Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?

Country Report - France

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The French NRF and regulatory practices for electricity and gas have many similarities, for this reason in this summary no distinction is made between electricity and gas.

The NRF in France

The national regulatory authority - the *Commission de Régulation de l'Energie* (Energy Regulatory Commission or "**CRE**") is an independent public body, which regulates the French electricity market. The CRE has an advisory role with the power to make proposals and give opinions, as well as approval and regulatory decision-making powers.

France applied the independent transmission operator ("**ITO**") and ownership unbundling operator (OU) models. There are one electricity and two natural gas transmission system operators ("**TSOs**") in France:

- **Réseau de Transport d'Électricité** (Electricity Transmission Network or "RTE") owns and operates the electricity transmission network and is responsible for its development.
- France applied the independent transmission operator ("**ITO**").
- **GRTgaz**, a subsidiary of Engie, which operates the network of natural gas with low calorific value (**L-gas**) in the **north** of France and most of the network of natural gas with high calorific value (**H-gas**); and
- Teréga, a subsidiary of a consortium composed of SNAM, C31, GIC and Predica, which operates the network of high calorific (H-gas) in the south-west of France.

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

There is a statutory objective to develop research in the field of energy. The TSO is required (through Public Service Contracts) to offer new technological solutions and develop methodology for optimisation and development of intelligent networks.

Generally, there are incentives for innovation in the way CAPEX are dealt when setting the tariff but there are no particular duties of the CRE to directly encourage innovation. The focus of the regulatory framework is primarily set on outputs and efficiency, so incentives are also focussed on efficiency.

Nevertheless, the TSOs have got duties to include technological and digital change.

The regulatory practice in France

Generally, interviewees state that both the NRF and the NRA are supporting innovative projects finally resulting in an integration of innovative projects into the RAB. There is enough flexibility in the regulatory framework to leave room for adaptation in parallel or after completion of a pilot project, hence the NRF should not be considered as a barrier before launching an innovative project, in the interviewees eyes.

Also, the framework sets appropriate incentives for the maintenance of the security of supply level, supplemented by incentive mechanism (Bonus/Malus) to enhance security of supply and to lower outages. The NRF was regarded as sufficient by the interviewees.

Options for improvement

The NRF is well-designed and functional for both security of supply and innovative projects. The interviewees are largely content with the existing framework. Yet, the following improvements to the NRF could be identified:

In electricity, the introduction of a joint discussion between NRA and TSOs about the of applied assessment criteria that are used to determine the necessity and the benefit of security of supply projects could be considered to avoid diverging views of the NRA and TSO on the implementation need.

In gas, an adjustment of incentives for connection of green gas production could be considered for the future.

Both changes could be implemented using legal powers already available to the NRA or others under the existing NRF.

Moreover, the NRF already contains a large number of individual regulatory instruments (such as public consultations, CBA) that - in case a need arises - can be adopted using legal powers already available to the NRA or others under the existing NRF.

Additionally, some improvement needs were reported by the interviewees, which consider should be addressed in EU legislation:

- The NRF is said not being able to support technologies enhancing the energy transition, such as biogas, PtG, sector coupling. Further, current unbundling rules partially prohibit the participation of transmission system operators in such projects;
- issues with TEN-E/PCI regulations: Currently the framework is said to be only focussed on increasing transmission capacity, but local production is out of scope;
- Also, the definition and the assessment of qualitative criteria used in CBA for PCIs should be harmonised to avoid divergent views on the benefit of PCI projects.

1. INTRODUCTION

The present Country Report is a deliverable of the study "Do current regulatory frameworks in the EU support innovation and security of supply in electricity and gas infrastructure?".

The key objective of the study is to analyse how the existing national regulatory frameworks (NRFs) in the EU guide and incentivise the electricity and gas transmission project promoters to undertake investments. The focus of the study is both on investments in new innovative technologies and investments to increase security of supply. The main objective of the study is to map how the regulatory frameworks in the MSs support such investments and how do these frameworks ensure that the necessary investments are made.

This Country Report provides an overview of both the current legal frameworks and their implementation practice related to investments in gas and electricity transmission infrastructure. As part of this analysis, selected specific infrastructure projects in electricity and gas are discussed. Based on this research, options for improvement are formulated, both relating to the implementation practice and to legal changes.

The Country Report is based on previous study deliverables and analysis. It is divided into two main sections, Section 2 which relates to electricity, and Section 3 which relates to gas. Each of these sections examines the legal framework (Section 2.1 for electricity and Section 3.1 for gas), including specific rights and duties of relevant parties, such as TSOs and NRAs (hereafter referred to as stakeholders), mechanisms for the financing of investment projects and the regulatory rules regarding innovation and security of supply in particular. Having studied the legal regulatory framework, Section 2.2 for electricity and Section 3.2 for gas examine the regulatory practice in France, drawing specifically on stakeholder interviews, and paying particular attention to the regulatory practice related to innovation and security of supply. The functioning of the legal framework and the regulatory practice are illustrated by selected specific projects in France. Lastly, options for improvement of the regulatory practice and the regulatory framework are discussed in Section 2.3 for electricity and Section 3.3 for gas.

These options for improvement are taken from a long list of best practises that the project team has compiled based on the analysis of regulatory frameworks in all Member States. We acknowledge that we have not carried out a full analysis of all the costs and benefits of the suggested options. Therefore, some of these options are conditional and there might be reasons that we did not take into consideration not to implement them.

The focus of this report is not primarily on R&D investments and projects, but rather on "innovative" transmission infrastructure related investments. In order to define what "innovative" is in the context of this report, we have introduced the notion of "typological investments" (see Annex I and II). The goal of selecting "typological investments", which, in our understanding, are categories of investments, was to make the discussion concrete and the investments comparable across countries. The term "typological investment" relates to technical solutions that TSOs can adopt to provide the transmission capacities needed to cover the transmission demand of grid users.

Thus, a typological investment is meant to be a type of solution that can be implemented, in principle, by any TSO in situations in which these solutions are appropriate to provide the desired benefit. Hence, typological investments are not specific to a concrete location or a particular TSO. Annex I provides a list of typological investments in the electricity sector, whereas Annex II provides the same for gas.

Ultimately, these technical solutions contribute to fulfilling the objective to improve or maintain the level of security of supply. It has to be noted that the degree of innovativeness of typological investments can be quite diverse, ranging from construction of conventional assets like AC overhead lines or pipelines with conventional materials and construction methods down to novel concepts of system automation and operation based on recent R&D achievements. Innovation aims at providing the desired level of transmission capacity – determined by the objectives of security of supply (see above) – in a way that is in some way superior to the conventional way, e.g.:

1. by immediately reducing overall cost as compared to a conventional solution;
2. by prospectively reducing overall cost in the future, subject however to a "learning curve" as to the cost level of the innovative solution;

3. by accelerating the process of transmission capacity expansion and thus reducing social welfare loss caused by temporarily insufficient transmission capacities; or
4. by providing improvements with respect to other criteria that are often difficult to monetarise, like environmental or public acceptance aspects.

Innovative investments, especially those whose benefits fall into category ii., iii. and iv. named above, can face certain barriers and market failures. We have identified five categories of innovative projects which might encounter potential regulatory barriers (see also Annex III for more explanation):

a. Capital intensive projects resulting in uncertain future OPEX gains (efficiency improvements / cost reductions) are not incentivised by the regulatory framework;
b. Projects with potential significant benefits, which would benefit primarily the wider society and where the concerned TSOs are not incentivised;
c. A roll out and investment in smart grids substituting planned physical investments may provide a reduction in the regulated asset base, but might not be realised due to an increase in tariffs or regulatory disincentives;
d. Projects with few or no commercial benefits to justify the investment, but with positive social impacts;
e. Projects, which result in a lower TSO TOTEX, but bring about a shift in the CAPEX/OPEX ratio, which is not incentivised by the regulatory framework.

Our understanding of innovative investments and typological investments, and the categorisation of investment projects in relation to possible regulatory barriers are the basis for the research done in the context of the analysis of the implementation practice in this report.

2. ELECTRICITY

2.1. Legal analysis of the NRF in France

2.1.1. Overview of the regulatory framework of France – legal rules

For the purposes of the Legal Framework in France, "transmission" is defined as 50kV or above[1].

The French Energy Code, which entered into force on 1 June 2011[2], (the "**Energy Code**") is the principal piece of primary legislation, which contains the legal and the regulatory framework for transmission development in France. The regulatory part of the code was adopted by decree in 2015[3]. The Energy Code has consolidated the numerous laws and decrees, which regulated the market until its entry into force and has been subject to numerous modifications since it was adopted. Both the national regulatory authority the - *Commission de régulation de l'énergie* (Energy Regulatory Commission or "**CRE**") - and the ministers responsible for energy, economy and/or environment have duties and objectives derived from this code.

The main objectives of the regulator and the ministers, in relation to transmission network development, are:

- to ensure security of supply;
- to maintain a competitive energy price;
- to ensure energy transport and storage adjusted to meet needs; and
- to develop research in the field of energy.[4]

The Energy Code sets up the concession regime for the electricity market in France. The regime is administered by the ministers and the CRE, which share duties and powers in an even manner. Licensable activities include interconnection, generation, transmission, distribution and supply. There are restrictions on the same person holding multiple different types of licence, in compliance with the Third Package.[5] Each activity has a separate concession and associated standard conditions or specifications (*cahier des charges*).

The ministers are vested with important decision-making powers, for instance, granting the concession to the TSO.

The CRE is an independent public body, which regulates the French electricity market.[6] The CRE has an advisory role with the power to make proposals and give opinions, as well as approval and regulatory decision-making powers.[7] The CRE:

- is entitled to primarily regulate access to electricity networks and facilities;
- engages in economic regulation (price control) of the transmission network licensees through the TURPE[8] model and sets, every four years, tariffs for use of the public transmission network[9]. The CRE transmits tariffs to the Minister of economy[10] for publication in the Official Journal. The Minister may, if it considers that the determination of tariffs does not take into account its energy policy guidelines, request by a reasoned decision a further determination;[11]
- guarantees the independence of the network operators;
- approves the annual investment program of the TSOs and supervises grid development according to the EU policy for the European electricity market[12].

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1 Article L.321-4 of the French energy code.
2 Ordonnance n° 2011-504 of 9 May 2011.
3 Decree n° 2015-1823 of December 2015.
4 Articles L.100-2 and L.100-3 of the Energy Code.
5 Article L.111-7 of the Energy Code.
6 Article L.132-1 of the Energy Code.
7 Articles L.134-1 to L.134-3 of the Energy Code.
8 The TURPE (*tarifs d'utilisation des réseaux publics de transport et de distribution d'électricité*) is the CRE's framework for setting price controls for electricity network companies, based on a traditional price cap regulation which evolves from time to time to incorporate new features and incentive. The current TURPE HTB 5 is in place from 2017 to 2021.
9 Article L.134-1 of the Energy Code.
10 Article L.134-1 of the Energy Code.
11 Article L. 341-3 of the Energy Code.
12 Article L.131-2 of the Energy Code.

The administration of the electricity sector in France is based on principles of security of supply, control of future technological choices and energy efficiency, national solidarity, among others[13]. Electricity as a public service implies firstly, the balanced development of facilities for electricity generation in accordance with a long-term annual investment programme[14]; secondly the development and operation of the networks for the transmission and distribution of electricity.

France applied the independent transmission operator ("**ITO**") model. *Réseau de Transport d'Électricité* (Electricity Transmission Network or "**RTE"**)[15] owns and operates the electricity transmission network and is responsible for its development.[16]

RTE is vested with exclusive rights as the French transmission system operator ("**TSO**") since 2000. RTE was granted a public service contract[17] by the state in 1997, which expires on 31 December 2051[18].

A public service contract is also concluded between the State (the "Public Service Contract") and the TSO[19] to better define the objectives of the mission of RTE. Pursuant to the Public Service Contract, RTE made 76 commitments to facilitate the energy transition and to ensure the proper functioning of the electric system.

RTE operates and maintains the public electricity network and is responsible for its development[20]. RTE's role also includes ensuring that electricity producers and consumers can be connected to it under non-discriminatory conditions[21] as well as responsibility for interconnections with other electricity transmission networks.[22]

Pursuant to article 6 of the concession type specifications,[23] the concessionaire shall develop and renew the public electricity transport network in order to ensure safety, quality, security and efficiency of the network:

- In particular, RTE shall implement: Annual ten-year development scheme:24 To meet the abovementioned obligations RTE prepares each year a 10-year Network Development Plan (the "10-Year Plan") based on existing and forecasted supply and demand, scenarios for medium-term production evolution and network for cross-border electricity exchanges which is submitted to the CRE for its approval and amendments, if necessary;
  The 10-Year Plan indicates the main transmission infrastructure that needs to be built or upgraded over the forthcoming ten years and also contains the investments already decided as well as the new investments to be executed within three years together with providing for a time frame of all investment projects;
  This scheme complements, at a national level, the European 10-year Network Development Plan implemented by ENTSOE (TYNDP);
  - **Annual Investment program**: RTE must also prepare, each year, an Annual Investment Plan, which it submits to the CRE for approval.[25]

For the application of the 10-Year Plan, RTE develops an annual investment program[26] to be submitted for the CRE's approval. RTE is required to carry out any investment projects to deliver on its legal and regulatory duties as more fully described above and Section 2.1.3. For

13 Article L.121-1 of the Energy Code.
14 Articles L.121-2 and L.121-3 of the Energy Code.
15 https://www.rte-france.com/en
16 Article L.321-6 (I) of the Energy Code.
17 Articles L.111-40, L.321-1 and L.321-2 of the Energy Code.
18 JORF n°0294 du 18 décembre 2008 page 19410.
19 Public Service Contract between RTE and the Stated dated 5 May 2017.
20 Article L.321-6 (I) para 1 of the Energy Code.
21 Article L.121-4 of the Energy Code.
22 *Ibid*.
23 Decree n°2006-1731 of 23 December 2006 *approving the standard conditions for the concession of the public transmission network.*
24 Article L. 321-6 of the Energy Code.
25 Article L.134-3 (2) and article L.321-6 (II) of the Energy Code.
26 Article L.321-6 of the Energy Code.

instance, this includes the development and the renewal of large transmission networks and regional transmission networks, information systems and real estate.

Role of NRA

CRE examines the 10-Year Plan submitted by RTE every year and carries out consultations with the users of the transmission network. The synthesis of such consultation is published each year[27] and may require the modification of the 10-Year Plan.[28]

In order to be approved, CRE verifies whether the plan covers, all investment needs consistent with the Third Energy Package requirements[29] (in case of any doubt, it consults the ACER) and may also require RTE to modify this plan.[30]

Also, CRE approves the Annual Investment Program prepared by RTE.[31]

In the event RTE does not carry out the investment in accordance with the 10-Year Plan within the period of three years, the CRE may require RTE to execute the investment or, in case of failure, call for a tender to carry out the investment. This tender is open to third-party investors, which are subject to the same rights and obligations as RTE.[32]

Institutional or procedural constraints on the performance of these roles

Planning processes and legislation can act as a legal constraint on the development of the transmission network. Any project will need various authorizations (environmental, town planning, forest, etc.). Recently, a unique environmental authorization was set up to obtain different authorizations at once; this authorization only concerns the installations classified for environmental protection (ICPE).

Moreover, general requirements relating to public law, such as the requirement to implement a public consultation with every project will also act as general constraining factor on the ability and speed at which the TSO and CRE can act within the regulatory framework.

Also, transmission network projects face judicial proceedings. The French judicial system is congested; as a consequence, projects cannot start until the end of the procedure, which may take several months, usually years.

2.1.2. Specific legal rights and duties

Planning consent is required for construction projects in France, including new high voltage transmission lines. Other authorisations are also needed for industrial facilities.

Easement procedure

If an easement is necessary to conduct the works on the power line or its construction, the project is declared of public utility by the prefect if the power line tensions are inferior to 250kV or by the Minister of Energy if the powerline tension is above 250kV.

A public enquiry or consultation must be conducted prior the public utility declaration.

An impact study must be conducted, aimed at assessing the project consequences on environment and health.

Town planning authorisations

Under the French Town Planning Code, a building permit is required for the building of power lines.

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27 Article L.321-6 (I) para 4 of the Energy Code.
28 Article L.134-7 of the Energy Code.
29 *Id est*, a non-binding European plan drawn up by the European Network of Transmission System Operators established by Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009.
30 Article L.321-6 (I) para 5 of the Energy Code.
31 Article L.321-6 (II) para 1 of the Energy Code.
32 Article L.321-6 (II) of the Energy Code.

When the maximum tension is under 63kV, only a prior declaration is required.

Approval of the project execution

Prior to project execution:

- It must be notified to the stakeholders;
- Its description is displayed in every concerned town;
- The layout must be approved by the prefect if the maximal tension is above 50kV (under this threshold, the layout is only communicated to the prefect).

Environmental authorisations

There are authorisations to be obtained on installations that are classified for the protection of the environment as far as the environment is concerned.[33]

Burying of power lines is mandatory when the project affects:

- A heritage site;
- A national park;
- A natural reserve.

Depending on the project characteristics, an authorisation may be required due to a project's possible proximity to historical monuments.

A fee is paid to the state for the occupation of the public domain by the transmission grid operator.

2.1.3. Mechanism for financing of investment projects

The CRE's main mechanism to ensure the delivery of appropriate investment in the transmission network is the economic regulation process through price control (TURPE).

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

CRE took into consideration energy policy guidelines received from the Minister in charge of Environment, Energy and Sea[34]. Methodologies followed to establish the tariffs for electricity public transportation network use are set by the CRE.[35]

Tariffs for the use of the transmission network are calculated in a transparent and non-discriminatory manner in order to cover the costs supported by RTE to the extent that those costs reflect the effectiveness of network management[36]. The TURPE allows RTE to ensure a fair compensation of the invested capital through the investment programs.

The tariff includes two types of expenses: OPEX and CAPEX. CAPEX expenses are related to RTE's investments.

The TURPE5 tariff also serves as an incentive to control costs is based on assumptions on the level of charges and subscription revenues. An ex post facto adjustment mechanism, the **expense and revenue account (CRCP)** was introduced to consider the differences between the costs and revenues recognized, and the costs and the forecasting income on items that are not predictable and cannot be controlled by RTE.

The main incentive measure for investment and innovation is the way CAPEX are dealt with at the time of setting the tariff.

Planned research and development operating expenses, which have not been actually spent, will be return to the network users. RTE's capital cost differentials between forecast and actual trajectories are now 100% covered by the tariff through the CRCP, which is likely to limit the

[33] Articles L.511-1 *et seq*. of the Environnemental Code.
[34] Article L.341-3 of the Energy Code.
[35] Article L.341-3 of the Energy Code.
[36] Article L. 341-2 of the Energy Code.

incentive for TSOs to control their investment costs. However, overruns beyond approved investment expenditure will not be compensated.

Therefore, the TURPE incentive mechanism provides RTE with the means to accomplish research and development and innovative projects required in order to develop the future electricity network.

For example, for certain **interconnection projects** for security of supply CRE defines incentive mechanisms. The mechanism is based on three distinct incentives:

- financial incentive for the completion of interconnection investments as soon as possible: allocation of a fixed bonus calculated according to the profit based on a cost / benefit analysis of the project, the amount of which will be defined by CRE prior to RTE's commitment decision;
- incentive to minimize the costs of carrying out the project: a bonus or a penalty set out according to the difference between the target cost of the project and the cost incurred. If the cost incurred exceeds the target cost, the amount of the penalty on the total remuneration of the RTE for the interconnection projects will be limited;
- incentive on the installation use: a premium or a penalty calculated each year from the commissioning of the installation and retained by the CRE as part of the cost / benefit analysis. If subscribed capacities are lower than the capacities initially reserved, the penalty cannot exceed the equivalent of the annuity of the fixed premium.

The mechanism above is designed to capture and accommodate a wide variety of projects. The general TURPE HTB price control framework covers a wide variety of potential development projects. The specific categories of projects to deliver are determined by RTE in its annual investment program, which is subject to CRE's control through the price control process.

These projects include:
Construction of new assets based on conventional technology such as the development of large electricity transmission network development, regional electricity transmission network and interconnection development[37]. Innovative technologies may also be developed through this financing mechanism as well as the installation of new or additional control and automation technology ("Use and operation of the electrical system" Program[38]) and the development of new operational concepts for using flexibility for congestion management ("Prospective, economic and Smart Grid" Program[39]).

Mechanisms to foster innovation:

The CRE may plan a multiannual framing of tariff increases and incentive measures, both short and long term, in order to encourage transmission operators to improve their performance, with regards to electricity quality, to encourage the integration of the electricity internal market and security of supply and to seek productivity[40].

Research and development, and innovative investments, especially in the field of smart grids, are entirely covered as well as RTE's other investment expenditures. TURPE 5 HTB strengthens financial performance incentives and gives to RTE the opportunity to obtain additional budgets during the tariff period for financing smart grid projects, subject to confirmation of its feasibility on the basis of the cost-benefit analysis.

Also, smart grid development will allow an investment costs decrease at the price of an exploitation costs (minor) increase. This extra charge is offset in the new TURPE 5 HTB in order to avoid discouraging these kinds of investment.

Measures to establish a balance between investing in new or innovative network infrastructure to meet the needs of current and future users in a timely manner and avoiding investment in stranded assets

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37 CRE Deliberation dated December 7 2017 approving RTE's 2018 investment program.
38 General outlines of RTE's R&D program (2017-2020).
39 *Ibid*.
40 Article L.341-3 of the Energy Code.

CRE seeks to establish a balance though the TURPE HTB price control. Investments of an innovative nature have to be efficient.

Regarding the incentive mechanism provided in TURPE 5 HTB, the CRE allows a budget to RTE in order to promote research and development and/or innovation. However, in the event that RTE spends more than the allocated amount, the difference will not be covered by the CRCP.

In addition to the TURPE 5 HTB price control, smaller projects, at a lower value and a smaller scale, may be promoted through mechanisms, which allow their development by limiting the risks in early stage of innovation before the project is considered for a wider development.

For instance, CRE has approved in 2018 the RINGO project (which is described more fully in Section 2.2.4 below).

2.1.4. Regulatory rules with respect to innovation

Specific duties of the TSO aimed at encouraging innovation

RTE contributes to research and technical progress in the energy sector.[41] RTE's duties include:

- **Technological change**: offering new technical development solutions by fostering the emergence of new components which take advantage of nanotechnology development, power electronics and superconductivity[42];
- **Digital change**: development of a methodology to facilitate infrastructure maintenance and optimization and contributing to the development of intelligent networks[43].

These developments aim to promote renewables integration to the network [44] by adapting exploitation rules, management electric system tools, market mechanisms and real-time data services, based on a wide diffusion of digital technologies in the network infrastructure[45] in order to support energy transition.[46]

Specific duties of the NRA aimed at encouraging innovation

There are no particular duties of the CRE to directly encourage innovation (one of its missions is to encourage the TSO to make productivity gains,[47] which can be accomplished through investment in innovative technologies). However, the CRE put in place incentives for innovation in the way CAPEX are dealt when setting the tariff (see Section 2.1.3 above).

2.1.5. Regulatory rules with respect to security of supply

Specific duties of the TSO aiming at safeguarding security of supply

RTE shall develop and renew the public transmission network in order to ensure its safety, quality, security and efficiency pursuant to the French energy code[48] and the concession contract[49]. RTE has also a role in ensuring security of supply, through market mechanisms.

Specific duties of the NRA aiming at safeguarding security of supply

CRE takes regulatory decisions regarding the operation and development of the network, supply and consumption programs and the financial compensation regarding electricity variances.[50]

Also, the CRE can implement incentive measures, long and short term, in order to support the network transmission operators and encourage the integration on the electricity internal market

41 Article L.121-1 of the Energy Code.
42 Commitment 54 of the Public Service Contract.
43 Commitment 54 of the Public Service Contract.
44 Article L.321-6-1 of the Energy Code.
45 Commitments 46 et 49 of the Public Service Contract.
46 Commitment 54 of the Public Service Contract.
47 Article L. 341-3 et L.452-3 du code de l'énergie.
48 Article L.121-1 of the Energy Code.
49 Article 6 of the Concession Type Specifications.
50 Article L. 134-1 et L. 134-2 du code de l'énergie.

and the security of supply[51]. See for instance the incentives for investments in interconnection at (ii) above.

Also, the CRE can impose the realization of investments included in the 10-Year Plan, which are not carried out in time by RTE.[52]

2.2. Regulatory practice

2.2.1. Overview over regulatory practice in France

The general regulatory principle can be described as incentive-based revenue cap with pass through elements. The treatment of CAPEX encourages innovative projects that are efficient.

There is a statutory objective to develop research in the field of energy. The TSO is required (through concession contract) to offer new technological solutions and develop methodology for optimisation and development of intelligent networks.

Generally, there are incentives for innovation in the way CAPEX are dealt when setting the tariff but there are no particular duties of the CRE to directly encourage innovation. The focus of the regulatory framework is primarily set on outputs and efficiency, so incentives are also focussed on efficiency.

Nevertheless, the TSO has duties to include technological and digital change as well as an aim to promote renewables integration. Also, the TSO can recover R&D costs via the TURPE tariff mechanism and can gain additional budgets for smart grid projects subject to a cost -benefit analysis. The NRA has no duties to do so but incentivises innovation in the way CAPEX are dealt with in setting tariffs.

Within the framework, there is a special way to deal with large projects. Projects in electricity exceeding 30 Mio. € must be presented to an external expert to challenge the budget, which is the case for approximately 20% of all projects. Other investments lower than the limits are generally approved. One could conclude that this regime might incentivise the TSO to prefer smaller projects and be reluctant against innovative solutions with higher specific costs but wider benefits. Even we must admit that we only had only limited response towards our questionnaires and interview requests, interviewees denied such developments.

Since the calculated costs of large projects must be challenged externally, no increase in the number of projects less than 30 Mio. € could be observed. Also, a project example proves the ability of the mechanism to also support innovation. In this particular project, innovative types of poles were planned with higher specific costs than conventional ones. The cost calculation was audited and regarded as reasonable, so the projects was approved without requesting the use of the least cost technology. Generally, there is no risk for investments, once they are approved by the NRA.

Moreover, an incentive mechanism (Bonus/Malus) to enhance security of supply and to lower outages is included in the NRF. Additionally, an incentive mechanism exists aiming at keeping projected and realised cost (CAPEX) within a corridor by providing conditional WACC premiums. This mechanism is explained in more details for Gas (c.f. Section 3.2).

Main regulatory barriers

According to the interviewees, the framework is generally open to cover innovative investments, but we have to stress on the fact that there was only limited response from the electricity sector. It was said that no major issues exist. Also regarding security of supply, the NRF is adequate to secure the desired level, which is currently very sufficient. Some interviewees report that sometimes discussions about the necessity of projects that further increase the security of supply level and about the objectivity of used assessment criteria occur.

Possible improvement of the NRF

[51] Article L. 341-3 du code de l'énergie.
[52] Article L.321-6 (II) of the Energy Code.

Despite the discussion about the necessity of projects that further increase the security of supply level and keeping in mind that we had only limited response, so that might not the view of all stakeholders had been taken into account, interviewees do not request any changes to the currently applied framework. However, we think that maybe a joint discussion between NRA and TSOs about the applied assessment criteria could be considered to avoid discussions about the necessity of security of supply projects.

2.2.2. Regulatory practice related to innovation

Innovative projects

The NRF encourages innovative projects that are efficient in terms of a reasonable relationship between monetary expenditure and economic/technical benefits.

Examples of 'innovative' projects, which are being conducted or planned, encompass:

- RINGO: RINGO can be characterised as a large-scale R&D battery project that aims at proving the relevance of smart storage for grid operating performance and congestion management (see also Section 2.2.4 for further details)
- Biscay Gulf (BG) project: the goal of this highly innovative 2 GW underwater line is to reinforce the link between the Iberian Peninsula and the rest of the European electricity market without getting through the Pyrenees mountains.

Adequacy of the NRF relating to its support for innovative investments

The RINGO project proves the flexibility of the NRF and its application to allow for innovation. Despite its R&D nature, RINGO is treated like any other regulated investment but some amendments have been made, especially concerning the allowance of the storage operation by the TSO and the length of the experiment (3 years). Nevertheless, the approval process is said to have been smooth. This project may have faced a regulatory barrier because of the unclear status of electricity storage. However, the NRA was said to enjoy some autonomy in the implementation.

During our interviews, no requests for changes to the NRF had been told by the interviewees and also we were not able to detect any targeted improvements.

2.2.3. Regulatory practice related to security of supply

Security of supply projects

The NRF was regarded as fully sufficient by the interviewees. The framework sets appropriate incentives for the maintenance of the security of supply level, supplemented by incentive mechanism (Bonus/Malus) to enhance security of supply and to lower outages.

Adequacy of the NRF relating to its support for security of supply investments

Generally, the NRF is considered adequate in supporting security of supply investments.

Despite occasionally occurring discussion about the necessity of projects that further increase the security of supply level and about the objectivity of used assessment criteria, interviewees do not request any changes to the currently applied framework and also we were not able to detect any targeted improvements.

2.2.4. Illustrative specific projects

The following projects are examples of successful innovative or security of supply projects and hence illustrate how the regulatory regime works in practice.

Interconnector projects:

Project « Savoie-Piémont » (increase of security of supply and market integration using latest technological developments)

The Project comprises a new 320 kV HVDC interconnection between France and Italy. The new HVDC link will connect the substations of Piossasco and Grande Ile mainly along motorway infrastructures and the Fréjus tunnel. The project also includes the removing of limitations on existing 380 kV internal Italian lines. The removing of limitation is necessary to take full advantage of the increase of interconnection capacity provided by the cross-border line. It will allow to strengthen the capacity of exchange and the electric solidarity between France and

Italy, but also to accompany the energy transition. It is currently under construction and will be completed in 2019.

As all projects on the northern Italian border, this project was assessed via the Multiple TOOT/PINT approach according to their maturity and expected commissioning date, taking into account the capacity increases confirmed by the grid studies. CBA results show a stable benefit for all visions, except for EP2020 and Vision 2 where it is higher, due to the fact that coal is before gas in the merit order, which increases the Italian imports. As for many projects in TYNDP, the project decreases CO2 emissions only in high RES scenarios (Visions 3 and 4), as for the other visions with low CO2 prices, increasing exchanges favour coal generation that is cheaper but more emitting than gas generation. Some benefit in terms of RES integration (especially solar energy in Italy) can be captured only in high RES scenarios.

The project comprises the construction of:

- Two 320 kV HVDC (VSC technology) converter stations (one on the French and one on the Italian side);
- A 190 km underground line.

The total cost of the project is estimated to 500 M€, on the French side. CRE has approved for 2018 an amount of 141,6 M€ in order to cover the expenditures.

Project IFA2 (increase of security of supply and market integration using latest technological developments)

IFA2 is a 1,000 MW high voltage direct current (HVDC) electrical interconnector currently under construction between the British and French transmission systems. It will be the second link to France that National Grid has developed with RTE and will help to enhance the security, affordability and sustainability of energy supplies in both countries.

The interconnection requires the construction of a converter station at the French and the British side each and 250km of subsea cable. IFA2 received all relevant planning permissions in 2017 and is currently under construction. IFA2 aims to be operational by 2020.

The IFA2 project presents a major national and European stake because it joins in the French and European energy transition. As such, it was appointed in 2013 by the European Commission and the Parliament as "a project of common interest" pursuant to the European regulation on the energy infrastructures.

Projected expenses for 2018 are estimated to 70 M€.

Security of supply:

Project "Filet de sécurité Bretagne"

Creation of an underground electric connection of 225 kV between the posts of Calan (Morbihan), Mûr-de-Bretagne and Plain-top (Côtes-d'Armor).

This project rests on 3 pillars:

- The control on power demand;
- The development of renewable energies;
- The improvement of operational safety of the electricity network.

Investment amount is estimated at 120 M€.

Project "Haute Durance"

This renovation program of the electricity network of Haute-Durance will allow to durably guarantee the security of supply of the region. The first works started in autumn 2014 and will continue until 2021.

On October 2017, the Council of State validated the public utility of the renovation program of the electricity network of Haute-Durance committed by RTE.

Investment amount is estimated at 230 M€.

Pilot project: (innovation)

RINGO Project

The RINGO project provides the opportunity to store renewable energy by using assets of storage placed in several places of the network to absorb the points of transit on certain portions of the network, while protecting the balance offer/demand, which RTE guarantees on a national scale.

This project has to spread in 2020 on sites presenting congestion. The CRE, in its deliberation approving the RTE's investment program for 2018 specified that from the phase II (from 2023), batteries will have to be able to participate in the management of the congestions and in the balancing of the electric system. RINGO is treated like any other regulated investment (RAB@6,125%), despite this project could have faced a regulatory barrier because of the unclear status of electricity storage. Nevertheless, some amendments have been made, especially concerning allowed storage operations by RTE and the length of the pilot project (3 years). Overall, the approval process is said to have been really smooth.

RTE plans a total investment of 80 M€ over the coming 4 years. CRE approved, in 2018, for the first year an investment of less than 2 M€.

2.3. Options for improvement

2.3.1. Options to improve regulatory practice

The above discussion shows that the NRF is well-designed and functional for both security of supply and innovative projects: there is flexibility to approve pilot projects and innovative solutions, incentives are provided to meet projected costs and maintain the level of security of supply. The interviewees are largely content with the existing framework. Maybe a joint discussion between NRA and TSOs about the of applied assessment criteria could be considered to avoid discussions about the necessity of security of supply projects.

Moreover, the NRF already contains a large number of individual regulatory instruments (such as public consultations, CBA) that - in case a need arises - can be adopted using legal powers already available to the NRA or others under the existing NRF.

2.3.2. National law mechanism(s) for implementing options

Clarifications on the applied assessment criteria for security of supply projects should be implemented using legal powers already available to the NRA or others under the existing NRF.

The NRA could clarify the assessment criteria for security of supply projects after having discussed the issue with the TSOs at any of the regular opportunities for dialogue among stakeholders included in the NRF (for instance, when reviewing the TURPE 5 HTB).

2.3.3. Impact assessment

We have not encountered any specific examples of projects that have been cancelled due to the regulatory framework. Furthermore, the stakeholders are largely satisfied with the current NRF. Furthermore, innovation is prominent in the current regulatory period. For these reasons, we do not expect considerable changes to investment levels.

3. GAS

3.1. Legal analysis of the NRF in France

3.1.1. Overview of the regulatory framework of France – legal rules

The French Energy Code, which entered into force on 1 June 2011[53], (the "Energy Code") is the principal piece of primary legislation, which contains the legal and the regulatory part of the national legal framework for transmission development in France. The regulatory part of the code was adopted by decree in 2015[54]. The Energy Code has consolidated the numerous laws and decrees, which regulated the market until its entry into force and has been subject to numerous modifications since it was adopted. Both the national regulatory authority, the *Commission de Régulation de l'Énergie* (Energy Regulatory Commission or "**CRE**") and the ministers responsible for energy, economy and/or environment have duties and objectives derived from this code.

The main objectives of the regulator and the ministers, in relation to transmission network development, are:

- to ensure security of supply;
- to maintain a competitive energy price;
- to ensure energy transport and storage adjusted to the needs;
- to develop research in the field of energy[55].

The Energy Code sets up the authorisation regime for the gas market in France. The regime is administered by the ministers and the CRE, which share duties and powers in an even manner. There are restrictions on the same person holding multiple different types of licence, in compliance with the Third Package.[56] Each activity has a separate authorisation and associated standard conditions or specifications (*cahier des charges*).

The ministers are vested with most decision-making powers. The principal role of the ministers responsible for energy include, for example, approval and designation of the TSOs[57]; or all the powers related to granting and withdrawal of the authorisations for construction and operation of natural gas transmission pipelines.[58]

The CRE is an independent public body, which regulates the French gas market.[59] The CRE has an advisory role with the power to make proposals and give opinions, as well as approval and regulatory decision-making powers[60]:

- The CRE is entitled to primarily regulate access to gas networks and facilities. It transmits tariffs for use of the public transmission networks to the Minister of economy and industry.[61] The CRE transmits tariffs to the Minister of economy[62] for publication in the Official Journal. The Minister may, if it considers that the determination of tariffs does not take into account its energy policy guidelines, request by a reasoned decision a further determination[63];
- The CRE guarantees the independence of the network operators, it approves the annual investment program of the TSOs and supervises the grid development according to the EU policy for the European gas market.[64]

The administration of the gas sector in France is based on principles of, among others, safety of persons and installations, application of energy saving measures, security of supply and energy efficiency.[65]

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53 Ordonnance n° 2011-504 of 9 May 2011.
54 Decree n° 2015-1823 of December 2015.
55 Articles L.100-2 and L.100-3 of the Energy Code.
56 Article L.111-7 of the Energy Code.
57 Article R.111-1 of the Energy Code.
58 Article L.431-1 of the Energy Code.
59 Article L.132-1 of the Energy Code.
60 Articles L.134-1 to L134-3 of the Energy Code.
61 Article L.134-1 of the Energy Code.
62 Article L.134-1 of the Energy Code.
63 Article L. 341-3 of the Energy Code.
64 Article L.131-2 of the Energy Code.
65 Article L.121-32 of the Energy Code.

France applied the independent transmission operator ("**ITO**") and ownership unbundling operator (OU) models. There are two natural gas transmission system operators ("**TSOs**") in France:

- **GRTgaz**[66], a subsidiary of Engie, which operates the network of natural gas with low calorific value (**L-gas**) in the **north** of France and most of the network of natural gas with high calorific value (**H-gas**); and
- **Teréga**[67], a subsidiary of a consortium composed of SNAM, C31, GIC and Predica, which operates the network of high calorific (**H-gas**) in the **south-west** of France.

The TSOs own and operate the national gas network in France and are responsible for its development. GRTgaz[68] and Teréga[69] have been initially certified by the CRE on 26 January 2012. Teréga's ITO certification was withdrawn with the sale of Total's shares to a third-party company and upheld in February 2016 with the entry in February 2016 of PREDICA in its capital share by a deliberation of the CRE dated 4 February 2016 decision on the prolongation of the certification of the company Teréga following the entry of Predica into the capital of Teréga Holding. Authorization for construction and operation of facilities and gas transmission were granted by the Minister responsible for energy to the TSOs to operate gas network following the procedure set out by the Environmental Code.[70] Public services contracts are concluded between the State and the TSOs. The TSOs are responsible for obtaining the authorisation required in order to carry out their activities.[71]

The TSOs provide technical access to the natural gas transmission system ensuring of the network's safety, efficiency, balance of the flows and compliance with the rules relating to the natural gas transmission networks interconnection.[72]

The TSOs shall implement:

- **Annual ten-year development scheme**: For implementation of the above-mentioned role, the TSOs prepare the 10-Year Network Development Plan (the "**10-Year Plan**") based on existing and forecast gas supply and demand, scenarios for medium-term development of the gas sector, gas consumption and international trade, which is to be submitted each year to the CRE for further approval and amendments, if necessary. The 10-Year Plan shall consider the assumptions and needs identified in the Report on Investment Planning in the gas sector prepared by the Minister in charge of energy.[73] The 10-Year Plan indicates the main transmission infrastructure that needs to be built or upgraded over the next ten years and contains the investments already decided as well as the new investments to be executed within three years together with providing a time frame of all investment projects.[74] This scheme complements, at the national level, the European 10-Year Network Development Plan implemented by the ENTSOG ("**TYNDP**");
- **Annual Investment Program:** For the application of the 10-Year Plan, TSOs develop their Annual Investment Programs and submit it to the CRE for approval.[75] These programs take into account implementation status of the investment program of the previous year, the invested amounts, the expenditure on different projects as well as a new budget and programs to be launched the following year in accordance with the trajectory of investment expenditure adopted under the applicable tariff.

TSOs also participate in the preparation and implementation of the Indicative Multi-annual Plan for Investments in the Gas Sector prepared by the Ministry responsible for energy. They are also engaged in implementation of the European Projects of Common Interest.[76]

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66 http://www.grtgaz.com/en/.
67 https://www.terega.fr/en/.
68 Deliberation of the CRE of 26 January 2012 on the decision for certification of GRTgaz.
69 Deliberation of the CRE of 26 January 2012 on the decision for certification of TERÉGA.
70 Article L.431-1 of the Energy Code and articles L. 555-1, R. 554-41 and R. 555-2 et seq of the Environment Code.
71 Article L.111-2 of the Energy Code.
72 Article L.431-3 of the Energy Code.
73 Article L.431-6 (I) of the Energy Code.
74 *Ibid*.
75 Article L.431-6 (II) of the Energy Code.
76 Article 2.4 of the Public Services Contract concluded between the State and the GRTgaz for 2015-2018.

Undertaking investments

TSOs develop their Annual Investment Programs in accordance with which they carry out investment projects as already described above and in Sections 2.1.4 and 2.1.5 below. For example, the breakdowns of the GRTgaz's and Teréga's Investment Programs for the year 2018 comprise, *inter alia,* debottlenecking of the main network investments, expenditures related to regulatory obligations and connections,[77] and development of the main network, reinforcement of the regional network, security and support, connection, general investments and approval of R&D investment projects respectively[78].

Role of NRA

CRE examines the 10-Year Plan submitted by the TSOs every year, carries out consultations with users of the transmission network. The synthesis of such consultation is published each year[79] and may require the modification of the 10-Year Plan.[80]

In order to be approved, CRE verifies whether the plan covers all investment needs consistent with the Third Energy Package requirements[81] (in case of any doubt, it consults the ACER) and may also require the TSOs to modify their plans.[82]

Also, CRE approves the Annual Investment Program prepared to ensure the realization of the necessary investments for the network development and its transparent and non-discriminatory access.[83] In the event the TSOs do not carry out an investment in accordance with the 10-Year Plan within the period of three years, the CRE may require the TSOs to execute the investment or, in case of failure, to call for a tender to carry out the investment. This tender is open to third-party investors, which are subject to the same rights and obligations as the TSOs.

Institutional or procedural constraints on the performance of those roles

Planning processes and legislation can act as a legal constraint on the development of the transmission network. Any project will need various authorizations (environmental, town planning, forest, etc.). Recently, a unique environmental authorization was set up in order to obtain different authorizations at once; this authorization only concerns the Installations Classified for the Environmental Protection (ICPE).

Moreover, general requirements relating to public law, such as the requirement to implement a public consultation with every project will also act as general containing factor on the ability and speed at which the TSO and CRE can act within the regulatory framework.

Also, transmission network projects face judicial proceedings, with suspensive effect on the start of the projects until the end of the procedure. As the French judicial system is congested, this may last several months, usually years.

3.1.2. Mechanism for financing of investment projects

The CRE's main mechanism to ensure the delivery of appropriate investment in the transmission network is the economic regulation process through price control (ATRT).

The current price control for transmission is "**ATRT6**" (*Accès des Tiers aux Réseaux de Transport*) and is effective from 2017- 2021, setting limits on what the TSOs can charge for development and operation of the network.

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77 Deliberation of the CRE N°2017-284 of 21 December 2017 approving the investment program for the year 2018 of the GRTgaz.

78 Deliberation of the CRE N°2017-303 of 21 December 2017 approving the investment program for the year 2018 of the Teréga.

79 Article L.321-6 (I) para 4 of the Energy Code.

80 Article L.134-7 of the Energy Code.

81 *Id est*, a non-binding European plan drawn up by the European Network of Transmission System Operators established by Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009.

82 Article L.431-6 (I) of the Energy Code.

83 Article L.431-6 (II) of the Energy Code.

Tariffs for network use and their changes are established in a transparent and non-discriminatory manner to cover all the costs borne by the TSOs to the extent that those costs reflect the effectiveness of the network management.[84]

The ATRT6 tariff encourages the TSOs to improve efficiency of their performance through incentive mechanisms both from the point of view of control of their costs in implementation of major network development projects as well as the quality of service provided to users. In particular, the ATRT6 tariff brings significant changes to the previous tariff regulation framework (ATRT5) and is aimed primarily at preparing the creation of a *Single Gas Market* in France by 2018 as well as strengthens the capacity of TSOs by participation in the energy transition through the "*GRTgaz 2020*" and Teréga's "*Research and Innovation*" projects implementation.[85]

The ATRT6 tariff also serves as an incentive to control costs, is based on assumptions on the level of charges and subscription revenues. An ex post facto adjustment mechanism, the **expense and revenue account (CRCP)** was introduced to consider the differences between the costs and revenues recognized, and the costs and the forecasting income on items that are not predictable and cannot be controlled by the TSOs.

The additional productivity gains that could be achieved by the TSOs beyond the trajectory set by the ATRT6 tariff (excluding items covered by the CRCP) will be retained in full by the TSOs, as for the ATRT5 tariff. Symmetrically, any additional costs will be borne entirely by the TSOs.

The ATRT6 allows the TSOs to ensure a fair compensation of the invested capital through the investment programs.

The tariff includes two types of expenses: OPEX and CAPEX. CAPEX expenses are related to the TSO's investments.

The main incentive measure for investment and innovation is the way CAPEX are dealt with at the time of setting the tariff, a new feature of ATRT6.

Planned research and development operating expenses, which have not been actually spent, will be return to the network users. TSO capital cost differentials between forecast and actual trajectories are now 100% covered by the tariff through the CRCP, which is likely to limit the incentive for TSOs to control their investment costs. However, overruns beyond approved investment expenditure will be compensated but won't receive any bonus (see sections on regulatory practice for further details).

Therefore, the ATRT6 incentive mechanism provides the TSOs with the means to accomplish research and development and innovative projects required in order to develop the future gas network, connect new users to the network, increase efficiency etc.

The rates are calculated by the CRE from capital charges and operating expenses of the operators as well as assumptions of infrastructure subscriptions.[86] For example, for certain **interconnection projects** for security of supply CRE defines incentive mechanisms. The mechanism is based on three distinct incentives:

- financial incentive for the completion of interconnection investments as soon as possible: allocation of a fixed bonus calculated according to the profit based on a cost / benefit analysis of the project, the amount of which will be defined by CRE prior to the TSO's commitment decision;
- incentive to minimize the costs of carrying out the project: a bonus or a penalty set out according to the difference between the target cost of the project and the cost incurred. If the cost incurred exceeds the target cost, the amount of the penalty on the total remuneration of the TSO for the interconnection projects will be limited;
- incentive on the installation use: a premium or a penalty calculated each year from the commissioning of the installation and retained by the CRE as part of the cost / benefit analysis. If subscribed capacities are lower than the capacities initially reserved, the penalty cannot exceed the equivalent of the annuity of the fixed premium.

84 Article L. 341-2 of the Energy Code.
85 Deliberation of the CRE of 17 November 2016 concerning a draft decision on the tariff for the use of natural gas transmission networks of GRTgaz and Teréga.
86 http://www.cre.fr/reseaux/infrastructures-gazieres/tarifs-d-acces-et-prestations-annexes#section3.

Mechanisms to foster innovation or limit innovative investments

For the ATRT6 tariff period, CRE has introduced an incentive regulation of R&D expenses similar to the TURPE. Before this, the TSOs therefore had an incentive to control their R&D expenses, in the same way as their other operating expenses. The amounts allocated to R&D that have not been committed will be returned to users at the end of the tariff period via the CRCP. If the TSOs exceed the four-year trajectory, the differences will remain their responsibility.

Measures to establish a balance between investing in new or innovative network infrastructure to meet the needs of current and future users in a timely manner and avoiding investment in stranded assets

CRE seeks to establish a balance through the ARTR6 price control. Investments of an innovative nature have to be efficient.

Regarding the incentive mechanism provided in ATRT6, the CRE allows a budget to TSOs in order to promote research and development and/or innovation. However, in the event that a TSO spends more than the allocated amount, the difference will not be covered by the CRCP.

In addition to the ATRT6 price control, smaller projects, at a lower value and a smaller scale, may be promoted through mechanisms, which allow their development by limiting the risks in early stage of innovation before the project is considered for a wider development.

For instance, CRE has approved in 2017 the West Grid Synergy projects (described more fully in Section 3.2.4 below).

3.1.3. Regulatory rules with respect to innovation

Specific duties of the TSO aimed at encouraging innovation

In accordance with the public service mission assigned to TSOs, the Public Service Contracts include provisions on R&D.[87] As such, GRTgaz 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).[88] Moreover, it encourages the projects for biomethane production to prepare the energy transition.[89]

Specific duties of the NRA aimed at encouraging innovation

There are no particular duties of the CRE to directly encourage innovation (one of its missions is to encourage the TSO to make productivity gains,[90] which can be accomplished through investment in innovative technologies). However, the CRE put in place incentives for innovation in the way CAPEX are dealt when setting the tariff (see Section 3.1.2 above).

3.1.4. Regulatory rules with respect to security of supply

Specific duties of the TSO aiming at safeguarding security of supply

The TSOs ensure the safety and the efficiency of their networks and the balance of the flows of natural gas considering existing technical constraints.[91] For example, they are required to provide a temporary supply of gas in the event of supplier failure by reserving storage facilities.[92] TSOs are also in charge of the following duties:

- *Contribution to the security of supply*: TSOs must scope and manage the network to ensure continuity of the gas transmission service to certain customers (those carrying out missions of general interest[93]);

87 Article L.121-46 of the Energy Code.
88 Article 7 of the Public Services Contract.
89 Article 3 of the Public Services Contract.
90 Article L. 341-3 et L.452-3 du code de l'énergie.
91 Article L.431-3 of the Energy Code.
92 Article L.451-3 of the Energy Code.
93 Article D141-12-6 of the Energy Code and Article 8 of the Decree No. 2016-1442 of 27 October 2016 on the multiannual programming of energy.

- Participation *in the mechanism of a supplier of last resort*: availability of a "security service" through allocated stored gas capacities[94];
- *Emergency situations:* detection of emergency situations together with the other operators, reinforcing the TSO's capacities to detect the risks of supply disruption, increasing transparency and informing the authorities, conducting a system monitoring, carrying out a crisis management exercise and implementing corrective measures[95];
- *Contribution to R&D*: TSOs contribute to research in technical developments for industrial safety, security and balancing, networks optimal management, energy transition implementation, respect for the environment and the networks communicative intelligence[96].

Specific duties of the NRA aiming at safeguarding security of supply

CRE takes regulatory decisions regarding the operation and development of the network, supply and consumption programs.[97]

Also, the CRE can implement incentive measures, long and short term, in order to support the network transmission operators and encourage the integration on the gas internal market and the security of supply[98]. See for instance the incentives for investments in interconnection at (ii) above.

Also, the CRE can impose the realization of investments included in the 10-Year Plan, which are not carried out in time by the TSOs.[99]

3.1.5. Institutional or procedural constraints on the performance of the TSO's role

Different authorisations are needed for the construction and operation of gas pipelines.

Environmental authorisations

The construction and operation of gas transport pipelines present significant dangers and are subject to authorisation.[100] These are authorisations to be obtained on installations that are classified for the protection of the environment as far as the environment is concerned.[101]

The Minister in charge of the safety of the gas transport pipelines may establish by an order (after the opinion with the Higher Council for the Prevention of Technological Risks) the technical and operational requirements relating to the design, construction, commissioning, operation, monitoring, maintenance, modifications and the temporary or permanent stoppage of the pipelines operation.[102]

Where the construction and operation of a transmission line is of general interest because it contributes to the national or regional energy supply, or to the expansion of the national or regional economy, or to national defence, the corresponding works may be declared of public utility.[103] A public enquiry or consultation must be conducted prior the public utility declaration.[104]

The owners of land, which is crossed by a gas transmission or distribution pipeline, must refrain from any action, which would harm the construction, the proper usage and the maintenance of the pipeline. The construction or extension of certain establishments receiving public or high-rise buildings is prohibited or subject to the implementation of special protection measures by the project owner in relation with the holder of the authorization.[105]

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94 Ministerial order of 19 May 2008 on last resort gas supply, Article R.121-6 of the Energy Code and Article 1.2 of the GRTgaz Public Services Contract.
95 Ministerial order of 28 November 2013 on adoption of the gas emergency plan and Article 1.3 of the Public Services Contract.
96 Article 7 of the Public Service Contract.
97 Article L. 134-1 et L. 134-2 du code de l'énergie.
98 Article L. 341-3 du code de l'énergie.
99 Article L.321-6 (II) of the Energy Code.
100 Article L555-1 of the Environmental Code.
101 Articles L.511-1 *et seq*. of the Environnemental Code.
102 Article L555-3 of the Environmental Code.
103 Article L.555-25 of the Environmental Code.
104 Article L.555-30 of the Environmental Code.
105 Article L.555-16 of the Environmental Code.

General Local Authorities

Royalties are due to the municipalities because of the occupation of their public domain by the gas transmission works and by the gas pipelines, as well as for the temporary occupations of their public domain by worksites.[106]

Approval of the project execution

Prior to the project execution:

- It must be notified to the stakeholders;
- Its description is displayed in every concerned town.

3.2. Regulatory practice

3.2.1. Overview over regulatory practice in France

The general regulatory principle can be described as an incentive-based revenue cap with pass through elements. TSO's capital cost differentials between forecast and actual trajectories are now 100% covered by the tariff through the reconciliation, which is likely to limit the incentive for TSOs to control their investment costs, therefore the NRA has set incentives on meeting proposed project budgets. There is a statutory duty to develop research in the field of energy. TSO required (through public service contract) to offer new technological solutions and develop methodology for optimisation and development of intelligent networks.

The TSOs are obliged to prepare and submit to the NRA for approval a development plan for the transmission system to guarantee Security of Supply for the following 10 calendar years. The plan must be revised on an annual basis. The TSOs must also prepare an annual investment programme taken from the 10-year plan, which is submitted to NRA for approval to ensure realisation of investments. The NRA reviews and approves the 10-year development plan and consults it with network users. Depending on the results of this process, the NRA can require amendments to the development plan.

In analogy to the electricity sector, there is also a special treatment for large projects in the gas sector. Projects exceeding 20 Mio. € must be reviewed externally to challenge the expected project costs.

Main regulatory barriers

The interviewees were generally satisfied with the NRF regarding support of security of supply and innovation projects.

Yet, the interviewees do not recognise any of the potential regulatory barriers listed in annex III, few improvements for the NRF and EU legislation could be identified by the consultants:

- To clearly foster the energy transition, more explicit incentives could be added to the NRF, e.g. a WACC premium for connection of green gas production, because currently there is no general financial incentive for TSOs to upgrade the system for upstreaming;
- Some interviewees state the NRF not being able to support technologies enhancing the energy transition, such as PtG, green gas, sector coupling etc, so the treatment of these technologies could be reviewed;
- Some interviewees see issues with TEN-E/PCI regulations. Currently the framework is said to be only focussed on increasing transmission capacity, but local production is out of scope;
- Also, the definition and the assessment of qualitative criteria used in CBA for PCIs should be harmonised to avoid divergent views on the benefit of PCI projects.

Possible improvement of the NRF

From the interviews, the following improvements to the NRF could be derived:

- Adjustment of incentives for connection of green gas production.

[106] Article L.433-2 of the Energy Code.

3.2.2. Regulatory practice related to innovation

Innovative projects and adequacy of the NRF relating to its support for these projects

Generally, interviewees state that both the NRF and the NRA are supporting innovative projects finally resulting in an integration of innovative projects into the RAB. There is enough flexibility in the regulatory framework that it can be adapted in parallel or after completion of a pilot project and should not be considered as a barrier before launching an innovative project, in the interviewees eyes.

In general, the interviewees note to undertake several innovative projects in different fields, e.g.:

- PtG (H2, Methane): Jupiter 1000 power to gas project, near Marseille, commissioned by end of 2019, approved by NRA.
  Involves production of hydrogen as well as synthetic methane, from excess renewable electricity. It is the first industrial demonstrator of Power to Gas with a power rating of 1 MWelec for electrolysis and a methanation process with carbon capture in France;
- Integration of green gas projects
  studies on biogas fed into local grids, feasibility studies on reversing flows from downstream (distribution grid) to upstream (transmission grid) in order to facilitate injection throughout the year;
- Improvement of transmission efficiency
  project to collect heat when gas pressure is lowered in transmission stations;
- Hydrogen-Transmission
  Establishment of a research platform to solve technical barriers of the injection of Hydrogen into high pressure transmission network at different levels of concentration (FenHYx project);
- CNG Mobility
  upgrade TSO's vehicle fleet to CNG, and develop the necessary filling stations;
- Gas booster
  During maintenance, mobile compressor units are collecting methane upstream of the pipeline section under maintenance to inject it into the pipeline downstream of the section under maintenance. This is done in order to avoid methane emissions (already in operation).

Furthermore, interviewees tell that they thoroughly review every investment project to make sure that it is needed on the long run. To avoid stranded investments innovative solutions, such as operational tools or market tools, are favoured if they spare investments in additional transmission capacity that might be superfluous in the future due to the decreasing trend for gas demand. Also, expected tariff increases due to consumption decrease are issues for the future.

The NRA is said to be willing to recognise innovative programs and a process for approval of innovative projects exists. If TSOs want to start activities that are not directly associated with their main tasks, the activities must be approved by the NRA in advance. This approach can be seen as suitable for reducing the risk of non-accepted expenditures.

In the consultants' eyes, to clearly foster the energy transition, it could be considered to add more explicit incentives to the NRF, e.g. a WACC premium for connection of green gas production, because according to our understanding currently there is no general financial incentive for TSOs to upgrade the system for upstreaming.

Also, some interviewees see issues with TEN-E/PCI regulations. Some interviewees make the point that criteria of the assessment process should be adapted in order to include green gas integration projects, even if the projects do not have or have only little impact on cross border flows. Currently the framework is said to be only focussed on increasing transmission capacity, but local production is out of scope. The cross-border CBA criteria should be adapted to acknowledge the cross-border impact of green gas projects such as larger available share of green gas for neighbouring countries.

Moreover, some interviewees see improvement needs for the incentives set for investments in future infrastructure including biogas, PtG, sector coupling etc. Currently, TSOs are not allowed to invest due to unbundling restrictions but this issue might have impact on EU legislation as well.

3.2.3. Regulatory practice related to security of supply

Security of supply projects and adequacy of the NRF relating to its support for these projects

Interviewees state that most projects aim at fostering market integration and competition, whereas very few are only purely related to security of supply. Therefore, interviewees widened the term security of supply and also include market integration and competition. In the interviewees eyes competition and market integration should be considered as the main drivers for investments needs.

The interviewees tell to have initiated and completed several projects including PCIs during the last 10 years. In Western Europe, the interviewees consider that the gas market has reached a high level of market integration and security of supply. Still, projects are started in coordination with adjacent network operators. Examples of ongoing or already completed projects are :

- connection to the new LNG terminal in Dunkirk ;
- developing interconnections with Belgium (former PCI), Germany and Spain ;
- reverse flow with Italy through Switzerland (former PCI) ;
- single market area in France (former PCI).

French Gas TSOs benefited from incentive mechanisms to encourage investment decisions on projects increasing market integration, with an additional remuneration rate. But these mechanisms are no longer used by the NRA, which now considers that this bonus should be granted depending on cost benefit analysis.

One important project is the achievement of a unique gas marketplace by the end of 2018. The aim of this project is to adopt the European gas target model. Building two infrastructure projects will lead to define a unique gas price on the French territories, debottlenecking the North South link, and diversifying the sources of supply especially for the southern trading region. As the NRA asked the TSOs to achieve the building of a unique gas market place, new incentives were designed for these projects that aim to make the TSOs respect the budget constraints and the date of commissioning. A duty to apply innovative technology is not expressed for these projects.

The unique gas marketplace benefits from a bonus/penalty incentive mechanism. This mechanism was put in place in order to incentivise the TSOs to respect the budget constraint. This project benefits from a 3% premium to the WACC for the TSO remuneration.

The NRA adopted the implementation of the incentive regulation mechanism on investments defined in the ATRT5 tariff for the Gascogne-Midi project, which notably requires that:

- Within a limit of 110% of the target budget, the TSO is compensated for its investment at the weighted average cost of the capital plus the 300 bps premium for ten years;
- if the investment expenses exceed 110% of the target budget, the TSO no longer gets the 300 bps premium for the fraction exceeding that threshold;
- the share of the cost of the project exceeding 130% of the target budget is compensated at the rate of current fixed assets;
- if the investment expenses are under 90% of the target budget, the TSO receives a premium equivalent to the application of the 300 bps premium for ten years on the difference between the budget achieved and 90% of the target budget.

Moreover, a parameter index is taken into account for the share of the investment budget depending on the cost of steel so to take account of changes in the steel price to which TSOs are submitted. Thus, the target budget will be reviewed by the CRE in order to take into account the costs of purchasing supplies of steel, the value of the index HRC (Hot Rolled Coil) recorded during the signing of the purchase contract.

The tariff in-force (known as ATRT6) extends this mechanism to all the projects whose budget is over € 20Mn.

- The NRA will audit the budget presented by the TSO and will set a target budget, taking account if applicable of the price index of steel (HRC - hot rolled coil - index);
- Independent of the investment spending of the TSO, the asset will enter the RAB at its actual value when commissioned (less any subsidies) ;
- if the investment spending on this project is between 90% and 110% of the target budget, no bonus or penalty will be attributed ;

- if the investment spending is below 90% of the target budget, the TSO will receive a bonus equal to 20% of the difference between 90% of the target budget and the actual investment spending ;
- if the investment spending is over 110% of the target budget, the TSO will be charged a penalty equal to 20% of the difference between the actual investment spending and 110% of the target budget.

As the budget requests of the TSOs for the unique gas market projects exceeded 20 Mn. € the budget had to be submitted to an external audit, aiming at determining the most efficient cost. The NRA's approval was granted taking into account the audit conclusions and discussions with the TSOs.

The above described incentive systems are results of an evolution process and do not seem to contain any obvious improvement needs. Also, the interviewees do not report useful changes to the NRF. Yet, some interviewees criticise that the view on PCIs may differ between national authorities and the EU. National authorities are said to consider mainly the impact on their own domestic customers in terms of cost and benefits. As not only quantitative but also qualitative benefits are considered to determine a positive or negative CBA result. This has the disadvantage that the qualitative criteria are often very hard to quantify or to prove and are subject to individual rating. On a trans-regional level, this can increase complexity and potentially result in 2 countries arguing against each other. Therefore, the definition and the assessment of qualitative criteria should be harmonised.

3.2.4. Illustrative specific projects

The following projects are examples of successful innovative or security of supply projects and hence illustrate how the regulatory regime works in practice.

Projects of GRTgaz:

Project for the conversion of L-gas to H-gas is an example of the project of the vital importance for provision of security of supply designated to ensure the continuity of gas supply for 1.3 million customers in northern France. The low-calorific gas network ("L-gas") from the Netherlands, notably the Groningen field, supplies most of the Hauts-de-France region with natural gas. The associated supply contracts will not be renewed and, therefore, the import of L-gas to France will expire in 2029. In order to ensure continuity of supply for consumers, it is necessary to convert this network into gas with a high calorific value ("H gas") which supplies the rest of the French territory. The conversion of the transmission is the objective of this project.

GRDF, Gazélec Péronne, SICAE Somme and Cambraisis, Storengy and GRTgaz have closely collaborated under the auspices of the public authorities to elaborate a conversion plan, which was submitted to the ministers concerned on 23 September 2016 to be further evaluated by CRE, the French NRA.

The project is essential to ensure the continuity of supply of L gas consumers. It will go further by improving the gas supply security of this part of the network, which is now only fed by a single point of entry and a single source of supply at Taisnières. The project will create new connections with the rest of the transmission system and provide access to diversified sources of H gas.[107]

Jupiter 1000 is a project encouraging innovation in the transmission network development. The Jupiter 1000 project is designed implement by 2019 an innovative solution to produce hydrogen by electrolysis, combined with an anaerobic digestion process and CO_2 capture. GRTgaz and Teréga together with RTE (TSO in the electricity transmission network) and other partners develop the technical and economic knowledge of the *Power-to-Gas* to contribute to the development of this technology to strengthen the connection between the gas and electricity transmission networks.[108]

For Jupiter 1000 no particular incentive mechanism was put in place. First, the NRA was said to be reluctant to accept the project as a TSO is not the most appropriate party to execute this project due to unbundling restrictions. Nevertheless, as the investment expenses of this project

[107] Ten-year development plan for GRTgaz's transmission network for years 2017 – 2026, p.74.
[108] Ten-year development plan for GRTgaz's transmission network for years 2017 – 2026, p. 18.

were approved by the NRA and are part of the regulatory asset base, so the TSO bears no risk, as long as the costs don't exceed the initial budget. The investment expenses are covered through the clawback mechanism (100%). For the OPEX, any budget allocated to R&D and which have not been used will be restored to users at the end of the tariff period through the revenues and expenses clawback account. In the event that the TSOs exceed the four-year trajectory, they will be responsible for the difference. The TSO is incentivised through a R&D trajectory: for the ATRT6 tariff period (2017-2021), CRE set up an incentive regulation for R&D expenditure that is similar to that of the ATRD5 tariff and the TURPE.

Even though the project was accepted, it is classified as pilot project. In case of commercial development, the following power to gas assets costs will most probably not be approved by CRE and so will not be covered by regulated tariff.

West Grid Synergy: In 2017, GRTgaz launched 2 pilot projects on the development of the Smart Grids in gas transmission and distribution in two experimental zones, namely, Bretagne and Pays de Loire with an ambition to explore and forecast what could be tomorrow's carbon-neutral gas system.

In particular, the project provides for installation of two countdown stations allowing a two-way flow. These smart stations will help to test configuration of the network by organizing flow management and storage of locally produced biomethane when supply exceeds demand. The two experimental zones will constitute laboratories to define the modalities of adaptation and management of the networks of tomorrow. [109]

They are financed in accordance with CAPEX provided for in the ATRT6 for GRTgaz.[110]

Teréga:

Strengthening Sauveterre de Guyenne (RSAU): as part of the development of the network, Teréga plans to strengthen the Sauveterre compressor station with the addition of a compressor (7 MW). This project is a response to the evolution of the natural gas market forms a part of the European energy policy and will contribute to diversify and secure the gas supply.

3.3. Options for improvement

3.3.1. Options to improve regulatory practice

The above discussion shows that the NRF is well-designed and functional for both security of supply and innovative projects: there is flexibility to approve pilot projects and innovative solutions, incentives are provided to meet projected costs and maintain the level of security of supply. The interviewees are largely content with the existing framework, but an adjustment of incentives for connection of green gas production could be considered for the future. Such change could be implemented using legal powers already available to the NRA or others under the existing NRF.

Moreover, the NRF already contains a large number of individual regulatory instruments (such as public consultations, CBA, bonus/penalty mechanism) that - in case a need arises - can be adopted using legal powers already available to the NRA or others under the existing NRF.

Additionally, some potential improvement needs were identified by the consultants based on the shareholder interviews that must be addressed in EU legislation:

- issues with TEN-E/PCI regulations: Currently the framework is said to be only focussed on increasing transmission capacity, but local production is out of scope;
- Also, the definition and the assessment of qualitative criteria used in CBA for PCIs should be harmonised to avoid divergent views on the benefit of PCI projects.

Some respondents have highlighted potential hurdles created by EU unbundling regime. Whether or not such hurdles are actually caused by the unbundling regime or not requires a careful analysis that falls outside the scope of this project. In the final report we point out that for some areas, a clarification of the boundaries of the activities that TSOs are allowed to

[109] Ten-year development plan for GRTgaz's transmission network for years 2017 – 2026, p. 78.

[110] http://www.injectionbiomethane.labomatix.com/wp-content/uploads/2017/01/GRTGAZ_Pr%C3%A9sentation-des-2-projets-pilotes-de-rebours.pdf.

undertake would be helpful. In other cases, the recently adopted Clean Energy Package (including e.g. the market test) provides a procedure to overcome such hurdles.

3.3.2. National law mechanism(s) for implementing options

The suggested adjustment of incentives for the connection of green gas production could be implemented using legal powers already available to the NRA or others under the existing NRF. The NRA could adjust such incentives after having discussed the issue with the stakeholders at any of the regular opportunities for dialogue among stakeholders included in the NRF.

3.3.3. Impact assessment

We have not encountered any specific examples of projects that have been cancelled due to the regulatory framework. Furthermore, the stakeholders are largely satisfied with the current NRF. Furthermore, innovation is prominent in the current regulatory period. For these reasons, we do not expect considerable changes to investment levels.

ANNEX I: TYPOLOGICAL INVESTMENTS – ELECTRICITY

Generally, the term typological investment relates to technical solutions that TSOs can adopt to provide the transmission capacities needed to cover the transmission demand of grid users. Thus, a typological investment is meant to be a type of solution that can be implemented, in principle, by any TSO in situations in which these solutions are appropriate to provide the desired benefit. Hence, typological investments are not specific to a concrete location or a particular TSO. In the following, we have listed a selection of typological investments for the electricity transmission sector, that are differentiated in 7 categories that can be considered innovative as compared to conventional solutions. For each of these categories we have provided a number of examples of solutions, based on our existing knowledge, a literature review and interviews. The list might not be completely comprehensive, but should give an idea of our understanding of the different types of typological investments, we are interested in.

Category	Examples of solutions
New transmission lines based on innovative technology or change of technology of existing lines	• New HVDC lines (→allow to control the power flow; less expansive for long distance transport; undergrounding less complex); • Replacement of HVAC by HVDC lines (→less complex and less expensive; more compact design); • Underground cables or GIL (→ more expensive than OHL but can help improving public acceptance and accelerate the authorisation process); • Design of overhead line poles (→can help improving public acceptance and accelerate the authorisation process); • Replacement of conventional overhead line conductors by high-temperature conductors (→more expensive than conventional ones but can allow to provide additional capacity at a lower cost level and more quickly than by building completely new lines).
Introduction of dynamic capacity rating with the aim of utilising existing transmission lines or transformers at higher levels	Spectrum of technological options ranging from a differentiation of rating levels according to fixed time intervals (e.g. seasonal or time-of-day) down to online monitoring of equipment temperature and adaptation of capacity rating in real-time operation.
Installation of power flow control components in order to better adapt power flow patterns to capacities and topology of the existing grid.	• Phase-shifting transformers; • Semiconductor-based FACTS elements (including HVDC converters).
Investment into components contributing to ancillary services provision (reactive power / voltage control, short-circuit power, momentary power reserves and black-start capability)	• Purely phase-shifting generators (→offer operational flexibility and can serve to improve cost efficiency); • FACTS elements (→ see above).
New or extended power system control and automation technology with the aim to lower the risk of disturbances threatening security of supply	• Improvements in observability and controllability based on conventional sensor and actor devices; • Wide-area measurement systems (aiming at synchronously measuring power phasor angles at the grid nodes to improve observability); • Real-time dynamic security assessment tools (aiming at observing stability phenomena beyond static voltage/current measurements).

Category	Examples of solutions
Partial automation of system operation processes aiming at better utilisation of existing grid capacities	Automatic switching of network devices (in connection with adaptive protection schemes) or of generation-side or demand-side flexibilities in case of grid component outages in order to reduce the demand for (n-1) capacity reserves.
Improvement of approaches to curative congestion management providing the possibility to operate systems closer to their technical limits and/or to improve security of supply	• Generation-side flexibilities (especially renewables); • Demand-side flexibilities (DSM/DR); • Storage components; and • Technologies coupling the electricity sector with other sectors (gas, heat, traffic).

ANNEX II: TYPOLOGICAL INVESTMENTS – GAS

Typological investments are meant to be those type of investments whose aim is to promote innovation in the gas transmission systems while ensuring or enhancing the level of security of supply of a region. Hence, by definition, they can be implemented independent of a specific TSO and location.

In the following table, we offer a resume of the typological investments for the gas transmission system we have deemed as innovative compared to "conventional" solutions.

The investments are broken down into four categories each accompanied by examples that emphasise their importance and impact on the gas system.

Category	Examples of solutions
Increased need for flexibility for market development and security of supply.	• (Power-to-gas) Usage of excess pipeline capacity as "energy" storage of excess wind or solar energy by utilizing electrolysis (an efficient utilization of the excess of electricity produced by non-programmable sources of energy); • Increase withdrawal and injection capacity in storages by incentivising investments supporting flexibility (support of gas market liquidity and security of supply level); • Allowance of higher pressure in selected pipeline/routes (increase of flexibility of the supply side).
Incentivise and facilitate upgrade of biogas to the transmission system.	• Investments in upgrade of biogas to transmission system (support of gas market liquidity and security of supply).
Digitalisation of operations, through e.g. drone inspections and artificial intelligence (AI), resulting in a safer and cost-efficient operation.	• Drone inspections and AI in combination with modern SCADA systems can serve as input to reliability based operation and maintenance (lower maintenance cost and reduction of unforeseen/unplanned shutdowns).
In order to support security of supply and add liquidity to the gas market, there is a need to build interconnectors in Europe.	• More reverse flow systems could be considered to increase flexibility in the supply routes (reduction of dependency and power of trading of the large gas suppliers); • Enhancement of available gas supply in situation of supply crisis; • possibility of arbitrage a price convergence between markets to support the development of the internal market.

ANNEX III: POTENTIAL REGULATORY BARRIERS FOR PROJECTS

Regardless of the character of a project (e.g. projects enhancing security of supply or applying innovative technologies, which this questionnaire is focussing on) there might be potential regulatory barriers for implementing projects in general but maybe also barriers for special kind of projects. To give you an impression what kind of barriers we have in mind, we have listed some examples of such barriers in the following. It should be noted that there might be different or even more or less barriers in the regulatory framework of your country.

Type	Description / Explanation
Higher TSO CAPEX but lower expected OPEX within the TSO	the investment upfront is more costly, but has a potential of lowering the operational costs in the future. However, because of its innovative and more risky character the lower OPEX is not guaranteed. If not allowed to put the costs in case of a failure in the tariffs, TSO would not invest in innovative solution.
Higher TSO CAPEX, but benefits go to the wider society, instead of the TSO	This is a situation where higher investment, including in new technologies, is needed on the part of a TSO but benefits in terms of RES integration, RES curtailment or CO2 avoidance benefit other players in the society, while the TSO is only faced with the cost increase. Projects in regulatory frameworks, which do not distribute adequately the benefits to the TSO that bears the costs and takes the risk, are less likely to happen. This could also apply to cross-border investments involving several TSOs.
Investments in smart grid elements /technology aimed at replacing planned grid investments	Investments in smart grids and other smart elements that actually reduce the need of physical construction of lines for example due to a better interactive/intelligent grid management of balancing tools (battery storage) may provide a reduction in the regulated asset base, however with a slight increase of tariffs, might not be realised.
Investments in security of supply – projects without commercial benefits	Projects that ensure security of supply will in some cases never bring enough commercial benefits such as a pipeline would be going to be used only in case of emergency. If the security of supply (e.g. diversification of the sources for gas) is not put into tariffs, a TSO is most likely not willing to invest.
Lower TSO TOTEX but shift in the CAPEX/OPEX ratio	In some member states CAPEX and OPEX are treated differently in the regulatory regimes. Depending on the incentives set by doing so, technical solutions/projects with higher CAPEX might be preferred by the TSOs even if they result in higher total costs.

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