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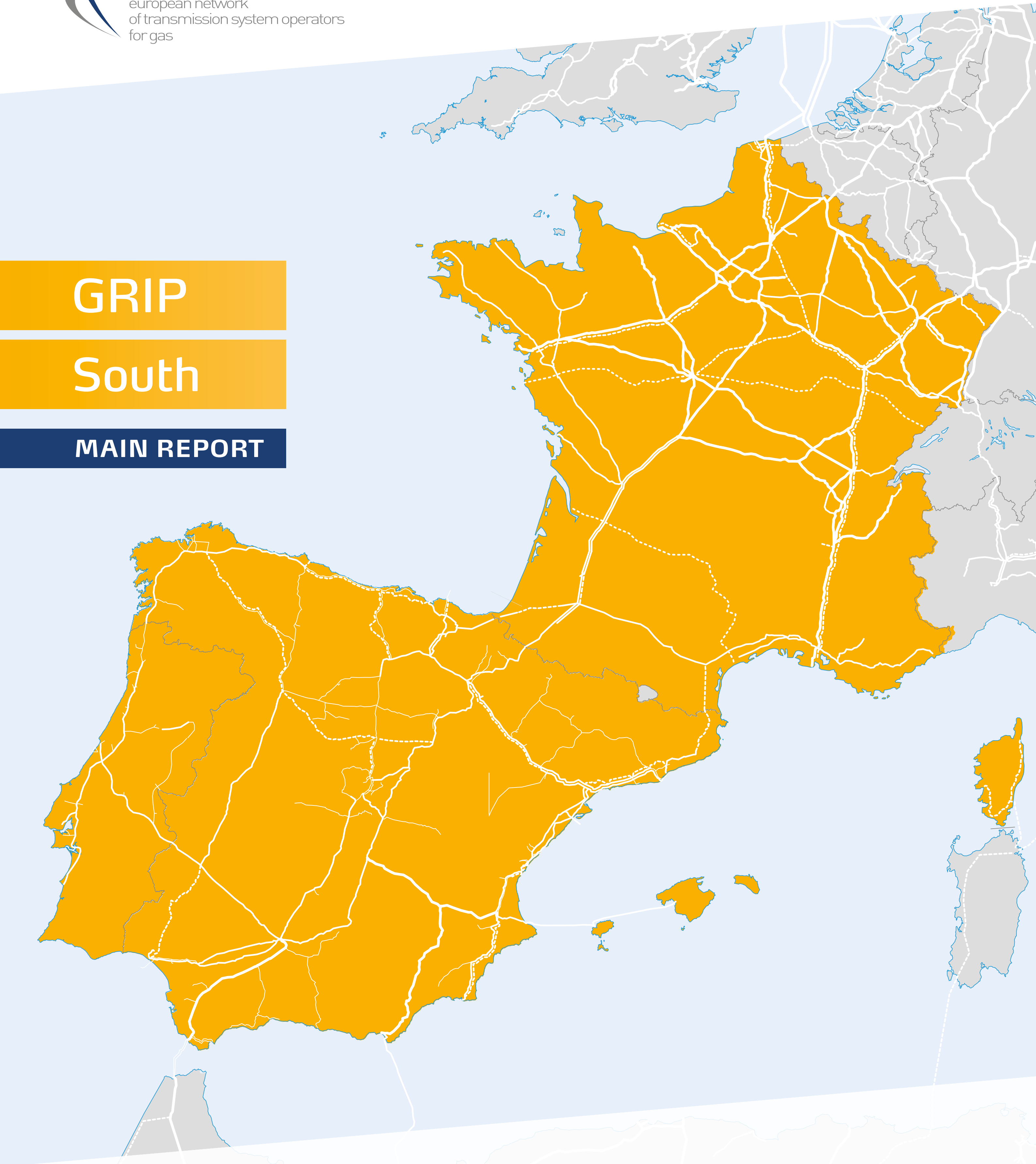
european network
of transmission system operators
for gas

GAS REGIONAL INVESTMENT PLAN 2017



GRIP South

MAIN REPORT

enagas GRTgaz reganosa REN TIGF

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Foreword

The third edition of the South European Gas Regional Investment Plan (GRIP South) builds on the previous editions of the GRIP South, published in 2011 and 2014, and also complements the Ten-Year Network Development Plan (TYNDP) 2017 published by ENTSOG in December 2016.

This GRIP South is the result of a close cooperation between the Transmission System Operators (TSOs) in the three countries of this European Region: Spain, Portugal and France. This fruitful cooperation between the five TSOs involved, Enagás, GRTgaz, Reganosa, REN, and TIGF, continues with projects for developing not only the interconnections between the different gas transmission systems, but also the robustness and flexibility of the existing infrastructures of the three gas systems. These projects, which are assessed in this document, intend to comply with the European gas target model.

For this edition, the coordination of this report was facilitated by TIGF.

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Executive Summary/ Conclusions

This third edition of the Gas Regional Investment Plan for the South Region gives a detailed assessment, from an infrastructure perspective, of the level of completion of the market integration of the region, the competitiveness and sustainability of the systems involved and the security of supply, which constitute the European Energy Policy pillars.

This report has been developed and improved from its last edition of 2013. Among the inputs that have taken part in the elaboration of this document, mention should be made to the feedbacks received on the last report (GRIP South 2013–2022) and the TYNDP 2017 development process, together with the proper coordination of the TSOs taking part in the South Group.

Being developed in concomitance with the TYNDP 2017, this GRIP edition provides a deeper analysis of the infrastructure needs in the regional gas systems of France, Portugal and Spain.

Image courtesy of TIGF

DEMAND EVOLUTION

TYNDP 2017 demand scenarios show a slightly declining trend of the total demand in France, while it grows in Spain and in Portugal, with previsions up to 2035. The same trend is observed in final demand forecast for the three gas systems in the South Region.

Natural gas demand for power generation in the Region is expected to increase, regardless of the considered scenario, because of the foreseen coal displacement and the role of gas complementing renewable generation.

Nevertheless, future of gas demand strongly relies on the adopted energy policies regarding penetration of renewable energies in the energy mix, as well as displacement of coal as the main fuel for power generation and the development of the LNG potentials such as its use as an alternative fuel for marine and road cargo transportation.

SUPPLY SOURCES

Countries in the South Region strongly depend on LNG imports, entailing a 28 % of its 2015 gas supply share, remaining higher than the European average (12 %). This fact guaranties the access to a flexible supply portfolio, allowing the diversification of LNG sources and the convenient arbitrage between them in order to face global demand and prices variations. In this sense, LNG enables the connection of the South Region to the global market.

Even though LNG comes primarily from Algeria, Nigeria and Qatar, the entry of USA LNG cargos in the South Region regasification terminals is expected in the upcoming years.

Regarding pipeline imports, the French gas system benefits from the Norwegian and Russian gas, while most of Portuguese and Spanish gas imports come from the interconnection with Algeria.

In the side of indigenous production, mostly sited in Norway and the Netherlands, an accelerated decline is expected for 2035, due to the absence of discovery of new gas fields and environmental issues regarding the extraction in the existing ones.

GAS MARKETS

Gas markets in the South Region have seen major evolution these last couple of years. Two events must be remarked in this sense: the creation of the Organised Gas Market in Spain operated by MIBGAS, in December 2015, and the merger of PEG Sud and the TIGF trading regions in one single trading hub (Trading Region South, TRS) in April 2015. Gas market will be further simplified with the merger of zones in France in 2018. The different level of maturity of these new markets is reflected in the traded volumes, being much higher in PEGnord than in TRS or MIBGAS, and in the high spread of prices between MIBGAS and TRS on one hand, and PEGnord on the other hand.

ASSESSMENT OF THE SOUTH REGION

According to the results of the Network Assessment developed in the TYNDP, security of supply is guaranteed in the South Region. Gas network in this Region is resilient enough to face wide variations of demand, and is able to re-route supply in case of a supply route disruption, bringing additional gas through LNG terminals and underground storage facilities. The only lack of robustness in the gas network is related to the N-1 indicator for Portugal, since the Portuguese gas system is not able to cover the supply in these circumstances for all the scenarios. However, the commissioning of the 3rd Interconnection between Spain and Portugal would solve this problem.

Regarding the competition and, more precisely, the access to different supply sources, differences are seen between the Iberian Peninsula and France: in 2017, France has significant access to four supply sources (Russia, Norway, LNG and European national production), while the Iberian Peninsula has significant access to two supply sources (Algeria and LNG). Nevertheless, the three countries of the South Region would have access to five different sources after the commissioning of the PCI infrastructure cluster (Russia, Norway, Algeria, LNG and European national production), thus complementing the respective supply mixes of each country.

The Iberian Peninsula and South of France have been identified in ENTSOG TYNDP 2017 as areas with dependency on LNG. The dependency on LNG in the South of France will disappear after the merger of zones in France in 2018. The dependency of the Iberian Peninsula would be mitigated with the commissioning of PCI projects, especially in low demand scenarios.

A great number of projects enhancing the interconnection of the countries in the area within them and other EU countries, together with the addition of new infrastructures and development of existing ones, such as LNG terminals or storage facilities, have been identified in the South Region. In this sense, projects submitted for TYNDP 2017, both FID and non-FID projects, are expected to enhance the operation of the network, increasing interconnectivity of the countries involved, ensuring the security of supply and granting the access to a more diversified portfolio.

The TSOs from France, Portugal and Spain hope that this report can be useful in terms of information and results. We encourage all the readers of the document to contribute to the next GRIP's edition development by actively provide their feedback on the present one.


Image courtesy of Reganosa

1 Introduction

Image courtesy of TIGF

Preamble

The GRIP South (Gas Regional Investment Plan of the South Region) is produced by the Transmission System Operators of the South Region, which covers France, Portugal and Spain.

Promotion of regional cooperation arises from the requirement for Member States and regulatory authorities to “cooperate with each other for the purpose of integrating their national markets at one and more regional levels” established in Article 7 of the European Directive 2009/73/EC. This requirement is further detailed in Article 12 of Regulation 715/2009, since “transmission system operators shall establish regional cooperation within ENTSO for Gas [...] they shall publish a regional investment plan every two years”.

In this context, the five TSOs of the South Region (Enagás, GRTgaz, Reganosa, REN and TIGF) have shared common efforts in the elaboration of this Gas Regional Investment Plan (GRIP South 2017), which is the third version of the GRIP since its first edition published in 2011.

The Gas Regional Investment Plan aims to provide a regional zoom of ENTSOG Ten-Year Network Development Plan (TYNDP 2017) which has been published on 28 April 2017, and is available at the following link: http://www.entsog.eu/publications/tyndp#ENTSOG-TEN-YEAR-NETWORK-DEVELOPMENT-PLAN-2017.

Joint scenario development process was established between ENTSO-s and, furthermore, an alignment between TYNDP and GRIP, guaranteeing a joint and coordinated development of both documents.

In this sense, the GRIP South provides complementary analysis of the gas system focus on Transmission, UGS and LNG Terminals projects, additional analysis of the gas system and of the infrastructures which remedy the various issues at regional level.

This GRIP South takes on added significance since it must anticipate and take into account the upcoming changes related to energy transition. Changes are coming, as countries have committed to reduce CO_2 emissions following the targets set at the Paris COP21. European gas infrastructures have a key role in achieving those ambitions. Therefore, the TYNDP 2017 and this GRIP South take in consideration the different scenarios that can be drawn from them.

Transmissions System Operators of the Region wish that this document will provide useful information to all stakeholders and will support fruitful discussions when assessing the ability of investment projects to answer the regional market needs.

Objectives and Enhancements

The main aim of the GRIPs, together with the TYNDP reports, is the assessment of the level of completion of the European Energy policy pillars (security of supply, market integration, competitiveness and sustainability) from an infrastructure perspective.

The TYNDP pursues the development of an assessment of the gas system resilience and a supply adequacy outlook, along with the identification of the investment gaps related to infrastructures needed in order to achieve the basis of the internal energy market. This way, the TYNDP analyses how the submitted infrastructure projects would contribute to cover these infrastructure gaps and gas system needs.

The added value of the GRIP is to go further in terms of analysis and details on the assessment of the transmission system at regional level, and the projects that remedy these needs. This plan investigates the role of these projects which improve the market integration in the South Region and of the South Region with Europe; the objective of this document is to explain in more depth their added value.

Special attention is put on the identification of the infrastructure gaps in the South Region, due to, the dependence of the South Region on LNG (specifically in Spain, Portugal and South of France) and limited access to alternative supply sources; resulting with large price spread between South hubs and North West hubs, particularly when LNG is expensive.

Since the first publication of the GRIP report, many efforts were put on the improvement of the quality of the documents by the TSOs in close cooperation with all stakeholders. Based on the feedback on GRIP 2013 and the views of the Agency for the Cooperation of Energy Regulators (ACER) during the Stakeholders Joint Working Sessions organised by ENTSOG throughout 2016, some significant improvements have been included in this document.

Firstly, this third edition of Gas Regional Investment Plan of the South Region is an important cornerstone as it gets closer to European Ten-Year Network Development Plan, sharing the same calendar and the same set of data. The projects collected in this document are sourced from the TYNDP 2017 portal according to the already mentioned three categories: Transmission, UGS and LNG Terminals. Demand forecast and project impact assessments are totally aligned with TYNDP 2017, allowing an in-depth analysis of the South Region investment gap and how the proposed projects address the regional needs.

Since this GRIP report has been developed in concomitance with TYNDP 2017, it shares the same principles in transparency and reliability.

In July 2016, once the collection and validation of the TYNDP input data was over, a workshop was organised by ENTSOG in order to offer an overview on information related to scenarios, domestic production long-term gas quality outlook, capacity, demand and projects reported to TYNDP, making all this data publically available on ENTSOG website. This data was used for the development of both TYNDP 2017 and this GRIP edition.

Regarding the contents of this GRIP, the first chapters of this report contain the description and analysis of the supply, the demand, the market and the projects identified in the South Region.

Project needs of the gas system in the South Region are explained in the evaluation of the South Region chapter. On one hand, an assessment of the gas system at a low infrastructure level is carried out through a deep analysis of the main results included in the Network Assessment chapter of the TYNDP 2017. On the other hand, a focus is made on the projects which are remedy to the needs detected in that assessment, at both high and advanced infrastructures levels, as well as on Projects of Common Interest (PCI) in the Region.

Image courtesy of Enagás

2 General Context

Image courtesy of Reganosa

2.1 Worldwide Context

The global context we face today is one of cheap energy, reduced economic growth and the challenge of maintaining environmental sustainability, particularly with regards to the implementation of environmental policies.

During the COP21 held in Paris in December 2015, the necessity of accelerating the reduction of global greenhouse gas emissions and the promotion of renewable energy was firmly stated.

Although some uncertainties remain regarding the future of natural gas use and consumption, in a world driving to a more sober low-carbon society, the conference also suggested some potentially interesting opportunities for natural gas. The conclusions drawn in Paris also underlined the importance of climatic change for both world economic development and public health. The political momentum that emerged at the COP21 suggests that natural gas may play an important role in the world's future energy mix, being a key in the transition towards a low-carbon economy, given that gas is flexible, abundant and cleaner than other fossil fuels. Gas is a large-scale resource used to facilitate electricity production in combination with renewable energy sources, and provides clean heating to industrial, commercial and residential customers. Compared to coal, gas presents the clear benefits of reducing emissions of carbon and highly polluting particles matter that contribute to poor air quality.

In the medium and long-term, natural gas has high potential, as it remains a competitive energy supply for a wide range of consumers and countries. Particularly promising markets include marine and road cargo transportation, specifically those using LNG.

In the short term, the consequences of lower gas prices are difficult to predict, which will bring considerable uncertainty to the supply side for the coming years. As a result, it is possible that some production investment decisions may be postponed or capacity reduced (Australia LNG), whereas several new production capacity will come into production (Yamal LNG due on 2017, etc…).

Another important fact is how the new role of the Unites States as a gas exporter will impact the market, as it becomes more and more relevant. The technical complexity, high leverage, and environmental policy restrictions associated with the exploitation of unconventional gas fields may complicate attempts to replicate the large scale shale gas experience outside of the United States, especially in Europe. In any case, the development of small or medium shale gas exploration fields in some countries may occur.

Pricing levels and structures have changed rapidly in the last two years. Regionalised until recently, NG and LNG prices have declined globally in recent years because of the reduction in oil price, slow demand and increased supply capacity. There was also a better balance between supply and demand in Asia that contributed to the LNG price convergence in the Atlantic and Pacific Basins and reduced arbitrage opportunities for shippers and producers.

The gap between LNG prices worldwide by January 2017 is much smaller than it was in the past, with prices ranging from 20.09 €/MWh[1] in the United States, to 26.6 €/MWh in Asia, 25.8 €/MWh in South America and around 21.8 €/MWh in Europe.

Furthermore, the LNG market will have to adapt to the entry of major new supplies from Australia and the US. Global LNG export capacity in 2020 will have increased by around 40 % of the capacity at the end of 2015, with half of the incremental supply capacity available by 2017. In the near future, the adjustment of supply to possibly lower LNG prices may be difficult, since operating costs is a small fraction of the overall investment costs. In this context, possible excessive supply will have to be absorbed by response to the price on the demand side.

1) Price of LNG exports in January 2017: 6.44 $/cft = 20.09 €/MWh (Conversion Units: 1.062876 $/€; 0.3407 kWh/cft)

2.2 Challenges for the European Gas Market

Gas consumption in Europe shows a declining general trend due to the impact of the reduced economic growth, the loss of competitiveness of gas compared to coal, increased energy efficiency and the development of renewable energy. However, due to the climate conditions and an increase in electricity production from gas, there was a slight increase of total gas demand in South Region in 2015 and 2016.

The current worldwide context, with the LNG price convergence in Europe, United States, and Asia shows that currently there are less opportunities for European shippers to re-export LNG to other locations than previously. However, this does not mean that in the future there will be no opportunities to re-export LNG from Europe to other continents.

The implementation of decisions adopted with regards to energy efficiency and the development of renewable energies may continue to impact the use of natural gas in the medium term, but as was stated in the above worldwide context section 2.1, natural gas has interesting opportunities in future worldwide and European energy mix, such as coal phase out, transportation, and complementing intermittent renewables.

Europe has developed several energy strategies, namely: the 2020, 2030 and 2050 Energy Strategies and the Energy Security Strategy. Of those European strategies, we highlight the objectives for the gas sector:

- The multi dimension Energy Union and Climate Strategy, made up of five closely related and mutually reinforcing dimensions, including: supply security, solidarity and trust; achieving a fully-integrated internal energy market; energy efficiency; climate action; and research, innovation and competitiveness. The implementation of the Gas Target Model promoted by the European Commission continues with the adoption of regulations to achieve European integration.
- The LNG and Storage Strategy aims to exploit the potential of liquefied natural gas (LNG) and gas storage to make the EU gas system more diverse and flexible, thus contributing to the key Energy Union objective of a secure, resilient and competitive gas supply.

Aware of the major financial constraints and significant economic stakes presented by energy issues, the European Commission is encouraging project promoters to perform cost-benefit analyses to determine which projects are the most promising within the framework of the “Projects of Common Interest” process.

2.3 The Energy transition in France, Spain and Portugal

In France, the law on “energy transition towards a sustainable growth” was passed on 17 August 2015. It establishes France’s energy policy framework along with precise targets by means of specific medium-term objectives.

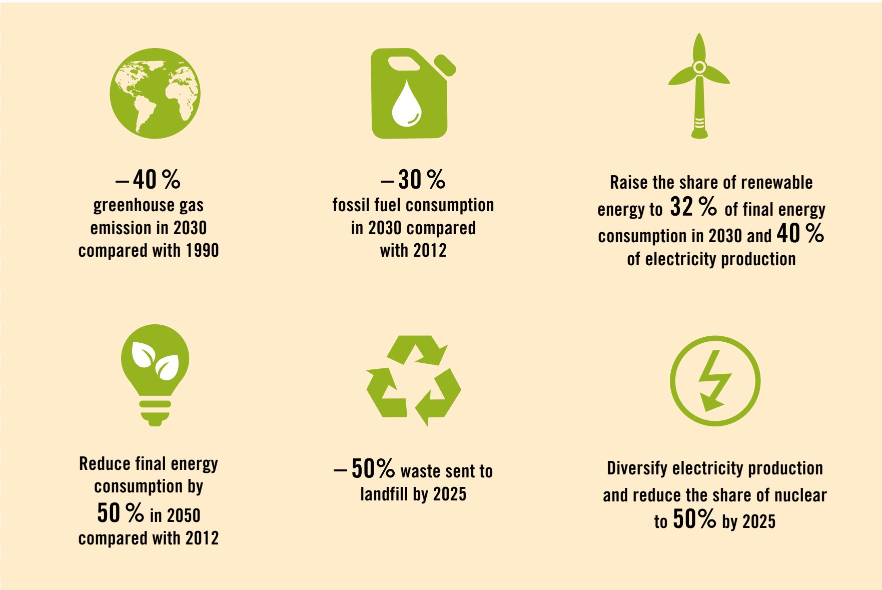


Figure 2.1: Main targets of the law on “energy transition towards a sustainable growth”
(Source: Ministère de l’Ecologie, du Développement Durable et de l’Energie)

This law is broken down into two implementing decrees:

- The Long Term Energy Schedule (PPE), which sets out priority actions by industry (published on 27 October 2016).
- The National Low Carbon Strategy (SNBC), which sets out strategic principles for implementing the transition to a low-carbon economy .

Spain is currently working on the development of an Energy Transition Law as well as a National Integrated Action Plan on Energy and Climate for the period 2021–2030. In addition, Spain has established a national energy efficiency action plan in 2017, in order to achieve European energy targets on annual basis.

Portugal has established emission reduction targets of greenhouse gases at national level, quantified by 18 % to 23 % reductions in 2020, and 30 % to 40 % reductions in 2030, when compared to 2005 emission levels. This objective reinforces the focus on renewable energies by setting a target of 40 % share of energy from renewable sources in the final energy consumption by 2030.

The Portuguese National Program for Climate Change 2020/2030, adopted by Resolution of the Council of Ministers n. 56/2015, of 30 July, integrates a set of measures for the decarbonisation of the economy, taking into account research, development and innovation, and the continuation of support for participation in the European New Entrants Reserves (NER300 and NER400).

Image courtesy of Reganosa

3 Demand

Image courtesy of REN

3.1 Regional Overview of Demand

In 2015, the primary energy consumption in the South Region was 398 MTOE (Million Tonnes of Oil Equivalent), 16 % of that being natural gas, as shown in Figure 3.1.

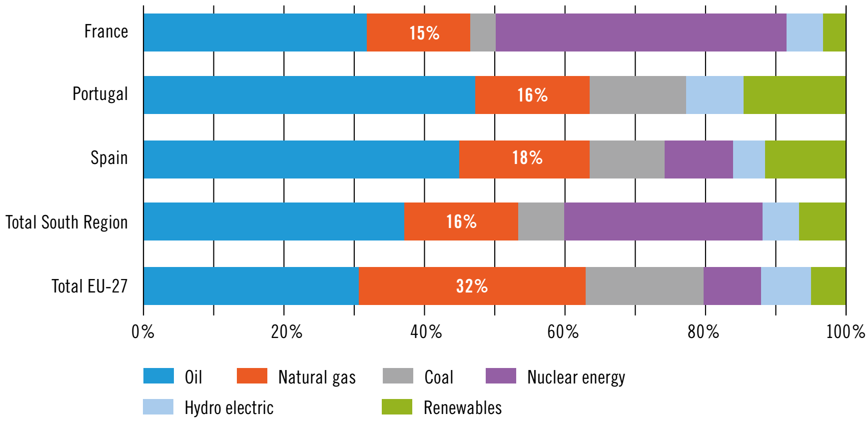


Figure 3.1: Primary energy breakdown by fuels in 2015 for South Region countries (Source: BP, 2015)

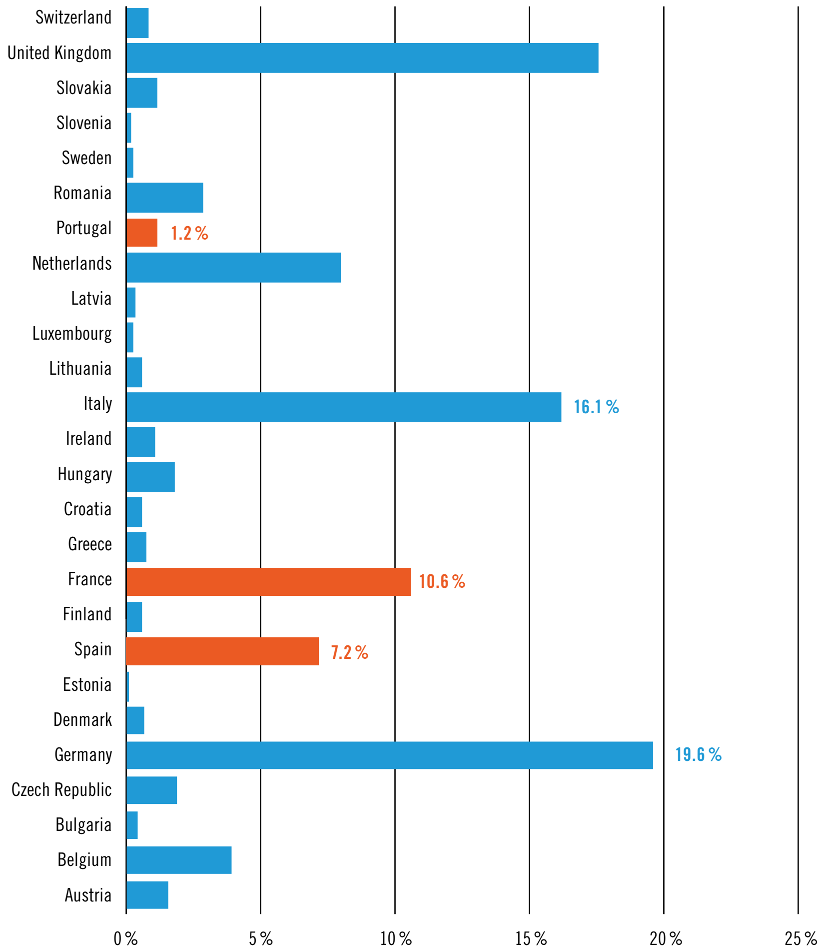


Figure 3.2: Share of each country in Europe's total gas demand, 2015 (Source: ENTSOG TYNDP 2017 data)

The annual demand in the South Region represents approximately 19 % of the total European gas demand. When focusing on the South Region, it appears that France represents 55 % of the demand, Spain 39 % and Portugal 6 %, as shown in Figures 3.3 and 3.4.

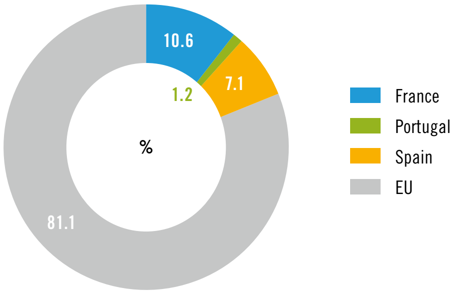


Figure 3.3: Share of each country in Europe's total gas demand, 2015
(Source: ENTSOG TYNDP 2017 data)

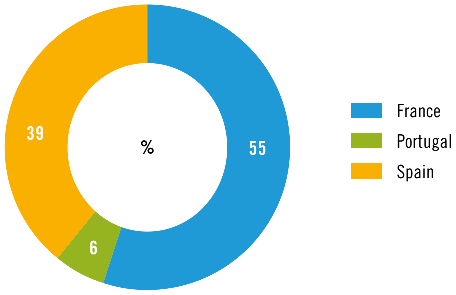


Figure 3.4: Share of each country in South Region's total gas demand, 2015
(Source: ENTSOG TYNDP 2017 data)

The demand for natural gas can be split down into two distinct sectors:

- The conventional sector includes Industrial, Commercial, Residential and Cogeneration (CHP) demand, which is called in this chapter final demand;
- Gas for power generation includes natural gas demand for power generation. This sector comprises combined cycle gas turbines (CCGT) in Portugal and Spain, while it includes also combustion turbines (TAC) in France.

These two sectors have specific characteristics. The conventional sector is, globally, much more linked to climatic conditions (for residential and commercial sector). Demand in the power sector is generally less linked to climate in the Iberian Peninsula, while in France CCGTs play a role in winter electricity peaks. In the South Region, the conventional sector (Residential + Commercial + Industrial) represented 89 % of the total gas demand in 2015 and 86 % in 2016. This breakdown of the demand varies from one country to another (Figure 3.5).

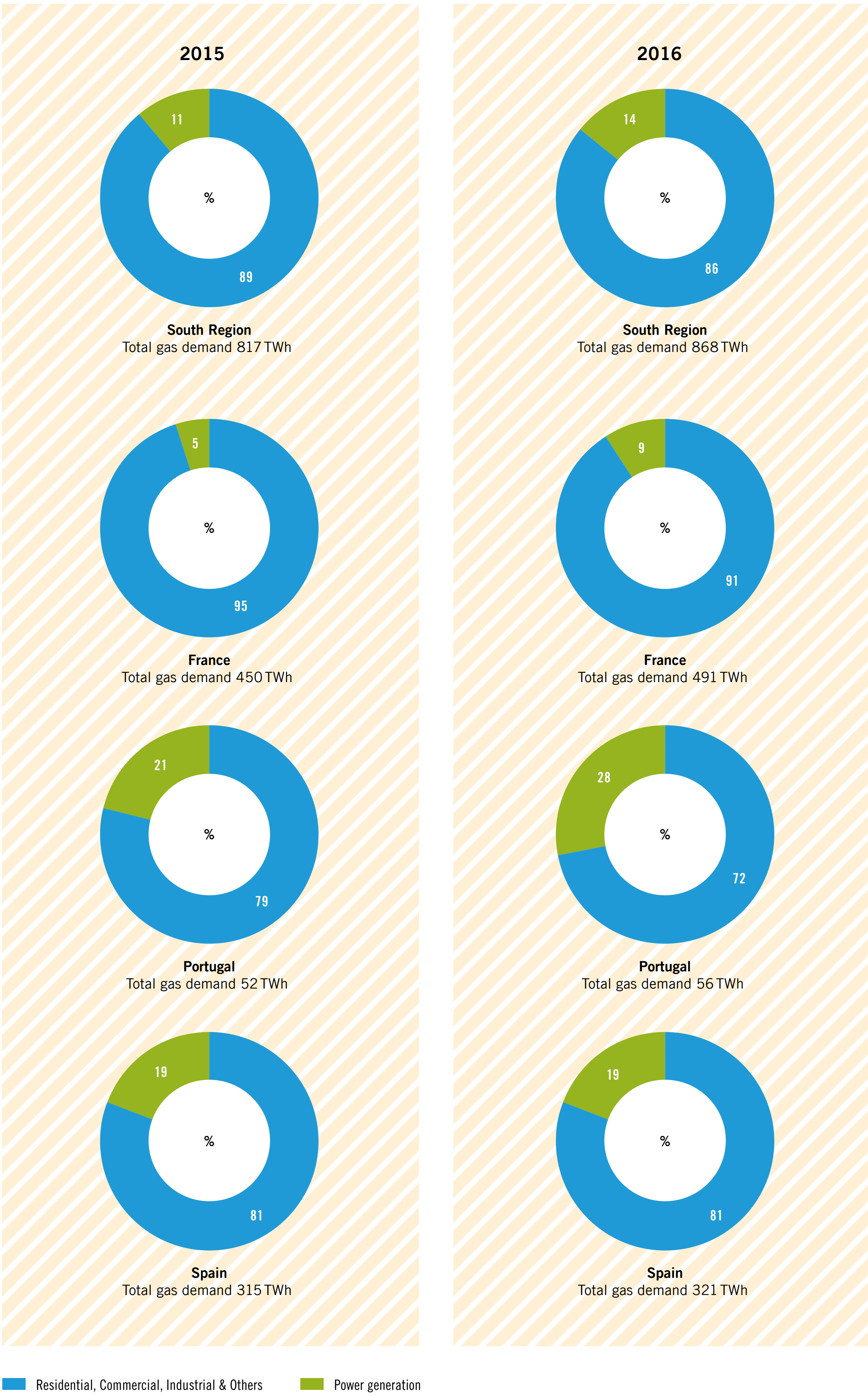


Figure 3.5: Share of power generation in total gas demand in the South Region and for France, Portugal and Spain, in 2015 and in 2016 (Source: ENTSOG TYNDP 2017 data)

The importance of the electricity generated by gas differs from each country of the South Region to another (Figure 3.6): for example, in 2016, whereas in Portugal and Spain approximately a quarter of the total electricity production was generated using natural gas, in France this part represented only 7 % of the total electricity generation. The numbers in 2015 were similar.

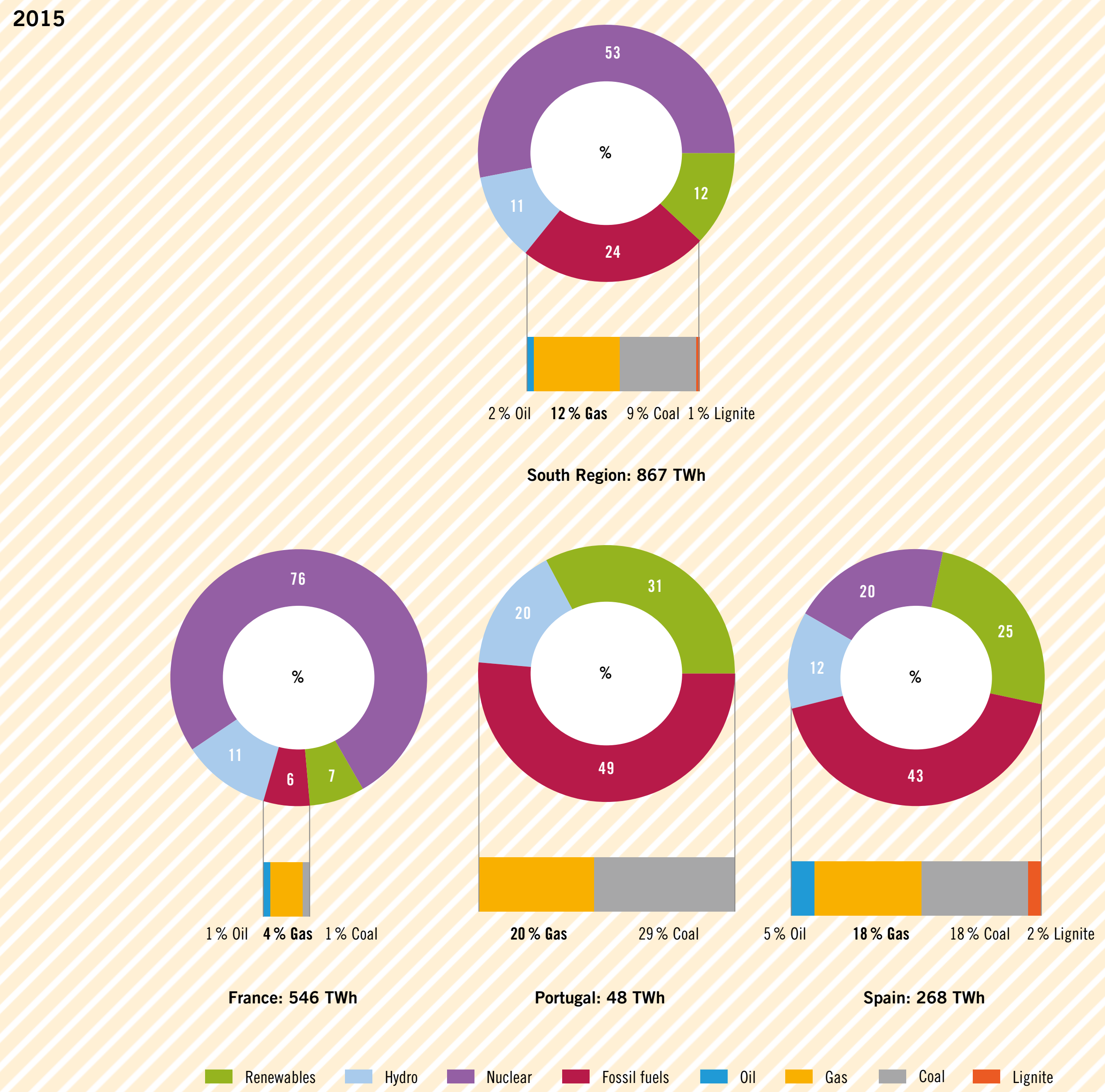
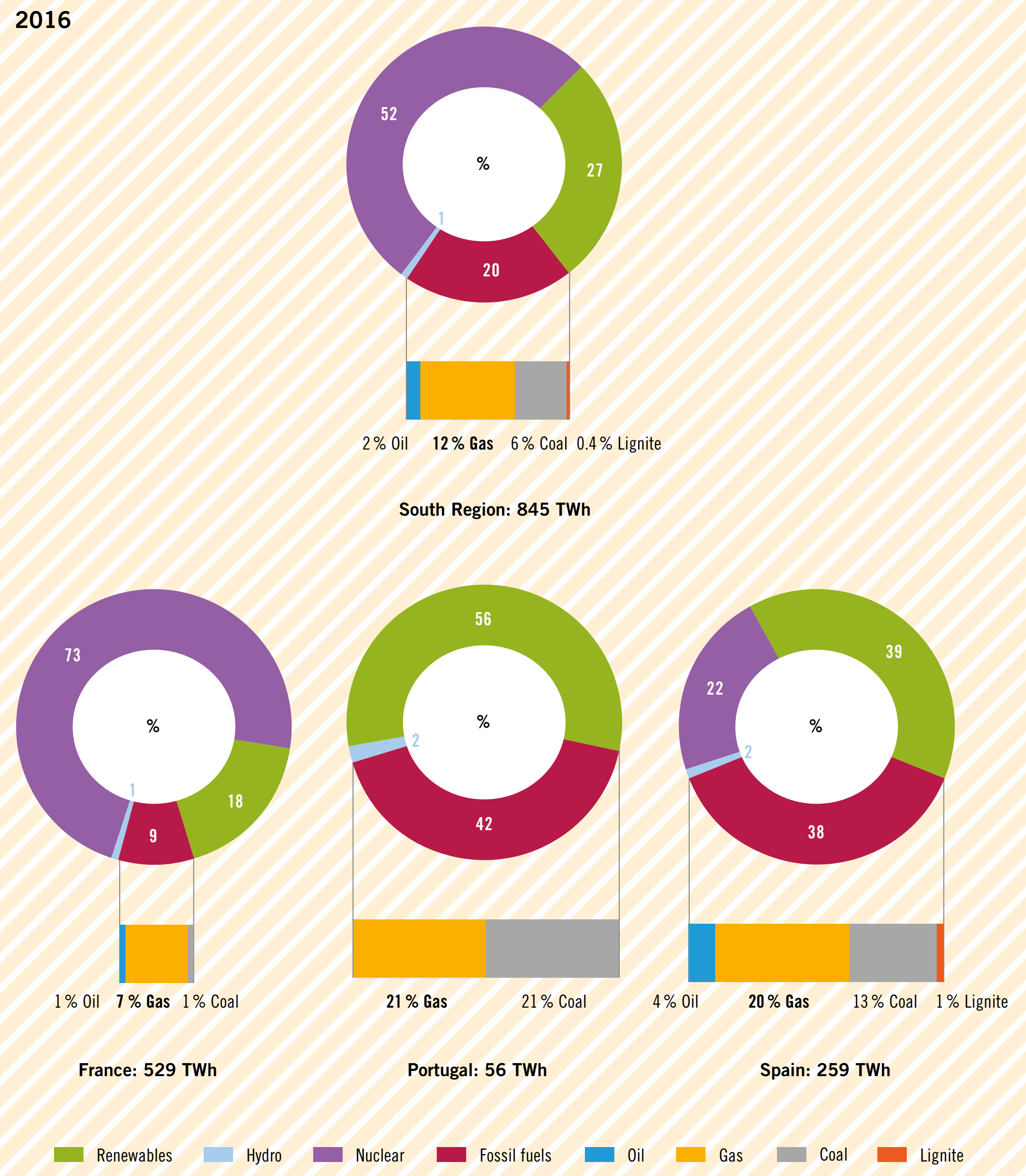


Figure 3.6: Yearly electricity generation by technology in 2015 and 2016 (TWh) for the South Region, France, Portugal and Spain (Data provided by ENTSO-E)


2016
52
27
20
1
%
2 % Oil
12 % Gas
6 % Coal
0.4 % Lignite
South Region: 845 TWh
73
18
9
1
%
1 % Oil
7 % Gas
1 % Coal
France: 529 TWh
56
42
2
%
21 % Gas
21 % Coal
Portugal: 56 TWh
39
22
38
2
%
4 % Oil
20 % Gas
13 % Coal
1 % Lignite
Spain: 259 TWh
Renewables
Hydro
Nuclear
Fossil fuels
Oil
Gas
Coal
Lignite

Gas demand can vary through the year, the week and daily due to meteorological conditions, competing sources of energy, economical and residential activities. Therefore, demand fluctuations can be categorized by the period over which the variation in supply is required, in general in the year, the week, and the day.

Figure 3.7 shows the modulation in demand in the South Region with:

- fluctuations in the year mainly caused by the weather conditions when the gas is used for heating,
- weekly cycle due to the economic activity,
- and intra-daily factors linked to the economical and residential activities, and also fluctuations in other power generation, in particular, when CCGT are used as backup of intermittent renewable power generation (mainly wind).

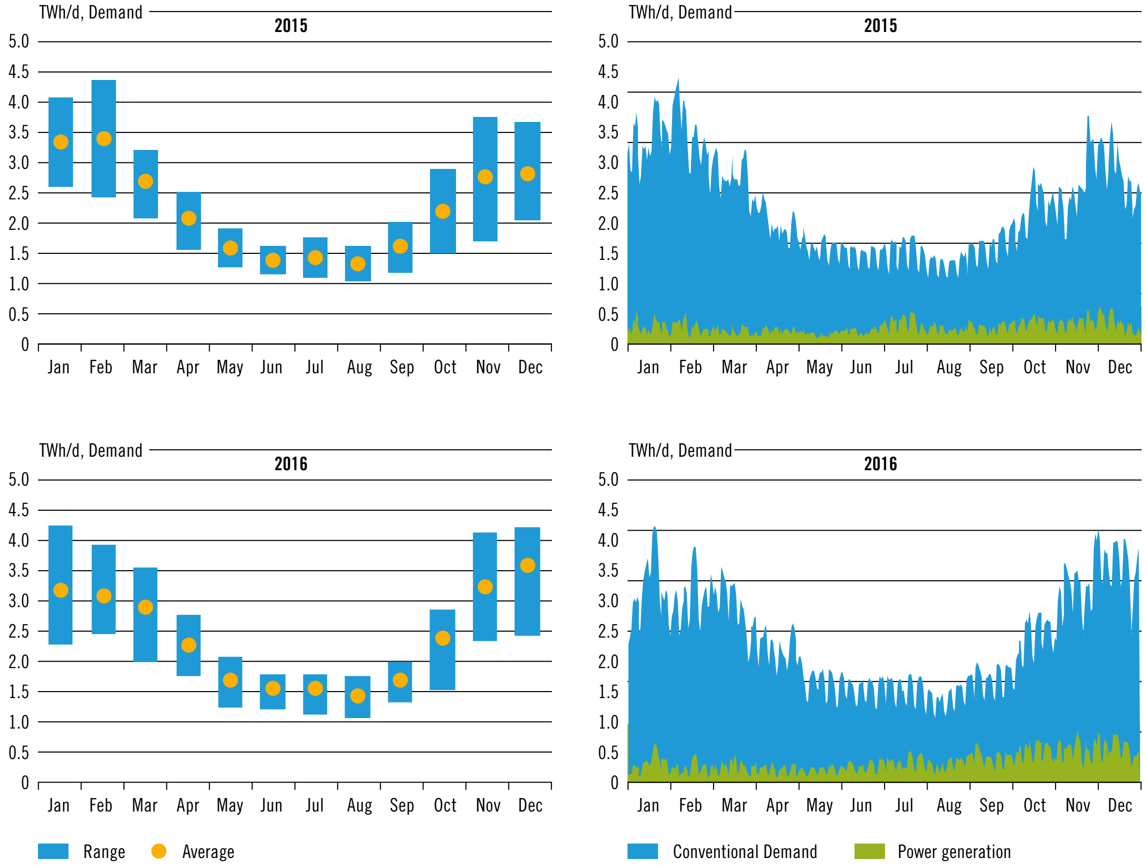


Figure 3.7: Total demand for gas in the South Region by sectors (2015 and 2016).
The graphs on the left show seasonal variation and intra-month variations. Graphs on the right show daily resolution.
(Source: ENTSOG TYNDP 2017 data, own elaboration)

Demand behavior is not homogeneous across each of the South Region composite countries.

Each country's profile is shown below in Figure 3.8 as a ratio between daily demand and total annual demand so that they can be compared on the same scale.

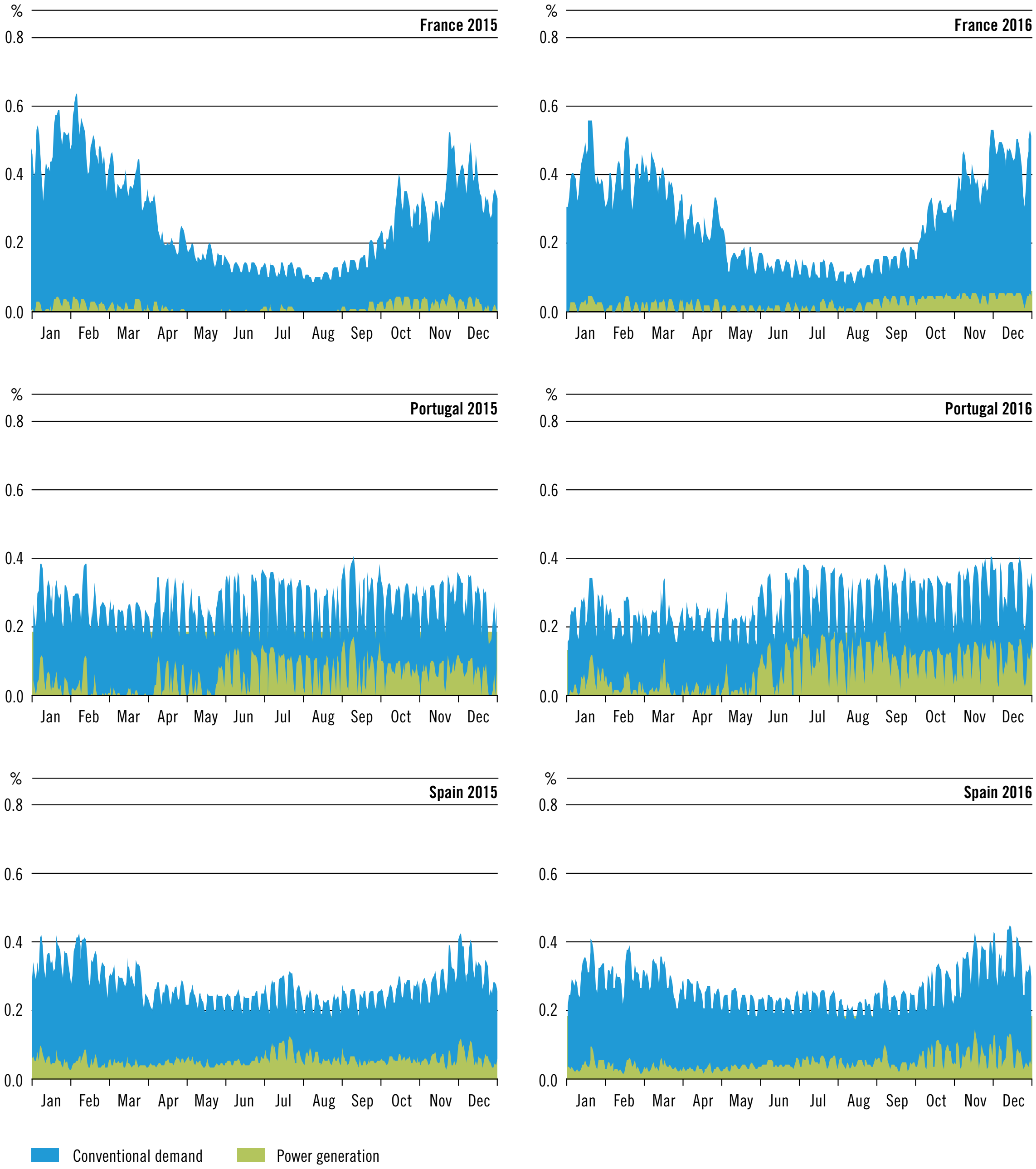


Figure 3.8: Modulation by country. Ratio Day/Year in 2015 and 2016. (Source: ENTSOG TYNDP 2017 data, own elaboration)

As it can be seen, each country demand has a different variation on a seasonal basis which is mainly due to different share of the residential and commercial sector (which represents more than half of the yearly demand in France as an example), stressed by different climate conditions. On the other hand, the weekly modulation is higher in Spain and Portugal, which is mainly due to Spain and Portugal both using gas more for power generation and industry.

The gas demand for power generation in 2015 and in 2016 is shown in Figure 3.9. It shows how the demand for power generation fluctuates a lot less with the seasons compared to the conventional demand (shown in Figure 3.8). It also shows the huge range found in the demand values explained by the role played by gas for power generation in providing flexibility for the electrical system demand modulation, in particular to deal with the intermittency of some renewable power generation (mainly for wind and solar sources).

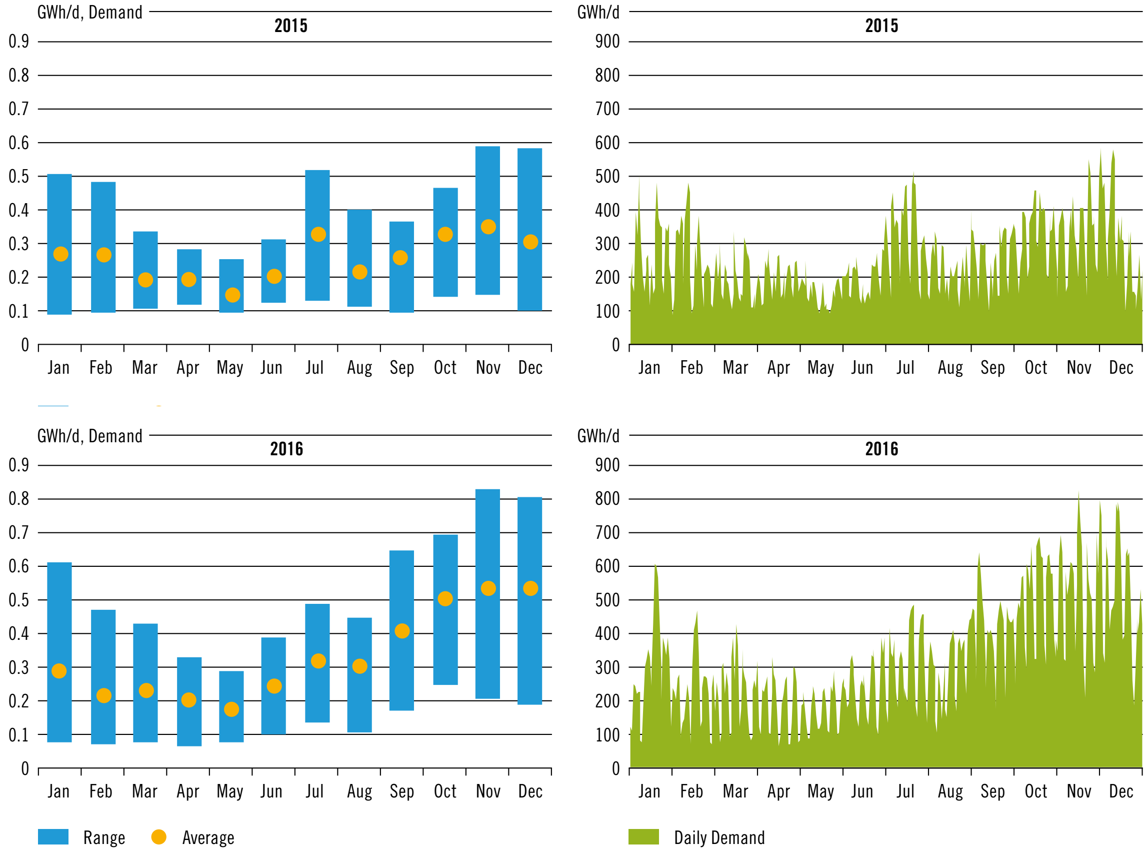


Figure 3.9: Gas Demand for power generation in 2015 and in 2016 in the South Region. (Source: ENTSOG TYNDP 2017 data, own elaboration)

In the South Region, the combined cycle gas turbines (CCGTs) are playing an important role as a support in the development of renewable energy production. Intermittency and unpredictability of renewable energy sources like wind require a flexible back-up. CCGTs can provide efficient flexibility and therefore makes the CCGT an enabler to introduce the development of renewable energies.

Nevertheless, gas for power generation is in competition with other sources of electricity, and the role of gas in electricity generation can vary according to the hydrologic regime, the gas prices (compared to other sources of power and flexibility, such as coal), the electricity demand and prices, and political decisions (price of CO_2 permits, subsidies on renewable energy, etc.).

The yearly modulation factor is defined as the daily average gas demand divided by the daily peak demand. A high yearly modulation factor means demand is relatively uniform, even in peak situation. A low yearly modulation factor shows that a high demand is set; to service that peak demand, capacity is sitting idle for long periods.

As it can be seen in Figure 3.10, France's total yearly modulation factor is lower compared to Portugal and Spain. This is mainly due to the seasonal modulation in France that is much less pronounced in Portugal and Spain. To cope with this seasonal modulation, France has developed important underground storage facilities.

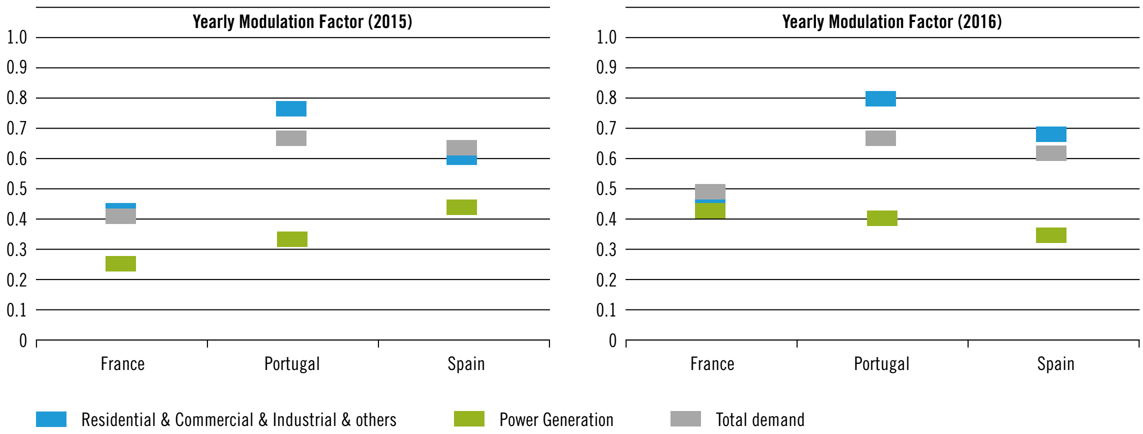


Figure 3.10: Yearly modulation factor for Final Demand (Residential & Commercial & Industrial & others), Power Generation demand and Total Demand, for France, Portugal and Spain (Source: ENTSOG TYNDP 2017 data, own elaboration)

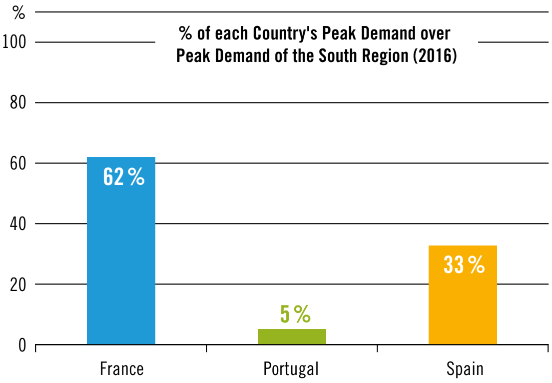


Figure 3.11: Share of each country (France, Portugal and Spain) in the peak demand of the South Region (Source: ENTSOG TYNDP 2017 data, own elaboration)

3.2 Demand Scenarios

In this section, it will be shown the most updated trend of the long-term demand scenarios for the South Region, and an analysis of deviations in comparison with the long-term forecast scenarios included in the TYNDP 2017 will be developed.

For power generation, it was used data from ENTSO-E TYNDP 2016 during the development process to create consistent scenarios. Each scenario of TYNDP 2017 is linked to demand for power generation relevant to the Visions (ENTSO-E TYNDP 2016).

ENTSOG Scenario	ENTSO-E Vision	IEA Scenario
Slow Progression	Vision 1	WEO 2015 Current Policies
Blue Transition	Vision 3	WEO 2015 New Policies
Green Evolution	Vision 4	WEO 2015 450
EU Green Revolution	Vision 4	WEO 2015 450

Table 3.1: ENTSOG scenarios vs ENTSO-E visions (Source: ENTSOG TYNDP 2017 data)

Image courtesy of Reganosa

ENTSOG has applied a methodology, to help TSO's use the data from ENTSO-E to determine the gas demand required for power generation, the thermal gap approach of coal and gas generation in order to account for specificities within countries or accurately reflect the merit order of the scenarios, which may not have been reflected in the visions.

The implementation of this methodology requires a significant number of assumptions, including electricity generation from alternative sources, the electricity exchange with neighbouring countries, assumptions regarding the usage of CHP (those facilities earn their money in both the heat and the electricity market) and limitations in the utilisation of coal and gas. These assumptions are based on the actual electricity mix, along with feedback from stakeholders and inputs from TSOs, reflecting the specific factors for each country.

The long-term evolution of gas demand depends on many factors, including demography, macroeconomic parameters, energy and emissions prices as well as targets set by energy and environmental policies. For TYNDP 2017, two main axes were considered, Economic Growth and Green Ambition.

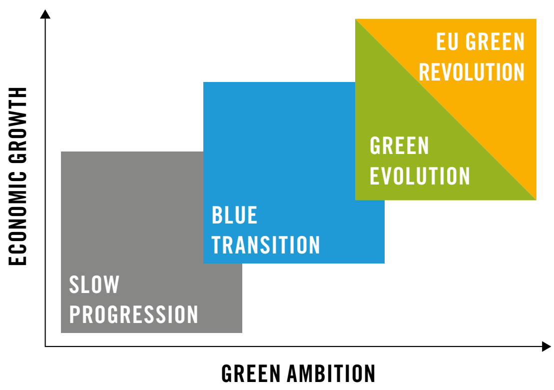


Figure 3.12: TYNDP 2017 Demand Scenario Axis Diagram (Source: ENTSOG – TYNDP 2017)

Based on these two axes, four scenarios were created: from Slow Progression, where there is little to no stimulus to change the energy sector radically from what we see today, to the Green scenarios where decarbonisation targets have caused fundamental changes to the energy background.

The Green Evolution scenario represents the standard bottom-up data collection process from TSOs, while EU Green Revolution was developed using a combined approach between TSO bottom-up data and top-down adjustment with EU climate targets that could be achieved earlier leading to a faster decline in gas consumption with which to perform TYNDP assessment.

In this chapter, results are shown for every scenario. Each of the scenarios had a storyline developed to reflect a possible future of gas demand.

SLOW PROGRESSION (SP)

The economic growth is limited in this scenario. Penetration of RES is at the lowest level as the incentives for renewables are limited in combination with a low CO_2 price. Green solutions are mostly not implemented due to economic reasons; energy efficiencies are at the slowest level of improvement. Overall, this scenario shows stagnation in natural gas demand at EU level.

BLUE TRANSITION (BT)

This scenario shows efficient achievement in terms of green ambitions under a context of moderate economic growth. Thus, the penetration of RES is higher than in the Slow Progression scenario but does not reach the level of the Green scenarios.

GREEN EVOLUTION (GE)

This scenario is characterised by favorable economic conditions and high green ambitions with high RES development. Realisation of environment targets and their fulfilment is set at a high priority and backed by public acceptance but are dealt with using more national policies than in the EU Green Revolution scenario. The European economy is prospering enabling a high support for renewable energy in the long-term perspective. This scenario is on track with the EU 2050 targets. Efficiencies for current technologies undergo a fast development, the CO_2 price is at highest level. The internal energy market is well working, European member states are characterised by a strong cooperation, especially regarding the reduction of CO_2 emissions.

EU GREEN REVOLUTION (EUGR)

This scenario is characterised by favorable economic conditions and high green ambitions with high RES development. The internal energy market is well working, where European member states have a strong cooperation, especially regarding the reduction of CO_2 emissions. Infrastructure projects which have a positive impact to reach the environmental targets will be commissioned in time.

For the South Region, there are some specificities and methodologies to calculate the demand to incorporate in the scenarios defined by ENTSOG for TYNDP 2017.

ES (SPAIN)

An increase in the final demand is expected related to the growth of new industrial and residential customers (fuel substituted by gas).

About power generation, for the Blue Transition scenario, a shutdown of coal fired power plants was considered, and RES and non-RES capacity are high. For the Green Evolution, a high capacity for RES and non-RES is expected. In the Slow Progression, the gas consumption will decrease and RES and non-RES will increase.

FR (FRANCE)

All scenarios are consistent with GRTgaz's and TIGF's Network Development plans for the 2015–2024 period. For the final gas demand a decrease is expected because of the enhancement of energy efficiency in households and the industrial sector (slow progression and blue transition scenarios). In the Green Evolution, the new environmental directives (reduction of fossil fuel consumption) were taken.

About power generation, for the scenarios Slow Progression and Top-down Green Evolution, TSOs use their lowest trajectory, with a stagnation. For the Blue Transition, the energy transition scenario was set in accordance with RTE's new mix scenario.

PT (PORTUGAL)

For the final gas demand, the main drivers for estimation are national policy, GDP (Gross Domestic Production), GVA (Gross Value Added) of the different sectors of the economy, the available income of the families and the extension of the NG networks in the country.

About power generation demand, from 2017 to 2030, the main driver for gas consumption is the decommissioning date of the two existing coal-fired power plants, which will be determined by the will of its promoters and the energy policy defined by the Government.

For the Slow progression scenario, the later decommissioning of the two existing coal-fired power plants and medium electricity demand was considered. In the Blue Transition Scenario, the decommissioning of the two existing coal-fired power plants (gas before coal) was considered earlier and high electricity demand too. In the Green Evolution scenario, the early decommissioning of the two existing coal-fired power plants (gas before coal) was considered, as well as a medium electricity demand to account for a faster efficiency improvement and higher renewables contribution. There are no forecasts for 2035.

3.3 Demand data

The level of gas demand has been influenced by the development of the gas market and the specific climatic conditions over the years.

3.3.1. YEARLY AVERAGE DEMAND

The yearly average total demand is shown in Figure 3.13.

For the South Region, the Blue Transition and Green Evolution scenarios display a continually increasing trend across the time period, due to the closure of coal plants and merit order switch to gas following regulation designed to reduce CO_2 emissions from the power sector, combined with increased economic output and the development of RES. In the EU Green Revolution, gas demand is expected to slightly decrease after 2025. The Slow Progression scenario has a relatively stable gas demand, but less demand than the others till 2025, after that the EU Green Revolution is the scenario with less demand.

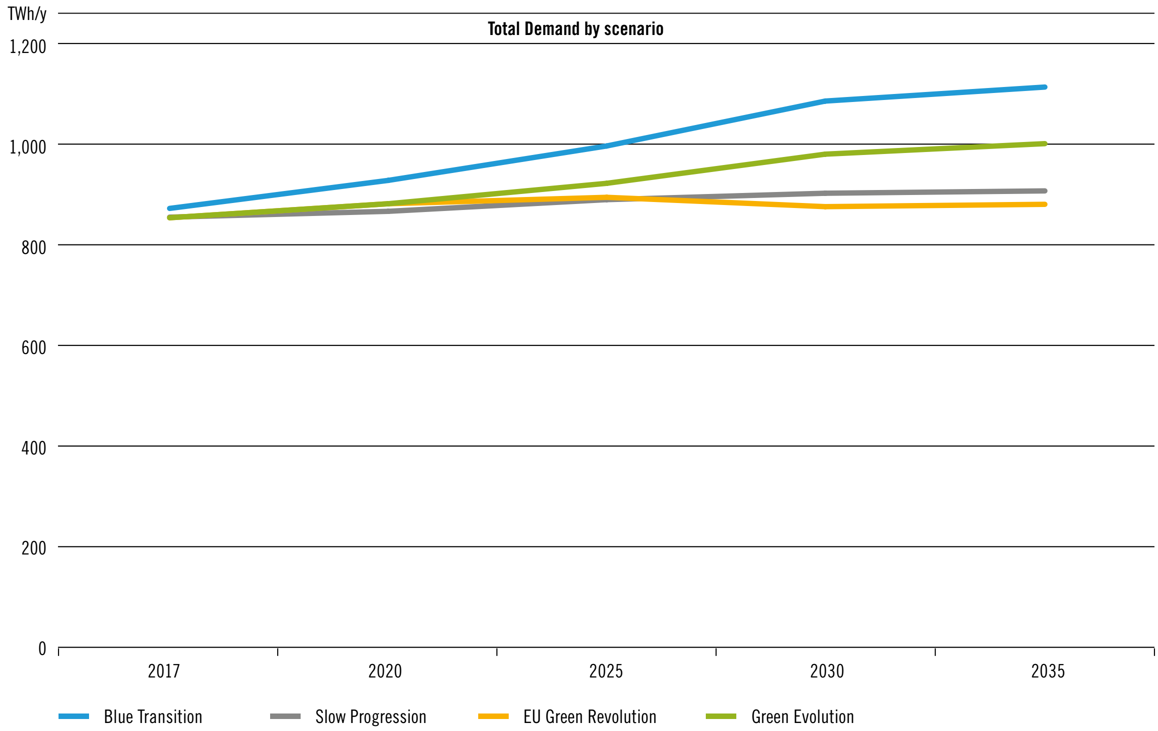


Figure 3.13: Yearly average total demand (Source: ENTSOG TYNDP 2017 data, own elaboration)

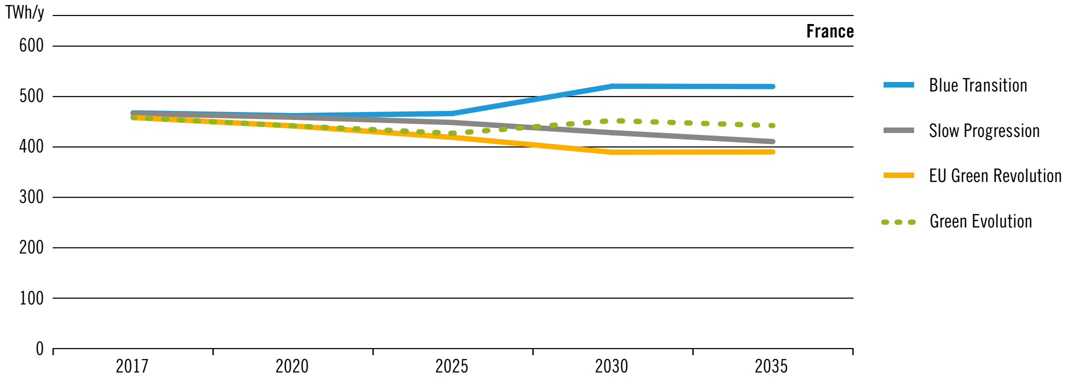


Figure 3.14: Total demand by country – France (Source: Data from TYNDP 2017, own elaboration)

For France, the demand is decreasing in most scenarios, especially in Slow Progression and EU Green revolution, whereas it is increasing in the Blue Transition Scenario and to a lesser degree in The Green Evolution scenario, pushed by a growing demand for power generation.

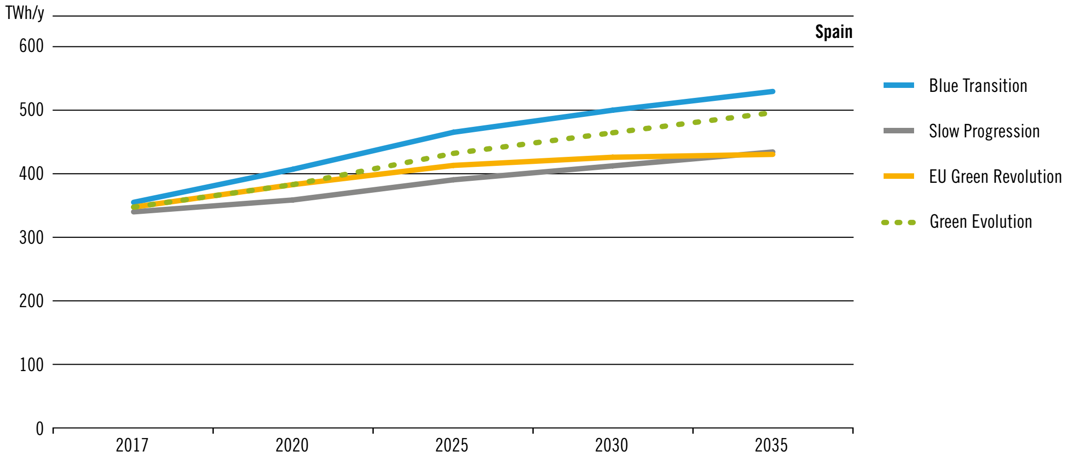


Figure 3.15: Total demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

For Spain, the demand increases in all scenarios, even for the Slow Progression situation. The EU Green Revolution is the scenario with the lowest demand increase.

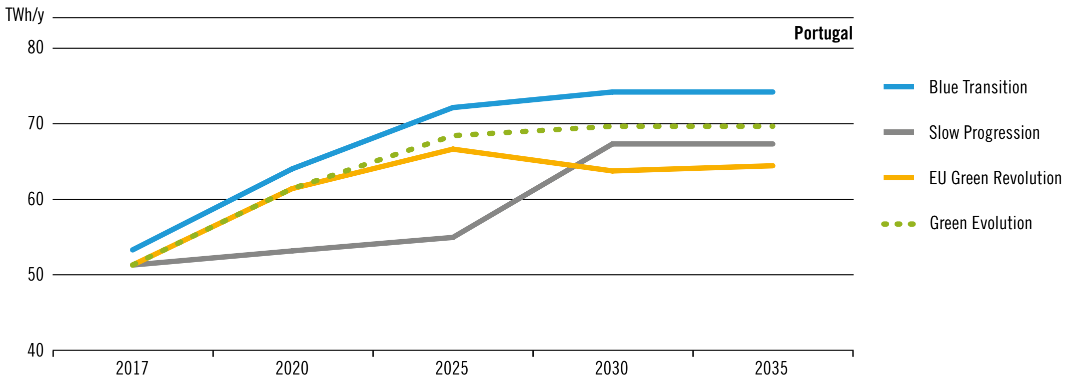


Figure 3.16: Total demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

In Portugal, the total demand increase for Blue Transition, Green Evolution and Slow Progression scenarios till 2030. The EU Green Revolution demand scenario decreases in 2030.

Final Demand (Yearly Demand Excluded Power Generation)

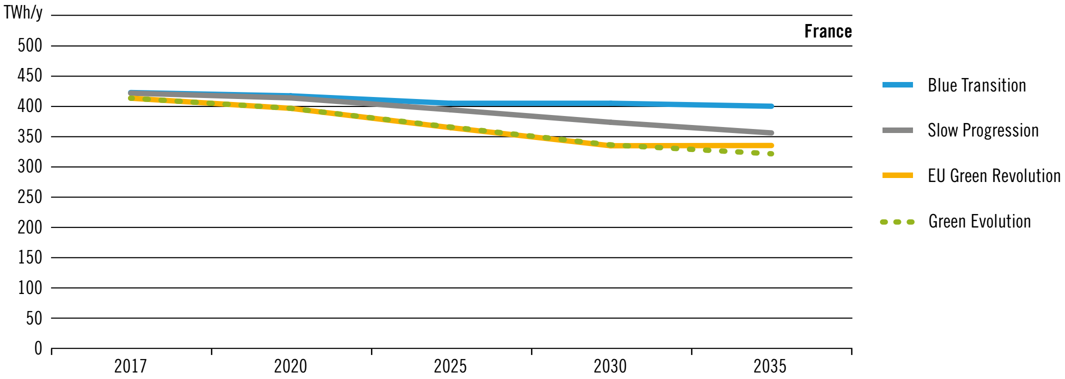


Figure 3.17: Final demand by country – France (Source: Data from TYNDP 2017, own elaboration)

In France, the final demand decreases in all scenarios due to energy efficiency in residential, commercial and industrial sectors, whereas demand for transport is increasing. The EU Green Revolution and Green Evolution have the same values, except after 2030.

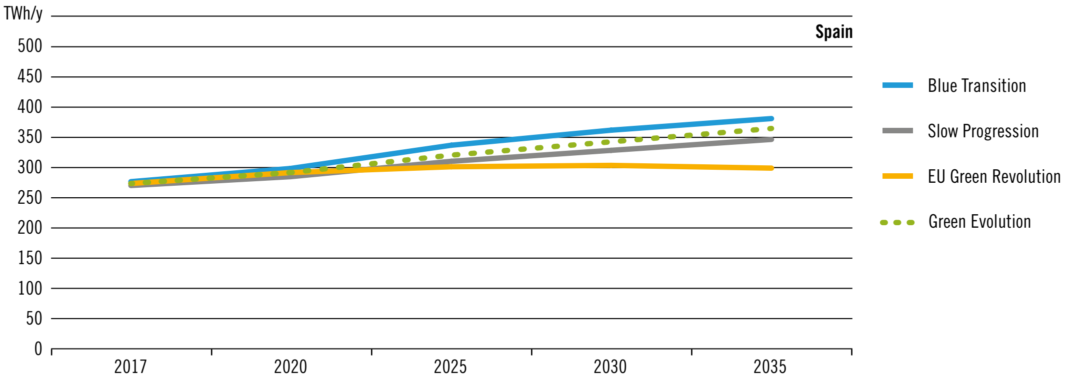


Figure 3.18: Final demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

For Spain, the final demand increases in all sectors and for the three scenarios. In the residential sector this increase is related to the rising number of final users and fuel switch of central heating`s. In the industrial sector, growth is related to new customers resulting from the increase of GDP. Additionally a moderate increase is expected in the transport sector The EU Green Revolution final demand increases less than the others and stabilises after 2030.

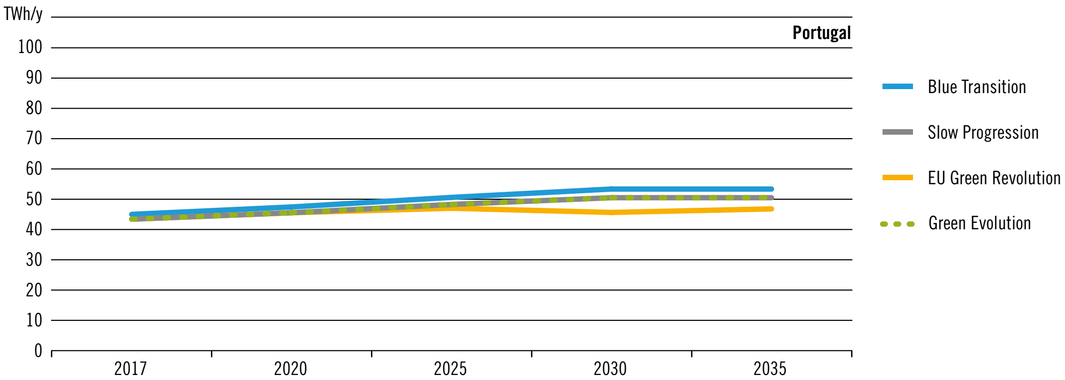


Figure 3.19: Final demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

For Portugal, the EU Green Revolution scenario has a slight decrease in 2030. In Portugal, the Green Evolution and Slow Progression scenarios have the same demand. In the Slow Progression scenario, less demand is expected due to the less favourable economic conditions and green ambition sees little growth or decarbonisation.

Power Generation Demand

In the power generation sector, all demand scenarios are showing a significant increase, which implies reductions in yearly CO_2 emissions.

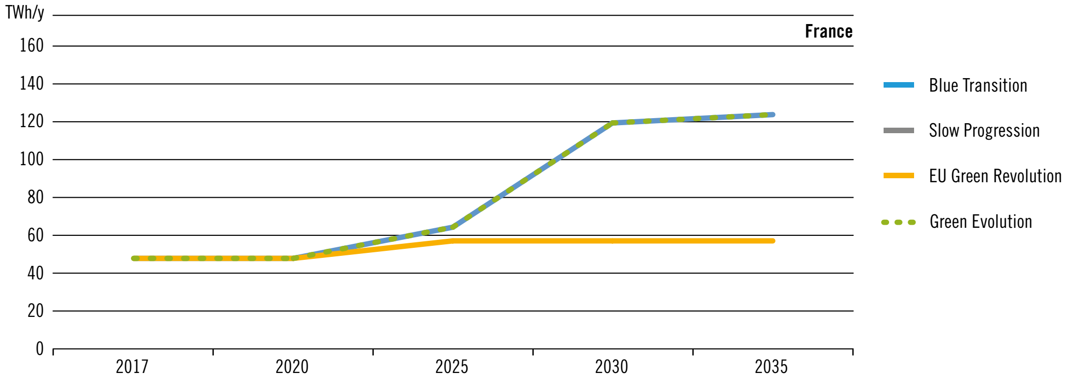


Figure 3.20: Power generation demand by country – France (Source: Data from TYNDP 2017, own elaboration)

In France, the Blue Transition and the Green Evolution scenarios are the same: the demand increases till 2030 and then stabilises. In the EU Green Revolution and the Slow Progression scenarios, starting from 2025, demand for power generation is assumed to remain stable (detrimental context for gas fired power plants).

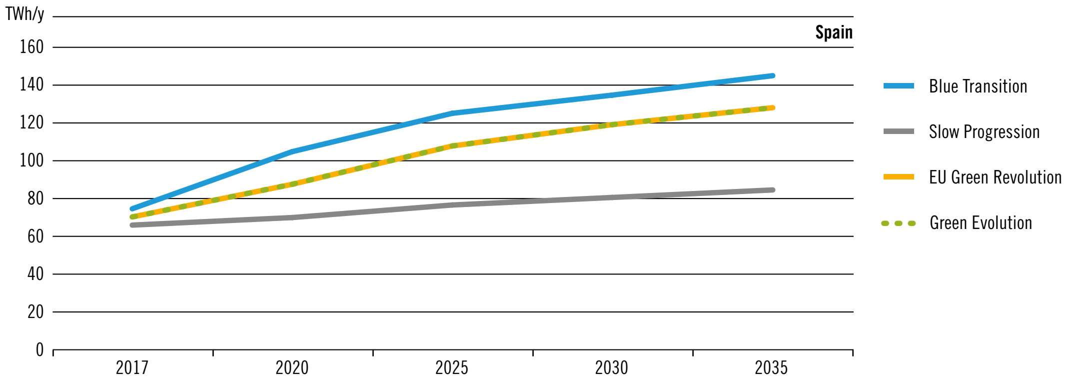


Figure 3.21: Power generation demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

For Spain, the demand increases for all scenarios, with more demand in the Blue Transition and less demand in the Slow Progression. In Spain, the EU Green Revolution and the Green Evolution have the same demand.

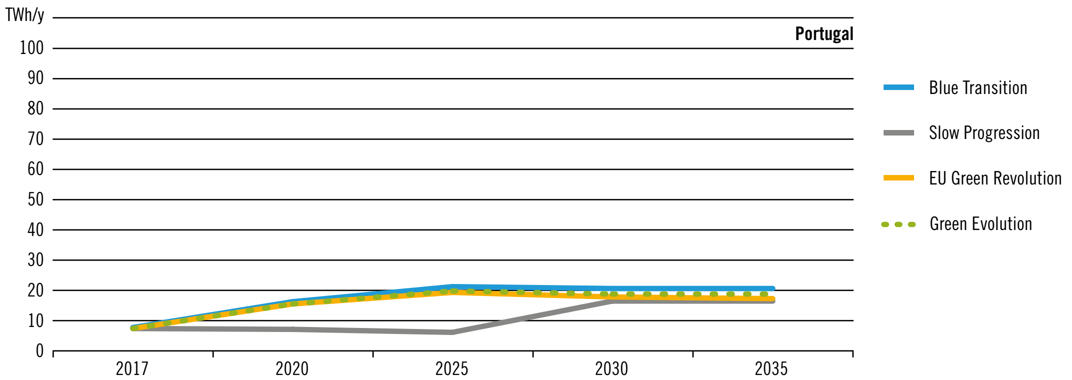


Figure 3.22: Power generation demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

In Portugal, the demand increases in all scenarios, but the Slow Progression Scenario has a special behavior, decreasing slightly until 2025, and then increasing in 2030 due to the decommissioning of the coal power plants before 2030. Slow Progression scenario is the only scenario with less demand for power because coal is expected to be a favored fossil fuel, rather than natural gas.

3.3.2 PEAK DEMAND

The peak demand represents one of the most stressful situations to be faced by the gas infrastructure (1-in-20 year situation for Iberian Peninsula and 1-in-50 year situation for France). It corresponds to the maximum level of gas demand used for the design of the network in each country to capture maximum transported energy and ensure consistency with national regulatory frameworks.

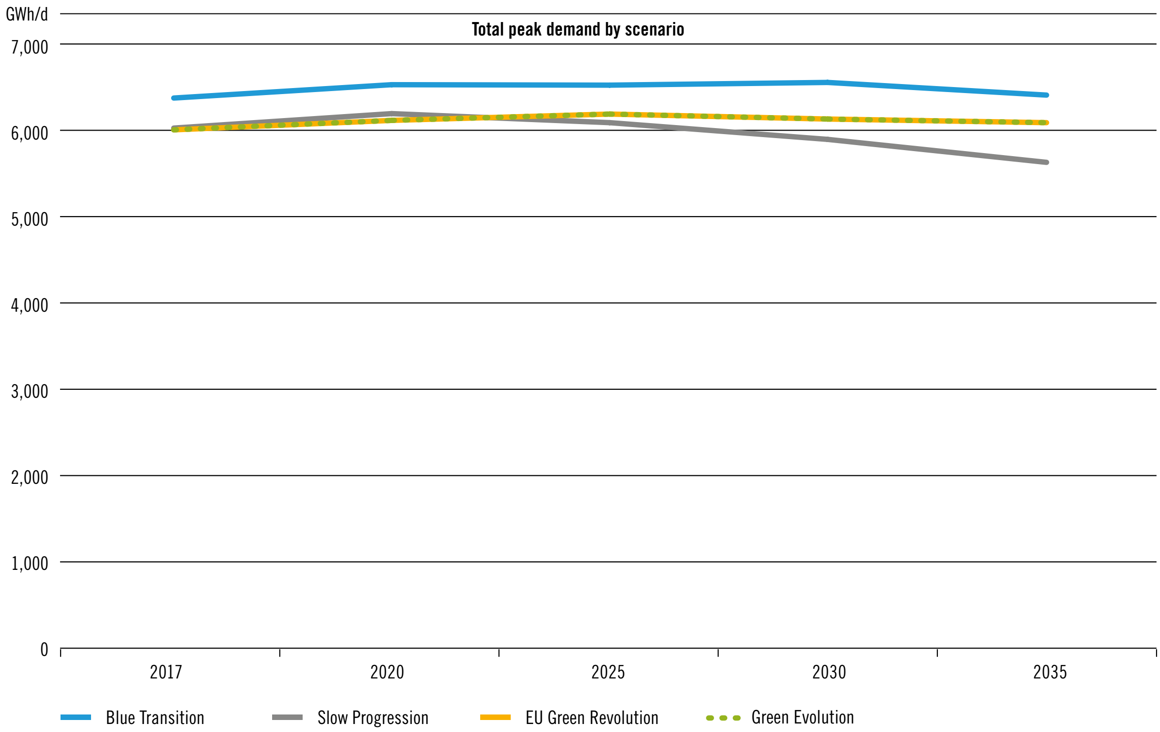


Figure 3.23: Total peak demand (Source: ENTSOG TYNDP 2017 data, own elaboration)

For the South Region, the EU Green Revolution and Green Evolution are the same. The Blue Transition is the scenario with more gas demand and in opposite the Slow Progression scenario with less gas demand.

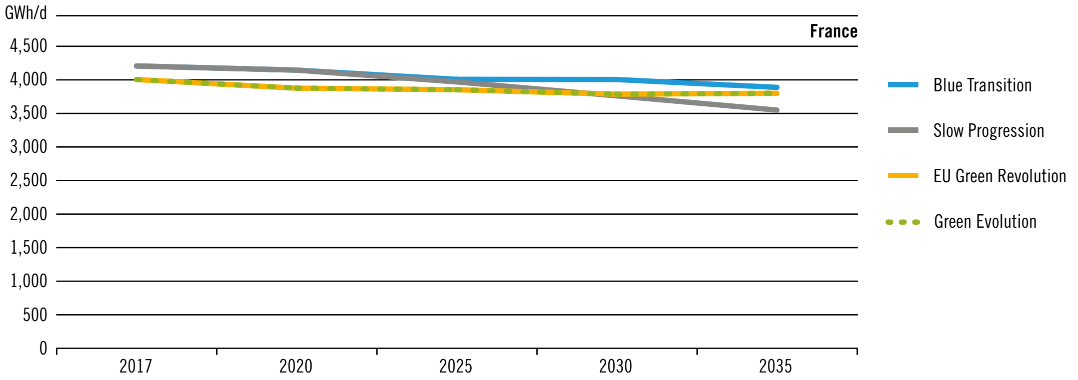


Figure 3.24: Total peak demand by country – France (Source: Data from TYNDP 2017, own elaboration)

The EU Green Revolution and the Green Evolution are equal for the three countries. In France, the peak demand decreases for all scenarios, more sharply in the Slow Progression scenario.

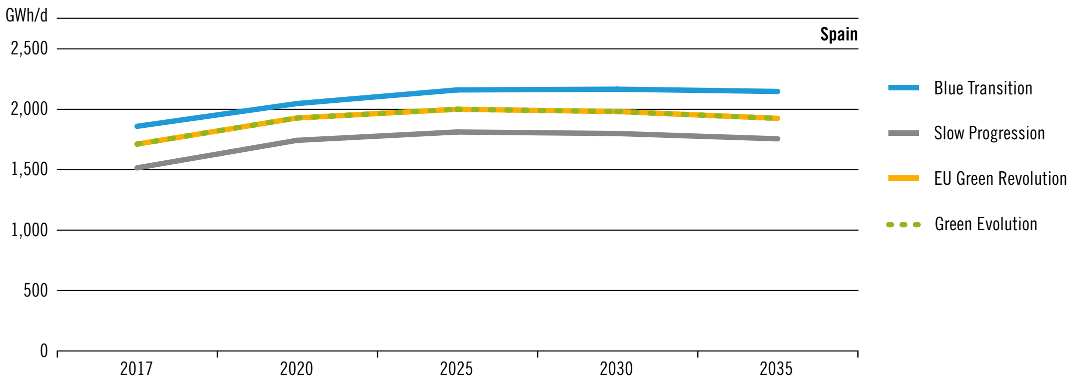


Figure 3.25: Total peak demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

In Spain, the peak demand increases in all scenarios, stabilising after 2025.

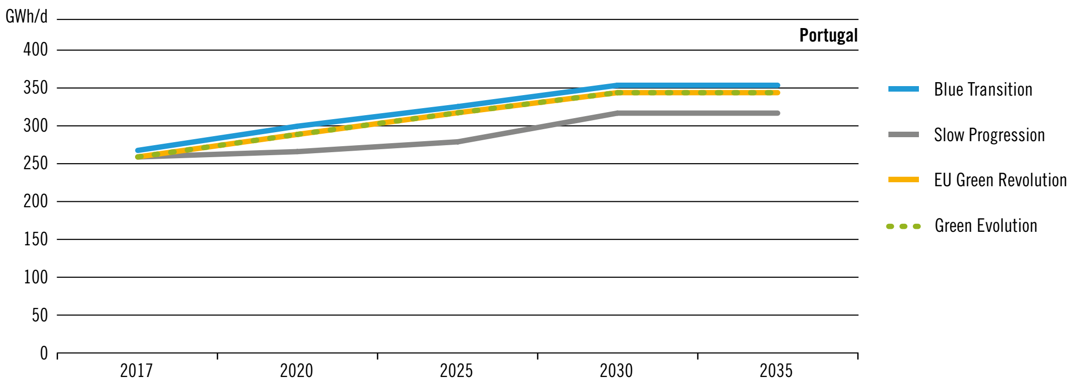


Figure 3.26: Total peak demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

For Portugal, the peak demand increases, too.

Final Peak Demand (Peak Demand Excluded Power Generation)

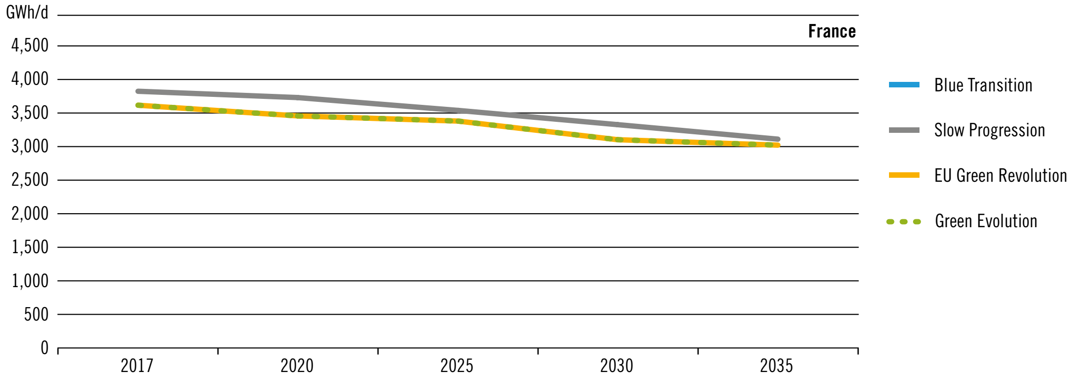


Figure 3.27: Final peak demand by country – France (Source: Data from TYNDP 2017, own elaboration)

In France, the final peak demand decreases in all scenarios. The EU Green Revolution is the same for Green Evolution. The Blue Transition demand is equal to the Slow Progression demand.

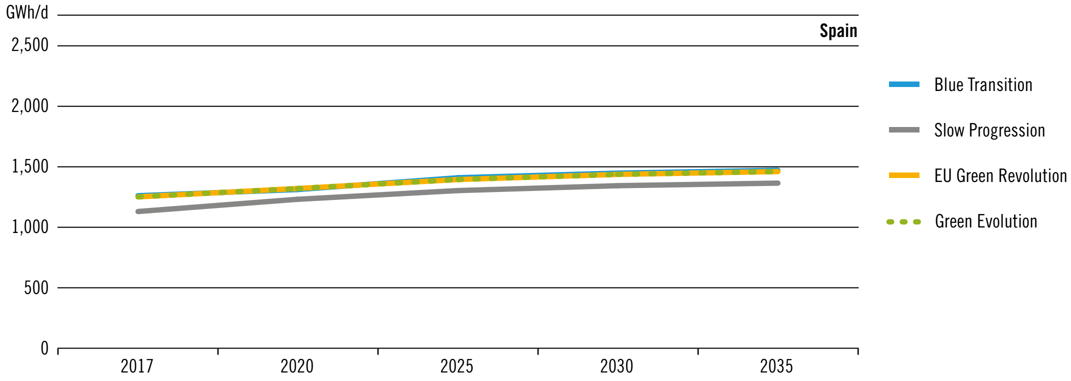


Figure 3.28: Final peak demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

In Spain, the demand increases for all scenarios, with a slight stabilisation at the end of the analysed period. The Blue Transition scenario is similar to the EU Green Revolution, which is coincident with Green Evolution scenario.

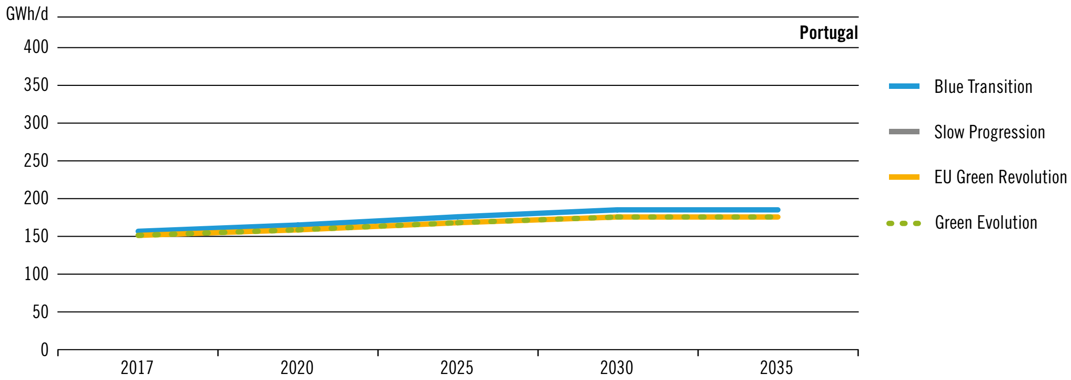


Figure 3.29: Final peak demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

For Portugal, the peak demand increases until 2030 (the Slow Progression scenario is coincident with Blue Transition Scenario, and the Green Evolution Scenario is coincident with the Green Revolution scenario).

Power Generation Peak Demand

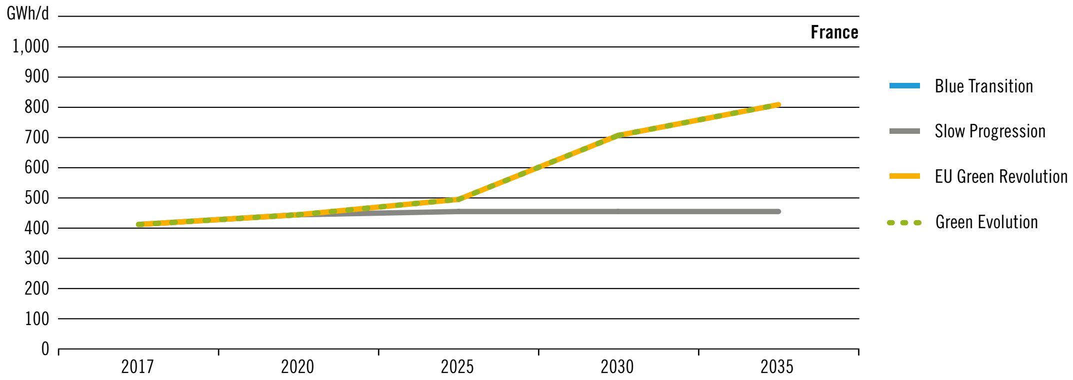


Figure 3.30: Power generation peak demand by country – France (Source: Data from TYNDP 2017, own elaboration)

For France, the power generation peak demand increases only for EU Green Revolution, which is coincident with Green Evolution. The Blue Transition scenario has the same demand that Slow Progression scenario, but these ones stay stable for all period.

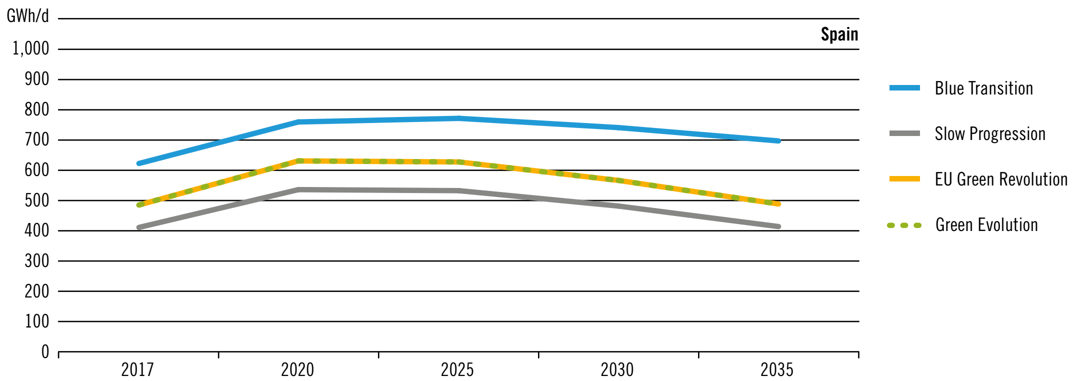


Figure 3.31: Power generation peak demand by country – Spain (Source: Data from TYNDP 2017, own elaboration)

In Spain the power generation peak demand increases till 2020, then starts decreasing in all scenarios.

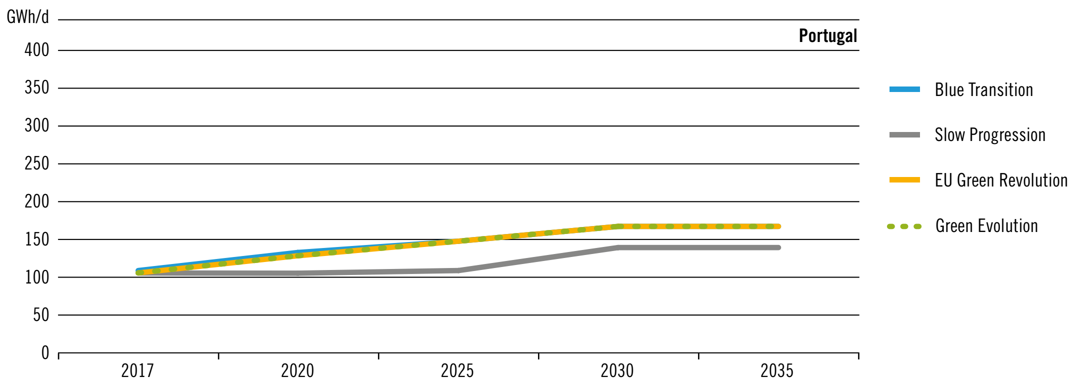


Figure 3.32: Power generation peak demand by country – Portugal (Source: Data from TYNDP 2017, own elaboration)

In Portugal, the peak demand increases for the Blue Transition and EU Green Revolution scenarios (this one is equal for the Green Evolution), and they coincide after 2025. In the Slow Progression scenario, the demand increases slightly until 2025 but significantly in 2030 due to the decommissioning of the coal power plants.

4 Supply

Image courtesy of REN

4.1 Regional Overview

With domestic gas production practically non-existent in Spain and Portugal, as well as in France since the shutdown of the Lacq gas field in 2013, the South Region imports nearly all of its natural gas consumption.

In 2015, 74 % of the natural gas imports in the South Region were delivered through pipelines, while the remaining 26 % were imported as LNG (see figure 4.1). While low compared to past averages (LNG represented 49 % of South Region gas imports in 2010), the share of LNG imports in the region remains higher than the European average (12 %, or 20 % for countries with LNG terminal). Furthermore, this distribution varies significantly from country to country: LNG accounts for 40 % of Spanish supply, 31% of Portuguese supply and 16 % of French supply (see figure 4.2), with a differentiated importance between the two French hubs: LNG is currently essential to the supply of TRS (39 % of supply), and marginal in PEG Nord (3 %).

The South Region gas sources are primarily non-European countries. This will become even truer in the coming years given the projected decline of EU indigenous production.

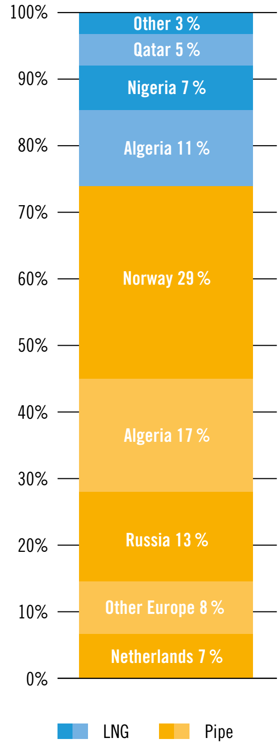


Figure 4.1: Breakdown of supply to the South Region in 2015 (Source: BP Statistical Review 2016)

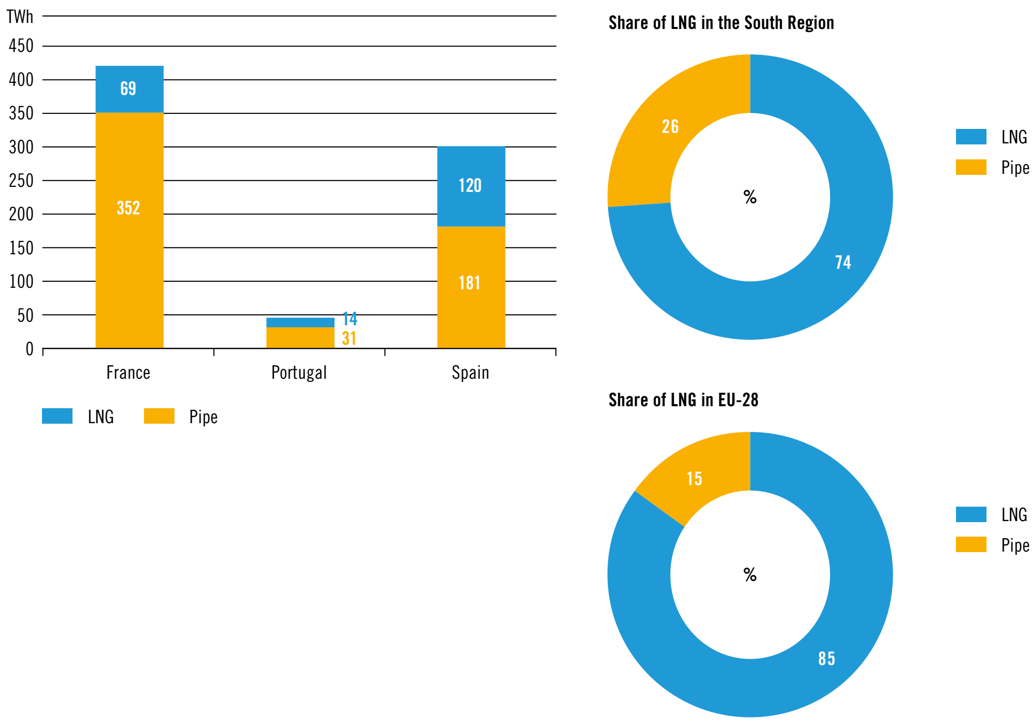


Figure 4.2: Share between pipeline and LNG in the South Region in 2014 in TWh (Source: Eurogas 2015 Report, 30 March 2016)

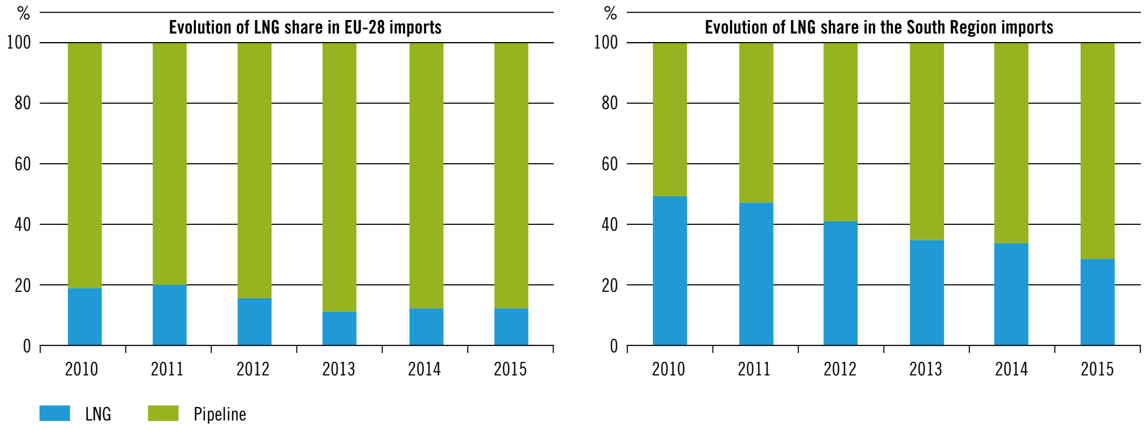


Figure 4.3: Evolution of the share of LNG supply to EU and the South Region from 2010 to 2015
(Source: BP Statistical Report and Direção Geral de Energia e Geologia for Portugal)

The South region has traditionally benefited from a highly diversified supply portfolio, in part due to the importance of LNG, which presents the advantage of connecting European markets to the wider world. High LNG prices spread in recent years have however led shippers to do some arbitrage in their supply portfolio.

With LNG prices falling worldwide, the share of LNG imports should once again increase in the region.

4.2 Pipeline Imports in the South Region

Pipeline gas in the South Region primarily originates from four sources, namely Norway, Russia, Algeria and the Netherlands, allowing for a fairly balanced and diversified supply portfolio (see figure 4.4).

Due to their level of interconnections, Spain, Portugal and South of France require imports of LNG in order to meet their gas needs. In situations where global LNG prices are high, as it was the case for the last five years, pipeline gas must serve as a viable source of supply.

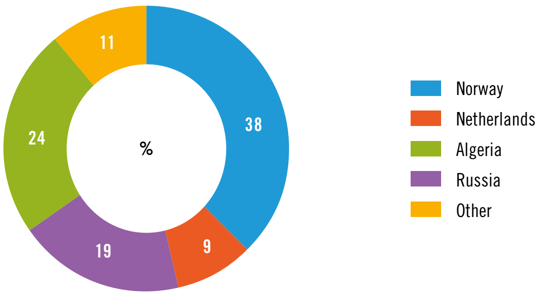


Figure 4.4: Breakdown of pipeline supply to the South Region in 2015 (Source: BP Statistical Review 2016)

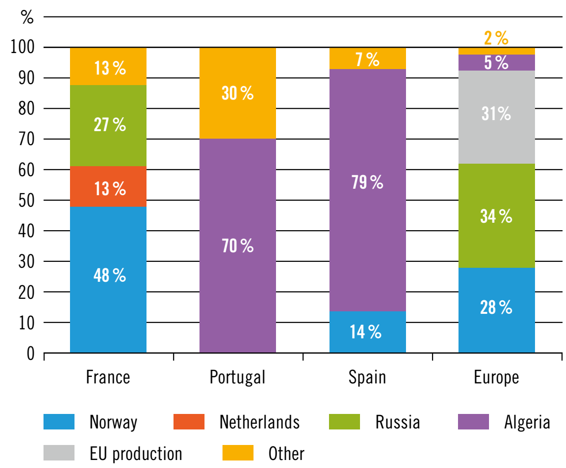


Figure 4.5: Origins of gas imported via pipeline to the South Region in 2015 (Source: BP 2016)

4.3 LNG imports in the South Region

In its liquid form, natural gas can be easily transported over large distances and re-exported towards the most profitable markets. It therefore traditionally serves as a connector between world gas markets and is highly sensitive to variations in global demand and prices.

Over the past five years, the global LNG market has been profoundly affected by the aftermath of the Fukushima nuclear catastrophe. Under the combined effect of high demand for gas in Asia and the shutdown of Japanese and South Korean nuclear power plants, a large portion of LNG shipments were redirected to Asia, which represented 75 % of world LNG imports in 2014. As a consequence, LNG deliveries to Europe were halved (see figure 4.6).

In 2015, worldwide LNG trade amounted to 245 million tons, of which 13 % was consumed by the European Union, 44 % going to the South Region. With LNG demand in Asia stabilising due to a combination of factor such as slow economic growth, energy efficiency, mild weather conditions and growing fuel substitution, LNG has started making a come-back in the EU, a trend that should continue in the coming years considering the new LNG liquefaction capacities going into production.

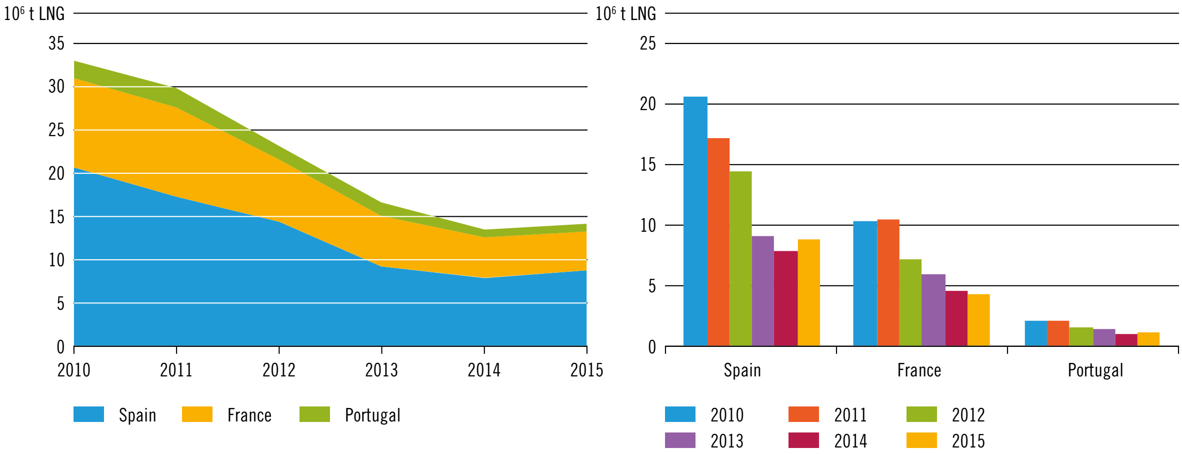


Figure 4.6: Imports in South Region, 2010 – 2015, 10^6 t LNG (Source: GIIGNL 2010 – 2016 reports)

South Region LNG comes primarily from Algeria (43 %, mainly to France), Nigeria (31 %, mainly to Portugal) and Qatar (18 %), while five additional LNG suppliers bring some diversity to the supply chain (see Figure 4.7). Algeria also represents the largest LNG supplier for France (76 %), and Nigeria the largest LNG supplier for Portugal (77 %), while Spanish LNG portfolio is more balanced (the largests suppliers are Algeria and Nigeria with a share of around 30 % each) as seen in Figure 4.7.

This distribution is set to change in the coming years with the launch of USA gas exports towards Europe in March 2016 (the two first American shipments to Europe were sent to Portugal and Spain). Furthermore, increased liquefaction capacity in Australia and slower demand for gas in Asia will most likely prompt Atlantic Basin and Middle Eastern producers to redirect LNG cargos to Europe and Middle East, further driving down prices.

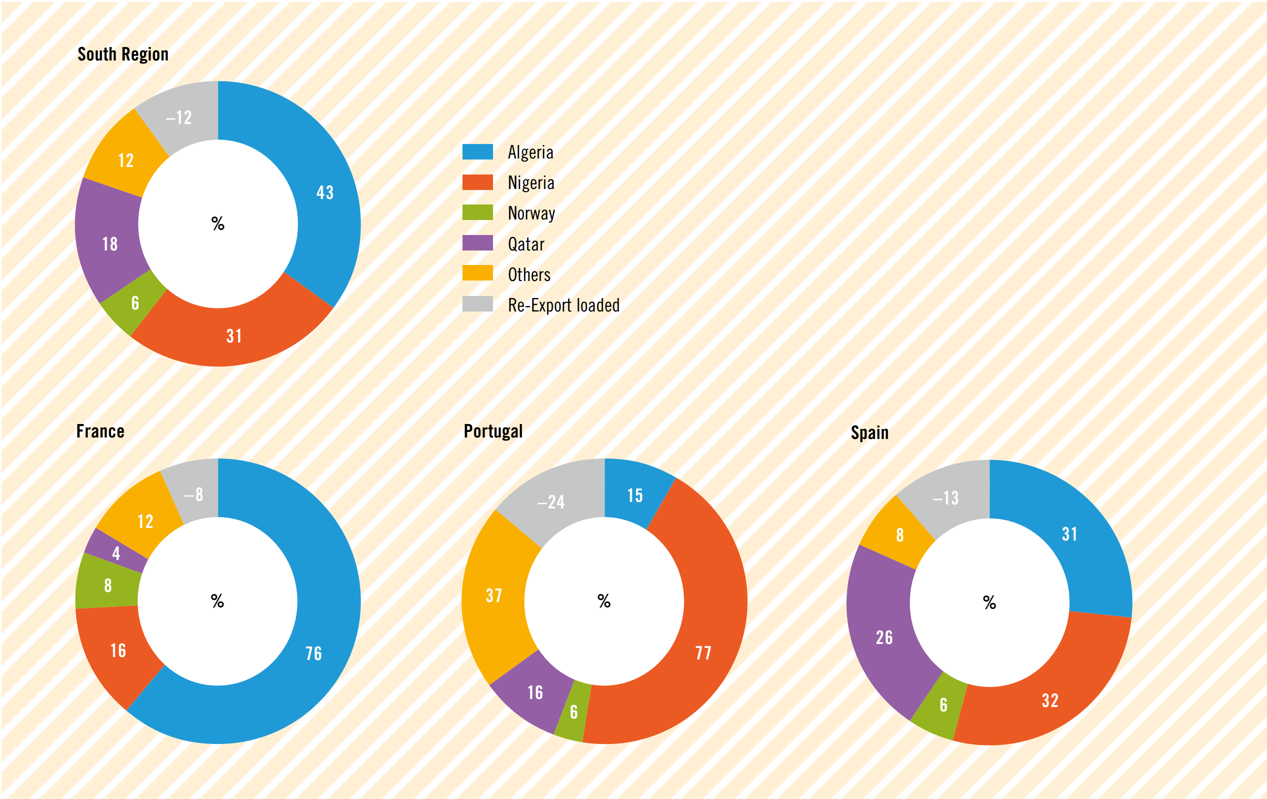


Figure 4.7: LNG source breakdown in the South Region in 2015 (Source: GIIGNL 2016)

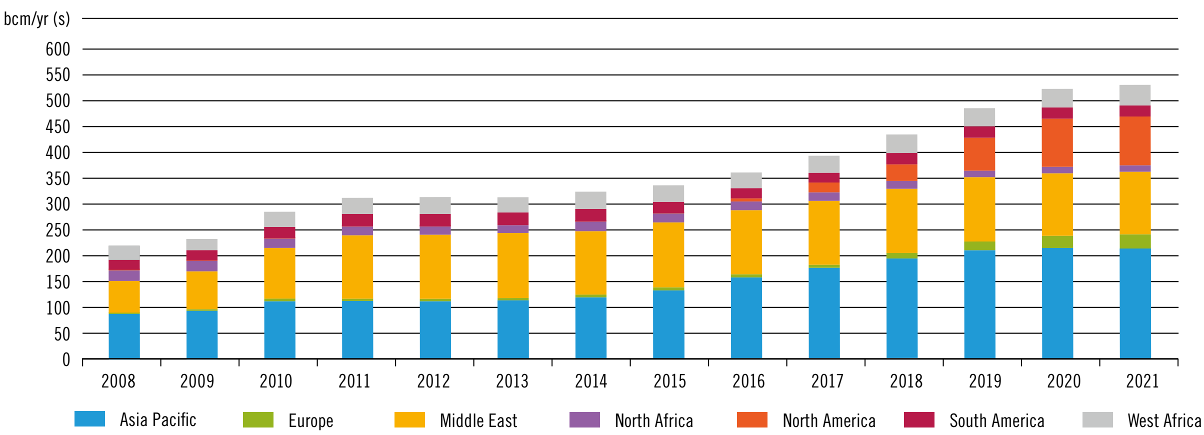


Figure 4.8: LNG liquefaction worldwide capacities constructed or under construction, bcm (Source: WoodMackenzie)

SHARE OF THE LNG WORLD MARKET IN 2015 (%)			
	WORLD	EU27	SOUTH REGION
Algeria	5%	3%	3%
Equatorial Guinea	2%	0%	0%
Nigeria	8%	2%	2%
Norway	2%	1%	0%
Trinidad & Tobago	5%	0%	0%
Atlantic Basin	22%	6%	5%
Abu Dhabi	2%	0%	0%
Oman	3%	0%	0%
Qatar	32%	8%	1%
Yemen	1%	0%	0%
Middle East	38%	8%	1%
Australia	12%	0%	0%
Brunei	3%	0%	0%
USA	0%	0%	0%
Indonesia	7%	0%	0%
Malaysia	10%	0%	0%
Papua New Guinea	3%	0%	0%
Peru	1%	0%	0%
Russia	4%	0%	0%
Pacific Basin	40%	0%	0%
Total	100%	14%	6%

Table 4.1: Share of each country as a supplier in trade for the World, EU-27, and the South Region (Source: GIIGNL 2016 report)

Given the EU's highly developed regasification capacities of 213 bcm/year, LNG is a reliable way to increase diversification of sources and ensure security of supply. In its communication from February 2016, on LNG and gas storage strategy, the EU commission confirmed its aim to improve access of all Member States to LNG as an alternative source of gas.[1] This goal was confirmed by a Resolution[2] from European Parliament on 25 October 2016, who underlined that priority should be given to market-based solutions.

1) https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v10-1.pdf

2) http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2016-0406+0+DOC+XML+V0//EN

4.4 Supply Potentials

European Union indigenous production is expected to reach its peak in 2020, and is set to decrease from 120 Gm³ in 2015 to 51 Gm³ in 2035 as is has been foreseen by ENTSOG for the TYNDP 2017, mostly due to an acceleration of the decline in the Netherlands and the North Sea. This will especially affect France, in which 9% of imported gas is L-gas produced in the Groningen gas field in the Netherlands where gas extraction is currently being slowed down to prevent earthquakes.

Gas production in Norway would remain stable over the coming years. However, in the absence of discovery of new gas fields, extraction will decrease by approximately 25 % by 2040 according to IEA predictions.

At present, the Iberian Peninsula is highly dependent on Algerian natural gas by pipeline (see figure 4.5). The current downward trend of Algerian exports (–37 % between 2005 and 2015, explained by increased Algerian domestic demand and uncertainty in the upstream's investments), could have significant impact in South Region. Therefore, it may be beneficial to ensure that access to other sources of pipe gas extends throughout the Southern Region, by way of the interconnections at the French and Spanish border.

In addition, the high level of regasification capacity in the South Region could help mitigate the potential decrease of Algerian imports.

Possible new sources of natural gas primarily include Russia, which could be exporting an additional 40 bcm to Europe in 2030 in the TYNDP 2017 "Maximum Scenario". LNG is also a potential supplier, especially given the highly developed regasification capacities in Europe.

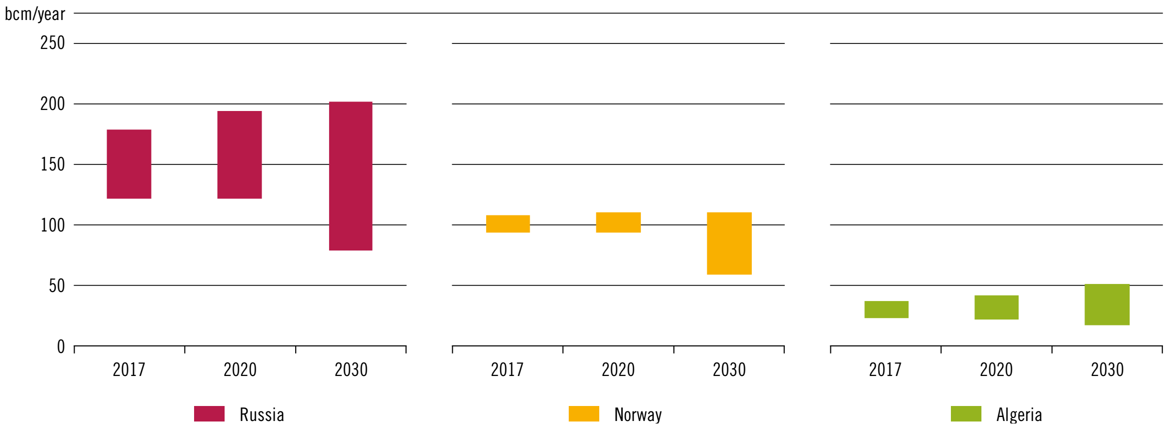


Figure 4.9: Supply potential forecasts to the EU 27 for Russia, Norway, and Algeria, bcm/year (Source: ENTSOG, TYNDP 2017)

5 Market Analysis

Image courtesy of Enagás

5.1 Descriptions of Hubs

The South Region has three organised gas markets: PEG Nord and TRS in France and PVB in Spain. Both French gas markets are operated by Powernext, whereas, the Spanish market, PVB, is operated by MIBGAS.

5.1.1 IBERIAN GAS MARKET

The Organised Gas Market in Spain has been stablished in December 2015, with the creation of a platform for trading gas products (MIBGAS) to be delivered at the Spanish Virtual Balancing Point (PVB) for different time horizons, and the designation of MIBGAS as the Organised Gas Market Operator.

In accordance with Spanish regulation, operational, cushion and heel gas is acquired at MIBGAS trading platform. Additionally, gas for balancing auctions is purchased or sold at MIBGAS trading platform. The different gas products that can be currently traded at MIBGAS are: within-day, day ahead, month ahead and balance of month product.

As MIBGAS is an emerging market with a relatively short run, the number of agents authorised for trading gas and traded volumes are still increasing day by day. Until January 2017, 45 agents have been registered on the Organised Gas Market.

With the objective of increasing the liquidity of the market, GUNVOR international B.V. Amsterdam has initiated, on a voluntary basis and for limited volumes, its activity as a Market Maker in the Organised Gas Market since January 2017.

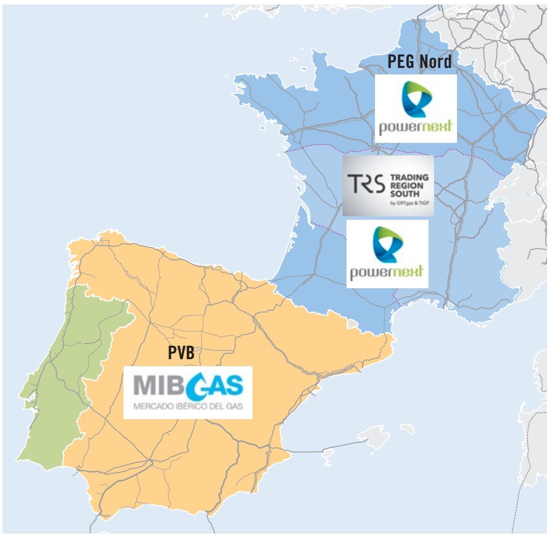


Figure 5.1: Gas Hubs and market operators in the South Region

5.1.2 FRENCH GAS MARKET

The PEG Nord hub ("Point d'Échange de Gaz") is the largest of the two trading regions in France. The TRS hub (Trading Region South) was launched on 1 April 2015. It is the product of the merger between the PEG Sud and the TIGF trading regions in the South of France, and is one of the first cases of successful market integration between gas hubs. The TRS was established with the aim of increasing the liquidity and depth of the southern French market. It is also part of a comprehensive plan overseen by the French National Regulator (CRE) to establish a unified trading zone for France in 2018.

PEG Nord and TRS constitute two balancing areas for shippers. PEGs allow both for a bilateral over-the-counter exchanges as well as exchanges on Powernext Gas. Different products can be traded at Powernext: within day, day-ahead, month-ahead. On PEG North monthly, seasonal, quarterly and yearly products can be traded up to two years ahead.

Around 94 customers are active on both hubs.

5.2 Liquidity

Volume of gas traded on French and Iberian Market have been growing steadily since their creation, reaching 911,3 TWh in 2016 (906 TWh in France and 5,3 TWh in Portugal and Spain).

The great difference of traded volume gas can be explained by the different maturity between markets: whereas Spanish gas market is only one year old, French gas markets were created one on 1 January 2009 (creation date for PEG-Nord) and TRS on 1 April 2015.

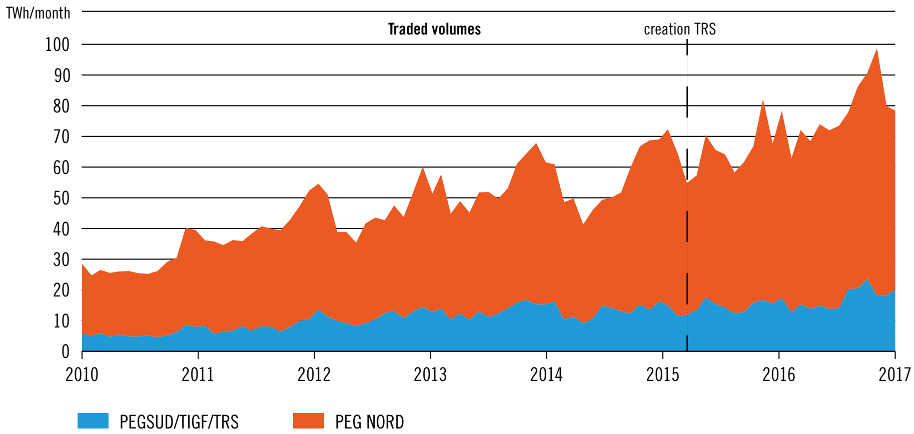


Figure 5.2: Traded Volume on all PEG, France (Source: TSO own elaboration)

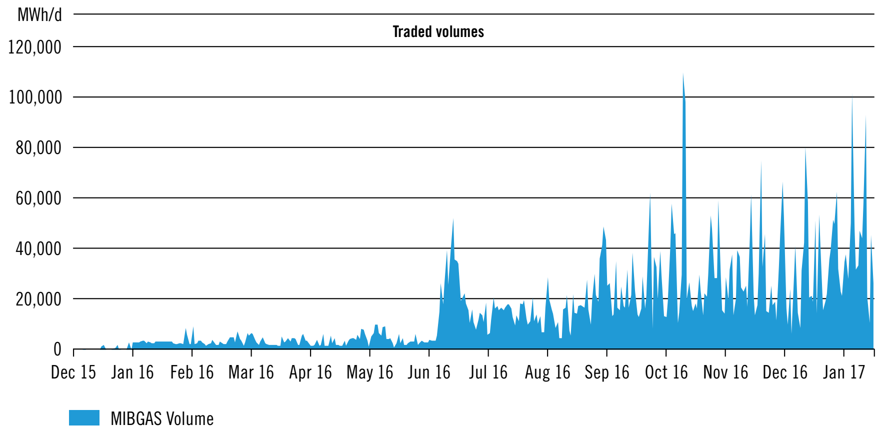


Figure 5.3: Traded volumes in MIBGAS, MWh/d (Source: TSO own elaboration)

The churn ratios (traded volume divided by physical volume) represents how many time a volume of gas is traded in average on a hub before consumption. In France, the churn ratio is stable, around four in average.

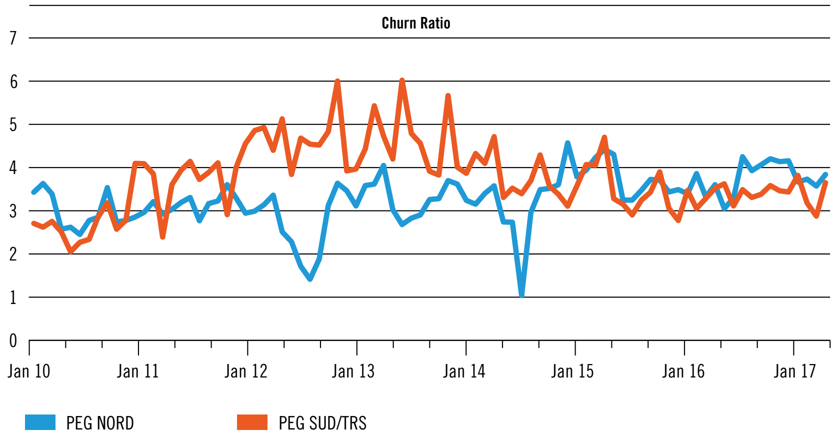


Figure 5.4: Churn ratio on all PEG, France (Source: TSO own elaboration)

Image courtesy of TIGF

5.3 Prices

5.3.1 EVOLUTION OF SPOT LNG PRICES IN EUROPE AND ASIA

As it has been described in TYNDP 2017, Supply chapter, LNG enables the connection of Europe to the global market and a large number of producing countries in the Middle East, the Atlantic (including the Mediterranean) and the Pacific basins. It gives access to reliable and diversified supply offering the shippers arbitrage opportunities at a global scale between different sources and regional markets.

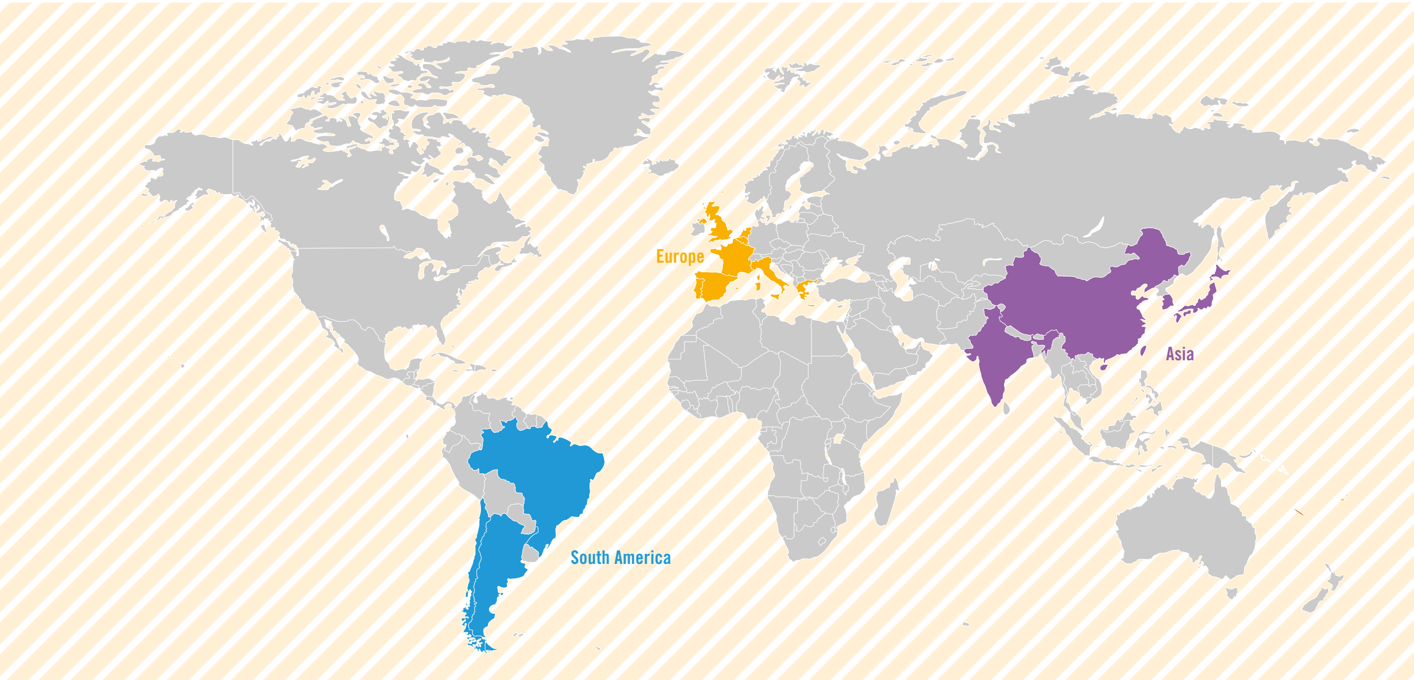


Figure 5.5: Main LNG importing areas (Source: TSO own elaboration)

In order to show the evolution of spot LNG prices in the different import basins, we have analysed the behavior of Europe, Asia and South America import LNG prices. Main facts:

- Divergence of prices between Asian and European LNG markets was considerably high during 2014. For this reason, re-export of LNG vessels increased during this period reaching the maximum amount of LNG re-exported from Europe.
- Since the beginning of 2015 a higher convergence of prices between LNG markets was achieved and in general terms, LNG prices went down. This fact is related to a combination of global LNG oversupply at production basins, with low gas overall demand.
- The convergence of LNG prices continued in 2016. The positive trend in prices of all LNG markets during 2016 is driven by a combination of factors: higher LNG demand, higher Brent prices and some problems in LNG production.
- The spread between prices from Asian and European LNG markets has increased progressively in the last quarter of 2016 due to several elements like higher demand and unavailability of some of the LNG production facilities.

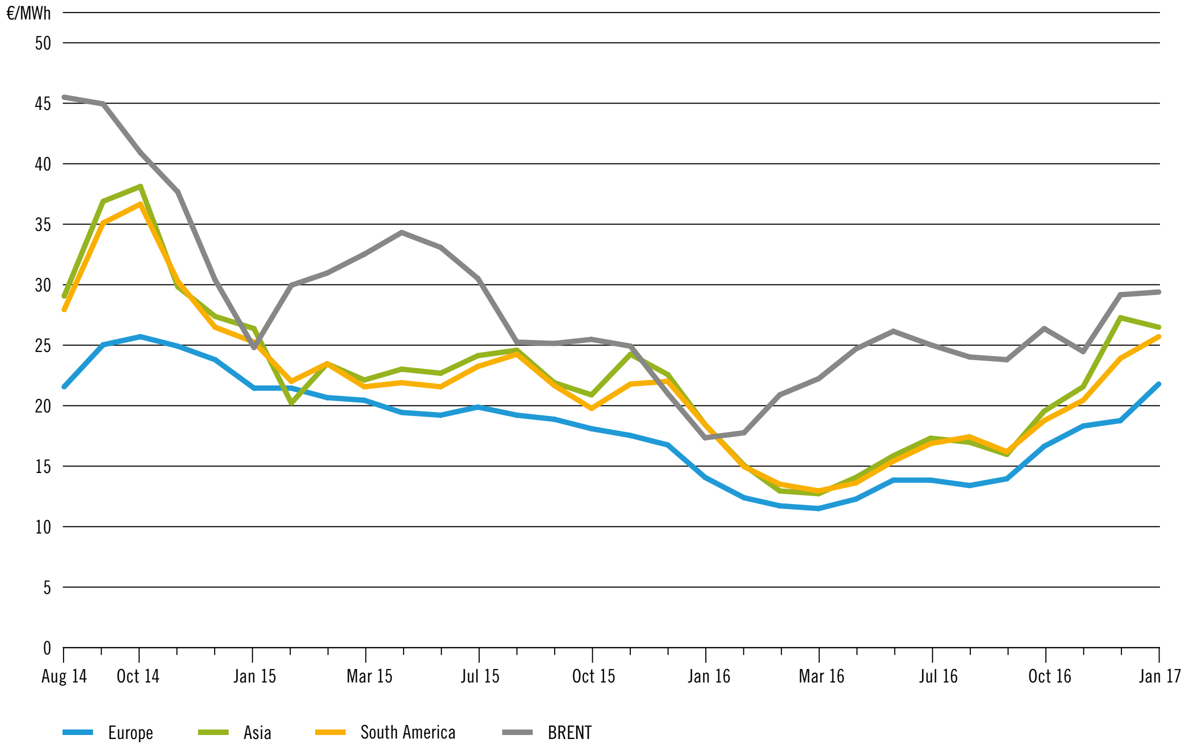


Figure 5.6: Spot LNG prices (Source: Platts, Bloomberg, ICIS Heren)

5.3.2 EVOLUTION OF EUROPEAN HUBS

In Europe, there are several organised gas markets, usually at country-level. Nevertheless in some countries there is more than one market area. Figure 5.7 shows the main natural gas European hubs.

Figure 5.7: Main gas Hubs in Europe (Source: TSO own elaboration)

In order to show the evolution of main European natural gas hubs, we have analysed the behavior of energy prices at these organised markets. Main facts:

- In general terms, until September 2016 convergence of day-ahead prices on main European hubs has continued, with the exception of Italian PSV and Spanish PVB, which remained higher for the whole period.
- During 2015 a continuous decreasing trend is observed. From February 2015, the low gas demand, low oil prices and steady LNG supplies have contributed to extend this decreasing trend in the main European hubs until the first quarter of 2016.
- From September 2016, increasing trends on European gas hubs were detected. Among the several factors that have influence on the raise of prices in Europe were: growing oil and LNG prices, decreasing of production in Groningen fields, and some problems in some infrastructures in Europe (in some underground storages, outages affecting Norwegian infrastructure and so on).

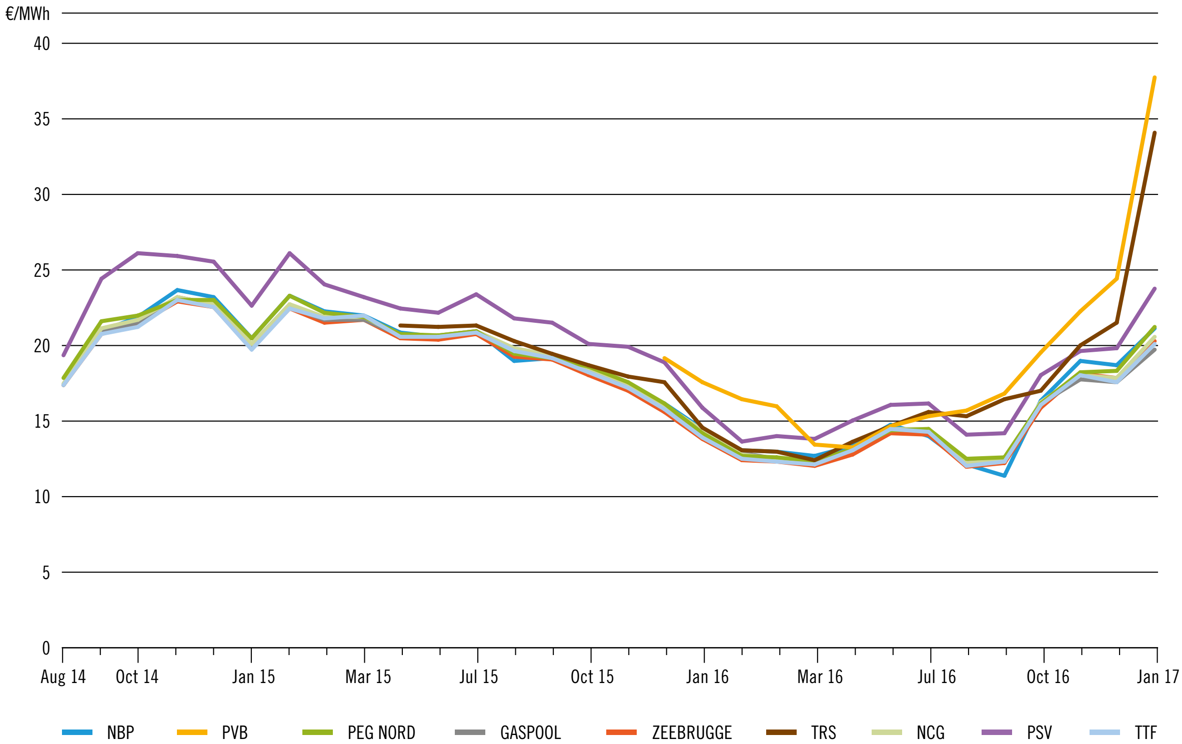


Figure 5.8: Day-ahead European hubs prices (Source: Platts, Bloomberg, ICIS Heren and own elaboration)

5.3.4 EVOLUTION OF GAS HUBS OF THE SOUTH REGION

As it has been previously remarked, Organised Gas Market in the Iberian Peninsula is a recently-created market and needs more time in order to develop and increase its liquidity. It can be observed how the PVB and TRS converge with mature European markets during some periods of the year, whereas divergent trends can be observed from the last quarter of 2016.

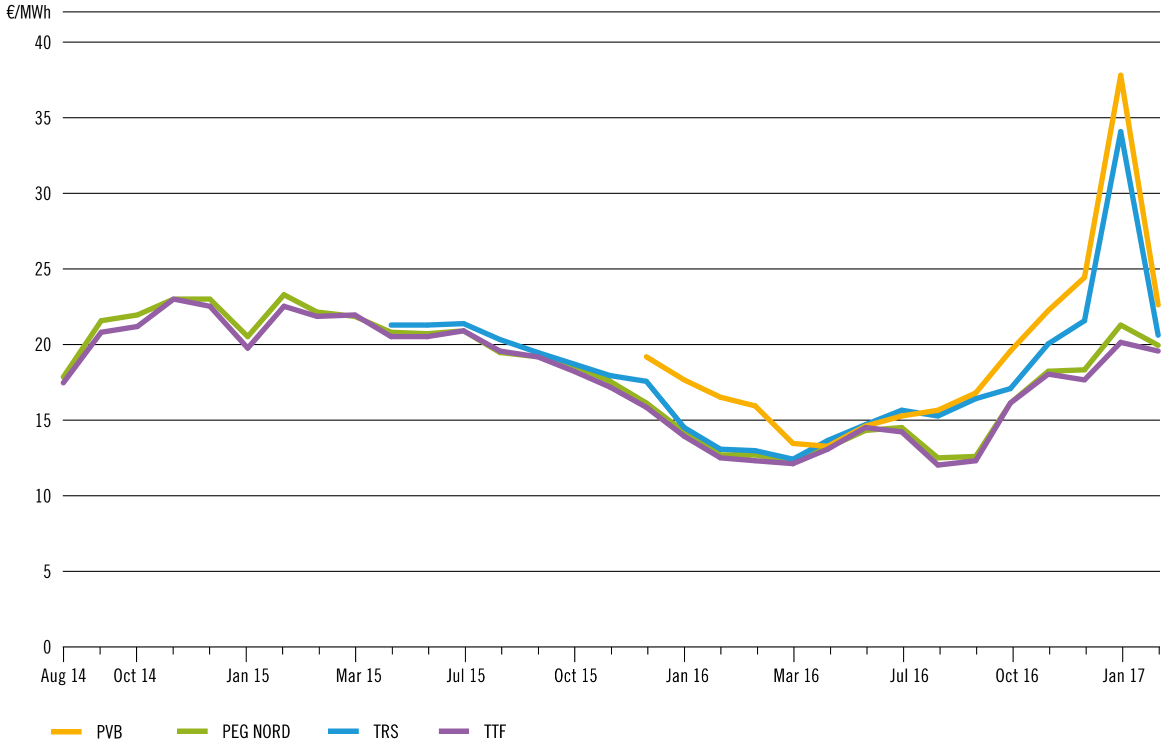


Figure 5.9: Day-ahead European hubs prices in South region (Source: Platts,Bloomberg, ICIS Heren and own elaboration)

Due to the low level of transactions and traded volumes in the PVB and the fact that MIBGAS has been created in December 2015, the reference price cannot be considered as significant as in other more mature markets, however, it is a first public reference in the price.

It is important to highlight the increase of European hub prices in the last quarter of 2016 and beginning of 2017, unusually steep for the South Region market.

5.3.5 MARKET SPREADS

Focusing on spread for the South Region, it can be observed a disconnection between prices of TTF and PEG Nord on the one hand, and prices of TRS and PVB on the other hand. Prices of TRS and PVB were particularly high for December 2016 and January 2017.

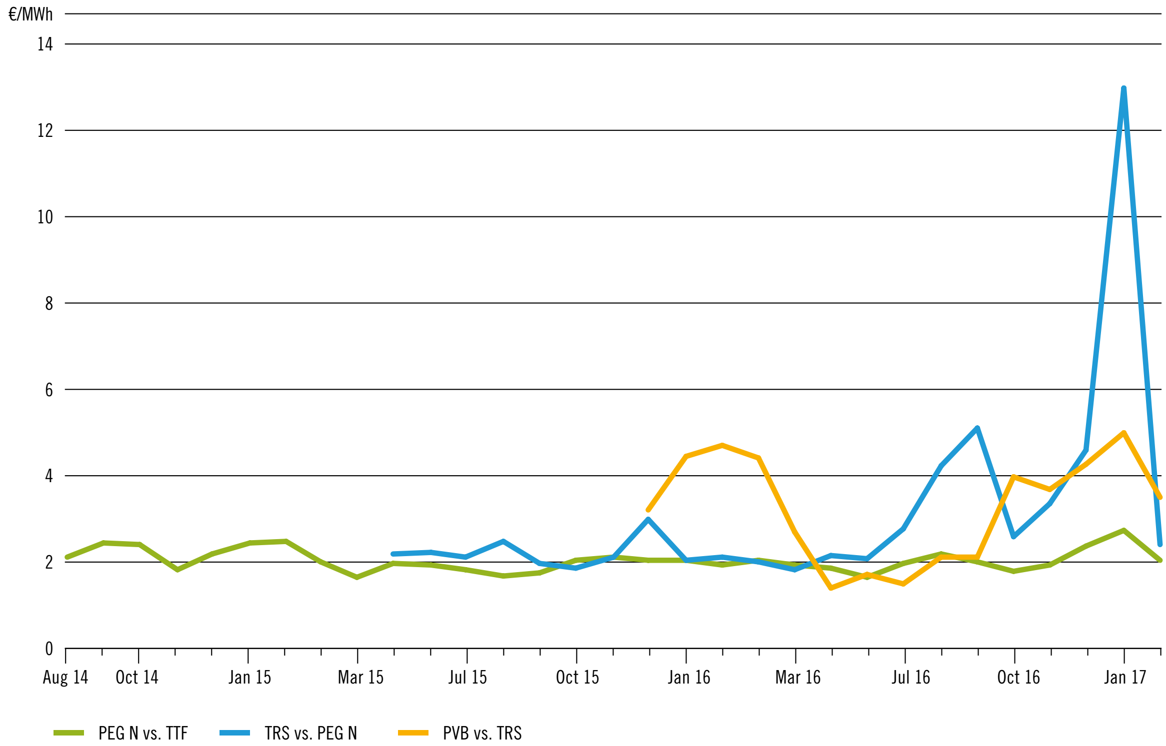


Figure 5.10: Spread in day-ahead European hubs prices (Source: Platts, Bloomberg, ICIS Heren and own elaboration)

The balance between demand and supply in the South Region has been particularly under pressure for the last period of 2016 and beginning of 2017. On the demand side, the high demand recorded for Europe in this period, including a cold period during January, contributed to increase supply-demand imbalance in the South Region. Additionally, the low supply availability for the South Region due to a combination of factors: high demand in Asia and maintenance and some unavailability's of LNG liquefaction facilities. Indeed, it has to be noted that, in the South Region, some areas are physically dependent on LNG for part of their balancing, due to the limited level of pipelines interconnections: it is the case for TRS area and for the Iberian hub. Therefore, those areas are sensitive to LNG prices.

From January 2017, spreads in the South Region are expected to decrease, due to lower gas demand and higher LNG supplies as liquefaction facilities progressively re-start production.

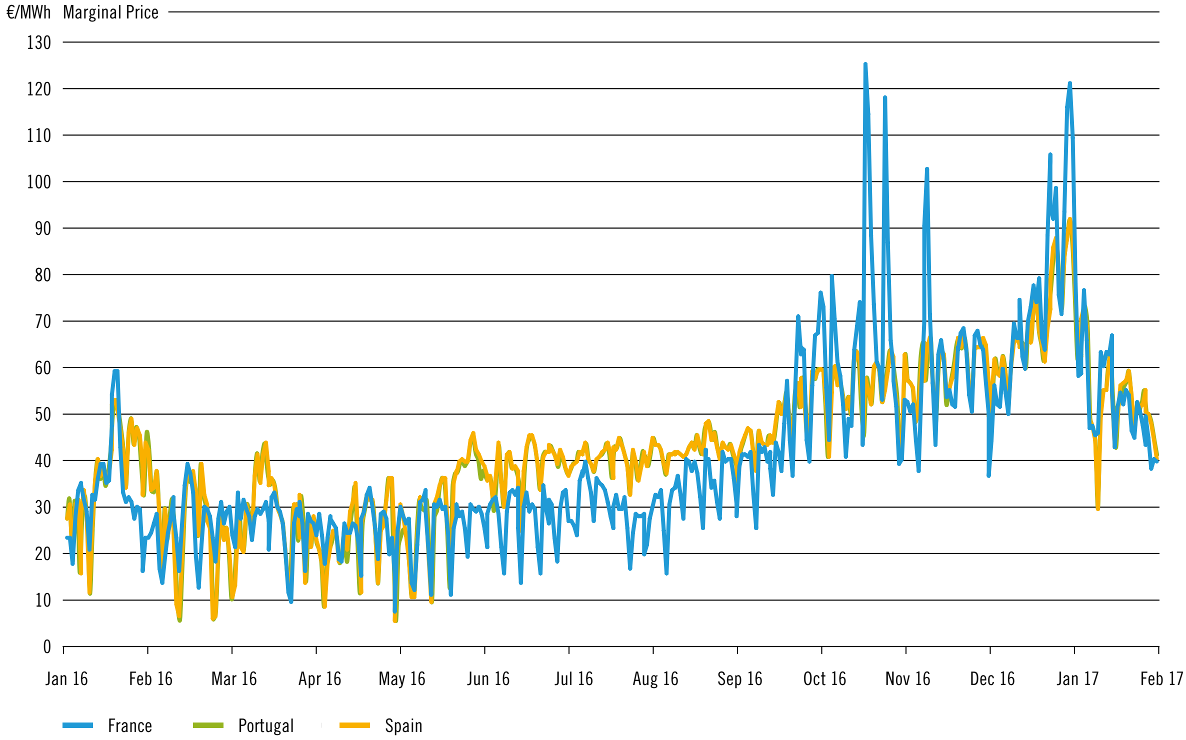


Figure 5.11: Marginal prices of day ahead electricity markets in Portugal, Spain and France from October 2016 until end of February 2017 (Source: REE)

During the last quarter of 2016 and beginning of 2017, French electricity market has been coping with the unavailability of several nuclear power plants. Gas power plants in France, and as well as in neighboring countries thanks to electricity interconnections, have largely made up for the resulting additional power needed. This illustrates how close electricity and gas system are interlinked, providing flexibility and solidarity, and optimising production capacities in each country through interconnections.

The facts previously described highlight the importance of guaranteeing security of gas supplies and show potential collateral effects of tense gas supply situations on electricity system. As it can be seen in figure 5.11, high electricity prices were reached in the South Region, especially for France, in the last months of 2016 and January 2017.

5.4 IP Subscription and Use

5.4.1 CAPACITY SUBSCRIPTION AT NORTH-SOUTH LINK (FRANCE)

Since April 2014, firm capacity has been set to 270 GWh/d, to which up to 150 GWh/d of interruptible capacity can be booked. GRTgaz also offers additional service to maximise the access to TRS with the JTS (Joint Transport Storage service) and market coupling mechanism. Annual capacities are sold through auctions once a year, annual interruptible capacity is available only if 95 % of firm capacities has been sold. Since the North South link will disappear in November 2018, last auction for annual available capacity will occur in March 2018.

Use of the North-South link is still very high, with a 95 % use of available technical capacity in 2016. Firm capacity in the opposite direction is booked at 26 %.

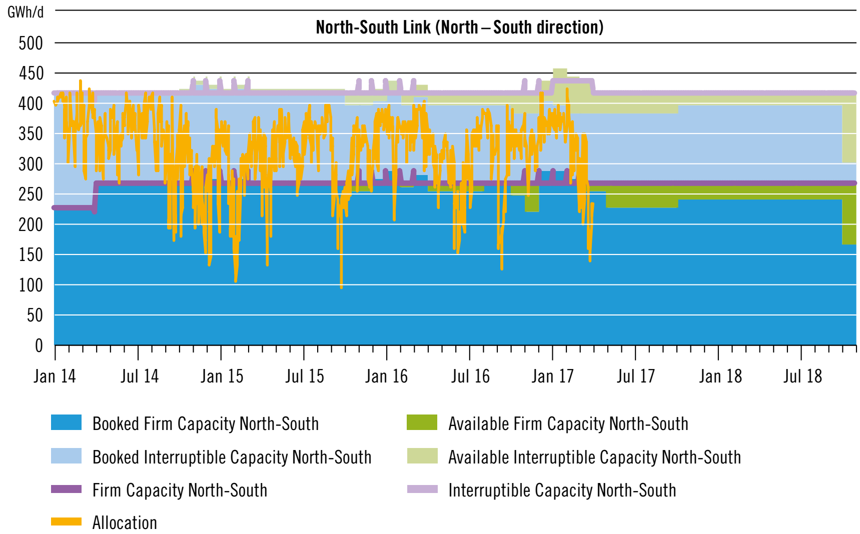


Figure 5.12: Capacity subscription at North-South Link (France), North-South direction (Source: TSO own elaboration)

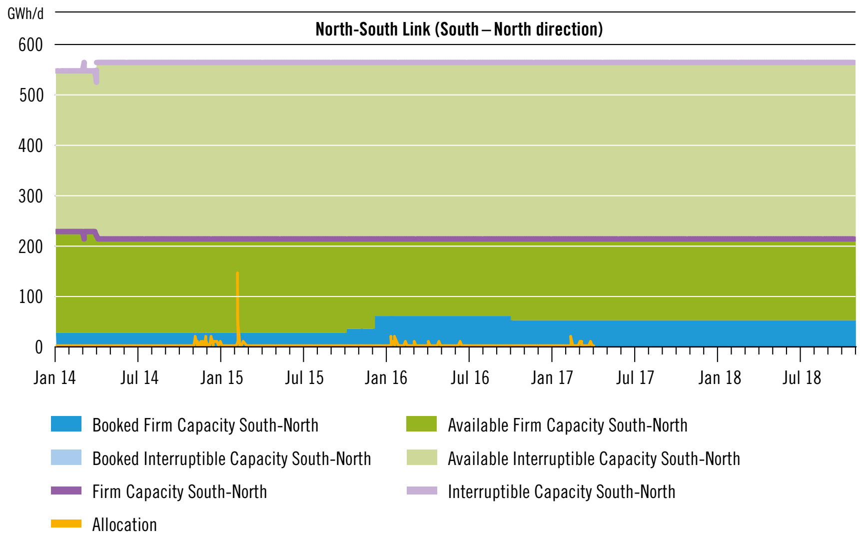


Figure 5.13: Capacity subscription at North-South Link (France), South-North direction (Source: TSO own elaboration)

5.4.2 CAPACITY SUBSCRIPTION AT IPS BETWEEN SPAIN AND FRANCE (VIP PIRINEOS)

After January 2017 60 GWh/d of capacity is offered to the market in the France–Spain direction, unbundled firm capacity in Spain, which can be matched with the already existing interruptible short-term capacity in France. This additional capacity has been booked, and used, in the first days of 2017 (from 08/01/2017 until 11/01/2017). (See Figure 5.14).

Since December 2015, as a result of the Open Season held in July 2010, approximately the 90 % of the common firm capacity from France to Spain is booked.

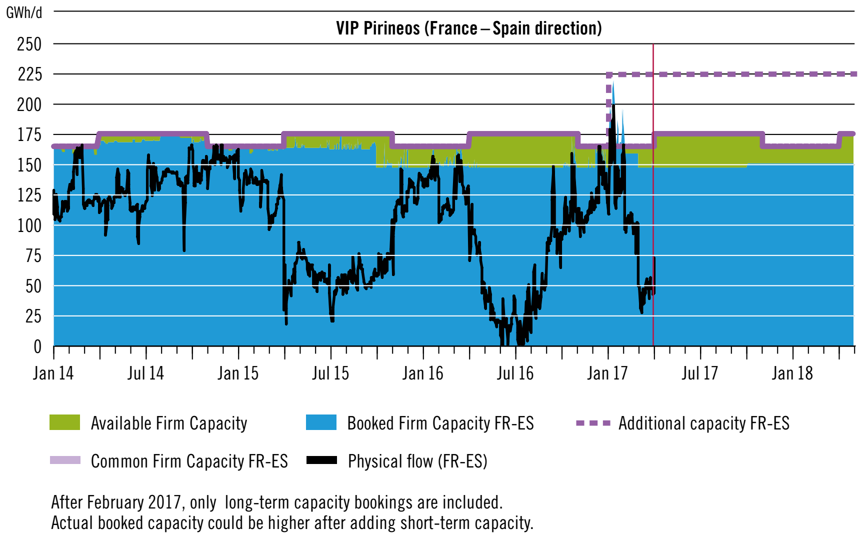


Figure 5.14: Capacity subscription at IPs between Spain and France (VIP PIRINEOS), France–Spain direction (Source: TSO own elaboration)

Since December 2015, regarding the Spain–France direction, the capacity increased from 165 GWh/d to 225 GWh/d after the commissioning of the infrastructures of Open Season 2010.

According to the latest subscription information, approximately only half of the capacity is already booked.

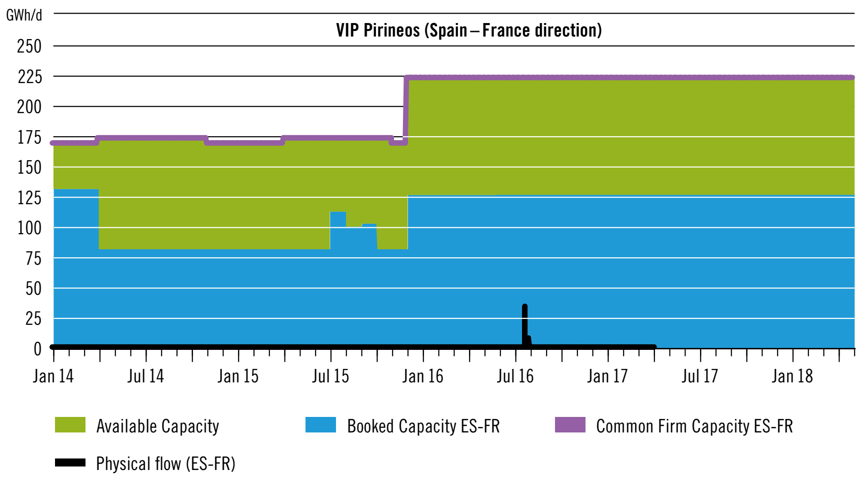


Figure 5.15: Capacity subscription (long term) at IPs between Spain and France (VIP PIRINEOS), Spain–France direction (Source: TSO own elaboration)

5.4.3 CAPACITY SUBSCRIPTION AT IPS BETWEEN SPAIN AND PORTUGAL (VIP IBERICO)

After October 2014, the cross-border capacity between Spain and Portugal is marketed in the VIP (Virtual Interconnection Point): VIP Iberico.

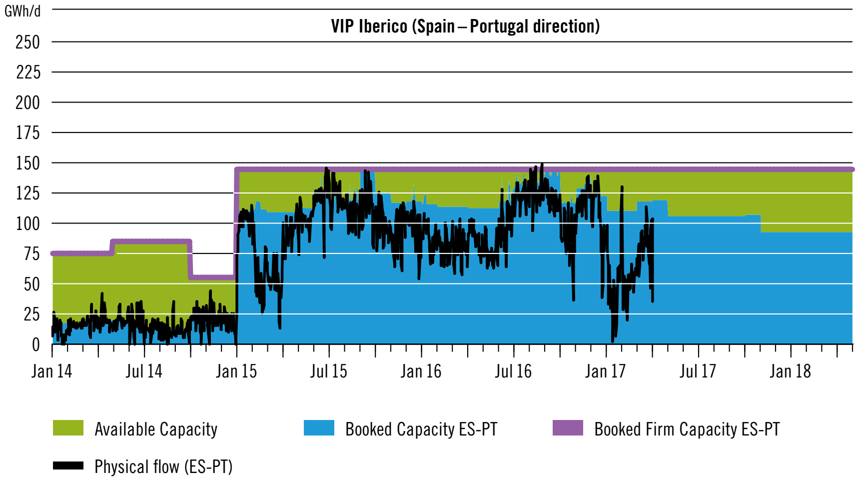


Figure 5.16: Capacity subscription at IPs between Spain and Portugal (VIP Iberico), Spain – Portugal direction (Source: TSO own elaboration)

In the Spain – Portugal direction, approximately two thirds of the capacity is booked in the long term.

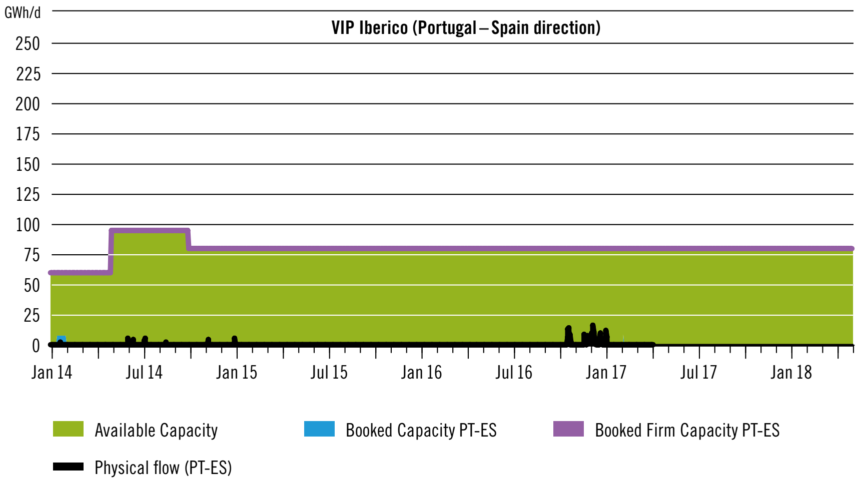


Figure 5.17: Capacity subscription at IPs between Spain and Portugal (VIP Iberico), Portugal – Spain direction (Source: TSO own elaboration)

In the Portugal – Spain direction, as of today no capacity is booked.

Physically, the flow is always Spain – Portugal direction; Portugal – Spain flow is a back hole flow capacity.

5.5 Future Challenges of Gas Markets in the South Region

5.5.1 HUBS

The analysis of historical flows and bookings at IPs shows that flows from North to South have been prevailing for years, with a physical bottleneck at the North South Link in France. Several factors should encourage the development of gas hubs in the South Region in the coming years.

- In France: the creation of a single hub by the end of 2018, merging PEG Nord and TRS will lead to an attractive and competitve gas market over the long term with a single national price. In addition to the commissioning of the necessary infrastructures in order to remove the bottleneck between North and South of France, the Val-de-Saône and Gascogne-Midi projects, additional market-based mechanisms are being developed to ensure a smooth running of the future single marketplace in all circumstances.[1)]
- Spain:
  - Recently created PVB, is expected to gain liquidity, as traded volumes increase in the future as it has happened with the main European natural gas hubs in their first stages. Infrastructures might be developped in accordance to support this flexibility
  - Convergence of prices between Iberian Peninsula and Northern Europe is possible at the moment for a limited period of time during the year, while during stressed periods price spreads increase.
  - In addition, the merger of zones in France could have an impact on price convergence between the Iberian Peninsula and France.
  - A new analysis should be done after its implementation in order to assess the evolution of price convergence and potential lingering spreads and to evaluate the need for further convergence.

5.5.2 LNG

As it has been described in the supply chapter, LNG covers an important share of the gas demand in the South Region; therefore future developments of worldwide LNG market might have an impact on LNG prices arriving to the South Region and consequently on the natural gas hubs prices of this region.

The LNG global market has been constantly growing these last years, with new exporting countries, increasing diversification of supply sources and security of supply for countries importing LNG.

It is uncertain how supply and demand for LNG might evolve in this global LNG market:

- On the demand side, the gradual restart of nuclear energy in Japan and development of emergent markets like China or India will definitely play a key role.
- On the supply side, significant new liquefaction capacities will start production, specially in the USA and Australia.

With an adequate balance between supply and demand, a more flexible and liquid traded LNG market could be expected in the future.

1) For further clarification on Projects creating a single market in France please go to Infrastructure chapter section 6.2 Projects in the South Region

6 Infrastructure Projects

Image courtesy of TIGF

6.1 Gas infrastructure in the South Region

At the western side of Europe, the South Region is a privileged gateway for LNG into Europe with up to 48% of the total European LNG send-out capacity (3,465 GWh/d).

The South Region also benefits from large storage capacity, representing around 15% of European working gas volumes. Underground storages, mostly located in France, are essential to meet winter demand, while storage in LNG tanks are useful to provide daily flexibility.

The South Region is located at a crossroad for various supplies by pipelines with direct sourcing from Norway and Algeria, and connections with Belgium, Germany and Switzerland.

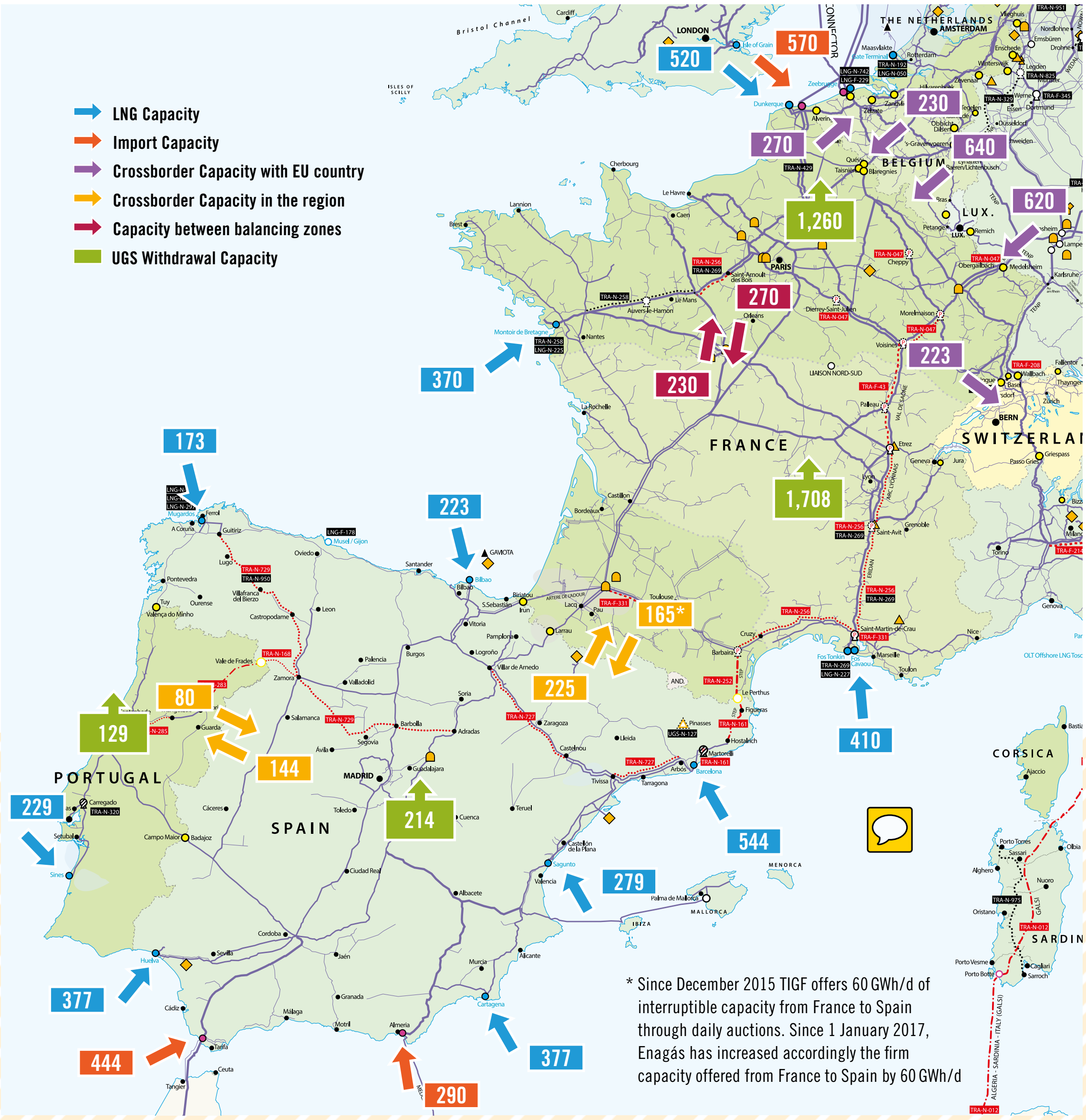


Figure 6.1: Interconnections and firm capacities in the South Region (TYNDP 2017)

Key progresses have been achieved to further integrate markets in the South Region, with a simplified access to the markets and additional capacities:

- Creation in October 2014 of a virtual interconnection point between Portugal and Spain with the VIP Iberico, gathering the two physical interconnection points in Valença do Minho (PT)/Tuy (ES) and Badajoz (ES)/Campo Maior (PT).
- Creation in October 2014 of a virtual interconnection point between Spain and France with the VIP Pirineos, gathering the two physical interconnection points in Larrau and in Biriatou (FR)/Irun (ES).
- Creation in April 2015 of the TRS in France, and removal of PIR Midi, between TIGF and GRTgaz's Zone Sud.

Several developments have been commissioned since 2013, creating new capacities for the market:

- **Reinforcement of capacities in VIP Pirineos between France and Spain:** After two Open Seasons in 2009 and 2010, the common firm capacity in VIP Pirineos has gone from 81.5 to 165 GWh/d from France to Spain, and from 0 to 225 GWh/d from Spain to France. In Open Season 2010, no new capacity from France to Spain was validated[1].
- **New Dunkirk LNG terminal in France:** With a 13 bcm capacity, the new Dunkirk LNG terminal is operational since the end of 2016. In order to connect it to the transmission network, GRTgaz has performed a major work program of infrastructures commissioned between 2015 and 2016.
- **A new exit capacity from France to Belgium:** Market consultations in 2010 and 2011 led to an increase of capacity by 50 GWh/d in 2013 from Belgium to France at Blareignies/Taisnières, and to a new interconnection point created in 2015 at Alveringem to provide non-odorised gas from the new Dunkirk LNG Terminal to the Belgian border up to 270 GWh/d.
- **Optimisation in the UGS Carriço** – At the end of 2015, an optimisation of the gas station was carried out in the UGS, which allowed the increase of the injection and extraction capacity of NG to 48.8 GWh/d and 128.6 GWh/d, respectively.
- **New UGS Carriço cavern (REN-C-6)** – At the end of 2014, a new salt cavern at Carriço was put in operation with a working volume of 54 mcm.

With these new developments, entry capacity to the South Region and interconnection capacity within the region have been significantly improved. When considering estimated demand for 2020 in the Blue Transition scenario:

- Total entry capacity can almost cover a doubled national demand.
- LNG terminals send-out capacity exceeds national demand in each country.
- Entry from interconnection capacity with EU countries represents between 22 % and 132 % of national demand, Spain remaining with low interconnection capacities compared to France or Portugal.

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1) Since December 2015 TIGF offers 60 GWh/d of interruptible capacity from France to Spain through daily auctions. Since 1 January 2017, Enagás has increased accordingly the firm capacity offered from France to Spain by 60 GWh/d

Differences between interconnection and LNG capacities in each country are a consequence of each country's geographical situation, transit needs and energy policy.

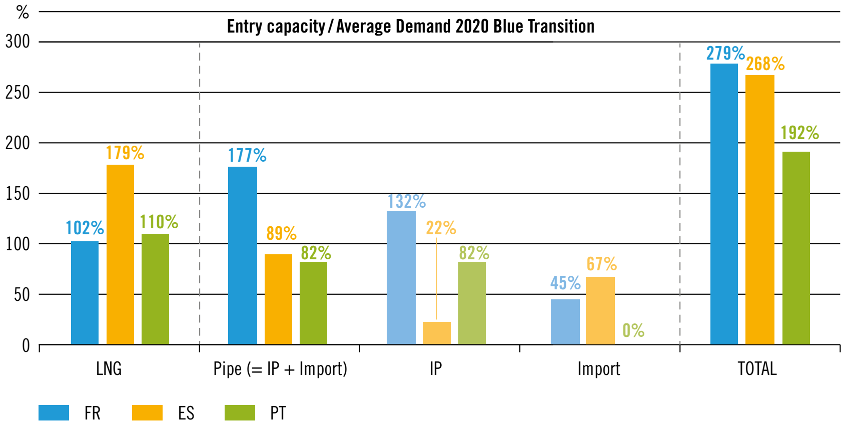

Figure 6.2: Entry firm capacity (GWh/d), excluding UGS, compared to average demand (GWh/d, Blue transition, in 2020). (Source: TYNDP 2017 Infrastructure projects in the South Region)

In TYNDP 2017, 29 projects to develop gas infrastructure are located in the South Region, representing 12 % of all projects.

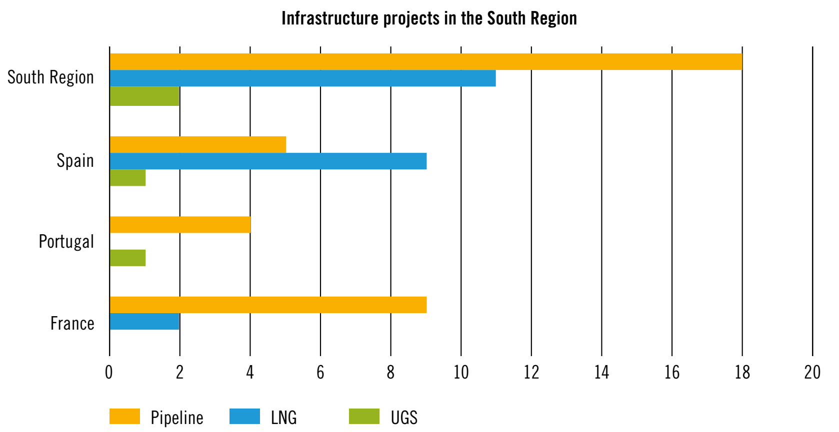

Figure 6.3: Infrastructure projects in the South Region (Source: TYNDP 2017)

Some of these projects are listed in the second PCI list from 18 November 2015[2], in the North South Gas Interconnection in Western Europe Corridor:

- 5.4 – 3rd interconnection point between Portugal and Spain.
- 5.5 – Eastern Axis Spain – France – interconnection point between Iberian Peninsula and France at Le Perthus, including the compressor stations at Montpellier and St. Martin de Crau (currently known as "Midcat").
- 5.6 – Reinforcement of the French network from South to North – Reverse flow from France to Germany at Obergailbach/Medelsheim Interconnection point (FR).
- 5.7 – Reinforcement of the French network from South to North to create a single market zone, including the following PCIs: 5.7.1 Val de Saône pipeline between Etrez and Voisines (FR) 5.7.2 Gascogne-Midi pipeline (FR).
- 5.8 – Reinforcement of the French network to support South to North flows, including the following PCIs: 5.8.1 Est Lyonnais pipeline between Saint-Avit and Etrez (FR) 5.8.2 Eridan pipeline between Saint-Martin-de-Crau and Saint-Avit (FR).

The infrastructure projects have been assessed in the TYNDP 2017 according to their status:

- Low level infrastructure: current infrastructures and "FID projects" (Final Investment Decision taken).
- Non-FID Advanced infrastructure: projects with a "non-FID advanced projects" status – in case 1) the project is commissioned by 31 December 2022 at the latest and 2a) the permitting phase of the project has started before 1 April 2016 or 2b) FEED has started or the project has been selected for receiving CEF grants for FEED before 1 April 2016.
- PCI infrastructure: low level infrastructure and PCI projects from the 2nd PCI list.
- High level infrastructure: all projects, whatever the status.

FID projects and advanced projects represent a third of all projects in the Region.

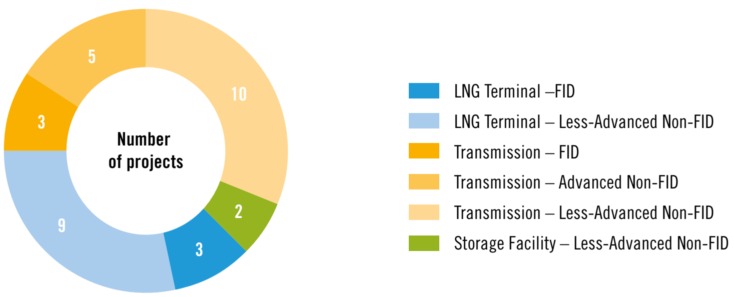

Figure 6.4: South Region projects in TYNDP 2017 (Source: TYNDP 2017)

2) COMMISSION DELEGATED REGULATION (EU) 2016/89 of 18 November 2015 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council as regards the Union list of projects of common interest http://eur-lex.europa.eu/legal-content/En/TXT/PDF/?uri=OJ:JOL_2016_019_R_0001&from=en

In 2018, three FID projects will be commissioned, all located in France. Most Non-FID advanced projects and Non-FID less-advanced projects are planned to be commissioned between 2020 and 2022.

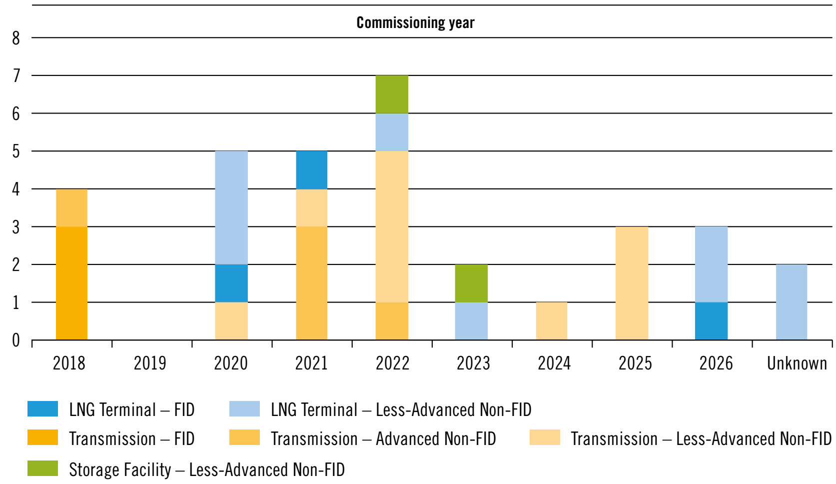

Figure 6.5: Commissioning year of South Region projects (Source: TSO own elaboration)

6.2 Projects in the South Region

Figure 6.6: Projects in Iberian Peninsula (Source: TYNDP 2017)

Figure 6.7: Projects in France (Source: TYNDP 2017)

6.2.1 LNG PROJECTS

The following tables detail the list of LNG projects, according to their status and commissioning year, and the related expected evolution of LNG capacities.

LNG PROJECTS IN THE SOUTH REGION

Name	TYNDP Code	Status	Commissioning Year	Promoter	Project Yearly Volume (bcm/y)	Project Ship Size (m^3 LNG)	Project Storage Capacity (m^3 LNG)
Tenerife LNG Terminal	LNG-F-183	FID	2020	Gascan	1.3	200,000	150,000
Gran Canaria LNG Terminal	LNG-F-163	FID	2021	Gascan	1.3	140,000	150,000
Musel LNG terminal	LNG-F-178	FID	2026	Enagás Transporte, S.A.U.	7.0	266,000	300,000
Montoir LNG Terminal Expansion	LNG-N-225	Less-Advanced Non-FID	2020	Elengy	2.5	0	19,000
Fos Cavaou LNG Terminal Expansion	LNG-N-227	Less-Advanced Non-FID	2020	Fosmax LNG	8.0	0	220,000
Mugardos LNG Terminal: 2nd Jetty	LNG-N-296	Less-Advanced Non-FID	2020	Reganosa	0	0	0
Mugardos LNG Terminal: Storage Extension	LNG-N-297	Less-Advanced Non-FID	2022	Reganosa	0	0	190,000
Mugardos LNG Terminal: Send-out Increase	LNG-N-295	Less-Advanced Non-FID	2023	Reganosa	3.6	0	0
Gran Canaria Send-Out increase	LNG-N-165	Less-Advanced Non-FID	2026	Gascan	0.7	0	0
Tenerife Send-Out increase	LNG-N-185	Less-Advanced Non-FID	2026	Gascan	0.7	0	0
Gran Canaria 2nd LNG Tank	LNG-N-162	Less-Advanced Non-FID	Unknown	Gascan	0	0	150,000
Tenerife 2nd LNG Storage Tank	LNG-N-184	Less-Advanced Non-FID	Unknown	Gascan	0	0	150,000

Table 6.1: LNG projects in the South Region (Source: TYNDP 2017)

CAPACITY CREATED BY LNG PROJECTS IN THE SOUTH REGION

LNG Entry IP (GWh/d)		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Barcelona	LNG > SP	544	544	544	544	544	544	544	544	544	544	544	544
Bilbao	LNG > SP	223	223	223	223	223	223	223	223	223	223	223	223
Cartagena	LNG > SP	377	377	377	377	377	377	377	377	377	377	377	377
Dunkerque LNG	LNG > FR and BE	519	519	519	519	519	519	519	519	519	519	519	519
Fos (Tonkin/ Cavaou)	LNG > FR	410	410	410	410	410	410	410	737	737	737	737	737
Gran Canaria LNG	LNG > SP (Canaria)	0	0	0	0	0	0	42	42	42	42	42	63
Huelva	LNG > SP	377	377	377	377	377	377	377	377	377	377	377	377
Montoir de Bretagne	LNG > FR	370	370	370	370	370	370	370	470	470	470	470	470
Mugardos	LNG > SP	173	173	173	173	173	173	173	173	288	288	288	288
Musel	LNG > SP	0	0	0	0	0	0	0	0	0	0	0	223
Sagunto	LNG > SP	279	279	279	279	279	279	279	279	279	279	279	279
Sines	LNG > PT	193	229	229	229	229	229	321	321	321	321	321	321
	PT > LNG	143	179	179	179	179	179	272	272	272	272	272	272
Tenerife LNG	LNG > SP (Canaria)	0	0	0	0	0	42	42	42	42	42	42	63

Less advanced-non FID   Advanced – non FID   FID

Table 6.2: Capacity created by LNG projects in the South Region (Source: TYNDP 2017)

Image courtesy of Enagás

Developments of LNG are expected in Montoir, Fos, Sines, Mugardos and Canary Islands (Gran Canaria and Tenerife).

The LNG terminal in Montoir could be expanded from 10 to 12.5 bcm by 2020/2022, requiring notably the reinforcement of the Maine pipeline and the reinforcement of compressor stations.

The expansion of the LNG terminal Fos Cavaou from 8 to 16 bcm by 2020/2022 would involve the reinforcement of the Rhône pipeline from South to North, including Eridan on 220 km, Arc Lyonnais on 200 km, the Beauce pipeline on 63 km and additional compressor power.

In Sines LNG terminal, the capacity of regasification will increase due to the startup of the project of a Compressor Station in the main high-pressure pipeline. The schedule of this project is aligned and is an enabler of the PCI project 5.4 – 3rd interconnection between Portugal and Spain (TRA-N-283, TRA-N-284, TRA-N-285).

In Mugardos LNG terminal, send-out nominal capacity would increase from 115 GWh/d to 230 GWh/d in 2023 (LNG-N-295). This regasification expansion would allow the effective balance of the send-out capacities between the LNG Terminals of the Cantabrian-Atlantic and Mediterranean basins, bringing the entry points of the system closer to consumption zones and therefore maximizing the interoperability of the system, providing it with greater flexibility and enhancing security of supply.

In addition, the construction of a third jetty (LNG-N-296) and the storage extension (LNG-N-297) in Mugardos are projected for 2020 and 2022 respectively. These two projects would allow the terminal to take advantage of its strategic location regarding the recent development of reloading and bunkering services, the LNG logistics business, the use of LNG in sea transportation and the development of an efficient local fleet. Besides, the expansion of LNG storage facilities would help to get slightly closer to the current storage capacities of the gas systems in central Europe. This third tank of Mugardos Terminal would increase the LNG storage capacity in 190,000 m^3 LNG.

New two LNG terminals will be created to supply the Canary Islands: one in Tenerife (Arico – Granadilla), and another one in Gran Canaria. Both plants have the same the regasification (42 GWh/d, 1.3 bcm/y), and LNG storage capacity (150,000 m^3 LNG). It is also planned to increase the regasification capacity of both plants up to 2 bcm/y (63 GWh/d), and the LNG storage capacity up to 300,000 m^3 LNG.

The LNG terminal in Musel, in the North of Spain, is only waiting for the start-up authorization of the government to come into operation. The construction of this plant has been completed, and the government will grant the start-up authorization when the capacity is required, which is assumed to take place within the TYNDP period. For practical purposes in the elaboration of the TYNDP 2017, it is assumed that the start-up date will be the last year of the ten-year period of the TYNDP 2017 (2016 – 2026), but it does not constitute an estimate of the start-up date.

6.2.2 UGS PROJECTS

The following tables detail the list of UGS projects, according to their status and commissioning year, and the related expected evolution of UGS capacities.

UGS PROJECTS IN THE SOUTH REGION				
Name	**TYNDP Code**	**Status**	**Commissioning Year**	**Promoter**
RENC-8 Carriço UGS cavern	UGS-N-659	Less-Advanced Non-FID	2022	REN – Armazenagem, S.A.
Underground Gas Storage in salt leached caverns in the Bages area (ES)	UGS-N-127	Less-Advanced Non-FID	2023	Gas Natural

Table 6.3: UGS projects in the South Region (Source: TYNDP 2017)

6.2.2.1 UGS capacity

CAPACITY CREATED BY UGS PROJECTS IN THE SOUTH REGION UNTIL 2021							
UGS	**Direction**	**Existing Capacity as of 01/01/2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Nord-Atlantique	FR (PEG N) > UGS	354.00	354.00	354.00	354.00	354.00	354.00
	UGS > FR (PEG N)	479.00	479.00	479.00	479.00	479.00	479.00
Nord-B/ SEDIANE B	FR (PEG N) > UGS	102.30	102.30	102.30	102.30	102.30	102.30
	UGS > FR (PEG N)	275.00	275.00	275.00	275.00	275.00	275.00
Nord-Est/ SERENE Nord	FR (PEG N) > UGS	148.50	148.50	148.50	148.50	148.50	148.50
	UGS > FR (PEG N)	192.50	192.50	192.50	192.50	192.50	192.50
Nord-Ouest/ SEDIANE	FR (PEG N) > UGS	194.70	194.70	194.70	194.70	194.70	194.70
	UGS > FR (PEG N)	313.50	313.50	313.50	313.50	313.50	313.50
Sud-Atlantique	FR (TRS) > UGS	329.00	329.00	329.00	329.00	329.00	329.00
	UGS > FR (TRS)	369.00	369.00	369.00	369.00	369.00	369.00
Sud-Est/ SALINE	FR (TRS) > UGS	150.00	150.00	150.00	150.00	150.00	150.00
	UGS > FR (TRS)	835.00	835.00	835.00	835.00	835.00	835.00
UGS Lussagnet/Izaute (TIGF)	FR (TRS) > UGS	261.80	261.80	261.80	261.80	261.80	261.80
	UGS > FR (TRS)	503.80	503.80	503.80	503.80	503.80	503.80
Virtual Storage (ES)	ES > UGS	133.00	150.00	228.00	233.00	259.00	262.00
	UGS > ES	214.00	232.00	255.00	288.00	369.00	371.00

Table 6.4: Capacity created by UGS projects in the South Region until 2021 (no capacity change afterwards). (Source: TYNDP 2017)

A new UGS salt cavern at Carriço in Portugal, is planned to be build and to be commissioned in 2022 with a working volume of 58 mcm. Carriço UGS is based on caverns leached in a salt dome. Surface plant includes the facilities for injection and withdrawal of natural gas from the caverns in operation.

The capacity of the UGS in the Bages area in Spain was not considered in the TYNDP 2017.

6.2.3 TRANSMISSION PROJECTS

The following table details the list of transmission projects, pipeline including compressor stations, according their status and commissioning year.

TRANSMISSION PROJECTS IN THE SOUTH REGION				
Name	**TYNDP Code**	**Status**	**Commissioning Year**	**Promoter**
Val de Saône project	TRA-F-43	FID	2018	GRTgaz
Reverse capacity from CH to FR at Oltingue	TRA-F-45	FID	2018	GRTgaz
Gascogne Midi	TRA-F-331	FID	2018	TIGF - GRTgaz
Adaptation L-gas – H-gas	TRA-N-429	Advanced Non-FID	2018	GRTgaz, GRDF and Storengy
South Transit East Pyrenees (STEP) – Enagás	TRA-N-161	Advanced Non-FID	2021	Enagás Transporte, S.A.U.
3rd IP between Portugal and Spain (pipeline Celorico-Spanish border)	TRA-N-283	Advanced Non-FID	2021	REN-Gasodutos, S.A.
Carregado Compressor Station	TRA-N-320	Advanced Non-FID	2021	REN-Gasodutos, S.A.
South Transit East Pyrenees (STEP) – TIGF	TRA-N-252	Advanced Non-FID	2022	TIGF
Guitiriz–Zamora pipeline	TRA-N-950	Less-Advanced Non-FID	2020	Reganosa
Interconnection ES-PT (3rd IP) – 1st phase	TRA-N-168	Less-Advanced Non-FID	2021	Enagás Transporte, S.A.U.
Iberian–French corridor: Eastern Axis – Midcat Project	TRA-N-727	Less-Advanced Non-FID	2022	Enagás Transporte, S.A.U.
Reverse capacity from France to Germany at Obergailbach	TRA-N-047	Less-Advanced Non-FID	2022	GRTgaz
Developments for Montoir LNG terminal 2.5 bcm expansion	TRA-N-258	Less-Advanced Non-FID	2022	GRTgaz
Developments for Fosmax (Cavaou) LNG 8.25 bcm expansion	TRA-N-269	Less-Advanced Non-FID	2022	GRTgaz
Iberian–French corridor: Eastern Axis–Midcat Project	TRA-N-256	Less-Advanced Non-FID	2024	GRTgaz and TIGF
Interconnection ES–PT (3rd IP) – 2nd phase	TRA-N-729	Less-Advanced Non-FID	2025	Enagás Transporte, S.A.U.
3rd IP between Portugal and Spain (Compressor Station)	TRA-N-284	Less-Advanced Non-FID	2025	REN-Gasodutos, S.A.
3rd IP between Portugal and Spain (pipeline Cantanhede–Mangualde)	TRA-N-285	Less-Advanced Non-FID	2025	REN-Gasodutos, S.A.

Table 6.5: Transmission projects in the South Region (Source: TYNDP 2017)

6.2.3.1 Projects developing Interconnection capacities within the South Region

CAPACITY CREATED BY TRANSMISSION PROJECTS IN THE SOUTH REGION

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
VIP IBERICO	ES > PT	144	144	144	134	134	134	204	204	204	204	273	273
	PT > ES	80	80	80	62	62	62	132	132	132	132	188	188
VIP PIRINEOS	ES > FR	225	225	225	225	225	225	225	225	225	455	455	455
	FR > ES	165	165	165	165	165	165	165	165	165	325	325	325

Less advanced non-FID

Table 6.6: Capacity created by transmission projects in the South Region (Source: TYNDP 2017)

Image courtesy of REN

6.2.3.1.1 Between Portugal and Spain

Capacities will be reduced starting 2019. As the export capacity PT> ES depends on the internal demand in Portugal, the Portuguese TSO does not assume all the firm capacity in VIP Iberico. In this sense, the capacity value was reduced from 80 GWh to 62 GWh from 2019 to 2021. The capacities of VIP Iberico are reviewed, updated and agreed every year by REN and Enagás[3], and the changes in capacities are not related to any infrastructure development.

3rd Interconnection between Spain and Portugal

The 3rd Interconnection Portugal–Spain will connect Celorico da Beira to Zamora (pipeline Celorico/Vale de Frades) with a DN700 (28") pipeline with a total length of 248 km. The project is developed in two stages, comprising different phases in each of the countries.

The first stage of the 3rd Interconnection between Spain and Portugal comprehends the first phase of the project (TRA-N-283) in Portugal and the first phase of the project (TRA-N-168) in Spain. The first phase of the 3rd Interconnection Portugal – Spain is a pipeline with 162 km from the junction station JCT 13200-Celorico da Beira, in Guarda, developing to the North to Vale de Frades direction (in the Portuguese/Spanish border) and getting into Spain to Zamora with a length of 86 km. Throughout the pipeline in Portugal there are five intermediate stations and also a Custody Transfer Station (CTS) in Vale de Frades. In this first phase in Spain there will still be compression reinforcement in the Zamora Compressor Station.

The first phase of the 3rd Interconnection Portugal–Spain will have a capacity from Spain to Portugal of 70.0 GWh/d and from Portugal to Spain of 70.0 GWh/d. The commissioning date for this infrastructure is early 2021.

The 2nd stage of the 3rd interconnection PT-ES comprises two projects in Portugal (TRA-N-284 and TRA-N-285) and one project (TRA-N-729) in Spain. In Portugal, the second phase of the project will include the installation of a compression station on the pipeline between the JCT 11000-Cantanhede and BV 11300-Mangualde stations, with a capacity of 12 MWh for flow rates of 500,000 to 550,000 m^3 (n)/h and an impeller of 35 bar. In the second phase a second gas pipeline with approximately 67 km of extension will be built, parallel to the pipeline between the JCT 11000-Cantanhede and BV 11300-Mangualde stations. In Spain, the second phase comprises the construction of a Guitiriz-Zamora-Adradas gas pipeline with a total length of 625 km.

The completion date for this stage is the end of 2025. The final capacity is 139.0 GWh/d from Spain to Portugal, and from Portugal to Spain the capacity is 126.0 GWh/d.

These two projects are considered less-advanced in the TYNDP, according the maturity of the project in Spain.

In August 2015, REN received a Connecting Europe Facility (CEF) grants from Innovation and Networks Executive Agency (INEA) for cartography and engineering studies for the 3rd Interconnection Point on Portugal side[4].

3) http://www.enagas.es/stfls/ENAGAS/Gesti%C3%B3n%20T%C3%A9cnica%20del%20Sistema/Documentos/Technical%20Capacities%20Agreement%20VIP%20Iberico.pdf

4) http://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/projects-by-country/portugal/5.4-0001-pt-s-m-15

The following table includes the technical information of this project:

3RD INTERCONNECTION BETWEEN SPAIN AND PORTUGAL: INFRASTRUCTURES*								
Type	**TYNDP Code**	**Name**	**Status**	**Commis-sioning Year**	**Section**	**Length (km)**	**Diameter (mm)**	**Compressor Power (MW)**
Pipeline including CS	TRA-N-168	Interconnection ES-PT (3rd IP) – 1st phase	Less-Advanced Non-FID	2021	CS Zamora			4
Pipeline including CS	TRA-N-168	Interconnection ES-PT (3rd IP) – 1st phase	Less-Advanced Non-FID	2021	Zamora – Portuguese Border	86	700	
Pipeline including CS	TRA-N-729	Interconnection ES-PT (3rd IP) – 2nd phase	Less-Advanced Non-FID	2025	Guitiriz – Lugo	28	740	
Pipeline including CS	TRA-N-729	Interconnection ES-PT (3rd IP) - 2nd phase	Less-Ad-vanced Non-FID	2025	Villafranca del Bierzo – Castropodame	30	740	
Pipeline including CS	TRA-N-729	Interconnection ES-PT (3rd IP) – 2nd phase	Less-Advanced Non-FID	2025	Castropodame – Zamora	170	600	
Pipeline including CS	TRA-N-729	Interconnection ES-PT (3rd IP) – 2nd phase	Less-Advanced Non-FID	2025	Lugo – Villafranca del Bierzo	90	740	
Pipeline including CS	TRA-N-729	Interconnection ES-PT (3rd IP) – 2nd phase	Less-Advanced Non-FID	2025	Zamora – La Barbolla – Adradas	307	800	
Pipeline including CS	TRA-N-283	3rd IP between Portugal and Spain (pipeline Celorico-Spanish border)	Advanced Non-FID	2021	Celorico-Spanish border	162	700	
Pipeline including CS	TRA-N-284	3rd IP between Portugal and Spain (Compres-sor Station)	Less-Advanced Non-FID	2025	Cantanhede Compressor Station			12
Pipeline including CS	TRA-N-285	3rd IP between Portugal and Spain (pipeline Cantanhede – Mangualde)	Less-Ad-vanced Non-FID	2025	Cantanhede – Mangualde	67	500	

* **The infrastructures considered in each step of this project are:**

Spain:

1st step: Zamora – Portuguese border (TRA-N-168)

2nd step: Guitiriz – Zamora – Adradras pipelines (TRA-N-729)

Portugal:

1st step: Celorico – Spanish border (TRA-N-283)

2nd step: Cantanhede CS (TRA-N-284)

3rd step: Cantanhede-Mangualde pipeline (TRA-N-285)

Table 6.7: 3rd Interconnection between Spain and Portugal: infrastructures (Source: TYNDP 2017)

This capacity enhances flexibility of both Spanish and Portuguese networks and consequently integrates the Portuguese market at Iberian Peninsula level. The 3rd IP between Spain and Portugal allows a better integration of Iberian and European markets and therefore improving competition in these markets. It also contributes to diversification of European gas supplies, promoting the market integration, security of supply and competition.

6.2.3.1.2 Between Spain and France

Following the Madrid Declaration in March 2015, a High Level Group (HLG) for Interconnections in Western Europe was established in order to follow its implementation. As part of the work done in this HLG, a Joint Technical Study between Enagás, GRTgaz and TIGF related to MidCat was developed during summer 2015.

Two different approaches were used in this technical study:

- The minimum infrastructure required for connecting both countries: STEP project.
- The infrastructures required to achieve the target firm capacity (230 GWh/d from Spain to France and 180 GWh/d from France to Spain): MidCat project.

STEP (TRA-N-161 + TRA-N-252)

In Spain, this project (TRA-N-161) consists of two pipelines (Hostalrich – Figueras and Figueras-French border), and a new compressor station in Martorell (36 MW). In France (TIGF zone), the project (TRA-N-252) consists in a pipeline between Barbaira and the Spanish border. The total length of the project is 107 km in Spain and 120 km in France. The commissioning date of this project is 2021 in Spain and 2022 in France (TIGF).

This project does not create firm annual capacities in both sides of the interconnection. Consequently, the capacity created by this project is not considered in the TYNDP 2017, as ENTSOG NeMo tool only considers firm capacities on an annual basis. Nevertheless, according to a probabilistic study developed by Enagás, this project creates in the Spanish side firm capacity: 120 GWh/d from Spain to France, and 110 GWh/d from France to Spain. Such probabilistic analysis wasn't performed on the French side as the behavior of the French market may change after the merger of zones in 2018.

According to TYNDP 2017 criteria the project was defined as "Advanced non-FID", as it received a CEF grant for FEED studies in the second CEF-E call of 2015[5].

STEP PROJECT: INFRASTRUCTURES

Type	TYNDP Code	Name	Status	Commissioning Year	Section	Length (km)	Diameter (mm)	Compressor Power (MW)
Pipeline including CS	TRA-N-161	South Transit East Pyrenees (STEP) – Enagás	Advanced Non-FID	2021	CS Martorell			36
Pipeline including CS	TRA-N-161	South Transit East Pyrenees (STEP) – Enagás	Advanced Non-FID	2021	Hostalrich – Figueras	79	900	
Pipeline including CS	TRA-N-161	South Transit East Pyrenees (STEP) – Enagás	Advanced Non-FID	2021	Pipeline Figueras – French Border	28	900	
Pipeline including CS	TRA-N-252	South Transit East Pyrenees (STEP) – TIGF	Advanced Non-FID	2022	Pipeline Spanish Border-Barbaira	120	900	

Table 6.8: STEP project: infrastructures (Source: TYNDP 2017)

5) Spain: https://ec.europa.eu/inea/sites/inea/files/fiche_5.5-0054-esfr-s-m-15_final.pdf
France: https://ec.europa.eu/inea/sites/inea/files/fiche_5.5-0048-fr-s-m-15_final.pdf

MidCat (TRA-N-161 + TRA-N-727 + TRA-N-256)

In Spain, this project consists of the infrastructures already included in STEP (TRA-N-161), and further infrastructure in Enagás transmission network: a pipeline from Castelnou to Villar de Arnedo (214 km), a pipeline from Tivissa to Arbós (114 km), and increments of the power of the compressor stations of Zaragoza (+5 MW) and Arbós (+5 MW). The commissioning date of these additional infrastructures is 2022.

In France, this project consists in the infrastructures already included in STEP (TIGF), plus Midi pipeline in TIGF and GRTgaz zones, and Eridan, Arc Lyonnais, Perche pipeline, CS Palleau, CS Saint-Avis and CS Saint-Martin-de-Crau in GRTgaz zone.

This last set of infrastructures is considered as French network reinforcement, and therefore is required for removing market tools (see page on merger of zones in France) and increase capacity in the South (either from Spain or from LNG terminals in Fos – TRA-N-269).

The commissioning date of these projects is between 2022 and 2024, considering that the artère du Midi project is less advanced.

MidCat project creates bidirectional capacity: 230 GWh/d from Spain to France and 160 GWh/d from France to Spain.

MIDCAT PROJECT: INFRASTRUCTURES

Type	TYNDP Code	Name	Status	Commis-sioning Year	Section	Length (km)	Diameter (mm)	Compressor Power (MW)
Pipeline including CS	TRA-N-161	Enagás Transporte, S.A.U.	Advanced Non-FID	2021	CS Martorell			36
					Hostalrich – Figueras	79	900	
					Pipeline Figueras – French border	28	900	
Pipeline including CS	TRA-N-252	TIGF	Advanced Non-FID	2022	Pipeline Spanish border – Barbaira	120	900	
Pipeline including CS	TRA-N-727	Enagás Transporte, S.A.U.	Less-Advanced Non-FID	2022	Loop Castelnou – Villar de Arnedo + CS Zaragoza (increment)	214	640	5
Pipeline including CS	TRA-N-727	Enagás Transporte, S.A.U.	Less-Advanced Non-FID	2022	Loop Tivissa – Arbós + CS Tivissa filters + CS Arbós (increment)	114	740	21
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Eridan (GRTgaz section)	220	1.200	
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Palleau CS (GRTgaz section)			50
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	St-Avit CS (GRTgaz section)			15
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Barbaira – Border (TIGF section)	120	900	
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Perche (GRTgaz section)	63	900	
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	St-Martin de Crau CS			30
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Arc Lyonnais (GRTgaz section)	150	1.200	
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Barbaira CS (TIGF section)			7
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Midi pipeline (GRTgaz section)	200	1.050	
Pipeline including CS	TRA-N-256	GRTgaz and TIGF	Less-Advanced Non-FID	2024	Midi pipeline (TIGF section)	40	1.050	

Table 6.9: MidCat project: infrastructures (Source: TYNDP 2017)

6.2.3.2 Interconnection capacities with other EU countries

- The creation of a reverse flow from France to Germany at Obergailbach/ Medelsheim (TRA-N-047).

Beyond commercial backhaul capacity already existing from France to Germany is considering physical **reverse flow from France to Germany**. The PCI creating a reverse flow from France to Germany would improve access to LNG for the German market and contribute to respond the need for additional supplies in western Germany as a replacement for L-gas. The creation of this reverse flow (100 GWh/d) will result in reinforcing the network on the North East pipeline. It would also require solutions to harmonise odorisation practises in France and Germany, since gas is odourised upon entry on the transmission system in France and Spain, whereas it is done upon entry on the distribution system in Germany. GRTgaz is currently conducting feasibility studies on two types of solutions. The first solution consists in adopting non-centralised odourisation practices. It is currently being assessed technically and economically on two small scale units. An alternative solution is also being considered, with a de-odourisation plant, more suitable for intermittents flows. The results from these two feasibility studies are expected in 2017.

- The creation of a reverse flow from Switzerland to France at Oltingue (TRA-F-045)

The Open Season conducted jointly by GRTgaz and FluxSwiss in 2012 to create a new entry point from Switzerland to France by 2016–2018 could not lead to investments although stakeholders confirmed their interest. GRTgaz proposed in 2014 a new product associated with less investments. Due to the reduced cost, CRE then decided to validate this new product without going through the process of Open Season. GRTgaz took a FID in 2015. The corresponding infrastructure will be commissioned in 2018, enabling a reverse flow at Oltingue from Switzerland up to 200 GWh/d, 100 GWh/d being interruptible. This new entry point will give access to new supply sources from Italy and will enable further arbitrage for shippers between hubs.

INTERCONNECTION CAPACITIES OF THE SOUTH REGION WITH OTHER EU COUNTRIES

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Alveringem	FR > Beh	270	270	270	270	270	270	270	270	270	270	270	270
Blaregnies (BE)/ Taisnières (H) (FR) (Segeo/Troll)	BEh > FR	640	640	640	640	640	640	640	640	640	640	640	640
Blaregnies L (BE)/Taisnières B (FR)	BEb > FR	230	230	230	230	230	230	230	230	230	230	230	230
Oltingue (FR)/ Rodesdorf (CH)		223	223	223	223	223	223	223	223	223	223	223	223
Obergailbach (FR)/ Medelsheim (DE)	DE > FR	620	620	620	620	620	620	620	620	620	620	620	620
	FR > DE	0	0	0	0	0	0	0	100	100	100	100	100

Less advanced non-FID

Table 6.10: Interconnection capacities of the South Region with other EU countries (Source: TYNDP 2017)

6.2.3.3 Projects creating a single market in France

In addition to the development of interconnections, the simplification of the gas market has been a constant priority for CRE (French NRA). The NRA has set a target in 2012 to finalise the integration of market in France and create a single market place by 2018. To this end, GRTgaz and TIGF have decided in 2014 and 2015 to invest 880 M€. The PCI projects Val de Saône (5.7.1) and Gascogne Midi (5.7.2) from the second list of PCI, together with market tools, will enable the merger of balancing zones by creating additional flows from North to South thus removing the current bottleneck between North and South and reducing the LNG dependency in the South of France. These projects have been approved by CRE and supported by stakeholders after a Cost Benefit Analysis in 2013. This Cost Benefits Analysis, performed by Pöyry on behalf of CRE, identified both projects as the best solution to create a single market. They were mapped out to cover a series of flow configurations shared with the market, meeting usual requirements from shippers. Exceptional systems such as market tools would have to be put in place when the flow configurations depart from initial assumptions. The CBA also concluded that the creation of a single market would generate benefits for the French and Iberian markets under all markets scenarios in which LNG is more expensive than gaseous gas delivered by pipeline. Upon request of GRTgaz, CRE and CNMC took a joint decision on the Cross Border Cost Allocation of Val de Saône in May 2014. Considering that Val de Saône would generate benefits for France, significantly higher than the investment costs, producing a positive net benefit in the hosting country,[6)] both NRAs agreed that Val de Saône was not subject to cross-border compensation and the investment costs were fully assigned to France. It should be noted that CNMC did not confirm the monetization of benefits, questioning the accuracy of the underlying assumptions.

The Val de Saône project consists in the looping of the Burgundy pipeline on 189 km, a third compressor adding 9 MW to the compressor station in Etrez, and adjusting the interconnections at Palleau, Etrez and Voisines. The permitting phase is completed and works will begin in 2017 to reach a commissioning in 2018.

The Gascogne Midi project aims to create a reverse flow from TIGF to GRTgaz through the Midi pipeline. It consists in the looping of the Gascogne pipeline on 60 km, and consolidation of the Barbaira compressor station and the adaptation of interconnections in Cruzy and Saint Martin de Crau. Permitting is ongoing. Commissioning is also expected in 2018.

6) In its Recommendation of September 2013, ACER takes the view that cross-border compensations should be restricted to situations where the country hosting the project is deemed to have a negative net benefit.

6.2.3.4 Other projects

- Adaptation L-gas/H-gas

The decrease of L-gas supply by 2029 will require converting the L-gas consumers in France. In 2016, French infrastructure operators have submitted to Ministries a plan to convert the L-gas customers to H-gas in the North of France. GRTgaz will start works to prepare the transmission network to enable the first conversions of L-gas customers in selected cities as a testing phase between 2016 and 2020. The conversion will then be extended and performed from 2021 to 2029. More details can be found in the GRIP NW.

- Guitiriz–Zamora Pipeline (TRA-N-950, Reganosa).

Currently, and as shown in the Capacity Analysis performed by the Technical Manager of the System, the Northwest part of the Spanish Gas System is shown to be one of the most constrained ones whenever the System is stressed.

In order to ensure a firm and real capacity of existing and future entries in the Northwest of the Iberian Peninsula (new LNG terminals such as El Musel or send-out increases of existing ones) and avoiding the physical congestions that can occur in this area, it is necessary to include Guitiriz-Zamora pipeline, allowing the maximization of entries contribution and improving North-South equilibrium in the system. Moreover, this project is an enabler of Reganosa send-out expansion, required for the transmission of the increased capacity.

Guitiriz–Zamora connection is projected as a 318 km pipeline with a 30"diameter.

Image courtesy of Reganosa

7 Evaluation of the South Region

Image courtesy of Reganosa

7.1 Local Context

7.1.1 TOWARDS A SINGLE MARKET PLACE IN FRANCE

On 1 April 2015, in accordance with the schedule decided by the French Energy Regulatory Commission (CRE) on 19 July 2012, TIGF & GRTgaz –sud merged their gas hubs to form a single trading region: the Trading Region South (TRS). In addition, with a view to promoting the development of the integrated gas market on a European scale, transit capacities are traded on the PRISMA platform, used by the majority of European gas transit networks.

The TRS is based on a "Trading Region" model, which is one of the European market integration models identified by the regulators. With the creation of the TRS, the Trading Region model has made it possible to retain two independent balancing zones within an extended Entry/Exit pricing region.

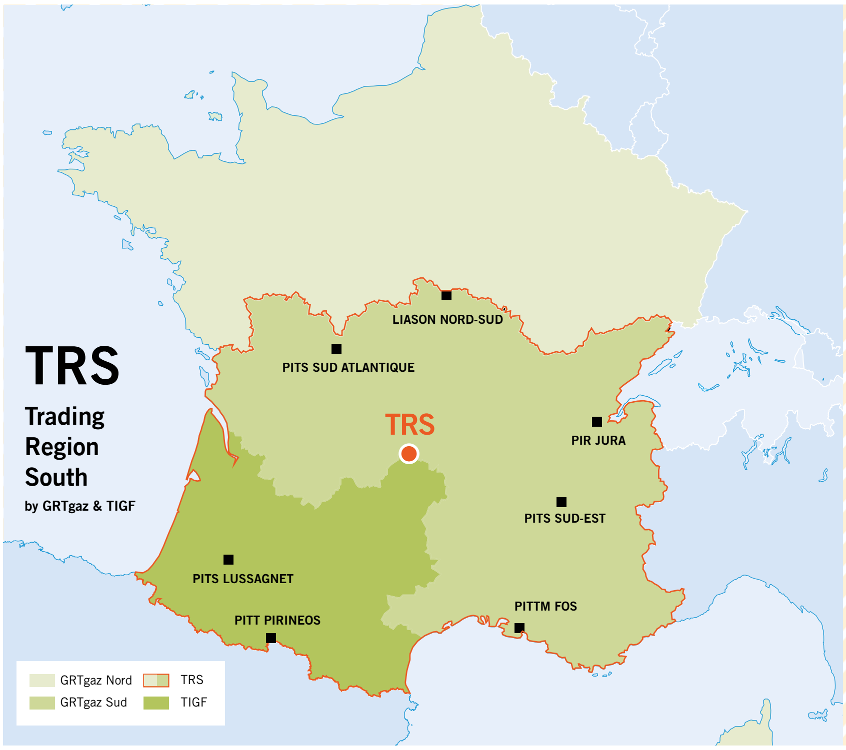

Figure 7.1: Trading Region South (TRS) (Source: TSO own elaboration)

In order to optimise the use of the interconnection between the TRS and PEG Nord, the French regulator asked the TSOs to put in place some market tools in its decision of 30 October 2014 in order to maximise availability of firm and interruptible capacity (JTS, buy local gas, …). This region, covering the South of France, is now serviced by eight diversified supply sources and represents an annual domestic consumption of approximately 12 billion cubic meter.

In 2018, the single market place will be implemented in France. It will lead to an attractive and competitive gas market over the long term with a single national price. In addition to the commissioning of the necessary infrastructures the Val-de-Saône and Gascogne-Midi projects, additional market-based mechanisms are being developed to ensure a smooth running of the future single marketplace in all circumstances. The single marketplace will work in compliance with the principles which have been selected to create the TRS with a balancing GRTgaz area and a balancing TIGF area.

7.1.2 MADRID DECLARATION

On 4 March 2015, the President of France, the Prime Minister of Spain, the Prime Minister of Portugal, and the President of the European Commission, signed the "Madrid Declaration[1)]". In the signature meeting were also present the Commissioner for Climate Action and Energy, and the President of the European Investment Bank. In this declaration, they "agree on the need to actively assess in order to complete the Eastern gas axis between Portugal, Spain and France, allowing bidirectional flows between the Iberian Peninsula and France through a new interconnection project currently known as the MidCat. The 3rd Portugal-Spain interconnection should be developed in accordance".

The three Governments also agreed on the setting up of a new regional High Level Group for South-West Europe on interconnections that will be led by the European Commission. This High Level Group will be in charge of monitoring the implementation of the Madrid Declaration.

According to the Memorandum of Understanding on the Establishment of the High Level Group, the Implementation Plan for gas "should focus on the development of the Eastern axis, allowing bidirectional gas flows between the Iberian Peninsula and the French gas systems, notably through the MidCat project and the third interconnection point between Portugal and Spain. Eliminating the existing bottlenecks within the three countries will also be considered".

As stated in the 1st Progress Report of Madrid Declaration[2)], the "French and Spanish transmission system operators, ministries and regulators launched a preliminary study regarding the MidCat project" (MidCat Technical studies, see section below). The results of this technical study were presented to the European Commission and the National Regulatory Authorities in April 2016.

At the same time, the European Commission launched a study, to analyse the benefits and costs of additional gas interconnections between the Iberian Peninsula and the rest of Europe. The study was developed by Ramboll[3)], and their final results were presented in April 2016.

The High Level Group agreed in September 2016 the Terms of Reference of a project specific Cost Benefit Analysis (PS-CBA) for STEP[4)] and the Implementation Plans for the gas and electricity projects identified as key project in the implementation of the Madrid Declaration. In summer 2016, the European Commission launched a call for tender to prepare a project specific Cost-Benefit Analysis (PS-CBA) for STEP. This PS-CBA will be used for the 3rd PCI list process, and will be consistent with the results from the Technical study (see below), updated technical information on the French side and with ENTSOG methodology.

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1) Madrid Declaration: https://ec.europa.eu/energy/sites/ener/files/documents/Madrid%20declaration.pdf

2) High Level Group on Interconnections for South-West Europe - Progress Report (March – December 2015) https://ec.europa.eu/energy/sites/ener/files/documents/Progress%20Report_December%202015%20for%20the%20South_West_Europe%20HLG.pdf

3) Study on the benefits of additional gas interconnections between Iberian Peninsula and the rest of Europe. Final report. http://bookshop.europa.eu/en/study-on-the-benefits-of-additional-gas-interconnections-between-iberian-peninsula-and-the-rest-of-europe-pbMJ0216421/?CatalogCategoryID=EhEKABstLQkAAAEjyZAY4e5L

4) Enagás and TIGF, the project promoters, changed the name of the project from "MidCat 1st Phase" to "STEP (South Transit East Pyrenees)". This new name was included in ENTSOG TYNDP 2017, for the first time in ENTSOG TYNDP. ENTSOG published the Annex A with infrastructure projects of TYNDP 21017 in July 2016. https://entsog.eu/publications/tyndp#ENTSOG-TEN-YEAR-NETWORK-DEVELOPMENT-PLAN-2017

7.1.3 MIDCAT TECHNICAL STUDIES

As stated in the 1st Progress report of Madrid Declaration, TSOs from countries hosting the project were encouraged to further study the implementation of MidCat project. MidCat technical study was carried out by the three TSOs (Enagás, GRTgaz and TIGF). This Joint technical study lasted six months and was developed between March and August of 2015.

7.1.3.1 Methodology

The methodology defined by TSO's for this technical study has taken two different approaches:

- From infrastructure to capacity (STEP): setting marginal infrastructure and calculating the generated capacity and its limitations. This methodology was used to evaluate the potential capacity of the First Step of MidCat (now known as STEP).
- From capacity to infrastructure (Full): defining the set of infrastructures in order to achieve targeted capacity (230 GWh/d from South to North, and 180 GWh/d from North to South).

7.1.3.2 Definition of scenarios

Several climatic scenarios were considered for the development of the joint technical study: average winter and summer conditions, as well as a peak. In order to cover a wide range of operational conditions a 'best case' and 'worse case' were considered for every climatic scenario.

The 'Best case' for every climatic scenario consists of assumptions on UGS utilisation and LNG terminal emissions that will determine the most favourable conditions for a given flow on MidCat interconnection (ES → FR or FR → ES). On the other hand, the 'worst case' consists of assumptions on UGS utilisation and LNG terminals production that will create the biggest constraint on the capacities offered at the border that can be guaranteed without making assumptions on other entry-exit points.

7.1.3.3 Results

MidCat project
In the South → North direction, the identified infrastructures generate 690 GWh/d firm capacity on the French side, a third of which (i.e 230 GWh/d) is dedicated to the cross-border capacity.

In the North → South direction, the firm capacity generated (i.e. 160 GWh/d) is dedicated to the cross-border capacity.

Its total cost is approximately M€ 3,100[5)].

The detailed information of the infrastructures included within this project is described in the infrastructure chapter of this GRIP South. The promoters of this project are GRTgaz and TIGF in France, and Enagás in Spain. A PS-CBA has been performed by ENTSOG within the third PCI selection process.

STEP project
The STEP project generates interruptible capacities at the French-Spanish border: up to 230 GWh/d South → North and 180 GWh/d North → South.

Its total cost is approximately M€ 470[6)].

The detailed information of the infrastructures included within this project is described in the infrastructure chapter of this GRIP South. The promoters of this project are TIGF in France and Enagás in Spain. A PS-CBA has been performed through a specific study under the umbrella of the High Level group, as part of the third PCI selection process.

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5) Joint Technical Study, July 2015

6) Joint Technical Study, July 2015

7.1.4 3RD INTERCONNECTION POINT BETWEEN PORTUGAL AND SPAIN TECHNICAL STUDIES

As agreed on the High Level Group developed after Madrid Declaration, the 3rd interconnection between Portugal and Spain should be developed in accordance with the development of the Eastern gas axis between Portugal, Spain and France, allowing bidirectional flows between the Iberian Peninsula and France (MIDCAT project). Accordingly, Enagás and REN decided to carry out technical studies on the 3rd IP between Spain and Portugal, as it was previously done for MidCat.

7.1.4.1 Methodology

The methodology applied was aimed at identifying the set of infrastructures needed in Portugal and in Spain in order to achieve 141 GWh/d in both directions as targeted capacity. The determined capacities were associated with a probability of occurrence of each network configuration in order to identify the capacity at risk.

Image courtesy of Enagás

7.1.4.2 Definition of scenarios

From the Portuguese and Spanish side, demand scenarios were stablished as following:

DEMAND SCENARIO			DESCRIPTION
Portugal	Base scenario	Final Demand	Moderate economic growth, scenarios were built from the forecasted values for summer, winter and peak demand for 2020, 2025 and 2030
		Power Sector	Moderate economic growth and existing coal fired power plants of Sines and Pego are not decommissioned until 2025
	SoS scenario	Final Demand	High economic growth, scenarios were built from the forecasted values for summer, winter and peak demand for 2020, 2025 and 2030
		Power Sector	High economic growth and existing coal fired power plants of Sines and Pego are decommissioned before 2025
Spain	Final demand & Power sector		Enagás stablished three scenarios in 2020, 2025 and 2030, average winter, average summer and peak winter day

Table 7.1: Description of demand scenarios in Portugal and Spain of 3rd Interconnection Point between Portugal and Spain technical studies (Source: TSO own elaboration)

In this joint study, each TSO determined the potential capacity in the 3rd IP PT-ES for all the scenarios and considered the values of highest probability of occurrence, obtaining the common capacities (lesser rule) shown in the following table:

			3RD IP CAPACITY		
			2020	2025	2030
	PT	ES	Final Value (GWh/day)		
Spain to Portugal	1st Step	1st Step	70		
	2nd Step	2nd Step	107		
	3rd Step		139		
Portugal to Spain	1st Step	1st Step	70		
	2nd Step	2nd Step	97		
	3rd Step		126		

Table 7.2: Final 3rd IP capacity for both directions (Source: TSO own elaboration)

The total cost of the considered infrastructures is approximately M€ 771.

The cost of the considered infrastructures for the 1st Stage of the project is approximately M€ 189 and for the 2nd Stage of the project is approximately M€ 582, with a total of M€ 771[7].

The outputs of both technical studies (capacities and related infrastructures) have been considered in ENTSOG TYNDP 2017[8] and have also been included in the infrastructure chapter of this GRIP South.

7) 3rd Interconnection point between Spain and Portugal, technical study between Enagás and REN

8) http://www.entsog.eu/publications/tyndp#ENTSOG-TEN-YEAR-NETWORK-DEVELOPMENT-PLAN-2017

7.2 Assessment of the Gas System in the South Region

UGS and LNG terminals use: the main role of these facilities

Analysing the behavior of LNG regasification terminals, IPs and UGS's in the South Region, the different way of covering gas demand in the three countries can be observed. The Iberian Peninsula relies primarily on LNG and Algerian gas, due to its proximity to Algeria and higher LNG import capacity. France, being well interconnected, has broader access to different supply sources and higher UGS withdrawal/injection capacity.

Focusing on the Spanish gas system, LNG stock varies according to the level of regasification and LNG cargos arriving to Spanish LNG terminals. In addition, fluctuations in the IPs are covered with a higher LNG regasification. Variations of Algerian pipeline imports have impact on the level of LNG regasification and IPs with European countries, due to its higher capacity. Seasonal modulation of underground storages plays a secondary role in the Spanish gas system resulting from its lower capacity compared to LNG terminals or IPs and strategic stocks.

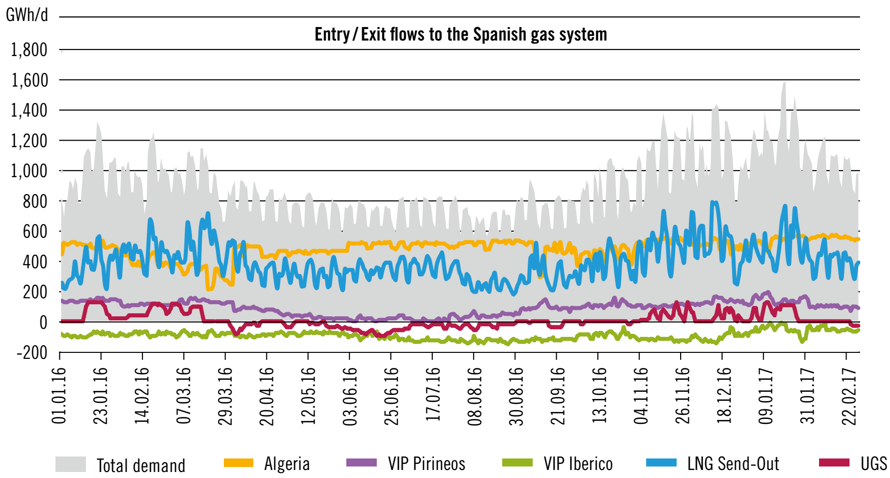

Figure 7.2: LNG and pipeline gas entry/exit flows to the Spanish gas system compared to total gas demand in Spain (Source: ENTSOG TP)

A similar behavior is observed in the Portuguese gas system: the level of LNG regasification noticeably increases with variations of VIP Iberico. An example of this can be seen in figure 7.3 below, where a significant increase of LNG regasification levels occurred during the month of October and December of 2016, enhanced by the decrease of VIP Iberico during the same period. Carriço underground storage in Portugal helps with daily modulation especially on higher demand days.

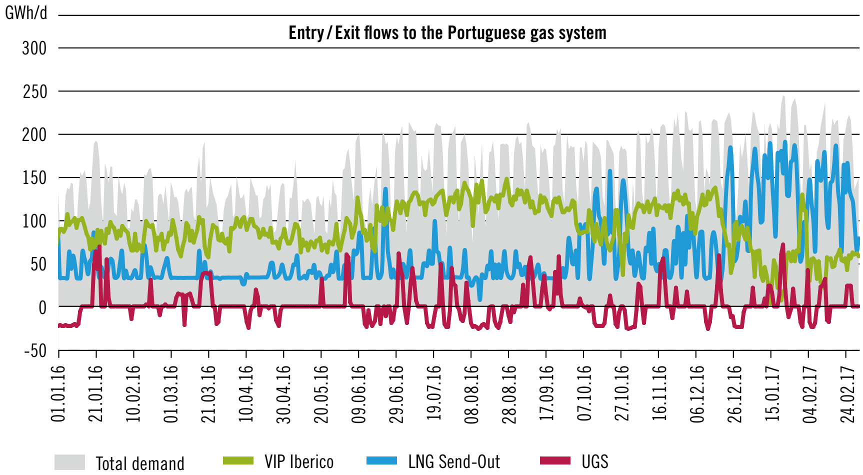

Figure 7.3: LNG and pipeline gas entry/exit flows to the Portuguese gas system compared to total gas demand in Portugal (Source: ENTSOG TP)

In France, there is higher modulation of the demand over the year linked to the heating for residential consumers (seasonal effect). From a general point of view, the regasification and pipeline entries are mainly stables over the time, and the variability of the demand is assured by the UGS which fully play their role.

As shown in the graph, the higher period of demand in the beginning of 2017 as been managed through a higher solicitation of the UGS, the LNG stocks in the terminals being at a low level at that time.

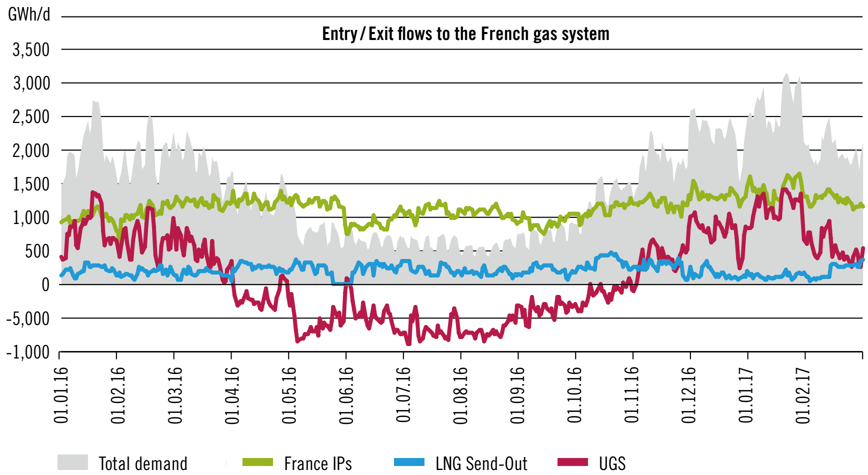

Figure 7.4: LNG, UGS and pipeline gas entry/exit flows to the French gas system compared to total gas demand in France (Source: ENTSOG TP)

The role of the UGS and LNG Terminals in the South Region during high demand periods (January 2017)

According to "EU strategy for liquefied natural gas and gas storage"[9], "gas storage facilities, play a key role on optimizing gas infrastructure use and balancing the system. Robust and sufficient gas storage facilities are crucial to energy security and resilience in times of major supply disruption".

With reference to the South Region, gas storages and LNG terminals are of paramount importance to ensure resilience of the gas system, on top of the interconnection capacities. Even though there are more tools, such as linepack, which contribute to modulate demand fluctuations, when dealing with larger fluctuations or even supply disruptions, due to storage dimensions, UGS and LNG terminals have higher relevance.

In Spain and Portugal, considering the number of LNG terminals, the high storage capacity in their LNG tanks and the share of demand covered by LNG in this region, variations on LNG terminals' send-out play a very important role regarding demand coverage and seasonal fluctuations. In France, the size and number of UGS, and the seasonal variation of demand give UGS a key role to provide security of supply during peak days.

Several increases of send-out during cold snaps can be observed: this extra flexibility provided by LNG terminals is essential in order to maintain suitable values of remaining flexibility in Spain and Portugal. It is important to highlight the responsibility of shippers regarding the availability of gas in these infrastructures in order to face demand fluctuations or severe situations such as cold weather conditions or supply disruptions.

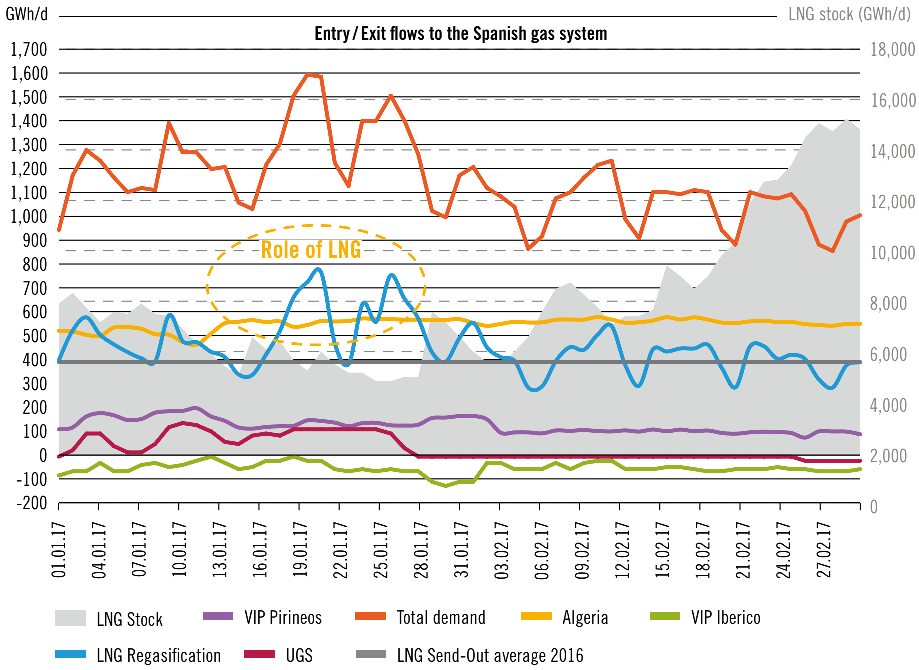

Figure 7.5: LNG stock values and send-out of Regasification Terminals in Spain for January 2017 and February 2017 (Source: ENTSOG TP)

9) COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS (Published 16/02/2016)
https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v10-1.pdf

As an example, illustrating the contribution of the LNG terminals in the South Region, the cold snap that took place during January 2017 has been analysed in more detail. LNG terminals contributed to face/cope with the cold snap providing short term flexibility by increasing the level of utilisation for all three countries of the South Region. During 2016, average values for the level of send-out utilisation of LNG terminals in the South Region were respectively: 20 % for Spain, 26 % for Portugal and 30 % for France. However, this utilisation value reached 46 % for Spain and 68 % for Portugal on the peak demand day of the cold snap mentioned above. On the contrary, in France, most of the flexibility is provided by UGS. During the same month of January 2017, LNG deliveries in Fos were below average values due to delivery problems.

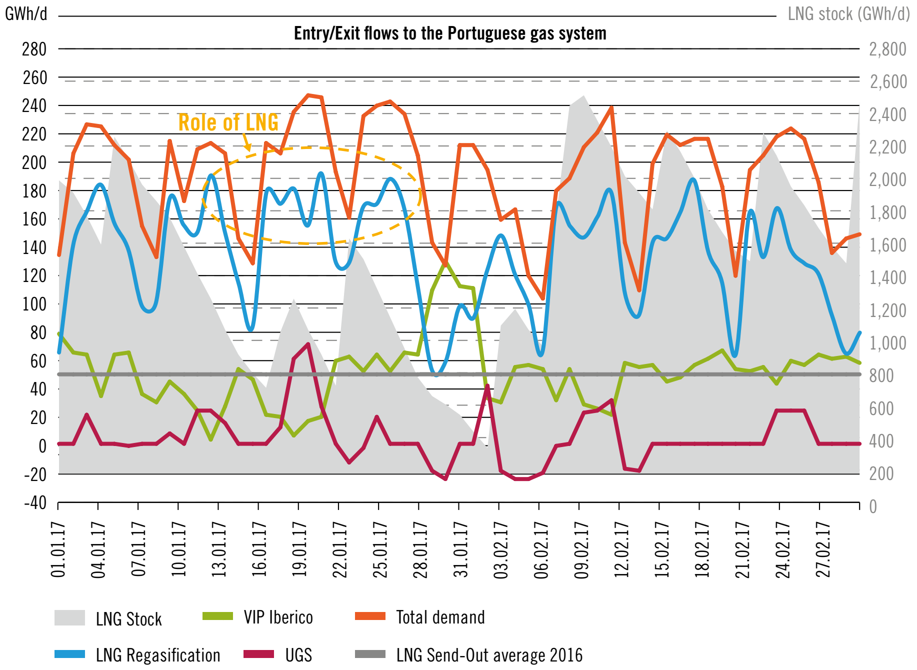

Figure 7.6: LNG stock values and send-out of Regasification Terminals in Portugal for January 2017 and February 2017 (Source: ENTSOG TP)

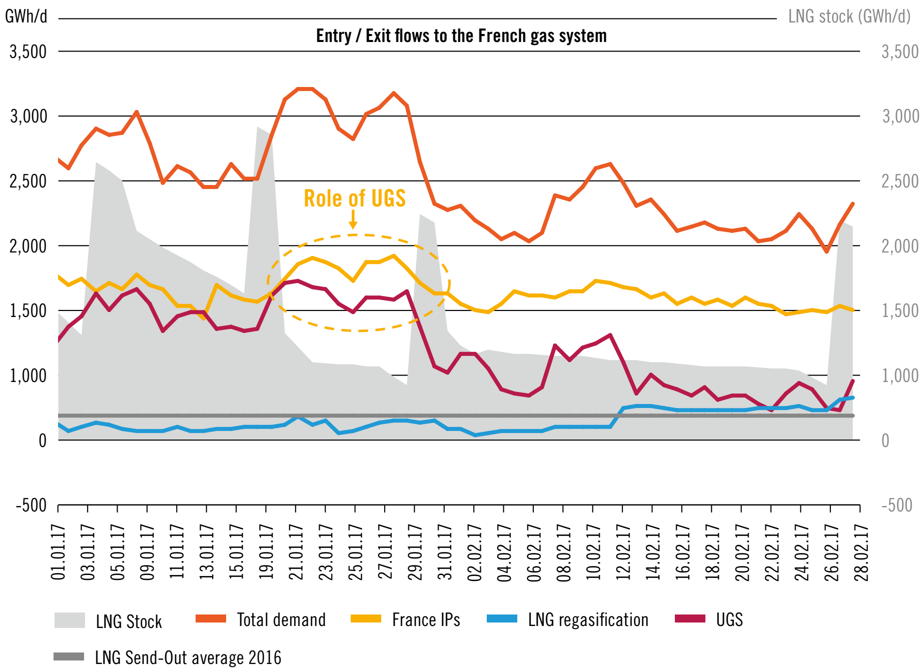

Figure 7.7: LNG stock values and send-out of Regasification Terminals in France for January and February 2017 (Source: ENTSOG TP)

Network Assessment

South Gas Regional Investment Plan 2017– deeply analyses the main results regarding the South Region obtained in the Network Assessment chapter from the ENTSOG TYNDP 2017.

The results of the ENTSOG TYNDP assessment give an overall assessment of infrastructure investment needs at a European level. Those are divided into areas defined as: security of supply, competition, sustainability and market integration. These pillars are supported by a set of different indicators which can be combined by the European Commission in order to evaluate the benefits of a specific project.

7.2.1 REMAINING FLEXIBILITY & DISRUPTED RATE

Disrupted Rate

In the South Region, no problems of disrupted rate have been identified for any demand scenario or disruption case in TYNDP 2017.

Remaining Flexibility

This indicator measures resilience at country level and is calculated as the additional share of demand each country is able to cover before an infrastructure or supply limitation is reached. Demand is set on design case. The higher the indicator value is, the better the resilience. In case where countries experience disrupted demand, the Remaining Flexibility is equal to zero.

It is of importance to emphasise that in order to stress the network, most unfavourable conditions were considered; results shown in Figure 7.8 are calculated for Blue Transition demand scenario for peak situation.

The results of ENTSOG simulations (Figure 7.8) show a good level of Remaining Flexibility for the South Region. It can be concluded that the network for these countries is sufficiently strong and can stand wide variations of gas demand in the system.

Additionally, ENTSOG analysed in the TYNDP 2017 a set of route disruptions, leading to only two route disruptions with relevant results in terms of remaining flexibility at a European level: the Belarus and Ukraine route disruptions. Nevertheless, for the South Region, neither disruption has significant impact on Remaining Flexibility. This can be explained by the robustness of the current gas system, being able to re-route supply of interrupted routes and bring additional gas through LNG terminals and UGS.

Despite showing good results in terms of remaining flexibility for the South Region, differences between the three countries can be observed as it is shown in the graphs below.

The graphs in figure 7.9 show that over time, the Iberian Peninsula is losing its remaining flexibility if there is no new development of infrastructure. This situation is due to the increase of demand which occurs for Spain and Portugal in all demand scenarios. In Portugal, remaining flexibility for PCI and High infra-levels increases considerably due to the commissioning of the 3rd interconnection between Spain and Portugal.

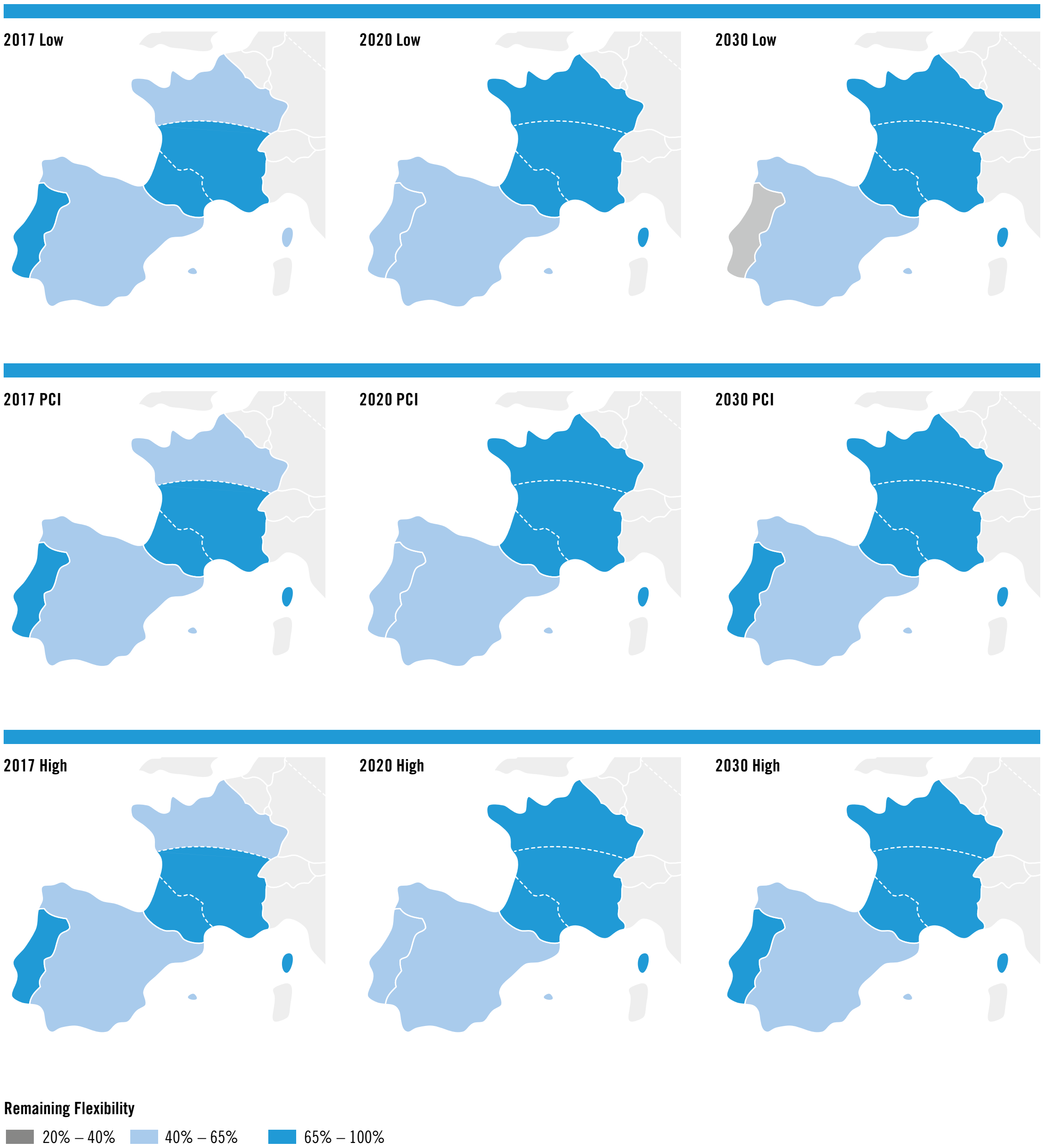

Figure 7.8: Evolution of Remaining Flexibility in the South Region. From top to bottom: low, PCI and High (Blue transition scenario). (Source: TYNDP 2017)

In France, the merger of zones allows an improvement of the remaining flexibility, even in the Low infrastructure scenario.

In this GRIP, all route disruptions from Algeria have been analysed. Algerian gas is exported to Spain and therefore to the South Region, through two pipelines:

- MAGHREB- Europe gas pipeline which came on line in 1996, linking Hassi R'Mel field in Algeria with Córdoba (Spain) via Morocco, where it is connected with the Spanish and Portuguese gas networks. The capacity of this pipeline is around 13 bcma.
- MEDGAZ is a deep-water gas pipeline which came on line in 2011 and directly connects Algeria with Spain. MEDGAZ supplies natural gas directly from Beni Saf on the Algerian coast to Almeria in Andalusia. The capacity of this pipeline is around 9 bcma.

As it has been described in the Supply chapter, Algeria is an important supplier for the Iberian Peninsula and South Region, covering around 48 % of total gas demand in the Iberian Peninsula through Algerian gas pipelines for 2015 and 46 % for 2016. For this reason, disruptions of both pipelines were considered in this study.

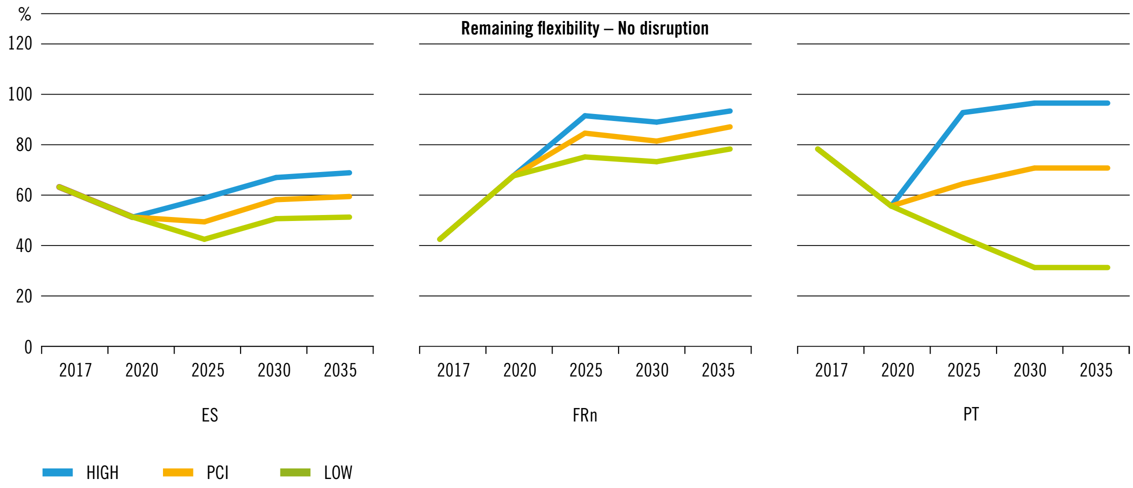

Figure 7.9: Evolution of Remaining Flexibility in the South Region for Blue Transition Demand scenario (no disruption) (Source: TYNDP 2017)

Analysis of Algerian disruption case

Under MAGHREB disruption, the main impacted country is Spain. Even in PCI and High levels of infrastructure, the country remains far below France and Portugal, but still with a Remaining Flexibility above 20 %.

As for MAGHREB disruption case, the main impact of MEDGAZ disruption is located in Spain with reduction in the remaining flexibility of approximately 10 % in comparison with no disruption case.

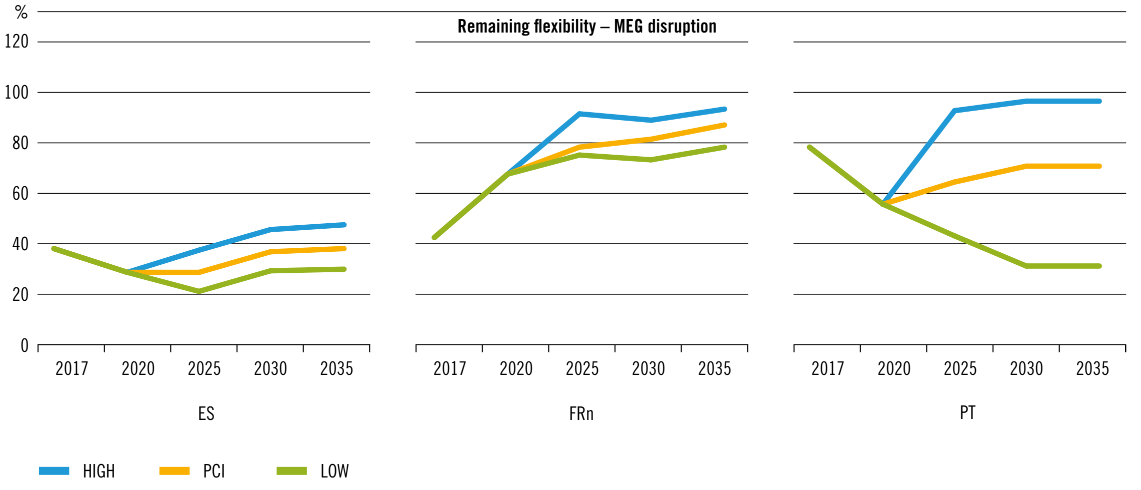

Figure 7.10: Evolution of Remaining Flexibility in the South Region for Blue Transition Demand scenario under MEG disruption (Source: TYNDP 2017)

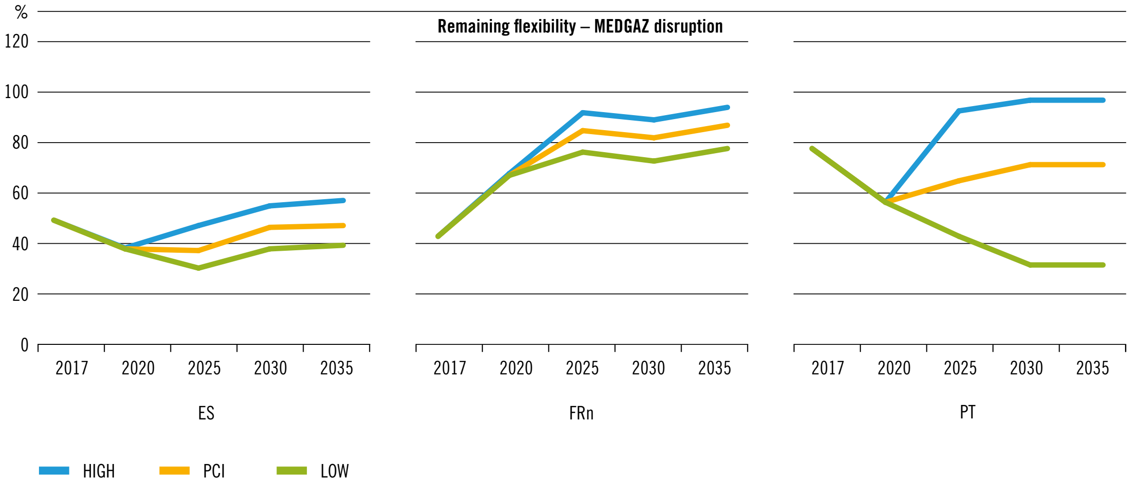

Figure 7.11: Evolution of Remaining Flexibility in the South Region for Blue Transition Demand scenario under MEDGAZ disruption (Source: TYNDP 2017)

7.2.2 N-1 INFRASTRUCTURE ASSESSMENT (FROM TYNDP 2017 ESW-CBA)

ENTSOG includes the N-1 indicator in the TYNDP assessment: this indicator derives from Regulation (EC) 994/2010. It aims at identifying which countries are not able to satisfy/meet its peak demand (1 in 20) without the larger infrastructure of the country.

N-1 (ESW-CBA) indicator shows security of supply needs for countries with values below 100 %. Portugal is the only country in the South Region not fulfilling for all scenarios the N-1 requirements.

The PCI 3rd Interconnection point PT-ES would mitigate the results for N-1 indicator in Portugal for all demand scenarios as it can be seen in the figure below from 2025 for Green Revolution scenario.


Image courtesy of Reganosa

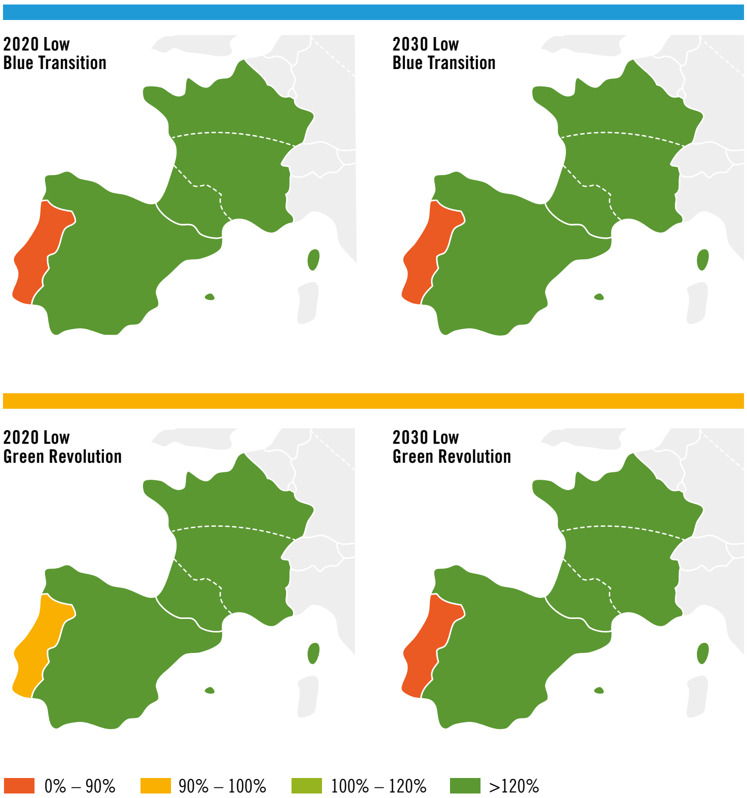

Figure 7.12: N-1 indicator for Low Infrastructure scenario and Blue Transition/ Green Revolution demand scenarios (Source: TYNDP 2017)

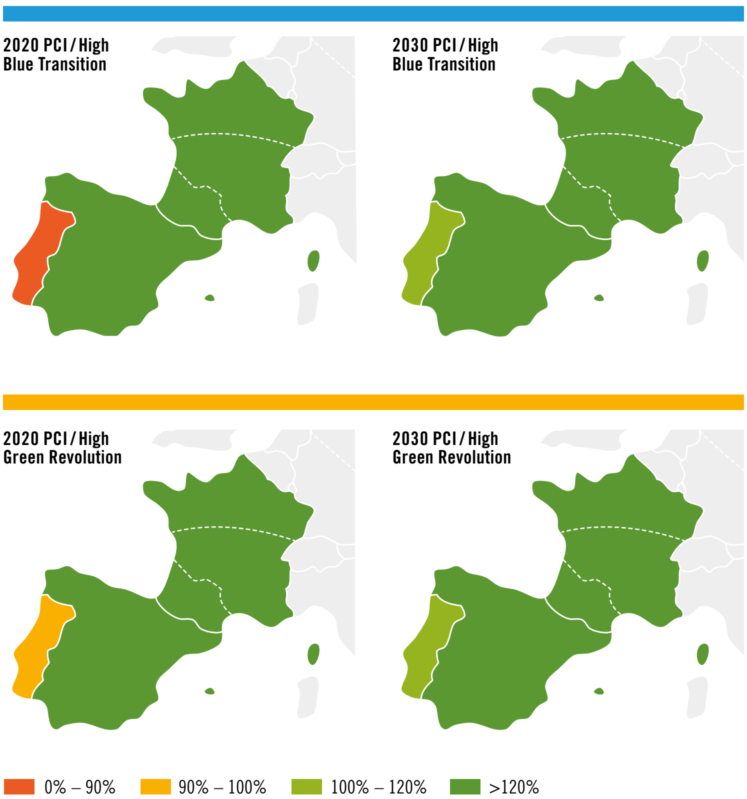

Figure 7.13: N-1 indicator for PCI infrastructure level and Blue Transition/ Green Revolution demand scenarios (Source: TYNDP 2017)

7.2.3 SUPPLY SOURCE DIVERSIFICATION

The access to different supply sources is a prerequisite for competition. ENTSOG uses the Supply Source Price Diversification Index (SSPDi) in order to evaluate the number of supply sources a country has access to. This indicator measures the ability of a country to benefit from the decrease of the price of one supply source. The higher the value of the indicator, the higher the benefits for the country is.

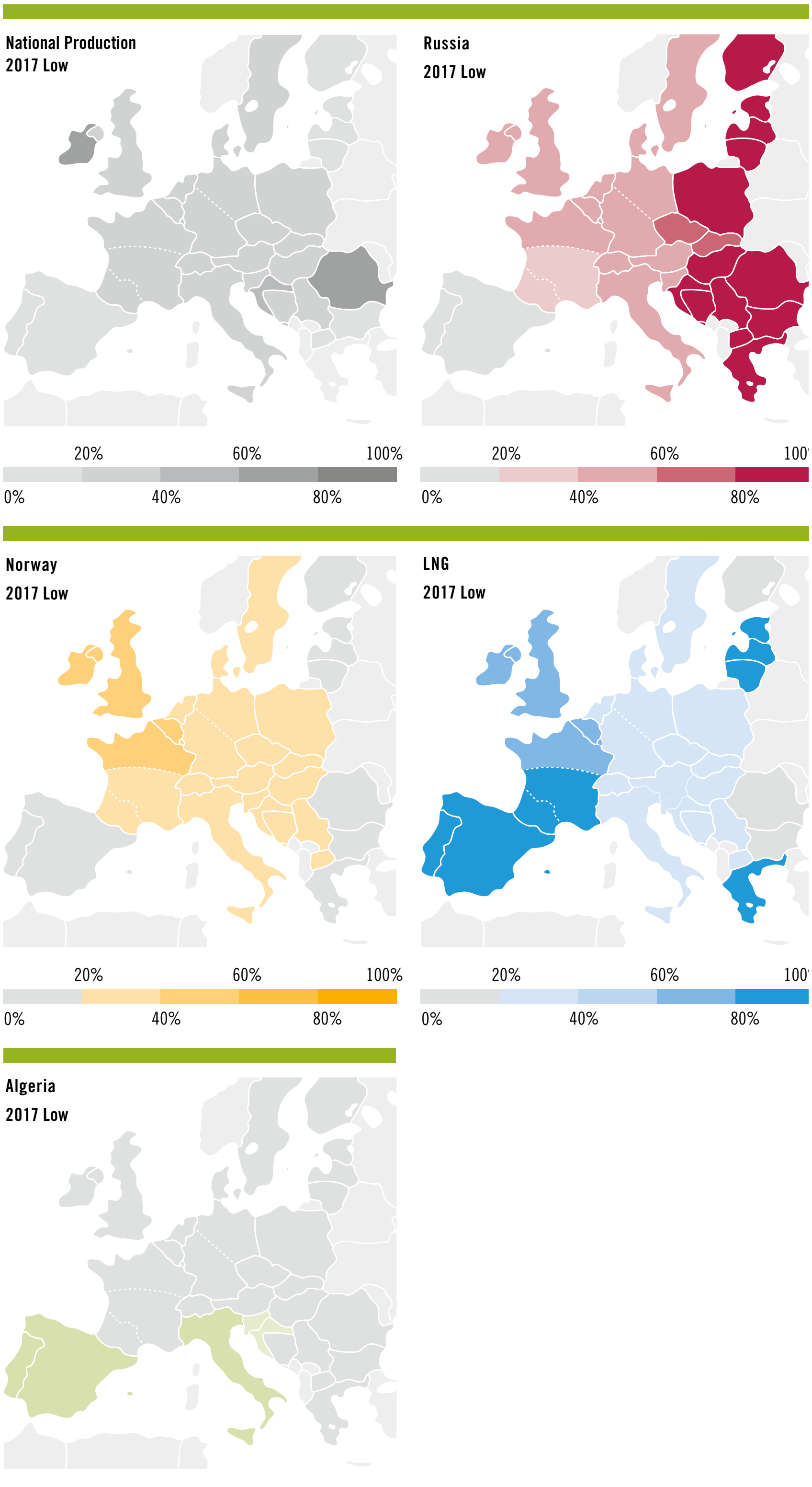

Figure 7.14: SSPDi, Green Evolution, Low infrastructure level, 2017 (Source: TYNDP 2017)

In order to define the number of supply sources that a country has significant access to, ENTSOG has stablished for the SSPDi indicator a threshold value of 20 %. When the value of the SSPDi indicator is higher than 20 % for a supply source, it is considered that the country has a significant access to this source.

In the previous maps, the results of the SSPDi indicator are presented for 2017 in Green Evolution Scenario, for all supply sources: National production, (grey), Russia (red), Norway (yellow), LNG (blue) and Algeria (green). According to this indicator, the Iberian Peninsula has only access to two supply sources (Algeria and LNG), due to the low level of interconnections with the rest of Europe, while France has access to National Production, Russia, Norway and LNG. Additionally, according to the SSPDi indicator, the Iberian Peninsula can cover 100% of its demand by LNG.

In the low infrastructure scenario, the difference in the supply mixes for the Iberian Peninsula and France does not change significantly in 2020 and 2030; the only differences come from Algerian gas in the Iberian Peninsula and Norwegian gas and LNG in France. Regarding Algerian gas, in 2030, the percentage of the Algerian gas in the supply mix of Portugal and Spain slightly decreases. Regarding Norwegian gas, the percentage of this supply source in France decreases from 2017 to 2020. At the same time, the importance of LNG in French gas supply increases from 2017 to 2020.

Based on the TYNDP indicators, the access to supply sources changes from one country to another. Only Green EU Revolution is represented in the graph as the conclusions are mainly the same than in the other scenarios.

Iberian Peninsula

- During all the period of the TYNDP 2017 (from 2017 to 2035), in the **low infrastructure scenario**, the **Iberian Peninsula** only has access to two supply sources: Algeria and LNG.
- In the PCI and High infrastructure scenario, the Iberian Peninsula improves its access to Norway, Russia and National production reaching five supply sources above 20 %, thanks to the implementation of PCI or High infrastructure level projects.

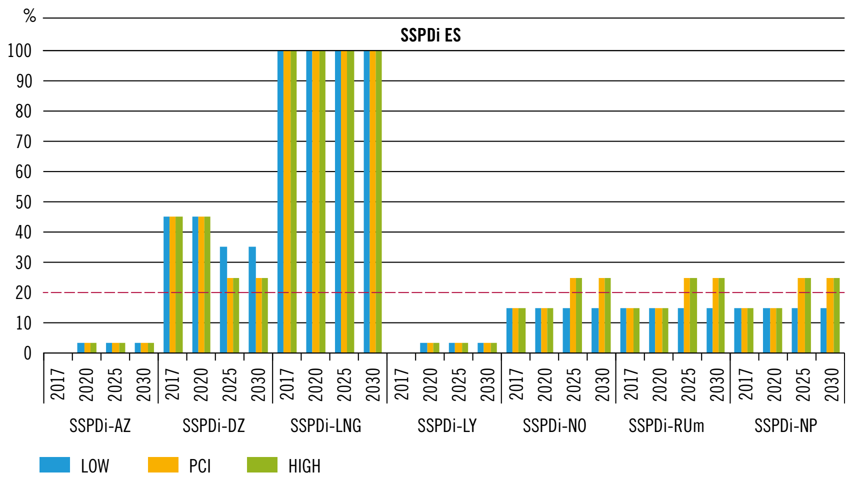

Figure 7.15: SSPDi Evolution for Spain, EU Green Revolution Scenario (Source: TYNDP 2017)

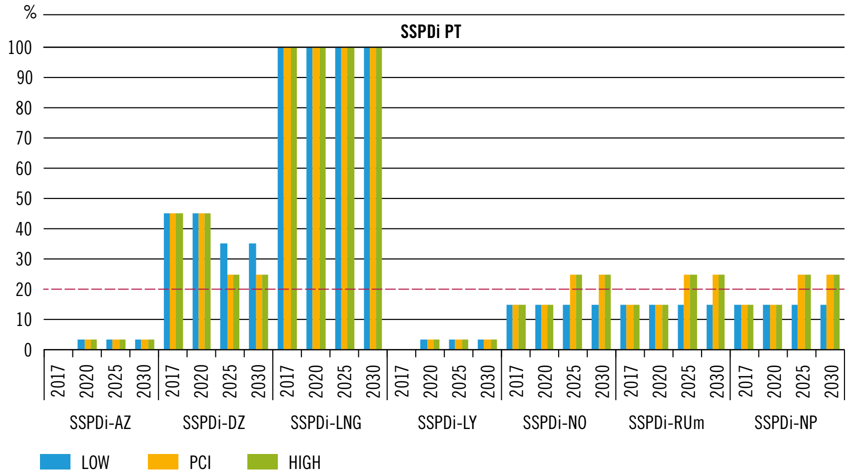

Figure 7.16: SSPDi Evolution for Portugal, EU Green Revolution Scenario (Source: TYNDP 2017)

France

- On the other hand, in the low infrastructure scenario France sees its number of supply sources decrease from four supply sources in 2017 (national production, Russian gas, Norwegian gas and LNG) to three supply sources in 2030 (Russia, Norway and LNG …) due to the decrease of Groningen exports from the Netherlands.
- In the **PCI and High** infrastructure scenario France has significant access to five supply sources: Russia, Norway, LNG, Algeria and National Production.

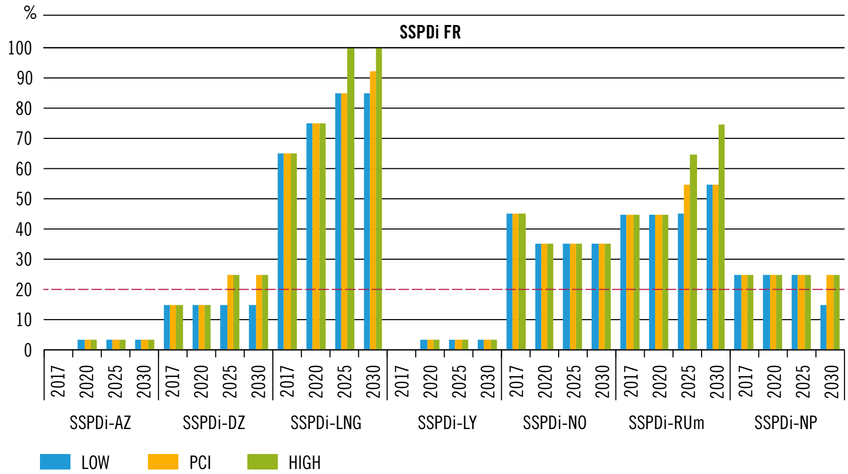

Figure 7.17: SSPDi Evolution for France, EU Green Revolution Scenario (Source: TYNDP 2017)

In the South Region, after the commissioning of PCI projects after 2020, the countries of the South Region have significant access to more supply sources. The main PCI projects improving the situation are the 3rd Interconnection between Spain and Portugal (1st phase in 2021 and 2nd phase in 2025), MidCat (2022), Eridan and Est Lyonnais (more details in Infrastructure chapter).

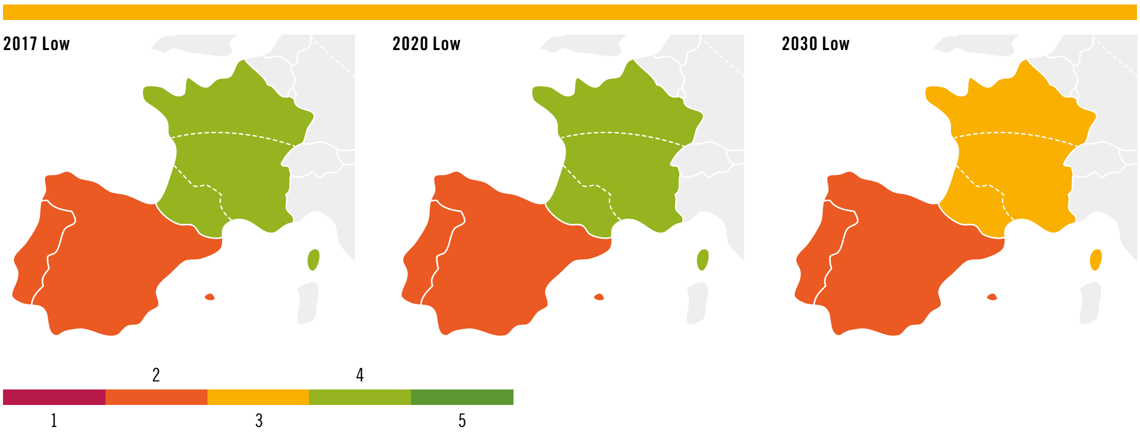

Figure 7.18: Access to supply sources in Low infrastructure scenario (EU Green Revolution Scenario), 2017 (left), 2020 (middle), 2030 (right) (Source: TYNDP 2017)

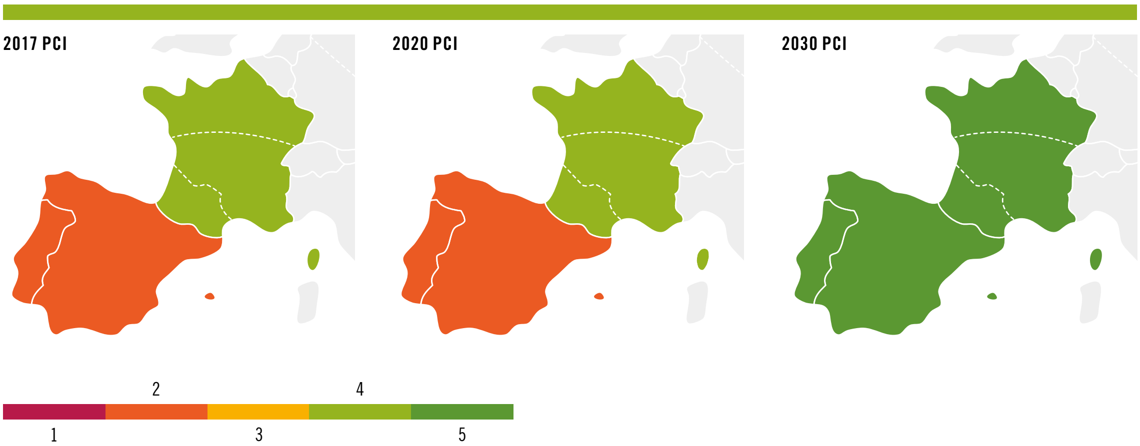

Figure 7.19: Access to supply sources in the PCI and High infrastructure scenario (EU Green Revolution Scenario). 2017 (left), 2020 (middle), 2030 (right) (Source: TYNDP 2017)

7.2.4 SUPPLY SOURCE DEPENDENCE

The supply source dependence is the minimum share of a given source that a country needs in order to cover its demand, and that cannot be covered by another supply source. The indicator from ENTSOG CBA methodology showing the dependence to a given supply source is the Cooperative Supply Source Dependence (CSSD). In this indicator, the dependence to each supply source is analysed independently, assuming cooperation between member States in order to share the level of dependence to a given supply source.

Norway & Russia

In 2017, the countries of the South Region need a percentage of the gas coming from Norway to cover their demand, linked to the limited supply flexibility of other sources [10]. After 2017, the countries of the South Region are able to cover their demand without showing any dependence to this source.

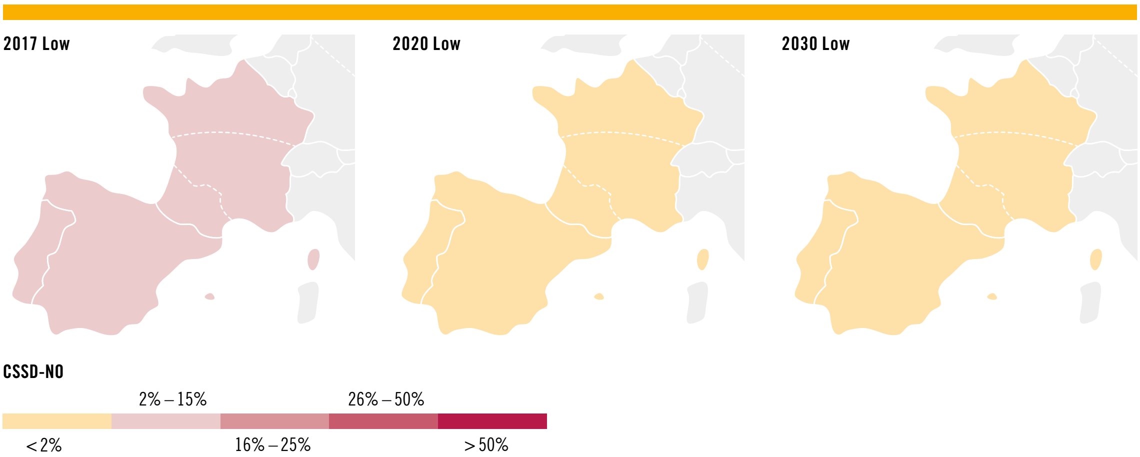

Figure 7.20: CSSD-NO, Green Revolution, Low and PCI/High infrastructure level, whole year (Source: TYNDP 2017)

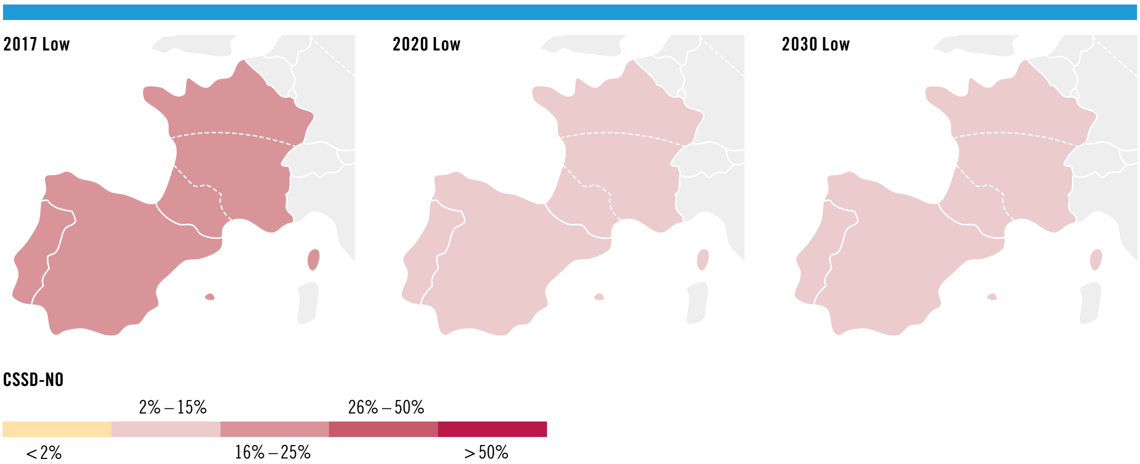

Figure 7.21: CSSD-NO, Blue Transition, Low and PCI/High infrastructure level, whole year (Source: TYNDP 2017)

10) see TYNDP 2017 p. 175

According to TYNDP 2017 results, there is some dependence to Russian gas in the South Region. Nevertheless, the dependence to Russian gas in the South Region reduces in 2030, mainly due to the higher availability of LNG.

Consequently, the dependency of the South Region to the Norwegian and Russian gas is not relevant in all scenarios.

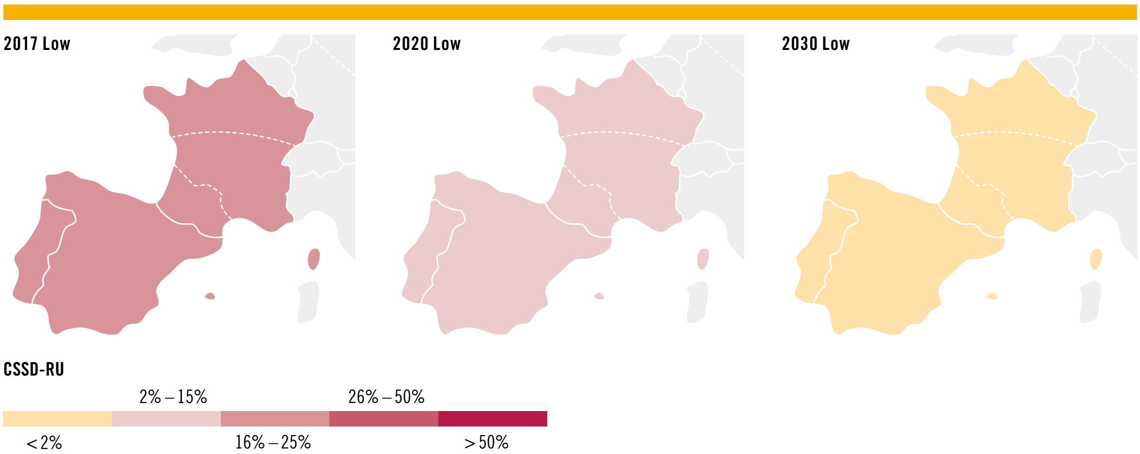

Figure 7.22: CSSD-RU, Green Revolution, low and PCI/high infrastructure level, whole year (Source: TYNDP 2017)

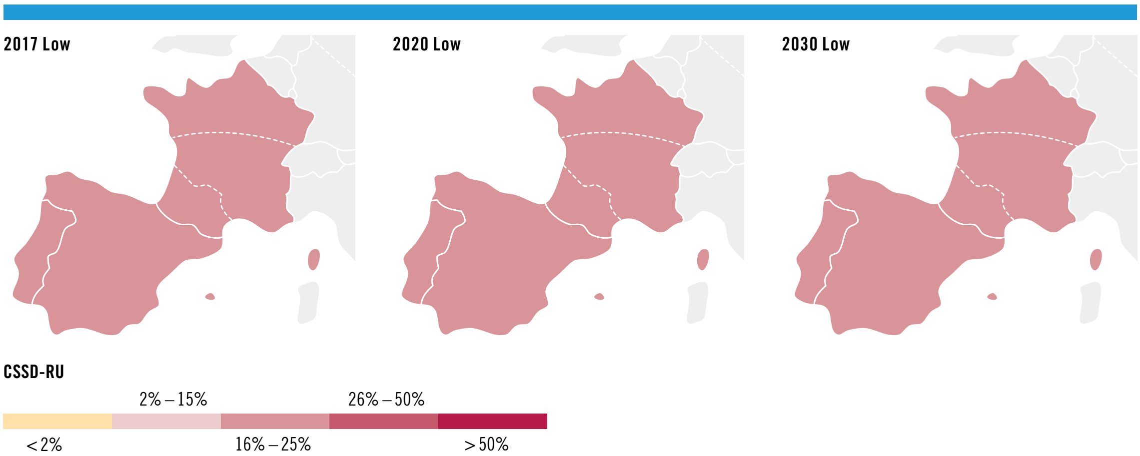

Figure 7.23: CSSD-RU, Blue transition, low and PCI/high infrastructure level, whole year (Source: TYNDP 2017)

LNG

According to TYNDP 2017, in 2017 only the Iberian Peninsula and the South of France show dependence to LNG.

In the blue transition scenario (highest demand scenario) the Iberian Peninsula covers its demand with gas coming from Algeria and LNG. In 2017, in the low infrastructure level, Spain dependency to LNG could be lower due to the fact that Algerian imports are limited by a minimum LNG level (minimum potential scenario) in the simulation.

Regarding France, LNG dependency would be mitigated from 2020 due to the merge of zones.

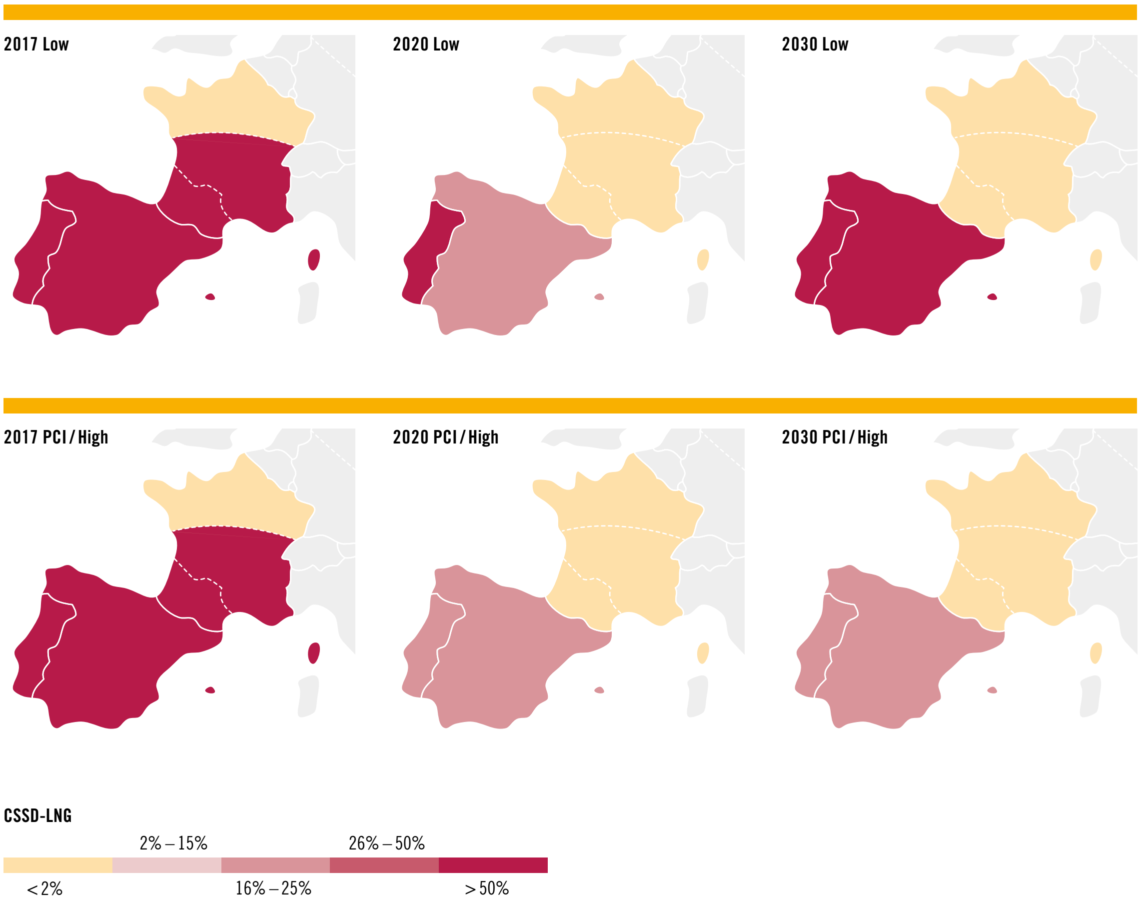

Figure 7.24: CSSD-LNG, Green Revolution, Low and PCI/High infrastructure level, whole year (Source: TYNDP 2017)

In 2035 in Blue Transition scenario, for the low and the PCI cluster there is still LNG dependency in the Iberian Peninsula, as Algerian supply reaches its maximum. In both Green Evolution and Green Revolutions scenarios, meaning lower demand, Algerian supply does not reach its maximum, in Low and PCI scenarios. In lower demand scenarios, the LNG dependency in the Iberian Peninsula is lower.

The dependence to LNG should be considered different to the dependence to a pipeline source, as the LNG is a multi-source supply. This multi-source nature is shown in the Supply chapter.

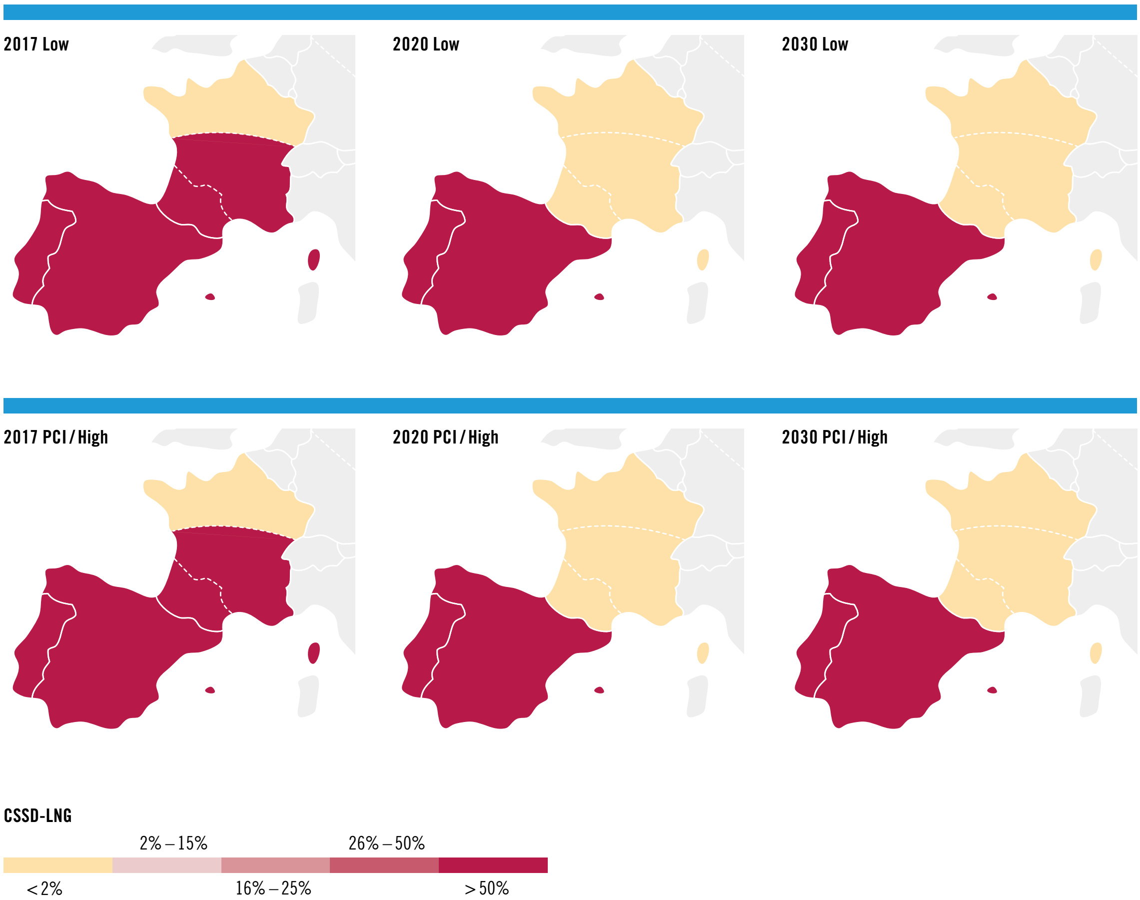

Figure 7.25: CSSD-LNG Blue Transition, Low and PCI/High infrastructure level, whole year (Source: TYNDP 2017)

7.2.5 IMPORT ROUTE DIVERSIFICATION

The import Route Diversification indicator is a capacity based indicator. For its calculation only the entry capacities (interconnections, import points, and LNG terminals) to a country are considered. According to the definition of the IRD indicator, each LNG terminal is considered independently and all the physical interconnections between two countries are considered all together (like a virtual interconnection point). The lower the value of this indicator the better the diversification route of this country is.

The higher value (10,000) corresponds to a country with a single entry point, whereas a value of 5,000 means a country with two entry points with the same capacity.

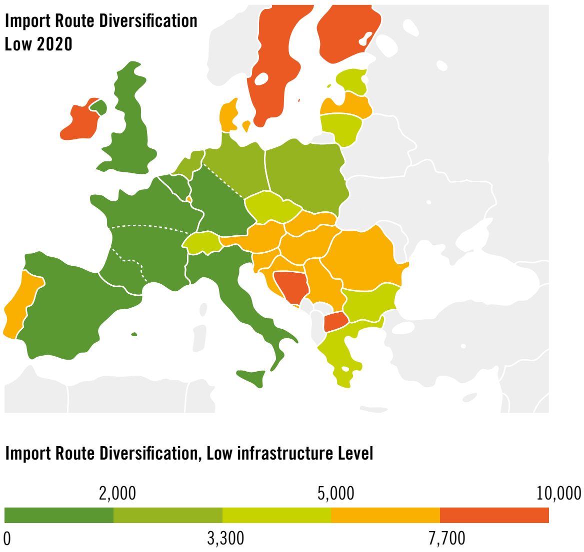

Figure 7.26: Import Route Diversification, Low infrastructure level (2020)

For Spain and France, the value of this indicator is always lower than 2,000, in all years and in all scenarios (as the capacity of the infrastructures is independent of the scenarios), showing a good value for import route diversification.

In the case of France, having three LNG terminals, and interconnections with Spain, Belgium and Germany, the value of IRD is low.

Spain has two import pipelines with Algeria (GME and MEDGAZ), interconnections with Portugal and France, and six LNG terminals in operation (Barcelona, Sagunto, Cartagena, Huelva, Reganosa and Bilbao). As in the definition of IRD each terminal is considered independently, the IRD value for Spain is low as expected.

In the case of Portugal, the value of the IRD is, in all years, slightly above 5,000. This value is the value expected, based on the IRD definition, for a country having one LNG terminal and only interconnected with the neighboring country (Spain).


Image courtesy of Enagás

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Abbreviations

ACER	The European Agency for the Cooperation of Energy Regulators
CAM	Capacity Allocation Mechanism
CCGT	Combined Cycle Gas Turbine
CEER	Council of European Energy Regulator
CNG	Compressed Natural Gas
CNE	Comisión Nacional de Energía, National Energy Commission
CRE	Commission de Régulation de l'Energie, French Regulator
CREOS	Luxembourg's TSO
DSO	Distribution System Operator
Enagás	Spanish TSO
ENTSOG	European Network of Transmission System Operators for Gas
FID	Final Investment Decision
GRIP	Gas Regional Investment Plan
GRIP South	Gas Regional Investment Plan in the South Region (ES, FR and PT)
GRTgaz	French TSO
GWh	Giga Watt hours
IEA	International Energy Agency
IP	Interconnection Point
LNG	Liquefied Natural Gas
Mtoe	Million Tonnes of Oil Equivalent
NRA	National Regulatory Authority
PEG	French gas hub
REN	Portuguese TSO
SoS	Security of Supply
TIGF	French TSO
TSO	Transmission System Operator
TWh	Tera Watt hours
TYNDP	Ten-Year Network Development Plan
UGS	Underground Gas Storage

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