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

Country Report - Germany

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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 and gas sector in Germany

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

The NRF in Germany

The regulatory principle for both the electricity and gas transmission sector can be characterised as incentive-based revenue cap mechanism. There are no provisions in the regulation explicitly facilitating innovation. The NRF is neutral regarding project categories, such as innovative or conventional, PCI or non-PCI. The regulation should ensure that the TSO operates effectively and efficiently. So, as long as project costs are reasonable, and the necessity and the benefit can be demonstrated, an investment will most likely be approved by the NRA. The NRF implicitly incentives the TSO to invest in innovation resulting in lower cost within the regulatory period but there might be reduced incentives for long-term cost reductions as efficiency gains must be passed on to consumers in the next regulatory period.

In order to provide regulatory support for the necessary adjustments to the transmission system as a result of the energy transition, the so-called investment measure mechanism was introduced. The NRA has to approve capital and operating costs of investment measures required for the expansion or restructuring of transmission systems, if these are necessary for system integrity or for integration into the national or international interconnected system or needed for expansion of the energy supply system. To the extent BNetzA approves an investment measure the relating costs are considered so-called permanently non-influenceable costs (for a certain period of time), which are not subject to individual efficiency targets and can, thus, be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period.

As a result of the introduction of the t-0 cost recognition, the NRA only approves the investment on the merits. Hence, the costs of the investment are included in the revenue cap based on planned costs (at t-0). Only thereafter an ex post control takes place by means of an as-is-evaluation. Any deviations between planned and actual costs will be recognised in the regulatory account.

The regulatory practice in Germany

Interviewees from both TSOs and the NRA were generally satisfied with the NRF in Germany regarding innovation and investments in security of supply. Yet, they also recognize one of the regulatory barriers mentioned in the questionnaire (“bias in the NRF favouring CAPEX”), at least on a theoretical basis. Most grid extension measures from the NDP are treated through the investment measure mechanism that, according to the interviewees, is well suited for the financing of this kind of investments in general. Also, interviewees are content with the approval processes. Cost not covered by the investment measure mechanism will be treated with the regular efficiency regulation regime consisting of a budget principle with base year system. This budget principle incentivises cost reductions but cost increases, maybe due to unforeseen developments, may result in a delay in being included in the revenue cap. Some respondents therefore argue that solutions with temporarily higher costs but lower costs in the long run may not be stimulated. At the same time interviewees also assessed the monetary relevance still being not significant in practice.

Also, some interviewees state the NRF not being able to support technologies enhancing the energy transition, such as PtG, green gas, sector coupling, storage etc. Currently stakeholders see unbundling issues that prevent them from promoting these technologies. This problem might be diminished by solely making targeted improvements to the national legal framework but very likely needs to be discussed at EU level (also).

Options for improvement

Although there were no major complaints about the NRF currently in place for innovation and security of supply, using the issues drawn from the above discussion, the following options for improvement could be worth being considered:

(i) Favouring of OPEX-based solutions;

(ii) Statutory obligation to consider alternatives;
(iii) Statutory reference to innovation; and
(iv) Consultation on investment plans (extension of existing consultation).

Option (i) could be implemented using legal powers already available to the NRA or others under the existing NRF but it is not easy to implement it well-balanced. The option has the risk to turn out to be a technology-specific incentive that does not necessarily lead to efficient decisions and may even encourage abuse. So, this risk must be carefully weighed against the effort of necessary changes to the law that are needed to implement the other options.

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 on investments to increase security of supply. The main objective of the study is to map how the regulatory frameworks in the Member States 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 2.12.1 for electricity and Section 3.1 for gas), including specific rights and duties of relevant parties, such as Transmission System Operators ("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 Germany, 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 Germany. 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 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 Germany

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

In Germany, while transmission networks encompass voltage levels of 220 kV and 380 kV, distribution networks operate on voltage levels of 110 kV downwards. There are four German electricity transmission systems operators ("**TSOs**") with control area (*Regelzone*) responsibility, namely TenneT TSO GmbH, Amprion GmbH, 50Hertz Transmission GmbH and TransnetBW GmbH. Network operators require an operating permit which shall ensure that TSOs have the necessary personal, technical and economic capability and reliability for the long-term operation of a network. In addition, TSOs are certified by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (*Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen,* "**BNetzA**") to ensure compliance with applicable unbundling requirements.

As a consequence of the transposition of the European Third Energy Package (2009) into German law in 2011, as well as the 'energy transition' (*Energiewende*) in the wake of the Fukushima accident in 2011, the German energy markets have undergone some transitions and are still facing significant challenges. In particular, new legislation was enacted in order to facilitate further liberalisation of the energy markets and promote the energy transition, which also includes the need for considerable network expansion. Also, the expansion of renewable energy sources ("**RES"**) provides for specific challenges on the capabilities of transmission networks and, consequently, on network development. New sources of energy must be synchronised with the expansion of the energy networks, such as rooftop solar panels, biogas plants on agricultural land and wind farms (onshore and offshore). The following shall provide a brief overview about the relevant statutory provisions and role of the regulator:

- The energy sector in Germany is governed by numerous acts and ordinances, which are subject to constant modifications and amendments. The main pieces of legislation in the electricity sector are the German Energy Industry Act (*Energiewirtschaftsgesetz*, "**EnWG**") which entered into force on 13 July 2005, the Renewable Energies Act, comprehensively amended in 2017 (*Erneuerbare Energien Gesetz 2017*, "**EEG 2017**") and several ordinances, notably the Ordinance on Access to the Electricity Supply Network (*Stromnetzzugangsverordnung*, "**StromNZV**") regulating the conditions under which access needs to be granted to an electricity network. In addition, the Ordinance on Tariffs for the Electricity Network Access (*Stromnetzentgeltverordnung*, "**StromNEV**") entered into force on the same date, 29 July 2005. In addition, as of 1 January 2009, the calculation of revenue allowances for all electricity network operators is based on the Ordinance on Incentive Regulation (*Anreizregulierungsverordnung*, "**ARegV**");
- Section 11 para. 1 EnWG contains a general obligation of TSOs to operate a safe, reliable and efficient network on a non-discriminatory basis. They have to maintain, expand and optimise the network meeting the demands (*bedarfsgerechter Ausbau*) to the extent this is economically reasonable;
- BNetzA is the competent regulator for electricity TSOs in Germany at a national level. Under the EnWG, it is BNetzA's central task to regulate the energy networks to create the prerequisites for fair and effective competition in the upstream and downstream markets for the supply of electricity and gas. BNetzA's regulatory task covers, in particular, ensuring non-discriminatory network connection (including the construction of offshore grid connection systems to connect offshore wind farms – "**OWFs**"), network access, the control of the network access tariffs charged by network operators, the safeguarding against anti-competitive practices by network operators and the monitoring of the implementation of the regulatory regime (see this Section below "Role of NRA").

The key instruments to develop the German transmission network are the national network development plans for both the onshore and offshore energy network:

- All German electricity TSOs have to submit to BNetzA every two years a joint (onshore) national network development plan (*Netzentwicklungsplan*) (section 12b EnWG). The plan needs to be based on a framework scenario (*Szenariorahmen*) having regard to future production and consumption of electricity as well as infrastructure projects and also take into consideration the non-binding, EU-wide network development plan

established by ENTSO-E under article 8 para. 3 lit. b) Regulation 714/2009/EC including, *inter alia*, a list of envisaged investment projects. The plan has to contain information regarding the network-related measures required for a secure and reliable network operation for the next ten to fifteen years. After public consultation of both the framework scenario and the national network development plan, BNetzA may require adjustments to the national network development plan before the plan becomes binding for the TSOs;

- Under the current regulatory regime, electricity TSOs that connect OWFs to the transmission network, i.e. TenneT TSO GmbH and 50Hertz Transmission GmbH, have to submit a separate offshore network development plan. The offshore network development plan is comparable to the onshore network development plan. In particular, the offshore network development plan has to contain information regarding the network-related measures required for an appropriate development of the offshore connection lines for the next ten to fifteen years. Additionally, it takes into account the federal offshore plan (*Bundesfachplan Offshore*) issued by the competent Federal Maritime and Hydrographic Agency (*Bundesamt für Seeschifffahrt und Hydrographie*, "**BSH**"). The offshore network development plan is aimed at more coordinated and harmonised planning of, but also improved control of, investments into the expansion of the German offshore transmission network;
  It should be noted, however, that this planning regime has recently been amended. The offshore network development plan and the federal offshore plan will be replaced by the "offshore area development plan" (*Offshore-Flächenentwicklungsplan*) as specified under the new “Offshore-Wind-Energy-Act” (*Windenergie-auf-See-Gesetz*, "**WindSeeG**"). While the current offshore network development plan of 2017 (covering planning until 2030) will be the last offshore network development plan based on the current regime, the first offshore area development plan will be issued in 2019 and will apply to offshore planning as of 2026. BSH will be responsible to set up the offshore area development plan in coordination with BNetzA. TSOs will be requested to submit a joint position containing the network-related measures required for an appropriate development of the offshore connection lines until at least 2030, which BSH must take into account when developing the offshore area development plan. The offshore area development plan must be renewed every four years unless BSH or BNetzA propose earlier renewals;
- The national network development plans (onshore and offshore) form the basis for draft federal necessity plan (*Bundesbedarfsplan*). Pursuant to section 12e EnWG, the draft federal necessity plan is submitted by the BNetzA to the German government every four years and forms the basis for the so-called Federal Necessity Plan Act (*Bundesbedarfsplangesetz*, "**BBPlG**"). All projects contained in the BBPlG benefit from a streamlined authorisation process (see this Section below “Role of NRA”).

Further instruments to develop the German transmission network include, *inter alia*, the following:

- TSOs responsible for certain control areas are obligated to continuously ensure the capability of the system to satisfy demands for the transmission of electricity. TSOs must, in particular, contribute to supply security by having appropriate transmission capacity and ensuring the reliability of the system (section 12 para. 1 EnWG);
- TSOs are generally obligated to connect, i.e. physically link to their network end-consumers, level or downstream network operators or power lines and power plants on an economically reasonable, non-discriminatory and transparent basis (section 17 para. 1 EnWG). Such obligation to connect to the network may, thus, be seen as another factor to foster the network development. Also, network connection is of particular relevance with regard to the connection of OWFs and the general obligation to prioritise and promote renewable energies as set out in the EEG 2017.

Network access tariffs (*Netzentgelte*) are the main source of income for network operators, including TSOs. Under German regulation, only network users taking electricity from the network are required to pay such tariffs, whereas the feed-in of electricity (irrespective of its form of generation) is free of charge. For the actual calculation of the admissible network access tariffs, the StromNEV provides for a regulatory scheme of three steps: First, the computation of the individual cost elements (cost category accounting, *Kostenartenrechnung*) taking into account the calculated operating and imputed costs, second, the distribution of these cost elements to the cost centres (cost centre accounting, *Kostenstellenrechnung*), and third, the cost unit accounting (*Kostenträgerrechnung*). Within the network access tariff calculation the imputed return on equity is to guarantee network operators a reasonable, competitive and risk

adjusted return on investment for the invested capital. In this context, it should be further noted that investment projects that are stipulated in the national network development plan are eligible for so-called investment measures (for details see Section 2.1.3).

TSOs are obligated to operate a safe, reliable and efficient network on a non-discriminatory basis (section 11 para. 1 EnWG). They have to maintain, expand and optimise the network meeting the demands (*bedarfsgerechter Ausbau*) to the extent this is economically reasonable. In terms of network development, it is one of the key responsibilities of the electricity TSOs to produce every two years the network development plans both for the onshore and offshore energy networks and electricity TSOs are obliged to realise the projects set out in these plans. Details about the procedure and tasks of the TSOs in relation to the network development plan are described above.

Role of NRA

BNetzA and the regulatory authorities of the federal states (*Bundesländer*) are responsible for the regulation of the electricity networks. The state regulatory authorities are responsible for regulating energy supply companies with fewer than 100,000 customers connected to their electricity supply networks and whose networks do not extend beyond a federal state's borders. Hence, BNetzA is generally competent for electricity TSOs in Germany at a national level. All regulatory tasks and powers which, under the EnWG, have not been assigned to the state regulators are performed by BNetzA.

BNetzA's regulatory tasks include, inter alia, ensuring non-discriminatory network connection and network access, control of network access tariffs, monitoring potential anti-competitive practices by network operators and the assessment of the network operators' investment activities. These regulatory powers have the primary objective to ensure safe and efficient energy network operation and to provide necessary prerequisites for effective competition on the upstream and downstream energy markets.

Role of BNetzA in terms of network planning

The regulatory authorities constantly monitor, coordinate and partly approve which investment costs are recognised with a particular view to TSOs. In this respect, electricity TSOs are required to bi-annually (in every even year) produce a 'scenario framework' as a basis for a biannual national network development plan (section 12a EnWG) (see this section above). After public consultation with all stakeholders involved, BNetzA will approve the scenario framework in light of the results of the public consultation (section 12a para. 3 sentence 1 EnWG). Furthermore, section 12b EnWG requires all German electricity TSOs to submit to BNetzA on 10 December of each even year a joint national network development plan (see section 2.1.1 above). BNetzA confirms that plan which eventually obliges the electricity TSOs to implement the measures contained in it (see section 12c para. 4 sentence 1 EnWG).

For the connection to the network of OWFs, there is a separate legal regime. Until 2018, the regime was similar to the network development plan: All electricity TSOs had to submit to BNetzA a joint offshore network development plan which contained, *inter alia,* all measures needed to optimise, reinforce and expand the network connection of OWFs (section 17b EnWG). The latest offshore network development plan, which BNetzA approved in 2017, contains offshore grid connection lines to be constructed until the year 2030. The legal regime changed in 2017, when the WindSeeG entered into effect. The WindSeeG introduces a new area development plan (section 5 WindSeeG), which the BSH drafts in coordination with BNetzA (section 6 para. 7 WindSeeG). The area development plan applies to offshore grid connection lines to be constructed as of 2026 and specifies areas and the chronological order for construction of offshore wind farms and connection lines (section 5 WindSeeG). Under the new planning regime, the offshore network connection lines contained in the area development plan will also be contained in the network development plan (section 12b para. 1 sentence 4 no. 7 EnWG). Based on the national network development plan, BNetzA drafts a four-year federal necessity plan which is the basis for the Federal Necessity Plan BBPlG. All projects contained in the BBPlG benefit from a streamlined authorisation process (see section below).

Role of BNetzA in terms of enforcing network development projects

BNetzA supervises the implementation both of the national network development plan and the offshore network development plan as well as the future offshore area development plan. In the event that a TSO – intentionally or negligently – does not implement the investments foreseen

in those plans for the first three years, BNetzA may resort to the following measures under section 65 para. 2a EnWG:

- BNetzA will set a deadline for the TSO to carry out the investment if such investment is still considered relevant under the most recent national network development plan;
- If the deadline elapses fruitlessly, BNetzA may initiate a tender proceeding for the implementation of said investment.

Role of BNetzA regarding the approval procedures for network development projects

In Germany, the authorisation procedures have been changed extensively in the recent years with the goal to streamline the procedures while taking into account potential objections of parties concerned by investment projects.

In general, the construction of onshore transmission networks is subject to a two-pronged authorisation process. After the corridor of the future transmission line has been decided, a planning approval (*Planfeststellungsbeschluss*) for a concrete project takes place. The approval of the plan substitutes all other public-law permissions (*Konzentrationswirkung*).

The Federal Network Expansion Acceleration Act (*Netzausbaubeschleunigungsgesetz*, **"NABEG"**), enacted in 2011 and last amended in 2017, provides a simplified permitting procedure for the decision about the corridor and established a special planning approval procedure for certain projects. Most importantly, under the NABEG, BNetzA is the competent authority for both procedures. The relevant NABEG-projects are to be found in the BBPlG. NABEG applies in particular to lines that run across Germany and those that are necessary to connect OWFs with the mainland electricity network. However, practice shows that the approval procedures are still time consuming even under the NABEG regime[1]. Thus, the Federal Government has taken the view that further adaptations to the procedures are necessary, so that network development projects can be realised in a timely manner. Therefore, the Federal Ministry for Economic Affairs and Energy has announced a revision of the NABEG which will include further streamlining of the approval procedures. A legislative proposal is expected to be published in late 2018.

For other investments into the transmission network, both planning procedures under the Federal Spatial Planning Act (*Raumordnungsgesetz* **"ROG"**) as well as planning approval procedures under the EnWG apply. For both, the authorities of the federal states are competent to approve the plans. Therefore, projects which cover more than one federal state necessitate the co-ordination of different state authorities. For the construction of electricity transmission networks and to support the German energy transition, the Federal Network Expansion Act (*Energieleitungsausbaugesetz*, "**EnLAG**") was enacted in 2009 and last amended in 2016. The EnLAG left the two-pronged approach unchanged. However, it allows several named projects to skip the usual necessity analysis procedure (*Bedarfsanalyse*) under the EnWG.

The construction of offshore network connection lines requires a planning approval currently still under the Sea Installations Ordinance (*Seeanlagenverordnung*) and for future projects under the WindSeeG. Competent authority is the BSH.

Institutional or procedural constraints on the performance of these roles

- Constraints for BNetzA stem from the legal landscape in which it operates. Regarding network tariffs, BNetzA is bound by the limits of the statutory provisions. In particular, the ARegV limits BNetzA's ability to acknowledge costs of TSOs to those cases which are specifically mentioned in section 23 on investment measures (see section3.1.3) and other relevant provisions of the ARegV. Besides BNetzA can acknowledge specific research and development costs under the ARegV if certain conditions are fulfilled;
- Furthermore, although BNetzA enjoys certain decisional power, the decision-making process is complex and subject to judicial scrutiny. In particular, BNetzA can issue general determinations (*Festlegungen*) on specific topics. If the determinations apply to several addressees (TSOs, others), BNetzA previously carries out extensive consultations with the parties concerned. This prolongs the time BNetzA needs to issue

[1] Regarding the projects under the NABEG regime it must be noted that the new projects that are regulated based on the NABEG regime are usually bigger in size and also often more complex. Further, the possibilities for stakeholder involvement have been improved. So, there are reasons, why the time needed for approval procedures have not significantly decreased and sometimes maybe also increased, when only looking at the time elapsed.

determinations. But even if BNetzA carries out the consultation process successfully, its determinations are still subject to judicial review. In practice, BNetzA determinations are often appealed before the courts with the result that courts repeal certain determinations. A recent example is the determination on the horizontal cost balancing among gas TSOs (file no BK9-13-607).

2.1.2. Specific legal rights and duties

Safeguarding security of supply

The aforementioned basic regulations regarding security of supply (e.g. network access, grid development etc.) have been recently supplemented by the following regulations. With effect as of 30 July 2016, the German legislator implemented the Electricity Market Act (*Strommarktgesetz*) thereby amending, *inter alia*, the EnWG and the Ordinance on Network Reserve (*Netzreserveverordnung*):

- The amended framework provides for certain capacity and network security mechanisms, most notably the mechanisms of redispatch measures and network reserve (*Netzreserve*) for securing network stability as well as the capacity reserve (*Kapazitätsreserve*) for securing electricity supply. These measures are all subject to compensation. With regard to redispatch, the responsible TSO compensates costs incurred as a result of the redispatch measures in particular in case of positive redispatch (increase of power). By contrast, in case of negative redispatch (reduction of power), the power plant operator also has to reimburse the responsible TSO for saved expenditures. This remuneration scheme applies retrospectively as of 1 January 2013 and replaced the former compensation regime based on a formal determination of the BNetzA which was appealed by network operators and power plant operators and eventually repealed by the competent court;
- Operators of generation facilities with installed capacities exceeding 10 MW may only decommission their facility (be it permanently or temporarily) if the responsible TSO considers the facility not as "system-relevant". In relation to the permanent decommissioning of power plants with installed capacities exceeding 50 MW, the BNetzA must classify the facility as "system relevant". A power plant is considered "system-relevant" if its decommissioning would likely significantly endanger the security and reliability of the energy supply which could not be prevented by other reasonable measures. The period of "system-relevance" shall not exceed 24 months, unless the responsible TSO demonstrates, and BNetzA approves, that the retention of the generation facility is required for a longer period of time. Within this period, the operator of the power plant must ensure a certain technical standard which allows reactivating the facility if requested by the responsible TSO and achieve the level of technical readiness within a certain timeframe. The operator of the system-relevant power plant receives certain compensation in return for providing the generation capacities.

As a new instrument, TSOs can also put in place so-called specific network facilities (*besondere netztechnische Betriebsmittel*) which are required when other network assets have failed and security as well as reliability of energy supply needs to be restored. Although TSOs maintain such specific network facilities by commissioning their operation to third parties (section 11 para. 3 sentence 1 and 2 EnWG), TSOs must provide BNetzA with analyses in which they specify the need of such network facilities. The costs that TSOs incur in connection with specific network facilities constitute so-called permanently non-influenceable costs and can be fully reflected in the network tariffs.

2.1.3. Encouraging innovation

Onshore grids

In Germany, the legislator has adopted an amendment to the legal framework applying to the construction of energy transmission lines (Gesetz zur Änderung von Bestimmungen des Rechts des Energieleitungsbaus). The amended law entered into force on 31 December 2015 and introduces, in particular, the innovative priority of underground cabling for all onshore DC connection transmission lines. In this respect, however, the amended law also provides for a number of exemptions under which overhead transmission lines are still permitted. As a consequence of the new approach, the planning and approval requirements have to be adjusted. Furthermore, such underground transmission lines require higher investments compared to conventional overhead transmission routes.

In this respect, the high-voltage direct current technology could be considered as an innovation as regards onshore transmission networks. As there are currently only few experiences with high-voltage direct current technology used in underground cables, SuedOstLink and SuedLink are considered a pilot project in that area. Statutory duties of the TSOs follow in particular from the EnLAG, the NABEG and the BBPlG.

Offshore grids

Since 2006, the innovative German regime of offshore wind generation has been heavily promoted. German coastal TSOs with control area responsibility have been obligated to construct and operate offshore network connection systems. This obligation does not depend on the conclusion of a network connection agreement between the respective TSO and the OWF operator. Conversely, the OWF operators are relieved of the construction and operation of the offshore network connection system and the costs and permit procedures relating thereto. The responsible TSO has to obtain the required permits and authorisation for the construction and operation of the offshore network connection system.

The purpose was and still is to accelerate and financially support the construction and use of OWFs in the North and Baltic Seas to foster production of renewable energy and to implement the above-mentioned energy transition in Germany (see section 2.1.1 above). The obligation to connect OWFs was originally limited in time. However, in August 2011, such time limitation was abolished so that under the current law the responsible TSOs face (time-wise) an unlimited obligation to realise offshore connection systems.

While the "Third Energy Amendment Act", which modified the EnWG and entered into force on 28 December 2012, provides for a "system change" as regards the offshore network development, it did not affect the responsibility for TSOs to connect OWFs to the onshore transmission network. In contrast to the previously uncoordinated development of offshore connection systems, which was only structured in a legally non-binding way by means of a BNetzA's position paper, the amended EnWG provides for a comprehensive offshore network development plan comparable to the onshore network development plan under section 12b EnWG. It takes into account the federal offshore plan issued by BSH under section 17a EnWG and has to be based on the framework scenario under section 12a EnWG (for details see section 2.1.1 above). Under the WindSeeG, the offshore network development plan will be replaced by an area development plan under section 4 WindSeeG (for details see section 2.1.1 above and “Role of NRA” above). Furthermore, the law in 2012 introduced a new compensation regime applying to cases in which the offshore connection lines are delayed or interrupted.

Undertaking of investments

As described above in detail, electricity TSOs are required to set out lists of envisaged investment projects in the onshore and offshore network development plan which are binding for the electricity TSOs, i.e. an electricity TSOs must realise the investment projects contained in the network development plans. The obligation of electricity TSOs to prepare a network development plan follows from section 12b EnWG (onshore) and section 17b EnWG (offshore).

2.1.4. Mechanism for financing of investment projects

While the conditions for access to electricity transmission networks are governed by the StromNZV, the EnWG regulates and the ARegV as well as the StromNEV provide the structure of the network tariffs for such access. Until December 31, 2008, network tariffs were as such subject to *ex ante* cost-oriented regulation. The determination of network tariffs was based on a cost-plus approach. According to this principle, network tariffs were approved only if they did not exceed the admissible costs of an efficient network operation, plus an imputed return on equity capital.

As of January 1, 2009, this regulation of the network tariffs was replaced by a regime of incentive regulation. Deviating from the previous static approval of cost-oriented tariffs, incentive regulation adds dynamic efficiencies by setting incentives for efficient operation of the network. The general aim of this incentive regulation regime is to eliminate inefficient network costs on the one hand and to provide network operators with sufficient revenues in order to enable necessary investments for replacements and expansions of network systems on the other hand. For each network operator, BNetzA defines a revenue cap (*Erlösobergrenze*) for each calendar year of a regulatory period, which includes a general as well as an individual efficiency target. Such efficiency targets will be formulated and distributed across the regulatory

period in a way that enables the network operator to achieve and exceed these targets by employing realistic and reasonable measures. Within the regulatory period of five years, network operators are allowed to collect the economic benefits resulting from efficiency gains, effectively decoupling actual costs of the network operation from admissible network tariffs. However, during the next regulatory period, the benefit resulting from improvements in efficiency must be passed on to the customers through a decrease in network tariffs.

The first step in the determination of the revenue cap is to calculate the relevant cost base level (*Kostenausgangsniveau*). The determination of the initial cost base level for the yearly revenue caps of the upcoming regulatory period is based on the operational and capital network costs incurred in the third closed business year (so called "photo year") of the current regulatory period. In the electricity sector, the year 2016 is the photo year for the upcoming third regulatory period 2019-2023. Thus, the revenue cap determined by BNetzA reflects both operational and capital expenditures. In this respect, capital expenditures comprise imputed cost components such as imputed depreciation for the regulatory asset base as well as an imputed return on equity. If assessed as being customary to the market, BNetzA fully recognises actual costs of debt.

For the second regulatory period (which runs until the end of 2018), the rate of return on the equity portion (based on an "imputed equity ratio" capped at a maximum of 40 %) of "old assets" is equal to 7.14 % (before corporate tax, after trade tax). Old assets are such assets that were commissioned prior to 1 January 2006. The rate of return on equity for "new assets", i.e. commissioned as of 1 January 2006, is fixed at 9.05 % (before corporate tax, after trade tax). For the upcoming third regulatory period (2019-2023), BNetzA has fixed the rate of return on the equity portion of old assets to 5.12 % (before corporate tax, after trade tax) and for new assets to 6.91 % (before corporate tax, after trade tax). After several network operators had challenged BNetzA's determination of the interest rates for the third regulatory period before the competent Higher Regional Court, the court has repealed that determination. The ruling is not yet binding.

In principle, the revenue caps will not be adjusted during a regulatory period; however, the TSOs can adjust the revenue caps in limited circumstances in order to reflect, inter alia, the annual inflation rate, a change of significant structural parameters or cost factors, or unpredictable events causing undue hardship for the network operator (section 4 para. 3 ARegV). If the TSOs adjust their revenue caps, they have to inform BNetzA (section 28 sentence 1no. 1 ARegV). If BNetzA takes the view that, the adjustment does not adequately reflect the factors mentioned in section 4 para. 3 ARegV, it can initiate proceedings against a respective TSO based on its general competences (see sections 2.1.4 and 2.1.5 below).

Pursuant to section 23 ARegV, BNetzA has to approve so-called investment measures for capital and operating costs required for the expansion or restructuring of transmission systems, if these are necessary for system integrity or for integration into the national or international interconnected system or needed for expansion of the energy supply system according to section 11 EnWG. Mere replacement investments are not subject to these investment measures rules. Section 23 para. 1 sentence 2 ARegV expressly mentions several "rule examples" (*Regelbeispiele*), including investments in offshore connection systems (no. 5), for which an investment measure is available. Beyond these rule examples, investment projects found in the national network development plan are also eligible for investment measures (section 23 para. 1 sentence 1 ARegV). BNetzA has issued guidelines on investment measures under section 23 ARegV (most recently in 2017) as well as a determination regarding the calculation of capital and operating costs stemming from investment measures (file no. BK4-12-656 dated 2 May 2012, as amended in file no. BK4-12-656A01 dated 30 November 2016).

To the extent, BNetzA approves an investment measure the relating costs are considered so-called permanently non-influenceable costs, which are not subject to individual efficiency targets and can, thus, be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period. While this was previously only the case with a two-year time lag ("t-2", which BNetzA compensated by granting a net present value compensation (*barwertneutraler Ausgleich*), in 2012, the ARegV was amended to allow for cost-effectiveness in the current year (i.e. at "t-0").

As a result of the introduction of the t-0 cost recognition, BNetzA only approves the investment on the merits. Hence, the costs of the investment are included in the revenue cap based on planned costs (at t-0). Only thereafter an ex post control takes place by means of an as-is-

evaluation (*Ist-Abgleich*). Any deviations between planned and actual costs will be recognised in the regulatory account (section 5 ARegV).

Costs for the construction and operation of offshore connection systems approved under investment measures are so far socialised by way of horizontal balancing (section 17d para. 6 EnWG) between the TSOs. Under this mechanism, the TSOs responsible for a control area shall bear the costs pro rata to the energy quantities off-taken by the end consumers within their respective control area. Under the current legal regime, the costs incurred by each TSO constitute permanently non-influenceable costs, which are not subject to efficiency targets and can thus fully be reflected in the revenue cap. From 2019, such costs will still be balanced horizontally (section 17f para. 1 sentence 2 EnWG-2019) but will cease to form part of the revenue cap and, thus, the network tariffs. Rather, these costs will be reflected in a separate levy (*Umlage*) ultimately to be incurred by the network consumers in addition to the regular network tariffs (section 17f para 5 sentence 1 EnWG-2019).

Section 25a ARegV allows BNetzA to approve under the revenue cap, upon application by the TSOs, certain costs for research and development. However, the scope of this provision is limited. It only applies to research and development carried out under publicly managed and publicly funded research schemes. Furthermore, it only covers 50 % of the costs which are not publicly funded and only if the respective TSO cannot receive those costs otherwise (e.g. through investment measures under section 23 ARegV).

Under the current legal regime, the individual network tariffs of the TSOs may differ depending on their revenue caps. In July 2017, the German legislator has enacted the law on the modernisation of the network tariffs (*Netzentgeltmodernisierungsgesetz*, **"NEMOG"**) which aims at equalising network tariffs of all TSOs from 2023 (section 24a EnWG based on an ordinance specifying the relevant statutory requirements.

The main instruments to finance large network investments are so-called investment measures (section 23 ARegV) (see section above). Investment measures accommodate a variety of projects. In general, investment measures apply to expansion and restructuring investments. In particular, they are necessary to either support the development of new types of energy generation (e.g. OWFs) or new types of electricity transmission (high-voltage direct current transmission systems, temperature monitoring, high temperature low sag cables). In terms of innovation and security of supply, the following projects are relevant:

- Investment projects contained in network development plans (section 23 para. 1 sentence 1 ARegV);
- Cables connecting OWFs with the electricity network (section 23 para. 1 sentence 2 no. 5 ARegV);
- Underground cables relating to section 2 para. 1 EnLAG (section 23 para. 1 sentence 2 no. 6 ARegV);
- Temperature monitoring of conductor cables, high temperature low sag cables (section 23 para. 1 sentence 2 no. 8 ARegV);
- Certain high-voltage direct current transmission systems (section 23 para. 1 sentence 2 no. 9 ARegV).

It is important to note that investment measures primarily focus on CAPEX with the result that such CAPEX are non-influenceable costs, which are not subject to efficiency targets. In addition, also a certain share of OPEX is approved as investment measure. While section 23 para. 1 sentence 4 ARegV provides for a general operating expense lump-sum of 0.8 % of the acquisition and production costs of the respective commissioned assets (*Anschaffungs- und Herstellungskosten*), BNetzA determined on 12 December 2011 (file no. BK4-11-026) that such lump-sum should be equivalent to 3.4 % of the accumulated historical costs of the fixed assets for offshore connection systems. However, it should be noted that BNetzA may in the future adjust this lump-sum.

Mechanisms to foster innovation

In general, the ARegV is technologically neutral and only indirectly fosters innovation by acknowledging costs for innovative projects in particular under investment measures (section 23 ARegV) or as specific research and development costs (section 25a ARegV, see this Section above). Projects contained in the network development plan and for which investment measures are available, contribute to security of supply of electricity in Germany.

Many projects for which investment measures are available are innovative products and help to develop new technologies: In particular, measures regarding underground cables as well as temperature monitoring and high temperature conductor cables refer to innovative technologies and foster the development of renewable energy sources. The energy transition in Germany requires the creation of new cable routes, which transport electricity generated from wind and solar energy in the North of Germany to the South where the energy is needed. There is much public opposition against the creation of such new routes:

- Underground cables appear to be more acceptable to the general public because they are not visible. However, new discussions have arisen because farmers and other persons fear that their crops and the soil might be negatively affected if lines are buried underground;
- Temperature monitoring and the use of high temperature low sag conductors are also likely to trigger less public opposition than the creation of new cable routes. Such technologies allow to take advantage of existing overhead line routes and to use them to their fullest extent possible. In general, cables need to be within a certain distance from the ground. They tend to get longer the warmer they become. Thus, the more electricity overhead line conductors transport, the closer they get to the ground. Therefore, the distance from the ground limits the overhead line's ability to transport electricity. Temperature monitoring and the use of new types of overhead line conductors are means to counter these limitations. Conventionally the maximum permissible current is calculated for standard conditions that comprise an outside temperature of 35°C and a wind speed of 0.6 m/s. Lower temperatures and higher wind speeds have a cooling effect and counter the line sag. Temperature monitoring is used to identify and quantify the natural cooling effects to allow for higher current flows on the line. Furthermore, high temperature low sag cables, which avoid hanging down by construction, can be used to replace older pre-existing cables.

Limitation of innovative investments:

If certain investments do not fall under the investment measure regime (e.g. innovative replacement investments), additional costs resulting from such investments and the cost structure of the network operator could be deemed relatively inefficient (at least in the short term, if advantages will become apparent in the long term) compared to other network operators. As a consequence, also TSOs with innovative but (maybe initially) inefficient investments will face efficiency targets and thus decreasing revenues during the regulatory period.

As described at the beginning of section 2.1.3, the actual costs of TSOs are decoupled from admissible network tariffs within the five year regulatory period. This creates incentives for the TSOs to use efficiency gains and thus innovate within the regulatory period. However, as efficiency gains must be passed on to network consumers in the next regulatory period, TSOs have less incentives to invest in the long-term and to support innovations with lead times exceeding one regulatory period even if they might result in major advances.

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

There is basically a three-step approach to avoid investment in stranded assets. Section 11 EnWG obliges TSOs to operate a safe, reliable and efficient network on a non-discriminatory basis. To meet this general obligation, TSOs produce plans (e.g. the network development plan and the offshore network development plan), which BNetzA approves (see "Role of the NRA" above). Hence, already at this planning level, the TSOs and BNetzA are able to identify projects / investments, which are deemed unnecessary or inefficient. Eventually, TSOs normally realise the measures described in their development plans and can apply for investment measures for the realisation of specific projects. BNetzA carefully reviews and approves investment measures subject to the measures being necessary for an appropriate network development in line with the needs identified. Hence, within the investment measure proceedings, BNetzA is able to identify unnecessary and inefficient investments. Any investments, which are not subject to investment measure approvals, are also reviewed by BNetzA when determining the cost base level for the revenue cap. Also, in this regard, certain investment costs can be rejected during the approval process if they are regarded as being inefficient.
In particular, with regard to the expansion of offshore wind energy as a field of innovation the following can be said:

When the first OWFs were developed, their completion was not synchronised to the completion of their network connection. Section 17 para. 2a EnWG, which had existed until 2013, only stipulated that the responsible TSO was obliged complete the network connection line when the OWF became operationally ready. This created uncertainty as to when the right time to set up the network connection line would be. If a responsible TSO had started the construction too early, he could face the risk of running into a situation in which the OWF could not be finalised at all or finalised only later than was originally planned. The responsible TSO would therefore risk that the investment into the network infrastructure would become useless. Furthermore, it was unsure whether early investments into the connection to the network of OWFs would qualify as investment measures (section 23 ARegV).

Therefore, in 2009 BNetzA released a legally non-binding position paper (which it amended in 2011) in which BNetzA attempted to synchronise construction of offshore wind farms and construction of their offshore network connection. The specific goal of that paper was to avoid stranded investment. However, also the regime under this position paper was insufficient and was unable to resolve regulatory and legal uncertainties, in particular with regard to liabilities in case of delays.

The current legal framework effective as of 28 December 2012 more clearly synchronises the development of OWFs and their connection to the electricity network. The offshore network development plan (section 17b EnWG) as well as the future area development plan (section 5 WindSeeG) contain an exhaustive list of new offshore connection systems and specific completion dates. This list and the completion dates are based on the expected demand of connecting capacity (section 17b para. 1 sentence 2 EnWG). Contrary to the prior legal regime, the TSO is only obliged to carry out the network development plan and in future the area development plan. This helps to generally avoid stranded investments in infrastructure for the connection to the electricity network of offshore wind farms. When the construction has started, the responsible TSO and the operator of the offshore wind farm align their plans so that both the wind farm and its offhsore network connection system are ready at a similar point in time (section 15 para. 2 sentence 5 EnWG).

Beyond, section 17d para. 2 sentence 2 EnWG contains an additional safeguard against stranded investments into network infrastructure. This provision dispenses the TSOs from the obligation to carry out the network development plan / the area development plan if the plan refers to areas, which have not yet been deemed suitable for OWFs.

The investment system of the ARegV mirrors the planning of offshore transmission systems such as that projects contained in the offshore network development plan or the area development plan are eligible for investment measures under section 23 ARegV (see section 23 para. 1 sentence 2 no. 5 ARegV).

2.1.5. Regulatory rules with respect to innovation

Specific duties of the NRA aimed at encouraging innovation

BNetzA has no explicit duty to encourage innovation. However, the regulatory landscape contains implicit powers and duties of BNetzA to encourage innovation provided that it is economically efficient:

- The method of incentive regulation, which BNetzA uses to decide about the network tariffs, creates implicit incentives for TSOs to innovate. As described in more detail above (see section 2.1.3 above), the network tariffs are somewhat decoupled from the TSO's actual costs. This incentivises TSOs to use innovative technologies in order to reduce their actual costs. The incentive regulation regime further contains certain cost approval mechanisms (e.g. investment measures and approval of certain costs for research and development under the revenue cap), which particularly incentivize innovation;
- Similarly, the auctioning process that applies to OWFs (section 23 WindSeeG) ensures that only the most efficient OWFs receive a bid and thus get the right to be connected to the electricity network (section 24 WindSeeG). This in turn creates incentives for the operators to use innovative technologies so that they can enter the auction with minimised costs. Similar auction processes apply also to other renewable energy sources under the EEG 2017 (even though this does not set any incentives for TSOs, this duty of the NRA is mentioned for being comprehensive);
- In the authorisation procedures applicable to the investments into the electricity network (see "Role of the NRA" above), BNetzA and the state authorities have certain

powers to decide whether a new line shall be constructed as underground cable or overhead power line. The statutory powers and obligations tend to favour underground cables over overhead power lines. Therefore, regarding projects, which fall under the EnLAG, the authorities can request that these projects be constructed as underground cables. For those lines that the BBPlG has designated as underground cables, the authorities can deviate from such method of construction only in exceptional circumstances (e.g. if an underground cable would infringe upon nature conservation areas) and allow that lines be built as overhead power lines.

2.1.6. Regulatory rules with respect to security of supply

Specific duties of the NRA aiming at safeguarding security of supply

There are generally applicable competences of BNetzA to ensure measures with regard to security of supply:

- In particular, BNetzA can step in if TSOs' actions are not in line with the aims of the EnWG (section 65 paras. 1, 2 EnWG). This general power applies to any actions or omissions by the TSOs, which are in breach of their general obligations under the EnWG (see sections 2.1.1 and 2.1.2). Under section 65 EnWG, BNetzA has the power both to prohibit certain behaviour and to order that a TSO adopts a specific behaviour that BNetzA deems fit;
- BNetzA can also initiate abuse proceedings against TSOs, if they infringe certain provisions under the EnWG and certain ordinances. (section 30 EnWG);
- Furthermore, the powers of BNetzA are complemented by its authority to impose fines if TSOs do not comply e.g. with their obligation to prepare network development plans (section 95 para. 1 no. 3b EnWG).

In addition, the Electricity Market Act, which entered into effect on 30 July 2016, introduced specific obligations and competences in relation to network security and security of supply. With the Electricity Market Act, the legislator took into account that the increasing amount of electricity generated from RES as well as their volatility in production is challenging from the perspective of stability of the network as well as security of supply. During the times when RES generate sufficient electricity, transmission and distribution can develop into a "bottleneck". In comparison to traditional fossil and nuclear plants, which are located near Germany's industrial centres in the west and south, electricity from RES is mainly produced in the north and east requiring transmission and distribution capacities to the load centres in Germany. This gap between electricity fed-in in the North and consumption in the South is gradually increasing, as by 2022 all German nuclear power plants with a capacity of approx. 5 GW will be decommissioned.

When the Electricity Market Act entered into effect, the German legislator amended, *inter alia*, the EnWG and the NetzResV (see section 2.1.2 above). The amended framework provides for certain capacity and network security mechanisms. Among these are redispatch measures, system relevant power plants which must not be decommissioned upon request by the respective TSO, as well as the capacity reserve for securing electricity supply (see section 2.1.2 above). Furthermore, the Electricity Market Act obliged TSOs to provide a so-called network reserve to ensure network security and reliability, in particular to avoid network congestions and to allow (if needed) the restart of network operations (i.e. black-start ability). The network reserve primarily consists of the following generation facilities:

- Power plants which are currently not operationally ready, but, due to their system relevance, shall be made operationally ready upon request of the responsible TSO;
- System relevant power plants which, upon request of the responsible TSO, must not be permanently or temporarily decommissioned (see section 2.1.2 above);
- "Suitable" power plants in other European countries.

Under consideration of an annual system analysis by the TSOs, BNetzA assesses on a yearly basis whether there is a need for additional generation capacity within the network reserve. Furthermore, the TSOs provide certain demand analysis for scenarios in winter half-years 2020/2021 and 2021/2022. If additional generation capacity is required, operators of power plants can state their interest in participating within the network reserve. If a certain power plant is selected, the operator and the TSOs enter into a bilateral contract subject to coordination with and approval by the BNetzA.

Such contracts normally specify the compensation for the power plant operators. In principle, according to the applicable law, the operators shall be reimbursed for costs resulting from the network reserve, in particular for providing redispatch energy. Respective costs components include in particular:

- Share of operational costs during the redispatch (feed-in) measures reflected by the working price (Erzeugungsauslagen);
- One-time costs for enabling operational readiness (Betriebsbereitschaftsauslagen);
- Share of fixed costs reflected the capacity price (Leistungspreis) incurred by the operator for providing the power plant within the network reserve.

This statutory remuneration regime is currently under review in court proceedings.

Despite the participation within the network reserve, operators of power plants are entitled to apply for parallel participation within the capacity reserve regime. However, in such case the compensation of the capacity reserve regime prevails.

Specific rules apply to lignite-fired power stations (section 13g EnWG). Operators must temporarily decommission such power stations but have to ensure that they can be operational in a certain period of time if such operation is required. BNetzA is entitled to fix the remuneration for these lignite-fired power stations.

2.2. Regulatory practice

2.2.1. Overview over regulatory practice in Germany

The regulatory principle can be characterised as incentive-based revenue cap mechanism. There are no provisions in the regulation explicitly facilitating innovation. The NRF is neutral regarding project categories, such as innovative or conventional, PCI or non-PCI. The regulation should ensure that the TSO operates effective and efficient. So, as long as project costs are reasonable, and the necessity and the benefit can be demonstrated, an investment will most likely be approved by the BNetzA (referred to as the NRA until the end of the section). The NRF implicitly incentives the TSO to invest in innovation resulting in lower cost within the regulatory period but there might be reduced incentives for long-term cost reductions as efficiency gains must be passed on to consumers in the next regulatory period.

In order to provide regulatory support for the necessary adjustments to the transmission system as a result of the energy transition, the so-called investment measure mechanism was introduced. The NRA has to approve capital and operating costs (fixed allowance calculated based on the construction costs, usually equals 0,8 % of the costs of the assets) of investment measures required for the expansion or restructuring of transmission systems, if these are necessary for system integrity or for integration into the national or international interconnected system or needed for expansion of the energy supply system. To the extent BNetzA approves an investment measure the relating costs are considered so-called permanently non-influenceable costs (for a certain period of time), which are not subject to individual efficiency targets and can, thus, be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period.

As a result of the introduction of the t-0 cost recognition, the NRA only approves the investment on the merits. Hence, the costs of the investment are included in the revenue cap based on planned costs (at t-0). Only thereafter an ex post control takes place by means of an as-is-evaluation. Any deviations between planned and actual costs will be recognised in the regulatory account.

Main regulatory barriers

The interviewees were generally satisfied with the NRF in Germany. Yet, they also recognize one of the regulatory barriers mentioned in the Annex III (“bias in the NRF favouring CAPEX”):

- Most grid extension measures from the network development plans are treated through the investment measure mechanism that, according to the interviewees, is well suited for the financing of this kind of investments in general. Also, interviewees are content with the cost approval processes. CAPEX will be accepted assuming they are 100% efficient for a certain period of time without any time lag. After that, they will be integrated into the regular cost base level and could be cut through efficiency regulation. Each approved investment measure receives a fixed allowance of OPEX;
- Other investments (e.g. 1:1 replacement measures) or OPEX will be treated with the regular efficiency regulation regime consisting of a budget principle with base year

system. This budget principle incentivises cost reductions but cost increases, maybe due to unforeseen developments, may result in a delay in being included in the revenue cap. Some respondents therefore argue that solutions with temporarily higher costs but lower costs in the long run may not be stimulated. At the same time interviewees also assessed the monetary relevance still being not significant in practice.

Additionally, they mentioned the following barrier also addressing the treatment of OPEX:

- Some interviewees see a rising number of projects emerging in the field of markets (e.g. control reserve, NC/GL implementation, bidding zone review) that are generating effort needs as well as creating new tasks. If such activities lead to cost increase (e.g. due to additional personnel) and this cannot be covered by cost reductions, the net increase could be included in the revenue cap with delay. To counteract this potential barrier the NRF contains pass-through positions (for example voluntary self-commitment European initiatives *FSV "Europäische Initiativen"*) and other mechanisms. However, it cannot be conclusively assessed whether, on the one hand, the relevant regulations are sufficient and, on the other hand, how substantive the barrier actually is in practice.

Possible improvement of the NRF

The following desirable improvements to the NRF could be considered:

- Eliminate CAPEX bias;
- Find a way to stimulate participation in fields of activity or the application of innovative technologies potentially showing high OPEX ratios, especially if (socio)-economic benefit is proven.

2.2.2. Regulatory practice related to innovation

Innovative projects

In the NRF, there is no definition or mentioning of innovation. Nevertheless, the interviewees distinguish between three types of innovative projects:

- Innovative projects resulting in lower costs for the TSO[2];
- Innovative projects falling under the investment measure regime;
- Innovative projects resulting in higher costs for the TSO, but also resulting in benefits to the society that are not taken into account sufficiently.

The regulation was said not to account sufficiently for the latter category. The NRF does provide incentives for projects that result in cost reduction. Also, projects falling under the investment measure regime are approved by the NRA primarily looking at the project reason rather than the cost. Even though the regulation was said not to account sufficiently for the latter category in principle, interviewees stated that in the past solutions for severe problems could always be found within discussion processes among the stakeholders.

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

- Phase-shifting transformers;
- Overhead line conductor material with higher transmission capacity;
- Overhead line monitoring / Thermal rating of overhead lines;
- HVDC lines;
- Operational tools for optimisation of system operation (system stability, transmission capacity etc.).

Adequacy of the NRF relating to its support for innovative investments

There are no provisions in the regulation explicitly facilitating innovation. The NRF is neutral regarding project categories, such as innovative or conventional, PCI or non-PCI. The regulation should ensure that the TSOs operate effective and efficient. So, as long as project costs are reasonable, and the necessity and the benefit can be demonstrated, an investment will be approved by the NRA. Interviewees from both the TSOs and NRA have not mentioned any major

[2] Since Germany has a incentive based revenue cap regulation, TOTEX reductions are incentivized. Yet, as we analyzed in section 2.2.1, a bias favoring CAPEX has been mentioned by the stakeholders.

barriers or indicated improvement needs except a slight CAPEX bias could be identified that exists for any project type (s. above).

2.2.3. Regulatory practice related to security of supply

Security of supply projects

The interviewees see security of supply on a system level and remarked that basically any investment supports the continuity of security of supply. Also, they remarked that the energy transition poses challenges to security of supply, especially for system operation.

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

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

Generally, the interviewees expressed their satisfaction with current situation, as there is discussion at eye level with the regulator and joint search for solutions. But also, some interviewees doubt that a shift of discussion of issues and regulation of security of supply towards EU level would be beneficial. Such shift would lead to difficulties within discussions because deeper knowledge of the specific network and the individual prerequisites/situations is needed. In the interviewees' eyes, the needed depth of this knowledge is not available at EU level.

Moreover, the interviewees said that some thinking needs to be done related to a possible role of the TSO in new developments, which enhance security of supply, such as sector coupling, hydrogen and storage.

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.

Currently, a number of projects regarding the electricity network are being planned or carried out. An overview of the projects contained in the network development plan as well as the offshore network development plan is accessible via joint databases of the electricity TSOs which also contain brief summaries of each project.

The joint databases can be reached under the following links:

- network development plan: https://www.netzentwicklungsplan.de/de/projekte/projekte-nep-2030;
- offshore network development plan North Sea: https://www.netzentwicklungsplan.de/de/projekte/projekte-o-nep-2030-nordsee;
- offshore network development plan Baltic Sea: https://www.netzentwicklungsplan.de/de/projekte/projekte-o-nep-2030-ostsee.

The following projects are particularly relevant for the German electricity infrastructure having an innovative nature and supporting security of supply:

- NordLink is the first direct electricity connection between Germany and Norway:
  - The project will provide a capacity of 1,400MW and will allow exchange of renewable energies, especially hydroelectric power and wind power, between both countries. The project will be commissioned in 2020. Upon completion, NordLink will serve as an essential project to enhance the flexibility of the German renewable electricity system. When there is a surplus of electricity from RES in Germany, this is exported to Norway where such electricity can be used to keep water in the reservoirs. Germany can import energy from Norway in times of high energy demand;
  - The project is based on the high-voltage direct current technology which allows transmission of electricity over long distances;
  - The project covers both cables and converter stations at the cables' ends to convert electricity from direct current to alternating current and vice versa;
  - NordLink is contained in the BBPlG and is a project of common interest (No. 1.8) under Regulation (EU) Nr. 347/2013 and its delegated acts (TEN-E Regulation);
  - DC Nordseekabel GmbH & Co. KG, in which the German TenneT TSO GmbH and the Germany development bank KfW each hold 50 % of the shares, and the Norwegian TSO Statnett will realise the project.

- The SuedOstLink project is to facilitate transmission of electricity generated through RES in the Northeast of Germany to the load centres in the South, mainly in Bavaria:
  - The project is needed, as the nuclear power plants that are still in operation in Bavaria will cease their operations in 2022. Furthermore, the project reduces the loop flows from the Northeast of Germany to the south of Germany via Poland and the Czech Republic;
  - SuedOstLink is part of the network development plan and the BBPlG. Furthermore, it is contained in the list of projects of common interest (no. 3.12) according to the TEN-E Regulation;
  - SuedOstLink covers a distance of 537 km between its network connection points in Wolmirstedt (Saxony Anhalt in the northeast of Germany) and Isar (Bavaria in the south of Germany);
  - SuedOstLink is based on high-voltage direct current technology. Cables are partly built as underground cables. As there are currently only few experiences with high-voltage direct current technology used in underground cables, SuedOstLink is considered a pilot project in the relevant areas;
  - The project falls within the control areas of TenneT TSO GmbH and 50Hertz Transmission GmbH;
  - It is expected that SuedOstLink will become operational in 2025.
- The SuedLink project is another project for the transmission of electricity from the North of Germany, including from OWFs, to the South of Germany:
  - Similar to SuedOstLink, the project is needed because of the energy transition in Germany which makes the nuclear power plants in the South cease their operations in 2022;
  - The project consists of two DC corridors with a transmission capacity of 2GW each. Between its network connection points in Wilster (Schleswig-Holstein in the North) and Bergrheinfeld (Bavaria in the South) as well as Brunsbüttel and Großgartach respectively, the project covers a distance of approximately 550 km and 700 km respectively.
  - The project is based on high-voltage direct current technology and will be carried out using underground cables. Also, this project is considered a pilot project;
  - The project falls within the control areas of TenneT TSO GmbH and TransnetBW GmbH;
  - It is expected that SuedLink will become operational in 2025.

All above mentioned projects are part of the German NDP and therefore will be treated under the investment measure mechanism and thus financed through regular tariffs. Currently, these projects are in the spatial planning phase.

Additionally, interviewees reported on the following project using innovative solutions.

TenneT, one of the four German electricity TSOs, was facing voltage issues in some parts of their grid. Due to the decrease of centralised generation power dynamic voltage stability problems started to increase as well as the need for remedial actions due to voltage constraints. To counteract these issues TenneT considered to build a static compensator (STATCOM) in Borken (federal state Hesse).

The Statcom plant in Borken with its hybrid design will be the first of its kind in the entire German power grid, beyond the TenneT grid. The great advantage of this system is that it requires comparatively little space compared to its reactive power control range. This reduces the impact on the adjacent flood area of the Schwalm river. TenneT is investing around 30 million euros in the Borken site. Currently the STATCOM is under construction and operation is planned to take place by the end of 2019.

TenneT applied for an acceptance as “investment measure” and supported the approval process of the project with a life-cycle cost analysis and an estimate of the reduced remedial costs, although the implementation of a CBA is not mandatory for such projects. By these analyses TenneT could show that the expected project costs are lower than the monetary benefits.

The NRA accepted the project as an “investment measure” and the regulatory approval process was said to be very smooth. However, the interviewees note that the other approval processes (e.g. emission control act) were sometimes very time consuming.

Additionally, the interviewees underline that the ex-ante approval of CAPEX and the absence of a time lag in the remuneration have been helpful to realize this project. Currently, interviewees see no improvement needs of the regulatory approval process.

2.3. Options for improvement

2.3.1. Options to improve regulatory practice

The above discussion shows that the NRF is well designed and functional for both security of supply and innovative projects. Especially a special regulatory instrument ("investment measures") is focussed on sustaining the functionality of the electricity system given the increase of renewable energy generation. As the above also shows, the NRA apply a "top down" approach for the investment approval, not looking deeply into individual projects and approving projects by their necessity rather than their cost.

Only a CAPEX bias could inhibit projects with high OPEX share, which might disincentivize TSOs to invest e.g. in innovative IT solutions, measurement systems etc. Another concern related to the sentiment that projects having wider societal benefits are not always incentivized. Also, it could be considered refining the NRF in the future to take into account new developments such as sector coupling, power to gas and storage if such technologies are not built market-driven to a useful amount from an economic perspective.

(i) Favouring of OPEX-based solutions

Generally, the NRF is considered adequate in supporting investments in security of supply and some kinds of innovative technologies. Currently, there are no indications that the implementation practices provide inadequate incentives to ensure security of supply. Also, a number of innovative technologies are being frequently used in recent projects. Respondents point out there might be a bias towards CAPEX-solutions. If this bias develops a significant distortion for the choice of solutions that becomes economically relevant, specific incentives could be introduced for these kinds of OPEX-based solutions, which have been identified as advantageous or necessary. Yet, the introduction of such incentives bears the risks of introducing new distortions.

(ii) Statutory obligation to consider alternatives

A more general approach to foster OPEX-based solutions in the long-term, i.e. beyond a single regulatory period, would be the introduction of an obligation to consider OPEX-related innovative options when making investment decisions, e.g. in the network development plan. The TSOs would then have to provide OPEX-based options as alternatives to CAPEX-based projects outlined in the network development plan. In the approval of the current scenario development report, the NRA has imposed to consider innovative solutions. Hence, a first introduction of an obligation is already made, which of course is a welcome improvement. In order to anchor this obligation permanently, we propose to include it at the level of ordinances or laws. Further, this approach necessitates that a framework is developed determining when OPEX-based solutions should be favoured over CAPEX-based solutions, so an application of a CBA could be considered, similar as foreseen in the approval of the scenario development report.

(iii) Statutory reference to innovation

There are only limited explicit statutory powers or duties aiming at encouraging innovation. To ensure that innovative projects are still encouraged and supported in the next regulatory period, an extended statutory reference to innovation could be included into the regulatory framework. This long-term strategic perspective could be shaped by governmental policies, statutory duties or could be included in the network development plan.

(iv) Consultation on investment plans (extension of existing consultation)

Both on the national net development plan and on project level of investments in general (also outside the national net development plan), additional stakeholder consultations could increase the likelihood that the output will ultimately be beneficial to the consumers, thereby moving towards a more output-focussed regulation. Additional stakeholder consultation can also be used to increase public acceptance by explaining which alternatives had been considered and why a certain solutions had been preferred, to determine OPEX solutions to be favoured from option (ii) and help shaping the long-term perspective on innovation of option (iii). Yet, the organisation of stakeholder consultations has disadvantages, such as the additional organisational burden on the party organising the consultation (the TSOs or NRA) and a

potential delay in implementing an investment project, even though consultations for certain types of infrastructure projects as well as parts of the planning processes already exist. Hence, one needs to think carefully how often and for which purposes one wants to additionally consult stakeholders.

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.

2.3.2. National law mechanism(s) for implementing options

We consider that, with the exception of the following, the above-mentioned changes could be implemented using legal powers already available to BNetzA or others under the existing NRF.

As regards option (ii) (statutory obligation to consider alternatives), we understand that the legal mechanism for implementing this option would involve the modification of the EnWG through the German legislative process[3]. For implementing additional monetary incentives beyond the ones already included in the legal framework, the legal mechanism would involve the modification of the StromNEV and ARegV[4].

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[3] The German parliament ("**Bundestag**") is the main organ for legislation in Germany. However, the legislative process involves many other institutions: Besides the members of the Bundestag, the Federal Government and the German Federal Council ("**Bundesrat**"), which represents the Federal States, have the right to introduce bills in the Bundestag. If the Federal Government wishes to amend or introduce a law, the Federal Chancellor must initially transmit the bill to the Bundesrat. As a rule, the Bundesrat then has a period of six weeks in which to deliver its comments on the bill, to which the government may in turn respond with a written counterstatement. The Federal Chancellor then forwards the bill to the Bundestag with the Bundesrat's comments. A similar procedure applies when the Bundesrat introduces legislative initiatives. Once the majority of the members of the Bundesrat have voted in favor of a bill, it goes first to the Federal Government, which attaches its comments to it, usually within six weeks, and then forwards it to the Bundestag. Draft laws may also be initiated by members of the German Bundestag, in which case they must be supported by either at least one of the parliamentary groups or at least five percent of the members of the German Bundestag.
As a rule, the Bundestag debates bills three times in the plenary (the so-called readings). The primary goal of the first reading is to designate one or several committees that are to consider the bill and prepare it for its second reading. If the Bundestag designates several committees, one committee is then given overall responsibility for the deliberations on the item. It is therefore responsible for the bill's passage through the Bundestag. The detailed work on legislation takes place in the permanent committees, which are made up of members from all the parliamentary groups. They are able to invite representatives of interest groups and experts to public hearings. Following the conclusion of the deliberations, the committee with overall responsibility for a bill presents the plenary with a report on the course and results of its deliberations. The decision it recommends forms the basis for the second reading that now takes place in the plenary. Usually, the plenary then moves directly to a vote on the bill as a whole. It is then possible for the third reading to begin immediately. Another debate is only held during the third reading if a parliamentary group or at least five percent of the members of the Bundestag so request. The final vote is held at the end of the third reading. Once a bill has gained the necessary majority in the plenary of the Bundestag, it is transmitted to the Bundesrat as an act. It is through the Bundesrat that the Federal States are involved in the shaping of every piece of legislation. The Bundesrat may not make amendments to an act adopted by the Bundestag. However, if it does not give its consent to an act, it may demand that the Mediation Committee (*Vermittlungsausschuss*) be convened. For some bills, the consent of the Bundesrat is a compulsory requirement. In the case of bills to which consent of the Bundesrat is not required but to which the Bundesrat may lodge an objection, the Bundestag may put an act into force even if no agreement has been reached in the Mediation Committee. However, this requires another vote in which the Bundestag passes the bill by an absolute majority.
Once Bundestag and Bundesrat have approved a bill, it is first printed and transmitted to the Federal Chancellor and the competent federal minister, who countersign it. The Federal President (*Bundespräsident*) then receives the act for signing into law. He or she examines whether the act has been adopted in accordance with the German Constitution (*Grundgesetz*) and is free of evident material contraventions of the German Constitution. Once these checks have been carried out, the Federal President signs the act and orders that it be published in the Federal Law Gazette.

[4] In contrast to the EnWG, the StromNEV and ARegV are ordinances, so the process of amending it would differ from the above-mentioned legislative process: Ordinances are usually used to specify or supplement a law with more detailed, often technical regulations. Article 80 of the German Constitution states certain requirements the ordinance has to comply with, e.g. every ordinance has to cite its legal basis. The Federal Government, the Federal Ministries and the Governments of the Federal States may

Turning to option (iii) (statutory reference to innovation), we expect that this could be implemented by including such an obligation in the EnWG through the German legislative process.

As regards option (iv) (additional consultation on investment plans and projects), the suggestion of incorporating a mandatory requirement in legislation for the TSOs to explain what alternatives have been looked at in more detail when developing the network development plan or the project, could be implemented by including such an obligation in the EnWG, the NABEG, the ROG or the German Code on the Administrative Procedure (*Verwaltungsverfahrensgesetz,* **"VwVfG")** through the German legislative process.

2.3.3. Impact assessment

Option (i) is not easy to be implemented well balanced. The option has the risk to turn out to be a technology-specific incentive that does not necessarily lead to efficient decisions and may even encourage abuse. Also, innovative and socially beneficial OPEX solutions to be favoured by the regulation need to be defined. Such projects would need to be redefined for each regulatory period, possibly in cooperation with the TSO and maybe including a stakeholder consultation in order to ensure technology neutrality. Therefore, depending on the specific implementation the effort for the NRA and the TSOs can be high. Additionally, adequate incentives for efficiency must be set to avoid abuse.

The long-term strategic perspective on innovation mentioned in option (iii) necessitates efforts and coordination between the TSOs and the NRA regarding the design of this long-term perspective (e.g. the organisation of stakeholder consultations, determining the scope of the innovation needed, monitoring and evaluating of how the statutory duty is translated into the long-term perspective).

As mentioned in option (iv) and the other options above, stakeholder consultations can contribute to moving to a more output-focussed regulation. Yet, too many consultations will increase the organisational burden of the TSOs and/or the NRA and possibly reduce the willingness of stakeholders to participate in the consultation. Moreover, consultations possibly lead to time lags. Therefore, consultations as instrument need to be used wisely.

We do not expect that any of the suggested changes will result in considerable changes to investment levels. Yet, if the perceived risk of innovative projects is lowered and a long-term strategic perspective on innovation could be attained, the share of innovative projects is expected to increase. Options (iv) is expected to have a similar effect. Moreover, if implemented well, option (i) could result in a shift from primarily CAPEX investments to more OPEX investments.

issue or amend an ordinance if authorized by the German legislator through a law. If the Federal Government or a Federal Ministry drafts an ordinance, usually the Federal Cabinet (i.e. the Federal Ministers representing the Federal Government) debates it at first. The Federal Chancellery will then transmit the draft to the Bundesrat. If the planned ordinance requires consent of the Bundesrat under Article 80 para. 2 of the German Constitution, the Bundesrat then has a period of six weeks to deliver its comments on the draft, make amendments or give its consent. If the Bundesrat made amendments to the draft, it can only enter into force after the Federal Cabinet or the responsible Federal Ministry approved of them. The draft will then be printed and transmitted to either the Federal Chancellor (if the ordinance was drafted by the Federal Government) or the responsible Federal Minister (if the ordinance was drafted by a Federal Ministry) to countersign it. It is then transmitted for publication to the Federal Law Gazette in order to enter into force.

3. GAS

3.1. Legal analysis of the NRF in Germany

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

The German gas market is divided into two market areas, which are currently being operated by 16 gas transmission system operators (**"TSOs"**) in total. The TSOs are (for the main part) sole owners or co-owners of the network, or they enjoy rights of use the network under beneficial use agreements. A list of the TSOs including a description of the market areas (in English) can be found here: https://www.fnb-gas.de/en/transmission-systems/market-areas/market-areas.html. Network operators (including TSOs) require an operating permit, which shall ensure that TSOs have the necessary personal, technical and economic capability and reliability for the long-term operation of a network. In addition, TSOs are certified by The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (*Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen,* "**BNetzA**") to ensure compliance with applicable unbundling requirements.

As a consequence of the transposition of the European Third Energy Package (2009) into German law in 2011, as well as the 'energy transition' (*Energiewende*) in the wake of the Fukushima accident in 2011, the German energy markets have undergone some transitions and are still facing significant challenges. In particular, new legislation was enacted in order to facilitate further liberalisation of the energy markets and promote the energy transition, which also includes the need for considerable network expansion. The following shall provide a brief overview about the relevant statutory provisions and role of the regulator:

- The energy sector in Germany is governed by numerous acts and ordinances, which are subject to constant modifications and amendments. The main pieces of legislation in the gas sector are the German Energy Industry Act (*Energiewirtschaftsgesetz*, "**EnWG**") which entered into force on 13 July 2005, and several ordinances, in particular the Ordinance on Access to the Gas Networks (*Gasnetzzugangsverordnung,* "**GasNZV**") and the Ordinance on Tariffs for the Gas Networks Access (*Gasnetzentgeltverordnung,* "**GasNEV**"). However, as of 1 January 2009, all gas TSOs have to calculate their network tariffs based on the Ordinance on Incentive Regulation (*Anreizregulierungsverordnung*, "**ARegV**");
- Section 11 para. 1 EnWG contains a general obligation of TSOs to operate a safe, reliable and efficient network on a non-discriminatory basis. They have to maintain, expand and optimise the network meeting the demands (*bedarfsgerechter Ausbau*) to the extent this is economically reasonable (see section below);
- BNetzA is the competent regulator for TSOs in Germany at a national level. Under the EnWG, it is BNetzA's central task to regulate the energy networks to create the prerequisites for fair and effective competition in the upstream and downstream markets for the supply of electricity and gas. BNetzA's regulatory task covers ensuring non-discriminatory network connection and network access, the control of the network tariffs charged by network operators, the safeguarding against anti-competitive practices by network operators and the monitoring of the implementation of the regulatory regime (see section below "Role of NRA").

The key instrument to develop the German gas transmission network is the national network development plan (*Netzentwicklungsplan*) for gas:

- All German gas TSOs have to jointly submit to BNetzA every two years a joint national network development plan (section 15a EnWG). The plan needs to be based on a framework scenario (Szenariorahmen) having regard to future production and consumption of natural gas as well as infrastructure projects and also take into consideration the non-binding, EU-wide network development plan established by ENTSO-G under article 8 para. 3 lit. b) Regulation (EC) No 715 / 2009 including, inter alia, a list of envisaged investment projects. The plan has to contain information regarding the network-related measures required for a secure and reliable network operation for the next ten years. More specifically, the national network development plan has to identify those projects, which need to be implemented in the course of the following three years. After public consultation of both the framework scenario and the national network development plan, BNetzA may require adjustments to the national network development plan before the plan becomes binding for the gas TSOs.

Further instruments to develop the German gas transmission network include, *inter alia*, the following:

- Gas TSOs must continuously ensure the capability of the system to satisfy demands for the transmission of gas. Gas TSOs must, in particular, contribute to supply security by having appropriate transmission capacity and ensuring the reliability of the system (section 16 EnWG);
- TSOs are generally obligated to connect, (i.e. physically link to their network end-consumers, level or downstream network operators or power lines and power plants) on an economically reasonable, non-discriminatory and transparent basis (section 17 para. 1 EnWG). Such obligation to connect to the network may, thus, be seen as another factor to foster network development;
- Network operators including all TSOs must grant access to their network to any third party on an economically reasonable, non-discriminatory and transparent basis, section 20 para. 1 EnWG. They are required to publish on the internet the relevant conditions, standard form agreement, and the tariffs for the access to their network. Network operators may only refuse access to their network if they can prove that granting access is impossible for operational or other reasons or in a case where the access would be unreasonable, section 20 para. 2 EnWG. The denial / refusal must be communicated in writing, including the reasons, and must be notified to BNetzA;
- In this respect, gas network operators shall offer entry and exit capacities in accordance with the so-called "Two Contract Model" (*Zweivertragsmodell*), *i.e*. without specifying transportation paths, section 20 para. 1b EnWG. By contrast, point-to-point contracts as well as contracts based on an individual network operator Entry-Exit System (*Einzelbuchungsvariante*) are not permissible. For the transportation of gas not more than two separate, tradable contracts with the relevant network, operators for the feed-in (entry contract, *Einspeisevertrag*) and the off-take (exit contract, *Ausspeisevertrag*) of the gas are required. The transmission system customer does not need to establish a transaction-dependent transport path based on the relevant network connection points of interconnected networks. If the intended transportation of the gas requires the use of more than one network within one market area, the respective network operators have the duty to cooperate in such a manner as to enable the requested transportation via only two contracts. To that effect, the operators of the German gas networks have entered into a Cooperation Agreement (*Kooperationsvereinbarung*, **"KoV"**), describing the roles, responsibilities and obligations of network operators along the contractual gas transportation chain.

Network tariffs (*Netzentgelte*) are the main source of income for network operators, including TSOs. For the actual calculation of the admissible network tariffs applied to gas system users (*Netzkunden*), the GasNEV provides for a regulatory scheme of three steps: First, the computation of the individual cost elements (cost category accounting, *Kostenartenrechnung*) taking into account the calculated operating and imputed costs, second, the distribution of the cost elements to the cost centres (cost centre accounting, *Kostenstellenrechnung*), and third, the cost unit accounting (*Kostenträgerrechnung*). Within the network tariff calculation, the imputed return on equity is to guarantee network operators a reasonable, competitive and risk adjusted return on investment for the invested capital. In this context, it should be further noted that investment projects that are stipulated in the national network development plan are eligible for so-called investment measures.

TSOs are obligated to operate a safe, reliable and efficient network on a non-discriminatory basis (section 11 para. 1 EnWG). They have to maintain, expand and optimise the network meeting the demands (*bedarfsgerechter Ausbau*) to the extent this is economically reasonable. In terms of network development, it is one of the key responsibilities of the gas TSOs to produce every two years the network development plan and gas TSOs are obliged to realise the projects set out in these plans. Details about the procedure and tasks of the gas TSOs in relation to the network development plan are described above.

Potential network expansion requirements can result particularly from the network connection of storage facilities, liquefied natural gas (LNG) and production facilities, gas fired power plants (sections 38, 39 GasNZV) and biogas facilities (sections 31 *et seq.* GasNZV). Respective connection requests must be considered within the capacity evaluation. BNetzA has held that section 39 GasNZV is in principle also applicable to gas storage facilities outside of Germany (file no. BK4-12-2172).

Further, specific expansion requirements are set out on a transnational basis (Ten Years Network Development Plan pursuant to article 8 para. 3 lit. b) of Regulation (EC) No 715 / 2009 and North West Gas Regional Investment Plan pursuant to article 12 Regulation 715 / 2009) and the national network development plan (section 15a EnWG).

Role of NRA

BNetzA and the regulatory authorities of the federal states (*Bundesländer*) are responsible for the regulation of the gas networks. The state regulatory authorities are responsible for regulating energy supply companies with fewer than 100,000 customers connected to their gas supply networks and whose networks do not extend beyond a federal state's borders. Hence, BNetzA is generally competent for TSOs in Germany at a national level. All regulatory tasks and powers which, under the EnWG, have not been assigned to the state regulators are performed by BNetzA. BNetzA's regulatory tasks include, inter alia, ensuring non-discriminatory network connection and network access, control of network tariffs, monitoring potential anti-competitive practices by network operators and the assessment of the network operators' investment activities. These regulatory powers have the primary objective to ensure safe and efficient gas network operation and to provide necessary prerequisites for effective competition on the upstream and downstream energy markets.

Role of BNetzA in terms of network planning

The regulatory authorities constantly monitor, coordinate and partly approve investment decisions with a particular view to TSOs. In this respect, every two years (in every even year) gas TSOs are required to produce a 'scenario framework' (section 15a para. 1 sentence 6 EnWG). After public consultation with all stakeholders involved, BNetzA approves the scenario framework in light of the results of the public consultation (section 15a para. 1 sentence 7 EnWG). Furthermore, section 15a para. 1 EnWG requires all German gas TSOs to submit to BNetzA in each even year a joint national gas network development plan (see section 3.1.1 above). BNetzA can request gas TSOs to make changes in their draft national network development plan. If BNetzA does not request the gas TSOs to implement changes within three months after they have published their draft, the network development plan becomes binding for the gas TSOs (section 15a para. 3 sentence 7 EnWG).

Role of NRAs regarding the approval procedures for network development projects

In general, the construction of gas transmission networks is subject to a two-pronged authorisation process. Based on a regional land use planning procedure under the Federal Spatial Planning Act (*Raumordnungsgesetz,* **"ROG"**), a planning approval procedure under the EnWG takes place. The approval of the plan substitutes all other public-law permissions (*Konzentrationswirkung*). For both, the authorities of the federal states are competent to approve the plans. Therefore, projects, which cover more than one federal state, necessitate the co-ordination of different state authorities.

3.1.2. Specific legal rights and duties

Undertaking of investments

As described above in detail (see section 3.1.1), gas TSOs are required to set out a list of envisaged investment projects in the network development plan which is binding for the gas TSOs, i.e. a gas TSOs must realise the investment projects contained in the network development plan. The obligation of gas TSOs is to create a network development plan follows from section 15a EnWG.

3.1.3. Mechanism for financing of investment projects

While the conditions for access to gas transmission networks are governed by the GasNZV, the EnWG regulates and the ARegV as well as the GasNEV provide the structure of the network tariffs for such access.

Until December 31, 2008, network tariffs were as such subject to *ex ante* cost-oriented regulation. The determination of tariffs was based on a cost-plus approach. According to this principle, network tariffs were approved only if they did not exceed the admissible costs of an efficient network operation, plus an imputed return on equity capital.

As of January 1, 2009, this regulation of the network tariffs was replaced by a regime of incentive regulation. Deviating from the previous static approval of cost-oriented tariffs, incentive regulation adds dynamic efficiencies by setting incentives for efficient operation of the network. The general aim of this incentive regulation regime is to eliminate inefficient network costs on the one hand and to provide network operators with sufficient revenues in order to enable necessary investments for replacements and expansions of network systems on the other hand. For each network operator, BNetzA defines a revenue cap (*Erlösobergrenze*) for each calendar year of a regulatory period, which includes a general as well as an individual efficiency target. Such efficiency targets will be formulated and distributed across the regulatory period in a way that enables the network operator to achieve and exceed these targets by employing realistic and reasonable measures. Within the regulatory period of five years, network operators are allowed to collect the economic benefits resulting from efficiency gains, effectively decoupling actual costs of the network operation from admissible network tariffs. However, during the next regulatory period, the benefit resulting from improvements in efficiency must be passed on to the customers through a decrease in network tariffs.

The first step in the determination of the revenue cap is to calculate the relevant cost base level (*Kostenausgangsniveau*). The determination of the initial cost base level for the yearly revenue caps of the upcoming regulatory period is based on the operational and capital network costs incurred in the third closed business year (so called "photo year") of the current regulatory period. In the gas sector, the year 2015 is the photo year for the current third regulatory period (2018-2022). Thus, the revenue cap determined by BNetzA reflects both operational and capital expenditures. In this respect, capital expenditures comprise imputed cost components such as imputed depreciation for the regulatory asset base as well as an imputed return on equity. If assessed as being customary to the market, BNetzA fully recognises actual costs of debt.

For the third regulatory period (2018-2022), the rate of return on the equity portion (based on an "imputed equity ratio" capped at a maximum of 40 %) of "old assets" is equal to 5.12 % (before corporate tax, after trade tax). Old assets are such assets that were commissioned prior to 1 January 2006. The rate of return on equity for "new assets", i.e. commissioned as of 1 January 2006, is fixed at 6.91 % (before corporate tax, after trade tax). After several network operators had challenged BNetzA's determination of the interest rates for the third regulatory period before the competent Higher Regional Court, the Court has repealed that determination. The ruling is not yet binding.

In principle, the revenue caps will not be adjusted during a regulatory period; however, the TSOs can adjust the revenue caps in limited circumstances in order to reflect, inter alia, the annual inflation rate, a change of significant structural parameters or cost factors, or unpredictable events causing undue hardship for the network operator (section 4 para. 3 ARegV). If the TSOs adjust their revenue caps, they have to inform BNetzA (section 28 sentence 1no. 1 ARegV). If BNetzA takes the view that, the adjustment does not adequately reflect the factors mentioned in section 4 para. 3 ARegV, it can initiate proceedings against the TSOs based on its general competences (see sections 3.1.4 and 3.1.5) below).

Pursuant to section 23 ARegV, BNetzA has to approve so-called investment measures for capital and operating costs required for the expansion or restructuring of transmission systems, if these are necessary for system integrity or for integration into the national or international interconnected system or needed for expansion of the energy supply system according to section 11 EnWG. Mere replacement investments are not subject to these investment measures rules. Section 23 para. 1 sentence 2 ARegV expressly mentions several "rule examples" (*Regelbeispiele*), for which an investment measure is available. Beyond these rule examples, investment projects found in the national network development plan are also eligible for investment measures (section 23 para. 1 sentence 1 ARegV). BNetzA has issued guidelines on investment measures under section 23 ARegV (most recently in 2017) as well as a determination regarding the calculation of capital and operating costs stemming from investment measures (file no. BK4-12-656 dated 2 May 2012, as amended in file no. BK4-12-656A01 dated 30 November 2016).

To the extent, BNetzA approves an investment measure the relating costs are considered so-called permanently non-influenceable costs, which are not subject to individual efficiency targets and can, thus, be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period. While this was previously only the case with a two-year time lag ("t-2", in 2012, the ARegV was amended to allow for cost-effectiveness in the current year (i.e. at "t-0").

As a result of the introduction of the t-0 cost recognition, BNetzA only approves the investment on the merits. Hence, the costs of the investment are included in the revenue cap based on planned costs (at t-0). Only thereafter an ex post control takes place by means of an as-is-evaluation (*Ist-Abgleich*). Any deviations between planned and actual costs will be recognised in the regulatory account, section 5 para. 1 sentence 2 ARegV.

Section 25a ARegV allows BNetzA to approve under the revenue cap, upon application by the TSOs, certain costs for research and development. However, the scope of this provision is limited. It only applies to research and development carried out under publicly managed and publicly funded research schemes. Furthermore, it only covers 50 % of the costs which are not publicly funded and only if the TSO cannot receive those costs otherwise (e.g. through investment measures under section 23 ARegV).

The main instruments to finance large network investments are so-called Investment measures (section 23 ARegV) (see section above). Investment Measures accommodate a variety of projects. In terms of innovation and security of supply in the gas sector, the following projects are relevant:

- Investment projects contained in network development plans (section 23 para. 1 sentence 1 ARegV);
- Investment projects for the construction of capacities for the transmission of gas between market areas, if permanent bottlenecks exist which can't be eliminated by other economically reasonable measures (section 23 para. 2 sentence 2 no. 4 ARegV).

It is important to note that investment measures primarily focus on CAPEX with the result that such CAPEX are non-influenceable costs, which are not subject to efficiency targets. In addition, also a certain share of OPEX is approved as investment measure. While section 23 para. 1 sentence 4 ARegV provides for a general operating expense lump-sum of 0.8 % of the acquisition and production costs of the respective commissioned assets (*Anschaffungs- und Herstellungskosten*), BNetzA determined on 5 December 2011 that such lump-sum should be equivalent to 5.2 % of the accumulated historical costs of the fixed assets for natural gas compressors (file no. BK4-11-027) and 5.8 % for pressure regulator and measuring stations (file no. BK4-11-028). However, it should be noted that BNetzA may in future adjust this lump-sum.

Mechanisms to foster innovation

In general, the ARegV is technologically neutral and only indirectly fosters innovation by acknowledging costs for innovative projects in particular under investment measures (section 23 ARegV) or as specific research and development costs (section 25a ARegV).

However, projects contained in the network development plan and for which investment measures are available (cf. above), contribute to security of supply of gas in Germany.

Limitation of innovative investments:

If certain investments do not fall under the investment measure regime (e.g. innovative replacement investments), additional costs resulting from such investments and the cost structure of the network operator could be deemed relatively inefficient compared to other network operators. As a consequence, TSOs with innovative but inefficient investments could face efficiency targets and thus decreasing revenues during the regulatory period.

As described above, the actual costs of TSOs are decoupled from admissible network tariffs within the five-year regulatory period. This creates incentives for the TSOs to use efficiency gains and thus innovate within the regulatory period. However, as efficiency gains must be passed on to consumers in the next regulatory period (see section above), TSOs have less incentive to invest in the long-term and to support innovations with lead times exceeding one regulatory period, even if they might result in major advances.

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

There is basically a three-step approach to avoid investment in stranded assets. Section 11 EnWG obliges TSOs to operate a safe, reliable and efficient network on a non-discriminatory basis. To meet this general obligation, TSOs produce plans (e.g. the network development

plan), which BNetzA approves (see section 3.1.1 above). Hence, already at this planning level, the TSOs and BNetzA are able to identify projects / investments, which are deemed unnecessary or inefficient. Eventually, TSOs normally realise the measures described in their development plans and can apply for investment measures for the realisation of specific projects. BNetzA will carefully review and approve investment measures subject to the measures being necessary for an appropriate network development in line with the needs identified. Hence, within the investment measure proceedings, BNetzA is able to identify unnecessary and inefficient investments.

Any investments, which are not subject to investment measure approval, are also reviewed by BNetzA when determining the cost base level for the revenue cap. Also, in this regard, certain investment costs can be rejected or regarded as inefficient in order to avoid over- or stranded-investments.

3.1.4. Regulatory rules with respect to innovation

Specific duties of the TSO aimed at encouraging innovation

Apart from the duties of gas TSOs described above, there is no general or explicit duty for gas TSOs to innovate. In addition, it should be noted that one of the key challenges for gas TSOs is the switch from L-Gas to H-Gas (*Marktraumumstellung*). Such switch is deemed necessary due to the fact that L-gas supplies in Germany are steadily declining. Thus, in order to ensure the security of supply in the medium to long term, network areas still supplied with L-gas will have to be gradually converted to H-gas in the next years. A detailed roadmap for the process to switch from L-Gas to H-Gas is set out in the network development plan.

Other innovations may follow from the incorporation of “green energy” into the transmission networks, e.g. biogas plants or power-to-gas facilities:

- Operators of biogas plants have the right that the TSOs connect them to the gas network (section 33 para. 1 GasNZV). The aim of this provision is to facilitate integration of biogas into the gas network;
- At power-to-gas plants, which under certain conditions also benefit from the right under section 33 para. 1 GasNZV to be connected to the gas network, electricity generated (e.g. by wind turbines) is converted into hydrogen and injected into the natural gas network. We learned from information provided by certain TSOs that it is their goal to support the development of this technology from its current pilot-status to full market maturity and that they, for this purpose, cooperate with various organisations and initiatives in order to improve the legal and regulatory framework for power-to-gas (e.g. the so-called “Green Gas Initiative” which is an association of seven European infrastructure operators with the common goal of achieving CO2-neutral energy supply by 2050).

Another driver for innovation is encouraging energy efficiency. Individual TSOs proclaimed that they aim at systematically realising new measures both in their technical and administrative divisions to optimise energy efficiency, energy use, and energy consumption by implementing tailored energy management concepts and improving the own network.

Specific duties of the NRA aimed at encouraging innovation

BNetzA has no explicit duty to promote innovation. However, the German legal landscape contains several powers, which implicitly allow BNetzA to encourage innovation:

- BNetzA has granted operating permits to TSOs, which were founded by several companies joining their financial capabilities to construct and operate specific pipelines of major importance. An example is the OPAL pipeline, which stretches over the area between Lubmin (where the Nord Stream pipeline lands) and the border between Germany and the Czech Republic). By granting operating permits to companies who run specific pipelines, BNetzA encourages those companies to join their forces and implement major and complex investment projects;
- Furthermore, section 28a EnWG (which transposes Article 36 of Directive 2009/73/EG into national law) allows the BNetzA to grant new gas infrastructures an exemption from the network access regime. The legislator took the view that the network access regime is subject to unforeseeable changes so that investors might be deterred from investing into new gas infrastructures. As the construction of new infrastructure for gas is important in light of Germany’s growing dependency on gas imports, the legislator wanted to allow operators of gas networks to be independent of possible unforeseeable

changes of the network access regime and thus be able to generate steady return. The legislator took the view that the expectation of steady and foreseeable returns would make it easier to find investors. Under this provision, BNetzA has granted an exemption to a share of the OPAL pipeline from the network access regime in 2009 and amended this decision in 2016 (file no. BK7-08-009);

- The method of incentive regulation, which BNetzA uses to decide the network tariffs, creates implicit incentives for TSOs to innovate. As described in more detail above (see section 3.1.3 above), the network tariffs are somewhat decoupled from the TSO's actual costs. This indirectly incentivises TSOs to use innovative technologies in order to reduce their actual costs. The incentive regulation regime further contains certain cost approval mechanisms (e.g. investment measures and approval of certain costs for research and development under the revenue cap), which particularly incentivise innovation;
- BNetzA can decide to what extent costs incurred by gas TSOs for the switch from L-Gas to H-Gas (see section 3.1.5) are eligible for funding through the cost balancing mechanism in section 19a EnWG. Since January 1st, 2017, eligible costs are socialised between all gas TSOs and later included into the tariffs for network access.

For the integration of power-to-gas, the legislator has amended the definition of "biogas" in section 3 no. 10c EnWG to include hydrogen (if generated through electrolysis) and methane (if the raw materials stem from renewable energy sources). The result is that power-to-gas facilities benefit from the obligations of the TSOs to connect and to grant them access to the gas network where they would not have otherwise. BNetzA has issued a position paper to clarify questions regarding the details of integration of power-to-gas facilities into the gas network.

3.1.5. Regulatory rules with respect to security of supply

Specific duties of the TSO aiming at safeguarding security of supply

The general role and obligations of TSOs to operate a safe, reliable and efficient energy supply network, which includes the duty to safeguard security of supply, is outlined above in sections 3.1.1 and 3.1.2 In addition, investment obligations concerning specific measures that aim at safeguarding security of supply are contained in the network development plan, which is based on a framework scenario having regard to future production and consumption of natural gas as well as infrastructure projects (see section 3.1.1 above). One important part in the network development plan for safeguarding security of supply forms the switch from L-Gas to H-Gas (*Marktraumumstellung)* by which the gas TSOs take into account the steady decline of L-gas supplies in Germany.

Specific duties of the NRA aiming at safeguarding security of supply

BNetzA's tasks have been described in "Role of NRA" in section 3.1.1 above. In general, BNetzA's regulatory powers have the primary objective to ensure safe and efficient energy network operation and to regulate energy networks to provide necessary prerequisites for effective competition in the upstream and downstream energy markets.

BNetzA supervises the implementation of the national network development plan (see sections 3.1.1 above). In the event that a gas TSO – intentionally or negligently – does not implement the investments foreseen in that plan for the first three years, BNetzA may resort to the following measures under section 65 para. 2a EnWG:

- BNetzA will set a deadline for the TSO to carry out the investment if such investment is still considered relevant under the most recent national network development plan;
- If the deadline elapses fruitlessly, BNetzA may initiate a tender proceeding for the implementation of said investment.

More generally, BNetzA can step in if TSOs actions are not in line with the aims of the EnWG (section 65 paras. 1, 2 EnWG). This general power applies to any actions or omissions by the TSOs, which are in breach of their general obligations under the EnWG (see sections 3.1.1 and 3.1.2 above). Under section 65 EnWG, BNetzA has the power both to prohibit certain behaviour and to order that a TSO adopts a specific behaviour that BNetzA deems fit.

Furthermore, the powers of BNetzA are complemented by its authority to impose fines if TSOs do not comply e.g. with their obligation to prepare network development plans (section 95 para. 1 no. 3b EnWG).

3.2. Regulatory practice

3.2.1. Overview over regulatory practice in Germany

The regulatory principle does not differ significantly from Electricity and therefore can also be characterised as incentive-based revenue cap mechanism. There are no provisions in the regulation explicitly facilitating innovation. The NRF is neutral regarding project categories, such as innovative or conventional, PCI or non-PCI. The regulation should ensure that the TSO operates effective and efficient. So, as long as project costs are reasonable, and the necessity and the benefit can be demonstrated, an investment will most likely be approved by the BNetzA (referred to as the NRA until the end of the section). The NRF implicitly incentives the TSO to invest in innovation resulting in lower cost within the regulatory period but there might be reduced incentives for long-term cost reductions as efficiency gains must be passed on to consumers in the next regulatory period.

In order to provide regulatory support for the necessary adjustments to the transmission system as a result of the energy transition, the so-called investment measure mechanism was introduced. The NRA has to approve capital and operating costs of investment measures required for the expansion or restructuring of transmission systems, if these are necessary for system integrity or for integration into the national or international interconnected system or needed for expansion of the energy supply system. To the extent BNetzA approves an investment measure the relating costs are considered so-called permanently non-influenceable costs (for a certain period of time), which are not subject to individual efficiency targets and can, thus, be fully reflected in the revenue cap. In addition, the costs are reflected in the revenue cap already during an on-going regulatory period.

As a result of the introduction of the t-0 cost recognition, the NRA only approves the investment on the merits. Hence, the costs of the investment are included in the revenue cap based on planned costs (at t-0). Only thereafter an ex post control takes place by means of an as-is-evaluation. Any deviations between planned and actual costs will be recognised in the regulatory account.

Main regulatory barriers

The interviewees were generally satisfied with the NRF regarding support of security of supply projects. But some interviewees state the NRF not being able to support technologies enhancing the energy transition, such as PtG, green gas, sector coupling etc. Also, the same mechanisms for the treatment of CAPEX and OPEX are applied as described above for the electricity sector, so some interviewees see a certain disincentive for OPEX-intensive fields of activity and technologies.

Possible improvement of the NRF

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

- Regulation of projects and technologies considered important for the energy transition, e.g. related to the integration of gas with different qualities, such as biogas, green gas, hydrogen in the current system or sector coupling;
- Mitigation of CAPEX-bias;
- Investment measures: Extension of the catalogue to include measures that do not primarily increase capacity (necessary criterion).

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.:

- Pipeline inspections with help of drones and AI systems for image analysis;
- Use of mobile compressors in biogas plants (no shutdown during maintenance) or pipelines (evacuation of power sections during maintenance to reduce CO2 footprint);
- Reversing biogas flows in case of low demand and biogas overfeeding from downstream distribution networks into upstream grids;
- Improvement of real-time system status detection;
- Online simulation for optimal capacity utilisation.

In the interviewees' view, the NRF is generally adequate to support these projects but also, they state that projects with high OPEX share are not incentivised. Also, the interviewees see

improvement needs of the NRF regarding their involvement in the implementation of new technologies like PtG, waste heat recovery, sector coupling. Currently they see unbundling regulation issues that prevent them from promoting these technologies. Therefore, targeted improvements of the NRF addressing these issues could worth being considered (see above and Section 3.3 for details), which is by no means synonymous with a fundamental abolition of unbundling. Further, issues with unbundling will be analysed in the draft final report (outcomes of Task 5) where we address potential options for improvement that could be considered at the EU level.

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

The regulation regarding security of supply is seen as adequate to generally guarantee sustainable continuity of security of supply. But the interviewees also see some challenges:

- Current framework does not stimulate long-term storage for security of supply reasons;
- The term "protected customer" (from the EU SoS Regulation) is defined differently in different countries and creates inequality in investment needs between countries.

Therefore, targeted improvements of the NRF addressing these issues are worth being considered (see above and Section 3.3 for details).

3.2.4. Illustrative specific projects

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

A number of projects regarding the gas transmission network are currently planned or constructed. An overview of the projects of the network development plan is accessible via the joint database of the gas TSOs (http://www.nep-gas-datenbank.de:8080/app/#/ausbaumassnahmen), which also contains brief summaries of each project.

Gas pipeline EUGAL (aiming to increase security of supply, market integration and diversification of gas sources):

- EUGAL is a newly constructed gas pipeline connecting the gas terminal Lubmin II in the Northeast of Germany (Mecklenburg-Western Pomerania) with the Czech gas network. In addition, EUGAL is supposed to receive three connections with pre-existing German gas pipelines (NEL in Lubmin, FGL 306/NERA in Kienbaum, JAGAL in Radeland);
- EUGAL shall run through the states of Mecklenburg-Western Pomerania in the Northeast over Brandenburg to Saxonia in the east of Germany and shall cover a distance of 480 km. Investment cost amounts to EUR 2.3 billion;
- EUGAL belongs to ENTSO-G's ten-year network development plan, where it is cited as project #TRA-N-763, and to the national network development plan as measure #507-01a;
- Currently, the authorisation procedure for the EUGAL pipeline is on-going and expected to be finalised by the end of the third quarter in 2018. Commissioning is expected to take place in 2020;
- The TSO applied for an acceptance as "investment measure" but the NRA's decision is still pending. In coordination with the German NRA, a specific CBA was carried out which was positive. Part of this test was above all the investigation of the effects on the existing system charge. Within the framework of the German NDP, the needs-based nature of the specific project was also determined which makes the approval of the project very likely.

ZEELINK (aiming to increase security of supply for L-gas customers):

- ZEELINK contributes to the transition of the gas supply from L-gas to H-gas (see section 3.1.4 above). The project consists of (1.) a H-gas pipeline from Aachen-Lichtenbusch at the German border with Belgium to Sankt Hubert and Krefeld in the West of Germany (North Rhine-Westphalia) and (2.) compressor stations;
- The project belongs to ENTSO-G's ten year network development plan, where it is cited as project #no TRA-N-329, and to the national network development plan as measure #no 204-02a, 02b, 02c, 02d and #no 205-02a, 02b;

- The project is carried out by the gas TSOs OGE and Thyssengas who have applied for funding of ZEELINK as investment measure in accordance with section 23 ARegV;
- The authorisation procedure was started in September 2017 and is currently on-going. It is expected that ZEELINK can become operational in March 2021.

Gas terminal Lubmin II (aiming to increase security of supply, market integration and diversification of gas sources):

- With this project, the gas TSOs Fluxy D, GASCADE, GUD and ONTRAS construct a gas terminal for reception and transmission of gas delivered through the enhanced Nord Stream gas pipeline;
- The project has a capacity of 6.500.000 m3/h. The investment volume is EUR 207.8 million. It is planned to put the terminal into service in 2020. To finance the project, the TSOs Fluxy D, GASCADE and GUD have applied for and been granted investment measures according to section 23 ARegV;
- The project in contained in the national network development plan as measure #412-03.

Additionally, interviewees reported on the following successful and unsuccessful projects.

Mobile biogas compressor (application of an innovative solution)

Biogas is fed into the ONTRAS, one of the German gas TSOs, pipeline network at several points, ONTRAS operates the technical feed-in and gas processing plants (gas conditioning to ensure that the minimum calorific value in the network is not fallen short of). Also, requirements for the connection of biogas plants exist (maximum duration of a connection must not exceed 24 months), but these requirements are no longer seen as an obstacle due to the project routine achieved in the meantime. Further, the TSO must guarantee an availability of the connection of 96%. In case of failures or maintenance, it is possible to use mobile compressors units to maintain upstreaming. These mobile compressor units are a tailor-made special development for the use in various biogas plants.

Costs are refinanced via the biogas levy. For this the annual filling of a survey form with CAPEX and OPEX is necessary. The biogas levy is not part of the "regular" incentive regulation but the handling of biogas feed-in and the levying of costs is legally anchored. There is no ex-ante cost recognition mechanism, but via the biogas levy biogas costs are allocated annually including a planned/actual comparison (independent of the regulatory period). The recognition of costs is based on the legal requirements and has so far run smoothly.

Self-supply of compressor station with CHP unit (application of an innovative solution)

Emergency power and heat supply for a compressor station is provided by a CHP unit. In normal operation, heating water for the fuel gas preheating of the gas turbines and the building heating is heated via an exhaust gas heat exchanger. Electrical energy for own consumption is supplied by the CHP unit, excess electrical energy is fed into the public grid. If the public power supply fails, the CHP unit supplies the compressor station with electrical energy without interruption.

Such electricity surpluses are problematic from a regulatory point of view due to unbundling restrictions. Regulatory, the fact that electricity is fed into the grid, regardless of the price, is already decisive in order to violate unbundling rules. Therefore, the operation of a CHP unit for self-supply and resilience purposes was not accepted by the NRA. So, the project was cancelled after a technically successful testing phase. In the interviewees eyes, less strict interpretation of unbundling specifications would be helpful to avoid using less efficient solutions. It should also be possible to recognise economically efficient CO2 avoidance costs.

Sector coupling by means of PtG (application of an innovative solution)

An electricity network operator has suggested to the gas TSO to build a PtG plant for grid security reasons and to reduce the need for expansion of the electricity grid. The gas TSO said to be generally open to the idea, but the project was not pursued beyond design phase, as unbundling problems are feared when network operators want to operate an energy conversion plant. Finally, no application for recognition was made as the regulator had previously found incompatibility with unbundling rules. An independent third party would therefore have to operate the plant. But as levies, duties and taxes are levied on the electricity or gas used or produced, since converted gas is assessed as final consumption (from the electricity point of

view), which makes such projects often ultimately uneconomical and thus unattractive for third parties at present.

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. In particular a special regulatory instrument ("investment measures") for is focussed on sustaining the functionality of the gas system. As the above also shows, the NRA apply a "top down" approach for the investment approval, not looking deeply into individual projects and approving projects by their necessity rather than their cost.

Only a CAPEX bias could inhibit projects with high OPEX share, which might disincentivize TSOs to invest e.g. in innovative IT solutions, measurement systems etc. Another concern related to the sentiment that projects having wider societal benefits or benefits in other sectors (e.g. electricity) are not incentivized. Also, it could be considered refining the NRF in the future to take into account new developments or technologies enhancing the energy transition such as sector coupling, power to gas and storage.

(i) Favouring of OPEX-based solutions

Generally, the NRF is considered adequate in supporting investments in security of supply and some kinds of innovative technologies. Currently, there are no indications that the implementation practices provide inadequate incentives to ensure security of supply. Also, a number of innovative technologies are being frequently used in recent projects. Respondents point out there might be a bias towards CAPEX-solutions. If this bias develops a significant distortion for the choice of solutions that becomes economically relevant, specific incentives could be introduced for these kinds of OPEX-based solutions, which have been identified as advantageous or necessary. Yet, the introduction of such incentives bears the risks of introducing new distortions.

(ii) Statutory obligation to consider alternatives

A more general approach to foster OPEX-based solutions in the long-term, i.e. beyond a single regulatory period, would be the introduction of an obligation to consider OPEX-related innovative options in the network development plan. The TSOs would then have to provide OPEX-based options as alternatives to CAPEX-based projects outlined in the network development plan. This approach necessitates that a framework is developed determining when OPEX-based solutions should be favoured over CAPEX-based solutions. This approach should be coupled with monetary incentives (like option (i)) for the TSOs to invest in OPEX solutions to counteract the CAPEX bias.

(iii) Statutory reference to innovation

There are only limited explicit statutory powers or duties aiming at encouraging innovation. To ensure that innovative projects are still encouraged and supported in the next regulatory period, an extended statutory reference to innovation could be included into the regulatory framework. This long-term strategic perspective could be shaped by governmental policies, statutory duties or could be included in the network development plan.

(iv) Consultation on investment plans (extension of existing consultation)

Both on the national net development plan and on project level of investments in general (also outside the national net development plan), additional stakeholder consultations could increase the likelihood that the output will ultimately be beneficial to the consumers, thereby moving towards a more output-focussed regulation. Additional stakeholder consultation can also be used to increase public acceptance by explaining which alternatives had been considered and why a certain solutions had been preferred, to determine OPEX solutions to be favoured from option (ii) and help shaping the long-term perspective on innovation of option (iii). Yet, the organisation of stakeholder consultations has disadvantages, such as the additional organisational burden on the party organising the consultation (the TSOs or NRA) and a potential delay in implementing an investment project, even though consultations for certain types of infrastructure projects as well as parts of the planning processes already exist. Hence, one needs to think carefully how often and for which purposes one wants to additionally consult stakeholders.

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 the following, 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) (statutory obligation to consider alternatives), we understand that the legal mechanism for implementing this option would involve the modification of the EnWG through the German legislative process[5].

Turning to option (iii) (statutory reference to innovation), we expect that this could be implemented by including such an obligation in the EnWG through the German legislative process.

As regards option (iv) (additional consultation on investment plans and projects), the suggestion of incorporating a mandatory requirement in legislation for the TSO to explain in more detail what alternatives have been looked at when developing the network development plan or the project, could be implemented by including such an obligation into the EnWG, the ROG and the VwVfG through the German legislative process.

3.3.3. Impact assessment

Option (i) is not easy to be implemented well-balanced. The option has the risk to turn out to be a technology-specific incentive that does not necessarily lead to efficient decisions and may even encourage abuse. Also, innovative and socially beneficial OPEX solutions to be favoured by the regulation need to be defined. Such projects would need to be redefined for each regulatory period, possibly in cooperation with the TSO and maybe including a stakeholder consultation in order to ensure technology neutrality. Therefore, depending on the specific implementation the effort for the NRA and the TSOs can be high. Additionally, adequate incentives for efficiency must be set to avoid abuse.

The long-term strategic perspective on innovation mentioned in option (iii) necessitates efforts and coordination between the TSOs and the NRA regarding the design of this long-term perspective (e.g. the organisation of stakeholder consultations, determining the scope of the innovation needed, monitoring and evaluating of how the statutory duty is translated into the long-term perspective).

As mentioned in option (iv) and the other options above, stakeholder consultations can contribute to moving to a more output-focussed regulation. Yet, too many consultations will increase the organisational burden of the TSOs and/or the NRA and possibly reduce the willingness of stakeholders to participate in the consultation. Moreover, consultations possibly lead to time lags. Therefore, consultations as instrument need to be used wisely.

Except for those projects encountering unbundling issues that cannot solely be solved by changes in the NRFs, 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 changes will result in considerable changes to investment levels. Yet, if the perceived risk of innovative projects is lowered and a long-term strategic perspective on innovation could be attained, the share of innovative projects is expected to increase. Options (iv) is expected to have a similar effect. Moreover, if implemented well, option (i) could result in a shift from primarily CAPEX investments to more OPEX investments.

[5] For further details, see footnote 2.

ANNEX I: TYPOLOGICAL INVESTMENTS – ELECTRICITY

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

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

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

ANNEX II: TYPOLOGICAL INVESTMENTS – GAS

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

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

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

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

ANNEX III: POTENTIAL REGULATORY BARRIERS FOR PROJECTS

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

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

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