



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

Country Report - Italy



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Contact: Henriette Nesheim

E-mail: Henriette.NESHEIM@ec.europa.eu

*European Commission
B-1049 Brussels*

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Authors: Robert Haffner, Laura Heidecke, Harry van Til, Karolina Ryszka (Ecorys), Wolfgang Fritz, Alexander Ladermann, (Consentec), Emiliano Catalini, Søren Løvstad Christensen, Frederik Roose Øvlisen (Ramboll), Gordon Downie, Samuel Hall, Liz McRobb (Shepherd & Wedderburn), Hans Auer (TU Wien), Leigh Hancher

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EXECUTIVE SUMMARY

Assessment of the NRF and the regulatory practice of the electricity sector in Italy

The electricity NRF in Italy

Italy has a hybrid approach where CAPEX is calculated using a rate-of-return mechanism and OPEX is calculated using an incentive-based method. OPEX are recognized through a typical RPI-X profit sharing mechanism, which provides strong incentives for efficiency. A snapshot is taken every 4 years and it is used as a basis for cost recognition of OPEX for the next 4 years regulatory period. So, the TSO can benefit from an OPEX decrease during the regulatory period but will be reluctant implementing projects that result in an OPEX increase. CAPEX are remunerated via WACC and only a fraction of CAPEX have a small incentive for cost reduction. For projects exceeding 15 Mn. € a CBA is mandatory.

The TSO does not have explicit duties aimed at encouraging innovation but a general obligation to operate the network in an efficient and effective way, which is an incentive to implement innovative solution leading to lower cost. Also, the NRA has no explicit statutory power to encourage innovation. Costs arising from efficient implementation of new technologies can be included in system charges. This allows the NRA some ability to set targets regarding innovation provided is efficient. In case innovative solutions that are regarded as promising approaches but showing a need for initial support, the introduction of special incentives is possible. In 2012 for example, the NRA promoted first electro-chemical storages and dynamic line rating applications in the transmission.

Further on, the TSO has a legal duty to prepare a network development plan, for minimum of next 10 years, and must submit it annually to the Economic Development Ministry. The NRA opens a public consultation of the network development plan and gives its opinion to the Ministry, which then approves it. The NRA defines some guidelines to the NDP (minimum info for each project, CBA methodology, etc.) and can enforce the fulfilment of the network development plan, also through tariff incentives.

The regulatory practice in the electricity sector in Italy

Interviewees from both TSOs and the NRA were generally satisfied with the NRF in Italy. Yet, they also recognize regulatory barriers mentioned in annex III as well as further issues could be identified:

- “Lower TSO TOTEX but shift in the CAPEX/OPEX ratio”: Disincentive for solutions resulting in increasing OPEX, but the NRA has already started approaching this issue through changes to the NRF, but presently the related discussions are at a starting point;
- TSOs are deterred from risky or innovative investments due to perceived high project risks because classic as well as innovative projects and solutions have the same WACC, generally;
- Permission processes are said to be time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation.
- Since 2016, costs for assets under construction are not remunerated. This issue has been partially addressed with Resolution 129/18, but it still lowers the internal rate of return of big/complex/time consuming investments as compared to smaller/simpler/shorter projects.

Options for improvement

Our assessment generally concluded that the NRF seems to be well-designed and functional for both security of supply and innovative projects: the NRA introduced a special support scheme encouraging the implementation of line monitoring systems and electro-chemical storages, mandatory CBAs for larger projects help to decrease the risk of non-approval in an early project phase. Yet, it must be considered that the existing NRF deters TSOs from the implementation of solutions increasing OPEX. But the NRA has already started approaching this issue through changes to the NRF. Basically, a more output-based incentive regulation to better align regulated entities interests with the overall public interest is being introduced. Even though the related discussions are at a starting point presently and the outcome is unclear, we do not

recommend any changes as the barrier is already addressed. Further improvements possibly worth to be considered are listed in the following:

- (i) Introduction of supporting tools and schemes for innovative or risky projects, such as conditional WACC values (e.g. premia on WACC for specific innovative or risky investments) or dedicated cost allowances;
- (ii) Simplification and acceleration of permitting processes both at EU and member states level;
- (iii) Recognition of remuneration for efficient work in progress;
- (iv) Higher protection of TSOs from stranded costs risk.

We consider that, with exception of option (ii), the above-mentioned improvements could be implemented using legal powers already available to the NRA or others under the existing NRF.

Assessment of the NRF and the regulatory practice of gas sector in Italy

The gas NRF in Italy

Italy has a hybrid approach where CAPEX is calculated using a cost-plus mechanism and OPEX is calculated using an incentive-based method. The system is very similar to the one applied in electricity (see above). The tariff system seeks to create a balance between the costs of maintaining and developing the network and remuneration of the service.

The regulatory practice in the gas sector in Italy

Interviewees from both TSOs and the NRA were generally satisfied with the NRF in Italy. Yet, they also recognize regulatory barriers mentioned in annex III as well as further issues could be identified:

- “Lower TSO TOTEX but shift in the CAPEX/OPEX ratio”: Disincentive for solutions resulting in increasing OPEX, but the NRA has already started approaching this issue through changes to the NRF, but presently the related discussions are at a starting point;
- TSOs are deterred from risky or innovative investments due to perceived high project risks because classic as well as innovative projects and solutions have the same WACC, generally;
- There are uncertainties within technical and commercial rules regarding the injection of biogases as well as CO₂ transmission and storage that should be clarified;
- Interviewees seek clearer support from the NRF for the support of innovative solutions at the point of first field application that show an expected benefit;
- Unbundling restrictions deter TSOs from taking actions in some sectors (→ EU legislation);
- Regarding a clear support of the further energy transition, decarbonisation could be considered more prominently in TYNDP and PCI processes (→ EU legislation);
- Permission processes are said to be time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation. (→ national and EU legislation).

Options for improvement

Generally, the NRF appears to be well-designed and functional for both security of supply and innovative projects, taking also into account the expected developments of the regulation. Numerous innovative and security of supply projects are implemented or going to be started in line with the evolutions of the regulatory framework, under overhauling in particular with reference to innovative projects. Mandatory CBAs for larger projects help to decrease the risk of non-approval in an early project phase. Yet, it must be considered that the existing NRF deters TSOs from the implementation of solutions increasing OPEX. But the NRA has already started approaching this issue through changes to the NRF. Even though the related discussions are at a starting point presently and the outcome is unclear, we do not recommend any improvements as the barrier is already addressed. Yet, identified additional issues could be approached by the following options if deemed necessary:

- (i) Introduction of supporting tools and schemes for innovative projects, such as conditional WACC values (e.g. premia on WACC for specific innovative or risky investments) or dedicated cost allowances;
- (ii) Clarification of technical and commercial rules; and
- (iii) Simplification and acceleration of permitting processes both at EU and member states level.

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

We consider that, with the exception of option (iii) and the EU level options, the above-mentioned changes could be implemented using legal powers already available to the NRA or others under the existing NRF.

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 analyses. It is divided into two main sections, Section 2, which is related to electricity, and Section 3 which is related 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 also 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 Italy, 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 Italy. 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.:

- i. by immediately reducing overall cost as compared to a conventional solution;
- ii. by prospectively reducing overall cost in the future, subject however to a “learning curve” as to the cost level of the innovative solution;

- iii. by accelerating the process of transmission capacity expansion and thus reducing social welfare loss caused by temporarily insufficient transmission capacities; or
- iv. 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 Italy

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

The national transmission network is formed by very high and high voltage lines, transformation and/or sorting stations, as well as interconnection lines that allow the exchange of electricity with foreign countries.

The extent of the national transmission network was established by Decree of the ex-Ministry of Industry, Commerce and Artisans (now The Ministry for Economic Development) of 25 June 1999 and subsequent amendments and additions, also on the basis of the completion of Development Plan's investments.

By Decree of the Ministry for Production Activities of 20 April 2005, amended by decree of the Ministry for Economic Development of 15 December 2010, electricity transmission and dispatching activities in Italy were granted under concession to the company Terna S.p.A.

Article 1-sexies of Law Decree no.239 of 29 August 2003 converted with amendments by Law no. 290 of 27 October 2003 provides that the construction and operation of the electric lines forming part of the National Transmission Grid (*Rete Nazionale di Trasporto (RTN)*) for electricity as well as the connected works and infrastructure indispensable for the operation of the same are subject to a sole authorisation granted by the aforementioned Ministry together with the Ministry of the Environment and Protection of the Territory and the Sea and by agreement with the Region or Regions concerned. The sole authorisation is granted following a single procedure carried out in compliance with the principles of simplification and in the manner laid down by Law no.241 of 7 August 1990 and the Decree of the President of the Republic no.327 of 8 June 2001. The authorisation of overhead lines at voltages higher than 100 kV, longer than 10 kms and cables longer than 40 km are subject to Environmental Impact Evaluation (EIA), as ruled by Legislative decree no.152 of 3 April 2006. Overhead lines at voltages higher than 100kV and longer than 3 kms are subject to a former exam by the Ministry of the Environment and Protection of the Territory and the Sea to verify if an EIA should be done. Terna is the sole TSO of the national high-voltage grid even though residual portions of the NTG (less than 1%) are owned by other parties.

With regard to the low and medium voltage lines, companies (system operators) distribute electricity under a license regime and own the electricity grids at local level.

Legislative Decree no. 93 of 1 June 2011 governs the activities for the planning of the development works for the National Transmission Grid (*Rete Elettrica di Trasmissione Nazionale (RTN)*) and provides that Terna shall draw up by 31 January of each year, a 10-year Development Plan containing the development lines for such infrastructure system, taking account of:

- the electricity requirement trend and forecast of demand to be satisfied;
- the need to upgrade the interconnection networks with other countries;
- the need to reduce to a minimum the risks of inter-zonal congestion, also on the basis of the forecasts of the increase and distribution of demand submitted by operators of the distribution grids; and
- connection requests to RTN submitted by parties that are so entitled.

Article 36, paragraph 12, of the aforementioned legislative decree no. 93/2011 also provides that Terna shall submit the Development Plan to the Ministry for Economic Development which shall approve it, after having obtained the opinion of the Regions that are competent by territory and taking account of the assessments of the Authority for Energy, Networks and Environment (ARERA) at the end of a public consultation.

Legislative decree no.152 of 3 April 2006 established also a Strategic Environmental Assessment (*Valutazione Ambientale Strategica (VAS)*) applicable to aforementioned Development Plans.

The VAS, introduced by Community Directive 2001/42/CE, intervenes upstream of planning choices with the aim of “guaranteeing a high level of protection for the environment and contributing to the integration of environmental considerations on the drawing up” of plans and programs.

Undertaking of investments

The 2018 Development Plan envisages investments of approximately 12 billion EUR. It is a modern and up to date plan both in form and content which confirms its main aims such as the integration of renewable sources, improvement in service quality and resilience, the development of interconnection capacity, the end of network congestion and connection works to the national grid.

The main expected results are:

- reduction in CO2 emissions by up to 8.5 million tonnes/year;
- reduction in congestion for approximately 3.000 MW;
- greater exchange capacity with other countries estimated up to approximately 6.000 MW; and
- greater capacity of power from renewable sources for approximately 4.500 MW.

Role of NRA

The electricity, gas and water Authority (ARERA) is the independent regulatory body for energy markets. It protects the interests of users and consumers, promotes competition and ensures efficient, cost-effective and profitable nationwide services with satisfactory quality levels in the electricity and gas sectors. The ARERA's core regulatory competences cover maintaining a reliable and transparent tariff system (reconciling the economic goals of operators with general social objectives and promoting environmental protection and the efficient use of energy), setting quality of service standards and defining a framework aimed at protecting and empowering consumers in competitive markets.

2.1.2. Specific legal rights and duties

Article 1-sexies of Law Decree no. 239 of 29 August 2003 converted with amendments by Law no. 290 of 27 October 2003 provides that the construction and operation of the electric lines forming part of the National Transmission Grid (*Rete Nazionale di Trasporto (RTN)*) for electricity as well as the connected works and infrastructure indispensable for the operation of the same are subject to a sole authorisation granted by the aforementioned Ministry together with the Ministry of the Environment and Protection of the Territory and the Sea and by agreement with the Region or Regions concerned. The sole authorisation is granted following a single procedure carried out in compliance with the principles of simplification and in the ways laid down by Law no.241 of 7 August 1990 and the Decree of the President of the Republic no. 327 of 8 June 2001.

Legislative decree no. 152 of 3 April 2006 has provided also that the approval process of the aforementioned Development Plans may be adopted only after having applied a Strategic Environmental Assessment (*Valutazione Ambientale Strategica (VAS)*) to them.

The VAS, introduced by Community Directive 2001/42/CE, intervenes upstream of planning choices with the aim of "guaranteeing a high level of protection for the environment and contributing to the integration of environmental considerations on the drawing up" of plans and programs. This represents an instrument to promote a development of the electric network, which is sustainable and compatible with the environment, agreed with the Regions and Local Authorities through the instrument of concertation.

2.1.3. Mechanism for financing of investment projects

The main mechanism for financing investment projects is the tariff.

The electricity required by end-users needs to be generated, transported and finally distributed to the delivery point. Production is entrusted to the market operators responsible for generation units (producers); transmission and distribution are respectively the responsibility of the national grid operator and local distributors. In addition, TERNA – which supervises the control of the entire high and very high voltage transmission grid – must ensure that the physical exchange of electricity among producers and consumers takes place in compliance with a safe and stable functioning of the electricity system (first of all guaranteeing the instantaneous equilibria of generation and consumption). These activities of TERNA are defined as electricity dispatching throughout the national territory. The providing of this service results in a dispatching cost to which all end customers (end-users) who withdraw electricity from the network contribute through the payment of fees for the dispatching service applied to the electricity drawn from the grid.

"The current regulatory framework – including tariff regulation – is set by the NRA (ARERA). With Resolution 654/15, following a consultation process, ARERA set out:

- (i) the criteria and formulae for calculating the grid transmission fees, valid for the first four years (2016-2019, a.k.a. NPR1) of the regulatory period (2016-2023); and
- (ii) the rules for the annual updating of the unit values of the grid transmission fees during the same period.

The unit values of the grid transmission fees are therefore determined annually by the ARERA on the basis of specific rules defined in the above-mentioned Resolution.

According to the current regulatory framework Opex and Capex have very different regulatory treatments:

- Opex are recognized through a typical RPI-X profit sharing mechanism, which provides strong incentives for efficiency (the x-factor in the current regulatory period - to be applied in the price cap formula - is determined in order to gradually absorb the productivity gains achieved by operators in the past, without any further targets for reducing operating costs). A snapshot of the OPEX level is taken every 4 years and it is used as a basis for cost recognition for the next 4 years regulatory period;
- Capex are remunerated via WACC – through a RAB based mechanism – with smaller incentive for cost reduction (work in progress are only partially remunerated).

Furthermore, the tariff regulation provides for the attaining of targets in terms of quality of the network through the achieving of premiums or the application of a penalty should they not be reached."

The cost of network services (transmission and distribution) has an overall impact on users' bills of approximately 15% to cover the cost for network services and infrastructure.

In addition, to financing via tariffs there are two other main financing options that are described in the following.

Aid to Electricity Infrastructure

The Ministerial decree of 19 October 2016 set up a State Aid regime to support investments in electricity infrastructure. The aid regime is established on the basis of the provisions laid down by EU Regulation 651/2014 of 17 June 2014 (*General regulations on category exemptions*).

The decree is the legal basis for all national or regional Administrations, which wish to promote investments in upgrading and optimising the electricity network in the assisted areas throughout Italy, upon the conditions laid down in it.

To incentivise this type of project, the MiSE (Ministry of Economic Development) has allocated 321,620,225 EUR to [PON 2014-2020 FESR](#) (*Area IV "Energy efficiency", Azione 4.3.1.*) and provides that additional financial resources may be made available by other Administrations to carry out the facilitated works provided under the new Aid regime.

In particular the decree outlines the legislation necessary to implement Action 4.3.1 of PON 2014-2020 FESR, which promotes the construction of smart grids in **Basilicata, Calabria, Campania, Puglia** and **Sicilia** and works to the transmission grid when strictly complementary.

The works will be implemented through specific tenders, acts and orders of the competent administrations, which are still to be published.

European Investment Bank Financings

Over the years, Terna has been granted certain financings from the European Investment Bank (EIB).

In 2017, Terna signed two agreement with EIB. The first one amounts to 130 million Euro and supports investments for the public part of the "Piemonte-Savoia" project, the new 320 kV continuous voltage interconnection between Italy and France; the second one amounts to 85 million Euro and is intended to fund investment in development of the Capri-mainland connection and in the restructuring of the network serving the Sorrento Peninsula, involving replacement of the current 60 kV network with a new 150 kV network.

In the previous years, EIB granted Terna several financings aimed at expanding, strengthening and/or enhancing the Italian electricity transport system in order to guarantee the safety and efficiency of the transmission service. For example, dealing with the financing signed in the last five years, we can mention the 200 million euro loan signed in December 2016, the 153 million Euro loan signed in December 2015 and the 570 Euro million loan signed in July 2013.

Finally, of remarkable note, are the two loans granted in 2008 and in 2010, for a total amount of 373 million Euro, for the financing of the Italy – Sardinia submarine link. The infrastructure achieved many records (it is still the longest undersea cable in the world at 1000 megawatts) and boasts economic, electrical and environmental benefits thanks to the elimination of “bottlenecks” between Sardinia and the rest of the electricity market, in addition to increased safety of the Sardinian electrical system and a more secure coverage of the demands of Lazio and central Italy.

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

The tariff system should create a balance between the costs of maintaining and developing the network and the remuneration of the service.

On the basis of the studies carried out by ARERA, the regulatory framework has proven to be adequate in attracting the considerable investments necessary for the modernisation of the Italian electricity grid and to cause operators to behave efficiently and to improve the quality of the transmission and distribution services. We are not aware of many situations where assets in a significant amount have been stranded i.e. constructed and then not used.

2.1.4. Regulatory rules with respect to innovation

Specific duties of the TSO aimed at encouraging innovation

There is no express duty on the TSO to innovate. Under Legislative Decree, no.93 of 1 June 2011 the TSO is required to submit a 10-year network development plan to ARERA and to the Ministry for Economic Development for its approval. The document is drawn up each year and which contains all the development activities undertaken, or to be undertaken in the ten-year period involved, to the Transmission Grid.

Specific duties of the NRA aimed at encouraging innovation

ARERA has no specific duty to encourage innovation, but it participates in the approval process for the 10-year Development Plan for the national transmission network through a public consultation on the Plan and shall make the results public. Furthermore, ARERA controls and assesses the implementation of the 10-year Development Plan of ENTSO-E (European network of grid operators of electricity transmission systems). This analysis is carried out by ARERA within the context of cooperation with the Agency for Cooperation of Energy Regulators (*Agenzia per la Cooperazione dei Regolatori dell'Energia (ACER)*), which publishes opinions on national development plans and the monitoring of investments in transmission.

2.1.5. Regulatory rules with respect to security of supply

Specific duties of the NRA aiming at safeguarding security of supply

ARERA has taken initial actions to increase the resilience of the networks. To make the electricity network more robust and resilient (i.e. to increase security of supply), and also to reduce the time taken for return to service when there are prolonged outages (for instance in bad weather), ARERA promotes incentive mechanisms for operators through the use of regulatory instruments.

2.2. Regulatory practice

2.2.1. Overview over regulatory practice in Italy

Italy has a hybrid approach where CAPEX is calculated using a rate-of-return mechanism and OPEX is calculated using an incentive-based method. OPEX are recognized through a typical RPI-X profit sharing mechanism, which provides strong incentives for efficiency. A snapshot is taken every 4 years and it is used as a basis for cost recognition of OPEX for the next 4 years regulatory period. The TSO can, therefore, benefit from an OPEX decrease during the regulatory

period but will be reluctant implementing projects that result in an OPEX increase. CAPEX are remunerated via WACC and have a smaller incentive for cost reduction. For projects exceeding 15 Mn. € a CBA is mandatory.

The TSO does not have explicit duties aimed at encouraging innovation but a general obligation to operate the network in an efficient and effective way, which is an incentive to implement innovative solution leading to lower cost. Also, the NRA has no explicit statutory power to encourage innovation. Costs arising from efficient implementation of new technologies can be included in system charges. This provides the NRA with some ability to set targets regarding innovation provided these are efficient. In the case of innovative solutions that are regarded as promising, the NRA may value the possibility of an initial support, including specific incentives. In 2012 for example, the NRA promoted first electro-chemical storages and dynamic line rating applications in the transmission system. In any case, the possibility to define specific cost recognition rules for specific innovative projects is not an automatic process and the outcome is in any case uncertain.

Further, the TSO has a legal duty to prepare a network development plan, for the minimum of the next 10 years, and must submit it annually to the NRA. The NRA approves the network development plan and can impose conditions via the approval process. The NRA can enforce the fulfilment of the network development plan.

Main regulatory barriers

The interviewees were generally satisfied with the Italian NRF that is regarded as being able to provide a solid foundation for investments. Yet, they also recognize regulatory barriers mentioned in annex III as well as further issues could be identified:

- “Lower TSO TOTEX but shift in the CAPEX/OPEX ratio”: Disincentive for solutions resulting in increasing OPEX, but the NRA has already started approaching this issue through changes to the NRF, but presently the related discussions are at a starting point;
- TSOs are deterred from risky or innovative investments due to perceived high project risks because classic as well as innovative projects and solutions have the same WACC, generally;
- Permission processes are said to be time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation. Also, the current NRF leaves the TSO exposed in case investments become useless, even if the change was unpredictable and outside the TSO’s control (e.g. policy change);
- Since 2016, costs for assets under construction are not remunerated. This issue has been partially addressed with Resolution 129/18, but it still lowers the internal rate of return of big/complex/time consuming investments as compared to smaller/simpler/shorter projects.

Possible improvement of the NRF

The main regulatory barriers could be addressed by following options:

- Introduction of conditional WACC values;
- Recognition of stranded investments if the TSO is not to blame;
- Recognition of Work In Progress remuneration
- Simplification and acceleration of permitting processes both at EU and member states level.

2.2.2. Regulatory practice related to innovation

Innovative projects

Despite both the TSO and the NRA, having no expressed duties regarding the application of innovative solutions, the use of different types of innovative solutions were reported. Since 2016, the TSO has developed a specific “Innovation Plan” which includes 80 projects that the TSO regards as being innovative. The TSO has grouped them into six clusters:

- a. Transmission Technologies;
- b. Electric Power System Operation;
- c. Grid & Markets Development;
- d. Smart Grid and Storage;
- e. Business improvement;

f. “Sustainability” intended as a crossing-cut cluster impacting on all previous clusters.

Referring to the above-mentioned clusters, project examples are:

- A: Transmission Technologies:
 - Application of innovative techniques for transformers insulation;
 - Line monitoring, innovative materials with improved electric characteristics for lines or transformers;
 - Reduction of EMF;
 - new anti-icing technologies.
- B: Power system operation:
 - new logic algorithms to optimise dispatching services;
 - Big Data Technologies for the development of innovative models of data analysis;
 - Application of Internet of Things tools in the management and monitoring of the transmission grid sensors.
- C: Grid and Market development:
 - New studies and models on the impacts of climate changes, electric mobility and renewable energy systems penetration on Italian electric grids;
 - Application of innovative tools for the electric grid planning;
 - Forecasting models of market scenarios and dispatching services optimization.
- D: Smart Grid and Storage:
 - Storage: analysis of different storage solutions in terms of material and management and studies on the possible regulation services provided by storage systems and new resources (enhanced primary regulation, balancing, synthetic inertia, etc.);
 - Optimal coordination of different flexibilities resources in grid context with high share of renewables penetration.

The TSO’s innovation plan is not only a collection of projects but also includes partnerships with different actors (universities, industries, other TSOs and DSOs etc.). To finance these projects the TSO is said to also consider different funding opportunities (EU funds, national tenders, ...).

Regarding the definition of innovation, some of the interviewees remark that in their view technology that is already applied in the field should not be regarded as innovative but as regular activity. These interviewees state that applications, technologies, materials etc. that have been successfully applied in test cases and are shortly to be used commercially should be called innovative.

Adequacy of the NRF relating to its support for innovative investments

Some interviewees underline that innovation is not promoted by the framework as an end in itself. Moreover, the regulatory framework must be sufficient for all projects (“innovative” or “classical”) that are seen as being necessary and efficient. But according to the interviewees, a support can be necessary to promote a technology at the point of first field application, if the application is expected to be beneficial in general. As such, certain technologies may benefit of explicit and potentially not technology-neutral regulatory mechanisms.

An example of an explicit regulatory support for specific technologies in Italy is the following. In 2012, the NRA promoted first electro-chemical storages and dynamic line rating applications in the transmission systems as being innovative and showing a need for initial support¹. The key (and project-specific) feature to support related projects was a (conditional) WACC premium. To balance this premium feature (200 basis points for 12 years), the NRA defined:

- A conditionality on the minimum performance of the pilot project related to the amount of saved RES curtailment energy in the first two years of operation of each pilot project;
- An extended allowance of ex-post CAPEX increases subject to NRA approval (CAPEX overruns are accepted in the general regulatory framework, as long as efficient).

The interviewees report further that the approval process was more complex than for other transmission investments. Project requests were reviewed, and a commission of independent experts was set up. Also, there were communications and clarifications with the TSO, e.g. on project cost deviations, as described in the recitals of regulatory order 66/2013 dated 21 February 2013.

¹ The main references are the regulatory orders 288/2012, 43/2013 and 66/2013 (in Italian only).

Although the CBA of the battery storage projects resulted in a lack of monetised benefits, the projects were approved by the NRA for learning purposes. Some interviewees state that the highest benefit from such support mechanisms are the mandatory public dissemination about experience, problems and found solutions rather than reduced expenses in the future. The created knowledge is said to be the surplus value that in the end might result in a cost reduction and/or in better and swifter implementation of future applications.

The cost recognition mechanism of OPEX strongly incentivises cost decrease, so TSOs might be reluctant implementing projects that result in an OPEX increase. Also, the incentive for the use of dynamic line rating, that has low investment cost but will increase OPEX during operation, underline an existing bias. Interviewees from both the NRA and the TSO recognise this as a potential regulatory barrier that is also listed in annex III "Lower TSO TOTEX but shift in the CAPEX/OPEX ratio".

But the interviewees tell that the NRA has already started approaching this issue through changes to the NRF, but presently the related discussions are at a starting point (first consultation with document 683/2017). Key elements of the changes are a TOTEX-oriented regulation and forward-looking plans.

Therefore, we do not recommend a modification of the NRF counteracting the CAPEX-OPEX-bias because a change is already being approached, even though due to the early stage of the process we cannot judge whether the CAPEX-OPEX-bias will be successfully eliminated without causing new barriers.

Additionally, some interviewees criticise that specific project risks are not considered because classic as well as innovative projects and solutions have the same WACC (except those who fall under the support mechanism described above). So, TSOs can be expected to be reluctant towards projects with higher implementation risks, e.g. innovative projects in an early phase of development. Although there is a regulatory provision for asking higher returns in case of PCIs with higher risks (Resolution 446/14), it is said to have never been applied as of now.

2.2.3. Regulatory practice related to security of supply

Security of supply projects

The interviewees report that approximately 30% of the network development plan can be categorized as being predominantly security of supply-related (including sub-categories such as reliability, quality of supply including voltage quality, resilience to extreme events). Nevertheless, it must be considered that security of supply will benefit from almost any project relieving system stress or providing more flexibility.

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

Generally, the NRF does not differ projects types, so the above-mentioned criticism for innovative projects is also valid for security of supply investments. Regardless of this, the following aspects were identified within the stakeholder interviews.

The framework grants only little remuneration for work in progress, which can lead to a bias on implementing rather small projects. As security of supply projects are usually larger projects this is a disincentive for such projects in general. But recently, this issue has been mitigated by a regulation according to which the TSO can request an early remuneration for large projects as a measure to balance the bias. Still, some of the interviewees believe that the process is unnecessarily burdensome, and the all works in progress should be remunerated, as in all other services regulated by ARERA.

Also, interviewees see obstacles for projects related predominantly to security of supply but without showing commercial benefits (barrier 4 of annex III). But the NRA tries to diminish the barrier by defining and refining minimum requirements for the network development plan and linking the approval of a project to the compliance with these requirements.

Further, interviewees criticise that the CBA (mandatory for projects > 15 Mn. €) only partly reflects cost for additional circuits enhancing resilience against outages as well as adequacy and flexibility aspects. For 2018, the NRA is consulting the introduction of additional and more detailed requirements for the CBA. But interviewees see the general challenge to find adequate

but simple metrics to value security of supply and avoid double counting of effects/values. Therefore, discussions and consultations will have to be intensified in the future but in the interviewees eyes a start towards that has already been made.

Apart from that, interviewees recommend to better consider future developments and uncertainties in the NRF. It takes time to get permissions of infrastructure construction and so the TSO must look far into future to estimate what supply task (including (development of RES, load, storage, flexibility, sector coupling etc.) will develop and which investments will be needed to fulfil this task. There is a risk – in applying the regulation – to be rather conservative regarding investments in a quickly changing environment, by a-priori excluding potentially inefficient investments (due to uncertainty of actual development of grid extension drivers). Reluctance of implementing projects could become a potential threat for security of supply if investments turn out to be necessary and have not been started early enough to be put into operation on time. When setting aggressive targets for decarbonisation on EU level the interviewees point out that it must be accepted that necessary investments to achieve these goals must be initiated early in time, even if there is a risk of imperfect investments (on retrospective).

Alternatively, to reduce the risk of imperfect investments, the time needed for permission processes could be reduced. Therefore, mitigation of authorisation obstacles is a key task that could be approached by simplifying and accelerating permitting both at EU and member states level to shorten the time needed to obtain permitting.

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:

- The “Piemonte Savoia” Project mentioned above was authorised on 7 April 2011 for the Italian side by order 239/EL-177/141/2011 of the Ministry for Economic Development and the Ministry of the Environment and 18 June 2012 on the French side. The Italy – France Interconnector was then identified among the European Projects of Common Interest (PCI) and is part of the TYNDP. The project aims to strengthen the North-South Electricity Interconnections in Western Europe, reduce congestions on parallel systems and therefore enhances security of supply. As the project is identified as PCI the PCI CBA methodology was applied. Generally, the project is treated among the regular regulatory framework and no specific exemptions were made;
- Inter-ministerial decree 239/EL-288/260/2017 of 2 November 2017 authorised Terna S.p.A. to set up and operate “Fuorigrotta-Astroni-Naples Centre” links. By this decree the Ministry for Economic Development jointly with the Ministry of Environment approved the megaproject for 36.8 million EUR for the construction of the Fuorigrotta 220/60 kV plant and installation of the new 220 kV electricity line which transports electricity from the western area of the city to the historic centre. The new electricity line will replace the current one operated on 60 kV, and therefore considerably increase transmission capacity to the city. The work, classified as “urgent and unpostponable”, started in the first half of 2018. The work is estimated to take 5 years. Further, it has been planned to reduce the impact on the territory to a minimum and to ensure the continuity of electricity supply. The Inter-ministerial decree has the effect of planning variant so that the Municipal Counsel will not need to intervene on the Planning Regulations. The Municipality of Naples, however, wishes to examine the new electricity grid project and there is still the risk of filing an appeal to the TAR.

2.3. Options for improvement

2.3.1. Options to improve regulatory practice

The above discussion shows that the NRF is mostly well-designed and functional for both security of supply and innovative projects: the NRA introduced a special support scheme encouraging the implementation of line monitoring systems and electro-chemical storages, mandatory CBAs for larger projects help to decrease the risk of non-approval in an early project phase. Yet, it must be considered that the existing NRF deters TSOs from the implementation of solutions increasing OPEX, from bigger projects, from projects whose outcome is uncertain (either due to technology innovation, to sensitivity to scenario changes, to permitting issues) and/or with a higher than normal risk of becoming stranded, even in a distant future. But the NRA has already started approaching this issue through changes to the NRF. Even though the related discussions are at a starting point presently and the outcome is unclear, we do not

recommend any improvements as the barrier is already addressed. Further improvements possibly worth to be considered are listed in the following.

(i) Introduction of supporting tools and schemes for innovative or risky projects, such as conditional WACC values (e.g. premia on WACC for specific innovative or risky investments) or dedicated cost allowances

The stakeholder criticized that in general conventional as well as innovative projects and solutions have the same WACC independent of their individual risk of success. One mechanism to counter this is to differentiate the WACC for different projects thereby reflecting the risk of innovative projects. This does not mean, of course, that a new WACC must be established for each new project. Rather, WACC categories could be defined for “regular” and particularly “risky” or “innovative” projects. In addition, the ex-ante approval of CAPEX and other costs based on planned values with ex-post adjustment with actual values can reduce perceived uncertainty of innovative projects. Alternatively or additionally, output-based incentives mechanisms could be used for the same purpose, with the added benefit of increasing the alignment of TSOs’ and public interests.

(ii) Simplification and acceleration of permitting processes both at EU and member states level

Interviewees reported that permission processes are time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation. To reduce the risk of imperfect or delayed investments, the time needed for permission processes could be reduced. Therefore, mitigation of authorisation obstacles is a key task that could be approached by simplifying and accelerating permitting both at EU and member states level to shorten the time needed to obtain permitting. Potential options for improvement that could be considered at the EU level will be analysed in the full report (outcomes of Task 5).

(iii) Recognition of remuneration for efficient work in progress

Interviewees reported that the lack of remuneration of work in progress introduce a bias towards smaller projects. The NRA already introduced a mitigation measure, allowing such remuneration for selected projects. Such measure could be extended to all projects, also to align electricity transmission regulation to all other services regulated by the Italian NRA.

(iv) Higher protection of TSOs from stranded costs risk

Interviewees criticized that, in the current NRF, the risk of stranded investments is incurred by the TSO, regardless of the reasons that caused them becoming stranded. As transmission project decisions must be taken many years before their commissioning date and many decades before their expected end of life, and since the value of use of an investment heavily depends on policies and other dimensions outside TSO’s control, mitigation measure could increase the TSO’s willingness to invest in innovative projects. The impact of this barrier (and the benefit of any mitigation measure) can be expected to increase as the decarbonisation policies accelerate the pace of changes in the energy world.

2.3.2. National law mechanism(s) for implementing options

We consider that, with the exception of option (ii) and the EU level options, the above-mentioned changes could be implemented using legal powers already available to the NRA or others under the existing NRF.

As regards option (ii) (Simplification and acceleration of permitting processes at member states level), the suggestion of further simplification and acceleration of permitting processes could be implemented through a legislative intervention that simplifies the environmental assessment procedures and implements greater coordination of the various authorities involved (Ministry of the Environment, Region, Municipality) and sets out binding terms for the issue of the related consents. This could be addressed in a general or specific way. If this is to be a general legislative intervention such that all projects (including energy infrastructure projects) are to benefit from a simplified and accelerated process, then this could be provided by an amendment to Legislative Decree 152/2006. If, however, the legislative intervention is to be made specifically for energy infrastructure projects then this could be done through a new piece of legislation.

2.3.3. *Impact assessment*

An assessment of the impact on investments of the amendments already under discussion is difficult as it depends on the specific implementation. On one hand, this kind of regulation might incentivize more creativity and innovation on the TSO's end, as being able to solve an issue using, for example, less resources than with traditional means. On the other end, it might achieve the opposite effect if risks will be perceived as prevalent vs opportunities for the TSO.

A simplification of permitting processes would provide a support in accelerating investments, hence allowing the system to enjoy in advance from investments' benefits and reduce the risk of sub-optimal investments by bringing investment decisions closer to actual system needs (i.e. TSO could have a better view of actual system needs if they could reduce investment lead time).

3. GAS

3.1. Legal analysis of the NRF in Italy

3.1.1. *Overview of the regulatory framework of Italy – legal rules*

The overlapping of liberalisation and privatisation processes at both a national and European level has caused the State to change its energy policy goals from a decision-making position to utilities sector regulator.

Directive 98/30/EC, which outlines the regulatory framework which all EU countries will have to follow, was transposed by Legislative Decree no. 164 of 23/05/2000, the so-called “Letta Decree” (after then Minister of Industry). This decree completely revolutionized the gas sector in Italy: from an integrated vertical market and fully concentrated State monopoly to a market open to competition in relation to production, supply and sale.

In relation to the so-called “Second Gas Directive” (2003/55/ EC), many of its provisions were implemented in domestic legislation by Law no. 239 of 23/08/2004, called “Reorganisation of the energy sector”.

This is true also for the rules of legal, organisational and decisional separation introduced by the Regulatory Authority for the Energy Network and the Environment (ARERA) by Resolution no. 11/07 in order to replace the effects of true ownership separation. In fact, this has extended the scope of application of functional unbundling to activities different from transmission and distribution and has envisaged the adoption of a very penetrating model of governance aimed at regulating relations between the parent company and subsidiaries in order to:

- guarantee the neutrality of the management of infrastructure essential for the development of a free energy market;
- prevent discrimination in accessing commercially sensitive information; and
- prevent the cross-transfers of resources between the segments of the supply chain.

Finally, the so-called “Third Energy Package” has been implemented with Legislative Decree no. 93/2011, as subsequently amended by Law 115/2015.

Article 16 of the above mentioned Legislative Decree provides that the transmission network operator shall send annually to the ARERA and MiSE (i.e. Ministry of Economic Development) the 10-year development plan for the network for its approval by MiSE. The 10-year development plan contains the works necessary to guarantee the adequacy of the system and the safety of supplies, and taking account of the economic efficiency of the investments and protection of the environment.

Article 8 provides that the transmission system operators must have a continuous bidirectional capacity throughout all the trans-frontier interconnections between Member States, including in the connection between Italy and Central Europe, through the Transitgas gas pipeline in Switzerland.

The most important transmission system operator (TSO) in Italy is SNAM. Before the liberalisation process, SNAM was owned by ENI S.p.A., the State-owned company in the Italian oil and natural gas industry.

Legislative Decree no. 93/2011 established the adoption of the Independent Transmission Operator model, thus requiring a functional separation of SNAM from ENI. Law Decree no. 1/2012 and DPCM of 25/05/2012 then provided for full ownership unbundling to be implemented by ENI, selling SNAM's shares.

The first 10-year plan 2017–2026 submitted by SNAM provides for the realisation of the following priority development: “Support to the North Western Market and Trans-Frontier Bidirectional Flows”; “TAP interconnections”; “Methanisation of Sardinia”. The same plan includes the development of the following projects: “; “Interconnection with Slovenia”; “Development for New Imports from the South (Adriatic Line)”; Matagiola – Massafra pipeline: “Import Developments from North-East”; “Additional Southern Developments”.

The 10-year plan contains investments that the TSO decides are fixed and investments that can change according to the evolution of the National Gas Pipeline Network (*Rete Nazionale dei Gasdotti* – RNG) as well as the Regional Transportation Network (*Rete Regionale di Trasporto* – RRT).

Undertaking investments

Under Legislative Decree no. 93/2011 and ARERA resolution, no. 351/2016/gas the 10-year plan must contain:

- a detailed description of the characteristics of the transmission network and of the areas in which it is functionally structured with the indication of existing and possible critical issues in the future;
- indication of the possible transmission infrastructure to be built and strengthened in the 10-year period;
- indication of the investments to be made in the three-year period following submission of the plan; and
- indication for all investment projects on the expected date of realisation.

In the case where a TSO (for reasons for which it is responsible) does not make an investment in accordance with the 10-year plan, which had to be carried out within the next three years, the MiSE or ARERA may require the TSO to realise this investment within a specified term. If the TSO does not comply, ARERA can initiate the sanction procedure that involves the application of a sanction, for an amount that cannot be lower than 2,500 EUR and cannot exceed 10% of the turnover achieved by the TSO the year before the start of the sanctions procedure.

Role of NRA

Under Italian Law, ARERA:

- establishes the tariffs for the use of infrastructure and guarantees equal access for operators;
- encourages investments in infrastructure with particular emphasis on adequacy, efficiency and safety;
- ensures advertising and transparency of service conditions;
- promotes higher levels of competition and more acceptable safety standards in procurement, with particular attention to harmonizing regulation for the integration of markets and networks internationally;
- establishes provisions on accounting separation for the electricity and gas sectors, the water sector and the district heating service, as well as on the compulsory functional separation for the electricity and gas sectors;
- defines the minimum quality levels for services in terms of the technical and contractual aspects and the service standards; and
- monitors, supervises and controls the service quality, safety, access to networks, tariffs, incentives for renewable and similar sources, including in collaboration with *Guardia di Finanza* (Tax Police) and other bodies, including *Cassa per i Servizi Energetici e Ambientali* (Fund for Energy and Environmental Services - CSEA) and *Gestore Servizi Energetici* (Energy Services Manager - (GSE)).

Institutional or procedural constraints on the performance of those roles

As explained in Section 3.1.2 below, the approval process for the development of new networks pipeline is very complex and it involves several authorities (MiSE, ARERA, Regions, Municipalities, Ministry of the Environment).

Situations of conflict between the authorities involved can stop the project.

Furthermore, according to Italian Law in the approval process of a development project, ARERA, which has the statutory role of encouraging investments in infrastructure with particular emphasis on adequacy, efficiency and safety, has only a consultancy role and therefore such role is not so fundamental.

3.1.2. Specific legal rights and duties

The transportation of methane gas produced domestically or imported from abroad takes place through the RNG. The RNG, as well as transporting gas to interconnection points through the RRT, local distribution networks and storage facilities, supplies large industries and thermoelectric power plants.

The legislation on the classification of the RNG is set forth in the Ministerial Decree of 22/12/2000 and subsequent amendments and integrations, while the legislation on the classification of the RRT is set forth in the Ministerial Decree of 29/09/2005 and subsequent amendments and integrations.

Operators of stretches of the RNG and of the RRT must submit an application for the updating of the networks to the Ministry by 31 July every year. As well as a complete list of the existing stretches, the operators must provide a list of any new gas pipelines that have entered into operation, planned ones and finally those shut down as at 30 June of the same year.

By 30 September, the Ministry shall examine the applications and, having obtained the opinion of the ARERA and of the Regions concerned, shall publish by 30 November on its website the decree updating the RNG and the RTR, which shall enter into force from 1 January of the following year.

The construction of the gas pipelines and associated infrastructure is subject to a sole authorisation under article 52-*quinquies* of Presidential Decree no. 327/2001 (the "Public Expropriation Act"), which replaces any other licence or approval required by law, including Environmental Impact Assessments.

The Environmental Impact Assessment (for which the Ministry of Environment and/or of the competent Region is responsible) is part of the procedure for the issue of the sole authorisation. The sole authorisation implies the Declaration of Public Utility of the project and the expropriation constraint.

Furthermore, if the land is owned by the State, or by a Region or Municipality, the applicant must ask the competent authority for the issuance of a land concession. Should the land be owned by a private subject, the applicant needs to reach an agreement with the owner to obtain the easement rights for the new pipelines.

However, the issuing of the sole authorisation gives the applicant the right to start the expropriation procedures.

3.1.3. Mechanism for financing of investment projects

By resolution no. 575/2017/R/GAS, ARERA approved the criteria for the regulation of gas transmission tariffs for the transition period 2018 and 2019. The revenues (RT) of the operator are recognized through the following tariff items:

- a) remuneration of the net invested capital recognized for regulatory purposes (RT_{capital}), equal to the product between the remuneration rate of the real invested capital and the recognized net invested capital. The remuneration rate of the real invested capital is equal to 6.3%. For investments made after 31 December 2013 and before 31 December 2016, the aforementioned value is increased by 1%;
- b) additional remuneration for development investments (extra remuneration from 1% to 2%);
- c) economic-technical depreciation (RT_{amm}); and
- d) recognised operating costs (RT_{co}).

The main financing mechanism is the tariff and is unitary for all types of network development projects.

Another financing instrument is project financing governed by Articles 183,184,185 and 186 of Legislative Decree 18 April 2016, no. 50, but this mechanism is only applied rather seldomly. Project financing is mainly used by local authorities for the creation of new networks, but it has not had much development.

Mechanisms to foster innovation

The tariff system, which provides a fixed percentage of return on invested capital, seeks to create a balance between the costs of maintaining and developing the network and remuneration of the service. We are not aware of any feature specifically designed to encourage innovation, however ANIGAS (the industry association of companies operating in the gas sector) has asked ARERA to amend the tariff mechanism to provide for an incentive for innovative projects, but at the moment the tariff does not provide for such incentive. The regulatory framework is expected to evolve according to the indications included in the initial consultation document DCO 347/2018/R/Gas published by ARERA on 22 June 2018, in the consultation

document on the quality and innovation of the services (DCO 420/2018/R/GAS of 2 August 2018) and in the final orientation consultation document DCO 512/2018/R/GAS, issued by ARERA on 16 October 2018. These documents introduce the possibility for incentive mechanisms for projects or applications having a particularly innovative nature and, specifically, aimed at achieving environmental targets (e.g. methane emission reductions) or supporting energy transition (e.g. pilot projects for the use of the gas network to transport biomethane and other green gases, hydrogen and power to gas projects).

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

The current tariff system cannot alone guarantee the development and innovation of the network infrastructure. As explained above, the regulatory framework is evolving to take into account the needs of current and future users to have in place new or innovative infrastructure aimed at achieving decarbonisation targets (e.g. methane emissions reductions) and supporting energy transition (e.g. pilot projects for the use of the gas network to transport biomethane and other green gases, hydrogen and power to gas projects). The NRA's oversight of investments in new infrastructure and initiatives ensures that projects are timely realised.

3.1.4. Regulatory rules with respect to innovation

Specific duties of the TSO aimed at encouraging innovation

The TSO is not under any express duty to encourage innovation. The 10-year development plan constitutes the main document where the TSOs describe their planned investments for the transmission network developments, so far not including a specific section for innovative investments. The MISE updates every year the National Gas Pipeline Network (*Rete Nazionale dei Gasdotti* – RNG) and of the Regional Transportation Network (*Rete Regionale di Trasporto* – RRT) including the information about the developments of the gas network that all Italian TSOs foresee.

Specific duties of the NRA aimed at encouraging innovation

ARERA has no specific duty to encourage innovation but participates in the 10-year plan approval process. Under ARERA regulations, the procedure for the approval of the 10-year plan for the development of the network provides for a public consultation launched by it, in which the other operators and local authorities involved take part.

3.1.5. Regulatory rules with respect to security of supply

Specific duties of the TSO aiming at safeguarding security of supply

As gas transmission is classified as a public service, gas transmission and dispatching owner-operators must grant access to their own network infrastructure to applicants, on a non-discriminatory basis and with the aim of granting the neutrality of gas transmission.

In order to regulate the conditions of access, each network owner/operator is required to adopt its own network code (*Codice di Rete*) on the basis of a standard format approved by the ARERA.

Specific duties of the NRA aiming at safeguarding security of supply

Under law 14 November 1995, no. 481 ARERA has the institutional role of regulating and controlling service quality, safety, access to networks (see "Role NRA" in Section 3.1.1). ARERA implements this role through its own regulations.

3.2. Regulatory practice

3.2.1. Overview over regulatory practice in Italy

Italy has a hybrid approach where CAPEX is calculated using a cost-plus mechanism and OPEX is calculated using an incentive-based method. The system is very similar to the one applied in electricity (Sections 2.12.1 and 2.2). The tariff system seeks to create a balance between the costs of maintaining and developing the network and remuneration of the service.

Interviewees from both TSOs and the NRA were generally satisfied with the NRF in Italy, also taking into account its expected evolutions. Yet, they also recognize regulatory barriers mentioned in annex III as well as further issues could be identified:

- “Lower TSO TOTEX but shift in the CAPEX/OPEX ratio”: Disincentive for solutions resulting in increasing OPEX, but the NRA has already started approaching this issue through changes to the NRF, but presently the related discussions are at a starting point;
- Currently there are no incentives to specifically undertake risky or innovative investments;
- There are uncertainties within technical and commercial rules regarding the injection of biogases as well as CO₂ transmission and storage that should be clarified;
- Interviewees seek clearer support from the NRF for the support of innovative solutions at the point of first field application that show an expected benefit;
- Unbundling restrictions deter TSOs from taking actions in some sectors (→ EU legislation);
- Regarding a clear support of the further energy transition, interviewees suggest considering decarbonisation more prominently in TYNDP and PCI processes (→ EU legislation); and
- Permission processes are said to be time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation. (→ National and EU legislation).

Possible improvement of the NRF

The main regulatory barriers could be addressed by following options:

- Introduction of supporting tools and schemes for innovative projects, such as conditional WACC values (e.g. premia on WACC for specific innovative or risky investments) or dedicated cost allowances
- Clarification of technical and commercial rules;
- Simplification and acceleration of permitting processes both at EU and member states level.

3.2.2. *Regulatory practice related to innovation*

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

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

- Pressure drop recovery transformed in electricity (Turbo Expander);
- Use of turbo compressors exhaust energy to generate electricity (Organic Rankine Cycle);
- Territory and grid monitoring via drones and satellites;
- Gas for transport:
 - CNG filling stations;
 - Microliquefaction (L-CNG).
- Energy efficient solutions in Heating&Cooling sector:
 - R&D project Gas Absorption Heat Pump;
 - Studies for the promotion of Gas Heat Pumps and Micro-CHP.
- Biomethane;
- Power to Gas (P2G);
- Carbon Capture Storage (CCS) and Utilisation (CCU); Bioenergy with carbon capture and storage (BECCS).

Regarding the categorization of investments provided in Annex I interviewees suggested to add a dedicated category for “Decarbonization”, including all the options TSOs can develop for reducing gas carbon footprint (gas CO₂ neutral/CO₂ absorber): Gas for Transport, Energy efficiency, Biomethane, Power-to-Gas, CCS/CCU/BECCS as well as solutions based on hydrogen.

During the interviews, stakeholders in the gas sector have mentioned almost the same issues in the NRF as the interviewees in the electricity sector did. This is somehow obvious because the regulatory framework is to a high extent the same.

According to the interview results, the following aspects could represent obstacles to TSOs involvement in innovative projects:

- “Lower TSO TOTEX but shift in the CAPEX/OPEX ratio”: Disincentive for solutions resulting in increasing OPEX;

- Currently there are no incentives to specifically undertake risky or innovative investments;
- There is uncertainty on recognition of innovative project costs, especially for non-mature technologies.

The current regulatory framework is said to implicitly consider some good elements with relation to innovation. Moreover, the framework is already expected to evolve by introducing specific incentivising mechanisms for projects or applications having a particularly innovative nature and, specifically, aimed at achieving environmental targets (e.g. methane emissions reductions) or supporting energy transition (e.g. pilot projects for the use of the gas network to transport biomethane and other green gases, hydrogen and power to gas projects). Reference here is to the consultation document DCO 347/2018/R/Gas published by the Italian NRA on 22nd June 2018 and following consultation documents DCO 420/2018/R/GAS of 2 August 2018 DCO 512/2018/R/GAS of 16th October 2018). Although discussions are at a starting point, we suggest awaiting the results of these discussions, so that we do not recommend any improvements at this point of time.

Additionally, interviewees tell that through a Ministerial Decree, incentives for the support of biogas have been set and a “guarantee of origin” system had been introduced. Despite these progresses, interviewees still see the need for clarifications of the technical and commercial rules regarding the injection of biogases as well as CO₂ transmission and storage.

Moreover, interviewees seek clearer support from the NRF for the support of innovative solutions at the point of first field application that show an expected benefit. This could probably be achieved by introducing specific support mechanisms like those implemented in electricity.

Finally, interviewees mention unbundling restrictions deterring them from taking actions in some sectors. Such issues might not be solved by changing the national framework but need to be reviewed on EU level to avoid contradictions between national and EU legislation.

Regarding a clear support of the further energy transition, it could be worth considering decarbonisation more prominently in TYNDP and PCI processes, e.g. by including decarbonisations aspects in the CBA.

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

In general, the interviewees note to undertake several projects related to security of supply, e.g.:

- Reverse flow (e.g. “Support to the north west market and bidirectional cross-border flows”);
- Interconnections to new supply sources: (e.g. “TAP Interconnection”; “Adriatica Line”);
- Biomethane interconnections (several ongoing as new indigenous sources);
- New Gasification (e.g. “Sardinia Methanization” and “Malta interconnection”);
- Increase of UGS withdrawal capacity (e.g. Cornigliano Laudense UGS and related interconnection; Sulmona compressor station).

Generally, interviewees confirm that the NRF and the regulatory practise is suitable. The NRA is said to have a good understanding of needed activity to guarantee a sufficient level of security of supply nowadays as well as in the future for the whole energy system. Further, interviewees underline the necessity that the regulatory framework takes into account the whole range of security of supply investments’ benefits. But stakeholders also point out that a monetary quantification of benefits is not always straightforward, with potential risks of underestimating the positive impacts on consumers and industries. The general challenge is seen to find adequate but simple metrics to value security of supply and avoid double counting of effects or values. Especially for the gas sector, it needs to be considered that also some political and strategic decisions for security of supply exist going beyond techno-economic metrics. Nevertheless, discussions and consultations will have to be intensified in the future but as far as we know, a start towards that has already been made.

Analogously to electricity, interviewees criticise permission processes being time consuming, so investment decisions must often be made under uncertainty bearing the risk of imperfect investments or decisions are made too late for a timely implementation. This issue could be

approached by simplifying and accelerating permitting both at EU and member states level to shorten the time needed to obtain permitting.

3.2.4. Illustrative specific projects

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

SUPPORT TO THE NORTH WEST MARKET AND BIDIRECTIONAL CROSS-BORDER FLOWS

The project "Support to the North West market and bidirectional cross-border flows" allows to increase the integration of the Italian market with other European markets, as enabling factor to promote price alignment between different European gas hubs. The project has not only a market integration dimension, but in terms of security of supply it makes available additional gas resources to Northern European countries directly or indirectly connected to Italy and thus it contributes to the diversification of supply sources, taking also into account a potential reduction in production in Europe.

In 2015, the first phase of the project ("Support to the North West Market") was dedicated mainly to the flexibility and security of supply in the North West of Italy. This first phase had already cross-border impacts, enabling the creation of a first availability of physical flows for export from October 2015. The completion of the first phase guarantees an export of 5 MScM/d from Gries Pass Interconnection Point towards Switzerland and up to 18 MScM/d from Tarvisio Interconnection Point towards Austria.

The second phase of the initiative has been commissioned in September 2018, making available from October 2018 an overall export capacity at the Interconnection Points of Passo Gries and Tarvisio of 40 MScM/d (with a maximum of 18 MScM/d at Tarvisio Interconnection Point competing with export capacity at Gries Pass Interconnection Point).

The project involved the construction of pipelines between Cervignano - Mortara (62 km - DN1400) and the line Minerbio – Poggio Renatico (19 km - DN1200 in operation from December 2015), as well as new compression plants in Minerbio (24 MW) and Sergnano (36 MW) together with the expansion of the existing compression plant in Poggio Renatico (+22 MW, in operation since December 2016).

The project "Support to the North West market and bidirectional cross-border flows" is included in ENTSOE TYNDP 2017-2026 and in the GRIP "Southern Corridor" and "South-North Corridor" with the identification code TRA-F-214. The project is also included in the PCI list of the European Commission of 23 November 2017 with n° 5.11.

While the following projects of innovative nature are ongoing or planned.

Production, utilisation and infrastructure evolutions for new renewable gases (e.g. biomethane and hydrogen)

The final purpose of this initiative is to increase the potential of new renewable/green gases in light of EU energy sector progressive decarbonisation. The initiative comprises various categories of projects, such as:

- projects for biomethane plants development and efficient solid biomass gasification processes. These projects aim at increasing the efficiency of biomethane production, reducing the costs of processes such as biogas upgrading, anaerobic digestion and thermal gasification;
- Projects for hydrogen and methane production aimed at selecting the most suitable configurations from technical and economical point of views (evaluation of cells: Alkaline, PEM, SOEC).

The above-mentioned projects are coupled with initiatives to evaluate the resilience of the current infrastructures (gas network and storages) to hydrogen (possible evolution of Hydrogen Separation Technology) and biomethane (reverse flow between DSOs and TSO grids) injections.

Energy recovery from grid operations

The final goal of this initiative is to enhance the adoption of existing technologies aimed at increasing energy and operational efficiency of the gas network.

The projects belonging to this innovative workstream look at the energy that can be recovered exploiting the pressure drop and transforming it in electricity ("Turbo Expander") or using the heat produced by the exhaust energy of the gas compression plants to generate electricity ("Organic Rankine Cycle"). The recovery of this energy, which would be otherwise lost, will bring both economic and environmental benefits. The recovered energy can be used to cover self-consumption needs or, when in excess and subject to positive evolutions of the normative framework, injected in the electricity network.

Digitalisation

This initiative aims at the development of innovative technologies for grid monitoring and simulation, which would be particularly useful for integrating renewable gases and facilitating gas and electricity sector coupling.

The underlying projects relates to the development of innovative technologies for grid monitoring (e.g. using fiber detectors, drones, satellites and others tools for gathering information to supervise the gas network, which is assumed to become more complex when the number of new renewable gases injection points increases) and simulation (e.g. developing a digital model of the whole gas network to analyse the impacts on the whole gas system of new renewable gases production and injection).

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: numerous innovative and security of supply projects are implemented, mandatory CBAs for larger projects help to decrease the risk of non-approval in an early project phase. Yet, it must be considered that the existing NRF deters TSOs from the implementation of solutions increasing OPEX. But the NRA has already started approaching this issue through changes to the NRF. Even though the related discussions are at a starting point presently and the outcome is unclear, we do not recommend any improvements as the barrier is already addressed. Yet, additional issues were identified within the stakeholder interviews that could be approached by the following options if deemed necessary.

(i) Introduction of supporting tools and schemes for innovative projects, such as conditional WACC values (e.g. premia on WACC for specific innovative or risky investments) or dedicated cost allowances

Some stakeholders see as point to be carefully evaluated the fact that in general conventional as well as innovative projects and solutions have currently the same WACC independent of their individual risk of success. One mechanism to counter this is to differentiate the WACC for different projects thereby reflecting the risk of innovative projects. This does not mean, of course, that a new WACC must be established for each new project. Rather, WACC categories could be defined for "regular" and particularly "risky" or "innovative" projects. In addition, the ex-ante approval of CAPEX and other costs can reduce perceived uncertainty of innovative projects. Further, interviewees seek clearer support from the NRF for the support of innovative solutions at the point of first field application that show an expected benefit. This could probably also be achieved by introducing conditional WACC premiums for certain solutions, similar to the solution applied in electricity already.

(ii) Clarification of technical and commercial rules

Incentives for the support of biogas have been set through a Ministerial Decree and a "guarantee of origin" system had been introduced. Despite these progresses, interviewees still see the need for clarifications of the technical and commercial rules regarding the injection of biogases as well as CO₂ transmission and storage to reduce an existing uncertainty that might inhibit biogas projects.

(iii) Simplification and acceleration of permitting processes both at EU and member states level

Interviewees reported that permission processes are time consuming, so investment decisions must often be made under uncertainty baring the risk of imperfect investments or decisions are made too late for a timely implementation. To reduce the risk of imperfect or delayed investments, the time needed for permission processes could be reduced. Therefore, mitigation

of authorisation obstacles is a key task that could be approached by simplifying and accelerating permitting both at EU and member states level to shorten the time needed to obtain permitting.

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 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

We consider that, with the exception of option (iii), the above-mentioned changes could be implemented using legal powers already available to the NRA or others under the existing NRF.

As regards option (iii) (simplification and acceleration of permitting processes at member states level), the suggestion to simplify and accelerate permitting processes in Italy could be implemented by a legislative intervention that simplifies the environmental assessment procedures and implements greater coordination of the various authorities involved (Ministry of the Environment, Region, Municipality) and sets out binding terms for the issue of the related consents. This could be addressed in a general or specific way. If this is to be a general legislative intervention such that all projects (including energy infrastructure projects) are to benefit from a simplified and accelerated process, then this could be provided by an amendment to Legislative Decree 152/2006. If, however, the legislative intervention is to be made specifically for energy infrastructure projects then this could be done through a new piece of legislation.

3.3.3. Impact assessment

An assessment of the impact on investments of the amendments already under discussion is difficult as it depends on the specific implementation. A simplification and acceleration of permitting processes will very likely not result in considerable changes to investment levels. Furthermore, we have not encountered any specific examples of projects that have been cancelled due to the regulatory framework. For this reason, we do not expect that any of the suggested improvements will result in significant changes to investment levels. Yet, if the perceived risk of innovative projects is lowered by introducing appropriate supporting regulatory measures and a long-term strategic perspective on innovation could be attained, the share and maybe also the total investment of innovative projects is expected to increase.

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	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• (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.	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• 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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