, partnership and knowledge transfer</i></b></p>	<p>The NIC incentivizes the participation of independent organisations (not network operators). Non-network operators have a specific role and evaluation criteria for NIC tenders. The involvement of several parties (e.g. gas DSO/TSO or electricity operators) is positively assessed during the evaluation process.</p> <p>To facilitate knowledge, transfer the NRA has developed a default treatment for Intellectual Property Rights.</p> <p>Online learning Portal is available for sharing knowledge from NIC and NIA Projects.</p>	<p>Partnership with DSOs, electricity SOs and R&amp;D entities is not explicitly incentivised. Regulation leaves flexibility to the TSOs to decide how to implement innovation projects.</p> <p>In fact, TSOs seek for external partnership. Most important R&amp;D project (Jupiter 1000) was developed with the participation of electricity TSOs and DSOs and external research entities.</p> <p>GRTgaz looks actively in start-ups, SMEs, mid-caps and laboratories, operational responses to technical issues not resolved by GRTgaz’s internal teams.</p> <p>R&amp;D projects results are published via yearly reports.</p>	<p>The Gas Innovation Fund is designed to encourage GNI (TSO) to award R&amp;D projects to external entities applying for funds.</p> <p>Project results and R&amp;D research must be published on GNI website.</p> <p>In the case that any benefits are derived on intellectual property rights by GNI as a result of projects funded under the innovation fund, these should accrue to the customers of GNI.</p>	<p>Collaboration with gas DSOs and electricity operators is not specifically treated in the regulation. External studies from research entities are considered as eligible R&amp;D costs of the TSO.</p> <p>The results of projects must be public to be used by other operators. Results protected by IPR do not need to be made public.</p>





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

#### 3.4.1 Overview

The promotion of gas transmission innovation activities at national level requires a close collaboration between several stakeholders. BOTAS, as the unique TSO in Turkey, has first-hand knowledge of the needs of the gas transmission network and the state-of-the-art technology. Therefore, BOTAS should lead the national innovation strategy of the gas 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 policy (gasification strategy, climate goals, etc) influencing which innovative solutions for the gas sector are considered priorities. Some governments have also put in place support mechanisms such as tax incentives or special funds devoted to innovation activities (e.g. biogas production facilities).
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>64</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 in the end they are funding innovation activities (via network tariffs) and should benefit from potential R&D activities' output: QoS improvements, efficiency gains, carbon emissions reduction, etc.

<sup>64</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 gas 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 gas sector to guarantee that DSOs and TSOs innovation efforts are aligned. In some countries (e.g. UK) the innovation incentive mechanisms are same for gas TSOs and DSOs. TSOs shall be encouraged to collaborate, as far as possible, with gas 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. *Electricity System Operators*. Collaboration between gas TSOs and electricity SOs is required for example for the development of power to gas solutions.
7. *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.
8. *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 gas TSOs of European countries. Turkish TSO (BOTAS) may take advantage 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:

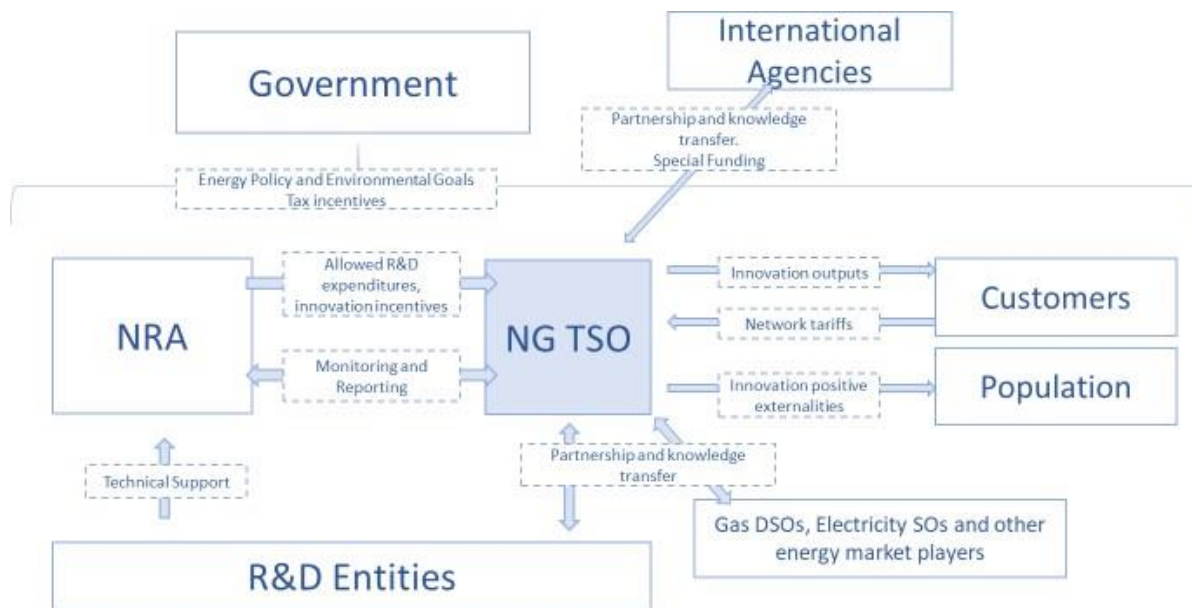


Figure 29: Innovation Strategy Stakeholders



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

Table 25: Turkey Gas Transmission Innovation Strategy: Key Stakeholders

Generic Stakeholder	Turkish Stakeholders
<b>Government</b>	Ministry of Energy and Nature Resource (MENR)
<b>NRA</b>	Energy Market Regulatory Authority (EMRA)
<b>Gas TSO</b>	BOTAS
<b>Gas DSOs</b>	72 Gas Distribution Companies (Regulated, Private)
<b>Other Gas Network Operators</b>	e.g. USF operators, LNG facilities operators, CNG facilities operators, etc.
<b>Market Operator</b>	EPIAS
<b>Electricity DSOs</b>	21 Electricity Distribution Companies (Regulated, Private)
<b>Gas Market Players</b>	Wholesale and Retail Suppliers
<b>Gas Customers</b>	14.7 Million household subscribers and 600k eligible customers.
<b>Public</b>	83 million population
<b>R&amp;D Entities</b>	TUBITAK, Universities, Regional Development Agencies
<b>Government</b>	Ministry of Transport and Infrastructure
<b>Government</b>	Ministry of Industry and Technology
<b>Government</b>	Ministry of Environment and Urbanization
<b>Government</b>	Presidential Science, Technology and Innovation Policies Board
<b>International Agencies</b>	European institutions: ENTSO-G, EU, European Gas Research Group

We have outlined the main stakeholders of innovation strategies and now we will present with more details the usual roles and responsibilities matrix (based on international experiences) for some innovation areas. We focus our presentation in the three key stakeholders (TSO, NRA and Government) but all above mentioned agents are also expected to take role in the implementation of the innovation strategies and plans.

### 3.4.2 Biogas Integration

Existing infrastructure for natural gas transmission may be used to bring biomethane to the final consumer. From a regulatory perspective, it is important to distinguish between production (and supply) of biogas and network operations and investment related to biogas transportation. Biogas production and supply is a liberalised activity open to competition, but the transportation of biogas should be a regulated activity.

According to ENTSO-G Road Map<sup>65</sup> to facilitate biomethane market development it is necessary to enable locally produced biogas to access the distribution and transmission grid via bidirectional reverse flows between TSOs and DSOs systems as well as the upgrading facilities to produce biomethane ready for injection into the gas grids.

<sup>65</sup> ENTSO-G (2020) roadmap 2050 for gas grids





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The TSOs role could be to invest in:

- Connection of biomethane production plants.
- Reverse flows facilities from distribution to transmission grids.
- Installations to upgrade biogas to biomethane in combination (or not) with methanation.

Biomethane with at least a capacity tariff discount and could be investor in connections of biomethane plants. Proper recognition of these roles and coverage in tariffs by NRAs would need to be allowed in order to promote the development of these decarbonization developments.

A report prepared by request of the Council of European Energy Regulators<sup>66</sup> considers several areas for NRAs action aiming to promote biogas integration:

1. Technical regulation. NRAs should set clear connection rules including connection charges, technical connection requirements, responsibilities for setting and maintaining the relevant product quality norms, metering and compression.
2. Incentives for biogas producers and suppliers: lower network tariffs and connection charges.
3. Incentives for network operators. R&D support via allowed revenues to foster network adaptation for new biogas sources.

For our assessment, the third point is the most relevant. We have already presented in the previous sections how biogas integration is a priority area for innovation in most of European countries. In France, Ireland and Great Britain, gas TSOs are currently undertaking R&D expenditures allowed by NRA innovation incentives related to biogas integration.

At government level, biogas integration is usually a key element of national energy planning and environmental goals. EU Renewable Energy Directive of 2009 allowed incentives mechanisms to be implemented at each national level. In Italy, the national government has adopted specific modalities for the incentive of biomethane since 2013. As an example of environmental goals, in France, the Energy Transition Law stated that 10% of gas consumed in 2030 should be from a renewable source.

Based on European experiences we have prepared a matrix with roles and responsibilities for each stakeholder focused on biogas integration in the transmission network. Some of these responsibilities are not directly related to regulatory innovation incentives but should be taken into consideration for the design of an adequate innovation regulation. For example, energy and climate plans are out of the scope of NRAs but NRA decisions (allowed revenues, innovation incentives, tariffs determination, etc) should be aligned with national goals and strategy<sup>67</sup>.

<sup>66</sup> CEER (2018), Study on the Future Role of Gas from a Regulatory Perspective

<sup>67</sup> For example, in Spain, in 2019, the national government rejected new revenue methodologies for gas transmission and distribution arguing that they were incompatible with national energy policy.





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Table 26: Roles and Responsibilities Matrix: Biogas Integration

Entity	Role	Main responsibility	Specific duties
Government		Energy policy: energy planning and environmental goals	<ul style="list-style-type: none"> <li>- Set national goals for biogas integration (% of consumption, national production).</li> <li>- Incentives (e.g. tax deductions) for biogas producers, suppliers, consumers, etc.</li> </ul>
National Regulatory Authority		Revenue determination (including innovation incentives) Network tariffs and connection charges	<ul style="list-style-type: none"> <li>- Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&amp;D expenditures of TSO related to biogas integration)</li> <li>- Setting promotional tariffs for biogas.</li> </ul>
Gas TSO		Network operations and investments	<ul style="list-style-type: none"> <li>- Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research Centres).</li> <li>- Network expansion and upgrading for easing biogas integration and the connection of biogas facilities.</li> <li>- Ensuring quality standards of biogas and safety of the network.</li> </ul>

We consider this roles and responsibilities matrix is compatible with current regulatory framework and institutional design of the Turkish Gas System.

### 3.4.3 LNG and CNG use in Transport Sector

Gas becomes increasingly important in the transportation sector, in both LNG and CNG forms. The use of gas for maritime transportation is not negligible in Europe while the gas fuelled private vehicles are getting more and more competitive especially due to environmental standards of the EU.

Form a regulatory perspective, CNG/LNG supply for transportation is a liberalised activity does no not require special regulation. However, parts of the CNG/LNG supply chain such as the of transport gas to the CNG refuelling stations constitute a natural monopoly and should be regulated.

Under the current European legal framework (3rd package), provision of services in contestable sectors by gas TSOs/DSOs (except for production and supply of natural gas) is not explicitly forbidden. In any case, the use of gas for transport sector is one of the activities that may require a flexibilization of unbundling regulation. The need for flexibility from general unbundling rules to foster new gas application has been identified as an important regulatory area of improvements by ENTSO-G and has been recommended to the CEER<sup>68</sup>. If there is a lack of market interest in the development of CNG/LNG refuelling stations, the active participation of network operators in the operation of these stations could be an alternative.

<sup>68</sup> CEER (2018), Study on the Future Role of Gas from a Regulatory Perspective





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There is one innovative project that illustrates the potential areas of activity for gas SOs in CNG use: the Irish Causeway Project.

The Causeway projects aims to examine the impact of increased levels of CNG fast refill stations on the operation of the transmission and distribution gas networks in Ireland. A pilot network of 17 CNG units (the global project foresees 134) will be built as a pilot activity to assess the impact on the gas network. Activities will encompass developing understanding of the operation and planning of the network, CNG equipment and user demand patterns and behaviours, and the injection of renewable gas into the gas transmission system<sup>69</sup>. This project is partially funded by CRU innovation incentive (12.8 Million €) and EU CEF (7.4 Million €).

According to the Irish NRA (CRU)<sup>70</sup>, the uptake of CNG has the potential to:

- reduce emissions from the transportation sector,
- provide a pathway for Renewable Natural Gas (RNG) to access the transportation market,
- reduce Ireland’s dependence on imported petrol and diesel,
- provide businesses the opportunity to reduce transportation costs; and
- provide businesses the opportunity to reduce their transportation emissions.

Based on European experiences we have prepared a matrix with roles and responsibilities of each stakeholder about CNG/LNG applications in the transportation sector.

Table 27: Roles and Responsibilities Matrix: LNG and CNG Use in the Transport Sector

Entity	Role	Main responsibility	Specific duties
Government		Energy policy: energy planning and environmental goals	<ul style="list-style-type: none"> <li>- Set national goals for gas fuelled vehicles.</li> <li>- Incentives such as tax deductions or emission limits of private vehicles.</li> </ul>
National Regulatory Authority		Revenue determination (including innovation incentives) of the TSO.  Network tariffs and connection charges for refuelling stations connection to the network.  Unbundling provisions.	<ul style="list-style-type: none"> <li>- Network tariffs and connection charges for refuelling stations connection to the network.</li> <li>- Unbundling provisions: In which segments of the CNG/LNG value chains are TSOs and DSO allowed to participate.</li> <li>- Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&amp;D expenditures of TSO related to CNG/LNG network upgrading)</li> </ul>
Gas TSO		Network operations and investments  (potential: active role in CNG/LNG supply chain)	<ul style="list-style-type: none"> <li>- Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres) related to CNG use in the transportation sector.</li> </ul>

<sup>69</sup> The Causeway Project, CEF profile

<sup>70</sup> CER (2016), Compressed Natural Gas Funding Request Decision Paper





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Entity	Role	Main responsibility	Specific duties
			<ul style="list-style-type: none"> <li>- Network expansion and upgrading for easing CNG integration and the connection of refuelling stations.</li> <li>- Develop and operate refuelling stations (if no market interest for these activities).</li> </ul>

LNG is already being used in the transport sector of Turkey. In January 2020, Turkey's first liquefied natural gas (LNG) station, was opened by Shell & Turcas in the Anatolian Motorway. The use of CNG in the transportation sector is also a reality in the Turkish energy sector. In 2018, there were 26 active CNG licenses (transmission + distribution). In 2018 natural gas consumption in form of Vehicular fuel amounted to 92.32 Million m<sup>3</sup><sup>71</sup>.

### 3.4.4 Grid Operation and Safety

To operate the gas transmission network in an efficient and safety manner is a responsibility of the TSO. Revenue Methodology should be designed to guarantee that the TSO has enough resources to operate the network in a safety 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.

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, around 2 million € were allowed to NGG (UK) 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 gas transmission network.

1. Local R&D funds for the industry could be prioritized to cover required technologies for gas TSOs.
2. Provide flexibilities in the regulations (non-energy) for gas 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.

<sup>71</sup> EMRA Turkish Natural Gas Report (2018)





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Table 28: 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)
Gas 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 Gas System.

### 3.4.5 Data Management and Digitalization

Automatization and digitalization are key to achieve efficient gas 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 [NCG] 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>72</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

<sup>72</sup> National Grid (2019) Digitalization Strategy.



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- Innovate with Artificial intelligence.
- Enhance customer relationship management and Digital experience.

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 to increase transparency.

Some digitalization investments related to the above topics (from National Grid Digitalization Strategy) 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 gas 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 IT. Objective A5 establishes that, by 2021, SCADA solutions should be 100% available in gas networks.

Table 29: 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>
Gas 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 Gas System.

### 3.4.6 Relation between TSOs and DSOs

A cross collaboration between TSOs and DSOs is fundamental for gas sector innovation strategy. To maintain a functional, efficiency and reliable gas 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.
- Smart meters at transmission – distribution connection points.



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- Flexibility: the successful implantation of innovative gas solutions (new storage technologies, biogas, P2G solutions) will require a flexible approach from all system operators.
- Critical infrastructure security. To safeguard the cyber and physical security of the national gas system.

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 30: 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>
Gas TSO	Operate and upgrade the gas 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 Gas System.

### 3.4.7 Power to Gas

Power-to-gas (P2G) is the functional description of the conversion of electrical power into a gaseous energy carrier like e.g. hydrogen or methane. Hydrogen can be transported by trucks or rail cars, or through pipelines. The latter can use hydrogen blend, i.e. a certain proportion of hydrogen is mixed with natural gas into natural gas network, where the existing network transports natural gas but with a changed energy content. Alternatively, it can be based on a full conversion, i.e. transportation of pure hydrogen via the network, where the network becomes essentially a hydrogen network<sup>73</sup>.

<sup>73</sup> CEER (2018), Study on the Future Role of Gas from a Regulatory Perspective



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The development of P2G solutions helps to achieve a functional energy sector coupling. Sector coupling and P2G solutions have several regulatory implications. We think ENTSO-G vision on this topic is useful to understand the problematic<sup>74</sup>:

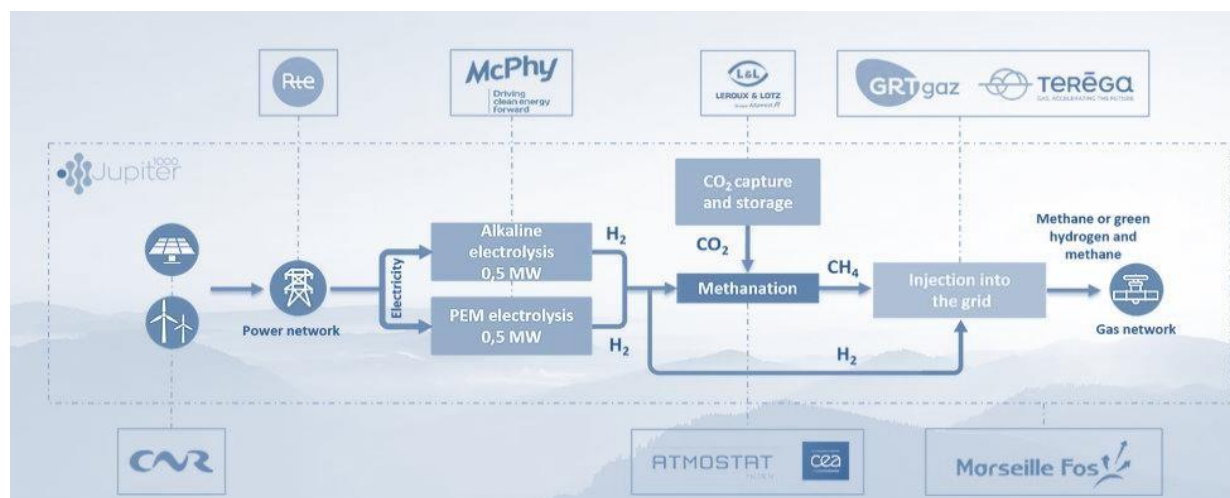
According to ENTSO-G the present market conditions do not seem to sufficiently support an up-scaling of commercial activities needed for optimising gas and electricity infrastructure functioning. ENTSO-G finds that TSO ownership of P2G facilities should be considered – as a way of socialising costs as well as ensuring third-party access to such infrastructure. P2G should be considered as conversion facilities – converting from the electricity system to the gas system. As a system activity, some similarities to LNG terminals can be seen. Neither electricity consumed, nor hydrogen produced by P2G, should be subject to end-user taxes and levies before the produced energy is being finally consumed.

ENTSO-G concludes that the operation of P2G facilities can be considered as commercial or regulated activity. Therefore, it is responsibility of the NRA to decide under which regulatory scheme will P2G facilities be operated. New energy legislative package of the EU is expected to include some provisions on this topic.

The role of TSOs in the operation of P2G facilities is yet to be determined. However, currently European gas TSOs are very active in R&D studies and pilot projects related to P2G solutions. In all European countries analysed, projects and R&D expenditures related to P2G solutions are included as innovation allowed costs subject to be recovered via allowed revenues.

In France, the NRA allows around 1 Million €/year of R&D expenditure to GRTgaz (TSO) for the next regulatory period to cover the expenses linked to its participation in the Jupiter 1000 project.

We think it is interesting to present the key features of Jupiter 1000 project as a good example of partnership between several stakeholders. The Jupiter 1000 projects is also a sample of how gas TSOs expend allowed R&D revenues.



<sup>74</sup> ENTSO-G Roadmap 2050



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Figure 30: Power to Gas Solution Pilot Project: Jupiter 1000<sup>75</sup>

The Jupiter 1000 project is the first industrial demonstrator of Power to Gas with a power rating of 1 MWe for electrolysis and a methanation process with carbon capture. Green hydrogen will be produced using two electrolyzers involving different technologies, from 100% renewable energy. The installation will be based on an innovative methanation technology and CO<sub>2</sub> will be captured on a nearby industrial site. In the light of the performance levels shown by the demonstrator, GRTgaz and its partners will work on future technical and economic standards of a full-sized installation of this type. Over the longer term, the objective is to launch the Power to Gas activity in France.

The role of the national government is related to its energy planning activities. National government may set targets for H<sub>2</sub> penetration within the national energy consumption mix.

Table 31: Roles and Responsibilities Matrix: Power to Gas Solutions

Entity \ Role	Main responsibility	Specific duties
National Government	Energy policy: energy planning and environmental goals	- Set national goals for H <sub>2</sub> integration (% of energy consumption).
National Regulatory Authority	Revenue determination (including innovation incentives) Network tariffs and connection charges Unbundling provisions.	- Network tariffs and connection charges for P2G facilities connection to the network. - Unbundling provisions: In which segments of the P2G value chain are gas TSOs allowed to participate. - Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&D expenditures of TSO related to P2G solutions)
Gas TSO	Network operations and investments  (potential: active role in the operation of P2G facilities)	- Undertake R&D expenditures: pilot projects and external R&D studies (research centres) related to P2G technologies. - Network expansion and upgrading for easing P2G facilities integration. - Develop and operate P2G facilities (optional).

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

### 3.4.8 Guarantees of Origin for Biogas

Establishing a national register of Guarantees of Origin for biomethane is another potential area for innovation. Both the national government, the NRA and the TSO shall play key roles to foster the GoO scheme.

<sup>75</sup> Jupiter 1000 Project Website





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We think it is useful to analyse the experience of the “European Renewable Gas Registry”<sup>76</sup> as an example of good practices on biogas certification.

ERGaR was founded as a cooperation between national renewable gas registries in Europe that will enable cross border transfer of renewable gas certificates among the member registries. The association currently counts 26 members from 14 European countries:

- Biomethane/renewable gas registries
- Gas DSOs & TSOs
- Biogas associations
- Biomethane market players.

ERGAR is built on national registries to establish an independent, transparent and trustworthy documentation scheme for cross border transfer and mass balancing of renewable gas injected into the European natural gas network securing the exclusion of double sale and double counting.

Looking at European experiences, the nature of the appointed entity in charge of the national renewable gas certificated registry varies considerably. In some countries the TSO operates the biogas GoO registers, in other countries governmental or regulatory authorities are in charge and there are also examples of suppliers and DSOs associations managing national GoO registers.

Considering the institutional set up of the Turkish gas market we think BOTAS is the agent best positioned to develop and operate the national renewable gas GoO register.

Table 32: Roles and Responsibilities Matrix: Biogas Integration

Entity	Role	Main responsibility	Specific duties
National Government		Energy policy: energy planning and environmental goals	<ul style="list-style-type: none"> <li>- Set national goals for biogas integration (% of consumption, national production).</li> <li>- Incentives (e.g. tax deductions) for biogas producers, suppliers, consumers, etc.</li> </ul>
National Regulatory Authority		Revenue determination (including innovation incentives) Monitoring and regulation	<ul style="list-style-type: none"> <li>- Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&amp;D expenditures of TSO related to the establishment of a GoO register)</li> <li>- Setting and approving the guidelines for the establishment of a national biogas GoO register.</li> </ul>
Gas TSO		Managing the national register of GoO	<ul style="list-style-type: none"> <li>- Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres).</li> <li>- Develop and operate the national register for biogas GoO ensuring non-discriminatory access.</li> </ul>

<sup>76</sup> ERGaR Present  
ation (2020)



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

### 3.4.9 Carbon Capture, Storage and Transportation

Carbon Capture and Storage (CCS) is the process of capturing waste CO<sub>2</sub> from large point sources, such as fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere. The aim is to prevent the release of large quantities of CO<sub>2</sub> into the atmosphere. The transportation of CO<sub>2</sub> can be done via dedicated pipelines or on ships.

There are several pilot projects undergoing in Europe related to CCS solutions<sup>77</sup>:

- Belgium: Antwerp Port Authority and Fluxys (TSO) are studying the feasibility of solutions for capturing CO<sub>2</sub> from industry in the port, transporting it by pipeline or ship and finally re-using or storing it.
- Ireland: Ervia and Gas Networks Ireland (TSO) are investigating the potential for a large-scale CCS project in Ireland to capture the CO<sub>2</sub> from a number of gas-fired CCGT power plants so that they provide low-carbon electricity. Initial findings suggest that CCS may be technically and economically viable for Ireland and over the next few years.

In all regulated innovation incentives schemes analysed, CCS projects are eligible to receive special funding. Based on the European experiences we propose the following responsibilities matrix to incentive the development of CCS solutions.

Table 33: Roles and Responsibilities Matrix: Carbon Capture and Storage Solutions

Entity	Role	Main responsibility	Specific duties
National Government		Energy policy: energy planning and environmental goals	<ul style="list-style-type: none"> <li>- Set national goals for carbon emissions.</li> <li>- Incentives for carbon emissions reductions (CO<sub>2</sub> emissions cap and allowance trading).</li> </ul>
National Regulatory Authority		Revenue determination (including innovation incentives) Monitoring and regulation	<ul style="list-style-type: none"> <li>- Implementation and monitoring of innovation regulatory incentives (e.g. allowing R&amp;D expenditures of TSO related to CCS technology)</li> <li>- Setting and approving the guidelines for the establishment of a national biogas GoO register.</li> </ul>
Gas TSO		Innovation activities and partnership	<ul style="list-style-type: none"> <li>- Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres).</li> <li>- Develop and operate the national register for biogas GoO ensuring non-discriminatory access.</li> </ul>

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

<sup>77</sup> ENTSO-G Innovative Platform Projects



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

BOTAŞ, unique natural gas transmission operator in Turkey, operates only in transportation of crude oil through pipelines, has engaged in natural gas transportation and trade activities with the aim of meeting the increasing energy demand of Turkey. BOTAS currently carries out the following activities.

- Crude Oil and Natural Gas Transportation and Pipeline Operation
- Project Design, Engineering, Land Survey, Expropriation and Construction of Crude Oil and Natural Gas Pipelines and Compressor Stations
- LNG/FSRU Terminal Operations
- Marine Terminal Operations
- Natural Gas and LNG Trade
- Natural Gas and LNG Storage Facilities
- International Natural Gas and Oil Transportation Projects.

The Article 14.4 of the “Principles and Procedures for Determining the Revenue Caps to be taken as basis to the Tariffs of Natural Gas Transmission License Holding Companies” is related with the R&D, certification and training expenses of the gas transmission system operator.

*“The maximum 1 % of the regulated operational expense of the transmission system operator can be allocated for the costs related with research and development, certification and training. Such costs are included for the determination of the revenue cap.”*

Ministry of Energy has published “National Energy Efficiency Action Plan” in 2017 which covers the term 2017 – 2023. The Action Plan requires the involvement of efficiency standards in gas transmission and distribution systems, one of the specified actions is referred as “ : **E2-Application of Efficiency Standards for Natural Gas Infrastructure**”

The purpose of the action is stated as the improvement of control mechanisms to reduce the losses. MENR is the responsible body; EMRA, BOTAŞ and Gas Distribution Companies are the assigned entities for implementation of the action. The expected activities are stated as

- The Road Maps and associated standards shall be defined in order to reduce losses and to increase energy efficiency
- In accordance with the specified road map, the actions shall be taken to assess the conditions of the gas transmission system in terms of energy efficiency and measures shall be put into application for cost efficiency
- It shall be monitored the preparation of road maps for energy efficiency and their put into practices.





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BOTAS has been disbursed its allocated funds for innovation activities on energy efficiency and sustainability projects during recent years. In line with this strategy, BOTAŞ was the first establishment that has implemented the TS EN ISO 50001 Energy Management System (started in 2017 and completed at the end of 2018) among all facilities in the energy sector as part of the projects initiated by the Ministry of Energy and Natural Resources within the framework of the National Energy and Mining Policy. Compared to 2018 energy consumption with the same period of 2017, BOTAŞ saved 35% in natural gas consumption and 25% in electricity consumption. Within the energy management studies, in addition to the existing 1 MW Solar Power Plant (GES) project, a new GES Project of 5 MW (1 MW- Adana Ceyhan, 2 MW Aksaray Salt Lake, 2 MW Ankara Yapracık) is included in to the energy management studies plan. Installation of Wind Power Plants (WPP) are also considered for facilities that meets the requirements.

BOTAŞ has been conducting studies for the use of high temperature exhaust gases through the compressor station chimneys in electricity production. The reduction of greenhouse gas emissions is another area of focus. A remarkable reduction has been noticed during past two years, as declared by BOTAŞ. The amount was 19.048 mg in 2017 and 11.710 mg in 2019.

Establishing an efficient R&D system is set one of the objectives of BOTAS as part of strategic goal “Prioritizing Innovation, Localization and Energy Efficiency”. Accordingly, R&D and Business Development Unit is constituted under Strategy Development Department. However, When the income statement of the company is analysed, it is seen that BOTAS has not used any R&D funds between 2016 and 2018 even the gross income is over 50 Billion TL. Income statement for 2019 has been published publicly yet, so R&D expenditures of respective year has not been known.

Ministry of Energy and Natural Resources (MENR) has set certain purpose and targets in its 2019-2023 strategic plan document<sup>78</sup>. Those targets that are noted to be relevant for BOTAS are stated in the following table:

*Table 34: Certain Goals Stated in 2019-2023 Strategic Plan for Gas Transmission*

Purpose	Associated Goals
<b>A1 Sustainable Energy Security</b>	H1.3 Natural Gas and Electricity infrastructures shall be improved
<b>A2 The activities shall be carried out in order to prioritize Energy Efficiency and improve it</b>	H2.1 Studies for the improvement of Energy efficiency shall be continued H2.2 For the electricity and natural gas markets, the legal framework shall be revised to include terms for demand side management.
<b>A4 To become an effective regional and global player for energy and natural resources</b>	H4.1 Activities shall be carried out for the purpose of becoming an energy trade hub
<b>A5 Innovations in the field of Energy and natural resources, improvement of localization</b>	H5.1 The strategically important R&D projects in the area of Energy and natural Resources shall be increased.

<sup>78</sup> MENR 2019-2023 Strategic Plan.





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Purpose	Associated Goals
<b>A6 To Enhance the Predictability for Energy markets</b>	<p>H6.1 The capacity and the effectiveness of the energy markets shall be enhanced.</p> <p>H6.3 Medium- and Long-Term Supply/Demand Projections shall be prepared.</p> <p>H6.5 The Transparency and Predictability in the energy markets shall be improved.</p>

There has been specified certain performance indicators for BOTAŞ for the achievement of above stated goals. Among those the following are directly related with the TSO.

- (In terms of security of supply) The Natural Gas Transmission System shall meet the (n-1) criteria in 2020 and (n-2) criteria in 2023.
- The expansion of the capacities at the interconnections with South East European countries in order to increase natural gas trade. The action was expected to be implemented in 2020.
- Commissioning of a new “National SCADA System” (*to be designed and developed by national sources*) for the pipeline is expected to be implemented until end of 2021 and completion rate is defined as key performance indicator. Impact on target is identified as 60% and project is scheduled to initiate in 2019 and completed in the 2021. It is targeted to complete 35% of the project in 2019, 80% in 2020 and completed in 2021,
- Pilot implementation for demand side participation in natural gas pipeline is expected to be implemented until end of 2021 and completion rate is defined as key performance indicator, likewise. Impact on target is identified as 15% and project is scheduled to initiate in 2021 and completed in the same year.

Beside internal funding of energy efficiency and sustainability projects and R&D activities, Involvement in R&D and European programmes should be encouraged. It is expected to focus on following R&D studies that can be done about pipelines in the upcoming years are:

- Pipeline construction technologies and new material technologies
- Development of maintenance-operation-monitoring equipment
- Pipeline damage (external) prevention
- Monitoring and control systems
- Pilot energy efficiency applications on different sites at facilities/buildings/vehicles of municipalities
- Pilot renewable energy and energy efficiency applications on different sites at facilities/buildings of municipalities, their subsidiaries and municipal service providers for self-consumption purposes





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- Precautions to be taken for earthquake, terrorism or natural disaster risks.

On the other hand, Turkish gas transmission sector has received support under CEF program for cross-border TANAP project. TANAP Natural Gas Pipeline Project was one of the natural gas projects which was selected for financial assistance under the first CEF Energy Call. Since 2014 up to date the total amount of grants received for TANAP project exceeded €10 million for various activities.

Some of the projects where Turkey is involved are listed as follows:

Table 34: Support to TANAP under CEF

Project Name	Country	Participant Company	Project Duration	Total Budget / Funding
Feasibility Study for the Interconnection Turkey-Bulgaria (ITB) <a href="http://www.eib.org/projects/loan/loan/20150467">http://www.eib.org/projects/loan/loan/20150467</a>	Bulgaria, Turkey	Bulgartransgaz EAD	03/2015-01/2016	€380.000/ €190,000
Environmental monitoring	Turkey	TANAP Natural Gas Transmission Company	08/2014-12/2019	€6,715,800/ €2,014,740
Detailed Engineering for Pipeline Security System (PSS)	Turkey	TANAP Natural Gas Transmission Company	10/2015-06/2016	€4,438,000/ €2,219,000
Engineering studies for TANAP SCADA System and Crossings under Dardanelle Strait and Evros River	Turkey	TANAP Natural Gas Transmission Company	05/2015-07/2017	€5,118,000/ €2,559,000
Design of Commercial Operations and Asset Integrity Management Systems	Turkey	TANAP Natural Gas Transmission Company	07/2016-07/2018	€7,070,000/ €3,535,000



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### 3.6 Gap Analysis and Recommendations

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

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

1. Effectiveness. The final objective is to upgrade gas 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 BOTAS invests on R&D studies and on the deployment of innovative solutions.
2. Flexibility. The mechanism shall be designed in a way that leaves enough flexibility for both BOTAS 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 BOTAS 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 BOTAS 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 gas 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 BOTAS R&D expenditures by EMRA.

These features are presented in more detailed in the following table:



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Table 35: Proposed Innovation Incentive Mechanism for Turkey: Key Features for Gas Transmission

Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<b>General objectives of TSO activities</b>	Clearly define the overall objectives of gas TSOs' innovation activities	<p>It is recommendable to establish a set of general objectives driving innovation efforts of BOTAS. These general objectives should be used to clearly defined which expenditures are eligible for the innovation incentive.</p> <p>Our proposal is to classify innovation activities under each of the following three final objectives:</p> <ul style="list-style-type: none"> <li>a) Value creation for customers.</li> <li>b) Carbon savings and environmental benefits.</li> <li>c) Knowledge transfers and new technologies dissemination.</li> </ul> <p>These objectives shall be used as the overall criteria to assess which projects are eligible to receive innovation incentives.</p>	<p>In most of European cases analysed, innovation incentives regulation or revenue methodologies include the general objective pursued.</p> <p>The evaluation criteria of each country are implemented taking into consideration whether candidate projects contribute to the achievement of the general objectives.</p>	Government, EMRA and BOTAS





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Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<p><b>Priority Areas for Innovation Activities</b></p>	<p>Develop and update periodically the list of innovation areas.</p> <p>The list of innovation areas for eligible projects must be flexible.</p>	<p>There are several areas for innovation in gas transmission activities.</p> <p>Innovation priority areas shall be aligned with national energy planning goals (in any) but the specific proposals for innovation projects/areas should come from BOTAS.</p> <p>BOTAS is expected to be aware of the state of the art of gas network innovation and also which features of gas transmission activities may be upgraded with innovative solutions.</p> <p>EMRA and R&amp;D institutes shall also be allowed to propose priority areas for innovation.</p> <p>The list of innovation areas/activities must be flexible.</p>	<p>The revenue determination of European NRAs present which TSOs' expenditures are allowed as R&amp;D expenditures classified under different areas for innovation.</p>	<p>Government, EMRA BOTAS and R&amp;D institutes.</p>



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Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<p><b>Funding innovation incentives</b></p>	<p>Include innovation incentives as part of the allowed OPEX</p> <p>Allowed innovation OPEX will be set by EMRA upon proposal of BOTAS.</p> <p>The amount of allowed R&amp;D OPEX should not be fixed in advance but our recommendation is to target a yearly allowed R&amp;D expenditure around 1% of total revenue.</p>	<p>For each regulatory period, BOTAS 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 topic (e.g. biogas or digitalization).</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 recommendations is to evaluate the proposal with external support (e.g. advisors).</p> <p>We recommend targeting a yearly R&amp;D budget of around 2% of total TSO OPEX (defined as up to 1% of OPEX in the effective regulation<sup>79</sup> for BOTAS).</p> <p>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 BOTAS. Unspent amounts shall be reconcile 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.</p> <p>In most countries analysed, innovation incentives are included as allowed OPEX of the TSOs</p> <p>CAPEX based alternatives lead to problems related to RAB and depreciation policy that may be hard to overcome.</p> <p>OPEX based solutions for innovation incentives are the alternative identified as best practice in a recent report of the European Commission (2019).</p> <p>1% of total revenue for R&amp;D expenditures is an international benchmark (which roughly corresponds to 2% of OPEX): 0.8% of total revenue (UK), 1.2% of total revenue (France), 2% of total revenue (Ireland), 1% of total revenue (Finland).</p>	<p>EMRA and BOTAS</p>





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Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<p><b>Evaluation Matrix for R&amp;D Project Applications (pre-project)</b></p>	<p>Upon proposal of BOTAS, EMRA shall evaluate which innovation projects and R&amp;D expenditures can be included in the allowed OPEX</p>	<p>EMRA shall evaluate proposed R&amp;D expenditures of BOTAS with three criteria:</p> <ol style="list-style-type: none"> <li>1. Innovation area. Is the proposed project or R&amp;D expenditure related to one of the priority areas?</li> <li>2. Technical evaluation. Is the project innovative? Is the project feasible? (external support is recommendable).</li> <li>3. Financial evaluation. Is the proposed budget reasonable? Considering the lack of historical expenditures at national level it may be hard to assess this, international benchmark could be an option (external support is recommendable).</li> </ol>	<p>The proposed evaluation matrix is aligned with evaluation criteria of EU NRAs.</p> <p>European NRAs usually engage external assistance for the evaluation of R&amp;D projects.</p>	<p>EMRA and BOTAS</p>

<sup>79</sup> Principles and Procedures for Determining the Revenue Caps to be taken as basis to the Tariffs of Natural Gas Transmission License Holding Companies



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Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<b>R&amp;D Project Monitoring Requirements (post-project)</b>	Yearly reporting of R&D expenditures	<p>Each year, BOTAS 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 BOTAS R&amp;D expenditures.</li> <li>- Knowledge dissemination. These reports must be published in both BOTAS and EMRA website.</li> </ul>	<p>In all countries analysed, TSOs must comply with reporting obligations related to innovation incentives.</p> <p>Usually innovation reports are publicly available to facilitate knowledge transfer.</p>	EMRA and BOTAS
<b>Amendments to Secondary Legislation</b>	<p>In principle the proposed innovation incentive (via OPEX allowance) does not require specific modifications of the tariff regulations.</p> <p>Only Revenue Requirement Methodology must be modified</p>	<p>Revenue Requirement Methodology must be modified to increase R&amp;D expenditures in the allowed OPEX. It is recommendable to include also the following aspects:</p> <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 BOTAS.</li> </ul>	<p>In most of the countries analysed there is not specific legislation for the innovation incentive.</p> <p>Innovation incentive regulation is included in the overall Revenue Requirement Model regulation.</p>	EMRA



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Feature	Recommendation	Explanation	Supportive Arguments	Key stakeholders involved
<p><b>BOTAS Internal Strategic Innovation Office</b></p>	<p>BOTAS should develop an internal corporate policy to regulate and support innovation activities within the company.</p>	<p>BOTAS internal innovation policy should cover, among other things:</p> <ul style="list-style-type: none"> <li>- Priority innovation areas for the company.</li> <li>- Procurement policy and rules. BOTAS will most likely enter into partnership with R&amp;D centres or procure external advisory services on specific innovation projects. Call for proposals' rules.</li> <li>- Internal audit. To comply regulated reporting obligations of EMRA, BOTAS should developed internal monitoring procedures. Internal audit will allow BOTAS to comply with EMRA reporting obligations but also to upgrade internal procedures related to innovation.</li> </ul>	<p>Most advanced European TSOs in terms of innovations tends to go beyond the regulated innovation obligations.</p> <p>TSOs tend to develop internal innovation strategies that work as a whole. Part of innovation costs may eb recovered via regulated incentives, but the overall strategy of the company is not limited to the scope of regulated incentives.</p> <p>For example, French TSO (GRTgaz) launched the Research and Innovation Centre for Energy (RICE) to concentrate all R&amp;D activities of the company.</p> <p>National Grid (UK) has developed an internal procedure governing the call for proposals to develop substantial innovations for gas transmission network.</p>	<p>BOTAS</p>



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The application of the above recommendations aims to support and incentivise R&D activities of BOTAS. The proposed incentive mechanism should not be considered as an excessive interference of EMRA on BOTAS activities since, in the end, BOTAS will be responsible to define the innovation strategy. The role of EMRA is to incentive certain innovation activities via additional revenues but the possibility exists that BOTAS do not undertake innovation activities and therefore do not benefit from the incentives. In all the countries analysed with innovation support and incentives mechanism, national TSOs tend to take advantage of additional revenue available for R&D activities but there are no penalties if a TSO freely decides not to invest. Incentive mechanism should be designed in way that encourages TSO to invest on innovation without excessive interferences from the NRA. With this purpose our recommendations have been prepared.

The aim of EMRA should be to encourage BOTAS to invest on R&D activities that could produce value for customers or environmental benefits. Incentives contribute to internalise into BOTAS revenues some of the positive externalities arising from its R&D activities.

In the following table we outline some recommendations on specific innovation areas. We also explain how innovation incentives may impact BOTAS activities compared with the business as usual situation.

Table 36: Recommendations for Innovation Areas in Gas Transmission

Innovation Area	Recommended innovation activities for BOTAS	Impact
<b>Renewable gases integration</b>	<p>Pilot projects and external R&amp;D studies</p> <p>Network expansion and upgrading for easing biogas integration and the connection of biogas facilities.</p> <p>Ensuring quality standards of biogas and safety of the network.</p>	<p>Without incentives, BOTAS might be reluctant to invest on renewable gases integration due to related operational challenges.</p> <p>Pilot and small-scale projects are not likely to be profitably during the first stages of the technology development.</p> <p>Incentives may foster the integration of renewable gases encouraging BOTAS to acquire the knowhow and implement new technology solutions.</p>
<b>LNG/CNG integration in transport sector</b>	<p>Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres) related to CNG and LNG use in the transportation sector.</p>	<p>Without incentives, BOTAS might be reluctant to invest on new infrastructure to related operational challenges.</p> <p>Pilot and small-scale projects are not likely to be profitably during the first stages of the technology development.</p>



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		Incentives may foster the deployment of CNG/LNG infrastructure to supply the transportation sector.
<b>Power to Gas Solutions</b>	<p>Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres) related to P2G technologies.</p> <p>Network expansion and upgrading for easing P2G facilities integration.</p> <p>Develop and operate P2G facilities (optional).</p>	<p>Without incentives, BOTAS might be reluctant to get involved in pilot P2G projects due to the operational challenges and the number of stakeholders involved (e.g. electricity SOs) .</p> <p>Pilot and small-scale projects are not likely to be profitably during the first stages of the technology development.</p> <p>Incentives may foster the development of P2G solutions in Turkey.</p>
<b>Guarantees of Origin</b>	<p>Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres).</p> <p>Develop and operate the national register for biogas GoO ensuring non-discriminatory access.</p>	<p>To manage a biogas GoO register will not be profitable until the volume grows.</p> <p>Pilot and small-scale projects are not likely to be profitably during the first stages of the technology development.</p> <p>Incentives may overcome this profitability problem.</p>
<b>Carbon Capture, Storage and Transportation</b>	<p>Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres).</p> <p>Develop and operate the CCS infrastructure ensuring non-discriminatory access.</p>	<p>Pilot and small-scale projects are not likely to be profitably during the first stages of the CCS technology development.</p> <p>Incentives may overcome this profitability problem.</p>
<b>Grid Operations and Safety</b>	<p>Undertake R&amp;D expenditures: pilot projects and external R&amp;D studies (research centres) to upgrade grid operations and safety.</p>	<p>Innovation incentives may encourage BOTAS to deploy new technology related to grid operations.</p>
<b>Data Management and Digitalization</b>	<p>Design and implementation of digitalization strategy</p> <p>Upgrade data management and information system.</p>	<p>Innovation incentives may encourage BOTAS to invest on digitalization and automatization.</p>



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### 3.7 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 BOTAS 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 BOTAS, thus it should have a broader scope. The Innovation Plan should be the guidance for any stakeholder potentially involved in gas transmission innovation activities both national and abroad.

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 gas 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.

BOTAS and EMRA should be in charge of developing the innovation master plan in close collaboration with the Ministry. We think BOTAS should be the primary responsible of the preparation of the innovation master plan considering its first-hand knowledge of the needs of the gas 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 gas transmission innovation master plan is aligned with the overall national energy strategy.

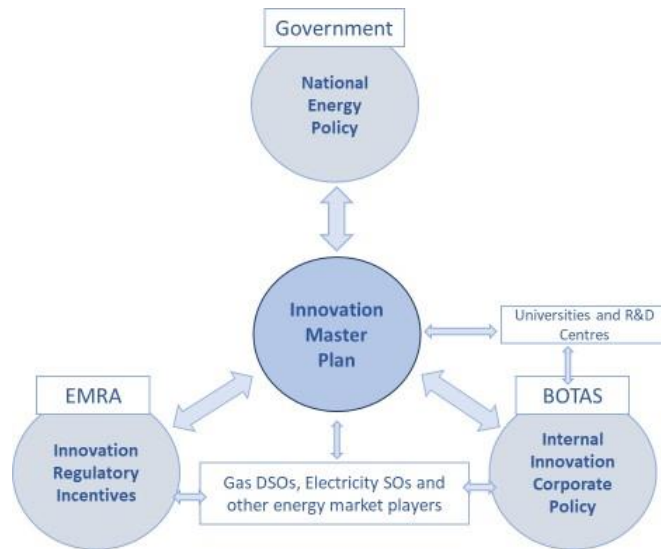


Figure 31: Gas Transmission Innovation Master Plan: Stakeholders Involvement

The Innovation Master Plan for Gas Transmission could follow a top-down approach like the one in use by the National Energy Strategy (2019-2023)<sup>80</sup>. The top-down approach is based on an objective-target-performance indicators sequence as we present below.

<sup>80</sup> MENR (2019-2023) Strategic Plan





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Figure 32: 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 gas transmission sector.

In this report we have assessed potential areas for innovation in the gas transmission sector:

- Biogas integration.
- LNG and CNG use in transport sector.
- Grid Operation and Safety.
- Data Management and Digitalization.
- Relation between TSOs and DSOs.
- Power to Gas.
- Guarantees of Origin for Biogas.
- Carbon Capture, Storage and Transportation.

The Innovation Master Plan may be developed around these activities.

Finally, we present a proposed outline of the Innovation Master Plan for Gas 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 gas distribution, EMRA is recommended to directly be involved in coordinating the preparation of the Innovation Master Plan since there are more than 70 DSOs. In gas transmission, BOTAS is the unique TSO and therefore is well positioned to play a leading role in the preparation of the national Innovation Master Plan for Gas Transmission.





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Table 37: Innovation Master Plan: Gas Transmission (Tentative Outline)

Innovation Master Plan: Gas Transmission	
<b>1. Background</b>	
1.1. Overview of national gas sector.	
1.2. Introduction to EMRA	
1.3. Introduction to BOTAS	
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 BOTAS and Gas 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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## 4 Appendix

### 4.1 Selected Gas Distribution Projects Funded Under the Horizon 2020 and LIFE

Project SmartGasGrid <sup>81</sup>	
<b>Description</b>	<p><b>Overview</b></p> <p>Gas grids have the potential to become an energy storage device for renewable energy in the form of biomethane but, at the moment, this potential is not fully exploited due to technical limitations in what are still largely manually driven grid systems. Gas grid systems are about to undergo fundamental changes, driven by the rapid growth in renewable energy production, which creates the need for a more flexible and active gas distribution system: a "smart gas grid", with real-time, precise monitoring and controlling of gas pressure, gas quality and the gas flow. Utonomy, a British/German SME, is developing a novel, cost-effective smart grid technology that monitors and controls gas pressure, flow &amp; gas quality by means of cloud-based, algorithm-driven hardware that can be easily installed without the need for any changes in the gas infrastructure. Utonomy has already developed a pressure management application that helps utilities reduce gas leakage to TRL 6, with the first field pilots planned for January 2018. However, during development work and in the course of discussions with future customers, Utonomy discovered that pressure management has even more commercial potential when applied to increase the grid feed-in capacity of biomethane plants. The system provides valuable data from day 1, it has an exceptionally short payback period and the increased output enabled by the innovation could result in total CO<sub>2</sub> mitigation of approx. 26m tonnes p.a. in the UK, France, the Netherlands and Germany. Utonomy's near-term marketing focus will be on these four countries, but the technology has significant sales potential everywhere there is a gas grid. Utonomy is targeting incremental revenues of EUR 19m from this project in 2022. The focus of this Phase 1 study will be to analyse the technical adaptations required for the optimization of renewable gas injection, build a demonstrator and evaluate go-to-market and pricing options.</p>

Project Enabling Smart Energy as a Service via 5G Mobile Network advances <sup>82</sup>	
<b>Description</b>	<p><b>Overview</b></p> <p>Despite a number of software frameworks and reference architectures have made available for 5G enabling technologies, there is a clear gap to bridge towards 5G seamless application with a number of "vertical" sectors. Energy vertical represents undoubtedly one of the most significant "test cases" for 5G enabling technologies, due to the need of addressing a huge range of very diverse requirements to deal with across a variety of applications (stringent capacity for smart metering/AMI versus latency for supervisory control and fault localization). However, to effectively support energy utilities along their transition towards more decentralized renewable-oriented systems, several open issues still remain as to 5G networks management automation, security, resilience, scalability and portability. To face these issues, NRG-5 will research and develop a novel 5G PPP-compliant software framework specifically tailored to the energy domain, which combines i) trusted, scalable and lock-in free plug 'n' play support for a variety of constrained devices; ii)</p>

<sup>81</sup> <http://www.utonomy.co.uk>

<sup>82</sup> <http://www.nrg5.eu>





This project is funded by the European Union

Project	
Enabling Smart Energy as a Service via 5G Mobile Network advances <sup>82</sup>	
	5G devices' abstractions to demonstrate mMTC, uMTC and xMBB communications coupled with partially distributed, trusted, end-to-end security and MCM to enable secure, scalable and energy efficient communications; iii) extended Mobile Edge Computing (xMEC) micro-clouds to reduce backhaul load, increase the overall network capacity and reduce delays, while facilitating the deployment of generic MTC-related NFVs and utility-centric VNFs; iv) an extended 5G ETSI-MANO predictive analytics framework to support automated, dynamic, elastic VNF reconfiguration. Extensive lab based validation will be complemented with real life demonstrations in two pilot sites (Italy, France) where proof-of-concept implementations for 5G-enabled electricity and gas distribution network optimized management will be offered, while offering support to 5G PPP phase III projects via demonstrating high replication potential towards other verticals.

Project	
VOLUME Induced micro-COgenerator for high energy efficiency of gas distribution networks <sup>83</sup>	
<b>Description</b>	<b>Overview</b>
	<p>To address its growing energy needs, Europe is seeking to increase the usage of more environmentally friendly energy sources with increased efficiency. In response, the market is leaning more towards natural gas, with market penetration growing at 64% faster than any other source! However, its wider adoption is being hampered by the energy losses and energy wastage resulting in the gas depressurisation from the transportation network pressure (40-60 bar) to the local distribution network pressure (<math>\leq 1.5</math> bar). The losses result in reduced efficiency in the gas networks and higher infrastructural and plant management costs – which are often passed to the final end users. There is a dire need to develop a technology that streamlines the gas distribution network, being capable to recover the energy lost during pressure drops and boosting its cost effectiveness. SINERGIA, is an Italian company specialized in the design and development of plants for the production, treatment, drying, filtration and separation of compressed air and technical gases. Leveraging 22 years of industrial experience and the closeness to the natural gas and its stakeholders, SINERGIA have developed the VOLUMICO micro-cogenerator. While providing in a single step the gas at the desired pressure to the required value of the domestic or industrial users, VOLUMICO recovers the energy loss from its expansion and pressure drop to produce additional low-cost, low-carbon electrical power to be used internally or fed to the grid. Targeting consumers – SMEs, municipal utilities, public institutions, industrial/residential districts – and gas suppliers, VOLUMICO will enable reduction in energy bills (-35%) through highly efficient energy extraction for the first ones, and reduction of infrastructure and maintenance costs (-30% of CAPEX/OPEX) for the latter. Within a 5-year period, Sinergia will generate a cumulative revenue and profit of €49.6M and almost €12.7M respectively, creating a total of 33 jobs.</p>

<sup>83</sup> <https://cordis.europa.eu/project/id/833066/it>





This project is funded by the European Union

Project Energy Forecasting	
<b>Description</b>	<p><b>Overview</b></p> <p>NRG4Cast is developing real-time management, analytics and forecasting services for energy distribution networks in urban/rural communities. We are analysing information regarding network topology and devices, energy demand and consumption, environmental data and energy prices data. The services that will be integrated in a software module pipeline providing prediction and the decision support system based on network monitoring, anomaly detection, root cause analysis, trend detection, planning and optimisation. These services will be using advanced knowledge technologies in particular machine learning, data and text mining, stream mining, link analysis, information extraction, knowledge formalisation and reasoning. The platform will be tested in the two orthogonal case studies energy efficiency in municipalities and energy efficiency in city districts. The two case studies will be complemented with the additional energy networks operated by project partners: electric vehicles network, public lighting system and energy positive buildings. The proposal concentrates on electric power networks through the development of a generic framework that will be able to control, manage, analyse and predict behaviour in an extensible manner on other energy networks like gas distribution, heat water distribution and alternative energy distribution networks. For these reasons, a generic toolkit with programmable data adapters will also be developed. Proposal gathers highly competent RTD organisations, developers, energy operators and case studies from four European countries. The project is led by JSI, has a consortium of 8 partners from 4 different countries and will run for 36 months.</p>

Project Distributed Information Acquisition and Decision-Making for Environmental Management <sup>84</sup>	
<b>Description</b>	<p><b>Overview</b></p> <p>The resulting methods and tools will support environmental management in industrial settings. In particular, the resulting system will support seamless and efficient integration of</p> <ul style="list-style-type: none"> <li>• robust and efficient gas monitoring systems and</li> <li>• advanced decision support/planning systems which facilitate rapid, high-quality decision making based on rich domain expertise and large quantities of relevant information.</li> </ul> <p>The resulting systems will contribute to safer and healthier environment in industrialized areas in different, complementary ways:</p> <ul style="list-style-type: none"> <li>• Mitigation of consequences of catastrophic chemical incidents through quick and reliable gas detection, monitoring and extremely efficient decision-making processes.</li> <li>• Prevention of catastrophic chemical incidents and reduction of chemical pollution through planning based on collaboration of many experts and efficient use of advanced tools.</li> </ul>

<sup>84</sup> <https://cordis.europa.eu/project/id/224318>





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Project Distributed Information Acquisition and Decision-Making for Environmental Management <sup>84</sup>	
	<ul style="list-style-type: none"> <li>• Prevention of chemical air pollution in industrial areas. By being able to quickly detect and discover the sources of pollution, the environmental protection agencies will be able to enforce stringent regulations upon the industry.</li> </ul> <p>This will be achieved through a unique combination of</p> <ul style="list-style-type: none"> <li>• advanced approaches to information fusion and gas distribution models,</li> <li>• a service-oriented approach to modular information processing,</li> <li>• seamless integration of human-based and automated reasoning techniques supported by multi criteria decision analysis and advanced human machine interfaces and</li> <li>• different existing tools will be integrated into various processing modules.</li> </ul> <p>While the project is addressing very challenging problems, a unique combination of consortium partners guarantees substantial breakthroughs within the planned time frame. The consortium consists of complementary partners, ranging from academics with excellent scientific track to SMEs and Multinationals serving the most demanding high-tech markets.</p>

Project LIFE GREEN GAS NETWORK – Intelligent System to Implement Smart Functions on Gas Networks to Mitigate the Greenhouse Effect by Reducing Gas Leaks <sup>85</sup>	
<b>Description</b>	<p><b>Background</b></p> <p>To meet the EU objective of an overall 8% reduction in its greenhouse gas (GHG) emissions from 2008 to 2012 - in accordance with the Kyoto Protocol - each Member State should implement a cap-and-trade type system applied to their industrial sectors characterised by high emission levels, which overall generate 40% of GHG emissions in the EU. At the end of 2008, the EU strengthened its commitment by adopting a new strategy, which stated 3 objectives to be reached by 2020: 1) primary source consumption reduced by 20% compared with trend forecasts; 2) GHG emissions reduced by 20%; and 3) a 20% increase in energy from renewable sources for final consumption. Gas leaks are not only a waste of resources, but also an important contributor to greenhouse gas emissions. Scientific evidence has shown that losses of methane and carbon dioxide - the GHGs contained in natural gas - are directly proportional to network operating pressure. This quantity is kept constant at an over-dimensioned value with the current operating method.</p> <p><b>Objectives</b></p> <p>The LIFE GREEN GAS NETWORK project set out to show that a new management and control system to regulate pressure levels in natural gas distribution networks could reduce greenhouse gas emissions caused by gas leaks by at least 3%. This system would include a new management and control system, including new devices for measuring and regulating pressure in natural gas distribution networks. New software would manage remote communication between devices on the network and a control centre and process data in real time to optimise gas pressure in each branch of the network. The project expected to be able</p>

<sup>85</sup>[https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n\\_proj\\_id=5072#PD](https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5072#PD)



This project is funded by the European Union

**Project** LIFE GREEN GAS NETWORK – Intelligent System to Implement Smart Functions on Gas Networks to Mitigate the Greenhouse Effect by Reducing Gas Leaks<sup>85</sup>

to maintain pressure above a minimum threshold at all times across the network and guarantee that off-peak pressure is lower than current values. Tests would compare the system's performance in pipes made of steel and of polyethylene. As well as reducing gas leaks, the new system was expected to at least match current service quality levels and demonstrate compliance with all relevant safety standards.

**Results**

The LIFE GREEN GAS NETWORK system achieved double the expected reduction in carbon dioxide emissions caused by gas leaks. The project installed a remote-controlled monitoring and pressure reduction system in the high to medium pressure stations and in the medium to low stations along 16 Km of the gas networks of the two municipalities of Cesate and Albate in Lombardy. The technology, which follows Smart City principles, that consists of a centralized software which modulates the gas pressure in the pipelines, thus reducing the gas leakages and, at the same time, guaranteeing a good gas service to the end user. It is compliant with the safety standards required by the EU Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres (ATEX legislation). The achieved 6% reduction in greenhouse gas emissions amounts to 534 tons of CO2 equivalent over the lifetime of the project. An analysis of the socio-economic economic benefits of the system found that in the best-case scenario, the gas distribution company could achieve a cost benefit of 23 500 in the pilot area over 10 years, subject to the system being applied to low-pressure areas of the network. If the Green Gas Network is applied in the medium-pressure segment of the network, cumulative savings for citizens could amount to some 1.6 million, also over 10 years. The project team calculated that if its highly replicable system was installed across the entire gas network of Italy (some 92 000 km long) and applied in both low and medium-pressure areas, 3.9 million tons per year of CO2 equivalent could be saved; if applied at European level, with its 670 000 km of pipelines, 28.5 million tons per year of CO2 equivalent could be saved. Thus, it could contribute 0.5% to the target of reducing greenhouse gas emissions by 40% by 2030 set by the European Commission in the Paris agreement of 2015. Further information on the project can be found in the project's layman report and After-LIFE Communication Plan.





This project is funded by the European Union

## 4.2 Selected Gas Distribution Projects Funded Under the Ofgem NIA/NIC

Project	
Remote Monitoring Device for Flammable and Toxic Gases <sup>86</sup>	
<b>Description</b>	<p><b>Introduction</b></p> <p>The Scope of this proposal is to design, manufacture (rapid prototype) and trial the detectors in gas riser systems specific to MOBs. The outputs of the project will be a developed, tested and trialed prototype which will be assessed at the end of the project via a Project End Stage Assessment. At this time, a decision will be made to progress the project to the next stage (detailed design, manufacture and further field trials).</p> <p><b>Objectives</b></p> <p>The project seeks to prove that this concept is able, through trialling, to demonstrate that offers a viable, cost effective means of monitoring potential gas escapes from assets. Success of the project may lead to further development to a deployable and certified system which could be used on the Network and potentially mitigate the need to replace riser assets located in spatially restrictive areas.</p> <p><b>Expected Benefits</b></p> <p>The Project can be considered a success if, upon completion of work:</p> <ul style="list-style-type: none"> <li>• The product has demonstrated capability of performing the desired task via successful field trials.</li> </ul>

Project	
Mobile Virtual Reality Modelling <sup>87</sup>	
<b>Description</b>	<p><b>Problem:</b></p> <p>There is a business risk to National Grid that is captured on the risk register – “Risk that knowledge is lost in NG for key assets, key individuals in critical job family roles as identified in the DEC paper because of our aging workforce/age profile analysis and current requirement gaps for Apprentices not being able to join early enough to cover all retirees/ leavers.”</p> <ul style="list-style-type: none"> <li>• The GDNs have the challenge of mitigating this risk. There is an opportunity to explore the method of capturing complex working procedures using interactive virtual-reality/augmented-reality technology. This will allow the GDNs to create a library of engineering scenarios, which can be delivered on central training courses or remotely accessed by an engineer in a vehicle before they undertake a complex procedure.</li> </ul>

<sup>86</sup> [https://www.smarternetworks.org/project/nia\\_nggd0084](https://www.smarternetworks.org/project/nia_nggd0084)

<sup>87</sup> [https://www.smarternetworks.org/project/nia\\_nggd0064/](https://www.smarternetworks.org/project/nia_nggd0064/)



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Project	
<b>Mobile Virtual Reality Modelling<sup>87</sup></b>	
	<p><b>Method</b></p> <p>The Method would consist of the virtual/augmented reality modelling of various Network assets allowing operatives to view, study and manipulate external and internal working parts to allow for a thorough yet safe understanding of the asset.</p> <p>The various models will be delivered to the operative via an augmented reality iBench situated at a central training facility or via “Cardboard” virtual reality goggles. These goggles will allow an operative to self-serve their training requirements whilst also delivering an additional platform from which an operative can simply re-familiarize themselves with an asset prior to working on it. The iBench will allow for staff to run through the complex maintenance and repair activities in a classroom environment to ensure competency.</p> <p>The cardboard goggles will make further use of existing network hardware (e.g. mobile phones) upon which the models will be delivered. The mobile phone will then simply fit inside the goggles which then create the virtual reality feel to the model.</p> <p><b>Scope</b></p> <p>The project will include:</p> <ul style="list-style-type: none"> <li>• The development of a National Grid specific mobile platform based on EON Experience VR the development of up to 3 individual VR/AR models, produced from CAD drawings.</li> </ul> <p><b>Objectives</b></p> <p>The objective of the Project is to assess whether the modelling of work procedures in Augmented Reality/Virtual Reality can be utilised within the UK Gas Industry, to support engineers completing complex operational working procedures.</p>

Project	
<b>SENSIT Acoustic Pipe Locator<sup>88</sup></b>	
<b>Description</b>	<p><b>Problems</b></p> <p>The British gas industry has, for a very long time, been unable to trace the route of polyethylene pipe (PE) networks operating at low, district, pressures ( greater pressure systems were protected by the use of detectable marker tape laid along their route).</p> <p>There are many reasons for needing to know the location of PE pipe systems, the primary being that it is a requirement that mains are to be recorded accurately and correctly. But put very simply, if you can't find the PE main or service, how are you going to repair it, extend it, cut it off, work alongside another PE main ( water or gas ) or be able to advise other parties of their location without, what could very easily be, excavating large areas to find the pipe. Excavations, and their subsequent reinstatement, especially in carriageways, can easily account for around 40% of the total job cost.</p>

<sup>88</sup> [https://www.smarternetworks.org/project/nia\\_nggd0061](https://www.smarternetworks.org/project/nia_nggd0061)



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Project	SENSIT Acoustic Pipe Locator <sup>88</sup>
	<p><b>Methods</b></p> <p>The Acoustic Pipe Locator (APL) will reduce the number of excavations and in most cases the apparatus will be located by a lone worker, not a team. If it is necessary to excavate, the APL will reduce the size of those excavations as the current method is to ‘search’ for the plastic apparatus by increasing the size of the excavations, digging ‘blind’ until the apparatus are located.</p> <p>The APL will sense through most surfaces: soil, grass, concrete, gravel and asphalt and will also detect drains, fibre optics, ducts etc. so not just gas apparatus but can ensure that other third-party apparatus are avoided. As, for instance, more HDD projects are being sanctioned it is imperative that other parties, as well as your own, kit is located.</p> <p><b>Scope</b></p> <p>The devices will be trialled across the Repair and Replace and Extend processes. This will allow the trial to cover different processes and different geographical areas.</p> <p>The acoustic pipe locator uses sound waves to detect underground pipes to a depth of 3m. It will be utilised in conjunction with as laid drawings and cable location devises (C Scope) as part of a holistic tool kit to pinpoint assets that need to be worked on.</p> <p><b>Objectives</b></p> <p>The main objectives identified for this project are to establish that utilisation of the SENSIT pipe locator will result in:</p> <ul style="list-style-type: none"> <li>• Greater accuracy in locating underground assets Reduced number and size of excavations,</li> <li>• Reduced reinstatement,</li> <li>• Reduced time spent on site; and</li> <li>• Improved customer experience.</li> </ul>





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**Project** Fracture Monitoring Using Acoustics<sup>89</sup>

**Description**

**Problem**

Under the current 30/30 rule (all metallic mains 30m from property must be replaced within the next 30years) gas distribution networks (GDNs) have to prioritize which mains need to be replaced. A number of these mains are in highly populated areas and although do not have known leakage issues, still need to be replaced under the above rule. There is no method currently available to monitor live mains and to report any significant approaching failure. The 30/30 rule stipulates all mains must be replaced regardless of history so using the 30/30 rule in all cases will result in some mains being replaced many years before the end of their serviceable life.

**Method**

Networks need to only replace mains that are at risk, but there is currently no system or method to monitor these mains so pipe replacement can be deferred with minimal risk. Syrinix are designing, testing and deploying a system, using acoustic technology in pre- determined locations, to monitor metallic gas mains remotely and inform the respective Network Licensee of major leaks so they can react immediately thus efficiently managing the risk. The proposed solution would consist of an instrumentation and control unit which would be situated at either end of the pipeline with acoustic monitoring sensors placed along the line of the main at pre-agreed distances. The sensors will listen for the specific acoustic signatures given by pipe fracturing or pipe movement communicating with each other along the pipeline. If there is any significant movement or a break within the pipeline wall, this will be reported in via text message. Data from the system will then provide an early indication of leakage enabling the networks to take appropriate action. This will enable asset lifetime to be maximised and renewal intelligently deferred.

**Scope**

The purpose of this Project is to design a system that remotely and continually monitors a pipeline and reports to a central location via text message should an incident occur, with the added benefit of giving a location of the incident on the pipeline.

The Project is in four stages.

Stage 1: To set up an experiment to record signals created by real pipe fractures in a suitable representative location. Detailed analysis will be undertaken to determine the practicalities of the proposed detection system

Stage 2: Upon successful completion of Stage 1, this Stage will determine the detection algorithm structure, parameters and decision rules. Syrinix would develop their existing TransientMinder product platform to incorporate the sensors and the new detection algorithm. Any issues surrounding intrinsic safety, practical deployment, sensor design and similar would be addressed during this Stage

Stage 3: This stage involves a trial and demonstration of the prototypes. The location would be as per the location identified during Stage 1. Two cycles of Stage 3 will be allowed for in case of failure and subsequent redesign on the first cycle.

<sup>89</sup> [https://www.smarternetworks.org/project/nia\\_ngn\\_0035/](https://www.smarternetworks.org/project/nia_ngn_0035/)





This project is funded by the European Union

Project	Fracture Monitoring Using Acoustics <sup>89</sup>
	<p>Stage 4: This is the final engineering and Product Acceptance stage including Procedural and Policy changes.</p> <p><b>Objectives</b></p> <p>Syrinix's existing product, TransientMinder (which detects, interrogates and analyses damaging pressure transients within both distribution and trunk main infrastructure) works on water mains of &gt;16" in diameter in the UK, and the objective of this Project is to investigate and demonstrate that the technology can be transferred on to the UK Gas Network, for the same pipe diameters.</p> <p>The primary objectives of the Project will be:</p> <ul style="list-style-type: none"> <li>• To give an immediate notification of a fracture event to the pipeline operator enabling a much-improved response time to locate the fracture event (assuming it falls between monitor stations)</li> <li>• To potentially detect the onset of a fracture event if pre-failure signals are generated (this is unknown at this time) Monitor pipeline 24 hour /day, 7 days/week.</li> </ul>

Project	Demand Scaling <sup>90</sup>
<p><b>Description</b></p>	<p><b>Problem</b></p> <p>National Grid Gas Distribution plans it is below 7 bar networks in accordance with industry guidance document IGE/GL/1, which requires that network analysis models are periodically validated against actual network performance. National Grid Policy T/PL/NP/16 and Management Procedure T/PM/NP/29 define the requirement in detail.</p> <p>Having confirmed the validity of the network model against actual network performance data it is then necessary to extrapolate the demand on the model from the level at the validation condition to the peak 1 in 20 six minute demand condition required for use in planning the network, as defined in IGE/GL/1. Over time a number of approaches to extrapolation have been applied, all of which can lead to an over or underestimate of the 1 in 20 peak six-minute demand condition, potentially resulting in over or under investment in the network.</p> <p>This project therefore seeks to develop a more robust, transparent and intuitive method of extrapolating from a validation demand condition to the 1 in 20 peak six-minute demand condition.</p> <p><b>Method</b></p> <p>This project seeks to develop a statistical demand methodology, based on learning from work carried out under a previous Innovation Funding Incentive (IFI) project, through use of a substantial quantity of actual consumer demand data collected, to provide improvements to the accuracy of network analysis.</p> <p>The method relies on training a statistical model against actual six-minute meter point demand data logged during winter 2009/10 and winter 2010/11. The model is likely to rely on "day of the week", "month of the</p>

<sup>90</sup> [https://www.smarternetworks.org/project/nia\\_nnggd0011](https://www.smarternetworks.org/project/nia_nnggd0011)





This project is funded by the European Union

Project	Demand Scaling <sup>90</sup>
	<p>year” and Composite Weather Variable to assess what percentage of the peak 1 in 20 six-minute demand condition occurred on the network validation day for each category of demand, thus enabling extrapolation to the peak demand condition.</p> <p>The new demand model tool will require population with meter point data taken from the existing Demand Derivation System (DDS). The tool would be presented to the user via an interface, with the output likely to be a simple set of scaling factors to be applied to the demand data in the network model to give the 1 in 20 peak six-minute demand condition.</p> <p><b>Scope</b></p> <p>The scope of this project includes:</p> <p>Stage 1: Development of a basic proof-of-concept statistical demand modelling tool. This will model loads based on DDS Tags and provide Validation day Scaling Factors for two example networks. This will include both standard model output (in the form of Scaling Factors) and detailed node-by-node diagnostic data, which together will allow assessment to determine if there is value in further developing the scaling model for use in the business. If the assessment of these example networks is that the model produces usable results in principle, the project will proceed to Stage 2, described below.</p> <p>Stage 2: Development of a functioning prototype spreadsheet including both demand modelling and scaling functionality.</p> <p><b>Objectives</b></p> <p>The aim of this project is to create a proof-of-concept off-peak demand model for below 7 bar networks, along with algorithms for scaling these demands to peak. In addition, a working prototype spreadsheet tool containing these models will also be produced.</p> <p>Both the demand model and the scaling model will use selected consumer data from DDS and produce output in the form of Scaling Factors, with one set representing validation day demand and a further set for 1:20 peak demands.</p> <p>If successful this will enable delivery of a consistent, robust and transparent demand model tool capable of providing a method of extrapolating from a validation condition to the 1 in 20 peak six-minute demand condition. This could potentially be further developed to extend the use of the tool and to implement the software within business systems, such as GBNA.</p> <p><b>Expected Benefits</b></p> <p>Success of this project will be the development of a new peak demand model that is proven to be consistent and readily applicable to network models.</p>





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Project Review and Validation of the Current Gas Demand Forecasting Methodology <sup>91</sup>	
<b>Description</b>	<p><b>Problem</b></p> <p>National Grid’s National Transmission System (NTS) provides the year-ahead annual gas demand forecasts. These forecasts are then used to book capacity to meet the UK’s year-ahead gas demand.</p> <p>Having accurate and robust demand forecasts is critical to the business. Current annual demand forecasting processes are based on historical methodologies which have not been subject to comprehensive review and there is evidence to suggest that refinements to this process could result in significant capacity booking cost savings to consumers, through the application of appropriate mathematics, statistics, modelling and algorithms.</p> <p><b>Methods</b></p> <p>This project will conduct an evaluation of the existing gas demand forecasting methodology through an exhaustive review of the intervening steps, and an assessment of the methodology that underpins the generation of the Future Energy Scenarios (‘Gone Green’ and ‘Slow Progression’) for the NTS.</p> <p>There will be an assessment of the methodologies used for generating year-ahead annual gas demand forecast and the 1 in 20 peak demand forecasts.</p> <p><b>Scope</b></p> <p>The scope of the project includes the following:</p> <ul style="list-style-type: none"> <li>• To undertake a comprehensive assessment of the methodology used for generating year-ahead gas demand forecasts Independently evaluating the existing methodology, by conducting an exhaustive review of all steps and testing all assumptions,</li> <li>• Exploring potential enhancements to the existing methodology based on sound mathematical and statistical methods, with a view to improving forecasts of annual gas demand and 1 in 20 peak demand and</li> <li>• Providing an insight into and understanding of the technical basis of the year ahead gas demand forecasts, with a view to underpinning their confidence in the use of the forecasts for making 2014/15 year-ahead gas capacity bookings</li> </ul> <p><b>Objectives</b></p> <p>The aim of this project is to undertake a comprehensive assessment of the methodology used for generating year-ahead gas demand forecasts. To identify enhancements and support scoping the future demand scenario and forecast requirements.</p> <p><b>Expected Benefits</b></p>

<sup>91</sup> [https://www.smartnetworks.org/project/nia\\_nggd0030](https://www.smartnetworks.org/project/nia_nggd0030)



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Project	
Review and Validation of the Current Gas Demand Forecasting Methodology <sup>91</sup>	
	Success of this project will be a comprehensive assessment of the methodology used for generating year-ahead gas demand forecasts having been successfully carried out and an output report produced to detail the findings and recommendations for suggested enhancements that can be carried forward for implementation.

Project	
Intelligent CO Monitors <sup>92</sup>	
<b>Description</b>	<p><b>Problem</b></p> <p>There is a business risk to National Grid that is captured on the risk register – “Risk that knowledge is lost in NG for key assets, key individuals in critical job family roles as identified in the DEC paper because of our aging workforce/age profile analysis and current requirement gaps for Apprentices not being able to join early enough to cover all retirees/ leavers.”</p> <p>The GDNs have the challenge of mitigating this risk. There is an opportunity to explore the method of capturing complex working procedures using interactive virtual-reality/augmented-reality technology. This will allow the GDNs to create a library of engineering scenarios, which can be delivered on central training courses or remotely accessed by an engineer in a vehicle before they undertake a complex procedure.</p> <p><b>Method</b></p> <p>The Method would consist of the virtual/augmented reality modelling of various Network assets allowing operatives to view, study and manipulate external and internal working parts to allow for a thorough yet safe understanding of the asset.</p> <p>The various models will be delivered to the operative via an augmented reality iBench situated at a central training facility or via “Cardboard” virtual reality goggles. These goggles will allow an operative to self-serve their training requirements whilst also delivering an additional platform from which an operative can simply re-familiarize themselves with an asset prior to working on it. The iBench will allow for staff to run through the complex maintenance and repair activities in a classroom environment to ensure competency.</p> <p>The cardboard goggles will make further use of existing network hardware (e.g. mobile phones) upon which the models will be delivered. The mobile phone will then simply fit inside the goggles which then create the virtual reality feel to the model.</p> <p><b>Scope</b></p> <p>The project will include:</p> <ul style="list-style-type: none"> <li>• the development of a National Grid specific mobile platform based on EON Experience VR,</li> </ul>

<sup>92</sup> [https://www.smartnetworks.org/project/nia\\_nggd0032](https://www.smartnetworks.org/project/nia_nggd0032)



This project is funded by the European Union

Project	Intelligent CO Monitors <sup>92</sup>
	<ul style="list-style-type: none"> <li>• the development of up to 3 individual VR/AR models, produced from CAD drawings,</li> <li>• the procurement of an Eon Reality iBench to allow the testing of Augmented Reality in the training environment,</li> <li>• the procurement of 20 “Cardboard” Virtual Reality Goggles to allow the testing of Virtual Reality in a training environment and</li> <li>• an assessment of the technology, by undertaking of a six-month trial of the technology, within the training environment at National Grid Eaking.</li> </ul> <p><b>Objectives</b></p> <p>The objectives of the trial are:</p> <ul style="list-style-type: none"> <li>• Give the Network Licensees confidence that the concept will deliver benefits in terms of reduced FCO callouts (elimination of unnecessary, i.e. false alarm, callouts due to non-CO related issues with CO detectors, typically caused by low battery condition or sensor faults),</li> <li>• Demonstrate to social housing providers that the concept is reliable, operationally efficient, economically viable and an assured way of them ensuring tenants are protected from the risks of CO (particularly the vulnerable),</li> <li>• Understand behavioural or acceptance issues of the use of the technology and</li> <li>• Demonstrate rapid incident notifications to Network Licensee First Call Operatives (FCOs).</li> </ul> <p><b>Expected Benefits</b></p> <p>The success criteria of the project are to identify:</p> <ul style="list-style-type: none"> <li>• social housing providers and trial target homes followed by the successful installation of the monitoring system in 600 properties,</li> <li>• the data collected from the 600 systems and analyse to establish a significant reduction in the number of false callouts for CO related issues,</li> <li>• the number and nature of behavioural and acceptance issues experienced with householders involved in the project,</li> <li>• the operational reliability of the system,</li> <li>• a reduction in response times and Network Licensee staff notification times to any CO incidents,</li> <li>• the commitment of the project hosts, i.e. social housing providers, to continue to use the system at the end of the trial. The quality of the householder experience (from feedback); and</li> </ul>



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Project	Intelligent CO Monitors <sup>92</sup>
	<ul style="list-style-type: none"> <li>the reduction in CO2 emissions from reduced travel as a result of elimination of false callouts.</li> </ul>

### 4.3 Selected Gas Distribution Projects in the Area of Flexibility Services

Project	GRHYD – Gestion des Réseaux par l’injection d’hydrogène pour décarboner les énergies <sup>93</sup>		
Country	France	Funding	
Horizon 2020			
Description	<p>The first power-to-gas project linked to the French gas distribution network. GRHYD stands for “Gestion des Réseaux par l’injection d’hydrogène pour décarboner les énergies” – network management by injecting hydrogen to decarbonize energy. The objective of the project is to evaluate and validate the technical and economical relevancy of blending Hydrogen with natural gas for both transport and heating sectors.</p> <div style="text-align: center;"> </div> <p style="text-align: right; font-size: small;">Source: GRHYD</p>		
	<p style="text-align: center;"><i>Figure 33: Overview of the GRHYD project</i></p> <p>The projects consist of two demonstrators in Dunkerque (North of France):</p> <ul style="list-style-type: none"> <li>a project of injection of hydrogen into the gas distribution network. A new built neighbourhood of 100 homes in Cappelle-la-Grande will be fed by a blend of natural gas and up to 20% of hydrogen and</li> </ul>		

<sup>93</sup> <https://innovation.engie.com/en/news/news/decentralized-energy/the-grhyd-project-converting-renewable-electric-power-into-gas-1/53>



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	<ul style="list-style-type: none"> <li>a project of Hythane® production at industrial scale. A refuelling station for buses will provide a fuel made of natural gas and 6 % of hydrogen, proportion that will be increased up to 20%.</li> </ul>
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<b>Project</b>	<b>INTERactions Between Automatic Energy Systems and FLEXibilities Provided by Actors of Energy Markets<sup>94</sup></b>		
<b>Country</b>	<b>France</b>	<b>Funding</b>	<b>Horizon 2020</b>
<b>Description</b>	<p>Interflex project (INTERactions between automatic energy systems and FLEXibilities provided by actors of energy markets) is a H2020 project aiming at inventing the future DSO. Officially launched in January 2017 for 3 years, the demonstrator in France is under the supervision of Enedis (electricity DSO), and represent a key innovation: ~150 kilowatt electric (kWe) of flexibility generated by smart gas solutions will be deployed and managed by aggregators to deal with local distribution flexibility needs. The project will thus advance both technical and economic aspects with an evaluation of the cost and value brought by the different flexibility assets integrated into the demonstration. Within three years, the project aims at validating the enabling role of DSOs in calling for flexibility sources according to local, time-varying merit orders. Demonstrations are designed to run 18 separate use cases involving one or several of the levers increasing the local energy system flexibility: energy storage technologies (electricity, heat/cold), demand response schemes with two coupling of networks (electricity and gas, electricity and heat/cold), the integration of grid users owning electric vehicles, and the further automation of grid operations including contributions of micro-grids. The use cases are clustered into three groups. Three use cases in Sweden and the Czech Republic address the enhancement of the distribution network flexibility itself. Five use cases in France, Germany and Sweden demonstrate the role of IT solutions to increase drastically the speed of automation of the distribution networks, which can then make the best use of either local single or aggregated flexibilities. Ten use cases in Czech Republic, France, The Netherlands, and Sweden combine an increased network automation and an increased level of aggregation to validate the plausibility of local flexibility markets where both distributed generation and controllable loads can be valued. Replicability of the results is studied by the DSOs and industry with an in-depth analysis of the interchangeability and interoperability of the tested critical technology components. Dissemination targeting the European DSOs and all the stakeholders of the electricity value chain will be addressed by deployment roadmaps for the most promising use cases, thus nourishing the preparation of the practical implementation of the future electricity market design, the draft of which is expected by end of 2016.</p>		

<sup>94</sup> <https://cordis.europa.eu/project/id/731289>



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Project		Flexible Residential Energy Efficiency Demand Optimisation and Management <sup>95</sup>	
Country	Wales	Funding	Network Innovation Allowance
<b>Description</b>	<p><b>Introduction</b></p> <p>The FREEDOM (Flexible Residential Energy Efficiency Demand Optimisation and Management) Project, a joint Wales &amp; West Utilities and WPD £5m innovation project in the Bridgend ‘living heat laboratory’ in South Wales, is a real example of a ‘whole systems’ approach to the future of heat. Using an air-source heat pump and high-efficiency gas boiler hybrid system in 75 residential properties, the project clearly demonstrates the value that an integrated approach to deploying low-carbon smart technologies can deliver. Project estimates suggest that a hybrid approach to decarbonising our heating that is combined with green gas growth could lead to as much as an 80% reduction in carbon emissions from domestic heat.</p> <p>Smart switching between the two technologies through a control panel enables the buying of fuel and the sale of heat simultaneously, creating value for both the consumer and enabling the system to offer heat and power flexibility services to the wider network. The project simulates a residential demand side response service, with an aggregator buying gas and electricity on live wholesale markets on behalf of the consumer to meet their chosen settings.</p> <p><b>Scope</b></p> <p>The proposed project runs for 27 months and has been broken down into two phases, which are defined in 14 work packages. The research objective is to better understand how hybrid heating systems can be:</p> <ul style="list-style-type: none"> <li>• Affordable through using advanced algorithms to unlock value from energy markets,</li> <li>• Trustworthy by building consumer trust in new technology whilst providing the same level of comfort in people’s homes and</li> <li>• Developing appropriate user interfaces and information systems to help drive adoption.</li> </ul> <p>All design and foundation development activities conclude in the first six months. Pilot installations are initially undertaken in four households before installations are rolled out to the rest of the trial properties, followed by a period of monitoring and experimentation phase which seeks to learn and then iteratively refine the heating and load management processes and the consumer interface and information provision over a full year.</p> <p><b>Objectives</b></p>		

<sup>95</sup> [https://www.smarternetworks.org/project/nia\\_wpd\\_023](https://www.smarternetworks.org/project/nia_wpd_023)



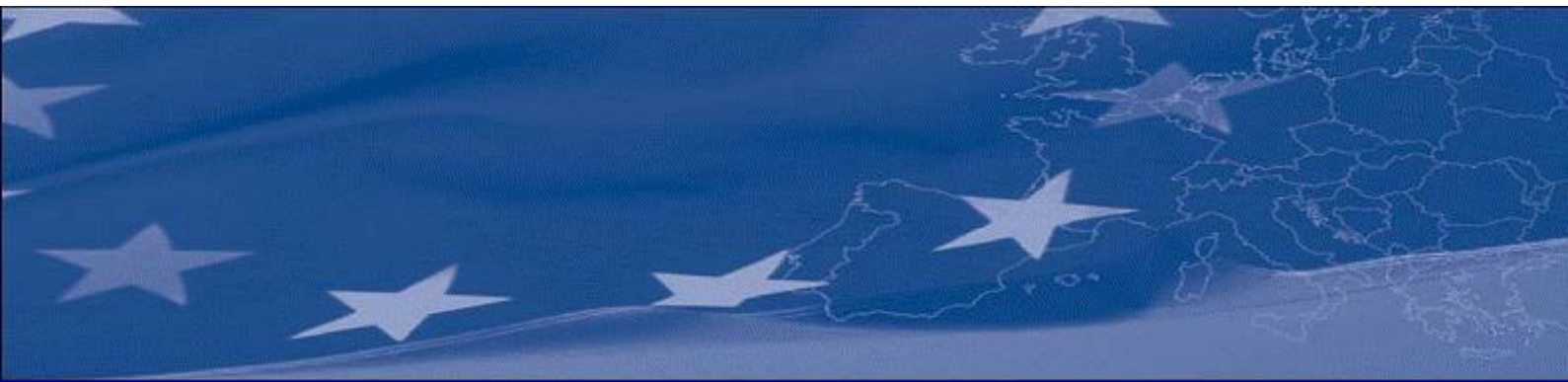


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**Project Flexible Residential Energy Efficiency Demand Optimisation and Management <sup>95</sup>**

The research objective is to better understand if hybrid heating systems are technically capable, affordable and attractive to customers as a way of heating homes. This project aims to investigate the feasibility of the use of heat pumps on both WPD's & WWU's network in order to:

- Demonstrate the ability of the hybrid heating system to switch between gas and electric load to provide full arbitrage and highly flexible demand response services,
- Demonstrate the consumer, network, carbon and energy system benefits of deployment of hybrid heating systems with an aggregated demand response system and
- Gain insights into the means of balancing the interests of the consumer, supplier, distribution and transmission network when seeking to derive value from the demand flexibility.



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