entsog
european network
of transmission system operators
for gas

TEN-YEAR NETWORK
DEVELOPMENT PLAN 2017

TYNDP 2017

EXECUTIVE SUMMARY

ENTSOG – A FAIR PARTNER TO ALL!

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1 Introduction

Over the coming years, the world and European energy sectors will undergo significant changes in order to ensure the energy transition. Europe has already set ambitious targets for 2030. This fifth edition of ENTSOG TYNDP includes three scenarios that follow different possible paths to achieve these targets and assesses the situation of the gas infrastructure for those different paths.

More change is to come following the Paris COP21 and its commitment to achieve a 80 to 95 % net GHG reduction by 2050.

The European gas infrastructure has seen decades of investment and development. It offers vast energy storage potential and an efficient solution for long distance energy transmission. In most parts of Europe it is well connected and ensures efficient access to LNG.

The European gas infrastructure has a key role to play in achieving the European energy and climate ambitions. Coupling it with the power, heat and mobility infrastructure will enable the decarbonisation of the European energy system in a cost effective and achievable way.

The TYNDP assessment confirms that the current gas infrastructure is close to achieving its contribution to the internal energy market. Some specific areas still show investment needs, in terms of better interconnections and connection to new supplies. The projects addressing these needs are part of TYNDP. Most of them are already at an advanced stage of development or are part of the 2nd PCI list, and are planned to be commissioned in the coming years. By opening the access to diversified supply sources, these projects will ensure security of supply and allow for improved competition. Full-scale implementation of the Third Package will be a pre-requisite for the benefits of these projects to fully materialise. Aside from a limited number of large-scale import projects, the projects needed to fully integrate the European gas infrastructure represent around 20 bn€.

2 An ever-improving TYNDP process

The TYNDP is developed for a wide range of stakeholders. For this reason, the dialogue, transparent information and engagement with all kinds of stakeholders is a fundamental element of developing the TYNDP.

2.1 AN INCLUSIVE PROCESS

The TYNDP is developed for a wide range of stakeholders. For this reason, the dialogue, transparent information and engagement with all kinds of stakeholders is a fundamental element of developing the TYNDP.

For TYNDP 2017, ENTSOG kicked-off the stakeholder engagement process with a workshop held on 12 January 2016, following the initial provision of material towards the end of November 2015. As part of this workshop, the European Commission and Agency for the Cooperation of Energy Regulators (ACER) provided their feedback on TYNDP 2015 along with their recommendations for TYNDP 2017, and ENTSOG presented the foreseen directions for improvement in TYNDP 2017.

From January to March, ENTSOG organised five full-day Stakeholder Joint Working Sessions (SJWS) to inform and get feedback from stakeholders on all building blocks of TYNDP: projects collection process, consideration of projects in the assessment, scenario storylines, supply potentials, modelling and outputs. In particular, to address stakeholder expectations on increased consistency between gas and electricity TYNDPs, ENTSOG endeavoured to align the power sector element of the scenario storylines with the Visions developed for electricity TYNDP 2016 by ENTSO-E, who were invited to present them in the first SJWS. These events were organised in close cooperation with the European Commission and ACER.

ENTSOG has built on the feedback collected in these SJWS to refine the TYNDP concept. In the concluding workshop organised in early May, ENTSOG presented this final concept as well as how the stakeholder feedback had been taken into account.

To facilitate participation, and allow it to be as wide as possible, ENTSOG announced the dates of all SJWS in December 2015 and invited all interested stakeholders to contribute: project promoters, NRAs and Member States representatives as well as associations and NGOs. Additionally, the supporting material was published ahead of the SJWS and minutes were made available afterwards. Finally, to encourage the participation of stakeholders from different parts of Europe, ENTSOG organised a SJWS and the concluding workshop in Vienna and Ljubljana respectively.

The stakeholder engagement process has proved to be efficient and valuable as on average 40 people have participated to the SJWS and workshops, with a number of elements that have been improved based on stakeholder feedback. This has included collecting TSO assumptions for the demand data provided along the different scenarios, adopting a "tomorrow as today" approach for supply flexibility in 2017 and improving the modelling of LNG terminals.

2.2 A THOROUGH INVOLVEMENT OF PROJECT PROMOTERS

One of the specific TYNDP tasks is to identify the investment gaps, where missing infrastructure prevents achieving the pillars of the internal energy market: sustainability, security of supply, competition and market integration. This constitutes a key element of the PCI selection process.

Subsequently, the projects submitted to the TYNDP are jointly assessed at energy system wide level to identify how they contribute to mitigating the investment gaps. To ensure a European-wide perspective, it is therefore fundamental that all relevant projects, promoted both by TSOs and third-party promoters, are submitted as part of the TYNDP project collection. For those projects in particular wishing to take part in the PCI selection process, submission to TYNDP is a pre-requisite under Regulation (EU) 347/2013.

To ensure the collection of proper and accurate information of all concerned promoters, ENTSOG provided information in the first SJWS in January 2016 about the dates of the project collection (11 April – 8 May) and related processes. The project collection topic was covered on several other occasions as part of the SJWS process.

To facilitate the submission of projects by promoters ENTSOG has further improved and developed its online Project Data Portal. This included new functionalities for promoters to monitor their submission and check the overall project submission situation on interconnection points, for both sides of the interconnection. ENTSOG has provided promoters with a project submission **Documentation Kit**, describing in detail the process and **Portal functionalities**.

In addition, ENTSOG published several Press Releases related to the project collection. The first[1)], released one month prior to the project collection starting date, announced the project collection and publication of the Documentation Kit. Two additional ones were released[2)] as reminders during the project collection phase.

ENTSOG organised a Webinar[3)] dedicated to promoters shortly before the opening of the project collection period and has been available throughout the whole collection period to answer questions from promoters at short-notice.

The timing of the project collection ensures that the TYNDP assessment is performed with as up-to-date information on projects as possible.

1) http://www.entsog.eu/public/uploads/files/publications/Press%20Releases/2016/PR0102_160318_Press%20Release%20ENTSOG%20starts%20Data%20Collection%20for%20TYNDP17.pdf

2) Respectively 10 days after the starting date and shortly before the closing date:

http://www.entsog.eu/public/uploads/files/publications/Press%20Releases/2016/PR0104_160421_Press%20Release%20ENTSOG%20reminds%20about%20Data%20Collection%20for%20TYNDP17.pdf

http://www.entsog.eu/public/uploads/files/publications/Press%20Releases/2016/PR0106_160503_Press%20Release%20ENTSOG%20reminder%20Only%20few%20days%20left%20for%20TYNDP%202017%20project%20submission.pdf

3) http://www.entsog.eu/events/webinar-on-project-data-collection-for-tyndp-2017#welcome

2.3 A HIGHLY TRANSPARENT TYNDP

ENTSOG has always considered transparency as a vital element for developing the TYNDP. For this edition, ENTSOG further increased its commitment to transparency by releasing additional information at an early stage of the development process.

In its Opinion on TYNDP 2015, ACER recommended that ENTSOG should publish the TYNDP as a draft version for public consultation and submission to ACER, and should release a final version considering the consultation outcome and ACER Opinion. ENTSOG subscribes to the principle of the ACER recommendation. Yet ENTSOG, the Commission and ACER shared the view that in order to contribute to the 3rd PCI selection, the TYNDP 2017 assessement had to be finalised and released by December 2016. The starting date of the TYNDP development process was at the end of 2015, shortly after reception of the ACER Opinion on TYNDP 2015. This, together with the necessary time to develop TYNDP, made it impossible to deliver a draft version of TYNDP for consultation and submission to ACER in Summer 2016.

Subsequently, the steps taken by ENTSOG in terms of early and increased transparency as described below have been proposed to ACER as a valuable solution, as it provided the ability to ACER, NRAs as well as other stakeholders to react at an early stage of the process. ENTSOG considers allowing such early reaction as an effective complement to receiving stakeholders and ACER Opinion at the end of the process.

In July, **immediately after the collection and validation of the TYNDP input data was finalised, ENTSOG organised a workshop**[1)] **to present stakeholders with the overview on the related information:** scenarios, indigenous production and projects submitted to TYNDP. At the same point in time, ENTSOG made this data available on its website. This data is used for developing both this TYNDP edition and the Gas Regional Investment Plans.

To support the 3rd PCI process in the most timely and efficient way, ENTSOG endeavoured to share the preliminary TYNDP results supporting the PCI process first phase in October 2016 with promoters and the Regional Groups, consisting of the identification of the regional infrastructure needs, well ahead of the TYNDP publication. Mid-October, ENTSOG organised a webinar[2)] dedicated to promoters which was attended by more than 45 participants to present those results and receive promoters feedback. Further on, ENTSOG presented the regional infrastructure gaps in the Regional Group meetings[3)] that took place between end of October and early November 2016.

Finally, at the end of October ENTSOG published on its website[4)] a map displaying the projects submitted to the TYNDP. This map displays the advancement status and labels which of these projects were part of the 2nd PCI list. This is the first time ENTSOG has produced a TYNDP Map.

1) http://www.entsog.eu/events/6th-stakeholder-joint-working-session-sjws6-on-tyndp-2017#welcome

2) http://www.entsog.eu/events/tyndp-2017-webinar-on-preliminary-tyndp-low-infrastructure-level-results#welcome

3) The Regional Groups are chaired by the European Commission and composed of representatives of the Member States, ACER, NRAs and promoters. Their task is to review the projects candidated to the PCI label in view of establishing the PCI list. Selection of projects is left to the decisional-making body of the Regional Groups, composed of the European Commission and Member States.

4) http://www.entsog.eu/public/uploads/files/publications/Press%20Releases/2016/PR0119%20161028_Explore%20the%20map%20of%20the%20TYNDP%202017-projects%20and%20learn%20more%20about%20the%20related%20scenarios.pdf

Table 2.1 below provides the overview of the interaction with stakeholders for TYNDP 2017.

The high level of transparency has encouraged further stakeholder involvement. Publication of the TYNDP demand and project data in July 2016 has allowed concerned stakeholders to review this data and start making use of it. Presentation of the TYNDP infrastructure needs assessment ahead of the report publication has supported the Regional Groups members – Members States, NRAs and project promoters – to get prepared for the PCI selection process.

OVERVIEW OF THE INTERACTION WITH STAKEHOLDERS FOR TYNDP 2017

Date	Interaction	Concerned stakeholders	Information shared *Where*
12 January 2016	TYNDP 2017 kick-off workshop	Open public (EC, ACER, NRAs, gas industry, promoters, NGOs …)	TYNDP pre-concept *ENTSOG website*
13 January 2016	SJWS#1	Open public	Scenario storylines and Project collection *ENTSOG website*
26 January 2016	SJWS#2	Open public	Modelling and Supplies *ENTSOG website*
9 February 2016	SJWS#3	Open public	Projects and Supplies *ENTSOG website*
23 February 2016	SJWS#4	Open public	Prices and TYNDP assessment frame *ENTSOG website*
10 March 2016	SJWS#5	Open public	Wrap-up *ENTSOG website*
18 March 2016	Press Release	Project promoters	Annoucement of project collection phase and publication of Documentation Kit *ENTSOG website*
4 April 2016	Webinar	Project promoters	Information on project collection
21 April 2016	Press Release	Project promoters	Reminder on project collection phase
3 May 2016	Press Release	Project promoters	Last reminder on project collection phase
11 May 2016	TYNDP workshop	Open public	TYNDP final concept *ENTSOG website*
13 July 2016	Early transparency workshop	Open public	TYNDP input data *ENTSOG website*
18 October 2016	Webinar	Project promoters	Preliminary TYNDP results *ENTSOG website*
28 October 2016	Press Release	Open public	Publication of TYNDP project map *ENTSOG website*
26 October – 8 November 2016	Presentation to Regional Groups	Regional Groups	TYNDP analysis of investment needs *EC CIRCABC website*

Table 2.1: Overview of the interaction with stakeholders for TYNDP 2017

2.4 AN IMPROVED ANALYSIS

ENTSOG developed TYNDP 2017 based on the Energy System Wide Cost-Benefit Analysis Methodology[1] (CBA Methodology) currently in force, approved by the European Commission in February 2015. Building on the experience of TYNDP 2015, as well as on stakeholder feedback, ACER Opinion and 2nd PCI selection process, ENTSOG has made improvements to the TYNDP.

To provide a clear picture of the investment gaps, the analysis is handled in a dedicated part of the Assessment chapter. The different indicators are structured using the categories of security of supply, market integration, competition and sustainability criteria stemming from Regulation (EU) No 347/2013. The European-wide assessment, together with the country-level granularity of the results, provide a clear view of the countries lagging behind these criteria and of the infrastructure limitations.

The energy system wide assessment has been improved by using a better reflection of the level of advancement of projects. More information has been collected on projects, regarding their detailed scheduling, if they have experienced delays since the previous TYNDP edition and if they are part of the national development plan.

Additionally, in close cooperation with ACER, ENTSOG has defined an additional advancement status for projects. Projects are now categorised as one of the following 3 statuses: FID (having taken their final investment decision), advanced non-FID or less advanced non-FID. The TYNDP subsequently assesses different levels of development of the gas infrastructure – Low, Advanced and High - corresponding to these 3 statuses, as well as an additional level as a feedback loop on the last PCI selection.

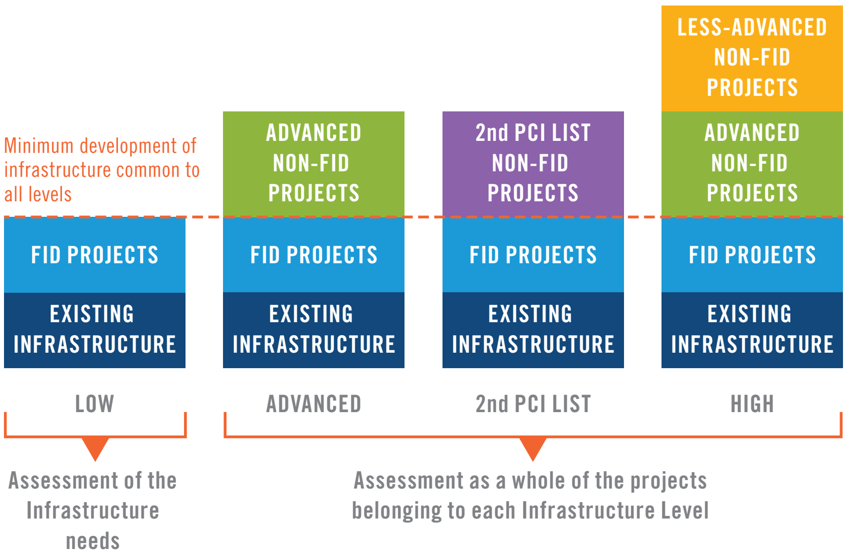

Figure 2.1: Infrastructure Levels

The Low infrastructure level, which considers only existing infrastructure and FID projects, is the basis for the assessment of the additional infrastructure needs.

The Advanced infrastructure level introduced in this TYNDP edition considers existing infrastructure, FID and advanced projects[2]. This represents a realistic development of the infrastructure, therefore providing a meaningful basis for the energy system-wide assessment of the concerned projects. This will also provide useful

1) http://www.entsog.eu/public/uploads/files/publications/CBA/2015/INV0175-150213_Adapted_ESW-CBA_Methodology.pdf

2) The advanced status, defined in coordination with ACER, covers the non-FID projects having already initiated either their front-end engineering or permitting phase and planned to be commissioned by 2022.

information for the assessment of specific projects as part of the 3rd PCI selection process.

A specific infrastructure level includes all projects listed on the 2nd PCI list as a feedback loop.

The High infrastructure level represents a very high number of projects, which includes a number of competing initiatives, as well as projects at a very early stage. Further studies or the realisation of other initiatives will determine the future viability of these projects. This infrastructure level should not be understood as a realistic gas infrastructure development objective and has demonstrated limited added-value in the TYNDP 2015 and 2nd PCI list processes. ENTSOG decided to maintain this infrastructure level in line with the CBA methodology in force, but will provide the results only in Annex E and not as part of the main TYNDP report.

ENTSOG has further improved the TYNDP energy system wide CBA, by collecting project costs from promoters[1)] and reflecting them per infrastructure level, and by proposing further monetisation of benefits in terms of competition and security of supply risk mitigation.

Finally, in accordance with the Interoperability Network Code[2)], this TYNDP edition incorporates for the **first time a regional-level long-term gas quality monitoring outlook, based on TYNDP results.**

1) These costs are collected for use in TYNDP 2017

2) COMMISSION REGULATION (EU) 2015/703 of 30 April 2015 establishing a network code on interoperability and data exchange rules http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R0703

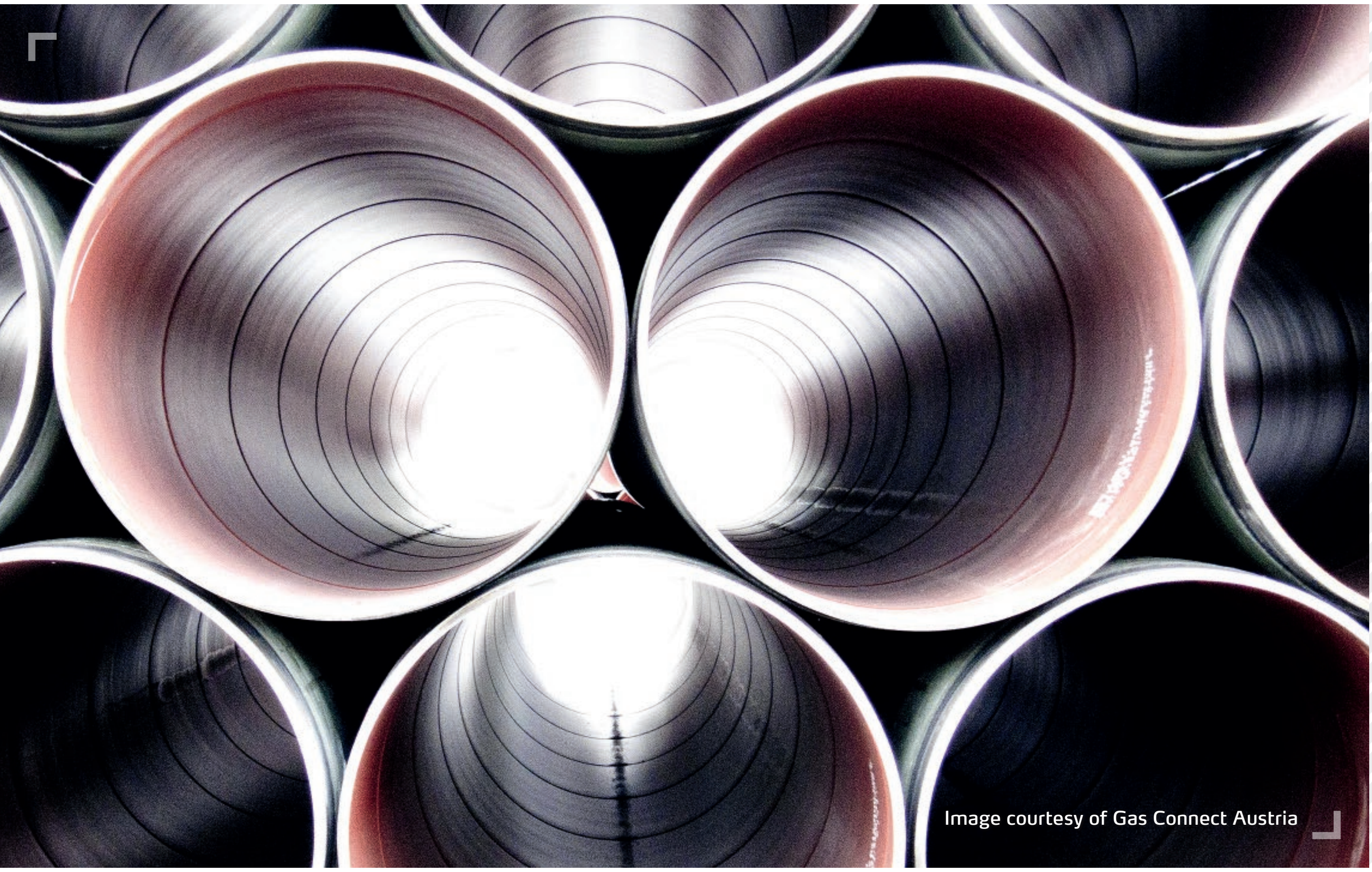

Image courtesy of Gas Connect Austria

3 The future role of gas: several paths to achieving the EU targets

TYNDP looks twenty years ahead. Performing the TYNDP assessment in a meaningful way requires the definition of scenarios that cover the reasonable scope of the gas and energy sector evolution. This requires an open-minded approach to the significant changes that the European energy sector will undergo in the coming decades to ensure the energy transition, taking into consideration the ambitious European climate and energy targets set for 2030 and beyond.

For this fifth edition of TYNDP ENTSOG developed four demand scenarios, among which three achieve the EU 2030 energy and climate targets, taking differentiated paths towards these targets. To ensure a meaningful TYNDP, it is fundamental that the assessment of infrastructure needs and of projects is handled for all three of the on-target scenarios. The demand level for the off-target scenario falls within the range of the other scenarios and has not been covered in the assessment.

To develop the scenarios, ENTSOG first elaborated storylines based on a number of parameters, ranging from general parameters such as economic conditions and achievement of the EU climate targets, to more specific factors influencing the role of gas in the heating, power and transport sectors.

Regarding the power sector, ENTSOG has strived to align as much as possible the scenarios with the Visions developed by ENTSO-E for the electricity TYNDP 2016. For each scenario, based on the Vision best matching in terms of storyline, ENTSOG used the electricity demand, generation capacities and generation mix from the ENTSO-E TYNDP scenario development process, as a basis for the annual gas demand in the power sector. This alignment further allows the TYNDP 2017 scenarios to reflect an overall view of the power sector, not only on gas-fired, but also on coal-fired and renewable generation. For their respective TYNDPs 2018, ENTSOG and ENTSO-E have committed to align even further. The related scenario development process, which has been launched in Spring 2016, will be fully common, in accordance with the consistent and interlinked model the ENTSOs have to deliver under Art. 11(8) of Regulation (EU) No. 347/2013.

Scenarios cover both the annual and peak demand perspectives. Indeed the national standards, set in regard to the peak demand which has to be secured, impose that gas operators design their infrastructure accordingly. Gas demand is highly temperature dependent, the massive development of generation from intermittent renewables will add even more volatility to the gas demand in the future.

TYNDP 2017 DEMAND SCENARIO PARAMETERS

TYNDP 2017 SCENARIOS	SLOW PROGRESSION	BLUE TRANSITION	GREEN EVOLUTION	EU GREEN REVOLUTION
ENERGY POLICIES / REGULATION	2030/2050 targets not realistically reachable	On track with 2030/2050 targets	On track with 2030/2050 targets	On track with 2030/2050 targets, potential to achieve early
ECONOMIC CONDITIONS	Limited growth	Moderate growth	Strong growth	Strong growth
GREEN AMBITIONS	Lowest	Moderate	High	Highest
CO_2 PRICE	Lowest CO_2 price (limited spread of carbon taxes)	Moderate CO_2 price (carbon taxes mainly spread)	Highest CO_2 price (carbon taxes well spread)	Highest CO_2 price (carbon taxes well spread)
FUEL PRICES	Highest fuel prices [expected gas price > coal price]	Moderate fuel prices [expected gas price > coal price]	Lowest fuel prices [expected gas price > coal price]	Lowest fuel prices [expected gas price > coal price]
INTERNAL ENERGY MARKET	Well-functioning, low MS cooperation	Well-functioning, moderate MS cooperation	Well-functioning, strong MS cooperation	Well-functioning, strongest MS cooperation
RENEWABLES DEVELOPMENT	Lowest	Moderate	High	Highest
HEATING SECTOR				
ENERGY EFFICIENCY	Slowest improvement	Moderate improvement	Fastest improvement	Fastest improvement
COMPETITION WITH ELECTRICITY	Limited gas displacement (new buildings)	Limited gas displacement (new buildings)	Some gas displaced (district heating, heat pumps)	Some gas displaced (district heating, heat pumps)
ELECTRIFICATION OF HEATING	Lowest	Moderate	High	Highest
POWER SECTOR				
GAS VS COAL	Coal before Gas	Gas before Coal (on regulatory basis)	Gas before Coal (on regulatory basis)	Gas before Coal (on regulatory basis)
TRANSPORT SECTOR				
Gas in transport	Lowest penetration	Highest penetration	Moderate penetration	Moderate penetration
Electricity in transport	Lowest penetration	Moderate penetration	Highest penetration	Highest penetration
EXPECTATIONS REGARDING EU OVERALL GAS DEMAND	EXPECTED TO REMAIN STABLE	EXPECTED TO INCREASE	EXPECTED TO DECREASE	EXPECTED TO DECREASE FASTER AFTER 2020
RELATED ENTSO-E 2030 VISIONS	VISION 1	VISION 3	VISION 4	VISION 4

Table 3.1: Parameter table for the four TYNDP 2017 scenarios

Among the four scenarios, Slow Progression falls short of the European energy and climate targets, whilst the other three all meet these targets, following differentiated paths.

This behind targets scenario pictures a "tomorrow as today" situation, where limited economic growth would not allow the necessary financial support to achieve the EU climate targets. The energy efficiency gains fail to materialise due to the lack of support to the insulation of buildings and replacement of heating devices. In the power sector, low financial support slows the development of renewable generation, while CO_2 emissions are penalised by low CO_2 prices, which favours coal over gas in the generation mix. Finally, economic conditions prevent both electricity and gas from playing a significant role in the decarbonisation of the transport sector.

At the other extreme, the Green Evolution and EU Green Revolution scenarios do achieve the EU climate targets, while having as pre-requisite a strong economic growth which can support the high economic costs implied by these scenarios, the ambitious rate of buildings insulation, the high efficiency standard for new buildings, the electrification of the residential sectors and the penetration of expensive energy solutions such as heat pumps and energy from biomass. These are the pre-requisite for the energy efficiency gains considered in these scenarios. The industrial sector decarbonisation relies on energy from biomass and power to heat, as well as carbon capture and utilisation. In the transport sector, the number of electric cars grows at a high rate, whilst gas vehicles only show a moderate penetration. Strong economic growth enables the strong development of renewables. This results in a decrease of thermal generation, in particular of high-carbon coal generation. Whilst the Green Evolution scenario builds on already high national ambitions, the EU Green Revolution scenario works under the assumption of even higher European level ambitions, potentially allowing for an earlier achievement of the climate targets.

In between those extremes, the Blue Transition scenario pictures a cost effective achievement of the climate targets, taking advantage of the existing energy infrastructure and allowing its materialisation under a context of a realistic, moderate economic growth. The scenario gives a role to gas as a low-carbon substitute to high-carbon fuels. In the residential sector, energy efficiency progresses despite a limited financial support to insulation and device replacement. Existing buildings predominantly remain with their current proven technologies, turning to more efficient devices, such as gas condensing boilers, when contemplating replacement. Carbon-neutral buildings remain too expensive for the masses, but new buildings generally prefer district heating and heat pumps. In the power sector, the penetration of renewable generation achieves the RES target. The CO_2 emission reduction is further supported by European regulation paving the way to a successive closure of coal-fired power plants, in line with decisions taken in this direction in Great-Britain, and increasing use of gas-fired units, in particular as back-up for renewable generation intermittency. Financial support allows both compressed and liquefied natural gas to play an important role in the decarbonisation of the transport sector, for private and commercial car fleets as well as for maritime transport.

Scenarios also consider the role biomethane will take in the European supply mix. The volumes vary across scenarios in accordance with the economic growth and green ambitions considered. Production evolves from on average 2 bcma in 2017 up to 20 bcma in 2035 in the most ambitious case.

These scenarios show contrasted sectoral evolution over time. In the final sector (residential, commercial, industrial and transport), the gas demand evolutions reflect the targeted energy efficiency gains and the role of gas and electricity in heating and transport. The 2030 final demand ends up ranging from flat (Blue Transition) to a 15 % reduction (EU Green Revolution) compared to 2017. In the power sector, the evolutions reflect the role of gas in complementing renewable generation and displacing coal. The 2030 gas for power demand subsequently ranges from flat (Slow Progression) to a 50 % increase (Blue Transition) compared to 2017.

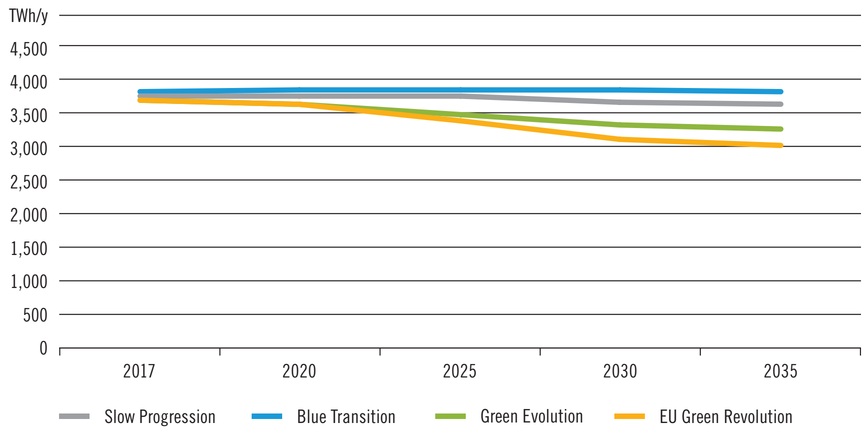

Figure 3.1: Final Gas Demand sector

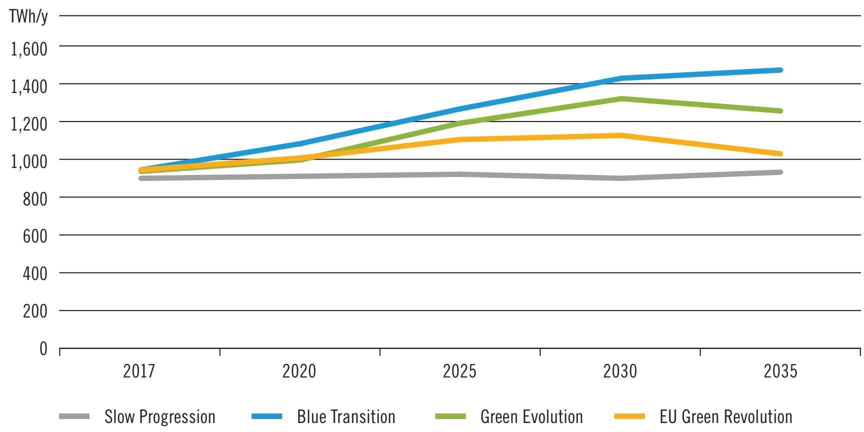

Figure 3.2: Gas Demand for power generation sector

Looking at the sectoral gas demand evolution across the scenarios demonstrates that differentiated paths exist in order to reach the climate targets.

Regarding the power sector, Blue Transition and the Green scenarios renewable generation is aligned with ENTSO-E Vision 3 and 4 respectively, which both achieve the RES targets.

When looking at the achievement of the emissions reduction or the energy efficiency targets from the gas sector perspective, gas being only one among several primary energy components, it is important to have in mind where the scenarios foresee gas displacing a more carbon-intensive primary energy. Depending on the scenario, the most substantial displacement is foreseen in the power sector, but this also occurs in the heating and transport sectors to varying degrees. The results shown in figures 3.3 and 3.4 only account for the role of gas in the power sector, not reflecting the extra gains in the other sectors.

Europe's non-binding 2030 targets aim at overall primary energy efficiency gains ranging from 27 % to 30 % compared to the baseline for 2030 defined in 2007. This can also be expressed as an overall gross inland energy consumption reduction between 18.5 % and 22 % when compared to the 2005 level. All scenarios are in-line with or exceed the energy efficiency targets. Coal displacement by gas in the power sector allows for extra gains, as gas-fired power plants have higher efficiencies than coal-fired plants.

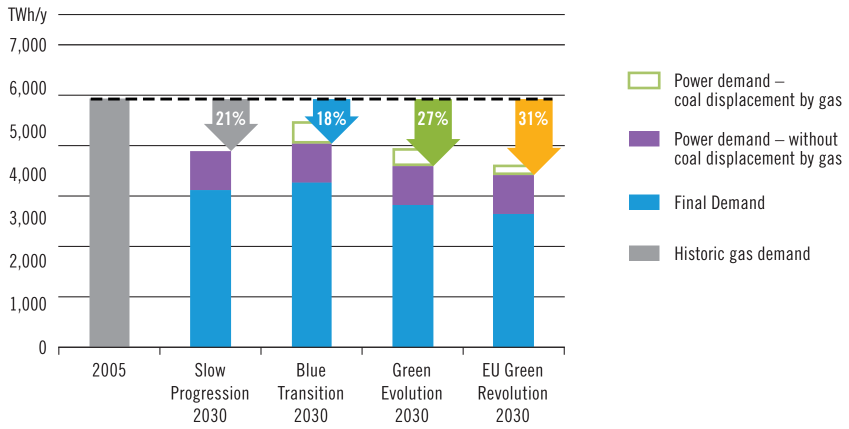

Figure 3.3: Energy efficiency gains by 2030

In terms of CO_2 emission reductions: **apart from Slow Progression, where the displacement of coal by gas does not materialise, all scenarios reach the objective of 40% reduction compared to the 1990 level. This is a result of the increasing role of renewable generation supported by low-carbon natural gas-fired generation as well as the energy efficiency gains.**

These results also reflect the foreseen increase of biomethane production in the European gas supply.

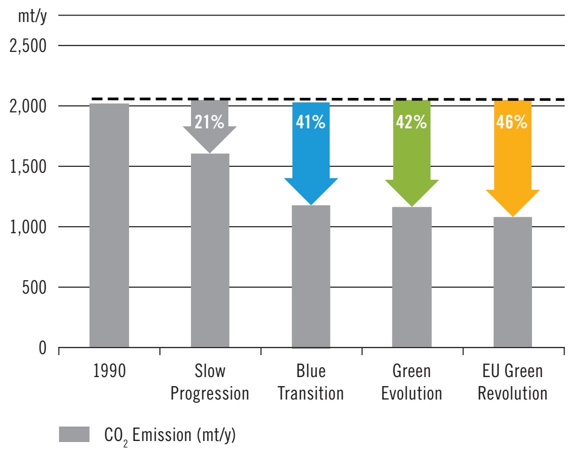

Figure 3.4: CO_2 emissions reduction by 2030 for the overall power and final gas demand sectors

The TYNDP demand scenarios indicate different possible paths for the overall gas demand, where achieving the European energy and climate 2030 targets could either be met with a continued decrease or a rebound of the demand. All four scenarios are analysed in detail in the Demand chapter. To ensure its meaningfulness, the TYNDP assessment is performed on the three on-target scenarios, covering a reasonable and possible range of future gas demand.

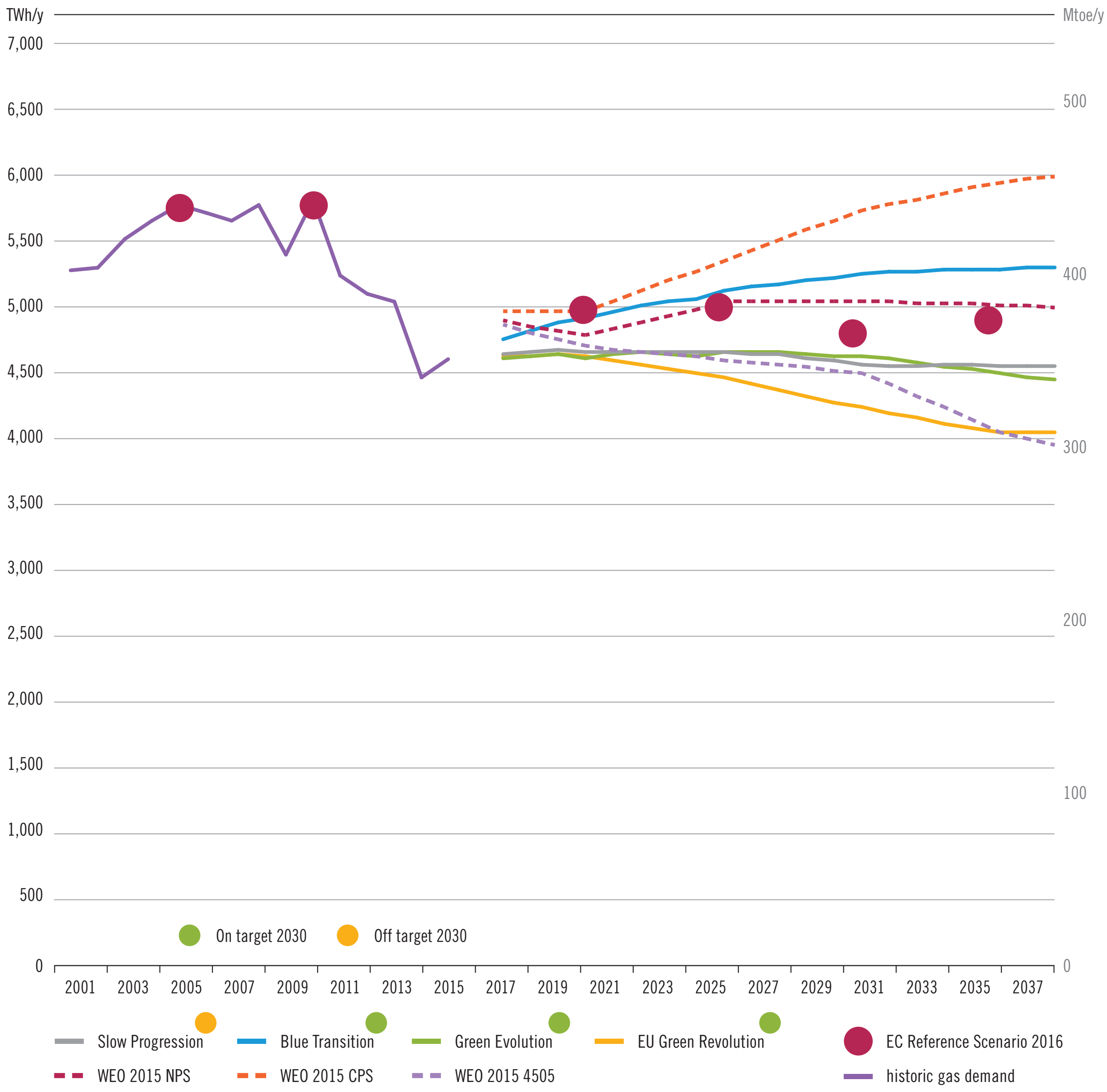

Figure 3.5: Comparison of TYNDP scenarios to European Commission Reference Scenario 2016 and IEA World Energy Outlook 2015 scenarios

The scenarios are comparable with those produced by the European Commission and International Energy Agency (IEA) World Energy Outlook (WEO) scenarios. The Green scenarios are closely aligned with the “World Energy Outlook 2015 450 ppm Scenario” which is the IEA scenario limiting the increase in the global average temperature to two degrees Celsius.

In the Blue Transition, the coal to gas switch helps to achieve the EU targets despite having similar gas demand levels as seen in the EC Reference 2016 and WEO CPS, which both fall slightly short of these targets. This provides evidence that gas energy and gas infrastructure can be an integral part of the energy transition and decarbonisation goals of Europe.

It will be the role of policy and decision makers to ensure that the retained path is the most cost-effective and makes the best possible use of the energy infrastructure already in place.

4 The future role of gas infrastructure

4.1 GAS INFRASTRUCTURE: ENABLER OF THE INTERNAL ENERGY MARKET

Since TYNDP 2015, progress has been made in terms of gas infrastructure projects enabling the EU to move towards the full achievement of the internal energy market with the implementation of 19 projects, among which 9 were listed on the 1st PCI list adopted in 2013.

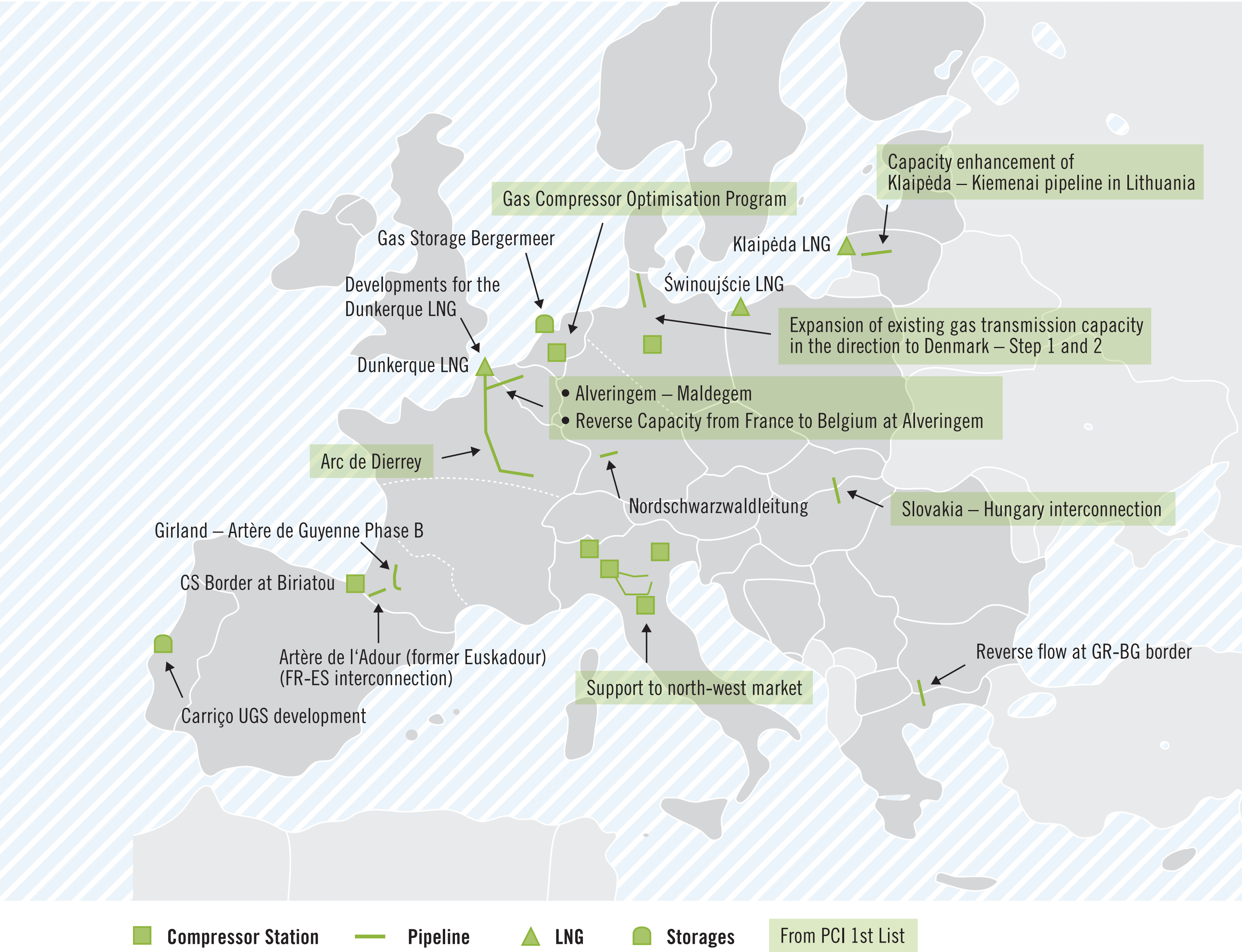

Figure 4.1: Map of commissioned projects between TYNDP 2015 and TYNDP 2017

The TYNDP assessment results show, by looking at the 2017 situation, that the current infrastructure already achieves many of the aims of the internal energy market except in some specific areas. To investigate the investment needs on the longer term, it looks at what the FID projects (representing 34 items, the majority of which are planned to be commissioned by 2020) will already allow to deliver in terms of security of supply, market integration and competition over the 20 next years, taking into consideration the evolution of the gas demand seen in the different scenarios.

It concludes that FID projects already significantly improve the current situation, in particular in the South-Eastern part of Europe, but that in other areas addressing the infrastructure needs will require additional projects.

Supply Adequacy is not at stake, maintaining its diversification is the challenge

Over the coming years, European indigenous natural gas production is set to decline in a number of countries, in particular in the Netherlands where the depletion of the Groningen field is under close monitoring by the authorities.

In a context where achieving the EU climate targets could result from either an increase or decrease of gas demand by 2030, this implies that European supply needs are foreseen to increase or at best stay stable.

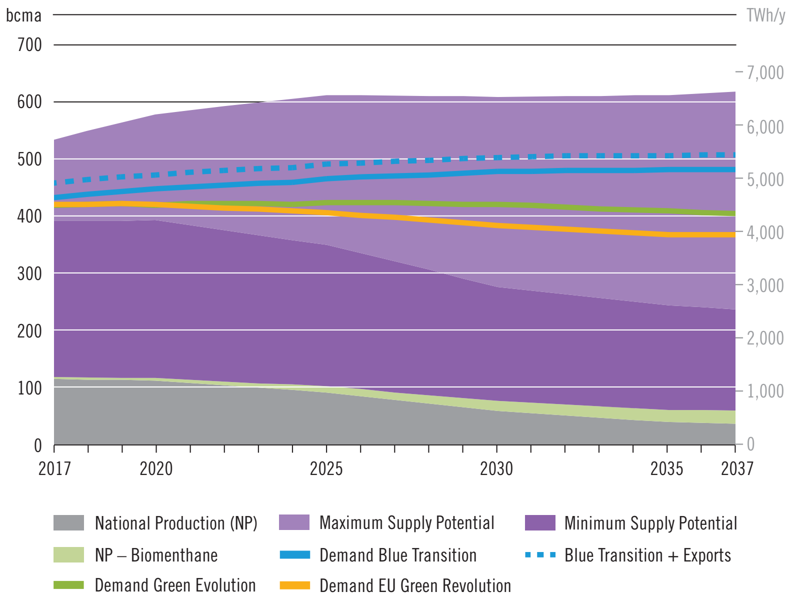

Figure 4.2: Supply Adequacy Outlook

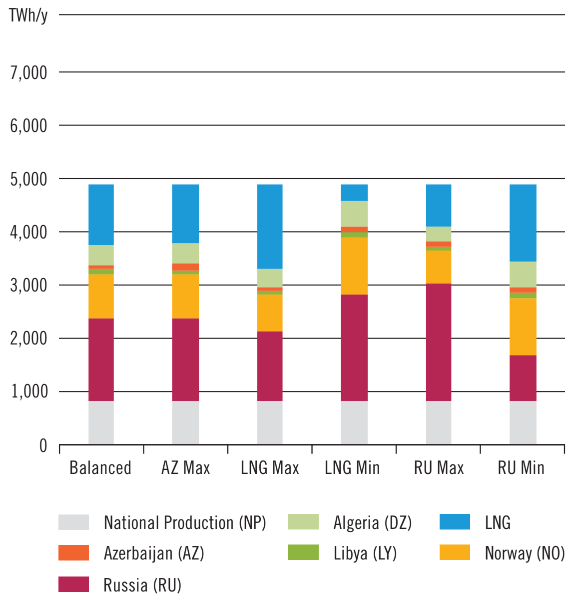

Figure 4.3: Green Evolution: Sources per supply mix – 2030

The TYNDP assessment shows that the supply-and-demand balance can be achieved at European level and that, from an infrastructure perspective, Europe can accommodate a wide spectrum of supply mixes.

The situation differs when considering areas (parts of Belgium, France and Germany) supplied with low calorific gas (L-gas). These areas face a declining production (Groningen and German L-gas fields) while L-gas cannot be directly substituted with high calorific gas (H-gas) at consumer level. For the concerned areas, this will require to start in parallel the connection of L-gas areas to the H-gas network and the conversion of consumers to H-gas. This specific situation, whilst not covered in detail in this TYNDP, is assessed in the North-West Gas Regional Investment Plan (NW GRIP) to be published shortly after this TYNDP.

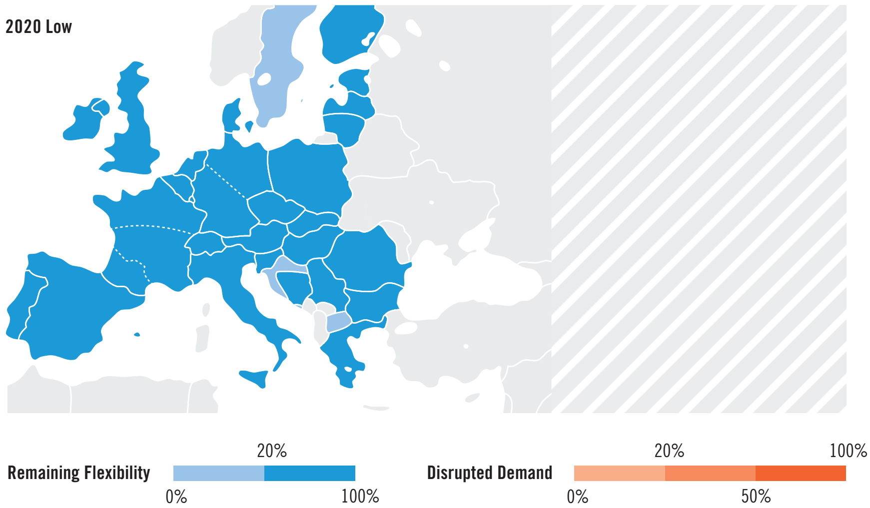

Figure 4.4: Remaining Flexibility and Disrupted Demand, Green Evolution, Low infrastructure level (existing infrastructure and FID projects), Design Case Peak Day

From a supply perspective, while Russian gas and LNG have the ability to address the increasing supply needs, maintaining supply diversification would require attracting new supplies. Uncertainty on the future of gas will make this challenging. Norway has the potential to deliver significant volumes (Barents Sea), but the investments that would connect this production with the existing European gas infrastructure are in competition with potential LNG developments that would allow access to the world market. Azeri, and more generally Caspian gas, would require a market signal strong enough to see supplies materialise in Europe at more significant levels.

In this context, it will be very important that additional European gas supply will get the necessary support. There are prospects for conventional gas production (Black Sea, Cyprus). For this TYNDP, TSOs have reported an increasing biomethane potential, from 2 bcma in 2017 up to possibly 20 bcma in 2035. But the potential for production of renewable gases has not yet been fully investigated and could be much wider. It can be additional biogas upgraded to biomethane to be injected into the gas grid. It can also be through power-to-gas units which convert excess renewable electricity generation to hydrogen or synthetic methane, by electrolysis and possible further methanation using CO_2. These green gases can then be used for green mobility (hydrogen fuel cell vehicles) or injected into the gas grid.

Green gases produced from power-to-gas have a key role to play in decarbonising the European economy in a cost-efficient way, as they represent a carbon-neutral primary energy source. These are also important elements of the physical coupling of the gas, power, heat and mobility infrastructure (sector coupling) with the aim of making the optimal use of their respective potentials, as they will allow cost-efficient long-haul transmission and storage of excess renewable energy using the existing gas infrastructure.

The TYNDP assessment confirms that the gas infrastructure is able to accommodate contrasted supply mixes on a European level on an annual basis. It also shows it is resilient to a peak demand situation, where all European countries would not only be able to face an EU-wide peak (including under the Blue Transition scenario demand) but most of these countries would still show a comfortable remaining flexibility under such an extreme situation.

4.2 SPECIFIC AREAS STILL IN NEED

The European gas infrastructure is able to ensure day-to-day supply-and-demand balance, even in the case of an extreme cold situation, for all assessed demand scenarios. Achieving the European energy and climate targets will generally not require any specific reinforcement of the gas infrastructure of cross-border relevance.

However, in some specific regions additional infrastructure would be needed to allow for sufficient supply diversification and alleviate excessive dependence to the main supply source, therefore improving competition and mitigating risks in the case of crisis situations.

Supply diversification: a corner stone of achieving the internal energy market

The TYNDP assesses the level of significant supply diversification that the European gas infrastructure would allow, if the markets were to function perfectly. Whilst the underlying assumptions tend to give an over-optimistic outcome, some specific areas clearly show lower ability to diversify supplies. In the long-term, the decline of indigenous production reduces the overall ability of Europe to diversify.

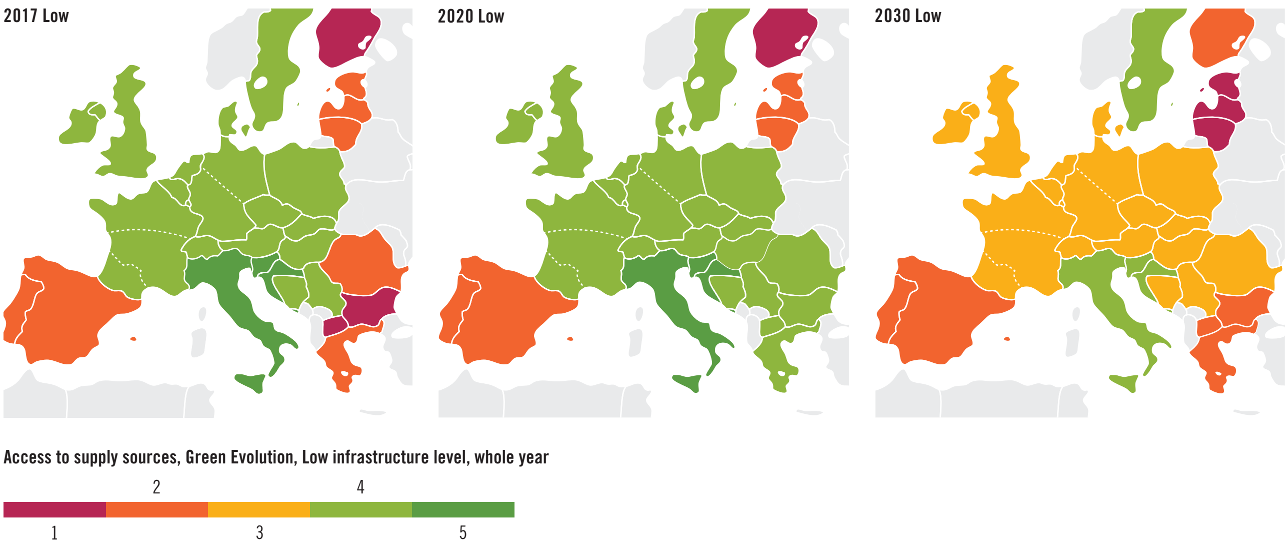

Figure 4.5: Level of supply diversification (expressed as number of supply sources to which countries can have significant commercial access), Green Evolution scenario, Low infrastructure level (existing infrastructure and FID projects) – Supply sources representing a limited share of the overall European supplies are not shown on the map.

This limited ability of specific areas to diversify is strongly related to their dependence to specific supply sources as displayed in Figure 4.6 and Figure 4.7.

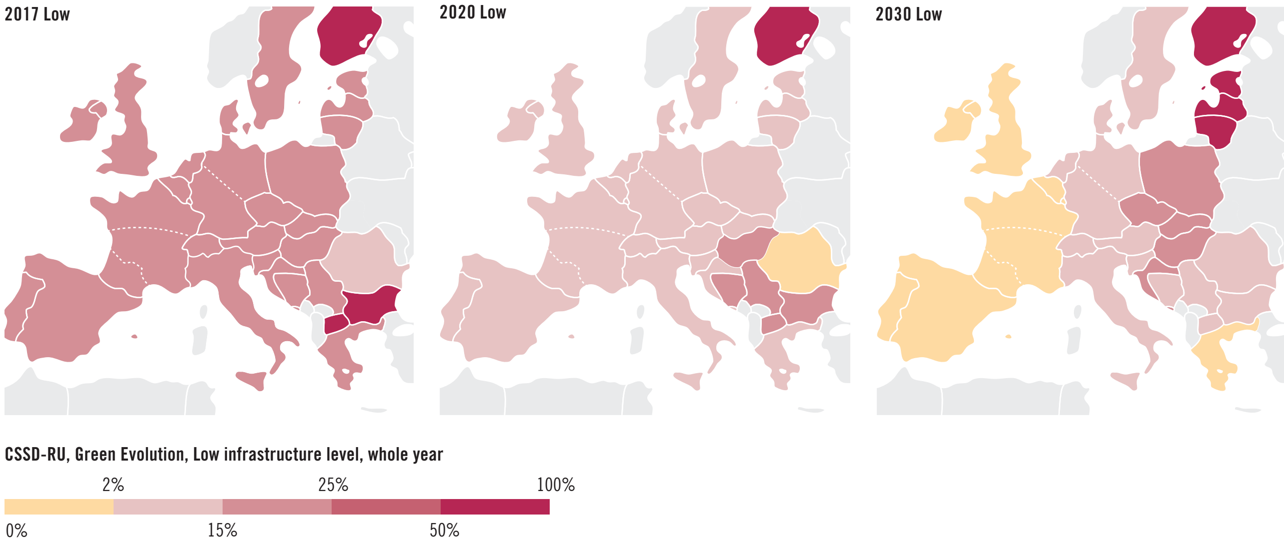

Figure 4.6: Dependence to Russian supply on annual basis under the Green Evolution scenario (cooperative behaviour), Low infrastructure level (existing infrastructure and FID projects)

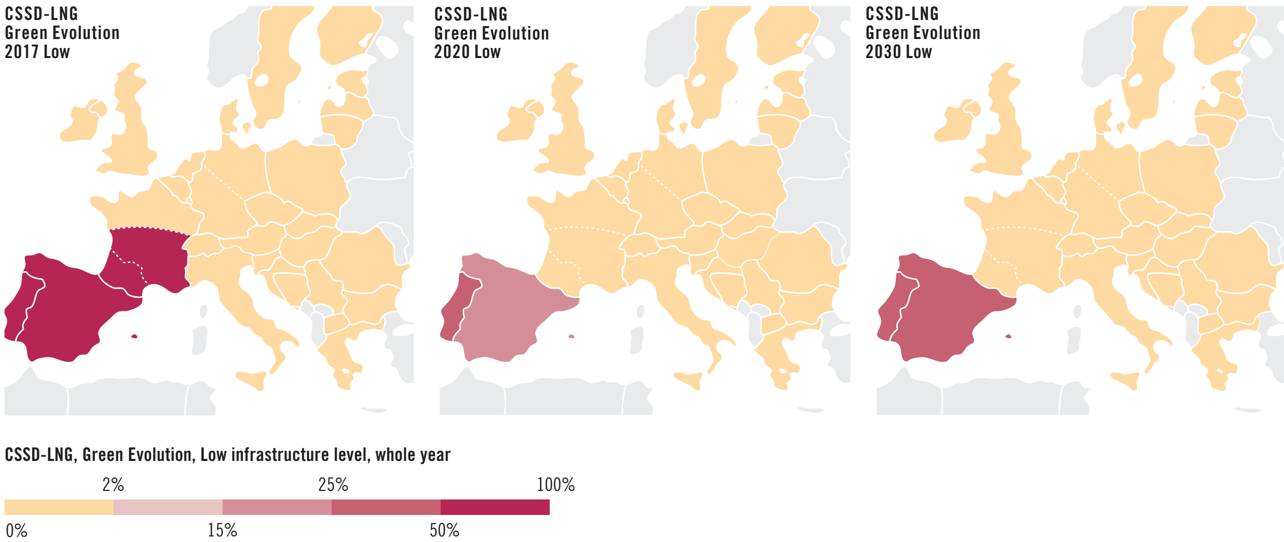

Figure 4.7: Dependence to LNG supply on an annual basis under the Green Evolution scenario (cooperative behaviour), Low infrastructure level (existing infrastructure and FID projects)

Today, a number of countries located in the East Baltic Region, Central-Eastern and South-Eastern Europe are mainly supplied by Russian gas. The commissioning of planned FID projects mitigate this situation, in particular for South-Eastern Europe from 2020. It will be key that this infrastructure will be implemented on time. In the longer term perspective, the dependence of Central-Eastern countries on gas supplies from Russia will increase. More infrastructure will be needed in the above regions so that they can further improve their diversification of supply sources, in order to fulfil the requirements of the internal energy market.

While in the case of LNG, the situation primarily raises competition concerns, the LNG supply being per se already well diversified. In the case of the Russian supply not only competition, but also security of supply could be at stake.

Security of supply

In some specific areas, capacities do not yet comply with or are only slightly beyond the N-1[1)] criteria, raising security of supply issues.

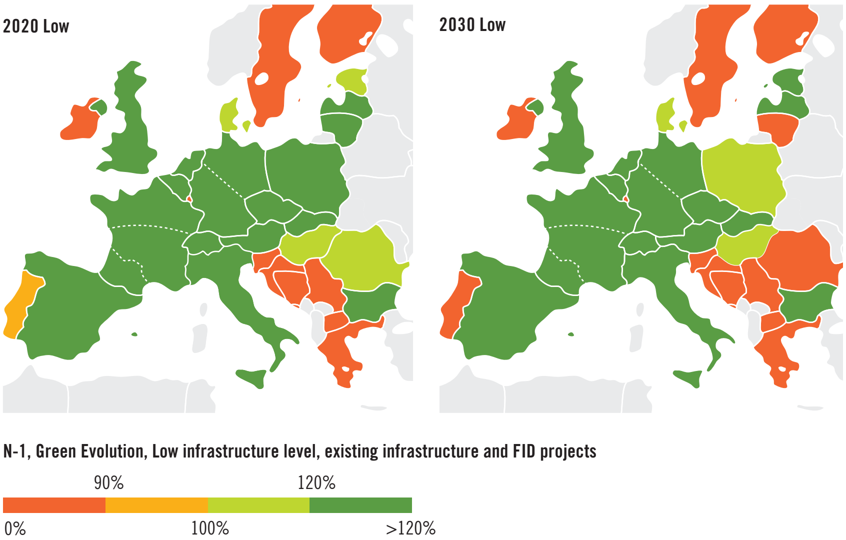

Figure 4.8: N-1, Green Evolution, Low infrastructure level (existing infrastructure and FID projects)

Access to diversified supply sources is key to ensure security of supply in the event of a supply- or infrastructure-related crisis situation. The gas infrastructure already ensures a level of diversification resulting in a high resilience in many parts of Europe. The gas system is able to cope with a wide range of route disruption cases. In the case of Ukraine route disruption, the situation for the South-Eastern part of Europe is foreseen to improve significantly by 2020 thanks to the commissioning of projects which have already taken their final investment decision. Mitigation of residual risks may call for additional infrastructure reinforcements. The TYNDP includes advanced projects as well as projects from the 2nd PCI list which are able to address these residual risks.

In the Baltic region, TYNDP advanced projects also have a positive impact on addressing the risks stemming from a Belarus route disruption by developing cross border capacities between the concerned countries.

1) The N-1 indicator stemming from the CBA methodology derives from Regulation (EC) 994/2010, but shows some differences with the N-1 calculated by Competent Authorities (in particular calculation for future time horizons and consideration of the lesser-of-rule on capacities).

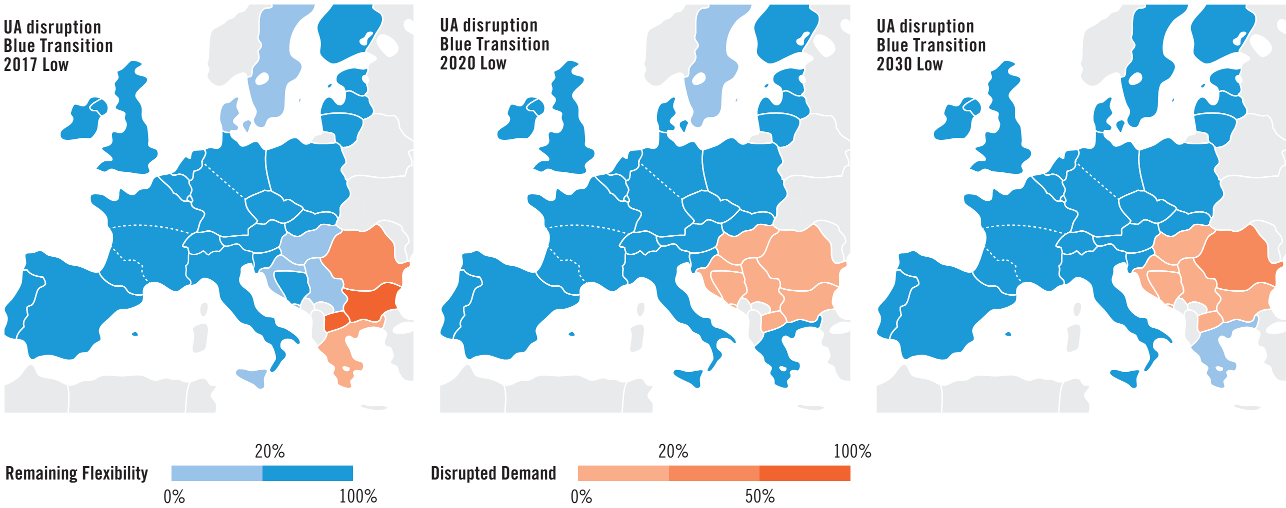

Figure 4.9: Risk of demand curtailment in the case of Ukrainian transit disruption, Green Evolution, Low infrastructure level (existing infrastructure and FID projects), Design Case peak day

Competition requires a fully functioning internal energy market

The infrastructure limitations pointed above, which locally lead to high dependence or an inability to sufficiently diversify supply sources, would also have an impact in terms of competition.

In particular, the isolation of Finland prevents the country from mitigating a high Russian supply price. Infrastructure limitations also prevent the Baltic States to share the benefit of their access to LNG with Finland.

In Central-Eastern Europe, countries are mainly supplied by Russian gas and face a low level of competition.

In the South-Eastern part of Europe, barriers prevent Greece from sharing, to a large extent, the benefit of its access to LNG, in particular with Bulgaria. In Romania, the lack of interconnection does not allow for Romanian national production to benefit neighbouring countries.

In the Western part of Europe, the limited ability of the Iberian Peninsula to substitute LNG with pipe gas would expose it in the case of high LNG price. Symmetrically the assessment identifies barriers preventing the Iberian Peninsula to fully share the benefits of its access to LNG with France.The access to LNG in the United Kingdom, France and Belgium can benefit countries to the East, up to a certain extent.

More generally, when taking a theoretical approach to price differentials between sources, with one source being more or less expensive than all other ones by an arbitrary price spread[1)], the impact on countries would relate to their ability to access diversified supply sources, as shown on Figure 4.10 to the right. While the price impacts presented in this figure derive from a standardised approach and would not materialise as such in reality, they indicate that diversification enables countries to benefit from low prices, whilst at the same time being able to protect themselves from high prices.

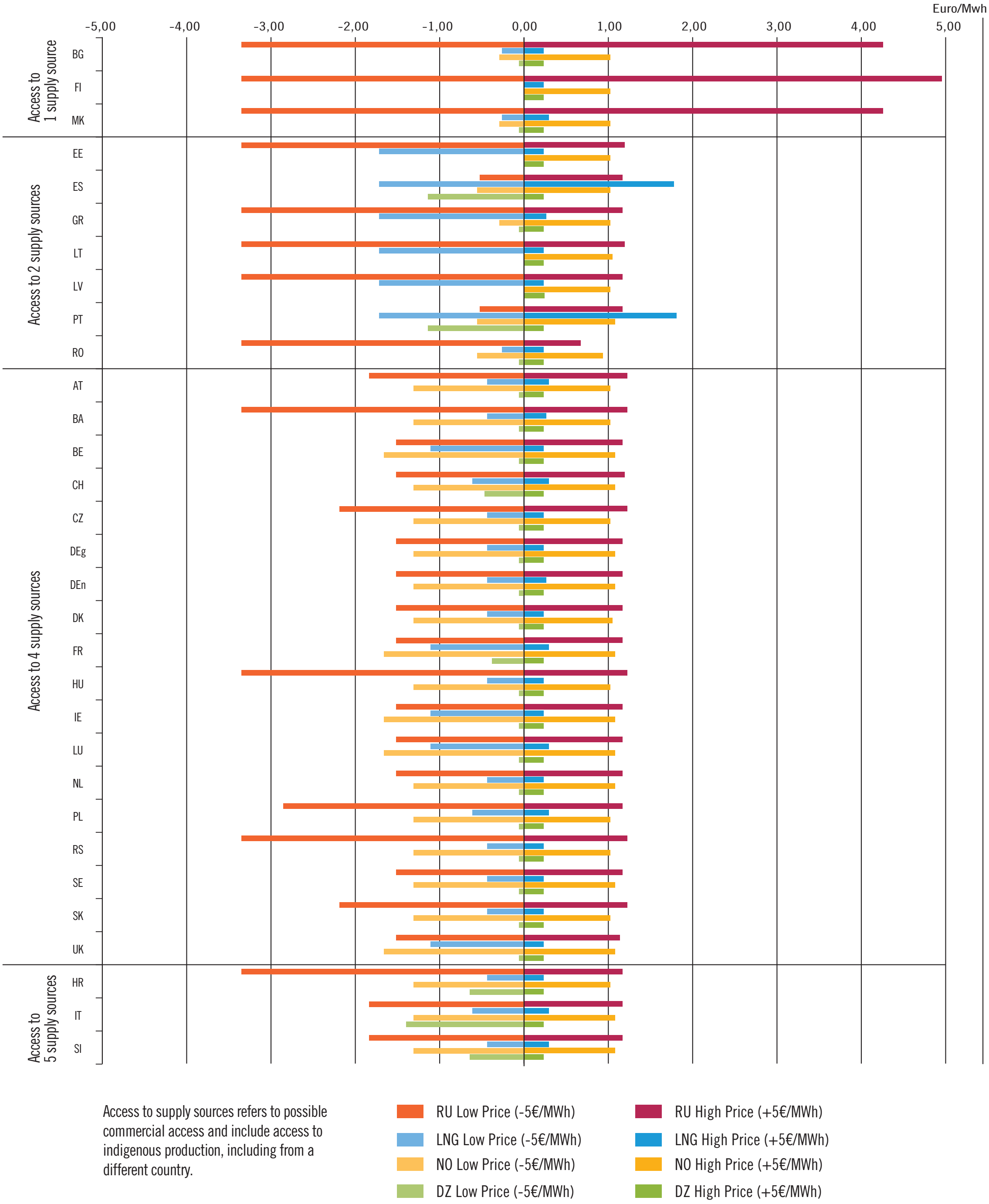

Figure 4.10: Impact at country level from high or low price of specific supply sources (standardised approach using arbitrary 5 €/MWh price spreads) in relation to their access to supply sources – Situation for 2017 – Low infrastructure level (existing infrastructure and FID projects)

1) For a given source same import price whatever the import point, and arbitrary price spread of 5 €/MWh between the expensive or cheap sources and the other ones

Additionally, the TYNDP assessment takes a more fact-based approach to look more closely at the case of those Eastern countries which are reported as experiencing higher import prices for Russian supply due to a monopolistic situation. In recent years, the example of the Lithuanian Klaipėda LNG terminal has shown that infrastructures creating the conditions for competition can have a positive impact on prices.

Based on publicly available import price information, the TYNDP assesses the market prices that would result from those import prices under an assumption of perfect market functioning. Under such assumption, areas where market prices do not align with Western countries indicate where additional infrastructure would enable the diversification of supply sources and support improving competition. FID and advanced projects included in the TYNDP improve the situation by enhancing market integration. Some additional targeted investments from the 2nd PCI list would completely mitigate the exposure to higher import prices for Russian supply.

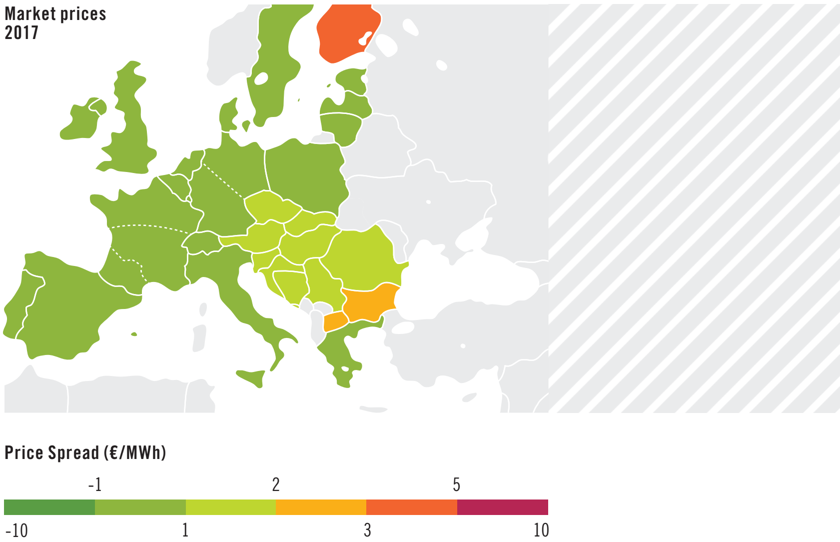

Figure 4.11: Market prices in 2017 as result from modelling based on observed import prices

4.3 THE SOLUTION IS AT HAND

While the existing infrastructure and upcoming reinforcement with FID projects already achieves many of the aims of the internal energy market, some specific areas are still in need. The TYNDP assessment of the advanced infrastructure level indicates that for most of the needs, the solution is at hand and achievable at limited cost. In the rare cases where advanced projects are still not enough, projects stemming from the 2nd PCI list prove to be an efficient complement.

The FID and advanced projects together represent 86 items, whose complete implementation would represent an investment close to 45 bn€, from which more than 25 bn€ refer to a limited number of large-scale import projects. The vast majority of those projects are foreseen to be commissioned by the end of 2022.

For those projects candidating for a PCI label on the 3rd PCI list, the selection process that is ongoing within the Regional Groups and led by the European Commission will identify, based on project specific assessments, which ones best address the needs of each of the priority corridors.

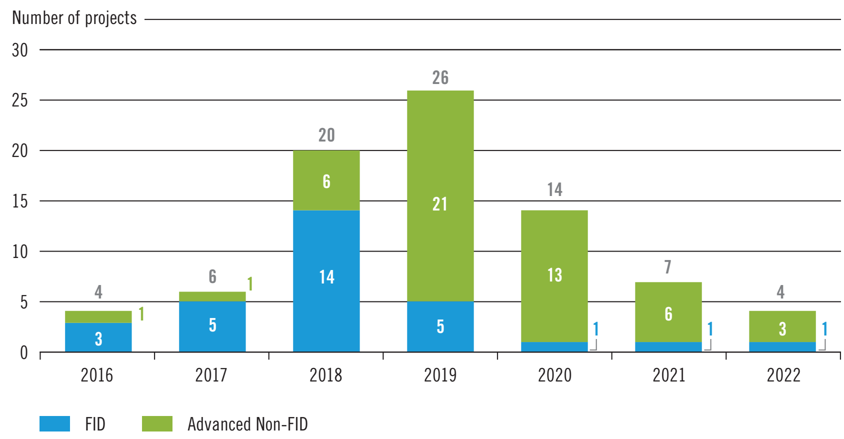

Figure 4.12: Projects by commissioning year and by project status

In terms of diversification the advanced projects, in addition to the FID ones, improve the situation for the Baltic region and allow the vast majority of EU countries to access at least 3 supply sources by 2020. The Iberian Peninsula still mainly has access to LNG. While LNG is intrinsically well diversified, this questions if the region would see competition benefits in further diversifying to pipeline supplies. By 2030, the situation reflects the decline of indigenous production across Europe.

Some advanced projects also contribute towards mitigating the dependence to Russian supply by decreasing the isolation of Finland and solving the issue in South-Eastern Europe. But they do not fully mitigate the dependence of the Iberian Peninsula to LNG. In this last case, projects in the region listed on the 2nd PCI list would further mitigate the situation.

The improvements enabled by projects in terms of competition closely follow the benefits they bring in increasing access to supply sources and decreasing dependence to Russian supply.

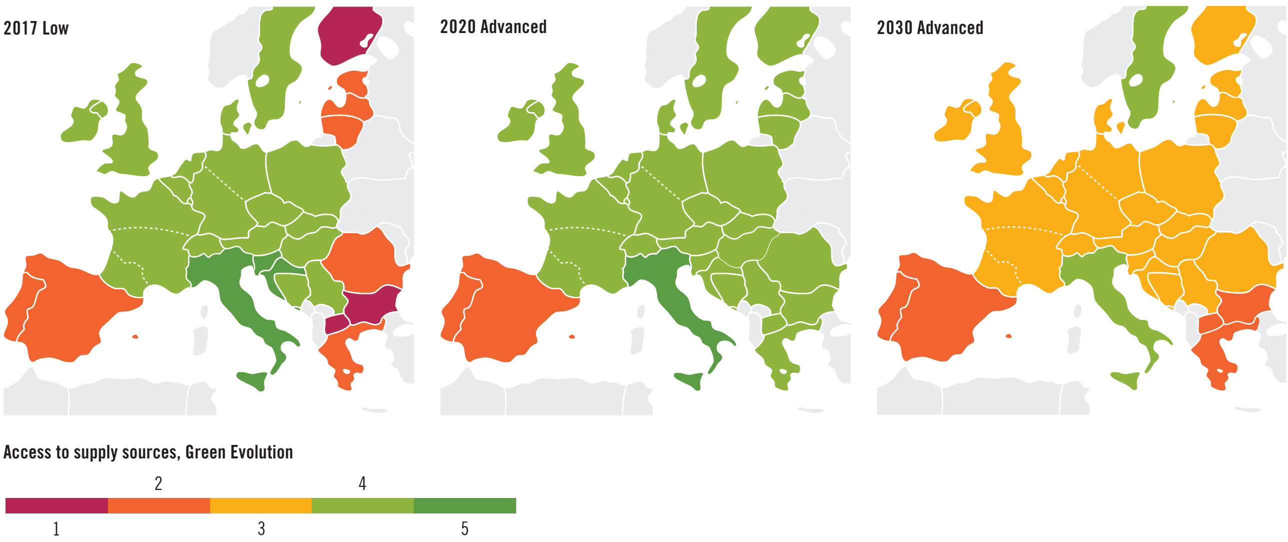

Figure 4.13: Level of supply diversification (expressed as number of supply sources to which countries can have significant commercial access), Green Evolution, Advanced infrastructure level (existing infrastructure together with FID and advanced projects)

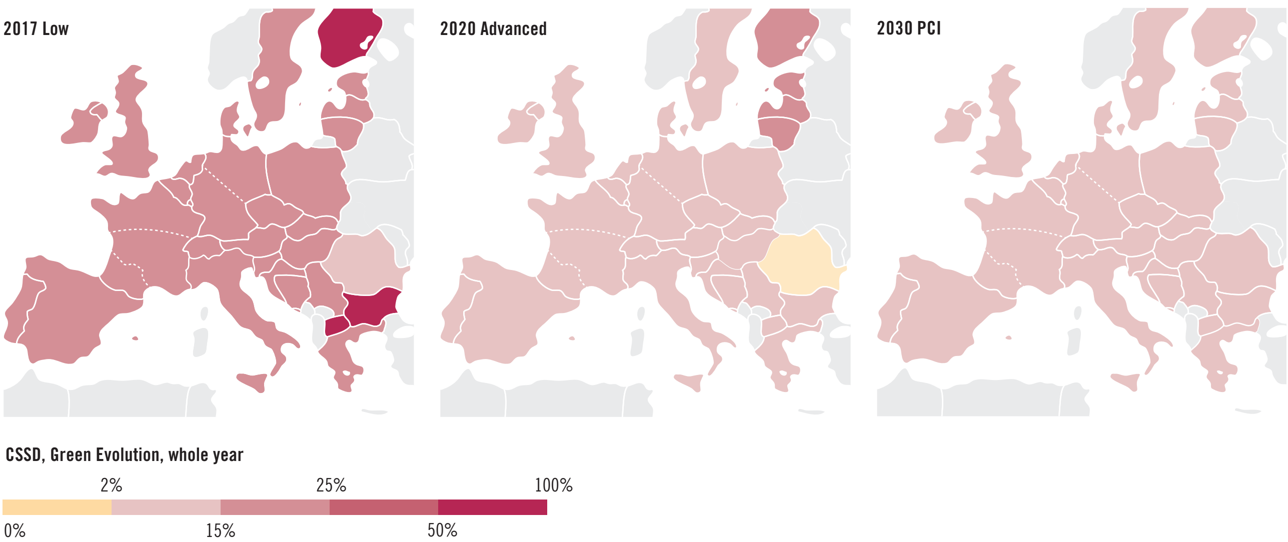

Figure 4.14: Dependence to Russian supply on an annual basis under the Green Evolution scenario (cooperative behaviour) – Advanced infrastructure level (existing infrastructure together with FID and advanced projects)

Security of Supply

The N-1 situation is improved for a number of countries by the implementation of advanced projects. The risks in the case of disruption of Ukrainian transit are also significantly mitigated. The implementation of further 2nd PCI list projects beyond 2020 would generally suppress any risk of demand curtailment in case of Ukraine or Belarus route disruption. (see figures 4.15 and 4.16)

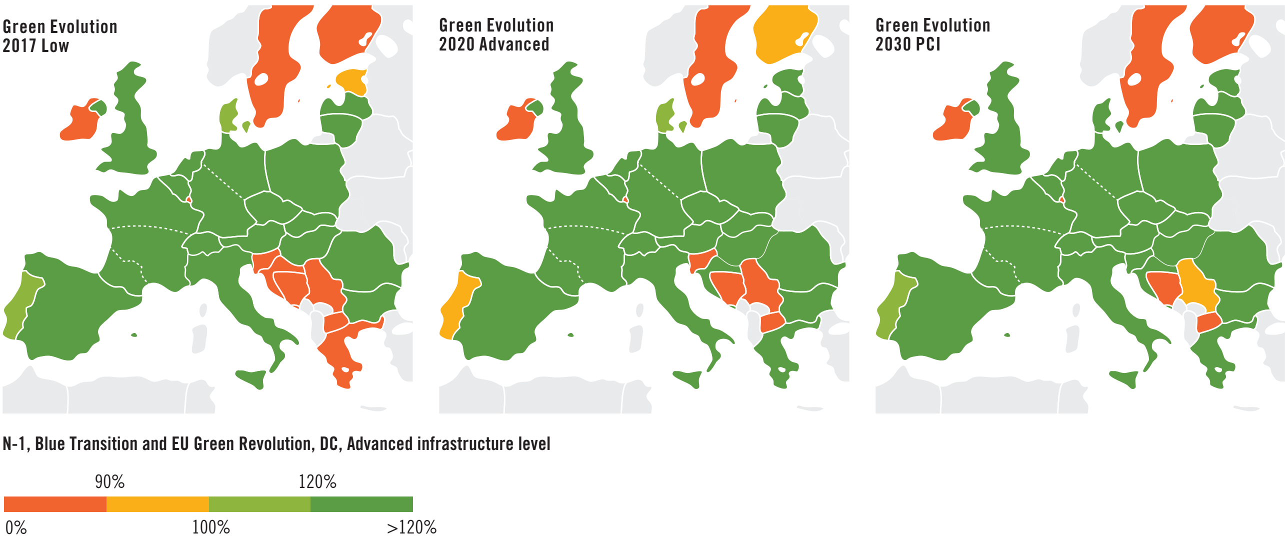

Figure 4.15: N-1 considering advanced projects in 2020 and 2nd list projects in 2030, Green Evolution

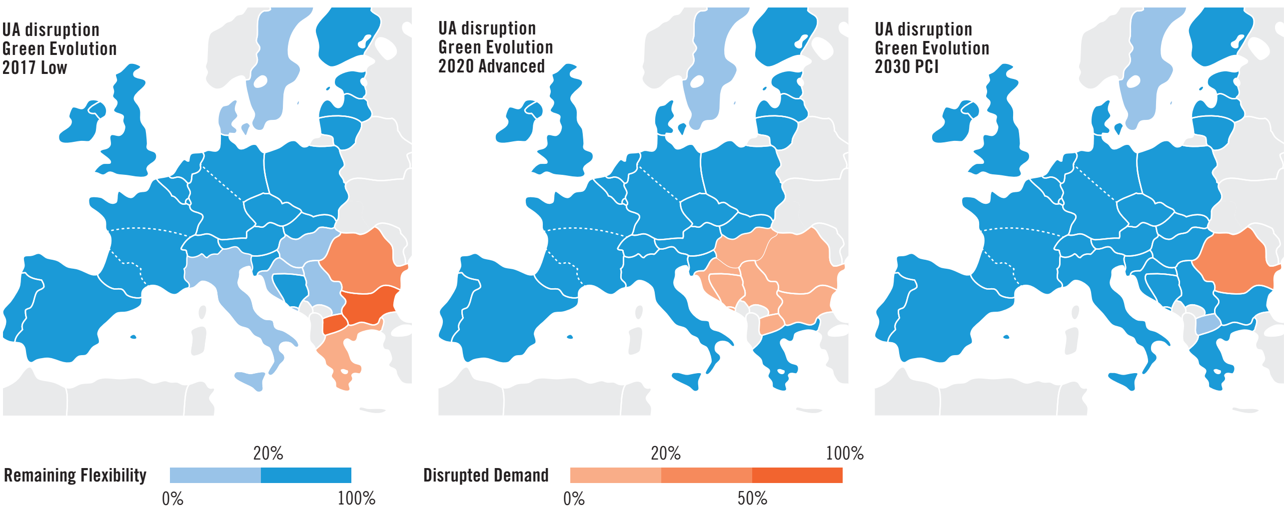

Figure 4.16: Risk of demand curtailment in case of Ukrainian transit disruption considering advanced projects in 2020 and 2nd list projects in 2030, Green Evolution, Design Case peak day

4.4 GAS INFRASTRUCTURE: A KEY ROLE IN THE FUTURE

The existing gas infrastructure is the result of development and investment over many decades. The resulting system is a well-connected network of transmission pipelines, LNG terminals and storage infrastructure. This system has proved resilient over time, day after day, winter after winter. Progress accomplished over recent years has further improved this system.

This cross-border network is, already today, well equipped to face the challenges of the future: it can cope with the evolution that the gas demand will undergo to achieve the climate targets, it allows a wide range of supply mixes and it is resilient to a number of disruption events.

The gas infrastructure misses only a limited number of additional elements to ensure that the internal energy market becomes a reality across all of Europe. The initiatives are already ongoing and can be realised for a limited cost.

Looking forward, this system will not only transport natural gas. Increasing volumes of biomethane are produced and injected into the gas grid. The future of gas infrastructure also includes synthetic gasses and hydrogen. Power-to-gas units are a unique opportunity to optimise renewable generation by connecting it to the already highly interconnected gas infrastructure, offering efficient and low cost energy transmission and long-term storage in the gas system, and potentially saving investments in new electricity infrastructure.

The gas infrastructure is a powerful asset. It should be used in the optimal way in the future to achieve the European energy and climate targets in the most cost-effective manner. This will require decision and policy makers to recognise the role that gas infrastructure has to play and to provide the necessary framework for this to be possible.

Image courtesy of Gascade

5 Way forward

Following the release of TYNDP 2017, a public consultation commences. The TYNDP is presented to stakeholders and as part of the ongoing process of considering stakeholder recommendations, workshops are organised to enable them to express their views. The TYNDP is submitted to ACER to receive its Opinion. ACER is also informed on the outcome of the public consultation. ENTSOG intend to publish a final version of the TYNDP in Spring 2017. ENTSOG endeavour to consider stakeholders feedback and ACER Opinion and incorporate it in this final version where manageable in a timely manner. Where consideration of stakeholder feedback or ACER Opinion would require more time, ENTSOG will consider it for its next TYNDP edition.

In parallel, TYNDP 2017 has also a key role to play in the 3rd PCI selection process. ENTSOG has been involved since October 2016, presenting to the Regional Groups the assessment of the infrastructure gap and supporting them in identifying the infrastructure needs per region. The TYNDP 2017 data and assessment will also constitute the common base for the cost-benefit analysis of all projects candidating to the PCI label. Regarding this, ENTSOG will provide further support by handling the modelling part of the project-specific CBAs on behalf of promoters, in line with the formal invitation received from the European Commission. ENTSOG will build on the experience gathered from the 2nd PCI selection process, to accomplish this task in a fair, transparent and user-friendly manner.

Developing the Union Wide Ten-Year Network Development Plan is a continuous process and ENTSOG has already started developing the next edition of the TYNDP. Intended to be released in the second half of 2018, it will be named TYNDP 2018. For this new edition, ENTSOG and ENTSO-E have been engaged in a fully common scenario development process, which relies on an intense day-to-day cooperation between both association's experts and a joint engagement of stakeholders to maximise their input and ensure a cross-sectoral approach. The ENTSOs organised a joint public consultation on scenario storylines in May-June 2016, joint stakeholder workshops in June and July 2016, and a joint webinar mid-October 2016 to inform stakeholders on the scenario framework retained and collect quantitative input. In the coming months, the ENTSOs will continue their close interaction, in view of publishing a joint Scenario Report by mid 2017.


VORWERK
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Country Codes (ISO)

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AT	Austria
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BY	Belarus
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DZ	Algeria
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Publisher: ENTSOG AISBL
Avenue de Cortenbergh 100
1000 Brussels, Belgium

Co-Authors: Céline Heidrecheid, Arturo de Onís Romero-Requejo, James Gudge, Louis Watine, Rares Mitrache, Stefan Greulich, Stefano Astorri, Vincent Scherrer, Antonio Gómez Bruque, Editing KG, Nemo KG, Supply & Demand KG, INT WG and INV WG Members

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ENTSOG AISBL

Avenue de Cortenbergh 100
1000 Brussels, Belgium
Tel. +32 2 894 51 00

info@entsog.eu
www.entsog.eu